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COMMISSION STAFF WORKING DOCUMENT

Progress of implementation of Council Directive 2011/70/EURATOM

Accompanying the document

REPORT FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT

on progress of implementation of Council Directive 2011/70/EURATOM and an inventory of radioactive waste and spent fuel present in the Community's territory and the future prospects - THIRD REPORT

{COM(2024) 197 final} - {SWD(2024) 127 final}

Contents

List of abbreviations and acronyms

ARTEMIS	Integrated review service for radioactive waste and spent fuel management, decommissioning and remediation programmes
DGR	Deep Geological Repository
DSRS	Disused Sealed Radioactive Source
EIA	Environmental Impact Assessment
ENSREG	European Nuclear Safety Regulators Group
EU	European Union
HLW	High-Level Waste
IAEA	International Atomic Energy Agency
ILW	Intermediate-level waste
IRRS	International Regulatory Review Service
KPI	Key Performance Indicators
LILW	Low- and Intermediate-Level Waste
LLW	Low-Level Waste
LTO	Long Term Operation
NORM	Naturally Occurring Radioactive Material
PP	Nuclear Power Plant
RAW	Radioactive Waste
SF	Spent Fuel
VLLW	Very Low-Level Waste

1. Introduction

This Staff Working Document expounds the Commission's assessment of European Union (EU) Member States' notifications on the implementation of Council Directive 2011/70/Euratom on responsible and safe management of spent fuel and radioactive waste (the "Directive").[1] The information used to carry out the assessment derived from the national programmes for the management of spent fuel and radioactive waste[2], and the national reports on the implementation of the Directive.[3]

This document provides background information related to the main findings, progress, challenges, and trends presented in the Third Commission Report COM(2024) 197 to the Council and the European Parliament on progress of implementation of Council Directive 2011/70/Euratom and an inventory of radioactive waste and spent fuel present in the Community's territory and the future prospects.

All Member States submitted their third national reports to the Commission by October 2021.[4] As part of their national report three Member States have also notified to the Commission their Joint Convention reports[5] for the 7th Joint Convention review meeting held in June-July 2022. Furthermore, during the reporting period nine Member States also notified to the Commission their updated national programmes.

Consistently with previous reporting cycle, the Commission has given particular attention to assess the progress made by the Member States in implementing the Directive, with the aim to provide the Council and European Parliament with a comprehensive overview of spent fuel and radioactive waste management in the EU.

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1 Council Directive 2011/70/Euratom of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste, OJ L 199, 2.8.2011, p. 48.

2 Article 13(1) and Article 15(4) of the Directive.

3 Article 14(1) of the Directive.

4 As per the Directive, the deadline for submission of national report was 23 August 2021. The UK formally withdrew from the EU on 31 January 2020. Although, the Union law, including the Euratom legislation, continued to be applicable during the transitional period from 1 February to 31 December 2021 – the UK authorities have not provided national report covering 2018-2021 period.

5 Reports under Article 32 of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

2. National policies and frameworks for the safe and responsible management of spent fuel and radioactive waste

In order to achieve the Directive's overarching objective, which is to ensure the responsible and safe management of spent fuel and radioactive waste to "*avoid imposing undue burdens on future generations*" [6], Member States must establish and maintain a national legislative, regulatory and organisational framework for spent fuel and radioactive waste management. The framework must include the adoption of a national programme for the implementation of national spent fuel and radioactive waste management policies[7].

2.1. National policies

2.1.1. General considerations

Member States are required to establish and maintain national policies for the long-term responsible and safe management of spent fuel and radioactive waste.

Each Member State bears ultimate responsibility for the management of the spent fuel and radioactive waste generated in it. It is up to the Member States to set the optimal policies based on national specificities and needs (e.g. whether to reprocess or dispose of spent fuel, or whether to build a single disposal facility for all radioactive waste or a number of facilities for different waste types).

All Member States have enshrined the principles defined in Article 4(3) of the Directive in their legislation to serve as the basis of their national policies. These principles are:

- Keeping the generation of radioactive waste to a minimum;
- Ensuring that the interdependencies between all steps in spent fuel and radioactive waste management are taken into account;
- Safe management of spent fuel and radioactive waste and passive safety features for long term safety;
- Graded approach in implementation of measures for spent fuel and radioactive waste management;
- The costs for the management of spent fuel and radioactive waste shall be borne by those who generated those materials;
- Evidence-based and documented decision-making processes in all stages of spent fuel and radioactive waste management.

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6 Article 1(1) of the Directive.

7 Article 5(1)(a) of the Directive.

All Member States have enshrined in their laws and regulations that the prime responsibility for the management of spent fuel and radioactive waste generated in their territory rests with the license holder, and in those cases in which that is not feasible (for instance due to disappearance or bankruptcy of the license holder), it is the State which bears the ultimate responsibility. The practical implementation of this principle is reflected in the obligations of the licensees, including bearing the costs of that management, and in the establishment of national waste management organisations.

Comprehensive national policies for the management of spent fuel and radioactive waste are established in the majority of the Member States.

Management of spent fuel from nuclear power plants

After use in a reactor, nuclear fuel is considered spent or used and must be removed from the reactor for subsequent safe management, which includes first interim storage (in wet or dry storage) for a number of years, followed by reprocessing or direct disposal. Hence, broadly speaking, national authorities have two technical options to decide upon: reprocessing or disposal.

Nearly all Member States have set out a policy of interim storage until a deep disposal facility will become available for direct disposal, while France and the Netherlands have continued to reprocess spent fuel.

Until a few years ago, a number of Member States used to reprocess spent fuel too, however, they have mostly shifted to the direct disposal option. Nonetheless, a few Member States declared that they have not necessarily discarded reprocessing as an option for the future.

The owners of the reprocessed spent fuel are responsible for disposal of the resulting waste, with one exception: between 1988 and 2014, Hungary shipped most of its spent fuel from research reactors and nuclear power plants to the Russian Federation. Initially Hungary was not obliged to take back the resulting waste, until the applicable contract was amended in 1994; afterwards, Hungary committed to take back the radioactive waste resulting from the reprocessing of the spent fuel in the Russian Federation.

Management of spent fuel from research reactors

In general terms, the policy for the management of spent fuel from research reactors is to send it back to the supplier, especially in the case of highly enriched uranium fuel, under the Global Threat Reduction Initiative.

When that is not possible, spent fuel from research reactors is managed like the one from nuclear power plants.

Management of radioactive waste

In line with international standards and practices, and depending on the nature of radioactive waste and countries' specificities, national policies for safe radioactive waste management

are articulated around safe interim storage and disposal in near surface, intermediate depth, or deep geological facilities.

Management of disused sealed sources

Generally, the policy for the management of disused sealed sources is to ship them back to the country of origin. When that is not possible, they are stored and disposed of when suitable disposal facilities are or become available.

Although progress is being made, there are still a few Member States that have not defined their policy to manage all their radioactive waste or spent fuel in the long term. In general, most of the Member States that have not clearly defined their policies have in any case taken some fundamental decisions so the absence of policies for some waste classes does not jeopardise the progress of implementation of their national programmes. For example, some countries that have not yet taken the decision of reprocessing or not their spent fuel, have decided that the direct disposal of spent fuel is a fundamental decision that orientates the ongoing work. Progress is ongoing in several of these countries to define a policy for all types of waste, usually on the basis of detailed technical assessments or advice by waste management organisations or specialised bodies.

2.1.2. Radioactive waste import and shared disposal policies

Although the Directive requires that the radioactive waste be disposed of in the Member State in which it was generated, it introduces conditions under which the radioactive waste may be disposed of in another Member State or in a third country (Article 4(4) of the Directive)[8].

Most of the Member States prioritise disposing of their radioactive waste and spent fuel in their territory, however the export of radioactive waste for disposal[9] into another Member State or a third country is considered a pursuable option by most Member States without a nuclear programme, or the ones with research reactor(s) and relatively small quantities of low level waste (LLW), intermediate level waste (ILW), or disused radioactive sources. While 12 Member States consider regional or shared disposal facilities as an option in parallel to developing their own disposal solutions, about three quarters of Member States ban import of

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[8] According to Article 4(4), one of the conditions is that at the time of shipment an agreement must have entered into force between the Member State concerned and another Member State or a third country to use a disposal facility in one of them. The contents of such an agreement must be notified to the Commission prior to the shipment. As of today, the Commission has not received any such notification. More information on shipments of radioactive waste and spent fuel can be found in the fourth report on Member States implementation of Council Directive 2006/117/EURATOM on the supervision and control of shipments of radioactive waste and spent fuel:

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52023DC0077

[9] Disposal is defined in Article 3(3) of the Directive as "the emplacement of spent fuel or radioactive waste in a facility without the intention of retrieval".

radioactive waste/spent fuel for disposal. Table 1 broadly classifies national policies about import of radioactive waste for disposal and search for shared solutions.

Table 1. Policies for radioactive waste import and shared disposal.

	Import for disposal	Shared solution for disposal
AT	Not prohibited nor authorised	Option
BE	Decided[10]	Not considered/ discarded
BG	Prohibited	Option
CY	Prohibited	Option
CZ	Prohibited	Option
DE	Not indicated	Not considered/ discarded
DK	Not indicated	Option
EE	Prohibited	Not considered/ discarded
EL	Prohibited	Not considered/ discarded
ES	Not indicated	Not considered/ discarded
FI	Prohibited	Prohibited
FR	Prohibited	Not considered/ discarded
HR	Prohibited	Option
HU	Not indicated	Not considered/ discarded
IE	Prohibited	Not applicable
IT	Not indicated	Option
LT	Prohibited	Not considered/ discarded
LU	Not prohibited nor authorised	Decided[9]
LV	Prohibited	Option
MT	Prohibited	Option
NL	Not prohibited nor authorised	Not considered/ discarded
PL	Prohibited	Option
PT	Prohibited	Not considered/ discarded
RO	Prohibited	Not considered/ discarded
SE	Not prohibited nor authorised	Not considered/ discarded
SI	Not indicated	Option
SK	Prohibited	Option

[10] Agreement between Luxembourg and Belgium.

2.1.3. National policy developments

National reports generally provide information on developments of national policies, however in around one third of the reports the information on the practical implementation of the policy principles is limited.

A few Member States have modified or further defined their national policies in this reporting cycle.

Denmark has defined a dual track for the management of spent fuel, which consists of exploring the viability of exporting it for disposal abroad, up to the moment a decision is taken on the deep geological disposal facility.

Italy has adopted a similar approach; the Italian national programme states that due to the small amount of high-level radioactive waste (including spent fuel) to be disposed of, the solution of creating a geological repository on national territory appears excessive, as well as economically non-viable. Therefore, during a transitional period when high-level radioactive waste will be stored in the national repository, the most appropriate solution will be identified for its disposal in a geological repository, also taking into account opportunities offered in the framework of any international agreements that may come about during the said period.

Ireland decided in 2018 not to implement a disposal facility, relying on shipping back disused sources, and on storage of institutional waste until the radioactivity levels decay below release limits. Contrary to its initial plans, Ireland has decided in 2021 that a centralised storage facility is no longer necessary.

Spain has considered to extend the temporary storage of spent fuel in individual storage facilities at the nuclear power plant sites in case a centralised spent fuel and high-level waste storage facility will not be built eventually.

Croatia and Slovenia have not reached an agreement on a common solution for the disposal of short-lived low- and intermediate-level waste from the operation and decommissioning of the Krško nuclear power plant co-owned by the two countries, and thus Croatia will have to dispose of its share in its territory. For the disposal of high-level radioactive waste and spent fuel from the power plant the search continues for a joint solution.

Portugal indicated its plans to reconsider use of its storage facility as disposal.

Although the legislation in Lithuania does not allow the import of radioactive waste for disposal, and states that the radioactive waste and spent fuel produced in Lithuania will be disposed of in a national facility, its national programme does not rule out the possibility of accepting foreign waste or spent fuel into its future deep geological disposal facility.

2.2. National programmes

Member States are required to establish national programmes for spent fuel and radioactive waste management, which define the measures, timeframes and milestones for the practical

implementation of national policies. They were also required for the first time to notify these programmes to the Commission before 23 August 2015.

Whereas in 2015 some national programmes were still draft versions, now all 27 Member States have legally approved national programmes. The majority of the programmes was adopted in 2015, while the Spanish programme dates back to 2006, and the Italian programme was adopted in 2019.

In the first and the second Commission reports it was noted that one Member State's national programme has been drawn-up in 2006 and therefore some of the reported information was outdated. In the third national report the Member State presented updated information on the spent fuel and radioactive waste management activities, as well as an updated inventory of the spent fuel and radioactive waste.

As regular reviews and updates of national programmes are due, the Commission expects Member States to submit their updated programmes, as per Article 13(1) of the Directive. Since 2015 almost half of the Member States have updated their national programmes; in this reporting cycle nine Member States notified their updated national programmes, partly modifying the strategy and the timelines for the activities. In most cases, updates resulted in pushing the various implementation milestones forward by several years, mostly reflecting current delays in the implementation of the national programmes.

Two out of the nine have been revised to take account of significant changes in the national framework and strategy. One of them has been modified to exclude the construction of national disposal or storage facilities, storing disused radioactive sources or possibly emerging radioactive waste instead at the premises of the users – including private entities – until they can be exported. There are ongoing, but so far unsuccessful efforts to reach an agreement with a third country for this purpose. Other non-nuclear power countries have also based their policy on the export of their small inventory of disused radioactive sources, but this is the only case in which a national storage facility is not foreseen. Another Member State whose national programme used to contain no disposal solution plans introduced plans for a disposal facility.

The remaining national programmes were amended either according to the revision frequency established by their national framework or in response to the letters of formal notice of non-compliance with the Directive sent by the Commission.

It is expected that a similar number of national programmes will be updated during the next 3-years period.

The majority of the Member States have defined in their legal framework the responsibilities for review, update and implementation of the national programmes, as well as specific arrangements, deadlines and conditions for such review and update (see Table 2). Incentives for reviewing and updating the national programmes are most often infringement procedures, recommendations of IAEA IRRS and/or ARTEMIS peer-review missions, national decisions

to change to the national policy or national programme, as well as the establishment of a fixed period for review and update in some cases. These review and update mechanisms constitute an important tool towards continuous improvement of national programmes and frameworks.

Article 11(2) of the Directive requires Member States to regularly review and update their national programmes. Two thirds of the Member States have established in their national framework a fixed maximum period of time to carry out the review or update of the national programme. However, there are already cases where Member States were not able to respect those deadlines, primarily due to lengthy or delayed approval or adoption procedures. As of mid-2022, seven Member States failed to review and update national programmes within the defined time frame. Out of those seven, three Member States updated their national programme with a delay not exceeding two years. The remaining four Member States still have not updated their national programmes as envisaged in their national legislations.

Some national programmes detail activities only for a specific timeframe, mostly covering a 5 to 10-year period. By the end of this period Member States are expected to prepare and legally approve the updated national programme for the subsequent period. However, in two such cases Member States were not able to timely adopt updated versions. Such situations do not ensure continuity of the national programmes and should be rectified in the shortest possible term. Member States are encouraged to optimize planning and adoption processes to prevent such cases and to ensure continuity of national programmes.

Overall, almost all national programmes cover all types of radioactive waste and spent fuel generated in the Member States' territory, however, concrete plans from generation to disposal, including deep geological disposal for spent fuel and high-level waste are included only in one-third of the programmes. There are still Member States with operating nuclear power plants that have not yet taken a final decision on the long-term management option for their spent fuel, keeping several options open (e.g. search for shared disposal, reprocessing or direct disposal). Notwithstanding, most Member States' default strategy is to proceed with the direct disposal of spent fuel.

In the previous report the Commission noted that Member States with nuclear power programmes focus on the management of spent fuel and radioactive waste generated in the nuclear industry, and provide much less detail (or no detail at all) on the management of institutional radioactive waste. The situation has not changed since the previous report.

Figure 1 and Table 2 provide an overview of all organisations in Member States that are responsible for developing the programme for managing radioactive waste and spent fuel, the entity approving it, as well as well as the frequency of their (national) review and update requirements. In some cases, the same entity is responsible for developing and approving the programme, which is not considered best practice.

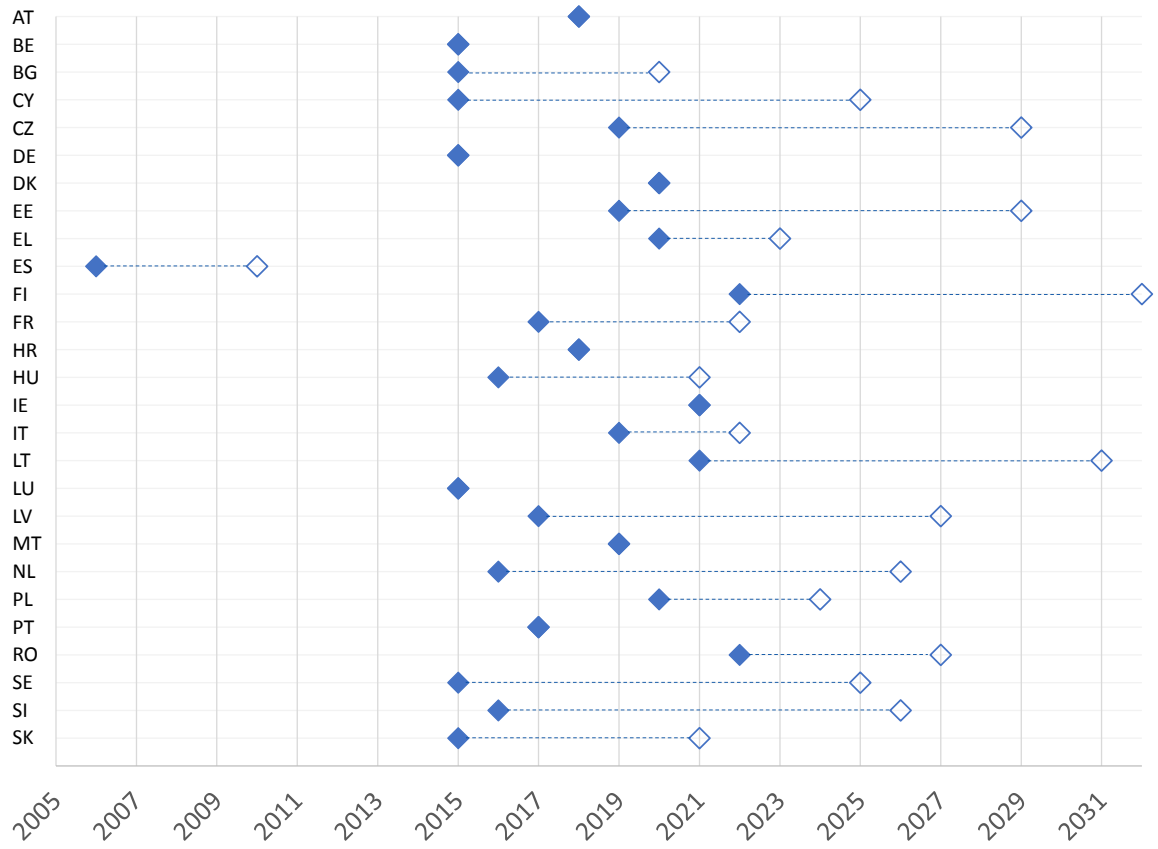

Figure 1 – Timeline of latest national programmes' releases and expected next reviews.

Table 2. Member States' National Programmes under Directive 2011/70/Euratom – Reference date: June 2023.

MS	Organisation developing the programme	Organisation approving	Latest issue	Review and update
AT	Inter-ministerial working group led by the Federal Ministry of Sustainability and Tourism	Federal Government	2018	No period
BE	National Programme Committee (*)	Federal Council of Ministers	2015	No period
BG	Ministry of Energy	The Council of Ministers	2015	Every 5 years
CY	Minister of Labour, Welfare and Social Insurance (MLWSI), Radiation Inspection and Control Service (RICS), Department of Labour Inspection (DLI)	MLWSI	2015	Every 10 years
CZ	Ministry of Industry and Trade	Government	2019	Every 10 years
DE	Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety	Federal Cabinet	2015	No period
DK	Danish Health Authority	Ministry of Health	2020	No period
EE	Ministry of Environment, with participation of A.L.A.R.A. AS, Radiation Monitoring Bureau, QPRE OÜ and experts. (†)	Ministry of the Environment	2019	Every 10 years
EL	Greek Atomic Energy Commission (EEAE)	Minister responsible for the EEAE (Ministers for Finance and for Development and Investment)	2020	Every 3 years
ES	ENRESA (•)	Government (‡)	2006	Every 4 years
FI	Ministry of Economic Affairs and Employment, and Ministry of Social Affairs and Health in cooperation with the Radiation and Nuclear Safety Authority	Ministry of Economic Affairs and Employment	2022	Every 10 years
FR	The Ministry of Ecological Transition (assisted by the PNGMDR steering committee) and the Nuclear Safety Authority	Government	2017	Every 5 years
HR	State Office for Radiological and Nuclear Safety (DZRNS)	Government of the Republic of Croatia	2018	No period
HU	Ministry of Innovation and Technology	Government after SEA completion	2016	Every 5 years
IE	Department of the Environment, Climate and Communications (DECC).	Government	2021	No period
IT	Ministry of Ecological Transition	Prime Minister	2019	Every 3 years
LT	Ministry of Energy together with other stakeholders	Government	2021	Every 10 years
LU	The Minister for Health	The Minister for Health	2015	No period
LV	Minister for Environmental Protection and Regional Development	Council of Ministers	2017	Every 10 years
MT	Radiation Protection Commission	Radiation Protection Commission	2019	No period
NL	Ministry of Infrastructure and Water Management	Parliament	2016	Every 10 years
PL	Ministry of Energy	Council of Ministers	2020	Every 4 years
PT	Portuguese Environment Agency (APA)	Council of Ministers	2017	No period
RO	Nuclear and Radioactive Waste Agency (ANDR)	Government	2022	Every 5 years
SE	Swedish Radiation Safety Authority	Ministry of the Environment	2015	Every 10 years
SI	Agency for Radioactive Waste Management (ARAO) and Slovenian Nuclear Safety Administration (SNSA) (⁑)	National Assembly	2016	Every 10 years
SK	The administrative board of the National Nuclear Fund for decommissioning nuclear installations and managing spent nuclear fuel and radioactive waste ('NNF')	Government	2015	Every 6 years

(*) Comprised of representatives from the Federal Public Service responsible for Energy, the Belgian Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF/NIRAS) and Synatom.

(†) The plan has been coordinated with the Ministry of the Interior, the Ministry of Economic Affairs and Communications, and the Ministry of Finance.

(•) The legal basis requires Empresa Nacional de Residuos Radiactivos S.A. (ENRESA) to submit to the Ministry for the Environmental Transition and the Demographic Challenge every 4 years, or whenever so required by the Ministry, a draft update of the programme.

(‡) Upon proposal by Ministry for the Environmental Transition and the Demographic Challenge, being heard the CSN and relevant Autonomous Communities.

(⁑) ARAO provides the expert basis for the revision of the Programme and based on this, SNSA prepares a draft National Programme which is adopted by National Assembly.

2.3. National legal and organisational frameworks

Member States are required to establish and maintain a national legislative, regulatory and organisational framework ('national framework') for spent fuel and radioactive waste management that allocates responsibility and provides for coordination between relevant competent bodies (Article 5(1) of the Directive).

Member States were required to transpose the Directive by 23 August 2013. All Member States had communicated to the Commission their transposition measures and declared full transposition by the time of the first Commission report to the European Parliament and the Council. During the conformity assessment of the latest notified legal measures the Commission concluded that the transposition in five Member States is incomplete. Some Member States already have indicated additional measures to ensure full transposition.

In the third national reports Member States listed the legal arrangements and the provisions for the national framework, with a very general summary of the issues addressed in the updated arrangements. While some details were provided on how those legal provisions are implemented in practice, some Member States simply listed new or amended legal acts without specifying what were the actual impacts of those changes (e.g. whether or not any new or amended legal acts modified the allocation of responsibilities or the coordination between relevant competent bodies).

National legal and organisational frameworks in Member States with nuclear power plants are generally well-structured and advanced since relevant national laws predate the Directive. As of the end of the reporting period Member States had completed transposition of the Council Directives 2014/87/Euratom (Nuclear Safety Directive) and 2013/59/Euratom (Basic Safety Standards Directive). About half of the Member States have reported that they included the provisions of the Basic Safety Standards in their national frameworks, and further defined the functions of the regulatory authorities, national waste management organisations, as well as other licensing related topics.

A few Member States have clarified financial aspects and safety aspects of radioactive waste management. Other topics addressed during the updates include nuclear security, requirements of the amended Nuclear Safety Directive, alignment of the national framework with IAEA standards or WENRA Safety Reference Levels, and obligations of license holders relative to public information and involvement, safety of radioactive waste management, radiation protection issues, radioactive sources, etc.

Most Member States' national framework prescribes updating and improving the national framework as per Article 5(2) of the Directive and establishes the responsibilities of stakeholders. In general, improvements of the national framework are mainly triggered by international peer reviews (i.e. IAEA IRRS and ARTEMIS peer-review services). Due to the COVID pandemic affecting international travel, few Member States could host an IRRS and/or ARTEMIS peer-review missions during the reporting period. The improvements of the

national framework originated by the outcomes and recommendations of these reviews are expected to be implemented in the following reporting period. Overall, about one third of the Member States reported that IAEA IRRS and ARTEMIS peer-review missions' outcomes and recommendations triggered the update of legal and other administrative and regulatory arrangements.

Member States without nuclear power programmes benefitted the most from the international peer reviews. Occasionally, international peer-review missions have even contributed to the development of the national framework.

All Member States have established laws or regulations requiring that the operating experience, insights gained from the decision-making process and the development of relevant technology and research be taken into account. However, most Member States provided very little or no detail on how the development and review of the national framework takes into account operating experience or research in practice.

2.4. Regulatory framework and competent regulatory authorities

Member States are required to establish and maintain a competent regulatory authority in the field of safety of spent fuel and radioactive waste management. This authority must be functionally separated from any other body or organisation concerned with the promotion or utilisation of nuclear energy or radioactive material, or with the management of spent fuel and radioactive waste. The authority must have the legal powers, as well as human and financial resources necessary to fulfil its obligations (Article 6 of the Directive).

All Member States established national competent authorities and defined their responsibilities and legal powers (see Table 3 below). The majority of Member States opted for one competent authority, while others preferred to set out two or more organisations which have competences and regulatory functions in different aspects of spent fuel and radioactive waste management. Occasionally, there are regional regulatory authorities (such is the case of Germany), along with federal or national ones. The Commission noted that the national reports did not provide sufficient information on the local/regional competent authorities (when applicable) dealing with radioactive waste management. Whenever regulatory functions are assigned more than one organisation (including local/regional), the Commission expects Member States to provide information on how authorities interact with each other to ensure safe management of radioactive waste and spent fuel.

In order to strengthen regulatory supervision, three Member States have introduced changes to their competent regulatory authorities during the reporting period, such as the creation of new authorities, reorganisation of existing ones or consolidation of functions.

Functional independence

Most of the Member States declared the independence of their regulatory authorities from any other organisation or body (i) promoting or using nuclear energy or (ii) managing spent

fuel and radioactive waste. In most cases, functional or administrative independency was established in the relevant national law. The regulatory authority is in some cases embedded in a ministry, and in others it is an autonomous body which reports to the national parliament, the council of ministries, or the government.

Most of the Member States have successfully demonstrated that the competent regulatory authority is functionally independent. Since the previous Commission report four Member States have implemented specific measures to ensure and strengthen functional independence of their competent regulatory authority. However, further efforts are needed in this domain by a few Member States. In general terms, regulatory authorities in countries without nuclear power programmes are often part of the state's central administration and are usually small, proportionate to the size of the managed radioactive waste inventories.

Technical and financial capacity

In addition to the functional and administrative independence, technical and financial capacity are also necessary elements for the effective independence of a regulatory authority capable of implementing its responsibilities. Most Member States' national reports provided information on measures for ensuring technical and financial independence. For instance, such measures included ensuring adequate human resources and sufficient funding by law, establishing fees to the licensees, negotiation of the budget.

Human resources

The national reports of 19 Member States contained information on the human resources of the competent authority by indicating the actual number of staff. However, in a number of cases information was limited to a generic statement that resources were sufficient, or no information was provided. There were a few cases when Member States indicated only the number of positions allocated to the regulatory authority without specifying how many of these were actually filled. A few Member States expressed concerns due to the high turnover rate of the staff and related challenges in knowledge preservation, training of new staff, and build-up of competence despite their total staff numbers remaining stable since the last reporting period.

Staffing requirements to fulfil regulatory functions were usually not clearly indicated, thus in most of the cases it was difficult to assess the adequacy of human resources based on the information provided in the third national reports. Moreover, the majority of Member States indicated the total number of staff in the regulatory authority without specifying how many of them actually deal with safety of radioactive waste and spent fuel management activities. This would be important as a large number of regulatory authorities' employees does not automatically guarantee that sufficient human resources are allocated to the safety of radioactive waste and spent fuel management activities.

Some Member States provided very limited information on their competent regulatory authorities in their national reports, much less than their Joint Convention reports (e.g. on financial and human resources, mechanisms to maintain competence, etc.).

All Member States face challenges with respect to maintaining adequate human resources in the long-term, as confirmed also by recent IAEA ARTEMIS international peer-review missions.

In most Member States staff numbers remained stable during the reporting period, while in a few cases staff increased. However, such increases do not necessarily reflect an actual improvement of the regulatory authority's human resources situation as they might have taken place after staff cuts or hiring bans.

Although it was already indicated in the previous Commission report, demonstration of the technical independence of the competent regulatory authorities still requires further improvements. Only half of the Member States provided information on the competence of their staff, availability of technical support organisations or other experts' support as well as on the mechanisms in place to maintain staff competence. A few Member States have not reported any information on competences of their staff or on mechanisms in place to maintain staff competence. Half of the Member States have clearly or partially reported the financial resources available to their competent regulatory authorities. A few Member States provided information on how the management of the regulatory authority is appointed or dismissed, to show that management is not subject to undue influence while fulfilling its mission.

Table 3. National Competent Authorities for spent fuel and radioactive waste management (*)

MS	Competent authority	Responsibilities for spent fuel and radioactive waste	Reporting to	Staff (year)
AT	Federal Ministry for Climate Action, the Environment, Energy, Mobility, Innovation and Technology (BMK)	The responsibility for the safety of radioactive waste management and for its regulatory control.	Federal Government	No data
BE	Federal Agency for Nuclear Control (FANC)	With regard to the safety of disposal facilities, the competent regulatory authority, i.e. the AFCN/FANC, retains all of its prerogatives	Ministry of Home Affairs	~160 (2018) ~150 (2021)
BG	Nuclear Regulatory Agency of the Republic of Bulgaria (BNRA)	BNRA has been assigned responsibility for all regulatory matters concerning radioactive waste and spent fuel management facilities	Council of Ministers	94 (2017) ~100 (2021)
CY	Radiation Inspection and Control Service – Department of Labour Inspection (RICS/DLI)	The MLWSI, acting through RICS/DLI, is the sole regulatory authority on radiation and nuclear safety and has the responsibility for the administration of relevant legislation and authorisation of all facilities, sources, activities and practices involving exposure to ionising radiation, including radioactive waste and DSRS management.	Ministry of Labour, Welfare and Social Insurance (MLWSI)	5 (2018) 6 (2020)
CZ	State Office for Nuclear Safety (SUJB)	State administration and supervision of the utilization of nuclear energy and ionizing radiation and in the field of radiation protection	Prime Minister	209 (2014) 215 (2020)
DE (†)	The Federal Office for Radiation Protection (BfS)	Establishment and maintenance of a register on the radiation exposure of occupationally exposed persons and on high-activity sealed radioactive sources, determination of the radiation exposure of individuals for medical reasons.	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)	No data
	Federal Office for the Safety of Nuclear Waste Management (BASE)	- Supervision of the site selection procedure - Public participation in the site selection procedure - Granting of approvals and permits under mining, water and nuclear law in approval procedures pursuant to §9b AtG for disposal facilities - Plan and approval for, and licensing of disposal facilities - Licensing of storage facilities and transport of nuclear fuel - Government custody of nuclear fuel - Long-term documentation of all documents and data relevant for storage and disposal - Task-related research		No data
	Länder	Licensing and supervision of nuclear installations and facilities.	Federal government	No data
DK	The Danish Health Authority The Danish Emergency Management Agency	Authorised to establish limits and conditions for operation and decommissioning, to issue terms necessary to ensure compliance and to access nuclear facilities at any time. The nuclear installations at the Risø site, including the national storage facilities for radioactive waste, are subject to oversight and inspection by the Nuclear Regulatory Authorities.	Minister of Health Minister of Defence	No data
EE	The Environmental Board	takes part in drawing up and implementing policies, development plans and programmes, it processes and issues radiation practice licences, assesses the radiation safety of planned and ongoing radiation practices, maintains radiation-related databases and cooperates with the Environmental Inspectorate to arrange supervision of radiation practice licences.	Ministry of the Environment	355 [18 in the Radiation Safety Dept.]
	The Environmental Inspectorate	coordinates and executes supervision of all areas of environmental protection and the use of natural resources, as well as conducts proceedings in environmental violations.		175 (2020) [122 inspectors, 15 involved in radiation supervision]
EL	Greek Atomic Energy Commission (EEAE)	Control, regulation and supervision in the fields of nuclear energy, nuclear technology, radiological, nuclear safety and radiation protection.	Minister of Development and Investments	75 (2018) 75 (2021)
ES	The Nuclear Safety Council (CSN)	Reporting on nuclear safety and radiological protection and authorisations to nuclear and radioactive installations as well as carrying out inspection and control and issuing Instructions, which take the form of mandatory rules	Parliament	448/214 (2017) 424/223 (2020) [Total staff/ Nuclear Safety and Radiological Protection Corps]
FI	Radiation and Nuclear Safety Authority (STUK)	STUK is responsible for controlling that the Radiation Act and other regulations based on the Act are followed. STUK grants safety licences for the use of radiation. The regulatory rights of STUK are described in the Radiation Act. STUK has the authority to issue binding regulations, which have replaced some of the lower level government decrees related to nuclear and radiation safety.	Ministry of Economic affairs and Employment Ministry of Social Affairs and Health	326 (2017) 350 (2020)

MS	Competent authority	Responsibilities for spent fuel and radioactive waste	Reporting to	Staff (year)
FR	The Parliament, the Government and Nuclear Safety Authority (ASN)	Regulates, authorises, controls and helps the public authorities to manage emergencies, participate in the public information	Parliament (•)	500 (2018) 529 (2020)
HR	Ministry of Interior Civil Protection Directorate	Radiological and nuclear safety	Ministry of Interior	Planned 30 (2021) [Actual number unknown]
HU	Hungarian Atomic Energy Authority (HAEA)	The supervisory and administrative regulatory competence relating to nuclear safety and physical protection regarding nuclear installations, radioactive waste disposal facilities as well as nuclear and radioactive materials lies with the HAEA in Hungary. The Atomic Energy Act authorises the HAEA to perform is supervisory activity.	The Minister for Innovation and Technology.	167 (2017) 181 (2019)
IE	Minister for the Environment, Climate and Communications (DECC), assisted by the Environmental Protection Agency (EPA)	The EPA is an independent public body and the competent authority in Ireland with responsibility for ensuring that people and the environment in Ireland are protected from the harmful effects of ionising radiation. The EPA is empowered to regulate radioactive material including practices involving radioactive waste, and radiation sources through an authorisation system of licences and registrations.	Government	No data
IT	National Inspectorate for Nuclear Safety and Radiation Protection (ISIN)	ISIN is entrusted with functions and duties related to technical regulation, implementation of licensing procedures, technical assessments, control and supervision of nuclear installations no longer in operation and in decommissioning, as well as of research reactors, of facilities and activities related to management of radioactive waste and spent fuel, of nuclear materials, of the passive physical protection of nuclear materials and facilities, of the use of ionizing radiation sources and of the transport of radioactive materials, issuing in this case, the certifications foreseen by the current legislation.	Government and the Parliament	Less than 60 (2018) Less than 60 (2021)
	The Minister of Ecological Transition (presently Minister of the Environment and Security of Energy Supply)	The Minister of Ecological Transition, the authority which grants the licence/authorization for nuclear activities (from the design and construction to the decommissioning and waste disposal) and for relevant major practices involving the use of ionizing radiations. Authorizations are granted on the bases of the technical advice, to be considered binding, provided by ISIN.	Government and the Parliament	
LT	State Nuclear Power Safety Inspectorate (VATESI)	Regulation and supervision of nuclear safety, radiation safety of nuclear energy activities involving sources of ionizing radiation, physical security of nuclear installations, nuclear materials and/or nuclear fuel cycle materials and accountancy and control of nuclear materials as well as supervision of requirements arising from international nuclear weapon non-proliferation obligations of Republic of Lithuania.	The Cabinet of Government and the President	66 (2018) 60 (2021)
	Radiation Protection Centre (RPC)	Regulatory control over the exposure of humans and the environment and practices except those with sources of ionising radiation within nuclear energy field.	Ministry of Health	59 (2018) 58 (2021)
LU	Radiation Protection Division (RDP)	All matters pertaining to protection against ionising and non-ionising radiation, nuclear safety and radioactive waste management safety.	Minister for Health	9 (2018) 9 (2021)
LV	Radiation Safety Centre of the State Environmental Service (VVD RDC)	The VVD RDC ensures national supervision and control in the area of radiation and nuclear safety, and also organises and coordinates training of the personnel whose work is related to radiation safety in order to increase the level of radiation safety in the country.	Ministry of Environmental Protection and Regional Development	No data
MT	Radiation Protection Commission (RPC)	The national competent body for radiation protection and nuclear issues	Ministry of Tourism and Consumer Protection	1 (2018) 2 (2021)
NL	Authority for Nuclear Safety and Radiation Protection (ANVS)	The Authority is the competent authority in matters of nuclear safety, nuclear security, radiation protection, transport safety, and waste management and emergency preparedness and response.	Ministry of Infrastructure and Water Management	130 (2018) [141 planned] 126 (2021) [+18 external staff]
PL	National Atomic Energy Agency (PAA)	The central government administrative authority responsible for nuclear safety and radiation protection.	Minister for Climate Matters	123 (2017) [incl. 26 inspectors] 110 (2019) [incl. 26 inspectors]
PT	The Portuguese Environment Agency (APA)	Licensing, evaluating, monitoring and inspecting facilities and activities relating to the management of spent fuel and radioactive waste (encompassing all phases, from initial choice of siting to decommissioning)	Ministry of Environment and Climate Action	20 (2020)
	The Inspectorate-General for Agriculture, Sea, Environment and Spatial Planning (IGAMAOT)			12 (2020) [inspectors]
RO	National Commission for Nuclear Activities Control (CNCAN)	Regulation, licensing, and control of all nuclear activities	Prime Minister, through the General Secretariat of the Government	88 (2017) [Number of positions 170] No data (2020)

MS	Competent authority	Responsibilities for spent fuel and radioactive waste	Reporting to	Staff (year)
SE	Swedish Radiation Safety Authority (SSM)	SSM is authorised to supervise spent fuel management and radioactive waste management in the areas of nuclear safety and security, radiation protection and nuclear non-proliferation.	Ministry of the Environment	302 (2017) 305 (2020)
SI	Slovenian Nuclear Safety Administration (URSJV)	Nuclear safety of facilities and the safety of industrial radiation sources	Ministry of Environment and Spatial Planning	44 (2017) 44 (2020)
	Slovenian Radiation Protection Administration (URSVS)	Radiation protection in medicine and veterinary practice, medical surveillance of exposed workers, surveillance of workplaces, dosimetry and dose registers and education in the area of radiation protection	Ministry of Health	No data
SK	Nuclear Regulatory Authority of the Slovak Republic (ÚJD SR)	State regulatory activities in the field of nuclear safety of nuclear installations, including management of radioactive waste, spent fuel and other parts of the fuel cycle, as well as transport and management of nuclear materials including their control and record keeping system.	The Government and subsequently to the National Council	126 (2017) 128 (2020)
	Public Health Authority (ÚVZ SR)	Supervision over radiation protection in nuclear installations.	Ministry of Health	30 (2017) 40 (2020)

(∗) The data does not include staff of separate technical support organisations that exist in some Member States.

(†) Germany as a federal state, the "regulatory body" consists of authorities of the Federation and the Länder – the regulatory structure comprised of BMU, BASE, BfS and the Land Ministries. The Federal Office for Economic Affairs and Export Control (BAFA) is responsible for the import and export of radioactive materials.

(•) In particular to the Parliamentary Office for the Evaluation of Scientific and Technological Choices (OPECST) and parliamentary committees.

2.5. License holders

License holders are primarily responsible for the safe management of spent fuel and radioactive waste present in the Member States' territory under Article 7 of the Directive.

In their national reports Member States provided very little information on the implementation of Article 7; generally, a summary of legal requirements without any explanation on how those requirements were implemented in practice, especially during the reporting period.

The reporting was somewhat more informative on matters related to Articles 7(2) and 7(3) of the Directive. About half of the Member States provided information on periodic safety reviews and safety improvements as well as on safety assessments during licensing process that took place during the reporting period.

Human and financial resources

Most of the Member States stated that license holders are legally required to provide for and maintain adequate financial and human resources to fulfil their obligations with respect to the safety of spent fuel and radioactive waste management. However, in most cases no information was disclosed on the actual human and financial resources of the license holders as well as how they developed over time. Only few Member States reported on the actual status of human resources, like the number of staff. In some cases, generic information was provided on how competence and skills were managed (this information was mostly linked to Article 8). Thus, it is difficult to assess whether Member States were able to guarantee that license holders ensured sufficient human and financial resources.

Waste management organisations

The presence of dedicated radioactive waste management organisations is a common feature (actually, in all nuclear power and most of non-nuclear power Member States). Waste management organisations are typically public entities, with few exceptions where they are established by nuclear power plant operators. In both cases, funding of spent fuel and radioactive waste management activities is based on the principle that the generators of spent fuel and radioactive waste cover the costs associated with the management of these materials. Some of these organisations also deal with decommissioning of shut down nuclear installations. In some cases, the Member State will take over the responsibilities for a disposal facility from the radioactive waste management organisation after the closure of that disposal facility.

The list of the radioactive waste management organisations as of mid-2022 in the EU is provided in Table 4. Since the publication of the second Commission report, no significant changes took place.

Table 4. Radioactive waste management organisations in the EU

MS	Radioactive waste management organisation	Type	Responsibilities
AT	Nuclear Engineering Seibersdorf GmbH (NES)	Public/private	Collection, processing, conditioning and temporary storage of radioactive waste, decontaminating installations and laboratories.
BE	Belgian Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF/NIRAS)	Public	Managing radioactive waste from all sources, managing spent fuel when declared as radioactive waste, incl. disposal.
BG	State Enterprise for Radioactive Waste (SE RAW)	Public	Management of radioactive waste and spent fuel, outside the facilities where it is generated; and decommissioning.
CZ	Radioactive Waste Repository Authority (SÚRAO)	Public	Operation of all low and intermediate level waste repositories; Monitoring of the now closed Hostim repository, Development of deep geological repository for disposal of HLW and spent fuel.
DE	Federal Company for Radioactive Waste Disposal (BGE)	Public/private (⁕)	In July 2016, Bundesgesellschaft für Endlagerung mbH (BGE) was founded as a private-law entity under the sole ownership of the Federal Government; its remit is to act as a project sponsor for the planning, construction, operation and decommissioning of final repositories. Operator responsibilities were transferred to BGE on 25 April 2017
	Federal Company for Radioactive Waste Storage (BGZ)	Private (†)	Interim storage of irradiated fuel elements and radioactive waste generated by the operators referred to in the Act reassigning responsibility for nuclear waste management. Since August 2017, BGZ has operated the centralised interim storage facilities in Ahaus and Gorleben. On 1 January 2019, responsibility for the 12 decentralised interim storage facilities at the sites of the German nuclear power plants were transferred to BGZ. On 1 January 2020, responsibility for the 12 interim storage facilities for low-level and intermediate-level radioactive waste at the nuclear power plant sites (as referred to in the Act) was also transferred.
DK	Danish Decommissioning (DD)	Public	Decommissioning and receiving, handling and storage of radioactive waste. Also licensed operator for all radioactive waste. The adoption of Parliamentary Resolution B90/2018 extended the tasks of Danish Decommissioning to also include contributions to establishing a long-term solution for radioactive waste.
EE	AS A.L.A.R.A.	Public	Management and storage of radioactive waste, incl. management and decontamination of former Paldiski nuclear site and Tammiku radioactive waste repository.
EL	National Committee for Radioactive Waste Management (EEDRA)	Public	Collegiate body with advisory and supportive role to the Minister on the implementation of the practical aspects of the national policy and national framework and on the coordination of the bodies involved in RW management. EEDRA can be interpreted as having a WMO-like role in the country by being independent from the waste producers, maintaining its autonomy in relation to the regulatory authorities due to its diverse composition, and having a flexible, optimal and effective form.
ES	National radioactive waste company (ENRESA)	Public (‡)	Management of radioactive waste and spent fuel. Decommissioning nuclear plants.
FI	POSIVA	Private (•)	Posiva is responsible for the preparations and later implementation of spent fuel disposal for its owners TVO and FPH.
FR	National agency for management of radioactive waste (ANDRA)	Public	Long-term management of radioactive waste.
HR	Radioactive Waste Management Centre (RWMC)	Public	Coordination, preparation and development of the Programme of the Krško NPP decommissioning and the Programme of the Krško NPP radioactive waste disposal.
HU	Public Limited Company for Radioactive Waste Management (PURAM)	Public	Management of all types of radioactive waste, decommissioning of nuclear facilities, as well as activities related to research and development.
IT	Company for the Nuclear Installations Management (SOGIN)	Public	Treatment and conditioning into certified form of all liquid and solid wastes, ready to be delivered to the National Repository; perform all the actions needed for managing spent fuel; contribute to the decommissioning of all nuclear facilities owned by other licensees; implement the single phase decommissioning strategy in all nuclear installations, reactors and fuel cycle facilities. Implementer responsible for the siting, construction and operation of the National Repository.
LT	State Enterprise Ignalina Nuclear Power Plant	Public	Assigned as sole entity which is responsible for safe management of all the Lithuanian radioactive waste and spent nuclear fuel, defined major requirements for the preparation of the final closure plan of the disposal facility.
LV	Latvian Environment, Geology and Meteorology Centre (LEGMC)	Public	Processing, reprocessing, storage for an extended period of time (long-term storage) and disposal of radioactive waste.
NL	Central Organisation For Radioactive Waste (COVRA)	Public	Implementing the Dutch policy with regard to radioactive waste in the Netherlands. Treatment and storage of all radioactive waste and spent fuel.
PL	Radioactive Waste Management Plant (ZUOP)	Public	Collection, segregation, and treatment, conditioning and interim storage/final disposal of all radioactive waste arising in the country. Operating the National Radioactive Waste Repository in Różan.
PT	Instituto Superior Técnico (IST)	Public	Collecting, segregating, conditioning and storing solid and liquid radioactive waste.
RO	Nuclear and Radioactive Waste Agency (ANDR)	Public	Coordination of the safe management of radioactive waste and spent nuclear fuel, including final disposal, at national level.
SE	Swedish Nuclear Fuel and Waste Management Company (SKB)	Private (⁑)	Planning and construction of all facilities required for the management of spent nuclear fuel and radioactive wastes as well as for research and development programmes necessary for the provision of such facilities.
SI	Agency for Radwaste Management (ARAO)	Public	Collecting, transporting, treating, storing and disposing of low and intermediate level waste and for the disposal of HLW. Management of the closed uranium mine.
SK	Nuclear and Decommissioning Company (JAVYS)	Public	Management of spent nuclear fuel and radioactive waste. Decommissioning of the nuclear power plants.

(⁕) Public with private legal personality.

(†) Private law entity under the sole ownership of the Federal Government.

(‡) State-owned company CIEMAT (80%) and SEPI (20%).

(•) Owned by the NPP operators Teollisuuden Voima Oyj and Fortum Power & Heat Oy.

(⁑) Reactors licensees.

3. Implementation of national programmes

3.1. Progress monitoring and KPIs

In order to achieve the Directive's overarching objective, among other elements, Member States must adopt national programmes for the implementation of national spent fuel and radioactive waste management policies. The content of the national programme is outlined in Article 12 of the Directive, which states that: "*The national programmes shall set out how the Member States intend to implement their national policies referred to in Article 4 for the responsible and safe management of spent fuel and radioactive waste to secure the aims of this Directive, and shall include all of the following: (a) the overall* ***objectives*** *of the Member State's national policy in respect of spent fuel and radioactive waste management; (b) the significant* ***milestones*** *and clear* ***timeframes*** *for the achievement of those milestones in light of the over-arching objectives of the national programme; (…) (g) the responsibility for the implementation of the national programme and the* ***key performance indicators*** *to monitor progress towards implementation*".

Together with the objectives and the milestones, to which they are closely connected but from which they must be distinguished, the key performance indicators (KPIs) constitute an essential element of the national programme, which enable to monitor progress towards its implementation, the implementation of the national policy and, ultimately, towards achieving the Directive's overarching objective of avoiding undue burdens on future generations. Moreover, as KPIs allow monitoring of progress towards national programme implementation, they are also an important tool for ensuring transparency towards the general public[11].

The application of KPIs is representing a challenge for the Member States. In order to support the Member States in addressing it, the Commission contracted a study, which was presented to the Member States' regulatory authorities and relevant stakeholders during a workshop held in February 2021. The final report[12] of this study identified qualities of a good KPI and provided indications on how relevance, completeness and soundness of the KPIs could be assessed. It suggested that for assessing the soundness of the KPI, the Commission should take into consideration whether (i) the KPI is clearly defined, (ii) its underlying data is

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[11] Article 10 of the Directive provides in fact that "Member States shall ensure that necessary information on the management of spent fuel and radioactive waste be made available to workers and the general public. This obligation includes ensuring that the competent regulatory authority inform the public in the fields of its competence".

[12] European Commission, Directorate-General for Energy, Study on key performance indicators for monitoring implementation of national programmes on safe and long-term management of spent fuel and radioactive waste: final report, Publications Office of the European Union, 2022, https://data.europa.eu/doi/10.2833/052078

auditable, (iii) it indicates thresholds for the adoption of steering actions, (iv) it is regularly updated and (v) reassessed. For the relevance and completeness assessment, the Commission should determine whether (i) the KPI is relevant for the implementation of the national programme and (ii) it covers the national programme's essential steps and challenges.

Having these general indications in mind and building on the results of the study mentioned above, KPIs should:

- cover the key objectives and milestones of the national programme;
- allow for the measurement of progress towards the achievement of the national programme's key objectives and milestones;
- be regularly updated;
- be subject to a review process;
- be reported to the Commission every three years;
- enable the Commission to adequately report to the European Parliament and the Council on the progress in the implementation of the national programmes.

In its first report[13] on the implementation of the Directive, the Commission noted that "*most Member States have not clearly defined key performance indicators*". During the reporting period, the Commission asked for clarifications and engaged in a dialogue with the Member States with the aim of encouraging them to develop their own KPIs to monitor progress towards the implementation of their national programme.

The second implementation report[14] identified the definition of KPIs as one of the main challenges of implementation related to the national programmes, referring to KPIs as "*an important tool not fully exploited thus far*". The report also stressed that *"…over a third of the Member States have not defined key performance indicators in line with the Directive*" and that the Commission "*called on these Member States to comply with the relevant requirements*".

The situation has not changed significantly since the second implementation report. Although during this period nine Member States have notified to the Commission their updated national programmes, nonetheless only in one case KPIs are in line with the criteria listed above. In the same time period, the Commission has received a few draft national programmes notified under the Article 33 of Euratom Treaty, some of which show interesting developments in the application of KPIs.

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13 Report from the Commission to the Council and the European Parliament on progress of implementation of Council Directive 2011/70/Euratom and an inventory of radioactive waste and spent fuel present in the Community's territory and the future prospects - COM(2017) 236 final.

14 Report from the Commission to the Council and the European Parliament on progress of implementation of Council Directive 2011/70/Euratom and an inventory of radioactive waste and spent fuel present in the Community's territory and the future prospects – Second report – COM(2019) 632 final.

Hence, generally speaking, Member States have to make further significant efforts to set out KPIs. Around half of the Member States use milestones and timeframes as means to measure the progress of implementation. This approach may allow monitoring the fulfilment of specific goals, however it cannot replace a set of well-defined KPIs which provide more appropriate means to monitor the progress and drive changes. One third of the Member States still have not defined any KPIs in their national programmes. KPIs are important tools not only to monitor implementation progress but as well to communicate the progress to the citizens, especially given the long-term nature of most radioactive waste and spent fuel management programmes.

Concerning reporting of the implementation progress in the third national reports – the situation remains broadly unchanged. Most of the Member States have reported progress in the implementation of national programmes mainly by describing what has been achieved since the last report, and many Member States have updated their milestones and timeframes. However, even in those cases where KPIs were defined, KPIs were not used as reporting tools in national reports. All Member States are expected to define KPIs in their national programmes and report on the status of these indicators in the periodic national reports so that the progress of implementation of the national programmes, and the progress of radioactive waste management and spent fuel in the EU at large can be properly assessed and communicated to the general public.

3.2. Implementation status

Except for a few countries, national reports clearly indicated the progress made since the last report. However, in a few cases, information on the physical advancements is either missing or unclear.

As a general consideration, apart from very few cases, the implementation of national programmes was delayed in a range from a few months up to 5 years. Delays are due in part to the recent pandemic, in part by lengthier than expected licencing procedures, in part by changes in the policy, and in part by political decisions. Delays, however, did not put at risk the safety of the population. In one case there had been no progress due to lack of funds. Some special attention should be given to this case as, if the situation persists, it could generate concerns over the safety of radioactive waste management.

A number of countries have not reported clear timelines or have not defined a long-term strategy making it difficult to assess whether there were delays in the implementation of the programme. In some cases, this is due to the fact that the national programme was only valid for a short timeframe and included milestones within that timeframe, but the programme was not updated as planned, therefore resulting in a time period with no timelines defined.

Most countries have plans for storage and disposal of all kinds of radioactive waste, however the decisions on the disposal of HLW and SF are in most some cases still pending.

The construction of disposal facilities was delayed in most countries and about one third of the countries still have no clear strategy for the final disposal of all radioactive waste. While there are no warning signals on the capacities for safe storage for the existing radioactive wastes, some concerns remain for the waste arising in the future.

During the reporting period two Member States have shipped their spent fuel from research reactors to the United States for disposal. A few Member States have shipped spent fuel for reprocessing abroad. Since the second Commission report one Member State completed the return of by-products from spent fuel reprocessing. Six Member States are expected to return by-products from spent fuel reprocessing in the coming years (Table 8).

Storage facilities

Construction, modernisation and extension of storage facilities for all types of waste is progressing in most countries according to plans, but with some delays.

For Cyprus, the construction of a national storage facility is planned, but the status of the progress on its establishment is not clear from the report.

While in two Members States facilities for storage of vitrified High-Level Waste are already in place, implementation progress of storage facilities in three Member States raise significant concerns over the possibility to have in place appropriate storage facilities to accommodate these wastes in time for their return. Member States shipping their spent fuel for reprocessing to the Russian Federation face additional risks and uncertainties.

Deep Geological Repositories (DGR)

Three Member States have progressed decisively on the realisation of disposal facilities for High-Level Waste and/or Spent Fuel.

Significant progress[15] has been made on the construction of a DGR for spent fuel in Finland where the disposal operations are scheduled to start in 2024. In Sweden, the DGR for spent fuel is now at the construction licence review phase. In France, activities on the DGR for High-Level Waste are well under way also at the Cigéo site.

Although all other countries with HLW or SF have included in their national programme the siting and building of a DGR, only four countries (apart from Finland, Sweden and France) have started any research on the siting. No concrete actions were reported by other countries on this point.

Most countries decided to keep the option for solutions shared with other countries and consider the DGR as a last resort in case no other solution is practicable. As a consequence, the related preparatory and siting activities stagnated and were pushed further into the future.

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[15] Compared to initial plans a delay of approximately 4 years was recorded due to licencing procedures. Notwithstanding the Finnish DGR will represent the first-of-a-kind on a global scale.

The envisaged dates for the commissioning of the repositories are currently ranging between the 2050s and 2070s, with the exception of the Netherlands that scheduled the possible DGR to be commissioned not before 2130. A few Member States have already postponed milestones for the site selection and/or or commissioning of their DGR and a few others are planning to do the same. Two Member States indicated plans to construct a DGR, but have not indicated any timeframes. The absence of concrete steps forward for the disposal of SF and/or HLW is a concern, in particular for those countries that have plans for building new reactors.

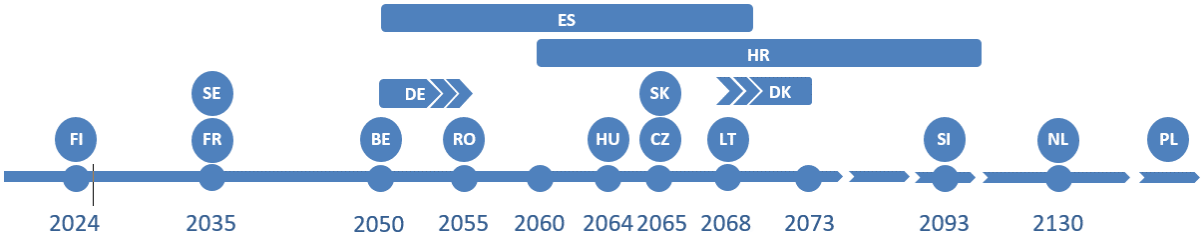

Figure 2 - Planned start of operation of deep geological facilities

Disposal of VLLW and LILW

As already mentioned for storage facilities, progress in the implementation of disposal facilities for other radioactive waste, or enlargement of existing ones, are progressing according to plans although with some delays in most of the countries (Table 5).

It is to be noted that not all countries have in place concepts and plans for the final disposal of radioactive waste. Two countries have decided they need no disposal facility on their territory as they plan to export all disused sources and radioactive waste to other countries. The same solution is still considered by other countries with only a very limited amount of disused sealed sources and radioactive waste. A few countries have delayed any decision on final disposal solutions. Among these also a country with a nuclear power plant. For a few other countries, the plans are only at a conceptual phase.

Special attention needs also to be paid to the consequence of the failure to reach an agreement between Slovenia and Croatia on the common management of short-lived radioactive waste from the Krško NPP in Slovenia. In 2019 the Intergovernmental Commission[16] stated that a joint solution to the disposal of Short-Lived Low- and Intermediate-Level Waste from Krško NPP was not possible. Following this conclusion, Slovenia and Croatia must take care of their share of radioactive waste by 2025. There appear to be significant delays for Croatia to be ready to accept the transfer of its portion of RAW from Krško NPP starting in 2023 and

[16] Intergovernmental Commission responsible for the implementation of the agreement between the Government of the Republic of Slovenia and the Government of the Republic of Croatia on Regulation of the Status and Other Legal Relations Regarding the Investment, Exploitation and Decommissioning of the Krško NPP.

completed in 2025 as currently scheduled and needed to free space on the Krško NPP site. Some delays on the construction of a LILW disposal facility are present also on the Slovenian side.

Decommissioning

The decommissioning of shutdown nuclear installations is ongoing in several Member States and plans were reported for those installations which are still operating (Table 7).

Decommissioning of shutdown nuclear power plants generates large amounts of materials. A very large share of those materials is typically released from regulatory control as non-radioactive and recycled or reused. The residual part is managed as radioactive waste ad mostly belongs to the categories Very-Low-Level and Low-Level Waste, with minor quantities of Intermediate-Level Waste. The progress in decommissioning is inherently linked to the availability of disposal sites for such type of waste.

In general terms, and except for a few cases, the implementation of the national programmes is progressing according to schedule. In some cases, a few milestones have been met earlier, in other cases they have been delayed without jeopardising the overall implementation in the longer term.

Table 5. Near surface and intermediate depth disposal facilities (∗) in EU (†)

MS	Status	Site	Commissioning	Operations (years)	Closure	Institutional Control (years)	Responsible organization	Comment
AT			2045					To be available by 2045. No decision on the disposal solution.
BE	Licensing	Dessel	2027 [2023] (‡)	50	2127 [2123] (‡)	300	ONDRAF/ NIRAS	Surface disposal for LLW (Category A). In Sept. 2019 FANC declared licence application complete. Licence was expected in 2023.
BG	Operations	Novi Han	1964				SERAW	LLW, ILW (institutional waste). Converted to storage. Planned decommissioning by 2025.
	Construction	Radiana / Kozloduy	2024		2086		SERAW	LILW surface disposal
CY								No decision on the disposal solution
CZ	Operations	Dukovany	1995	95	2090	300	SÚRAO	Capacity sufficient for all RAW from NPPs Dukovany and Temelín, incl. LTO
	Closed	Hostim / Beroun	1959	5	1964	Ongoing (at least 50 y more)	SÚRAO	Closed. Final sealing 1997.
	Operations	Bratrstvi / Jáchymov	1974		2025	120	SÚRAO	Capacity until 2020 for NORM waste. Closing to start in 2025.
	Operations	Richard / Litoměřice	1974		> 2025	120	SÚRAO	First phase of refurbishment started in 2018; second phase is planned for 2020-2022
DE (•)	Construction	Konrad	2027					
	Remediation planned	Asse II / Remlingen	1967	Until 1978			BGE	LLW and ILW. Retrieval of waste planned. BGE since April 2017. At least 511 m or 725 - 750 m below surface.
	Closing	Morsleben	1971	Until 1998	In progress		BGE	Closure under licensing. BGE since April 2017
DK	Planned		2073					No later than 2073
EE	Planned	2019-2023	2040		2050		A.L.A.R.A. AS	Concept for low and intermediate level waste disposal to be decided
EL								No decision yet on the disposal solution
ES	Operations	El Cabril	1992		2040	300	ENRESA	LLW and ILW
	Operations	El Cabril	2008		2040	60	ENRESA	VLLW
FI	Operations	Lovisa	1977/ 2005/ 2019		2068	Not foreseen	FORTUM	Lovisa NPP LLW and ILW in granite bedrock at 110 m depth
	Operations	Olkiluoto	1992		2080	Not foreseen	TVO	Olkiluoto NPP. LLW and ILW in granite bedrock at 60-95 m depth. Planned to be extended in 2030 for all LILW from OL 1-3.
	Planned	Hanhiviki (Pyhäjoki)	2035		2040		FVO	Hanhikivi, VLLW
	Planned	Hanhiviki (Pyhäjoki)	2037		2139			Hanhikivi, LILW
FR	Operations	Vendeuvre-Soulaines - Aube district; Centre de L'Aube	1992		Later than 2050	300	ANDRA	Low level waste and intermediate level waste-short lived
	Closed	Digulleville - Manche district; Centre de La Manche	1969		1994	300 (since 2003)	ANDRA	
	Operations	Morvilliers -Cires	2003		2028		ANDRA	VLLW disposal facility. Saturation in 2028
HR	Planned	Čerkezovac	2058		2065			Not before 2058. LILW
HU	Operations	Püspökszilágy	1976		2067	150	PURAM	Radioactive Waste Treatment and Disposal Facility (RWTDF) Institutional waste
	Operations	Bataapati	2008		2084	50	PURAM	National Radioactive Waste Repository (NRWR) Waste nuclear power plants
IE	Not planned							Policy is based on storage of DSRS at the premises of the user until return or export
IT	Siting		2026				SOGIN	National repository

MS	Status	Site	Commissioning	Operations (years)	Closure	Institutional Control (years)	Responsible organization	Comment
LT	Operations	Ignalina NPP	2021	2021	2038	30 active 100 passive	Ignalina NPP	Industrial landfill for VLLW disposal
	Operations	Ignalina NPP	2022		2038		Ignalina NPP	Landfill disposal facility – VLLW Planned to be released from institutional control by 2038
	Planned	Ignalina NPP B25/NSR	2027 [2021-2023]	2028 [2023]		Active 100 Passive 200	Ignalina NPP	Near Surface Repository for Short Lived LILW
	Licensing	Ignalina NPP B20/BWR	Decision in 2025 [2022]				Ignalina NPP	Conversion of bituminised waste storage facility into a disposal facility
LU	Not planned							Policy is to send all RAW to Belgium for treatment and disposal
LV	Operations	Baldone	1962				LEGMC	Radon type surface disposal Also used for storage
MT								No decision yet on the disposal solution
NL	Not planned							
PL	Operations	Różan	1961		2038-2040 [2025-2029]		RWMP	Closing of the NRWR depends on the start of operation of the NNRWR
	Planned	Site selection 2022 [2018]	2032 [2030]	2033-2152	2153-2163 [2144-2155]		RWMP	NNRWR
PT	Operations	CTN/IST campus					IST	Pavilhão de Resíduos Radioativos Surface storage facility licensed as disposal facility in 2016
RO	Operations	Baita-Bihor	1986		2040	100 active 200 passive	ANDR	
	Planned	Saligny	2028 [2021]		2100 [2090]	100 active 200 passive	ANDR	DFDSMA
SE	Operations	Forsmark	1983-1988		2070-2074		SKB AB	SFR (low and intermediate level waste) Extension of operations requested in 2014
	Planned		2045				SKB AB	SFL (long lived low and intermediate level waste) License application to be submitted in 2030
	Operations	Forsmark				30	Forsmarks Kraftgrupp AB	Forsmark NPP (VLLW)
	Operations	Oskarshamm				30	OKG AB	Oskarshamm NPP (VLLW)
	Operations	Ringhals				30	Ringhals AB	Ringhals NPP (VLLW)
	Operations	Studsvik				30	AB SVAFO	Studsvik (VLLW)
SI	Planned	Vrbina	Later date (not specified) [2020-2021]				ARAO	LILW
SK	Operations	Mochovce	1999	Until 2080		several decades active 200-300 passive	JAVYS	LLW. Existing facility; extension recently finished.
	Operations	Mochovce	2016				JAVYS	VLLW. Module 1 (A1) in operation since 07/16; Module 2 (V1) construction finished in 2017

(∗) The terms near surface, intermediate depth and deep geological disposal are used in the meaning of IAEA Safety Guide GSG-1 “Classification of Radioactive Waste”, 2009.

(†) Dates in square brackets indicate information from the 2nd national reports.

(‡) Commissioning 4 years after start of construction; closure 104 years after start of construction.

(•) Asse II salt mine remediation is planned around 2033.

Table 6. Deep Geological Disposal Facilities (∗) in EU Member States.

MS	Siting / Site	Commissioning	Operation (years)	Closure	Institutional Control	Cost [EUR billion (†)]	Responsible organization	Comment
BE	Not indicated	~2050	Minimum 100	~2150		3.2 (2012)	ONDRAF/NIRAS	Planned start of disposal of B cat. waste in ~2065 and of C cat. waste in ~2105.
BG	Dates not yet defined (‡)					Not available	SERAW	
CZ	2025 [2022]	2065				4.1 (2011)	SURAO	Site selection ongoing. According to the draft of Policy update 2021 - selection of the final and backup site is by 2030.
DE	By 2031	> 2050				7.7	BGE	
DK	Not specified	< 2073				0.3	Danish Decommissioning	(DKK 2.3 billion)
ES	2016-2050	2050-2069				3.0 (2005)	ENRESA	Data from the 6th GRWP (2006). In the draft 7th GRWP, commissioning of DGR is planned in 2073.
FI	Eurajoki (Olkiluoto)	2024		2120	Not foreseen	5.0 (2020)	POSIVA	Cost includes the disposal of spent fuel, the construction, operation and closure of the overall facility, Posiva's R&D expenses, property taxes and the costs of regulatory control.
	Hanhikivi						FVO	Fennovoima has withdrawn construction licence application for the planned Hanhikivi 1 NPP
FR	Bure (Cigéo)	2035	more than 100	> 2125		25 (2016)	ANDRA	100 year reversibility; concept for submission for authorization.
HR	2050 (start of siting)	2060-2095					Fund (•)	Disposal facility in Croatia or Slovenia (2060-2095)
HU	Site selection ongoing	2064	20	2084	Not established	1.8	PURAM	(HUF 745 278.5 million)
LT	2047 [2033]	2068 [2066]	2068-2074	2075-2079 [2072]		2.5 (2004)	Ignalina NPP	
NL		2130	50	2180		2.05 (2017)	COVRA	Decision will be taken around 2100.
PL							ZUOP	Deep Radioactive Waste Repository. Timeframes not yet defined
RO	2044	2055	100	2150		2.8	ANDR	
SE	Forsmark	2035 [2032]			Not foreseen	2.39	SKB AB	License application to build disposal approved by the Government in 2022.
SI	2086 [2045-2055]	2093 [2065]	10	2103 [2075]	No data	Not available	ARAO	
SK	First stage (2013-2016) Site selection in 2030	2065	40-60	2105-2115	Not foreseen	3.7-4.4 (2014)	JAVYS	EUR 3.7 billion / EUR 4.4 billion depending of NPP operations 40 / 60 years respectively.

(∗) The terms near surface, intermediate depth and deep geological disposal are used in the meaning of IAEA Safety Guide GSG-1 "Classification of Radioactive Waste", 2009.

(†) Otherwise specified.

(‡) Dates in square brackets indicate information from the 2nd national reports.

(•) Fund for Financing the Decommissioning of the Krško Nuclear Power Plant and the Disposal of Krško NPP Radioactive Waste and Spent Nuclear Fuel.

Table 7. Schedule for Decommissioning of Nuclear Power Plants in EU Member States (†)

MS	Reactors/Units	Operation	Shutdown	Decommissioning	Comments
BE	Doel (unit 1)	1975	2025		End of operation dates by Phase-out Law of 31/01/2003 modified by the law of 28/06/2015.
	Doel (unit 2)	1975	2025		End of operation dates as established by the Phase-out Law of 31/01/2003 modified by the law of 28/06/2015.
	Doel (unit 3)	1982	2022		
	Doel (unit 4)	1985	2035		
	Thiange (unit 1)	1975	2025		
	Thiange (unit 2)	1983	2023		
	Thiange (unit 3)	1985	2035		
BG	Kozloduy (unit 1)	1974	2002	ongoing	Decommissioning end date 2030
	Kozloduy (unit 2)	1975	2002	ongoing	Decommissioning end date 2030
	Kozloduy (unit 3)	1980	2006	ongoing	Decommissioning end date 2030
	Kozloduy (unit 4)	1982	2006	ongoing	Decommissioning end date 2030
	Kozloduy (unit 5)	1987	2047		Life time extension
	Kozloduy (unit 6)	1991	2051		Life time extension
CZ	Dukovany (units 1-4)	1985 ÷ 1987 (*)	2038 ÷ 2047		Life time extension
	Temelin (units 1-2)	2000 ÷ 2002 (*)	2060 ÷ 2062		60 years operation
	Dukovany (unit 5)	planned	no data		60 years operation
	Temelin (unit 3)	planned	no data		60 years operation
DE	36 reactors shutdown	1962 ÷ 1989	1971 ÷ 2021	3 completed, others ongoing	
ES*	2 reactors undergoing decommissioning (José Cabrera and Vandellos I)	1968 ÷ 1972	2006 and 1989	Ongoing	
	1 reactor shutdown (Santa María de Garoña)	1971	2017		
	7 operating reactors (*)	1983-1988	2027 ÷ 2035		
FI	Olkiluoto (unit 1)	1979	2038	2070-2080	
	Olkiluoto (unit 2)	1982	2038	2070-2080	
	Olkiluoto (unit 3)	2022	2080	2080-2090	
	Loviisa (unit 1)	1977	2030	2030-2035	
	Loviisa (unit 2)	1981	2030	2030-2035	
	Hanhikivi	Cancelled 2022 (*)			
FR	56 operating reactors and 9 shutdown reactors and EPR Flamanville	1977 ÷ 1999	2027 ÷ 2078	After 2030	Operating lifetime of 50 years
HU	Paks (units 1-4)	1982 ÷ 1987	2032 ÷ 2037	2061	20 years LTO
	Paks (units 5-6)	2026 ÷ 2027			Planned
IT	Caorso	1978	1990	Ongoing	
	Enrico Fermi (Trino)	1964	1990	Ongoing	
	Garigliano	1964	1982	Ongoing	
	Latina	1963	1987	Ongoing	
LT	Ignalina (unit 1)	1983	2004	Ongoing	Decommissioning end date 2038
	Ignalina (unit 2)	1987	2009	Ongoing	Decommissioning end date 2038
NL	Dodewaard	1968 (*)	1997 (*)	After 2045	
	Borssele	1973 (*)	2033		
PL	New build	2033	2096		
RO	Cernavoda (unit 1)	1996	2049	2049 ÷ 2056	

MS	Reactors/Units	Operation	Shutdown	Decommissioning	Comments
	Cernavoda (unit 2)	2007	2059	2059 ÷ 2066	
	Cernavoda (units 3-4)	Planned 2024 ÷ 2025	2075 ÷ 2076	2075 ÷ 2083	
SE	Barsebäck (units 1-2)	1975 1977	1999 2005	Started in 2020	
	Forsmark (units 1-3)	1980 1981 1985	2040 2041 2045		
	Oskarshamn (units 1-3)	1972 1975 1985	2017 2015 2045	Units 1 and 2 under way. Planned to end in 2028	
	Ringhals (units 1-4)	1976 1975 1981 1983	2020 2019 2041 2045	Units 1 and 2 planned to start in 2023	
	Ågesta	1964	1974	2020 ÷ 2024	
SI	Krško	1983	2043	2043	
SK	Bohunice V1 (units 1-2)	1978 (*) 1980 (*)	2006 2008	2011 ÷ 2027	
	Bohunice V2 (units 1-2)	1984 (*) 1985 (*)	2045		
	Bohunice A1	1972 (*)	1979	2033	
	Bohunice (unit 3)	2029			
	Mochovce (units 1-2)	1998 (*) 1999 (*)	2061	2066 ÷ 2083	
	Mochovce (units 3-4)	Planned 2022-2023	2061		Possible LTO to 60 years

(†) At the time of reporting to the Commission (2018).

(*) Information from other sources to the Commission than the national programmes/reports

Table 8. Return of By-products from Spent Fuel Reprocessing to EU Member States

MS	Type of material	Timeframe
BG	Return of HLW from Kozloduy NPP spent fuel reprocessing in Russia	After 2025
CZ	Return of residual waste from highly enriched Uranium (LRV-15 reactor) sent to Russia	First batch in 2024 Second batch in 2033
DE	According to current planning, the return of the CSD-B waste from France is scheduled for 2022. From 2024, the return of the CSD-C waste (152 casks) is planned. In November 2020, six casks containing vitrified high-level radioactive waste from reprocessing of spent fuel from Germany in Sellafield (United Kingdom) were shipped to the Biblis spent fuel storage facility. In 2024 and 2025, the remaining casks from the United Kingdom are to be returned to the spent fuel storage facilities Brokdorf and Isar (seven casks each).	2022 ÷ 2025
IT	Almost all spent fuel from NPPs was shipped to the United Kingdom and France. The return of radioactive waste from reprocessing is planned by 2025.	By 2025
NL	Part of vitrified HLW from France received and additional expected to be returned.	At the latest in 2052
ES	Products from reprocessing that need to be returned to Spain are vitrified HLW located in France (spent fuel from Vandellos I NPP)	2026

3.3. Self-assessments and international peer reviews

Periodically and at least every 10 years, Member States shall arrange for self-assessments of their national framework, competent regulatory authority, national programme and its implementation, and to invite an international peer review of their national framework, competent regulatory authority and/or national programme (Article 14(3) of the Directive).

The aim is to ensure that high safety standards are achieved in the safe management of spent fuel and radioactive waste. The Member States define the scope, timing and type of international peer reviews in line with Article 14(3) of the Directive. As the Directive had to be transposed in 2013, for the first time by 2023[17] self-assessments must be carried out and international peer reviews must be invited. A Member State must report the outcome of these international peer reviews to the Commission and the Member States. The results may also be made available to the public unless there is conflict with security and proprietary information. The majority of Member States addressed periodic self-assessments and international peer reviews in a general way in their national programmes and reports.

[17] With a mission to NL to take place in November 2023, and another mission to BE in December 2023, all Member States will have their self-assessments and international peer reviews carried out until the end of 2023.

Services for international peer reviews

While Member States are free to choose and devise the international peer reviews, the IAEA offers relevant services in this area that have been the main method for carrying out international peer reviews for more than a decade.

Major advantages of carrying out the reviews under the same system are the guarantee of a higher level of consistency, as well as the keeping of pools of trained experts. For these reasons, the Commission has been consistently supporting the IAEA in setting up, developing and maintaining this kind of services.

Integrated Regulatory Review Service (IRRS)[18]

The IRRS steers and drives the Member States in strengthening and enhancing the effectiveness of their regulatory infrastructure for nuclear, radiation, radioactive waste and transport safety. The IRRS is a tool to review the competent regulatory authorities in a broader sense than the requirements of the Directive; while the setting up of IRRS predates the adoption of the Directive, it provides relevant results in line with the Directive.

In all Member States a self-assessment of the competent authorities was established and carried out via IRRS. While the majority of Member States reported IRRS missions, only a few Member States provided details on the self-assessment outcomes related to spent fuel and radioactive waste management. IRRS mission reports are generally publicly available, however only few Member States reported details of follow-up actions addressing the outcomes of these reviews for achieving higher level of safety. Accordingly, in comparison to the previous reporting cycle, no improvement is noted; Member States should give further attention to the implementation of this Article in future reports to the Commission.

Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS)[19]

When the Directive entered into force, dedicated international peer review services were not available; therefore, since 2014 the Commission has been supporting the IAEA in developing a self-assessment tool based on the IAEA safety standards and best practices to enable EU Member States to fulfil their periodic self-assessment obligation (Article 14(3) of the Directive). ARTEMIS is an integrated expert peer review service for radioactive waste and spent fuel management, decommissioning and remediation programmes.

By the end of 2022, 18 missions had been carried out in the EU Member States, in spite of schedule disruptions due to the COVID pandemic restrictions to travel. All remaining missions (9) – to be invited in the EU Member States by August 2023 – have been actually

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18 https://www.iaea.org/services/review-missions/integrated-regulatory-review-service-irrs

19 https://www.iaea.org/services/review-missions/integrated-review-service-for-radioactive-waste-and-spent-fuel-management-decommissioning-and-remediation-artemis

invited[20] and will be carried out in the course of 2023. Thus, at the end of 2023, all Member States will have gone through the first round of self-assessments and international peer reviews.

In addition to the full scope review missions, Germany and Latvia requested the ARTEMIS follow-up missions in 2022 and 2024 respectively.

The Commission Services are closely following developments and execution of ARTEMIS peer-review services by IAEA not only by having regular meetings with the IAEA, but also by attending the review missions as observer.

Synergies of international peer review services

Member States ensure compliance with the Article 14(3) requirements through the IRRS and ARTEMIS peer-review missions of the IAEA. Although IAEA worked around and avoided overlaps between the ARTEMIS and the IRRS review services, this creates challenges in some cases which require further considerations.

Synergies between the ARTEMIS and IRRS missions were explored in several ways. The peer-review mission to Spain (in 2018) was the first, and so far, the only occasion when a joint/combined IRRS and ARTEMIS peer-review mission was requested by a host country. Despite some (limited) advantages of the joint mission, numerous challenges emerged when trying to integrate IRRS and ARTEMIS peer-reviews.

Based on this experience, most of the Member States decided to proceed with separate missions, i.e. one followed up by the other shortly after (preferably IRRS first, ARTEMIS second). This approach is named "back-to-back missions". To avoid overlaps between the missions, the IAEA has started developing additional guidelines for back-to-back missions. The first back-to-back mission took place in Slovenia in May 2022.

Reporting

According to Article 14(3) Member States are required to report the outcomes of the international peer reviews to the Commission and the other Member States.

All ARTEMIS and IRRS reports are published on the IAEA website in due time after the completion of a mission. However, it should be noted that only five Member States have reported to the Commission the outcomes of conducted international peer-reviews of their national framework, competent regulatory authority, national programme and its implementation in the reporting period.

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[20] https://www.iaea.org/services/review-missions/calendar

Table 9. Recent and planned international peer reviews as per Article 14(3) of the Directive.

MS	National programme and/or National framework [ARTEMIS]	Competent regulatory authority [IRRS]
AT	2022	2018
BE	2023	2013; 2017 (*); 2023
BG	2018	2013; 2016 (*); 2024 (†)
CY	2022	2017
CZ	2023 (†)	2013; 2017 (*); 2023 (†)
DE	2019; 2022 (*)(†)	2019; 2023 (*)(†)
DK	2022 (†)	2021 (†)
EE	2019	2016; 2019 (*)
EL	2023	2012; 2017 (*)
ES	2018 (•)	2008; 2011 (*), 2018 (•)
FI	2022 (†)	2012; 2015 (*); 2022 (†)
FR	2018	2014; 2017 (*); 2024 (†)
HR	2023	2015; 2019 (*)
HU	2022	2015; 2018 (*)
IE	2021	2015
IT	2023	2016
LT	2022	2016; 2020 (*)
LU	2018	2018
LV	2019; 2024 (*)	2019; 2024 (*)
MT	2022	2015; 2020 (*)
NL	2023	2014; 2018 (*); 2023
PL	2017	2013; 2017 (*); 2023
PT	2023 (†)	2022 (†)
RO	2022 (†)	2011; 2017 (*); 2023
SE	2023	2012; 2016 (*); 2022
SI	2022 (‡)	2011; 2014 (*); 2022 (‡)
SK	2023	2012; 2015 (*); 2022

(*) Follow-up mission.

(†) When no information was provided in the 3rd national report or that information was outdated, data were retrieved on the IAEA website.

(‡) Back-to-back mission IRRS-ARTEMIS.

(•) Combined mission IRRS-ARTEMIS.

4. Cost assessments, financing mechanisms and available resources

Article 9 of the Directive requires Member States to ensure adequate financial resources for the implementation of their national programmes. In addition, Article 12 (h) and (i) require each Member State to have an estimate of the national programme costs and financing schemes in force to ensure the financial resources.

Almost all Member States provided information on the cost assessments of their national programmes, although the estimates vary widely in terms of the methodology, assumptions, completeness of data, scope and the time frames. Two Member States (having only institutional waste) did not provide any cost assessment. Some cost estimates were not updated since the first reporting period in 2015, however, half of the Member States, mainly those with nuclear power programmes, updated their cost estimates recently. Nevertheless, these updates did not always completely reflect cost developments during the last decades. Some Member States added new elements to their overall cost assessment, but did not update the price level on which those calculations were based, e.g. in some cases the updated cost assessment still calculated based on price levels from early 2000. As a cost estimate serves as a basis for providing sufficient funding for the implementation of the national programme, it is important to periodically review and when necessary, update it.

In 2020 the Commission carried out a study on methodologies of cost assessment and financing mechanisms for radioactive waste and spent fuel management in use in the European Union. The study demonstrates that despite the wide range of approaches, methods and practices in cost assessment of radioactive wastes and spent fuel in the Member States, there are also many similarities. While in most Member States operators perform a cost assessment (mostly every year), ministries or regulatory bodies review the cost calculations. Most Member States use a combination of several methods, however, all include a deterministic approach.

In the first Commission report the total cost of spent fuel and radioactive waste management in EU was estimated at around EUR 250 billion (2017). In the second Commission report, the Commission's estimate was higher, at around EUR 300 billion[21] (2019). The total reported cost estimate remains at the same level.

The majority of Member States provided information on the financing schemes in force for the implementation of national programmes. There are considerable differences in the schemes used by different countries with a few Member States relying on a fee levied on electricity generation, others on payments based on characteristics of the waste and some on

[21] These figures do not include the UK.

state budget. There were no changes reported during the reporting period related to the financing schemes.

About half of the Member States provided information on the status of the funds for spent fuel and/or radioactive waste management, although with varying levels of detail (Table 10). A few Member States reported electricity levy modifications to ensure sufficient payments to the fund following a cost assessment update. In the majority of cases, Member States only applied corrective measures (e.g. by increasing payments to the fund) when it became clear that the performance of the funds was below expectations. However, there were cases when Member States acted proactively by periodically reviewing changing market conditions and adjusting payments to the fund based on the predicted future performance of these funds.

Overall, very little indications were reported on the performance of the funds. Sufficient and timely availability of funding is crucial for the timely implementation of the national programme. Member States are encouraged to regularly assess the performance of their funds in order to proactively react to any changes in the performance of funds or to take corrective measures timely when needed.

Smaller (without nuclear power) national programmes' implementation is funded mostly from the state budget. However, from the national reports it seems that the necessary funding for the implementation of the national programmes is not always ensured, and this leads to delays. The Member States that are funding the implementation of their national programmes solely from the state budget are encouraged to ensure the sufficient and timely allocation of resources for the timely implementation of the programme.

Limited information has been reported on the funds' investments and management to ensure sufficient availability of funds when needed in the future.

Table 10. Estimated total cost of spent fuel and radioactive waste management based on EU Member States' programmes.

Member State	Estimated total costs EUR million (*) (year)	Timeframes	Assumptions	Notes
AT	No data	No data	No final decision yet on the final disposal scenario	-
BE	13 836 (2020)	≥ 2150	The seven existing commercial nuclear reactors will be operated for 40 years; B and C type waste will be disposed of in Boom Clay at 200 metres depth (financial hypothesis only); spent fuel from commercial reactors will be reprocessed (contractual hypothesis); geological disposal of category B waste will start in 2047; geological disposal of category C waste will take place over the period 2100–2110	Decommissioning of NPP: EUR_{2020} 6 085 million Management of spent fuel: EUR_{2020} 7 751 million Not included: management of the spent fuel and radioactive waste of future nuclear installations. Does not account for substantial changes in the hypothesis.
BG	3 897 (2015) [information from NP 2015]	until 2030	No assessment of the overall costs of the programme has been made beyond 2030. Included: decommissioning, spent fuel processing and storage for Kozloduy NPP units 1-4 and 5-6. Not included: costs for the geological disposal for HLW and long-lived ILW. Kozloduy NPP units 5 and 6 operations extended until 06.11.2027 and 03.10.2029 respectively.	Annual costs for RAW management are financed by State funds and fees collected from waste producers.
CY	0.5 (2016)	No data	Cost estimation (by IAEA) of repatriation of DSRS only; no further cost estimations reported ('application waste'; 'decommissioning'; 'other storage/disposal options for legacy and new DSRS')	
CZ	5 020 [CZK 123.5 billion]	2015 – 2100	Overall cost estimation for the implementation of the Concept for 2015-2100 period (in case of no new NPPs)	(1 CZK = 0.041 EUR)
DE	66 900 (2012)	2080	EUR 34 billion for NPP waste (excluding disposal costs), Asse – EUR 5 billion; Morsleben – EUR 2.4-4.7 billion; Konrad – EUR 7.5 billion and new geological disposal facility – EUR 7.7 billion; +EUR 2.2 billion for site selection procedure; public radioactive waste management – EUR 6 billion; Gorleben site – EUR 2 billion (EUR 40 million/year for 50 years until 2065) all at 2012 prices.	No updated info in the 3rd report -
DK	455	No data	Costs related to the implementation of Parliamentary Resolutions B48/2003 and B90/2018. DKK 1.120 billion for B48/2003, DKK 2.271 billion for B90/2018.	(1 DKK = 0.134 EUR)
EE	124	2018 – 2050		Shortcomings in cost assessment and funding, are to be addressed in next update of the national programme in 2023
EL	1.54 (2020) [partial and preliminary cost estimations]	No data	Cost estimation for exporting nuclear material: ~ EUR 400 000. Cost estimation for running the IPRETEA Radioactive Waste and Sources Management Facility of NCSR Demokritos: ~ EUR 100 000 per year Cost estimation for obligations related to the EEDAPRA objectives: ~ EUR 40 000 per year. Preliminary analysis of the cost of the possible extension of the operations of the IPRETEA as a disposal facility: ~ EUR 1 000 000.	The national programme 2020 does not provide further details on the underlying basis and hypotheses for the cost assessments. For the disposal facility, not clear whether only constructions costs are included or other costs as well. No indications on decommissioning costs of GRR-1. No indication on when those estimations were made.
ES	23 044 (2019)	2100	Open cycle, present fleet, closure of all operating nuclear power plants by 2035.	
FI	6 500 (2012) [For 5 reactors (LO1-2, OL1-3)]	2023-2115	EUR 3.5 billion for geological disposal; EUR 1 billion for decommissioning of 5 reactors (LO1-2, OL1-3); EUR 0.1 billion for near surface disposal; EUR 2.5 billion for R&D, interim storage, and taxes.	
FR	110 500 (2014)	2135	Including institutional control; EUR 5.1 billion for legacy sites recovery; EUR 45 billion for decommissioning; EUR 25 billion for geological disposal.	
HR	900 (2015)	After 2043	Immediate decommissioning of the Krško NPP after shut-down in 2043. Include: waste management, spent fuel and decommissioning.	
HU	5 300 (2015)	2064	HUF 1 650 402 million (2015) for: decommissioning of 4 NPP Units in operation; decommissioning of spent fuel interim storage facility (ISFS); radioactive waste disposal facilities; HLW disposal facility; PURAM operating costs, supervision fees, fund management and support to local governments.	
IE	No data	No data		Arrangements and costs for waste management incl. shipment abroad are borne by the waste producers in line with polluter pays principle

Member State	Estimated total costs EUR million (*) (year)	Timeframes	Assumptions	Notes
IT	19 500 (2021)	2030 (excluding geological disposal)	EUR 1.5 bn for siting and construction of the Technological Park EUR 7.88 bn for complete decommissioning of the 4 NPPs and of the nuclear fuel cycle facilities are given as estimate in the 3rd NR compared to 6.5 bn estimated in the NP	The estimate was EUR 18.1 billion in 2015. Due to delays, estimated costs were increased in 2017 by EUR 0.7 billion and in 2020 by additional EUR 0.7 billion
LT	5 323 (2016)	2138	2021-2030 period: EUR 1.001 billion, mainly Ignalina NPP decommissioning 2031-2038 period: EUR 0.922 billion, mainly Ignalina NPP decommissioning 2038-2138 period: EUR 3.4 billion, mainly implementation of deep geological repository and further decommissioning activities	
LU	EUR 15948 per year	2029	Only orphan sources and materials considered. Costs for shipment to Belgium and interim storage. The government states it is capable of covering any additional cost.	Not clear if the final disposal in Belgium is charged.
LV	8.9 (2014)	2015-2020 2015-2020	Overall costs of the whole RAW management programme (EPG2020, Table 7, II, 2.1). EUR 3.1 million. Budget allocated for maintenance and decommissioning of Salaspils nuclear reactor. EUR 5.8 million.	-
MT	0.433 - 0.901	Total 10-years cost	Total unconditioned volume of waste approx. 1.5 m^3 Depending on chosen option (§9), total costs vary between 432 800 EUR (= option 'export of waste') and 901 200 EUR (= option 'bore hole disposal'); costs for 'deep geological disposal', option estimated.	
NL	2 050 (2017) + EUR 13 million per year	2130	2.05 (2017) for the deep geological repository The cost of the above-ground management of radioactive waste at COVRA is estimated at approx. EUR 13 million per year (excluding transport and processing costs)	
PL	16 000	Up to 2152	The costs were evaluated on the basis of data for other countries and presented PLN in prices of 2018. (The closure of NNRWR is planned for 2163)	
PT	EUR 200 000 / 250 000 per year	Annual	No SF or HLW. RAW (VSLW, VLLW, LLW, ILW) costs includes; reception, sorting, conditioning, storage and disposal in near surface disposal at PRR Annual costs for RAW management is financed by State funds and fees collected from waste producers.	
RO	EUR 4 864 million + EUR 5.865 million EUR per year		a) Pre-storage activities for SF and RAW – EUR 123.7 million + EUR 5.7 million per year b) Decommissioning cost estimation (4 NPP) – EUR 1 860 million c) Final disposal cost estimation for SF and RAW – EUR 2 880 million + EUR 0.165 million per year	
SE	10 560 (2019)	Remaining basic costs, from and including 2021	Based on 50+6 years of NPPs operation period. SEK 110.0 billion	(1 SEK = 0.096 EUR) (23/01/2022)
SI	185.835	2016-2025 After 2025 - Not covered (except decommissioning of Krško NPP)	Details on financial provisions, mechanisms, costing profiles etc. are not provided	For the longer term, only costs related to the construction and operation of the Vrbina LILW disposal facility are available which are EUR 327 million. New cost estimate (2020) for decommissioning of Krško NPP is EUR 417.6 million (Slovenia pays 50%)
SK	1 237 (2019)	2027	No new information. Total estimated decommissioning costs for V-1 NPP (expressed in the price level of 2019)	

(*) Otherwise specified.

Table 11. Financing mechanisms and accumulated funds by Member State

MS	Financial mechanisms (organisation)	Instalments	Funds accumulated, billion EUR (year)	Comments
AT	Operation fee (NES) Disposal fee (transferred from NES to the State)	Fees upon transfer of the radioactive waste to NES	No info	
BE	Long-term Fund (NIRAS/ONDRAF) Medium-term Fund (NIRAS/ONDRAF) Insolvency fund (NIRAS/ONDRAF)	Financed by financially liable entities (waste producers, Federal State for historical nuclear liabilities, …)	No info	
BG	Radioactive Waste Fund (Ministry of Energy)	Annual fees	0.073 (2020) (BGN 0.149 bn)	Included EU funds for Kozloduy NPP units 1-4. Recognised insufficiency of fund to date.
	Nuclear Facilities Decommissioning Fund (Ministry of Energy)	Annual fees	0.851 (2020) (BGN 1.668 bn)	Included EU funds for Kozloduy NPP units 1-4. Recognised insufficiency of fund to date.
CY	Legal provisions: polluter-pays principle = license holder; State responsible for orphan DSRS	No info	No info	Setting out fees for waste/DSRS management services was expected by 2020; still pending. Included: disposal, decommissioning, R&D.
CZ	Nuclear Account Fund	Fees	CZK 55 (= EUR 2.23) per MWh(e) generated by NPPs CZK 30 (= EUR 1.22) per MWh(t) generated by research reactors For the disposal of SF/RAW from reprocessing there is one-off fee which amounts to CZK 145000 (=EUR 5890) per m3 and it is increased by 2% every year CZK 28.4 bn (=EUR 1.15 bn) (2016)	Established by the Atomic Act to cover the costs of all activities related to both radioactive waste management and (future) disposal of spent fuel.
	Decommissioning reserves	Licence holders are obliged to create financial reserves for the future decommissioning of their nuclear facilities or other facilities containing significant or very significant ionising radiation sources	Dukovany NPP (2014): CZK 22.355 billion (EUR 0.91 billion); Temelín NPP (2015): CZK 18.372 billion (EUR 0.75 billion); Spent Fuel storages (2015): CZK 65 million (EUR 2.64 million); Other installations (2015): CZK 482 million (EUR 19.58 million).	Funds must be accumulated in the required amount and in a timely manner in compliance with timetables approved by the SÚJB and according to the decommissioning technology to be utilised.
DE	Fund (Nuclear Power Plants) Fees from radioactive waste producers	Fee for interim storage and disposal (*); recently established Waste Management Fund	24.1 from NPP operators paid in (2017)	No updated info in the 3rd national report
DK	Primarily Danish State budget			Financed through reserve funds
EE	State budget			Shortcomings in cost assessment and funding are to be addressed in next update of the national programme in 2023
EL	Deposit fund (2018) State budget		EUR 1 million (2018)	Deposit fund primarily meant for orphan sources and legacy waste; no clear information on funding mechanisms for other waste but most probably to be financed by State budget
ES	Fund for the financing of activities included in the General Radioactive Waste Plan (ENRESA)	Annual fees	No info	costs at 31/12/2019 EUR 4.616 bn
FI	State Nuclear Waste Management Fund	Annual fees	2.621 (2020)	Based on 5 reactors
FR	Portfolio of dedicated assets under the responsibility of the license holder	Licensees create a portfolio of dedicated assets	55.9 (31/12/2015)	No updated information; data from previous assessment. When sold, the assets must cover the entire estimated cost.
HR	Fund for Financing the Decommissioning of Krško NPP and disposal of NPP RAW and SF	Annual fees	0.25 (2017)	For reactor's operations extended until 2043, estimate EUR 0.62 billion
HU	Central Nuclear Financing Fund (Ministry of Innovation and Technology)	Annual fees from license holders and from Government funds (for license holders financed by Government)	0.8 (2015)	Fund to cover the costs for management of waste, spent fuel and decommissioning; HUF 246 386 million, 2015 (0.0032HUF/€)
IE	Radioactive Waste Management Fund (for orphan sources)		EUR 60 000 (2021)	

MS	Financial mechanisms (organisation)	Instalments	Funds accumulated, billion EUR (year)	Comments
IT	State pays for state owned facilities. SOGIN manages the funds for waste management.	Annual fee applied on the electricity bill for decommissioning. Fund from former utility ENEL transferred to SOGIN.	No info	The national programme cost is until 2030 and excludes geological disposal. ISIN is authorised to apply and collect by license holders for the exploitation of its regulatory functions.
LT	Ignalina Programme (EU funded), International Ignalina Decommissioning Support Fund (EU funded), State Budget, Reserve (Stabilisation) Fund, Ignalina NPP own funds	No info	No info	
LU	Government will provide necessary resources for 'orphan waste'. No funds created			
LV	Mainly State budget and generators' fees		No info	
MT	Each owner of a source will need to pay a fee for disposal to the government	Fees charged by RPC but paid to the Financial Ministry	No info	
NL	COVRA	Fees charged to license holders (incl. all estimated costs for processing, storage, research and geological disposal)	0.101462 (2020)	
PL	Polluter pays; Costs of MARIA reactor paid by the State budget; Two funds (one for RAW management and one for decommissioning) planned when the new built programme is established	The RWMP collects charges on the services provided from producers of RAW in accordance with a price list approved by the Ministry of Energy. For NPP waste, both funds receive quarterly contributions from the operator on the basis of the electricity generated and from revenues from investing fund resources.	No info	
PT	Disposal revenue; General state budget and IST budget	Fees charged to licensees	No info	
RO	Waste Disposal Fund (ANDR)	Annual fees	EUR 1.4 per MWh per NPP 0.168 (2007-2020) *(data from NP2022)* *1 RON = 0.20 EUR (05/08/2022)*	Financing mechanism (still) under revision to address the insufficiency of funds
	Decommissioning Fund (ANDR)	Annual fees	EUR 0.6 per MWh per NPP 0.088 (2007-2020) *(data from NP2022)* *1 RON = 0.20 EUR (05/08/2022)*	Financing mechanism (still) under revision to address the insufficiency of funds
	State budget	-		All costs related to the Baita Bihor repository; Cost for decommissioning of 2 research reactors; Costs for institutional RAW management from RATEN ICN and IFIN-HH.
SE	Nuclear Waste Fund	Fee per delivered kWh	EUR 7.44 bn (2020) EUR 0.061 bn (2020)	*1 SEK = 0.096 EUR (23/01/2022)*
	Studsvik Legacy Fund			
SI	Slovenia and Croatia governments established a Decommissioning Fund for NEK. Other nuclear installation are funded by Slovenian Government	Slovenia's share of the funds for NEK are being collected through levy for the kWh delivered to the Slovenian grid (in 2020 increased from EUR 0.003 to EUR 0.0048/ kWh).	EUR 0.195 bn (2016)	In January 2022, the payments to the Slovenian NEK fund was further increased to EUR 0.012 per kWh. The increase is in response to the revised fund performance projections.

MS	Financial mechanisms (organisation)	Instalments	Funds accumulated, billion EUR (year)	Comments
SK	National Nuclear Fund EBRD and SIEA (implementation of V-1 NPP)		*1.853 (2020) (according to nuclear world.org)*	*No new info in NR*

(*) NPP operators continue to be responsible for the entire management and financing of decommissioning, dismantling and proper packaging of the radioactive waste until interim storage.

5. Expertise, skills, R&D

5.1. Expertise, skills

All parties in Member States have to make arrangements for education and training for their staff, as well as research and development activities to cover the needs of the national programme in order to obtain, maintain and to further develop necessary expertise and skills for spent fuel and radioactive waste management (Article 8 of the Directive).

Compared to the last reporting period a clear improvement is noted: nearly all Member States have set out national legal requirements for training and education of staff involved in spent fuel and radioactive waste management. This is a positive outcome after a number of infringement procedures which led to the resolution of legal issues in the transposition of the Directive's training and education requirements.

On the other hand, further improvements are needed insofar as information was not systematically provided on the actual implementation of those legal requirements on education and training. Around one third of the Member States did not report any training and education activities for regulators and/or licensees. More than half of the Member States have not indicated any change of education and training arrangements. In general, training and education of the regulatory authority staff is better defined compared to license-holders' staff.

National schemes and arrangements remained unchanged and are summarised below:

- Post-graduate courses at universities;
- Training centres (basic and specialised, some at nuclear power plants);
- Training programmes or plans (i.e. at national, facility, or organisational entity level);
- Regular self-assessments of staff and needs analysis;
- Specialised, regular training for different levels of staff (e.g. on-the-job training with experienced staff);
- Specialised courses (e.g. for newcomers or experienced staff).

5.2. Research and development

Each Member State national programme shall include the research, development and demonstration activities that are needed to implement solutions for the management of spent fuel and radioactive waste (see Article 12(1)(f) of the Directive).

In the third national reports very little information was provided by the Member States on the research, development and demonstration activities planned to support implementation of the solutions needed for long-term safe management of spent fuel and radioactive waste. Research and development activities to build national radioactive waste and spent fuel management competences were reported by around half of the Member States. Only six

Member States (mainly with large and medium nuclear programmes) reported on the progress of their research and development activities/programmes achieved since the last reporting period (or using KPIs). The rest of the Member States did not report any information or reported in generic terms.

Not surprisingly, mainly the countries without a nuclear power programme have difficulties to fulfil the research and development requirements of the Directive, while Member States with a nuclear power programme have in general more developed formal arrangements for training and education, and advanced research and development activities. It is notable that international exchange of experience through peer reviews, workshops, conferences and technical visits has been recognized by Member States as a useful tool, especially by the ones without a nuclear power programme. It is worth mentioning the Joint European Programme EURAD which contributes to establishing the basics of an RD&D programme for the management of radioactive waste and promotes collaborative research between participants. Almost all Member States participate in this programme.

Most of the other Member States with smaller nuclear programmes presented the research and development activities and timeframes concerning final disposal of ILW, HLW and spent fuel in very general terms. Nearly half of the Member States have not reported any details or confirmed that they do not have a specific research programme defined. It should be noted that the Member States with only disused radioactive sources in their inventories do not plan to develop specific research, development and demonstration programmes, but rely on participating in, or following the results of international programmes or projects (e.g. through the International Atomic Energy Agency and European Commission) that are in-line with their radioactive waste management needs. Nevertheless, a few of these Member States, recognising the importance of research plan to conduct their own research, development and demonstration activities and to describe them in future reviews of their national programmes.

Overall, the situation remained unchanged, i.e. the research programmes in the EU are at different implementation stages, depending on the national radioactive waste and spent fuel management programmes' implementation status. Only a few Member States have established comprehensive research, development and demonstration programmes that support the implementation of the national programme. Several of these Member States periodically review and update their research programmes and are among those Member States that have made significant progress in developing deep geological disposal facilities. Usually, these Member States carry out a national research programme and are actively participating in international research initiatives, such as Euratom research programmes. In addition, they participate, drive, and promote international cooperation and exchange forums that have been established at European and international level. Member States with smaller programmes report participation in international research initiatives as well. Reporting is usually limited to the list of international projects where they take part in. Member States are encouraged not only to list international R&D projects in their national reports, but to provide information on the expected impact of those projects on the implementation of their national programmes.

6. Transparency and public participation

National frameworks must include the national policy and process for transparency (see Article 10 of the Directive). Member States have to ensure that the necessary information on the management of spent fuel and radioactive waste is made available to workers and the general public (including information from the competent regulatory authority) and that the public is given the necessary opportunities to participate effectively in the decision-making process regarding spent fuel and radioactive waste management in accordance with national legislation and international obligations.

All Member States provided information in their national programmes and reports on the policy and regulatory arrangements governing transparency and referred to the obligation to inform the public as well as the consultation and participation mechanisms. Member States reported no significant changes in these policy and regulatory arrangements.

Information on activities related to radioactive waste and spent fuel management is publicly available in all Member States. Mostly institutional websites are primary sources of information; typically, relevant information is found on the websites of the regulatory authorities and waste management organisations. Key documents (including national programmes, national reports, international evaluations, and annual reports) on strategies and their implementation are usually public. Countries with nuclear power plants use generally a diversity of information channels and techniques, including adapted products that are understandable by a broad audience. Long-term decisions, such as the siting and construction of geological repositories, are often accompanied by nationwide information campaigns.

Some Member States regularly provide information using other media or through information or visitor centres. In a few cases regular meetings with the general public were reported. Several Member States reported that documents concerning licensing procedures of nuclear and radioactive waste facilities are public and easily accessible on the authorities' websites. In some cases, every official record of the regulators activities is systematically published.

A few Member States provided descriptions or recent examples of how their transparency policy is implemented in practice, especially as concerns effective participation practices.

Almost all Member States reported on consultation mechanisms set out in national frameworks. Public consultation is required for political decisions with environmental implications, including those related to radioactive waste management. Consultation most often takes place as part of strategic environmental assessments, environmental impact assessments and/or during the licensing of activities. In some countries the adoption of new legislation with environmental effects is also subject to public consultation.

In many cases, national reports and national programmes either did not provide any description of participation or offered generic explanations. The actual impact of the public participation in the decision making was usually not explained.