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**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**

FOURTH REPORT

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1 INTRODUCTION

Under Article 14(2) of Council Directive 2011/70/Euratom ⁽¹⁾ on the responsible and safe management of spent fuel ⁽²⁾ and radioactive waste ⁽³⁾ ('the Directive'), the Commission has to regularly submit the following to the European Parliament and Council:

- a report on progress made with the implementation of the Directive;
- an inventory of radioactive waste and spent fuel present in the European Atomic Energy Community's ('the Community') territory and the future prospects.

The information presented is based on Member States' national reports, which are due every three years as per Article 14(1) of the Directive; the last reporting deadline for Member States was 23 August 2024. This fourth report covers the 2021-2023 period. The report is accompanied by two staff working documents:

- one presenting the overall situation in the Community based on the Commission's analyses of the national reports;
- one presenting the Community's inventory of radioactive waste and spent fuel and future prospects, with a reference date of December 2023.

The Commission previously presented three progress reports – in 2017, 2019 and 2024, each providing a comprehensive overview on the implementation of Directive. This report describes few changes or developments compared with the situation presented in the 2024 report ⁽⁴⁾; therefore, most of Commission's conclusions remain valid. In 2025, the Commission launched the evaluation of the Directive, along with the evaluation of Council Directive 2006/117/Euratom on the supervision and control of shipments of radioactive waste and spent fuel ⁽⁵⁾.

Section 2 provides an overview of radioactive waste and spent fuel inventories in the Community. Section 3 summarises the assessment of the current state of implementation of national frameworks and programmes under the Directive, highlighting recent progress and unresolved challenges.

⁽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, ELI: <http://data.europa.eu/eli/dir/2011/70/oj>).

⁽²⁾ Spent fuel is 'nuclear fuel that has been irradiated in and permanently removed from a reactor core' (Article 3(11) of the Directive) and that is no longer usable in its current form. It is generated by the operation of nuclear reactors for power generation, research, training and demonstration.

⁽³⁾ Radioactive waste is 'radioactive material in gaseous, liquid or solid form for which no further use is foreseen or considered' (Article 3(7) of the Directive) and which has been classified as radioactive waste. Its generation is associated with the production of electricity in nuclear power plants or with non-power-related uses of radioactive materials for medical, research, industrial and agricultural purposes. See SWD(2026) 286 on progress on implementation of Council Directive 2011/70/Euratom for the definitions of other important concepts set out in the Directive, such as storage and disposal.

⁽⁴⁾ 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, [https://ec.europa.eu/transparency/documents-register/detail?ref=COM\(2024\)197&lang=en](https://ec.europa.eu/transparency/documents-register/detail?ref=COM(2024)197&lang=en)

⁽⁵⁾ This evaluation process involved also Call for Evidence and Public Consultation (2026): https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14619-Radioactive-Waste-Directive-and-Shipments-Directive-evaluation_en

2 RADIOACTIVE WASTE AND SPENT FUEL IN THE EUROPEAN UNION

2.1 Origin of radioactive waste and spent fuel

All Member States generate radioactive waste through a range of activities, from medical applications to electricity generation. Most radioactive waste comes from nuclear power plants and associated nuclear fuel cycle activities, while the non-power use of radioactive materials generates smaller volumes of radioactive waste.

Each Member State determines its own electricity generation mix. In 2023, nuclear power plants were in operation in 12 countries ⁽⁶⁾. Three others – Germany, Italy and Lithuania – had ended their nuclear power programmes and were decommissioning their nuclear installations.

In 2023, 101 nuclear power reactors were in operation ⁽⁷⁾, 74 nuclear power reactors had been permanently shut down and were being decommissioned, and 3 nuclear power reactors had been fully decommissioned. In addition, 30 research reactors were in operation in 12 countries ⁽⁸⁾.

In total, 17 Member States currently manage spent nuclear fuel on their territory.

The decommissioning of nuclear power plants is a major activity for the European nuclear industry. Decommissioning of nuclear facilities is ongoing in a quarter of the Member States, and the volume of radioactive waste from decommissioning is increasing.

2.2 Inventory estimates

By the end of 2023, the estimated total inventory of radioactive waste in the EU was **2 593 000 m³** (an 11% increase since the previous reporting period, corresponding to an average yearly production of less than 65 000 m³). Table 1 shows the overview of the amount of radioactive waste in 2023 compared with 2019. Approximately 66% (1 692 000 m³) of this waste had been disposed of, and 34% (901 000 m³) was in storage and still required further management. By the end of 2023, the amount of radioactive waste in the 15 Member States with nuclear power programmes ⁽⁹⁾ accounted for 99.5% of the total volume of radioactive waste inventory in the EU.

Most Member States have presented their radioactive waste inventories using the classification scheme set out in the International Atomic Energy Agency (IAEA) safety guide GSG-1 ⁽¹⁰⁾ or have provided matrices enabling data to be converted from their national classification scheme into the classification scheme recommended by the IAEA. Most

⁽⁶⁾ Belgium, Bulgaria, Czechia, Finland, France, Hungary, the Netherlands, Romania, Slovakia, Slovenia, Spain and Sweden. In addition, although it has no nuclear power plant within its own national borders, Croatia co-owns the Krsko nuclear power plant with Slovenia

⁽⁷⁾ See IAEA Power Reactor Information System: <https://www.iaea.org/pris>.

⁽⁸⁾ See IAEA Research Reactor Database: <https://nucleus.iaea.org/rddb/home#/home>.

⁽⁹⁾ Belgium, Bulgaria, Czechia, Finland, France, Germany, Hungary, Italy, Lithuania, the Netherlands, Romania, Slovakia, Slovenia, Spain and Sweden.

⁽¹⁰⁾ ‘Classification of Radioactive Waste’, General Safety Guide, IAEA, Vienna, 2009.

countries also used the harmonised set of data for reporting national inventories, which was prepared jointly by the Commission, the IAEA and the OECD Nuclear Energy Agency.

Data show that in those countries where disposal routes are open for very-low-level waste (VLLW) and low-level waste (LLW), the process from generation to disposal appears to generally function well. This is not the case for intermediate-level waste (ILW), high-level waste (HLW) and spent fuel, as there are currently no operational disposal facilities to handle these categories.

Table 1: Volume of radioactive waste in the EU in 2019 and 2023.

Waste	EU radioactive waste amounts (m ³ , rounded to thousands*)					
Class	Stored		Disposed		Total	
Year	2019	2023	2019	2023	2019	2023
VLLW	233 000	303 000	462 000	558 000	695 000	861 000
LLW	353 000	381 000	1 068 000	1 109 000	1 421 000	1 491 000
ILW	191 000	211 000	22 000	25 000	213 000	236 000
HLW	4 800	5 200	0	0	4 800	5 200
Total (m³)	782 000	901 000	1 552 000	1 692 000	2 334 000	2 593 000

* Except for HLW, which is rounded to hundreds.

By the end of 2023, approximately **59 500 tHM** of spent fuel was stored in the EU (an increase of approximately 6% from 2019). All spent fuel in the EU is currently in storage, as no civil disposal facility for spent fuel is in operation anywhere in the world. There are still small amounts of spent fuel that are sent for reprocessing outside the EU; therefore, radioactive waste resulting from reprocessing is expected to be returned latest in the next decades.

3 SAFE AND RESPONSIBLE MANAGEMENT OF RADIOACTIVE WASTE AND SPENT FUEL

3.1 National frameworks and programmes

Across the EU, national frameworks have generally continued to improve in recent years; the self-assessments, strengthened by international peer reviews, have proven to be one of the driving forces behind these positive developments.

One key obligation under the Directive is the development of a national programme – a national strategic roadmap or plan setting out how national policies are being or will be implemented. All Member States have national programmes in place and are continuously developing them. During the reporting period, 11 Member States notified the Commission of their updated national programmes. However, there were also cases where Member States did not review and update national programmes as regularly as set out in their national legislation. The steady implementation of national programmes and their prompt updating when needed are hallmarks of responsible management of radioactive waste and spent fuel. This requires Member States to optimise planning, commit sufficient resources, carry out the required research and training activities and secure engagement with the public and other stakeholders.

There are no ongoing infringements related to transposition of the Directive and national frameworks. However, during the previous reporting cycles, the Commission had to initiate several procedures against some Member States regarding the implementation of the Directive and on the compliance of their national programmes with the Directive's requirements. By the end of 2025, there were 16 ongoing infringement procedures ⁽¹¹⁾.

3.2 Competent authorities

Competent regulatory authorities are granted technical and financial independence, based on the information provided in national reports.

Adequate staffing of regulators is essential for the safe and effective rollout of national programmes. The recent renewed interest and investments in nuclear energy projects means that Member States need to anticipate strengthening their competent authorities, including for the safe management of radioactive waste and spent fuel. The Commission has provided an analysis of the needs related to new reactors and long-term operations in the latest nuclear illustrative programme (PINC) ⁽¹²⁾, keeping in mind that different Member States have different administrative approaches.

3.3 Circularity and disposal policies

The generation of radioactive waste, as well as amount of radioactive waste to be disposed should be kept to the minimum which is reasonably practicable. The options as clearance of materials from regulatory control and their subsequent reuse or recycling are particularly apparent in ongoing decommissioning activities.

While most Member States plan to dispose of radioactive waste and spent fuel in their territory, not all of them have made their final decision and some are still considering the possibility of joint multinational disposal solutions. The Commission has carried out the pilot project 'Proposal for a Joint European Approach towards Radioactive Waste' ⁽¹³⁾, involving as many national authorities as possible in setting up a forum to discuss potential joint solutions to waste management in Europe.

Member States with nuclear power programmes intend to dispose of their spent fuel in deep geological facilities. Some countries are reprocessing their spent fuel, while others are keeping that option open.

The first spent fuel disposal facility is scheduled to begin operations in Finland by 2027. In Sweden and France, investment projects for the construction of similar facilities are under way and expected to be completed in the next decade. Compared with the previous report,

⁽¹¹⁾ Austria, Belgium, Bulgaria, Denmark, Germany, Estonia, Ireland, Greece, Croatia, Italy, Latvia, Lithuania, Netherlands, Portugal Romania and Slovenia.

⁽¹²⁾ Communication from the Commission, Nuclear Illustrative Programme presented under Article 40 of the Euratom Treaty – Final (after the opinion of the EESC), COM/2026/120 final of 10.3.2026, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52026DC0120>.

⁽¹³⁾ Based on the initiative from Members of the European Parliament, the financing was included in the EU budget. https://energy.ec.europa.eu/document/download/b74f0a8f-ef96-45ce-8301-5c8d86b9c5d1_en?filename=C_2023_4577_1_EN_annexe_acte_autonome_nlw_part1_v1.pdf

more Member States are actively working on different preparatory stages for deep geological facilities. The envisaged dates for commissioning most deep geological repositories for high-level waste and spent fuel currently fall between 2050 and 2075.

3.4 Cost assessments and financing

Nearly all Member States provided information on the cost assessment of their national programmes. In 2023, the assessed total cost of management of radioactive waste and spent fuel ⁽¹⁴⁾ in the EU remained around EUR 300 billion, in line with the Commission's previous reports.

The national estimates vary widely in terms of methodology, assumptions, completeness of data, scope and time frames because different national circumstances require different domestic approaches. To achieve a higher level of transparency and greater security of funding, the Commission is working with Member States through the Nuclear Backend Financial Aspects expert group ⁽¹⁵⁾ to provide guidance on reporting the costs of national programmes for radioactive waste and spent fuel management.

Most Member States also provided information on the financing schemes for implementing national programmes, taking into account the responsibility of spent fuel and radioactive waste generators. There are considerable differences in these schemes, 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 state budget.

As expenditure is typically incurred only after the use of radioactive materials or nuclear fuel – in some cases several decades later – back-end costs must be taken into account at an early stage of new nuclear activities. In the PINC, the Commission pointed out that government commitment and adequate funding from waste generators for effective decommissioning and responsible management of radioactive waste and spent fuel is key to ensuring safety and continued public support for the use of nuclear energy.

3.5 Programme monitoring and reporting

Several Member States have made progress in using key performance indicators to monitor implementation of national programmes. However, challenges remain in ensuring effective progress monitoring and performance reporting.

Reporting on the research, development and demonstration activities that are needed to implement solutions for the management of radioactive waste and spent fuel was, in most cases, very general. Member States are encouraged to provide more specific and targeted information on those activities. The Commission notes positively that most Member States make use of the ongoing European Partnership on Radioactive Waste Management ⁽¹⁶⁾.

⁽¹⁴⁾ Estimated total cost of radioactive waste management' means the aggregated total cost of all the EU Member States' national programmes covering all types of spent fuel and radioactive waste under their jurisdiction and all stages of spent fuel and radioactive waste management from generation to disposal.

⁽¹⁵⁾ <https://ec.europa.eu/transparency/expert-groups-register/screen/expert-groups/consult?lang=en&groupID=3777>.

⁽¹⁶⁾ <https://www.ejp-eurad.eu/>.

3.6 Transparency and public participation

Member States have not reported major updates on measures and approaches to transparency and public participation. The Commission reiterates the importance of implementing the transparency and public participation requirements effectively, including by providing specific information on practices when reporting to the Commission.

4 CONCLUSIONS

During the reporting period radioactive waste and spent fuel were managed safely in Member States. National frameworks and programmes are in place across the EU and were generally set up in a transparent and participative manner. All Member States should make sure that their national programmes are up to date. The system of self-assessments and international peer reviews appeared consistent with the needs and is driving updates and continuous improvement in waste management.

For the largest share of radioactive waste by volume, safe solutions for management (including disposal) were pursued, as once again demonstrated by the increase in disposed volumes against the decrease in stored volumes. Overall, most Member States are working to develop disposal facilities. However, several still lack clearly defined management strategies for radioactive waste and spent fuel, which hampers their progress.

The monitoring and funding of Member States' national programmes remain the main unresolved issues requiring the attention of national authorities. Cost assessments are sometimes outdated or not comprehensive enough. This can affect the effectiveness of financing schemes and create the risk that they will be insufficient to cover future costs, thereby placing an undue burden on future generations. There are already ongoing activities relating to guidance on reporting the costs of national programmes ⁽¹⁷⁾. However, there are additional areas where more specific reporting criteria would support Member States in preparing their national reports.

⁽¹⁷⁾ Nuclear Back-end Financial Aspects expert group Draft the guidelines on reporting on the costs related to the national programme on spent fuel and radioactive waste management <https://ec.europa.eu/transparency/expert-groups-register/screen/expert-groups/consult?lang=en&groupID=3777>