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To:	Permanent Representatives Committee/Council
Subject:	REPORT on the implementation of the obligations under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management - Seventh Review Meeting of the Contracting Parties, Vienna, 24 May to 4 June 2021

Delegations will find in the annex a pre-copy of the above document[1].

[1] This report is in the process of being formally adopted by the Commission

EUROPEAN ATOMIC ENERGY COMMUNITY

REPORT

On the implementation of the obligations under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

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Seventh Review Meeting of Contracting Parties

Vienna, 24 May to 4 June 2021

FOREWORD

The European Atomic Energy Community ('Euratom' or 'the Community') is a regional organisation within the meaning of Article 39(4) of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management[2] ('Joint Convention'). Euratom has been a Contracting Party to the Joint Convention since 2 January 2006[3]. Euratom has the same Member States as the European Union ('EU'). Currently, all EU Member States are Contracting Parties to the Joint Convention.

Euratom was established by a Treaty signed in Rome on 25 March 1957, under the general objective of tackling the shortage of conventional energy in the 1950s. The Euratom Treaty also mandated the adoption by the Community of basic safety standards for the protection of workers and the general public. In addition, it provided for a safeguards system to prevent nuclear materials from being diverted from their intended uses. The powers of Euratom are limited to civil applications of nuclear energy[4].

Each EU Member State has the right to determine its choice between different energy sources including nuclear. In 2018, nuclear power plants generated 26% of the electricity produced in the EU[5]. As of mid-2020, there were 108 operating nuclear power reactors in 13 Member States; an additional 64 were shut-down and are under decommissioning.

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2 INFCIRC/546 of 24 December 1997.

3 Commission Decision 2005/510/Euratom of 14 June 2005 concerning the accession of the European Atomic Energy Community (Euratom) to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (OJ L 185, 16.7.2005, p. 33–34).

4 Thus, they do not cover spent fuel or radioactive waste within military or defence programmes.

5 Eurostat, 2020.

Euratom neither possesses nor operates nuclear power plants. However, Euratom owns nuclear research facilities located at the Commission's Joint Research Centre (JRC) sites, in Ispra (Italy), Geel (Belgium), Karlsruhe (Germany) and Petten (the Netherlands). As these installations are located in the territory of EU Member States, they are subject to all safety, environmental and other relevant legal and regulatory requirements of the host countries. In addition to the information related to Euratom facilities that could be provided in the national reports of the host countries, the present report includes relevant information on the activities of the JRC and the inventories of radioactive waste and spent fuel, pertinent to the obligations under the Joint Convention. The report includes as well the progress achieved within the JRC's Decommissioning and Waste Management Programme.

All EU Member States handle radioactive waste. It is generated from various activities, such as electricity production in nuclear power plants and a range of radioisotope applications in medicine, industry, agriculture, research and education. Spent fuel has also been generated and is currently managed by 20 Member States.

Each EU Member State has the right to define its own fuel cycle policy, i.e. to consider spent fuel as a valuable resource that may be reprocessed or as waste destined for disposal.

Hence, EU Member States can set different specifications for radioactive waste; for example, some Member States declare NORM waste[6] as radioactive waste, while others do not.

[6] Waste containing naturally occurring radioactive material.

The management of radioactive waste and spent fuel has been regulated at Community level through various legal instruments adopted under the Euratom Treaty. Council Directive 2011/70/Euratom[7] ('the Directive'), establishing a Community framework for the responsible and safe management of radioactive waste and spent fuel, is the central legislation in this field. The Directive aims at ensuring the responsible and safe management of radioactive waste and spent fuel to avoid undue burdens on future generations. It is based on the International Atomic Energy Agency (IAEA) Safety Standards and reaffirms the principles of prime responsibility of licence holders, under the supervision of the national competent regulatory authority, and the ultimate responsibility of Member States for the management of the radioactive waste and spent fuel generated in them. Member States are required by the Directive to establish and maintain an appropriate national policy and a national programme for its implementation, as well as a legislative, regulatory and organisational framework, which amongst other provides for coordination between national bodies. Besides, the Directive lays down obligations regarding the periodical conduct of self-assessments and international peer reviews, with the aim of ensuring that high safety standards are achieved in the radioactive waste and spent fuel management.

Other key legal instruments under the Euratom Treaty are: Council Directive 2013/59/Euratom laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation; Council Directive 2006/117 Euratom on the supervision and control of shipments of radioactive waste and spent fuel; the amended Council Directive 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations; and Council Directive 2013/59/Euratom laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation.

The Report indicates developments and initiatives taken by Euratom at EU and at international level since the last Review Meeting.

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7 OJ L 199, 02.08.2011, p.48. The Directive had to be transposed in the EU Member States legislation by 23 August 2013.

Over the last period, the European Commission ('the Commission') has closely monitored the correct implementation of the Directive by the Member States. The Commission has initiated infringement procedures against fifteen EU Member States for the incorrect transposition of the Directive into national legislation, and seventeen Member States for the non-compliance of their national programmes for spent fuel and radioactive waste management with the requirements of the Directive. In 2018, the Commission also referred three Member States to the Court of Justice of the EU (CJEU) for the non-notification of their national programmes. While the Commission withdrew two of these cases following the notification of the final programmes by the Member States, the CJEU upheld the claims of the Commission in the third case in a judgement delivered on 11 July 2019[8].

As required by the Directive, EU Member States submitted to the Commission their second national reports on the implementation of the Directive, and the Commission released its second report to the Council and European Parliament on progress made with the implementation of the Directive as well as an inventory of spent fuel and radioactive waste present in the EU's territory[9].

At the same time, the Commission has also adopted its third report on Member States implementation of the Council Directive 2006/117/Euratom on the supervision and control of shipments of radioactive waste and spent fuel[10].

The latest Commission's Nuclear Illustrative Programme, the so-called PINC[11] provided an overview of Member States' plans in terms of investments in the EU for all the steps of the nuclear lifecycle. With the EU nuclear industry moving into a new phase characterised by increased activities in the back-end of the lifecycle, it contributed to an informed debate on the associated investment needs and the management of nuclear liabilities.

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8 Case C-434/18, Commission v. Italy, ECLI:EU:C:2019:603.

9 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(2019)632final of 17 December 2019. https://ec.europa.eu/energy/en/topics/nuclear-energy/radioactive-waste-and-spent-fuel

10 COM(2019) 633 final. https://ec.europa.eu/energy/sites/ener/files/third_report_implementing_directive_on_transport_of_radioactive_waste_and_spent_fuel.pdf

11 COM(2017) 237 final.

Pursuant to the 2013 Memorandum of Understanding with the IAEA for a partnership on nuclear safety cooperation, the Commission has been supporting on behalf of Euratom the development of the ARTEMIS[12] tools for international peer reviews required by Article 14(3) of the Directive. Two workshops were organised with EU support in 2016-2017 to discuss the ARTEMIS guidelines with EU (2016) and non-EU Member States (2017). Eight EU Member States[13] underwent an ARTEMIS peer review mission in the period 2017 to 2019. Three Member States[14] have scheduled to carry out such a mission by the 1st quarter 2021.

The cooperation with IAEA lead also to the release of the database Spent Fuel and Radioactive Waste Information System (SRIS) that keeps information on national spent fuel and radioactive waste management programmes, spent fuel and radioactive waste inventories and facilities, as well as relevant laws and regulations, policies, plans and activities.

The Commission has also been working together with the Nuclear Energy Agency (NEA) and the European Nuclear Safety Regulators Group (ENSREG) on possible ways of harmonisation in the area of spent fuel and radioactive waste management.

The European Nuclear Energy Forum (ENEF) discussed spent fuel and radioactive waste management aspects at the meeting in May (22-23) 2017 in Prague, remarking the publication of the first report on the implementation of Directive by the Commission to the European Parliament and the Council.

The main instrument to support research at European level in the fields covered by the Joint Convention is the Euratom Research and Training Programme, which complements Horizon 2020, the EU Framework Programme for Research and Innovation.

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12 IAEA integrated review service for radioactive waste and spent fuel management, decommissioning and remediation programmes.

13 Poland, France, Bulgaria, Luxembourg, Spain, Germany, Estonia and Latvia.

14 Cyprus, Romania and Slovakia.

The Report sets out the conclusions drawn from the discussion of the Euratom reporting at the last Review Meeting of Contracting Parties and outlines positive features in recent Community actions and practices.

The Report covers the status of implementation of the obligations arising under the Joint Convention, in the Euratom Community, until June 2020 and how the challenges identified in the last review meeting have been addressed.

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Section A
INTRODUCTION

A.1 MAIN THEMES AND STRUCTURE OF THE REPORT

This Report is submitted in compliance with Articles 30 and 32 of the Joint Convention, in view of the forthcoming Seventh Review Meeting of the Contracting Parties, to be held in Vienna, in May 2021.

It is based on the previous Report submitted by Euratom to the Sixth Review Meeting of Contracting Parties to the Joint Convention held in May 2018. Updated information is highlighted in ***bold italics font.***

The Report has taken account of the developments falling within the scope of the Joint Convention over the past three years. It displays Euratom actions that are relevant to the following themes, which according to the conclusions of the Sixth Review Meeting of Contracting Parties should be considered by subsequent National Reports:

- ***Implementation of national strategies for spent fuel and radioactive waste management;***
- ***Safety implications of long term management of spent fuel;***
- ***Linking long term management and disposal of disused sealed radioactive sources; and***
- ***Remediation of legacy sites and facilities.***

It also pays specific attention to reporting on progress in the areas identified as challenges during the previous Review Meeting, i.e.:

- ***Euratom facilitation of continued implementation by Members States of Council Directive 2011/70/Euratom;***
- ***Achievement of dedicated milestones for ongoing decommissioning activities at JRC sites;***
- ***Completion of the transfer of the license of the Ispra-1 reactor to the Italian operator and start of the related decommissioning work.***

The report also contains descriptions of the overall situation on spent fuel and radioactive waste management in the EU.

In addition, the Report contains information on the Euratom Treaty, the Community, the legal measures that can be adopted by Euratom, their effect on national law, and the respective obligations of Member States[15].

The Report follows the Guidelines regarding the Form and Structure of national Reports[16].

The Report covers the regulatory obligations of Euratom under the Joint Convention. It furthermore provides information on the nuclear research installations located at sites of its Joint Research Centre (JRC), in: Ispra (Italy), Geel (Belgium), Karlsruhe (Germany) and Petten (the Netherlands). Further details on these installations, as regards safety obligations arising under the Joint Convention, can be found in the respective National Reports of the above Member States, in whose territories the installations are located. Nuclear research installations at JRC sites are subject to the regulatory framework and supervision in the host country[17]. For clarity sake and with a view to ensuring a more comprehensive reporting, the Report gives account of the nuclear research facilities at JRC sites and of the progress of the JRC's Decommissioning and Waste Management Programme. This Programme aims at the safe decommissioning of JRC obsolete facilities, the long-term integration of decommissioning and dismantling plans of operational nuclear research facilities, and the management of legacy radioactive waste and the waste generated during the implementation of the Programme.

The structure of the Report is as follows:

- ***the present Section A introduces the Euratom and the Euratom Treaty, the institutional structure and Member States of the Euratom and the latter's competences in the framework of the Joint Convention;***

15 See Sections A.2 and E below.
16 INFCIRC/604/Rev.3, 18 December 2014.
17 Accordingly, the competent authorities of the Member States issue licenses, and the monitoring of the safety of nuclear facilities and activities takes place at national level.

- ***Section B covers general Euratom policies in the field of radioactive waste and spent fuel management, as well as relevant activities in the JRC nuclear research facilities;***

- ***Section C deals with requirements of Article 3 of the Joint Convention (scope of application);***

- ***Section D reports the inventories in the nuclear research installations at JRC sites;***

- ***Section E presents Euratom legal and regulatory framework, and cites all main legislative measures in force;***

- ***Sections F to J follow an article-by-article review of the implementation of the Joint Convention, citing several measures adopted by Euratom with regard to general safety provisions and requirements (such as those relating to siting and operation, or the safety assessment of nuclear facilities), transboundary movement of radioactive waste and spent fuel, and the management of disused sources;***

- ***Section K covers various complementary actions aimed, inter alia, at enhancing nuclear safety at both Euratom and international level (such as the conclusion and follow up of "stress tests" at European nuclear power plants) and advancing research in the field of radioactive waste management. It also explains the measures taken by Euratom to address the challenges identified at the 6th review meeting in 2018.***

  Moreover this Section:

  - recalls Euratom provisions relating to international peer reviews and transparency matters,

  - mentions the conclusions drawn from the discussion of Euratom's reporting at the previous Review Meeting of Contracting Parties and measures taken to address the identified challenges,

  - summarises strong features in recent Euratom actions and foresees future challenges and priorities;

- the Report closes with an Appendix (additional information on Euratom initiatives implemented through the Euratom Research and Training Programme).

A.2 INTRODUCTION TO EURATOM AND ITS ACCESSION TO THE JOINT CONVENTION

A.2.1 The Euratom Treaty vis-à-vis the Treaties establishing the European Community and the European Union: history and evolution

Since its entry into force in 1958, the Treaty establishing the European Atomic Energy Community[18] ('Euratom Treaty' or simply 'Treaty') has not faced extensive amendments.

Following the entry into force of the Treaty of Lisbon in 2009, the European Community was dissolved into the European Union ('EU') and the Treaty establishing the European (Economic) Community of 1957 was thus renamed "Treaty on the Functioning of the European Union" ('TFEU')[19]. On the other hand, Euratom has not been dissolved into the EU. It has therefore maintained its separate legal personality[20] to this day.

However, Euratom is closely associated with the EU. More specifically, the Treaty of Lisbon recalls in its Protocol No. 2 that the provisions of the Euratom Treaty shall continue to have full legal effect, yet certain amendments are made to this latter Treaty. These amendments concern, for the most part, institutional and financial aspects. Accordingly, Article 106a(1) of the Euratom Treaty lists those provisions of the EU Treaties (i.e. the TEU[21] and the TFEU[22]) that shall also apply to the Euratom Treaty, the majority of which concern the institutions, legislative procedures and financial matters[23].

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18 Treaty establishing the European Atomic Energy Community (consolidated version) (Official Journal of the European Union) C203/01 of 7 June 2016.

19 The current text of the "Treaty on European Union" (TEU) states that the EU "shall replace and succeed the European Community" and "shall be founded on the present Treaty (TEU) and the Treaty on the Functioning of the European Union (TFEU)"); Article 1 TEU.

20 Article 184 of the Euratom Treaty states: *"The Community shall have legal personality"*.

21 OJ C202/13 of 7 June 2016.

22 OJ C202/1 of 7 June 2016.

23 Article 106a(1) provides: "Article 7, Articles 13 to 19, Article 48(2) to (5), and Articles 49 and 50 of the Treaty on European Union, and Article 15, Articles 223 to 236, Articles 237 to 244, Article 245, Articles 246 to 270, Article 272, 273 and 274, Articles 277 to 281, Articles 285 to 304, Articles 310 to 320, Articles 322 to 325 and Articles 336, 342 and 344 of the Treaty on the Functioning of the European Union, and the Protocol on Transitional Provisions, shall apply to this Treaty".

However, Article 106a(3) of the Euratom Treaty lays down a basic rule, according to which this Treaty has *lex specialis* status, and therefore prevails in case of conflict between its own provisions and those of the EU Treaties[24].

A.2.2 The institutional structure of Euratom

The institutional structure of Euratom is linked with that of the EU. Thus, the fulfilment of the tasks entrusted to Euratom is ensured by the Council of the European Union ('Council'), the European Parliament, the European Commission, the Court of Justice and the Court of Auditors, which are all institutional organs of the EU. Each of these institutions acts within the limits of the powers conferred to it by the common institutional framework provided in the Euratom Treaty, the TEU and the TFEU[25].

The Council is the main decision-making institution, but it also exercises budgetary as well as policy-making and coordinating functions. Each Member State presides over the Council for a six-month period.

The European Parliament represents the citizens of the Member States. The members of the European Parliament are elected by direct universal suffrage. Together with the Council, it exercises legislative and budgetary functions. In the framework of the Euratom Treaty, the European Parliament has only a consultative role in the ***decision-making process***.

The Commission promotes the general interest of the EU and Euratom, and takes appropriate initiatives to that end, including the preparation and making of legal proposals. In principle, ***legal*** acts in the field of nuclear energy may only be adopted (by the Council) upon the basis of a Commission proposal. The Commission also ensures the application of the Treaties and of measures adopted pursuant to them and it can initiate judicial proceedings before the Court of Justice of the EU for non-compliance with this law. In addition, the Commission has an executive role; for example, it executes the budget and manages Euratom research programmes.

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24 Article 106a(3) provides: "The provisions of the Treaty on European Union and of the Treaty on the Functioning of the European Union shall not derogate from the provisions of this Treaty".

25 Respectively: Articles 106a, 134, 135, 144, 145, 157 and 164 of the Euratom Treaty; Articles 13 to 19 TEU; and Articles 223 to 270, 272 to 274, 277 to 281 and 285 to 287 TFEU. :

The Court of Justice of the EU ensures that in the interpretation and application of the Treaties the law is observed.

In addition, several advisory bodies exist under the Euratom Treaty, some of which are unique to Euratom while others are common to the EU and Euratom. The purpose of these bodies is to assist the decision-making institutions of Euratom in the exercise of their functions. For example, the Economic and Social Committee is such an advisory body operating within both the EU and Euratom, and is consulted by the Council, the European Parliament or by the Commission where it is so provided. In principle, the Economic and Social Committee has a consultative role in the legislative process. Other advisory bodies, which are attributed exclusively to Euratom, include the group of scientific and health experts provided for in Article 31 of the Euratom Treaty. This group gives its opinion to the Commission during the development of basic safety standards for the protection of the health of workers and the general public against ionising radiation. Further, Article 134 of the Euratom Treaty provides for the Scientific and Technical Committee, which is attached to the Commission and has an advisory status. Amongst other, this Committee advises the Commission on strategic aspects of nuclear research.

A.2.3 Member States of Euratom

The following ***twenty seven (27)*** States are presently members of Euratom[26]: the Kingdom of Belgium, the Republic of Croatia, the Czech Republic, the Kingdom of Denmark, the Federal Republic of Germany, the Republic of Estonia, the Hellenic Republic, the Kingdom of Spain, the French Republic, Ireland, the Italian Republic, Republic of Bulgaria, the Republic of Cyprus, the Republic of Latvia, the Republic of Lithuania, the Grand Duchy of Luxembourg, Hungary, the Republic of Malta, the Kingdom of the Netherlands, the Republic of Austria, the Republic of Poland, the Portuguese Republic, the Republic of Romania, the Republic of Slovenia, the Slovak Republic, the Republic of Finland, the Kingdom of Sweden.

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26 ***The United Kingdom of Great Britain and Northern Ireland left the EU and Euratom on 1 February 2020. The Withdrawal Agreement entered into force on that date, securing the UK's orderly departure, and providing legal certainty in important areas, including in Euratom matters. However, in accordance with the Withdrawal Agreement, EU/Euratom law continues to apply to and in the UK for a transition period lasting until 31 December 2020. Therefore, this report includes data on the UK.***

A.2.4 Euratom competences in the framework of the Joint Convention

A.2.4.1 Accession of Euratom to the Joint Convention

With regard to Euratom's aspirations on the international scene, the signatory States stated in the preamble to the Euratom Treaty that they were, inter alia:

> *"Desiring to associate other countries with their work and to cooperate with international organisations concerned with the peaceful development of atomic energy".*

Hence, the Euratom Treaty stipulates that Euratom may, within the limits of its powers and jurisdiction, enter into obligations by concluding agreements or contracts with international organisations or third States[27]. In fact, Euratom is Contracting Party to several bilateral and multilateral international agreements as well as important Conventions in the area of nuclear energy, which, apart from the Joint Convention, include the Convention on Nuclear Safety[28], the Convention on Early Notification of a Nuclear Accident[29], the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency[30] ***and the Convention on the physical protection of nuclear material and nuclear facilities[31] and its Amendment[32]***.

Euratom acceded to the Joint Convention by a Commission Decision of 14 June 2005[33], following a Council Decision of 24 January 2005[34]. The instruments of accession were deposited with the Director General of IAEA on 4 October 2005. Euratom's accession came into effect on 2 January 2006, in accordance with Article 40(2) of the Joint Convention. Currently all EU Member States are Contracting Parties to the Convention.

The instruments of accession included the declaration required by Article 39(4) (iii) of the Joint Convention, which stipulates: *"When becoming party to this Convention, such an organization shall communicate to the Depositary referred to in Article 43, a declaration indicating which States are members thereof, which Articles of this Convention apply to it, and the extent of its competence in the field covered by those articles".*

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27 Article 101.
28 INFCIRC/449, 5 July 1994.
29 INFCIRC/335, 18 November 1986.
30 INFCIRC/336, 18 November 1986.
31 ***INFCIRC/274, 1 November 1979.***
32 ***INFCIRC/274/Rev.1/Mod.1, 8 July 2005.***
33 2005/510/Euratom, OJ L 185, 16.07.2005, p. 33.
34 2005/84/Euratom, OJ L 30, 03.02.2005, p. 10.

A.2.4.2 The declaration by Euratom according to the provisions of Article 39(4)(iii) of the Joint Convention regarding Community competences in the framework of the Joint Convention

In December 2002, the Court of Justice defined the scope of Euratom competences with regard to the Convention on Nuclear Safety. In its judgment[35], the Court found that Euratom possesses competences relating not only to radiation protection, but also to nuclear safety[36]. Based on this landmark ruling, the existing basic safety standards, aiming at the protection of the health of workers and of the general public against the dangers arising from ionising radiations, can be "supplemented" with safety requirements governing the safe management of radioactive waste and spent fuel. Moreover, the Court had already adjudicated in 1988 that the provisions of Title II, Chapter 3, of the Euratom Treaty, on health and safety, form a coherent whole conferring powers of a considerable scope, in order to protect the population and the environment against risks of nuclear contamination[37].

The declaration of competences of Euratom, under Article 39(4)(iii) of the Joint Convention, was consistent with the above principles established by the Court. It stated:

> *"The Community declares that Articles 1 to 16, 18, 19, 21 and 24 to 44 of the Joint Convention apply to it.*
>
> *The Community possesses competences, shared with its Member States, in the fields covered by Articles 4, 6 to 11, 13 to 16, 19 and 24 to 28 of the Joint Convention as provided by the Treaty establishing the European Atomic Energy Community in Article 2(b) and the relevant Articles of Title II, Chapter 3, entitled 'Health and Safety'."*

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35 Case C-29/99 *Commission v. Council*, ECLI:EU:C:2002:734, p. I-11221; judgment of the Court of 10 December 2002.

36 In paragraphs 82 and 83 of the Court's reasoning, it is stated that: "it is not appropriate, in order to define the Community's competences, to draw an artificial distinction between the protection of the health of the general public and the safety of sources of ionising radiation. Those considerations should inform the determination as to whether the Community possesses competences in the fields covered by articles of the Convention…".

37 Case C-187/87, ECR 1988, p. 5013.

Section B

POLICIES AND PRACTICES

(Article 32(1) of the Joint Convention)

ARTICLE 32. REPORTING

1. In accordance with the provisions of Article 30, each Contracting Party shall submit a national report to each review meeting of Contracting Parties. This report shall address the measures taken to implement each of the obligations of the Convention. For each Contracting Party the report shall also address its:

(i) spent fuel management policy;

(ii) spent fuel management practices;

(iii) radioactive waste management policy;

(iv) radioactive waste management practices;

(v) criteria used to define and categorize radioactive waste.

B.1 GENERAL EURATOM POLICIES AND PRACTICES

B.1.1 Foreword: relevant data

Through its Member States, Euratom is a significant producer of radioactive waste and spent fuel[38]. Therefore, management of radioactive waste and spent fuel is one of the key issues in EU's nuclear energy policies. This is also reflected in the number of legal instruments the Community has produced, upon the basis of the Euratom Treaty, regulating amongst other radioactive waste management and decommissioning. An overview of the relevant Euratom legislation can be found in Section E.1 of this Report.

[38] ***In 2016*** the main producers of radioactive waste and spent fuel in terms of volume and radioactivity were France, the UK and Germany.

During the reporting period, fourteen (14) of the twenty eight (28) Euratom Member States ***have been operating*** nuclear power plants[39]. Each Member State ***is responsible for*** its fuel cycle policy, ***in particular to decide whether to consider*** spent fuel as a valuable resource that may be reprocessed or as waste for direct disposal.

While the EU Member States report national inventories of spent fuel and radioactive waste as Contracting Parties to the Convention, the European Commission reports all national inventories and an overview to the European Parliament and to the Council every third year[40]. The latest such overview is presented below.

As of the end of ***2016*** the estimated total inventory of radioactive waste on the territory of the EU ***was 3 466 000 m^3*** (see Table 1), of which about ***71.6%*** had been disposed of ***(2 483 000 m^3)*** and about ***28.4 %*** is in storage ***(983 000 m^3). The volume of radioactive waste disposed of increased by 7% between 2013 and 2016.*** The main composition of the total volume of radioactive waste ***was 72.7%*** low-level waste (LLW), ***17.4%*** very-low-level waste (VLLW), ***9.7%*** intermediate-level waste (ILW) and ***0.2 %*** high-level waste (HLW) (see Figure 1).[41] ILW and HLW are generated and stored across the EU, predominantly in the Member States with nuclear programmes.

At the end of ***2016***[42] approximately ***58 000 tHM*** of spent fuel was stored in the EU. ***About 1.5% of this spent fuel*** was stored in a third country pending reprocessing with the expected resulting material to be returned to the EU after ***2024.***

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39 The Member States having nuclear power plants in operation are:
Belgium, Bulgaria, the Czech Republic, Finland, France, Germany, Hungary, the Netherlands, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.

40 COM(2019) 632 final.

41 The IAEA General Safety Guide GSG-1 Classification system also defines exempted waste (waste with concentrations of radionuclides small enough to not require provisions of radiation protections) and very short lived waste (waste containing only very short half-life radionuclides allowing it to be stored until it has fallen beneath levels of clearance and managed as conventional waste). These do not require future long-term management or disposal as radioactive waste owing to their short lifetime and/or activity levels, thus enabling exemption from regulatory control. Consequently, exempt waste and very short-lived waste are in most cases not reported by Member States. Thus, these waste classes have not been used for data aggregation in this document.

42 The cut-off date for most of the data is the end of 2016 in order to reduce reporting burden on the Member States and facilitate a joint reporting with the Joint Convention. Article 14(1) of the Directive states "...taking advantage of the review and reporting under the Joint Convention." In the last Joint Convention reporting cycle (6th Joint Convention meeting in May 2018) the Member States used 2016 as a reference date. Nevertheless, a few have chosen to report more recent inventories.

B.1.2 General Euratom policies

All Member States generate radioactive waste, and ***twenty*** manage spent fuel on their territory. This requires containment and isolation from humans and the living environment over a long period of time. By adopting Council Directive 2011/70/Euratom, Member States have acknowledged their legal and ethical obligation to ensure a high level of safety when managing radioactive waste and spent fuel and to avoid undue burden on future generations.

Radioactive waste and spent fuel management policy remains largely a national competence and varies between Member States. ***Under Council Directive 2011/70/Euratom, spent fuel may either be considered as a usable resource that can be reprocessed or be destined for disposal if regarded as radioactive waste.***

Although historical and current practice in certain Member States is to reprocess spent fuel, the majority of Member States operating nuclear power plants intends to dispose of their spent fuel. This is expected to lead to an increase in the volume of high-level waste for storage and disposal. France will remain the only Member State with an industrial policy on reprocessing domestically, while some other Member States are reprocessing fuel abroad and are considering doing so in the future.

As for the previous reporting period, the most important outstanding issue in a large number of Member States is the decision on the long-term management of intermediate-level waste, high-level waste and spent fuel, and specifically their disposal. ***However, the national programmes adopted by Member States under Council Directive 2011/70/Euratom showed the level of progress and developments across the continent.*** A few countries have established precise programmes for the development of geological disposal with fixed milestones and deadlines; ***only three are substantially advanced. Finland is the first country on a global scale where the construction of a deep geological facility has begun and is expected to be in operation by 2024. Sweden and France will follow in the next decade.***

Shared disposal solutions are not prohibited under Council Directive 2011/70/Euratom. However, there are other important challenges in putting shared solutions into practice, for example the ban of waste import in some Member States, the identification of the host country, or resolving legal questions in relation to responsibilities, liabilities and ownership. As is the case for the development of any disposal facility, engagement with all stakeholders and the public, and commitment at the highest political level are needed. ***While about half of the Member States consider the option of a shared solution for disposal, either as a primary or secondary policy option, in particular for high-level waste and spent fuel, no significant development has been observed in practice in the last three years.***

The Commission encouraged[43] EU Member States to increase their efforts in developing long-term management solutions for intermediate-level waste, high-level waste, and spent fuel, including research, development and demonstration activities as soon as possible to avoid placing undue burdens on future generation.

B.1.3 European Nuclear Safety Regulators Group

The European Nuclear Safety Regulators Group (ENSREG) (established on 17 July 2007[44]) ***brings together the EU's senior regulators in the areas of nuclear safety and the safe management of spent nuclear fuel and radioactive waste***. It plays an important role in advising the Commission on the development of policies and legal proposals in these areas. ***ENSREG normally meets in plenary twice per year.***

At the end of 2019, nineteen members (eighteen Members States[45] and the European Commission) plus two international organisations – IAEA and NEA/OECD (as observers) were participating in the ENSREG Working Group 2 "Improving Radioactive Waste Management, Spent Fuel and Decommissioning Arrangements". The group normally meets twice per year to discuss specific regulatory issues related to spent fuel and radioactive waste.

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43 COM(2019) 632.

44 By Commission Decision 2007/530/Euratom, OJ L 195/44 of 27.07.2007.

45 Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Lithuania, The Netherlands, Poland, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom

In the last years, the group focussed on the identification of lessons learned[46] from the first Member States reports on Council Directive 2011/70/Euratom, ***the inventories and key performance indicators to monitor progress towards the implementation of national programmes.***

ENSREG's Working Group 3 covers transparency in nuclear safety and management of spent nuclear fuel and radioactive waste. This group updated its guidance to regulators on openness and transparency at the end of 2019[47].

ENSREG also conducts biannual conferences to address at a high-level progress and challenges in the field of nuclear, radiation and waste safety, the most recent edition of the ENSREG Conference being held in Brussels on 6-7 June 2019. Topics addressed included decommissioning, where participants identified the need for a holistic approach for waste treatment and conditioning, interim storage, dismantling activities, material management and waste disposal.

B.1.4 European Nuclear Energy Forum

The European Nuclear Energy Forum (ENEF) is a platform for a broad discussion on the opportunities and risks of nuclear energy, including spent fuel and radioactive waste management, as well as on transparency issues. ENEF gathers all relevant stakeholders in the nuclear field, such as the governments of all Member States of Euratom, European institutions (with active participation of Members of the European Parliament), the European Economic and Social Committee, nuclear industry, electricity consumers and the civil society. ***ENEF annual meetings take place alternatively in Bratislava and Prague.***

At the 14th ENEF meeting in Prague, between 29-30 April 2019, the question of EU or multinational nuclear waste repository solution was also raised. The 13th ENEF meeting in Bratislava, between 4-5 June 2018, highlighted the importance of safeguarding the expertise in the area of radioactive waste and spent fuel management. The ENEF conclusions emphasised the needs of sufficient number of qualified professionals for an indefinite period of several generations or even longer in order to handle the safe decommissioning and safe management of spent fuel and radioactive waste.

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46 http://www.ensreg.eu/news/ensreg-working-group-2-workshop-member-states-lessons-learned-notification-national-programmes

47 http://ensreg.eu/sites/default/files/attachments/guidance_for_regulators_on_openness_and_transparency.pdf

B.1.5 Decommissioning Funding Group

Commission Recommendation 2006/851/Euratom[48] addresses the management of financial resources for the decommissioning of nuclear installations, spent fuel and radioactive waste. ***The Decommissioning Funding Group ("DFG") assists the Commission in its proceedings in the context of this Recommendation. The DFG is composed of nominated experts from Member States and experts from IAEA, OECD-NEA and Switzerland as "observers". The DFG worked on financial issues, related to decommissioning of civil nuclear installations and to the management of spent fuel and radioactive waste generated through the lifecycle of civil nuclear facilities and, when relevant, assisted the Commission services in preparation of topical studies. Concretely, in 2018 on the preliminary results of the studies "Risk profile of funds allocated to finance the back-end of the nuclear fuel cycle" and "Market of decommissioning" and in 2019 on the final report of the study "Methodologies of cost assessment for radioactive waste and spent fuel management. An overview of the practices adopted in the EU (Study N° 2017-160)".***

B.1.6 Sustainable Nuclear Energy Technology Platform

The Sustainable Nuclear Energy Technology Platform (SNE-TP[49]) was ***founded*** in 2007. ***Over the years, SNE-TP has gathered more than 130 organisations and succeeded to promote collaboration between European partners coming from industry, research and safety organizations, and academia. Such collaboration between experts is essential for assessing the maturity of nuclear technology, in its capability to seek continuously for improving safety and performance of the industrial installed base, while preparing the next nuclear generation and developing nuclear heat process application as well. SNE-TP confirms its viability in providing a forum for technical exchange, expertise and joint undertaking in Research – Development and Innovation for nuclear fission.***

The SNE-TP decided in 2017 to pursue an evolution of the platform towards a legal association that has been officialised by a royal decree in September 2019.

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48 OJ L 330, 28.11.2006, p.31.
49 https://www.snetp.eu

Within the framework of the Strategic Energy Technology Plan (SET-Plan), stakeholders have formulated a collective vision of the contribution which fission could make towards Europe's transition to a low-carbon energy mix by 2050, with the aim of integrating and expanding R&D capabilities in order to reach this objective.

Regarding safe and efficient handling of radioactive waste: new and innovative technologies to more efficiently characterise, treat, condition and minimise waste streams at the pre-disposal phase are sought by waste producers, waste management organisations, governments and society with the overall objectives:

- ***Reduce radioactive waste volumes, radioactivity concentration of waste streams, and the associated costs and time needed for waste treatment prior to disposal;***

- ***Demonstrate technical, economic and environmental feasibility of the new solutions;***

- ***Deploy new solutions on a wide international scale;***

- ***Train new experts in the field of pre-disposal waste management technologies.***

The SNETP works in synergy with the co-fund project NFRP-2018-6 European Joint Program on Radioactive Waste Management (EURAD) running 2019-2024. This includes cooperation on handling of waste streams and waste acceptance criteria (from the EURAD-ROUTES work package), knowledge management, training and mobility schemes. Complementary engagement have also been settled with other existing and emerging networks of international parties, including IGD-TP, SITEX, EuradScience, IAEA-NEA and multiple other EC-funded projects like SHARE and CHANCE pertaining to decommissioning.

B.1.7 Implementing Geological Disposal Technology Platform

The Implementing Geological Disposal of radioactive waste Technology Platform (IGD-TP[50]) was launched in November 2009 ***by the European Commission and waste management organisations. The IGD-TP is dedicated to initiating and carrying out European strategic technical research, development and demonstration initiatives to facilitate the stepwise implementation of safe, deep geological disposal of spent fuel, high-level waste and other long-lived radioactive waste. The vision of the platform members is for industrialisation of radioactive waste disposal in Europe by 2040, via three pillars: (1) safe operation of the first geological disposal facilities in Europe; (2) optimisation and industrialisation of the planning, construction and disposal operations; and (3) development of tailored solutions for disposal of the diverse waste inventories in Europe.***

The IGD-TP is now solely funded and led by an Executive Group comprising representatives from 12 European waste management organisations and organisations responsible for implementation-related R&D programmes. The group welcomes all interested parties (industry, research and academia, research centres, technical safety organisations, non-governmental organisations, associations, SMEs, …) endorsing the IGD-TP Vision and willing to contribute positively and constructively to the group's goals, such as establishing and implementing the Strategic Research Agenda and participating in information exchange and knowledge transfer. There are currently around 140 different member organisations and over 600 individual members.

Within the ongoing EURAD Joint Programme, the IGD-TP provides the Waste Management Organisation College by acting as the co-ordination body and facilitating the formation of a joint position among all waste management organisations participating in EURAD. Additional activities are focused on direct implementation-related opportunities for collaboration between members and their common research needs.

[50] https://www.igdtp.eu/

B.1.8 Complementary solutions to disposal

Since many years, certain countries as well as Euratom have been promoting research on complementary solutions to direct disposal, in particular on 'partition and transmutation'. 'Partition and transmutation' aims at decreasing the inventory of high level and long lived radioactive waste that would eventually need disposal.

While it would not completely eliminate all such waste constituents and therefore is not a replacement for geological disposal, it could be a valuable complement enabling the optimum use of deep geological disposal facilities in particular by reducing their size and footprint as the amount of waste to be disposed of would be smaller.

B.1.9 Transparency and public opinion

European citizens are concerned about the management of spent fuel and radioactive waste in Europe. The Eurobarometers published in July 2008[51] and April 2010[52] show that European citizens think that Member States should take up their responsibilities and implement now demonstrated solutions for high-level radioactive waste, instead of leaving it for the future, and that nuclear waste management should be regulated at European level. An open consultation carried out in the website of the Commission during the months of March to May 2010 showed similar conclusions, where an overwhelming majority of the respondents declared their support for the development of binding Community legislation in this area[53].

The public, workers and other stakeholders are interested in various aspects of spent fuel and radioactive waste management. Transparency is of high importance for Euratom.

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51 Special Eurobarometer survey 297 – Attitude towards radioactive waste, Commission, 2008: https://ec.europa.eu/public_opinion/index_en.htm

52 Special Eurobarometer survey 324 – Europeans and nuclear safety, Commission, 2010: https://ec.europa.eu/energy/nuclear/safety/safety_en.htm

53 Public Consultation, 31 March 2010 to 31 May 2010 – Approaches for a possible EU legislative proposal on the management of spent fuel and radioactive waste: https://ec.europa.eu/energy/nuclear/consultations/2010_05_31_fuel_waste-en.htm

In its first report on the implementation of Council Directive 2011/70/Euratom (COM(2017)236)[54], the Commission encouraged Member States to report on the mechanisms in place to ensure public participation in the decision-making process beyond public consultation, such as working groups, advisory bodies or national committees.

In their second national reports on the implementation of Council Directive 2011/70/Euratom, which had to be notified to the Commission by 23 August 2018, EU Member States provided more detailed information on their policies and legal frameworks regulating transparency arrangements. Over half of the Member States underwent strategic environmental assessments of their national programmes and over two thirds consult the public in the framework of the environmental impact assessment as a precondition for issuing licenses for nuclear and radioactive waste management installations.

In general, Member States with nuclear power programmes make use of a broader variety of techniques and channels of information. Some specific programmes, namely those concerning deep geological disposal, have led to the adoption of ad hoc communication strategies and the undertaking of great scale information campaigns. A few Member States also emphasised in their reports the importance of promoting education of citizens to improve public understanding and acceptance of spent fuel and radioactive waste management.

B.1.10 Council Directive 2011/70/Euratom

Council Directive 2011/70/Euratom establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste was adopted on 19 July 2011[55].

The general objective of the directive is the establishment of a Euratom framework for the responsible and safe management of spent fuel and radioactive waste to avoid imposing undue burdens on future generations, ensuring that Member States provide for appropriate national arrangements for a high level of safety, as well as for necessary public information and participation.

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54 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 of 15 May 2017 https://ec.europa.eu/energy/en/topics/nuclear-energy/radioactive-waste-and-spent-fuel.

55 OJ L 199, 02.08.2011, p.48.

After assessing the national transposition measures for Directive 2011/70/Euratom, the Commission concluded in 2018 that more than half of the Member States had not correctly transposed the Directive's provisions. The Commission thus started infringement procedures against 15 Member States[56]. The main issues encountered concern the transposition of the requirements on: financial resources (Article 9), safety demonstrations of facilities or activities (Article 7(3)), expertise and skills (Article 8) and definitions (Article 3). For one third of the Member States the Commission assessed as not adequate the transposition of the provisions requiring effective independence and sufficient legal powers, financial and human resources of the competent national authorities (Article 6(2) and (3)of the Directive).

The Commission also initiated infringement procedures against 16 Member States in 2018 and one Member State at the beginning of 2019 for the non-compliance of their national programmes to several requirements of the Directive. The Commission concluded that most of these Member States have not adequately addressed the assessment for the national programmes costs (Article 12(1)(h)). The other main challenges identified are related to: the setting of financing mechanisms ensuring sufficient funding for the national programme implementation (Articles 12(1)(i) and 5(1)(h)); the definition of adequate timeframes and milestones for the entire national programme, including disposal (Article 12(1)(b)); and the definition of key performance indicators for monitoring the implementation of the programme (Article 12(1)(g)).

In addition, the Commission adopted at the end of 2019 its second report to the Council and the European Parliament on progress made with the implementation of the Directive as well as an inventory of spent fuel and radioactive waste present in the EU's territory[57]. This report is based on the Member States' national reports which had to be submitted to the Commission by 23 August 2018 as per Article 14(1) of the Directive.

References to specific aspects of this directive are made in subsequent parts of this Report.

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56 Three of these procedures have been closed, following clarifications by Member States or adoption of new legislative measures.

57 COM(2019) 632 final

B.2. EURATOM POLICIES IN THE FRAMEWORK OF THE JOINT RESEARCH CENTRE (JRC)[58]

B.2.1 General introduction to the JRC and the Decommissioning and Waste Management Programme

The JRC was set up at the beginning of the 1960s, under Article 8 of the Euratom Treaty, with sites in Ispra (Italy), Geel (Belgium), Karlsruhe (Germany), Petten (Netherlands), Brussels (Belgium) and, later, Seville (Spain). Article 8(1) of the Treaty provides in particular: "*After consulting the Scientific and Technical Committee, the Commission shall establish a Joint Nuclear Research Centre. The Centre shall ensure that the research programmes and other tasks assigned to it by the Commission are carried out…*"

Originally, the JRC was dedicated entirely to nuclear research, but in the meantime it has diversified its activities. The mission of the JRC, as the science and knowledge service of the Commission, is to support EU policies with independent evidence throughout the whole policy cycle.

In 1999, the Commission decided to launch the Decommissioning and Waste Management Programme ("D&WM Programme") for decommissioning its obsolete nuclear research installations on the JRC sites. The Programme allows the Commission to implement a comprehensive global approach to the decommissioning and dismantling of its nuclear research facilities, and to manage the radioactive waste generated as a consequence of past research activities, as well as that generated as a consequence of decommissioning and dismantling, following up-to-date practices and strategies.

The Programme is implemented by the recently established Nuclear Decommissioning Department in the Nuclear Safety and Security Directorate of JRC, and is governed by a High Level Steering Committee that provides guidance and takes strategic decisions, supported by an Operational Level Steering Committee for the more direct day-to-day management.

[58] See the paragraphs in bold on the first page of the Foreword as the status of JRC facilities.

The decommissioning and related waste management costs are paid through a dedicated budget line, which is fixed on a seven-year basis. Costs associated with the running operational waste production of research activities are covered by the research budget or by third parties if the research is performed on their account.

The last Commission Communication[59] to the Council and European Parliament on the progress of the D&WM Programme presented in 2013 a consolidated estimate for the entire JRC D&WM Programme after 2013 of EUR 989,2 million.

B.2.2 Brief overview of JRC nuclear installations and liabilities

On the largest JRC site in Ispra, Italy, most of the nuclear installations are either obsolete or no longer required. They include research reactors (Ispra-1 and Essor), a cyclotron, three major buildings for experiments (a radiochemical laboratory, a hot cell fuel-handling laboratory and a fuel-melting oven) and installations for the processing of the solid and liquid waste. It also concerns areas where historical raw unconditioned research waste was stored in temporary facilities and areas where conditioned waste was either temporarily stored in dedicated facilities or buried.

Currently, almost all the nuclear research installations of the JRC-Ispra site have been definitively shut down, and require decommissioning. The decommissioning programme at JRC-Ispra is the most advanced.

The radiochemistry laboratory has been fully decommissioned, ***and the dismantling of the Fuel Melting test facility (FARO), is completed***. ***The process for obtaining the decommissioning licenses for other facilities such as the research reactor ESSOR, the hot cell laboratory LCSR, the old liquid effluent stations STRRL, the cyclotron and the waste handling complex area 40 is still on-going, at different stages of development. The research reactor Ispra-1 has been transferred to SoGIN following the implementation of the agreement signed on 27 November, 2009 between Euratom and the Italian Government.***

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[59] Communication from the Commission to the Council and the European Parliament - Decommissioning of Nuclear Installations and Management of Radioactive Waste: Management of Nuclear Liabilities arising out of the Activities of the Joint Research Centre (JRC) carried out under the Euratom Treaty (COM (2013) 734).

The implementation of the D&WM programme at the JRC-Ispra site has focused on the design and building of several waste handling and interim storage installations for waste sorting, characterisation, decontamination, material "clearance" from ***regulatory*** control, and condition and temporary storage of radioactive waste until adequate radioactive waste interim long-term storage facilities or waste disposal facilities are available in Italy.

This JRC-Ispra D&WM programme has five main objectives:

– keeping obsolete installations safe in accordance with the safety standards in force (operations which are known as "safe conservation");

– constructing or improving of waste characterisation, treatment, conditioning and interim storage installations;

– recovering, treating and reconditioning existing waste;

– conditioning nuclear materials with a view to their storage on-site or their transfer to third parties;

– decommissioning of obsolete installations and managing the resulting waste.

The overall approach is based on the concept of the JRC as awarding authority, managing and maintaining control of the decommissioning and waste management activities and maximising the use of experienced contractors, when feasible from a technical, managerial and legal viewpoint. A staffing policy has been drawn up, indicating the evolution of profiles and competences as the programme develops. Moreover, major long-term contracts for assistance in managing the various projects have been placed.

In order to reduce the risks on the Italian liabilities linked to previous common nuclear research activities at the JRC-Ispra site, the risks on the long term waste storage capacities on the site and on the waste acceptance criteria, Euratom signed on 27 November 2009 an Agreement with the Italian Government in order to:

- regularise the historical liabilities on the site by transferring the responsibility for the Ispra-1 reactor decommissioning to the Italian Government;

- formalise the transfer of all waste on the JRC-Ispra site to the future Italian national repository by the end of the D&WM programme;

- limit the risk of later waste reconditioning which could be the result of changes in Italian waste acceptance criteria.

The Agreement was formally ratified by the Italian Government in 2019. As a consequence, the licence of the Ispra-1 reactor has been transferred to SoGIN, the Italian State-owned company responsible for the decommissioning of Italian nuclear plants and the management of radioactive waste on 26 September, 2019.

The remaining JRC nuclear research installations, located in Petten (the Netherlands), Geel (Belgium), and Karlsruhe (Germany), are still in operation. Decommissioning of the related operating facilities will not start before their shutdown, which is not planned yet. Nevertheless, in accordance with IAEA's recommendations and corresponding host countries regulations, the Commission has drawn up and periodically updates decommissioning plans including costs estimations. In addition, pre-decommissioning activities are carried out for the dismantling of out-of-use equipment from past research work and for the removal off-site (including transfer of ownership) of obsolete nuclear spent fuel and non-irradiated nuclear materials. This situation is going to change starting in the next decade, with relatively large pre-decommissioning and decommissioning projects to be initiated at more than one site. The new "multi-site" configuration affecting the D&WM programme of JRC will be reflected in the definition and implementation of updated strategic and operational approaches.

Table 1 - Overview matrix providing types of liabilities and the general policies and practices for the JRC sites.

Type of Liability	Long-Term Management Policy	Funding of Liabilities	Current Practice/ Facilities	Planned Facilities
Spent Fuel	***Reprocessing or long-term storage and disposal in national repository***	Funds provided from the EU budget	- Interim storage	- Interim storage
Nuclear Fuel Cycle Waste	N.A.	N.A.	N.A.	N.A.
Application Wastes (i.e. research wastes)	National repositories	Funds provided from the EU budget or third parties	On-site temporary storage Waste sorting and conditioning Waste minimization	None
Decommissioning Liabilities	National repositories	Funds provided from the EU budget or third parties	Elaboration of decommissioning plans Clean-up, pre-decommissioning,	– Waste immobilisation

			decommissioning Waste sorting and conditioning Interim storage of conditioned waste Characterisation and free release	
Disused Sealed Sources	Sources collection, ownership transfer and storage at third parties facilities	Funds provided from the EU budget	On-site temporary storage Ownership transfer and shipment to third party facilities	None

The policies and practices for managing radioactive waste and spent fuel aim at integrating JRC liabilities to the corresponding final radioactive waste or spent fuel disposal route available, or to be made available in the host State.

B.2.3 Policies and practices at JRC nuclear sites

B.2.3.1 Spent fuel management policy

Currently, the Commission is responsible for the management of residual amounts of spent fuel of the JRC Ispra site shutdown reactor Essor.

The spent fuel management policy followed by the Commission is dictated by:

– safety, ensuring interim storage conditions in compliance with the existing regulations in the host country;

– efficiency, producing ultimate waste forms/packages that are compatible with the national disposal requirements;

– economics or the ultimate cost to the EU taxpayer, i.e. making use of existing routes (reprocessing or return to third party) whenever feasible (rather than waiting for theoretical national solutions for which the actual cost is uncertain) .

B.2.3.2 Spent fuel management practices

At JRC-Petten the management of spent fuel from the High Flux Reactor (HFR) is the responsibility of NRG (Nuclear Research and Consultancy Group), the Dutch operator and licence holder of the HFR. Spent fuel can be stored on site for a maximum period of five years before being transported to the interim storage facility for high-level waste (HABOG) managed by COVRA (the Dutch central organisation for nuclear waste management). All Highly Enriched Uranium (HEU) spent fuel under the responsibility of the JRC was shipped to the USA or to HABOG between 2005 and 2011. At JRC-Karlsruhe, residual irradiated fuel no longer used for research activities which cannot be returned to an external owner is subject to temporary storage in view of joining the relevant waste streams foreseen in Germany for this type of materials.

At JRC-Ispra most of the spent fuel has been returned to the USA. The remaining spent fuel in the pool of the Essor reactor and in dry pits and vaults will be temporarily stored in an interim store installed in one of the former hot cells of the Essor reactor complex. ***Two alternatives are being explored:***

– ***Repackaging in dual-purpose storage casks and subsequent transfer to a dry storage facility on-site (to be built) until shipment to the national long term storage or disposal facility when available,***

– ***Shipping all remaining irradiated material to reprocessing; title transfer of the recovered nuclear material, storage of vitrified waste at the reprocessing plant and final shipping to the Italian national repository.***

About 95% of the non-irradiated nuclear material has been removed from the site, the corresponding title of ownership transferred, and shipped to the USA (along with nuclear material from Karlsruhe, in the framework of the Global Threat Reduction Initiative (GTRI) launched by US in 2004 with the aim to reduce and protect vulnerable nuclear and radiological material located at civilian sites worldwide) or France. The last shipment took place in 2015. ***The JRC is exploring the feasibility of transferring part of the remaining non-irradiated nuclear material, which is potentially useful for research purposes, to interested research institutions in EU Member States.***

B.2.3.3 Radioactive waste management policy

The policy of the JRC sites is to reduce the amount of radioactive waste to the lowest reasonably achievable level, and to transfer the resulting waste packages to the national waste management organisation in the host country.

On the JRC sites which have still nuclear facilities in operation, the efforts to reduce waste originating from the research activities are focussed mainly on waste segregation and, when possible, decontamination and release of the waste from regulatory control. Concerning future waste from the decommissioning of the JRC facilities, studies on technological solutions of waste conditioning which could reduce the volumes of waste anticipated in the decommissioning plans are ongoing.

B.2.3.4 Radioactive waste management practices

At JRC-Petten, radioactive waste generated at the HFR is managed under the responsibility of NRG, the operator and licence holder of the HFR, and transferred to COVRA.

At JRC-Geel, waste is transferred to the Belgian National Agency for Radioactive Waste and enriched Fissile Material (ONDRAF/NIRAS) and shipped to the Belgoprocess facilities.

At JRC-Karlsruhe, waste is transferred to the Central Decontamination Operations Department (KTE[60]), located within the premises of the Karlsruhe Institute for Technology (KIT). The KTE manages radioactive wastes originating from the Karlsruhe site, including JRC, and various other sites in Germany.

At JRC-Ispra the waste is temporarily stored in facilities on site, waiting for the availability of a national repository or national long term storage facilities. In the meantime, JRC-Ispra is constructing and refurbishing several waste management facilities in order to treat, characterise, condition and package the existing (historical) waste and the (future) waste arising from dismantling operations according to relevant regulations.

At the JRC-Ispra site, the following activities have been carried out during the last three years:

- ***A new facility for the immobilisation of waste is being constructed;***
- A 5 m^3 final waste package for the conditioned waste has finalised the qualification process and is awaiting the acceptance by the National Authority;
- ***the "interim storage facility" for conditioned waste has been completed, commissioned and authorised for conditioned VLLW and LLW; an extension of the license to store unconditioned VLLW was approved in 2019;***
- historical technological waste present in various buildings has been sorted (on-going activity, ***approximately 70% progress achieved***), characterised, properly repackaged and stored per category in a dedicated "transit area", awaiting conditioning.

B.2.3.5 Waste categorisation criteria

At each site, JRC follows the relevant national waste categorisation criteria, defined by law or by national standards. Reference is made to the national reports from Belgium, Germany, Italy and the Netherlands for the corresponding legislation and criteria.

[60] Kerntechnische Entsorgung Karlsruhe GmbH

Section C

SCOPE OF APPLICATION

(Article 3 of the Joint Convention)

ARTICLE 3. SCOPE OF APPLICATION

1. This Convention shall apply to the safety of spent fuel management when the spent fuel results from the operation of civilian nuclear reactors. Spent fuel held at reprocessing facilities as part of a reprocessing activity is not covered in the scope of this Convention unless the Contracting Party declares reprocessing to be part of spent fuel management.

2. This Convention shall also apply to the safety of radioactive waste management when the radioactive waste results from civilian applications. However, this Convention shall not apply to waste that contains only naturally occurring radioactive materials and that does not originate from the nuclear fuel cycle, unless it constitutes a disused sealed source or it is declared as radioactive waste for the purposes of this Convention by the Contracting Party.

3. This Convention shall not apply to the safety of management of spent fuel or radioactive waste within military or defence programmes, unless declared as spent fuel or radioactive waste for the purposes of this Convention by the Contracting Party. However, this Convention shall apply to the safety of management of spent fuel and radioactive waste from military or defence programmes if and when such materials are transferred permanently to and managed within exclusively civilian programmes.

4. This Convention shall also apply to discharges as provided for in Articles 4, 7, 11, 14, 24 and 26.

The scope of application of various requirements under the Joint Convention is defined in the aforementioned declaration submitted by Euratom at the time of its accession[61].

In addition, the following observations are made:

- To date, Euratom has not made a declaration under Article 3(1) of the Joint Convention[62].
- Euratom has not made a declaration under Article 3(2) of the Joint Convention.
- Euratom has not made a declaration under Article 3(3) of the Joint Convention[63].

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61 See Section A.2.4.2 above.

62 Reprocessing is not covered further by this Report.

Section D

INVENTORIES AND LISTS

(Article 32(2) of the Joint Convention)

ARTICLE 32. REPORTING

(...)

2. This report shall also include:

(i) a list of the spent fuel management facilities subject to this Convention, their location, main purpose and essential features;

(ii) an inventory of spent fuel that is subject to this Convention and that is being held in storage and of that which has been disposed of. This inventory shall contain a description of the material and, if available, give information on its mass and its total activity;

(iii) a list of the radioactive waste management facilities subject to this Convention, their location, main purpose and essential features;

(iv) an inventory of radioactive waste that is subject to this Convention that:

(a) is being held in storage at radioactive waste management and nuclear fuel cycle facilities;

(b) has been disposed of; or

(c) has resulted from past practices.

This inventory shall contain a description of the material and other appropriate information available, such as volume or mass, activity and specific radionuclides;

(v) a list of nuclear facilities in the process of being decommissioned and the status of decommissioning activities at those facilities.

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63 The Court of Justice has ruled that activities falling within the military sphere are outside the scope of all the provisions of the Euratom Treaty, as well as of Euratom secondary legislation {Case C-61/03 *Commission v. UK* [2005] ECR I-2477 and Case 65/04 *Commission v. UK* [2006] ECR I-2239}.

Euratom neither possesses nor operates nuclear power plants itself. However, Euratom owns nuclear research facilities located at the European Commission's Joint Research Centre (JRC) sites, in Ispra (Italy), Geel (Belgium), Karlsruhe (Germany) and Petten (the Netherlands). In its premises in Luxembourg, the Commission runs a laboratory for calibrating and testing safeguards non-destructive measurement equipment and radiation detection instruments.

These installations are subject to all safety, environmental and other relevant legal and regulatory requirements of the host countries where they are located. Notwithstanding the information related to Euratom facilities that could be provided in the National Reports of the host countries, this section includes relevant information on the facilities of the JRC and the inventories of radioactive waste and spent fuel, pertinent to the obligations under the Joint Convention.

D.1 JRC GEEL (BELGIUM)

The current nuclear installations of the JRC-Geel site consist of two major accelerator buildings (GELINA and Van de Graaff) and a series of research laboratories located in two separate buildings.

In 2002, JRC-Geel completed a first stage of its programme for the removal of obsolete facilities: a radiochemical laboratory building was decommissioned and is now being used for non-nuclear activities; and an obsolete Van de Graaff accelerator was dismantled. Since then, no decommissioning activities have taken place.

Radioactive waste inventory and practices

The radioactive waste produced on the JRC-Geel site is transferred to Belgoprocess in Dessel, where it is conditioned and stored, pending its disposal.

No radioactive waste originated from the refurbishment of the research facilities in Geel remains on-site.

A detailed radiological investigation was conducted of all still active nuclear installations, with a view to establishing an accurate forecast of future waste volumes and decommissioning costs. This evaluation of future liabilities also includes the provisional decommissioning plan. It was formally approved by ONDRAF/NIRAS in 2001 and is updated every five years.

The most up-to-date version (2016) states that the expected waste volumes that will be produced as a result of the decommissioning of all installations amount to 1300 m^3 (non-conditioned waste) and around 2500 tons of recyclable waste.

About 80% of this amount is related to the evacuation of the activated concrete shielding of the GELINA facility.

Sealed source inventory and practices

Currently, 225 sealed or encapsulated sources are still in use for research purposes and related activities.

D.2 JRC KARLSRUHE (GERMANY)

The nuclear research installations at JRC-Karlsruhe are located within the German site of the Karlsruhe Institute of Technology (KIT) and comprise a series of annexed buildings ("wings") for actinides, nuclear safety and safeguards scientific and technological research. The research activities are mainly performed in glove boxes and hot cells. A new building (wing M) is currently under construction.

The continuously evolving research activities have led to a variety of nuclear facilities being installed, nuclearized and renewed. Equipment which is no longer operational is gradually removed to allow optimum utilisation of the nuclear infrastructure. The focus of the JRC-Karlsruhe decommissioning and waste management programme is on management of historical waste and the dismantling of obsolete nuclear equipment, such as glove boxes. In the next decade, with the start of operation of the new wing M, some of the old laboratory wings will become obsolete and thus will be decommissioned.

Spent fuel inventory

The quantity of JRC-Karlsruhe owned irradiated fuel related to research activities is approximately 50 kg. Additional irradiated fuel owned by external research partners is temporarily stored on site, waiting to be returned to its owners.

Specific installations are under development for the treatment of the obsolete irradiated material for which no further use is foreseen, to allow its transport and later disposal in deep geological disposal facilities, according to relevant national regulations.

Radioactive waste inventory and practices

The radioactive waste produced at JRC-Karlsruhe is transferred to the conditioning and interim storage facilities of KTE, located on-site within the premises of KIT.

Currently, about 30 m^3 of non-conditioned waste originating from past research activities as well as from dismantling works are present at JRC-Karlsruhe. This historical legacy waste is currently being repackaged, characterised and transferred to KTE. At KTE, the waste is conditioned and stored until the ILW disposal repository Konrad is operational.

The total waste volumes that will be produced after the decommissioning of all installations have been estimated at 4500 m^3 (conditioned waste).

Sealed source inventory and practices

All sources present on the site are inventoried according to the terms of the German legislation.

Currently, the feasibility of transferring disused neutron sources to external facilities for recycling is being investigated.

D.3 JRC PETTEN (NETHERLANDS)

In 2005, the operating licence of the HFR at the Petten site was transferred from JRC to the Dutch company NRG, which previously operated the reactor under a JRC licence. This has clarified the responsibilities towards the national safety authorities as the operator and the licence holder became a single body. Nevertheless, the Community will continue to own the HFR (under a long-term lease contract with the Dutch Government) and has the liability for its later decommissioning.

In 2005 and 2011, JRC-Petten has conducted detailed assessments of these future decommissioning liabilities, including the amount of waste that will be generated. An updated decommissioning plan and cost estimation for the decommissioning of the HFR was prepared in July 2018. The total waste volumes that will be produced after the decommissioning of all installations has been estimated at 1300 m^3 (non-conditioned).

A list of legacy waste items belonging to JRC Petten was identified and agreed upon with NRG in 2019. This waste will be removed and shipped to COVRA.

Spent fuel inventory and practices

All JRC-owned spent fuel was shipped back to the USA or to the Dutch spent fuel and radioactive waste management agency (COVRA) by March 2011. Since then, all HFR spent fuel is managed under NRG responsibility.

D.4 JRC ISPRA (ITALY)

Currently, almost all the nuclear research installations of the JRC-Ispra site have been definitively shut down. It concerns two former research reactors (Ispra-1 and Essor), a cyclotron, three major buildings for experiments (a radiochemical laboratory, which has been decommissioned and released from regulatory control in 2010, a hot cell fuel handling laboratory and a fuel melting oven) and the older installations for the processing of the solid and liquid waste having reached the end of their technical lifetime. The areas where historical raw unconditioned research waste was stored in temporary facilities and areas where conditioned waste, according to applicable Italian norms and prescriptions issued in the 60's/70's, was either temporarily stored in dedicated facilities or buried are also included

As Italy does not currently have any facilities to store the JRC-Ispra waste, JRC has built its own interim storage facility for conditioned waste and has also focussed on the construction or refurbishment of waste characterisation and treatment installations on its site.

Spent fuel inventory and practices

About 700 kg of spent fuel is still present on the JRC-Ispra site, essentially residual fuel assemblies, bundles and pins from past experiments. Most of this fuel is currently stored in the pool of the Essor reactor and in dry pits and vaults**.** Additionally, there are about 900 kg of flashed bars made of U-Pu metallic alloy stored in a protected location inside the Essor reactor.

The reference strategy is to dismantle and repack part of the experimental fuel in dry storage structure inside a hot cell. In a second stage, all the fuel will be transferred in one or two dry storage dual-purpose casks and temporarily stored on-site, pending the shipment to the national interim storage or disposal facility***, when available***.

An alternative option, currently under evaluation, consists in sending all remaining irradiated material to reprocessing, transferring the title of the recovered nuclear material, storing the vitrified waste at the reprocessing plant and finally shipping it to the Italian national repository when it is ready.

A new project is exploring the feasibility to transfer part of the flashed bars together with remaining unirradiated material potentially useful for research purposes to interested research organisations of EU Member States.

Radioactive waste inventory and practices

The total radioactive waste inventory for the JRC-Ispra site can be summarised as follows:

- 2 000 m^3 of unconditioned historical waste from previous operational and dismantling activities;
- 1 200 m^3 of conditioned bituminised historical waste;
- 700 m^3 of historical waste conditioned in concrete pits and concrete blocks;

– ***1 600 m^3 of waste generated during the pre-decommissioning activities;***

– 5 000 m^3 of unconditioned waste expected to be produced in future decommissioning activities. This figure does neither include the decommissioning of the Cyclotron, shut-down in 2014, nor the decommissioning of the new or refurbished facilities built on site to manage the historical and the decommissioning waste (up to its interim storage). The definitive shutdown and decommissioning of these last facilities is planned towards the end of the JRC-Ispra D&WM Programme (2038).

General criteria for waste management strategy

The general waste management strategy is based on the criteria listed in the Italian national guide for the waste management, called "Guida Tecnica 26", revised in relation to waste classification by Ministerial Decree of 7 August, 2015 in the frame of the implementation of Council Directive 2011/70/Euratom. These criteria are:

1) Radiological and environmental protection guided by the ALARA principle;

2) Waste volume reduction;

3) Classification of waste based on the radioisotope qualities and quantities into three different categories which necessitate different confinement times, conditioning and management strategies.

In order to implement the strategy, the infrastructures created during the 60's to supply routine services, including storage of all radioactive waste coming from research and development activities carried out in the JRC, underwent significant modifications and improvements.

Waste pre-treatment, characterisation and conditioning

Pre-treating operations are carried out on-site. The following installations have been installed over the last decade:

- waste drum measurement systems (under upgrading);

- facilities for waste sorting, cutting and decontamination (in operation);

- an abrasive blasting unit (in commissioning phase);
- a waste release facility (in operation);
- ***a renewed radiochemical laboratory (in operation);***
- a new treatment station for liquid waste (in operation);
- a new grouting facility for waste conditioning (under construction).

Concerning waste conditioning (volume optimisation and reduction), the choice has been made to do it mainly off-site***, by external service providers***. This includes the following contracts:

- super-compaction services (contract in place, pending authorisation***);***
- ***metal melting services (contract in place, awaiting authorisation);***
- ***incineration (contracts in tendering phase);***
- conditioning of sludge (planned).

Final Waste Package and Waste Immobilisation

A standardisation of waste containers is pursued. JRC-Ispra will generally employ for its low-level waste 5.2 m^3 prismatic containers (IP-2 containers). A dedicated design in conformity with the Italian UNI standards has finalised its qualifications phase. The containers are awaiting the approval of the National Authority, ***having already obtained the declaration of conformity with the waste acceptance criteria of the future final disposal facility.***

Where necessary, alternative qualified 440 l drums will also be used, e.g. for the conditioned sludge (not planned yet).

The turnkey contract for the supply of an on-site immobilisation facility (grouting station) had to be repeated. The procurement has been relaunched by splitting the services in two parts: ***civil works (completed) and electro-mechanical equipment (installation ongoing).***

For the packing of the intermediate-level waste, suitable existing qualified containers are under investigation, awaiting the issuance from the Italian standardisation body (UNI) of a specific norm for ILW containers, currently in preparation.

Interim Storage Facilities

For the temporary storage of the conditioned and immobilised low-level waste, JRC-Ispra has opted for a lightweight interim storage facility (ISF, commissioned in 2013) realized near other waste management facilities (commissioned in 2013). The building has been designed to store 10 500 m^3 of waste (conditioned mainly in 5.2 m^3 containers, but partially also in 440 l drums) for a period of 50 years. This facility is already licensed for conditioned waste. ***Due to the delay in the realisation of the grouting station and considering that the licensing procedure of the conditioning process is in progress, JRC has applied for and obtained a license to use ISF for unconditioned very low-level waste.*** A small complementary facility for the storage of intermediate-level waste and the irradiated material packaged in dual-purpose dry casks is currently in the planning phase.

Management of historical waste on the site

Since 1999, actions have been undertaken to sort and if necessary treat the historical non-conditioned waste stored on the site. This waste is repacked in standard 200 l drums. All the waste drums will be characterised and shipped for super-compaction to an external facility.

In addition, some of the waste from previous research activities, which has been conditioned in the past according to existing applicable Italian norms and prescriptions, are temporarily stored in a dedicated facility or buried inside the site waste management area. The conditioning and packing does not comply with the current applicable international standards as well as the storage underground practices. Therefore, this waste will have to be retrieved, re-conditioned and packed according to the current applicable standards and norms. It concerns:

- about 1 200 m^3 of low-level waste (about 6 000 drums) conditioned in bitumen and disposed in three underground trenches covered with earth, which will be retrieved, characterised and incinerated in an offsite facility (contracts in tendering phase). ***This activity is planned to be completed by 2030;***

- about 700 m^3 of low-/intermediate-level waste conditioned in concrete; part is stored underground in 15 concrete pits, which will be retrieved, characterised and dismantled to segregate waste from the inert matrix. This activity is planned to be completed by 2022; part is conditioned in about 230 concrete blocks which are stored in a dedicated facility. The blocks must undergo characterisation, segregation and/or repacking. ***This activity is planned to be completed by 2026.***

It should be noted that no safety-reportable events have been recorded during the period of storage of the above mentioned conditioned waste.

Decommissioning activities

In parallel, the decommissioning of the shutdown installations has been initiated on the JRC-Ispra site. During the period between the shutdown and decommissioning, a programme of routine activities is undertaken to keep the installation in a safe state, in compliance with regulatory and site requirements. These activities also include keeping operating and maintenance knowledge and records of both installations and existing radioactive wastes. All installations and equipment have been submitted to a global physical and radiological characterisation ***in preparation for decommissioning***.

Other activities include clean-up and preliminary dismantling works, preparation and update of decommissioning plans, as well as preparation and submission of decommissioning license applications.

Sealed source inventory and practices

Three campaigns to collect and evacuate obsolete sealed sources present on the site were organised from 2007 to 2010. More than 1 700 sources were shipped off-site for recycling and/or future disposal.

Currently about 300 sealed sources are still in use for research purposes, instruments calibration and training activities (the large majority of which in the Safeguards Performance Laboratory (PERLA). Like in the past, it is envisaged to transfer disused sources to a third party, either for recycling or for future disposal.

D.5 COMMISSION PREMISES IN LUXEMBOURG

Sealed source inventory and practices

The Directorate-General for Energy (DG ENER) holds a total number of 122 low-radioactivity sealed sources and 28 fissile materials calibration standards. The sources and calibration standards are used for calibrating and testing safeguards non-destructive measurement equipment and for calibrating and testing radiation detection instruments.

All sources present are inventoried according to the terms of the licence issued by the Health Ministry of Luxembourg. The radioactive sources inventory is subject to annual updates reported to the Luxembourg radiation protection competent authority and the fissile materials are under Euratom safeguards. Whenever a radioactive source becomes disused, it is envisaged to transfer it to a third party either for recycling or for future disposal.

Section E LEGISLATIVE AND REGULATORY SYSTEM
(Articles 18 and 19 of the Joint Convention)

E.1 LEGISLATIVE AND REGULATORY FRAMEWORK (ARTICLE 19 OF THE JOINT CONVENTION)

ARTICLE 19. LEGISLATIVE AND REGULATORY FRAMEWORK

1. Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of spent fuel and radioactive waste management.

2. This legislative and regulatory framework shall provide for:

(i) the establishment of applicable national safety requirements and regulations for radiation safety;

(ii) a system of licencing of spent fuel and radioactive waste management activities;

(iii) a system of prohibition of the operation of a spent fuel or radioactive waste management facility without a licence;

(iv) a system of appropriate institutional control, regulatory inspection and documentation and reporting;

(v) the enforcement of applicable regulations and of the terms of the licences;

(vi) a clear allocation of responsibilities of the bodies involved in the different steps of spent fuel and of radioactive waste management.

3. When considering whether to regulate radioactive materials as radioactive waste, Contracting Parties shall take due account of the objectives of this Convention.

The sources of EU and Euratom law are the respective Treaties, which are regarded as "primary" sources of law, and secondary law that can be enacted by the institutions participating in the legislative process by virtue of the powers bestowed on them by the Treaties. Additional sources of law in both EU and Euratom legal order are: the case-law of the Court of Justice of the EU, general principles of law, fundamental rights and agreements or contracts with third countries or nationals of third countries or other international organisations.

E.1.1 Primary law

According to the above, the Euratom Treaty constitutes Euratom's "primary law", in other words the original supreme source of law on the strength of which the Community is established and secondary legislation can be adopted. It is the legal basis for the competences and activities of Euratom.

This Treaty was signed in Rome on 25 March 1957, for an indefinite duration[64]. On the basis of the Treaty, the Community coordinates research programmes in the area of nuclear energy. Furthermore, it seeks international cooperation and it aims to prevent nuclear materials from being diverted from their intended uses as declared by the users[65].

The Treaty also foresees the adoption of appropriate basic safety standards. Article 2(b) of Title I of the Euratom Treaty states that in order to perform its task, Euratom shall "*establish uniform safety standards to protect the health of workers and of the general public and ensure that they are applied*". In turn, Title II, Chapter 3, of the Treaty ("Health and Safety" – Articles 30 to 39) sets out a number of detailed provisions intended to establish and apply basic safety standards, so as to materialise the proviso of Article 2(b). Thus, Article 30 of the Treaty stipulates: "*Basic standards shall be laid down within the Community for the protection of the health of workers and the general public against the dangers arising from ionising radiations*...". In addition, Articles 31 and 32 provide for the details regarding the adoption and the revision of such Community standards, while Article 33 ensures that Member States' implementing legislation complies with them. Articles 34 et seq. ensure, in various ways, the monitoring by the Commission of national health and safety measures, including any plans for the disposal of radioactive waste[66].

In the context of the Lisbon Treaty, which entered into force on 1 December 2009, a limited number of amendments were agreed for the Euratom Treaty, while explicitly recalling the necessity that the provisions of this Treaty should continue to have full legal effect[67].

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64 Article 208 of the Euratom Treaty provides: "This Treaty is concluded for an unlimited period".
65 It is recalled that Euratom activities are limited to peaceful civil uses of nuclear energy.
66 For more details on these Treaty provisions, see Section E.2 below.
67 See above, Section A.2.1.

E.1.2 Secondary law

It has been explained that "secondary law" means measures that are adopted by the institutions under the express empowerment of a Treaty provision.

Under the combined provisions of Article 106a(1),(2) of the Euratom Treaty and Article 288 TFEU, the secondary law and other relevant instruments adopted by Euratom, as well as their impact on the national regulatory systems of the Member States, are as follows:

> *"...the institutions shall adopt regulations, directives, decisions, recommendations and opinions.*
>
> *A regulation shall have general application. It shall be binding in its entirety and directly applicable in all Member States.*
>
> *A directive shall be binding, as to the result to be achieved, upon each Member State to which it is addressed, but shall leave to the national authorities the choice of form and methods.*
>
> *A decision shall be binding in its entirety. A decision which specifies those to whom it is addressed, shall be binding only on them.*
>
> *Recommendations and opinions shall have no binding force".*

Therefore, with the exception of recommendations and opinions, the other three types of instruments mentioned in Article 288 TFEU, namely regulations, directives and decisions, are legally binding (either on all Member States[68] or on those to whom they are specifically addressed[69]).

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68 This is the case for regulations.
69 This is the case for directives and decisions.

In fact, a substantial corpus of Euratom binding secondary law has been adopted and updated over the years. With regard to spent fuel and radioactive waste management, the central ***legally binding*** act is Council Directive 2011/70/Euratom establishing a Community framework for such responsible and safe management. The Directive applies to all stages of management of spent fuel and radioactive waste from civilian activities. It supplements the basic standards referred to in Article 30 of the Euratom Treaty, as regards the safety of spent fuel and radioactive waste, and is without prejudice to the basic safety standards directive (***Council Directive 2013/59/Euratom***[70]).

Council Directive 2011/70/Euratom

Council Directive 2011/70/Euratom reflects the main principles and requirements of the IAEA Safety Standards and of the Joint Convention. The directive imposes ***legal*** obligations on the Member States to establish and maintain a national policy, as well as a national legislative, regulatory and organisational framework for the management of spent fuel and radioactive waste that allocates responsibilities and provides for coordination between relevant competent bodies. The national framework shall provide for the following:

- a national programme for the implementation of spent fuel and radioactive waste management policy;
- national arrangements for the safety of spent fuel and radioactive waste management;
- a system of licencing of spent fuel and radioactive waste management activities, facilities or both, including the prohibition of spent fuel or radioactive waste management activities, of the operation of a spent fuel or radioactive waste management facility without a licence, or both and, if appropriate, prescribing conditions for further management of the activity, facility or both;

[70] Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom, OJ L 13, 17.1.2014.

- a system of appropriate control, a management system, regulatory inspections, documentation and reporting obligations for radioactive waste and spent fuel management activities, facilities or both, including appropriate measures for the post-closure periods of disposal facilities;

- enforcement actions, including the suspension of activities and the modification, expiration or revocation of a licence together with requirements, if appropriate, for alternative solutions that lead to improved safety;

- the allocation of responsibility to the bodies involved in the different steps of spent fuel and radioactive waste management;

- national requirements for public information and participation;

- the financing scheme(s) for spent fuel and radioactive waste management.

The effective independence of national regulatory bodies in the field of safety of spent fuel and radioactive waste management is also addressed by the directive. Article 6, entitled "competent regulatory authority", provides:

> *"1. Each Member State shall establish and maintain a competent regulatory authority in the field of safety of spent fuel and radioactive waste management.*
>
> *2. Member States shall ensure that the competent regulatory authority is functionally separate from any other body or organisation concerned with the promotion or utilisation of nuclear energy or radioactive material, including electricity production and radioisotope applications, or with the management of spent fuel and radioactive waste, in order to ensure effective independence from undue influence on its regulatory function.*
>
> *3. Member States shall ensure that the competent regulatory authority is given the legal powers and human and financial resources necessary to fulfil its obligations in connection with the national framework (...)"*

With reference to transparency issues, Article 10 requires Member States to ensure that necessary information on the management of spent fuel and radioactive waste is made available to workers and the general public. This obligation includes ensuring that the competent regulatory authority informs the public in the fields of its competence. ***Member States are also required to ensure 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.***

Moreover, Member States shall ensure that the national framework is improved where appropriate, taking into account operating experience, insights gained from the decision-making process and the development of relevant technology and research.

At least every ten years Members States have to carry out self-assessments and invite international peer reviews of their national framework, competent authority and/or national programme (the first one is due by August 2023). The Member States shall also inform the Commission and the other Member States about the outcome of such reviews, which may be made available to the public where there is no conflict with security and proprietary information. ***Eight Member States, i.e. Poland, France, Bulgaria, Luxembourg, Spain, Germany, Estonia and Latvia, completed an ARTEMIS peer review mission in the period 2017 to 2019. Three Member States, i.e. Cyprus, Romania and Slovakia are planning to carry out such a mission by the 1st quarter 2021.***

Finally, Member States must submit a report to the Commission on the implementation of the above directive for the first time by 23 August 2015, and every 3 years thereafter, taking advantage of the review and reporting under the Joint Convention. ***To date all Member States have submitted their second national reports on the implementation of the directive to the Commission. On the basis of these documents, the Commission has released its second report .on progress made with the implementation of the Directive as well as an inventory of spent fuel and radioactive waste present in the EU's territory.***

According to ***Article 13*** of the Directive, Member States shall notify to the Commission their ***national programmes for the management of spent fuel and radioactive waste and any subsequent significant changes***. ***According to Article 12, the national programmes shall set out how EU Member States*** intend to implement their national policies for the responsible and safe management of spent fuel and radioactive waste, to secure the aims of the directive. They had to be notified to the Commission for the first time by 23 August 2015, in line with Article 15(4) of the Directive. ***To date all Member States notified their final national programmes.***

Council Directive 2006/117/Euratom

Council Directive 2006/117/Euratom of 20 November 2006 on the supervision and control of shipments of radioactive waste and spent fuel (repealing previous Council Directive 92/3/Euratom)[71] lays down a Community system of supervision and control of transboundary shipments of radioactive waste and spent fuel in, through and outside the Community. In particular, it provides for a compulsory and common scheme of notification and a standard control document, for shipments of radioactive waste or spent fuel which have a point of departure, transit or destination in an EU Member State, provided that the quantities in question exceed certain limits. The Directive establishes an Advisory Committee[72] to support the Commission in its work in the field of shipments of spent fuel and waste (e.g. review the Commission's 3-year reports to the Council, the European Parliament and the European Economic and Social Committee on implementation of this Directive). ***The first report (for the period 2009-2011) was published in 2013, the second report (for the period 2012-2014) in 2017 and the third report (for the period 2015-2017) in 2019.***

71 OJ L 337, 05.12.2006, p. 21–32.

72 The 10th meeting of the Advisory Committee was held on 25 January 2017, Luxembourg (attended by 20 Member States)

Council Directive 2009/71/Euratom

Council Directive 2009/71/Euratom of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations ('Nuclear Safety Directive')[73] imposes obligations on the Member States to establish and maintain a national legislative, regulatory and organisational framework for nuclear safety. Like Council Directive 2011/70/Euratom, Directive 2009/71/Euratom supplements the basic standards referred to in Article 30 of the Treaty, as regards the safety of nuclear installations, and is without prejudice to the basic safety standards directive (Council Directive 2013/59/Euratom, referred to ***above***). Directive 2009/71/Euratom was amended in July 2014[74] ('the amended NSD'), following the lessons learned from the Fukushima-Daïchi accident and the EU stress tests[75] and is based on various sources of technical expertise, such as the Western European Nuclear Regulators Association[76] and the technical provisions of the IAEA. It has been drawn up in close cooperation with national regulators. ***The amended NSD sets out an EU-wide safety objective to prevent accidents and, should an accident occur, mitigate their consequences and avoid early and large radioactive releases.*** It sets up a European system of regular topical peer reviews to ensure a common application of high nuclear safety standards and to exchange experiences. It also increases transparency in nuclear safety and strengthens the independence and the powers of national regulators[77].

73 OJ L 172, 02.07.2009, p. 18.
74 Council Directive 2014/87/Euratom of 8 July 2014 amending Directive 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations, OJ L 219, 25.7.2014
75 See Section K.6 below.
76 See at: http://www.wenra.org
77 For further information, also Section K.7 below.

The goal of Nuclear Safety Directive is to promote the continuous improvement of nuclear safety and to ensure that at all times a high level of nuclear safety is provided by the Member States to protect workers and the general public against dangers arising from nuclear installations. Towards this end, it reflects the fundamental safety principles and requirements of the IAEA Convention on Nuclear Safety[78] and the Joint Convention and builds upon the Fundamental Safety Principles[79] established by the IAEA[80].

The Nuclear Safety Directive covers spent fuel storage facilities, as well as storage facilities for radioactive waste that are on the same site and are directly related to a nuclear power plant, an enrichment plant, a nuclear fuel fabrication plant, a reprocessing plant, or a research reactor facility.

Council Directive 2013/59/Euratom

Following the entry into force of the Euratom Treaty, a comprehensive set of legislation establishing basic safety standards has been enacted on the basis of Article 31 of the Treaty. The main pillar of that legislation has been the Basic Safety Standards Directive ('BSS Directive'), which was first adopted in 1959 and subsequently updated in 1962, 1966, 1976, 1980, 1984, 1996 and 2013.

78 See Section A.2.4.2, footnote 38 above.
79 IAEA Safety Standard Series No. SF-1 (2006).
80 Detailed reference to Council Directive 2009/71/Euratom has been made in the Euratom report on the implementation of the obligations under the Convention on Nuclear Safety which was submitted to the Secretariat of the IAEA in 2010, in view of the Fifth Review Meeting of Contracting Parties (Vienna, April 2011).

Its latest version, Council Directive 2013/59/Euratom, is laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation ('the BSS Directive')[81]. The BSS Directive consolidates the existing set of Euratom radiation protection legislation into one single piece of legislation, repealing five Directives – the Medical Exposure Directive[82], the High Activity Sealed Sources Directive[83], the Outside Workers Directive[84], the Public Information Directive[85] and the previous BSS Directive [86].

Euratom adopted the BSS Directive in order to: (i) take account of the scientific and technological progress since 1996, in particular the new recommendations in Publication 103(2007) of the International Commission on Radiological Protection (ICRP) but also of the operational experience with the current requirements, and (ii) to consolidate the existing set of Euratom radiation protection legislation into one single piece of legislation. These recent basic safety standards offer the highest protection of workers, patients and members of the public based on latest scientific knowledge. The BSS Directive establishes uniform standards for the protection of the health of individuals subject to occupational, medical and public exposures against the dangers arising from ionising radiation. The directive applies to any planned, existing or emergency exposure situation which involves a risk from exposure to ionising radiation which cannot be disregarded from a radiation protection point of view or with regard to the environment in view of long term human health protection. The directive applies in particular to the manufacture, production, processing, handling, disposal, use, storage, holding, transport, import to, and export from the Community of radioactive material.

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81 OJ L 13, 17.1.2014

82 Council Directive 97/43/Euratom of 30 June 1997 on health protection of individuals against the dangers of ionising radiation in relation to medical exposure. OJ L 180/22, 9.7.1997

83 Council Directive 2003/122/Euratom of 22 December 2003 on the control of high-activity sealed radioactive sources and orphan sources. OJ L 346, 31.12.2003

84 Council Directive 90/641/Euratom of 4 December 1990 on the operational protection of outside workers exposed to the risk of ionising radiation during their activities in controlled areas. OJ L 349/21, 13.12.1990

85 Council Directive 89/618/Euratom of 27 November 1989 on informing the general public about health protection measures to be applied and steps to be taken in the event of a radiological emergency. OJ L 357/31, 7.12.89

86 Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation. OJ L 159/1, 29.6.96

The directive introduces a graded approach to regulatory control of practices by way of notification, authorisation and appropriate inspections commensurate with the magnitude and likelihood of exposures resulting from the practice, and commensurate with the impact that regulatory control may have in reducing such exposures or improving radiological safety. Authorisation can take the form of a registration or a licence. Justified practices, such as the disposal or storage of radioactive waste, need to be notified prior to the practice commencement. Article 28 stipulates that Member States shall require licencing, inter alia, for the operation, decommissioning and closure of any facility for the long term storage or disposal of radioactive waste, including facilities managing radioactive waste for this purpose. Article 30 defines the requirements for release of regulatory control and defines general clearance criteria. It is worth noting that this graded approach to regulatory control now consistently applies also to practices involving naturally-occurring radioactive material (NORM) and leading to exposure of workers or members of the public which cannot be disregarded from a radiation protection point of view.

The directive clearly defines the responsibilities of an undertaking or an employer for the radiation protection of their workers, including emergency workers, and provides for detailed requirements on the radiation protection programme for workers. The operational protection of exposed workers[87] is based on:

- prior evaluation to identify the nature and magnitude of the radiological risk to exposed workers;
- optimisation of radiation protection in all working conditions;
- classification of exposed workers into different categories;
- control measures and monitoring relating to the different areas and working conditions, including individual monitoring;
- medical surveillance of workers;
- education and training of workers.

[87] Article 32.

It provides also for the protection of members of the public in normal circumstances, as well as in emergency exposure situations. The operational protection of members of the public[88] from practices subject to licencing, in normal circumstances, shall include:

- examination and approval of the proposed siting of the facility from a radiation protection point of view;
- acceptance into service of the facility subject to adequate protection being provided against any exposure or radioactive contamination liable to extend beyond the perimeter of the facility or radioactive contamination liable to extend to the ground beneath the facility;
- examination and approval of plans for the discharge of radioactive effluents;
- measures to control the access of members of the public to the facility.

For practices where a discharge authorisation is granted, the radioactive discharges into the environment need to be monitored and reported. Further to this, the BSS Directive requires the estimation of doses to members of the public from authorised practices, and the set-up of an environmental monitoring programme.

The directive requires that Member States shall establish an adequate legislative and administrative framework ensuring the provision of appropriate radiation protection education, training and information to all individuals whose tasks require specific competences in radiation protection. In addition, it contains detailed requirements for radiation protection education, training and information of workers, including emergency workers, and members of the public.

Member States ***were required to*** transpose the BSS Directive[89] in their national legal order by 6 February 2018. ***During the pre-transposition phase,*** the Commission organised seven workshops to discuss with Members States various aspects of the BSS Directive in view of its transposition, some of which have been attended by civil society representatives. ***The Commission is currently assessing the compliance of national transposition measures with the various requirements of the BSS Directive.***

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88 Article 65.

89 The text of the directive is available at: http://ec.europa.eu/energy/nuclear/radiation_protection/radiation_protection_en.htm

Council Regulation 2013/1368/Euratom[90] and Council Regulation 2013/1369/EU[91]

Upon accession, Bulgaria, Lithuania and Slovakia committed to close down and subsequently decommission eight older Soviet design nuclear power units before the end of their scheduled operational lifetime. The EU agreed to assist financially the decommissioning of the concerned power reactors, as follows:

- Kozloduy units 1 to 4 in Bulgaria;
- Ignalina units 1 and 2 in Lithuania; and
- Bohunice V1 units 1 and 2 in Slovakia.

The EU assistance was implemented in distinct periods:

1) Pre-accession period through the PHARE programme,[92]
2) Post–accession under the Protocols to the relevant Acts of Accession,[93,94,95]
3) Extension until 2013 as per relevant Council Regulations,[96,97,98]
4) ***Period 2014-2020 as provided for by Council Regulations 2013/1368/Euratom and 2013/1369/EU.***

For the next Multiannual Financial Framework (2021-2027), the Commission has adopted two proposals[99] for continued support for decommissioning activities in Bulgaria, Slovakia and Lithuania. The Council is expected to adopt in 2020 new Regulations based on those proposals.

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90 Council Regulation (Euratom) No 1368/2013 of 13 December 2013 on Union support for the nuclear decommissioning assistance programmes in Bulgaria and Slovakia, and repealing Regulations (Euratom) No 549/2007 and (Euratom) No 647/2010, OJ L 346, 20.12.2013 and OJ L8, 11.1.2014, p.31.

91 Council Regulation (Euratom) No 1369/2013 of 13 December 2013 on Union support for the nuclear decommissioning assistance programme in Lithuania, and repealing Regulation (EC) No 1990/2006, OJ L 346, 20.12.2013, p. 7–11 and OJ L8, 11.1.2014, p.30 & OJ L121, 24.4.2014, p.59.

92 Programme of aid to central and east European countries

93 OJ L236, 23.9.2003, p.33 and p.944

94 OJ L236, 23.9.2003, p.33 and p.954

95 OJ L157, 21.6.2005, p.11 and p.38

96 OJ L 411, 30.12.2006, p.10

97 OJ L 131, 23.5.2007, p.1

98 OJ L 189, 22.7.2010, p.9

99 COM(2018) 466 and COM(2018) 467.

The scope of the nuclear decommissioning assistance programmes is and will remain to assist the relevant Member States in implementing the steady process towards the decommissioning end-state whilst ensuring that the highest safety standards are applied.

In all three cases, the end-state is defined as brownfield: the equipment in nuclear reactor buildings will be dismantled as well as those auxiliary buildings that are not intended for re-use; near-surface repositories will be built or upgraded to dispose of low and intermediate level radioactive waste from decommissioning; and interim storage facilities will be commissioned for spent fuel and radioactive waste that cannot be disposed of in near-surface repositories. ***The disposal of spent fuel and radioactive waste is not part of the scope of the nuclear decommissioning assistance programmes. It is being*** developed by each Member State in its national programme for the management of spent fuel and radioactive waste as required by the relevant Council Directive 2011/70/Euratom.

E.1.3 Soft law[100]

Also, the following (non-binding) Recommendations relate with the management of spent fuel and radioactive waste:

– Commission Recommendation of 15 September 1999 on a classification system for solid radioactive waste (SEC(1999) 1302 final)[101].

[100] EU and Euratom non-binding acts are often called "soft law". Such acts include recommendations, as well as opinions, which, as it is expressly provided in Article 288 TFEU, "have no binding force". However, while this precludes soft law measures from having legally binding effect on the national legal order, it does not immunize them from the judicial process. It is, for example, open to a national court to make a reference to the Court of Justice of the EU concerning the interpretation or validity of a measure of that kind. Moreover, soft law instruments are useful for developing Community policy.

[101] OJ L 265, 13.10.1999, p. 37–45.

– Commission Recommendation of 24 October 2006 on the management of the financial resources for the decommissioning of nuclear installations, spent fuel and radioactive waste[102]. The focus lies on the adequacy of funding, its financial security and the transparency in its use, ensuring that the funds are only used for the intended purposes;

– The standard document for shipment of spent fuel and radioactive waste and its corrigendum[103].

– Commission Recommendation 2008/956/Euratom of 4 December 2008 on the criteria for the export of radioactive waste and spent fuel to third countries[104]. The Recommendation clarifies the main requirements relating to the export of radioactive waste or spent fuel to third countries, referred to in Article 16(1)(c) of Directive 2006/117, as well as the criteria which Member States should take into consideration in order to evaluate whether the above requirements are met;

– Commission Recommendation (2010/635/Euratom) on the application of Article 37 of the Treaty[105]. Article 37 requires Member States to provide the Commission with general data relating to any plan for the disposal of radioactive waste; thereupon, the Commission delivers an opinion with regard to the plan concerned[106]. The 'disposal of radioactive waste' within the meaning of Article 37 actually covers any planned or accidental release of radioactive substances in gaseous, liquid or solid form into the environment.

102 OJ L 330, 28.11.2006, p.31.
103 OJ L 343, 23.12.2011, p. 149.
104 OJ L 338, 17.12.2008, p. 69.
105 OJ L 279, 23.10.2010, pp. 36-67.
106 See also Sections E.2, F.1, F.4.1 and G-H.2, below.

E.2 IMPLEMENTING MEASURES (ARTICLE 18 OF THE JOINT CONVENTION)

ARTICLE 18. IMPLEMENTING MEASURES

Each Contracting Party shall take, within the framework of its national law, the legislative, regulatory and administrative measures and other steps necessary for implementing its obligations under this Convention.

The obligations under the Joint Convention are reflected in the requirement under the Euratom Treaty to implement the basic safety standards provided for in its Articles 30 et seq. (Title II, Chapter 3, of the Euratom Treaty) and related secondary law. More specifically:

- Elaboration of basic safety standards relevant to radiation protection is a task conferred to Euratom by the aforementioned Articles 2(b), 30 and 31 of the Treaty. It is restated that Article 2(b) empowers the Community to establish uniform safety standards for the protection of the health of workers and the general public and to ensure that they are applied, while Article 30 elucidates this general empowerment by stipulating: "*Basic standards shall be laid down within the Community for the protection of the health of workers and the general public against the dangers arising from ionising radiations. The expression 'basic standards' means: (a) maximum permissible doses compatible with adequate safety; (b) maximum permissible levels of exposure and contamination; (c) the fundamental principles governing the health surveillance of workers*".

- Article 31 is specifically concerned with the procedure, which is required for the adoption of such uniform basic standards. It provides: "*The basic standards shall be worked out by the Commission after it has obtained the opinion of a group of persons appointed by the Scientific and Technical Committee from among scientific experts, and in particular public health experts, in the Member States. The Commission shall obtain the opinion of the Economic and Social Committee on these basic standards. After consulting the European Parliament the Council shall, on a proposal from the Commission, which shall forward to it the opinions obtained from these Committees, establish the basic standards; the Council shall act by a qualified majority*".

- Article 32 makes express provision for the possibility to revise or supplement the basic standards which have already been adopted, specifying that "*At the request of the Commission or of a Member State, the basic standards may be revised or supplemented, in accordance with the procedure laid down in Article 31*".

To ensure that the basic safety standards are properly incorporated into the legal systems of the Member States, Article 33 of the Treaty provides: "*Each Member State shall lay down the appropriate provisions, whether by legislation, regulation or administrative action, to ensure compliance with the basic standards which have been established and shall take the necessary measures with regard to teaching, education and vocational training. The Commission shall make appropriate recommendations for harmonising the provisions applicable in this field in the Member States. To this end, the Member States shall communicate to the Commission the provisions applicable at the date of entry into force of this Treaty and any subsequent draft provisions of the same kind. Any recommendations the Commission may wish to issue with regard to such draft provisions shall be made within three months of the date on which such draft provisions are communicated*". Thus, Member States are under an obligation to lay down the appropriate provisions to ensure compliance with the basic standards adopted by the Community and to communicate those provisions to the Commission.

Moreover, with regard to Euratom health and safety measures, there are additional provisions in Title II, Chapter 3, of the Euratom Treaty ensuring monitoring by the Commission. Reference is made here below to the following provisions of the Treaty:

- *"Any Member State in whose territories particularly dangerous experiments are to take place shall take additional health and safety measures, on which it shall first obtain the opinion of the Commission. The assent of the Commission shall be required where the effects of such experiments are liable to affect the territories of other Member States" (Article 34).*

- *"Each Member State shall establish the facilities necessary to carry out continuous monitoring of the level of radioactivity in the air, water and soil and to ensure compliance with the basic standards. The Commission shall have the right of access to such facilities; it may verify their operation and efficiency" (Article 35).*

- *"The appropriate authorities shall periodically communicate information on the checks referred to in Article 35 to the Commission so that it is kept informed of the level of radioactivity to which the public is exposed" (Article 36).*

- *“Each Member State shall provide the Commission with such general data relating to any plan for the disposal of radioactive waste in whatever form will make it possible to determine whether the implementation of such plan is liable to result in the radioactive contamination of the water, soil or airspace of another Member State.*
  The Commission shall deliver its opinion within six months, after consulting the group of experts referred to in Article 31” (Article 37).

- *"The Commission shall make recommendations to the Member States with regard to the level of radioactivity in the air, water and soil. In cases of urgency, the Commission shall issue a directive requiring the Member State concerned to take, within a period laid down by the Commission, all necessary measures to prevent infringement of the basic standards and to ensure compliance with regulations. Should the State in question fail to comply with the Commission directive within the period laid down, the Commission or any Member State concerned may forthwith, by way of derogation from Articles 258 and 259 of the Treaty on the Functioning of the European Union, bring the matter before the Court of Justice" (Article 38).*

Furthermore, the Treaties guarantee that Euratom possesses the necessary enforcement mechanisms to ensure that Community binding acts are complied with by the Member States. To this end, the Court of Justice of the EU is entrusted with an important role[107]: this Court, which includes the Court of Justice, the General Court and specialised courts[108], ensures that the law is observed in the interpretation and application of the TEU, the TFEU and the Euratom Treaty, as well as of secondary law adopted by the institutions. The Court of Justice has competence, inter alia, over actions brought against Member States for failure to fulfil their obligations, references for a preliminary ruling and appeals against decisions of the General Court. It most commonly adjudicates on matters of interpretation of the Treaties or of secondary law, raised by:

- claims by the Commission that a Member State has not implemented a Euratom or EU directive or other binding legal requirement, in the framework of an infringement procedure[109].

- references from national courts of the Member States, asking the Court of Justice questions about the meaning or validity of a particular piece of Euratom or EU law[110]. The Court gives its ruling on the interpretation of the law, which is binding on the national court.

Council Directive 2011/70/Euratom also comes within the ambit of the above legal mechanisms, which ensure compliance of national laws with binding Community rules.

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107 Article 19 TEU and Articles 251 to 281 TFEU.

108 According to Article 19(1) TEU: "The Court of Justice of the European Union shall include the Court of Justice, the General Court and specialised courts…".

109 Articles 19 TEU and 258 TFEU, in conjunction with Article 106a of the Euratom Treaty.

110 Articles 19 TEU and 267 TFEU, in conjunction with Article 106a of the Euratom Treaty.

Section F

OTHER GENERAL SAFETY PROVISIONS

(Articles 21, 24, 25 and 26 of the Joint Convention)

F.1 RESPONSIBILITY OF THE LICENCE HOLDER (ARTICLE 21 OF THE JOINT CONVENTION)

ARTICLE 21. RESPONSIBILITY OF THE LICENCE HOLDER

1. Each Contracting Party shall ensure that prime responsibility for the safety of spent fuel or radioactive waste management rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.

2. If there is no such licence holder or other responsible party, the responsibility rests with the Contracting Party which has jurisdiction over the spent fuel or over the radioactive waste.

The Commission is involved in the licencing process for radioactive waste management under Article 37 of the Treaty, which states: "*Each Member State shall provide the Commission with such general data relating to any plan for the disposal of radioactive waste in whatever form as will make it possible to determine whether the implementation of such plan is liable to result in the radioactive contamination of the water, soil or airspace of another Member State. The Commission shall deliver its opinion within six months…*". The 'disposal of radioactive waste' within the meaning of Article 37 covers any planned or accidental release of radioactive substances in gaseous, liquid or solid form into the environment in line with Article 1 of Commission Recommendation 2010/635/Euratom and should not be confused with the concept of disposal as in emplacement of spent fuel and/or radioactive waste in a facility without the intention of retrieval ***(although this latter concept is covered by the aforementioned recommendation under its point 1.(10)).*** The licence cannot be granted at national level, before the Commission's opinion is delivered.

The principle of responsibility of the licence holder, incorporated in the IAEA Fundamental Safety Principle 1, is fully endorsed by Council Directive 2011/70/Euratom (Article 7)[111]. The directive requires Member States to ensure that the prime responsibility for the safety of spent fuel and radioactive waste management facilities and/or activities rests with the licence holder and cannot be delegated.

Member States reported their measures to ensure that the primary responsibility for spent fuel and radioactive waste management rests with the license holder, as called for in Article 7(1) of Council Directive 2011/70/Euratom.

Council Directive 2011/70/Euratom provides further that each Member State has ultimate responsibility for the management of spent fuel and radioactive waste generated in it, in accordance with the IAEA Fundamental Safety Principle 2. Where radioactive waste or spent fuel is shipped for processing or reprocessing to a Member State or a third country, the ultimate responsibility for the safe and responsible disposal of those materials, including any waste as a by-product, remains with the Member State or third country from which the radioactive material was shipped.

F.2 OPERATIONAL RADIATION PROTECTION (ARTICLE 24 OF THE JOINT CONVENTION)

ARTICLE 24. OPERATIONAL RADIATION PROTECTION

1. Each Contracting Party shall take the appropriate steps to ensure that during the operating lifetime of a spent fuel or radioactive waste management facility:

(i) the radiation exposure of the workers and the public caused by the facility shall be kept as low as reasonably achievable, economic and social factors being taken into account;

(ii) no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection; and

(iii) measures are taken to prevent unplanned and uncontrolled releases of radioactive materials into the environment.

2. Each Contracting Party shall take appropriate steps to ensure that discharges shall be limited:

(i) to keep exposure to radiation as low as reasonably achievable, economic and social factors being taken into account; and

[111] As well as by the BSS Directive (Article 29).

(ii) so that no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection.

3. Each Contracting Party shall take appropriate steps to ensure that during the operating lifetime of a regulated nuclear facility, in the event that an unplanned or uncontrolled release of radioactive materials into the environment occurs, appropriate corrective measures are implemented to control the release and mitigate its effects.

As already noted, Title I, Article 2(b), of the Treaty requires Euratom to establish uniform safety standards to protect the health of workers and of the general public and ensure that they are applied. Hence, Title II, Chapter 3, of the Treaty, empowers the Community to lay down basic standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation.

The current safety standards with regard to radiation protection are set out in ***the BSS Directive. The BSS Directive explicitly lays down a system of radiation protection based on the principles of justification, optimisation and dose limitation. The justification principle requires that decisions introducing or altering the radiation exposure of an individual shall be justified in the sense that the individual or societal benefit resulting from the practice outweighs the health detriment that it may cause. The optimisation principle requires that radiation protection of individuals subject to public or occupational exposure shall be optimised with the aim of keeping the magnitude of individual doses, the likelihood of exposure and the number of individuals exposed as low as reasonably achievable, economic and societal factors taken into account. To further emphasise the importance of optimisation, the Directive promotes the introduction of dose constraints and reference levels for the purpose of optimisation of protection. Dose limits are established for occupational exposure and for public exposure (20 mSv per year for occupational exposure and 1 mSv per year for public exposure).***

As requested by the national regulations, the operational radiation protection of staff, the public, the environment and the nuclear safety of the JRC nuclear installations are ensured by dedicated services and experts. The organisational structure differs between the sites:

- at JRC-Geel the Health Physics Service (HPS) is managed by a qualified radiation safety expert ("Hoofd Fysische Controle") and is part of ***the Standards for Nuclear Safety, Security and Safeguards Unit (G.2);***

- at JRC-Karlsruhe the Site Management and Radiation Protection Unit ***(G.1)*** is managed by a qualified radiation protection expert ("Strahlungschutzbeauftragter");

- at JRC-Ispra the radiation protection service and the licensing & operation service are both integrated in the Nuclear Decommissioning unit ***(G.III.9)***, supported by two qualified radiation protection experts ("esperto qualificato") from the Safety and Security unit ***(R.I.4)***;

- ***at JRC-Petten there is a qualified radiation protection officer ("Stralingsdeskundige") of the Nuclear Reactor Safety and Emergency Preparedness Unit (G.I.), working in close cooperation with the safety, environment and security sector of JRC-Petten (Unit F.1).***

The JRC has also nominated a Radiation Safety Coordinator to support the continuous improvement of the safety culture on the JRC nuclear sites and to stimulate a corporate approach. The role of this coordinator is complementary to the legal duties of the on-site radiation and nuclear safety responsible ***persons*** and experts as required in the national regulations.

F.3 EMERGENCY PREPAREDNESS (ARTICLE 25 OF THE JOINT CONVENTION)

ARTICLE 25. EMERGENCY PREPAREDNESS

1. Each Contracting Party shall ensure that before and during operation of a spent fuel or radioactive waste management facility there are appropriate on-site and, if necessary, off-site emergency plans. Such emergency plans should be tested at an appropriate frequency.

2. Each Contracting Party shall take the appropriate steps for the preparation and testing of emergency plans for its territory insofar as it is likely to be affected in the event of a radiological emergency at a spent fuel or radioactive waste management facility in the vicinity of its territory.

General remarks

The primary responsibility of protecting the general public in the event of a nuclear or radiological emergency lies with the Member States' authorities. However, Euratom has some legislative competences regarding emergency preparedness and emergency response. Articles 30 to 32 of the Euratom Treaty confer on Euratom the competence to lay down basic standards, ***which includes the power to require Member States to put in place an emergency management system establishing emergency preparedness and response arrangements both on-site and off-site***[112]. At the international level, this competence of Euratom in the area of emergency preparedness is reflected in the accession of Euratom to the Convention on Early Notification of a Nuclear Accident[113] and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency[114]. The Commission contributes to these actions by initiating and participating in international systems for radiological emergency preparedness.

In light of the above, Article 97 of the BSS Directive stipulates that Member States shall ensure that account is taken of the fact that emergencies may occur on their territory and that they may be affected by emergencies occurring outside their territory. Member States shall establish an emergency management system and adequate administrative provisions to maintain such a system. Article 98 of the BSS Directive requires that emergency response plans are established in advance for the various types of emergencies identified by an assessment of potential emergency exposure situations and that these emergency response plans are tested, reviewed and, as appropriate, revised at regular intervals, taking into account lessons learned from past emergency exposure situations and the results of the participation in emergency exercises at national and international level. Undertakings are requested to notify the competent authority immediately of any emergency in relation to the practices for which it is responsible and to take all appropriate action to mitigate the consequences. Further requirements concern the protective measures to be taken. In addition, the directive requires prior information provision to the members of the public likely to be affected by an emergency, as well as an information provision to the affected members of the public in the event of an emergency.

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112 See Article 8d of the amended NSD and Articles 97-98 of the BSS Directive.
113 OJ L 314, 30.11.2005, p. 22.
114 OJ L 314, 30.11.2005, p. 28.

The European Community Urgent Radiological Information Exchange (ECURIE)

Council Decision 87/600/Euratom[115] outlines the requirements for the early exchange of information in the event of a radiological emergency (ECURIE). The resulting arrangements cover Euratom Member States, Switzerland, Norway, ***North Macedonia and Montenegro***, and "*apply to the notification and provision of information whenever a Member State decides to take measures of a wide-spread nature in order to protect the general public in case of a radiological emergency*" (Article 1). A radiological emergency may be declared either due to an accident at a facility where a significant release of radioactive material occurs or is likely to occur, or due to detection of abnormal levels of radioactivity which are likely to be detrimental to public health. Article 2(i) of the decision sets out the actions to be taken by the Member State that initially decides to take measures, as follows: (a) forthwith notify the Commission and those Member States which are - or are likely to be - affected of such measures and the reasons for taking them; (b) promptly provide the Commission and those Member States which are - or are likely to be - affected with available information relevant to minimising the foreseen radiological consequences, if any, in those States. The decision also specifies the nature of the information which shall be provided and requires that the initial information is supplemented at appropriate intervals. The Commission forwards the information it receives from a Member State to all Member States.

[115] Decision 87/600/Euratom of 14 December 1987 on Community arrangements for the early exchange of information in the event of a radiological emergency, OJ L 371, 30.12.1987, p. 76.

ECURIE is a 24h emergency notification and information exchange system. The system notifies the competent authorities of the participating states and the Commission in case of a major nuclear accident or radiological emergency. During an emergency, the system provides an information exchange platform for the participating States, in order to inform about the current and foreseeable status of the accident, meteorological conditions, national protective actions, etc. The legal basis for the participation of Euratom Member States in ECURIE is the aforementioned Council Decision 87/600/Euratom and the Agreement between Euratom and non-Member States on the participation of the latter in the Community arrangements for the early exchange of information in the event of a radiological emergency[116]. The Commission is responsible for ECURIE management and development[117]and the practical arrangements for the exchange of information under ECURIE are reviewed and agreed with the Competent Authorities at their biennial meetings.

New Council Regulation establishing maximum permitted levels of radioactive contamination of food and feed following a nuclear accident or any other radiological emergency

Following the nuclear accidents of Chernobyl in 1986 and of Fukushima in 2011, specific EU Regulations on import conditions into the EU of agricultural products, food and feed were put in place. On the basis of the experience gained, the Commission proposed to the Council in 2014 a revision of the existing legislation establishing maximum permitted levels of radioactive contamination of food and feed following a nuclear accident or any other radiological emergency.

116 OJ C 102 of 29.04.2003, p. 2.
117 For more details on the ECURIE system, see at: http://rem.jrc.ec.europa.eu/40.html

Council Regulation (Euratom) 2016/52 laying down maximum permitted levels of radioactive contamination of food and feed following a nuclear accident or any other case of radiological emergency[118] (OJ L13, 15.01.2016) was adopted on 15 January 2016. With the adoption of the Regulation, the relevant existing legislation was consolidated, new procedures for the exercise of implementing powers by the Commission were set out and more flexible procedures were provided, allowing specific reactions to any nuclear accident or radiological emergency in the EU, in the vicinity of the EU or in a remote country.

It should be noted that the pre-established maximum permitted levels remain unchanged and can be made immediately applicable through the adoption of a regulation by the Commission.

The European Radiological Data Exchange Platform (EURDEP)

The European Commission has complemented ECURIE with the European Radiological Data Exchange Platform (EURDEP), a web-based platform for the exchange of radiological monitoring data between participating countries almost in real-time. Monitoring information is collected from automatic surveillance systems in 39 countries. EU Member States participation is based on the Council Decision 87/600/Euratom on ECURIE, while non-EU countries participate on a voluntary basis. Those countries that send their national radiological monitoring data have access to the data of all the other participating countries. The system is continuously operating with a daily data exchange routine and on the basis of an administrative arrangement it is expected that participating in the system automatically means that the data transmissions will continue during a radiological or nuclear emergency in which case the data must be available at the right time and in sufficient quantities. A freely accessible version of the website allows the public to view graphical information on radioactivity levels over the EURDEP area.

[118] Council Regulation (Euratom) 2016/52 of 15 January 2016 laying down maximum permitted levels of radioactive contamination of food and feed following a nuclear accident or any other case of radiological emergency, and repealing Regulation (Euratom) No 3954/87 and Commission Regulations (Euratom) No 944/89 and (Euratom) No 770/90, Official Journal L 13, 20.1.2016, pages 2–11).

In 2010, the Commission concluded a Memorandum of Understanding ***(MoU)*** with the IAEA concerning the EURDEP-system. This Memorandum makes EURDEP technology available for the IAEA, for the purpose of creating a global on-line environmental radiation data exchange application. ***While the Commission followed through on its obligations and supported the establishment of the IAEA's International Radiation Monitoring Information System (IRMIS) and indeed established data transmission from EURDEP, the IAEA did not configure its system according to the terms of the MoU and there is currently no reciprocal data transmission from the IAEA.***

Inter-Agency Committee on Response to Nuclear Emergencies (IACRNE)

Further, the Commission participates in the IACRNE and via this mechanism deals with other international organisations on arrangements in the area of radiological emergency preparedness. Other radiological emergency preparedness activities of the Commission include training of national authorities on ECURIE related issues, assistance to research activity coordination and regular preparedness exercises.

Emergency Preparedness at JRC nuclear sites

On the four sites of the Joint Research Centre (Ispra, Karlsruhe, Geel and Petten) where nuclear research and decommissioning activities are performed, internal emergency plans are in place in conformity with the requirements of the national legislation and the competent authorities. As the sites of Karlsruhe and Petten are integrated in national research centres, the plans are also directly linked to the emergency plans of these national sites. ***Emergency drills*** are organised regularly in compliance with the national requirements.

F.4 DECOMMISSIONING (ARTICLE 26 OF THE JOINT CONVENTION)

ARTICLE 26. DECOMMISSIONING

Each Contracting Party shall take the appropriate steps to ensure the safety of decommissioning of a nuclear facility. Such steps shall ensure that:

(i) qualified staff and adequate financial resources are available;

(ii) the provisions of Article 24 with respect to operational radiation protection, discharges and unplanned and uncontrolled releases are applied;

(iii) the provisions of Article 25 with respect to emergency preparedness are applied; and

(iv) records of information important to decommissioning are kept.

F.4.1 Implementing legislation

The EU legislation applying to decommissioning of nuclear and any other facility using radioactive material is the Euratom Treaty, and Council Directives 2013/59/Euratom, 2011/70/Euratom and 2014/87/Euratom. When shipment of radioactive waste is involved, Directive 2006/117/Euratom also applies.

Under the BSS Directive decommissioning of nuclear installations is subject to ***licensing***[119]. This ***licensing*** relates specifically not only to the disposal of radioactive waste from decommissioning, but also to conventional disposal of residues from dismantling with very low levels of contamination, or recycling or reuse thereof (e.g. in foundries). However, such materials may be released from the requirements of the BSS Directive as per its Article 30, provided they comply with the clearance levels established either by Table A of Annex VII or by national legislation or the national competent authority following exemption and the criteria set out in Annex VII and taking into account technical guidance provided by the Community. Such guidance has been provided by the Group of Experts established under Article 31 of the Euratom Treaty.

Until now, specific clearance levels for the recycling of metals, buildings and building rubble, as well as default values (general clearance levels) for any other type of material, were made available to Member States as guidance. Some Member States have incorporated these values into their legislation; others apply them on an ad hoc basis or apply values calculated specifically for the disposal or recycling pathways relevant to national practice. With the BSS directive, generic clearance levels are prescribed although specific levels and associated requirements for specific materials or for materials originating from specific types of activities can still be established at national level.

[119] See Article 28 b),

Further to the BSS Directive, decommissioning also falls within the scope of Council Directive 2011/70/Euratom with respect to management of all decommissioning waste from generation to disposal. The General Principles defined under its Article 4 require the *"generation of waste to be kept to a minimum ... by means of appropriate design measures and of operating and decommissioning practices, including the recycling and reuse of material"*. According to Article 7, the safety case as part of the licencing of a new facility shall cover inter alia the decommissioning of the facility. The national programmes to be prepared by the Member States shall cover all types of radioactive waste (including decommissioning waste) under its jurisdiction and all stages of radioactive waste management from generation to disposal (see Article 11 and 12).

The Nuclear Safety Directive also applies to the safety of decommissioning activities at ***nuclear installations***, including decommissioning of spent fuel storage facilities and of radioactive waste management facilities ***that are on the same site and are directly related to nuclear installations as defined by the Directive.***

In order to support Member States in decommissioning planning and cost assessments the Commission is assisted by the Decommissioning Funding Group; this group supported the Commission to issue a number of reports (first in 2004) related to the status of financing mechanisms in EU. The scope of work is proposed to be confirmed and the focus increased in areas such as the cost assessment and financing for managing spent fuel and radioactive waste.

General data on the dismantling of nuclear installations have to be notified by the Member States to the Commission under Article 37 of the Treaty, which has the objective to forestall any possibility of radioactive contamination of other Member State(s). Following this notification to the Commission, the latter delivers its opinion, thereupon, within six months, after consulting the Group of Experts referred to in Article 31 of the Treaty. The details concerning this procedure are dealt with by the abovementioned Commission Recommendation 2010/635/Euratom[120].

[120] OJ L 279, 23.10.2010, p. 36.

Over the period January 2015 to ***December 2019 included,*** the Commission has ***delivered 18*** opinions on the disposal of radioactive waste from the dismantling/decommissioning of nuclear installations

- Isar KKI,	1 Boiling Water Reactor (BWR)	DE;
- Phénix	1 Fast Breeder Reactor (FBR)	FR;
- Bohunice A-1		SK;
- La Hague UP2-40		FR;
- Biblis KWB		DE;
- Brunsbüttel KKB	1 BWR	DE;
- Kozloduy units 3+4	2 Pressurised Water Reactor (VVER)	BG;
- Barsebäck 1st stage	2 BWR	SE;
- Philippsburg KKP-1	1 BWR	DE;
- Neckarwestheim GKN-1	1 Pressurised Water Reactor (PWR)	DE;
- Unterweser KKU	1 PWR	DE;
- ***Oskarshamn***	***2 BWR***	***SE;***
- ***Grafenrheinfeld KKG***	***1 PWR***	***DE;***
- ***Gundremmingen KRB-2***	***2 BWR***	***DE;***
- ***Ignalina Unit-1***	***1 RBMK***	***LT;***
- ***Philippsburg KKP-2***	***1 PWR***	***DE;***
- ***Barsebäck 2nd stage***	***2 BWR***	***SE;***
- ***Agesta***	***1 PHWR***	***SE.***

F.4.2 Qualified staff and adequate financial resources

Education and training

With respect to qualified staff, Council Directive 2011/70/Euratom provides that the national framework in place requires all parties to make arrangements for education and training for their staff, in order to further develop necessary expertise and skills, in accordance with the IAEA Fundamental Safety Principles 1, 2 and 3.

It is a key-concern, not only for decommissioning and waste management but of policy makers, regulators and industry in general, that human resources could be at risk, especially because of high retirement expectations in countries with nuclear installations, and a lack of ***pre-existing nuclear experience in countries that would start a nuclear programme***. Highly qualified people are needed over a long time period to safely operate installations, build new facilities, decommission facilities as well as manage radioactive waste and deal with radiation protection issues. For that reason, broad and deeply rooted research and training programmes, at both national and international level, are essential for the proper mastering of the many disciplines used in the nuclear ***industry*** and for the strengthening of the nuclear safety culture.

While the majority of Member States have legal requirements in place to ensure the training and education of staff of all parties involved in spent fuel and radioactive waste management, in line with Article 8 of the Council Directive 2011/70/Euratom, the Commission asked around one third of Member States to improve their legislation on this issue. The Commission notes that in general, these requirements are better defined, and their implementation is better reported upon, for regulatory authorities than for other stakeholders and licensees.

The overall approach of JRC regarding staffing for the implementation of the D&WM Programme is based on the concept of the JRC as awarding authority, managing and maintaining control of the decommissioning and waste management activities and maximising the use of experienced contractors, when feasible from a technical, managerial and legal viewpoint. A staffing policy has been drawn up, indicating the evolution of profiles and competences as the programme develops. Moreover, major long-term contracts for assistance in managing the various projects have been put in place.

To be mentioned in this context are the JRC's education and training activities. In collaboration with relevant European and international partners, JRC's education and training activities are based on educational and training tracks in the fields of nuclear security and safety, nuclear safeguards, nuclear materials and fuel cycle, nuclear decommissioning and waste management, nuclear data and actinide science. JRC education and training activities cover higher academic education through grants for PhD students; vocational training through specific JRC courses; user facility (access to infrastructure); and knowledge management. In the specific area of decommissioning, JRC and its partners have launched the initiative ELINDER which aims at creating a European "pool of training initiatives" offering a series of courses, visits and practical studies in different locations across Europe. ***Training is organised*** in complementing modules, reducing redundancies, developing commonly shared tools and harmonizing the learning outcomes through the application of the European Credit System for Vocational Education and Training (ECVET). The initiative is also seeking to offer an EU "quality label" or "endorsement" to those initiatives contributing to qualitative competence building in decommissioning and waste management. ***This initiative now encompasses the longer standing Decommissioning and Waste Management summer school in JRC-Ispra, which celebrated its 11th edition in 2019.***

Aspects relating to financial resources

Nuclear decommissioning is the final step in the lifecycle of a nuclear installation which requires a long term financial planning. The number of nuclear power plants in the EU (as well as research reactors and other nuclear fuel cycle installations) that are definitively closed and undergoing decommissioning is steadily increasing. ***In the EU, 63 nuclear power reactors are in decommissioning and 85% of the 109 operating nuclear power reactors are older than 30 years,*** which underlines the increasing importance of decommissioning in the years ahead.

To assure safe decommissioning of nuclear installations and the related management of waste it is vital to have adequate financial resources available in time for its intended use. ***According to the latest information collected by the Commission,[121] nuclear operators in the EU estimated that EUR 65 billion will be needed for nuclear decommissioning until 2060.***

According to Council Directive 2011/70/Euratom, the costs for the management of spent fuel and radioactive waste shall be borne by those who generated those materials (in accordance with the IAEA Fundamental Safety Principle 1)**.** Member States shall ensure that the national frameworks require that adequate financial resources be available when needed for implementation of their national programmes for the management of spent fuel and radioactive waste, taking due account of the responsibility of spent fuel and radioactive waste generators. The financing scheme(s) for spent fuel and radioactive waste management are mandatory elements of the national frameworks and programmes.

Article 12(1)(h) of the Directive 2011/70/Euratom requires Member States to present an assessment of the national programme costs, basis and profile over time. ***Based on the updated data from about a third of Member States, reported until March 2019, the Commission provided, in its second report on the implementation of the Directive (COM(2019)632), a new estimate in the range of EUR 422 - 566 billion for the total cost of spent fuel and radioactive waste management in the EU[122]. Until the timing of the costs is clearer in all Member States, allowing for a time value adjustment of the costs, these figures should however be taken as preliminary. The Commission has undertaken several initiatives, including through the Decommissioning Funding Group and the collaboration with international organisations, to improve the understanding of financial issues related to nuclear decommissioning and management of spent fuel and radioactive waste. In this regard, the Commission published in 2019 a study on the risk profile of the funds allocated to finance the back-end activities of the nuclear fuel cycle. Two more studies aiming at benchmarking of development of spent fuel and radioactive waste inventory, and on the review of cost estimates for spent fuel and radioactive waste management in the context of the Member States national programmes were finalised in 2020.***

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[121] Study on market for decommissioning nuclear facilities in the European Union, EU publication, 2019 https://op.europa.eu/en/publication-detail/-/publication/2bf03904-ebf1-11e9-9c4e-01aa75ed71a1

[122] The previous estimate made by the Commission on the basis of data reported by Member States until September 2016 was about EUR 400 billion.

The Commission has adopted in 2006 Recommendation 2006/851/Euratom[123] on the management of financial resources for the decommissioning of nuclear installations, spent fuel and radioactive waste.

Then, in 2007, the second report[124] on the use of financial resources earmarked for the decommissioning of nuclear installations, spent fuel and radioactive waste was adopted comparing EU nuclear operators and Member States funding practice with that detailed in the Commission's Recommendation (of 2006). Whereas the first report of 2004 was limited to power reactors, the second report covers all nuclear installations with an emphasis being placed on those which are at greatest risk, should decommissioning funding be inadequately addressed. The report highlights examples of good practice in countries where the polluter-pays-principle is enshrined in national legislation and where funds show a demonstrable performance from the viewpoint of providing adequate resources when needed. Nevertheless, despite specific national legislation, there are grounds for progress in several aspects of fund adequacy, management and use, in particular through detailed monitoring and reporting at both national and EU level.

The Commission expressed its intention to focus on the adequacy of funding, its financial security and the ring fencing that is required in order to ensure that the funds are only used for the purposes intended.

For future nuclear constructions a common approach to methodology should be progressed, but for currently operating systems the Commission's activities need to be based upon independent evaluation and reporting.

Following the adoption of the Commissions' second report in 2007, the third report on the use of financial resources earmarked for the decommissioning of nuclear installations, spent fuel and radioactive waste was adopted in 2013[125]. This report is based on Member States' responses to a dedicated survey. The survey was aided by specific guidance, elaborated by the Decommissioning Funding Group, as to the interpretation and implementation of the 2006 Recommendation.

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123 OJ L 330, 28.11.2006, p.31.
124 COM (2007) 794 final and SEC (2007) 1654.
125 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2013:0121:FIN:EN:PDF

Subsequently the Commission updated the survey with the support of the Decommissioning Funding Group and complemented the relevant information on financial issues related to decommissioning and waste management in the PINC.

Regarding financial resources for decommissioning, there is a specific case in which the Community has taken part in the raising of financial resources and provides financial support under the specific terms of accession of Lithuania, Slovakia and Bulgaria to the EU, where certain nuclear power reactors were subject to early shutdown as pre-condition to grant accession. Funding support is being provided until 2020 based on Council Regulation (Euratom) No 1368/2013 and Council Regulation (EU) No 1369/2013, adopted in December 2013[126]. ***Further financial assistance has been proposed for the period 2021-2027.***

JRC Decommissioning and Waste Management Programme staff and financial resources

The management of the decommissioning programme requires a specialised workforce experienced in various fields such as leading of nuclear projects, nuclear safety licensing and radiation protection. Part of the work is currently ensured by JRC staff, whereas the rest is outsourced to external companies.

Approximately 55 JRC staff currently manage the D&WM projects and ensures the safe conservation and the safe operation of the research and radioactive waste management facilities, including licensing obligations, updates of the decommissioning plans, evacuation of nuclear material, operation and maintenance, safety surveillance, administrative support, management of outsourced activities, and radiation protection of the staff and of the environment.

The staff actually dedicated to decommissioning activities in the JRC sites is complemented with the staff belonging to the companies to which decommissioning activities are outsourced. The great majority of these resources are working in the JRC-Ispra part of the Programme.

[126] OJ L 346, of 20.12.2013, p. 1 and p.7.

The budget needed for the implementation of the JRC D&WM Programme was secured with the approval of the first Communication[127] to the Parliament and the Council. The D&WM Programme is financed through a dedicated budget line. The funds are earmarked in the framework of the multi-annual financial programs of the European Commission and made available annually following a dissociated credits mechanism (commitment and payment credits).

After 1999, three further Communications[128,129,130] followed (COM 2004/621, COM 2008/903 and COM 2013/734). These documents updated the D&WM Programme progress, its status and financial perspectives.

127 Communication from the Commission to the European Parliament and the Council - Historical liabilities resulting from nuclear activities carried out at the JRC under the Euratom Treaty - Decommissioning of obsolete nuclear installations and waste management)COM (1999) 114)

128 Communication from the Commission to the Council and the European Parliament - Decommissioning of nuclear installations and waste management - Nuclear liabilities arising out of the activities of the Joint Research Centre (JRC) carried out under the Euratom Treaty (SEC(2004) 621)

129 Communication from the Commission to the Council and the European Parliament - Decommissioning of Nuclear Installations and Management of Radioactive Waste: Management of Nuclear Liabilities arising out of the Activities of the Joint Research Centre (JRC) carried out under the Euratom Treaty (COM (2008) 903)

130 Communication from the Commission to the Council and the European Parliament – Decommissioning of Nuclear Installations and Management of Radioactive Waste: Management of Nuclear Liabilities arising out of the Activities of the Joint Research Centre (JRC) carried out under the Euratom Treaty (COM (2013) 734).

Sections G and H

SAFETY OF RADIOACTIVE WASTE MANAGEMENT AND SAFETY OF SPENT FUEL MANAGEMENT

(Articles 4, 6 to 11 and 13 to 16 of the Joint Convention)

G-H.1 General safety requirements (articles 4 and 11 of the Joint Convention)

ARTICLE 4. GENERAL SAFETY REQUIREMENTS

Each Contracting Party shall take the appropriate steps to ensure that at all stages of spent fuel management, individuals, society and the environment are adequately protected against radiological hazards. In so doing, each Contracting Party shall take the appropriate steps to:

(i) ensure that criticality and removal of residual heat generated during spent fuel management are adequately addressed;

(ii) ensure that the generation of radioactive waste associated with spent fuel management is kept to the minimum practicable, consistent with the type of fuel cycle policy adopted;

(iii) take into account interdependencies among the different steps in spent fuel management;

(iv) provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards;

(v) take into account the biological, chemical and other hazards that may be associated with spent fuel management;

(vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation;

(vii) aim to *avoid* imposing undue burdens on future generations.

ARTICLE 11. GENERAL SAFETY REQUIREMENTS

Each Contracting Party shall take the appropriate steps to ensure that at all stages of radioactive waste management individuals, society and the environment are adequately protected against radiological and other hazards.

In so doing, each Contracting Party shall take the appropriate steps to:

(i) ensure that criticality and removal of residual heat generated during radioactive waste management are adequately addressed;

(ii) ensure that the generation of radioactive waste is kept to the minimum practicable;

(iii) take into account interdependencies among the different steps in radioactive waste management;
(iv) provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards;
(v) take into account the biological, chemical and other hazards that may be associated with radioactive waste management;
(vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation;
(vii) aim to *avoid* imposing undue burdens on future generations.

General safety requirements and the regulatory framework set up by the BSS Directive are reported in Section E.1.2 above.

Avoiding unduly burdening future generations is an objective of Council Directive 2011/70/Euratom, in accordance with the IAEA Fundamental Safety Principle 7. Through the implementation of this Directive Member States shall demonstrate that they have taken reasonable steps to ensure that that objective is met. The Directive requires that the national policies on spent fuel and radioactive waste management are based on the following principles, taking also into account the IAEA Fundamental Safety Principles 3 and 7:

- the generation of radioactive waste shall be kept to the minimum which is reasonably practicable, both in terms of activity and volume, by means of appropriate design measures and of operating and decommissioning practices, including the recycling and reuse of materials;

- the interdependencies between all steps in spent fuel and radioactive waste generation and management shall be taken into account;

- spent fuel and radioactive waste shall be safely managed, including in the long term with passive safety features;

- implementation of measures shall follow a graded approach;

- the costs for the management of spent fuel and radioactive waste shall be borne by those who generated those materials;

- an evidence-based and documented decision-making process shall be applied with regard to all stages of the management of spent fuel and radioactive waste.

The Directive specifies requirements for demonstration of the safety of any activity or facility for spent fuel and radioactive waste management, related in particular to the IAEA Fundamental Safety Principles 1 and 3.

Member States must, at least every ten years, invite international peer review of their national frameworks, competent regulatory authority and/or national programmes with the aim of ensuring that high standards are achieved in the safe management of spent fuel and radioactive waste. ***The outcome of any peer review has to be reported to the Member States and the Commission and may be made available to the public where there is no conflict with security and proprietary information.***

The nuclear installations at JRC sites are located in the territories of Belgium, Germany, Italy and the Netherlands, and they must comply with the safety requirements of the host Member States.

G-H.2 SITING OF PROPOSED FACILITIES (ARTICLES 6 AND 13 OF THE JOINT CONVENTION)

ARTICLE 6. SITING OF PROPOSED FACILITIES

1. Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed spent fuel management facility:

(i) to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime;

(ii) to evaluate the likely safety impact of such a facility on individuals, society and the environment;

(iii) to make information on the safety of such a facility available to members of the public;

(iv) to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.

2. In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 4.

ARTICLE 13. SITING OF PROPOSED FACILITIES

1. Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed radioactive waste management facility:

(i) to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime as well as that of a disposal facility after closure;

(ii) to evaluate the likely safety impact of such a facility on individuals, society and the environment, taking into account possible evolution of the site conditions of disposal facilities after closure;

(iii) to make information on the safety of such a facility available to members of the public;

(iv) to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.

2. In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 11.

All Member States have predisposal measures in place that differ in scope and scale. For the disposal of intermediate-level waste, high-level waste and spent fuel, the concepts for disposal are not concrete in most of the Member States, often due to the need for policy decisions to be made or sites to be selected. Of the Member States that are planning to develop geological disposal facilities in the coming decades, Finland, France and Sweden have so far selected sites, demonstrating the challenges of moving from the planning stage to practical implementation.

Another 12 Member States have plans for a deep geological repository and are at different stages of implementation ***between 2040s and 2100s, however only a few of them reported progress in site selection.***

In addition, about half of the Member States are considering the option of shared solutions for disposal. ***As of 2019, none of the Member States had reported concrete plans or activities towards the implementation of such a solution. Most Member States have forbidden by law the import of radioactive waste into their territory. A few Member States do not expect progress in development of shared disposal solutions and decided to focus primarily on development of a national disposal facility.***

Routes for disposal of very-low-level waste and low-level waste are open in most Member States with nuclear power plants. Overall, the situation of very-low-level waste and low-level waste disposal remains unchanged in comparison with the previous reporting period, with over 30 disposal facilities that have been developed in 12 Member States. About half of the Member States are planning to build new disposal facilities in the next decade. However, this remains a challenge in other Member States.

As required by Council Directive 2011/70/Euratom, siting of radioactive waste and spent fuel management facilities is subject to national licencing processes. The directive requires for a "safety demonstration" to be carried out as a part of the licencing a facility or activity in accordance with the IAEA Fundamental Safety Principles 1 and 3[131].

Similarly, Article 65 of the BSS Directive requires licensing of the proposed siting of installations by the national competent authorities. In terms of emergency preparedness (Article 99 of the BSS Directive), Member States must seek to cooperate with other Member States, or non-Member States, in relation to possible radiological emergencies that might affect other Member States. The assessment of such consequences is an important feature of the procedure under Article 37 of the Euratom Treaty. The general data on the proposed site, features of the surroundings, planned discharges and envisaged magnitude of design basis accidents, which could lead to unplanned discharges, enable the Commission to give an opinion on the ***potential*** impact on other Member States, both during normal operation and in the event of an accident. While the site location and distance to borders are important in this judgment, the Commission does not give an opinion on the proposed siting as such.

[131] See more detailed information given in Section G-H.4 below.

Also, according to Articles 41, 42 and 43 of the Treaty,

- *"Persons and undertakings engaged in the industrial activities listed in Annex II to this Treaty shall communicate to the Commission investment projects relating to new installations and also to replacements or conversions which fulfil the criteria as to type and size laid down by the Council on a proposal from the Commission…",*

- *"The projects referred to in Article 41 shall be communicated to the Commission and, for information purposes, to the Member State concerned not later than three months before the first contracts are concluded with the suppliers or, if the work is to be carried out by the undertaking with its own resources, three months before the work begins…" and*

- *"The Commission shall discuss with the persons or undertakings all aspects of investment projects which relate to the objectives of this Treaty. It shall communicate its views to the Member State concerned", respectively.*

In recent years, the Commission has expressed its views under Articles 41-43 of the Treaty:

- Olkiluoto; Encapsulation plant and geological repository of spent nuclear fuel;

- Bohunice; A1 nuclear power plant decommissioning stages;

- ***RECUMO - Recycling of Uranium from ^{99}Mo Production.***

G-H.3 DESIGN AND CONSTRUCTION OF FACILITIES (ARTICLES 7 AND 14 OF THE JOINT CONVENTION)

ARTICLE 7. DESIGN AND CONSTRUCTION OF FACILITIES

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the design and construction of a spent fuel management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases;

(ii) at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a spent fuel management facility are taken into account;

(iii) the technologies incorporated in the design and construction of a spent fuel management facility are supported by experience, testing or analysis.

ARTICLE 14. DESIGN AND CONSTRUCTION OF FACILITIES

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the design and construction of a radioactive waste management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases;

(ii) at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a radioactive waste management facility other than a disposal facility are taken into account;

(iii) at the design stage, technical provisions for the closure of a disposal facility are prepared;

(iv) the technologies incorporated in the design and construction of a radioactive waste management facility are supported by experience, testing or analysis.

The measures required by the Joint Convention concerning design, construction and operation of nuclear installations can come under the provisions which the Member States lay down to ensure compliance with the basic safety standards, adopted in accordance with the first paragraph of Article 33 of the Euratom Treaty. The Commission has powers to make recommendations for harmonising those provisions, as is clear from the second paragraph of Article 33.

With reference to the opinions delivered by the Commission under Articles 41-43 of the Euratom Treaty[132], these also take into account aspects relating to design and construction.

The first deep geological facilities are planned to be put in operation in the 2024-2035 period. The rest are mainly planned for 2050-2065. In addition to the existing five underground laboratories in 4 Member States, four more Members States are planning such laboratories for the research and development of geological disposal facilities. Several Members States are also planning to develop and operate near surface disposal facilities, and a number is considering remediation of existing sites used in the past for disposal.

[132] See Section G-H.2 above.

Pursuant to Council Directive 2011/70/Euratom, design of radioactive waste and spent fuel management facilities is included in national licencing processes. The Directive requires for a "safety demonstration" to be carried out as a part of the licencing of a facility or activity in accordance with the IAEA Fundamental Safety Principles 1 and 3[133].

G-H.4 ASSESSMENT OF SAFETY OF FACILITIES (ARTICLES 8 AND 15 OF THE JOINT CONVENTION)

ARTICLE 8. ASSESSMENT OF SAFETY OF FACILITIES

Each Contracting Party shall take the appropriate steps to ensure that:

(i) before construction of a spent fuel management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out;

(ii) before the operation of a spent fuel management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).

ARTICLE 15. ASSESSMENT OF SAFETY OF FACILITIES

Each Contracting Party shall take the appropriate steps to ensure that:

(i) before construction of a radioactive waste management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out;

(ii) in addition, before construction of a disposal facility, a systematic safety assessment and an environmental assessment for the period following closure shall be carried out and the results evaluated against the criteria established by the regulatory body;

(iii) before the operation of a radioactive waste management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).

[133] See more detailed information given in Section G-H.4, below.

In accordance with Article 33 of the Euratom Treaty, the Commission makes appropriate recommendations for harmonising the provisions applicable in this field in the Member States, and therefore requires Member States to communicate those provisions to the Commission.

As stipulated in Article 65 of the BSS Directive (Council Directive 2013/59/Euratom), all Member States shall ensure the operational protection of the population through a set of measures including for example the examination and approval of the proposed siting of the facility from a radiation protection point of view, taking into account relevant demographic, meteorological, geological, hydrological and ecological conditions.

Council Directive 2011/70/Euratom introduces the concept of "safety demonstration" (or "safety case" according to the IAEA Safety Standards). Member States shall ensure that the national framework in place requires licence holders, under the regulatory control of the competent regulatory authority, to regularly assess, verify and continuously improve, as far as is reasonably achievable, the safety of the radioactive waste and spent fuel management facility or activity in a systematic and verifiable manner. This shall be achieved through an appropriate safety assessment, other arguments and evidence.

As part of the licencing of a facility or activity, the safety demonstration shall cover the development and operation of an activity and the development (i.e. siting, design, construction and commissioning), operation and decommissioning of a facility or closure of a disposal facility as well as the post- closure phase of a disposal facility. The extent of the safety demonstration shall be commensurate with the complexity of the operation and the magnitude of the hazards associated with the radioactive waste and spent fuel, and the facility or activity. The licencing process shall contribute to safety in the facility or activity during normal operating conditions, anticipated operational occurrences and design basis accidents. It shall provide the required assurance of safety in the facility or activity. Measures shall be in place to prevent accidents and mitigate the consequences of accidents, including verification of physical barriers and the licence holder’s administrative protection procedures that would have to fail before workers and the general public would be significantly affected by ionising radiation. That approach shall identify and reduce uncertainties.

Member States shall further ensure that the national framework requires licence holders to establish and implement integrated management systems, including quality assurance, which give due priority for overall management of spent fuel and radioactive waste to safety and are regularly verified by the competent regulatory authority (cf. IAEA Fundamental Safety Principles 1 and 2).

In addition, Member States shall ensure that the national framework requires licence holders 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 (cf. IAEA Fundamental Safety Principle 1).

Moreover, based on Article 8c(a) the amended Nuclear Safety Directive: "any grant of a licence to construct a nuclear installation or operate a nuclear installation, is based upon an appropriate site and installation-specific assessment, comprising a nuclear safety demonstration…"

G-H.5 OPERATION OF FACILITIES (ARTICLES 9 AND 16 OF THE JOINT CONVENTION)

ARTICLE 9. OPERATION OF FACILITIES

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the licence to operate a spent fuel management facility is based upon appropriate assessments as specified in Article 8 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements;

(ii) operational limits and conditions derived from tests, operational experience and the assessments, as specified in Article 8, are defined and revised as necessary;

(iii) operation, maintenance, monitoring, inspection and testing of a spent fuel management facility are conducted in accordance with established procedures;

(iv) engineering and technical support in all safety-related fields are available throughout the operating lifetime of a spent fuel management facility;

(v) incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body;

(vi) programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate;

(vii) decommissioning plans for a spent fuel management facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body.

ARTICLE 16. OPERATION OF FACILITIES

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the licence to operate a radioactive waste management facility is based upon appropriate assessments as specified in Article 15 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements;

(ii) operational limits and conditions, derived from tests, operational experience and the assessments as specified in Article 15 are defined and revised as necessary;

(iii) operation, maintenance, monitoring, inspection and testing of a radioactive waste management facility are conducted in accordance with established procedures. For a disposal facility the results thus obtained shall be used to verify and to review the validity of assumptions made and to update the assessments as specified in Article 15 for the period after closure;

(iv) engineering and technical support in all safety-related fields are available throughout the operating lifetime of a radioactive waste management facility;

(v) procedures for characterization and segregation of radioactive waste are applied;

(vi) incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body;

(vii) programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate;

(viii) decommissioning plans for a radioactive waste management facility other than a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body;

(ix) plans for the closure of a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility and are reviewed by the regulatory body.

Article 35 of the Euratom Treaty requires Member States to establish the *"facilities necessary to carry out continuous monitoring of the level of radioactivity in the air, water and soil and to ensure compliance with the basic standards"* and gives the Commission the right of access to such facilities for verification purposes. Article 36 of the Treaty requires periodic communication to the Commission of the monitoring data referred to in Article 35.

The BSS Directive (Council Directive 2013/59/Euratom) states in Article 28: *"Member States shall require licencing for the (...) operation and decommissioning of any nuclear facility"*.

Equally, according to Council Directive 2011/70/Euratom, operation of facilities is subject to national licencing processes. As already noted, the directive requires for a *"safety demonstration"* to be carried out as a part of the licencing of a facility or activity[134]. Concepts or plans for the post-closure period of a disposal facility's lifetime, including the period during which appropriate controls are retained and the means to be employed to preserve knowledge of that facility in the longer term are mandatory elements of the national programmes.

G-H.6 DISPOSAL OF SPENT FUEL (ARTICLE 10 OF THE JOINT CONVENTION)

ARTICLE 10. DISPOSAL OF SPENT FUEL

If, pursuant to its own legislative and regulatory framework, a Contracting Party has designated spent fuel for disposal, the disposal of such spent fuel shall be in accordance with the obligations of Chapter 3 relating to the disposal of radioactive waste.

Council Directive 2011/70/Euratom provides for the same requirements in respect to disposal of radioactive waste and spent fuel destined for disposal if regarded as radioactive waste. It is clearly stated in the Preamble to this directive that storage of radioactive waste (including storage of spent fuel considered as radioactive waste, as well as long-term storage), is an interim solution, but not an alternative to disposal.

As mentioned earlier, Finland, France and Sweden are realising deep geological facilities to enter in operation within 5 to 15 years. Another 12 Member States have plans for a deep geological repository and are at different stages of implementation. The Members States that rely on shared disposal solutions consider this option either as a main scenario or as a back-up.

[134] See Section G-H.4 above.

Section I

TRANSBOUNDARY MOVEMENT

(Article 27 of the Joint Convention)

ARTICLE 27. TRANSBOUNDARY MOVEMENT

1. Each Contracting Party involved in transboundary movement shall take the appropriate steps to ensure that such movement is undertaken in a manner consistent with the provisions of this Convention and relevant binding international instruments. In so doing:

(i) a Contracting Party which is a State of origin shall take the appropriate steps to ensure that transboundary movement is authorized and takes place only with the prior notification and consent of the State of destination;

(ii) transboundary movement through States of transit shall be subject to those international obligations which are relevant to the particular modes of transport utilized;

(iii) a Contracting Party which is a State of destination shall consent to a transboundary movement only if it has the administrative and technical capacity, as well as the regulatory structure, needed to manage the spent fuel or the radioactive waste in a manner consistent with this Convention;

(iv) a Contracting Party which is a State of origin shall authorize a transboundary movement only if it can satisfy itself in accordance with the consent of the State of destination that the requirements of subparagraph (iii) are met prior to transboundary movement;

(v) a Contracting Party which is a State of origin shall take the appropriate steps to permit re-entry into its territory, if a transboundary movement is not or cannot be completed in conformity with this Article, unless an alternative safe arrangement can be made.

2. A Contracting Party shall not licence the shipment of its spent fuel or radioactive waste to a destination south of latitude 60 degrees South for storage or disposal.

3. Nothing in this Convention prejudices or affects:

(i) the exercise, by ships and aircraft of all States, of maritime, river and air navigation rights and freedoms, as provided for in international law;

(ii) rights of a Contracting Party to which radioactive waste is exported for processing to return, or provide for the return of, the radioactive waste and other products after treatment to the State of origin;

(iii) the right of a Contracting Party to export its spent fuel for reprocessing;

(iv) rights of a Contracting Party to which spent fuel is exported for reprocessing to return, or provide for the return of, radioactive waste and other products resulting from reprocessing operations to the State of origin.

I.1 COUNCIL DIRECTIVE 2006/117/EURATOM ON THE SUPERVISION AND CONTROL OF SHIPMENTS OF RADIOACTIVE WASTE AND SPENT FUEL

Council Directive 2006/117/Euratom of 20 November 2006 on the supervision and control of shipments of radioactive waste and spent fuel[135] replaced previous legislation[136] containing the rules applicable for authorising the movement of radioactive waste from one country to another and extended these rules to spent fuel, whether it is intended for disposal or for reprocessing, while making the rules easier to apply and more consistent with other EU and international provisions.

It lays down a standardised system of controls and authorisations for the transboundary shipments of radioactive waste and spent fuel, from the point of origin to the destination.

It applies both to shipments between Member States and to imports into and exports out of the Community. It ensures that the Member States of destination and of transit are informed about movements of radioactive waste or spent fuel to or through their country and that they have an opportunity to object to, or impose conditions, in relation to a shipment of radioactive waste or spent fuel which requires their consent.

As well, the mandatory acknowledgement of receipt of the application by the authorities of the countries of destination and transit, together with the extension of the period for granting consent, allow tacit approval to be assumed with a high degree of certainty.

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135 OJ L 337, 05.12.2006, p. 21.

136 In particular, Council Directive 92/3/Euratom of 3 February 1992, OJ L 35, 12.02.1992, p. 24.

As regards exports, the authorities of the third country of destination should be informed of a shipment, and give their consent to it. Export of radioactive waste to certain places is totally forbidden, e.g. to the Antarctic, to the parties to the Cotonou ACP[137]-EC Agreement or to States which do not have the administrative and technical capacity and regulatory structure to manage the radioactive waste or spent fuel safely.

Directive 2006/117 is fully consistent with the existing legislation for the health protection of workers and the population against the dangers arising from ionising radiation. It also ensures consistency with international Conventions, in particular with the Joint Convention.

Commission Decision 2008/312/Euratom of 5 March 2008[138] established the standard document for the supervision and control of shipments of radioactive waste and spent fuel, referred to in Article 17 of Directive 2006/117[139]. This standard document is made available in electronic form and is used for any shipments of radioactive waste or spent fuel between Member States, or into, out of and through the Community, which come within the ambit of Directive 2006/117.

[137] African, Caribbean and Pacific countries.
[138] OJ L 107, 17.4.2008, p. 32.
[139] A corrigendum was issued in 2008.

Moreover, on 4 December 2008, the Commission issued Recommendation 2008/956/Euratom on the criteria for the export of radioactive waste and spent fuel to third countries[140]. The Recommendation clarifies the main requirements relating to the export of radioactive waste or spent fuel to third countries, referred to in Article 16(1)(c) of Directive 2006/117, as well as the criteria which Member States should take into consideration in order to evaluate whether the above requirements are met. In doing so, the Recommendation draws a distinction between "leading" criteria and "additional" criteria. The former include amongst others *"IAEA membership and resultant adherence to the relevant safety standards of the International Atomic Energy Agency"* and the *"signature and ratification of, and compliance with the Joint Convention on the Safety of Radioactive Waste Management and the Safety of Spent Fuel Management, the Convention on Nuclear Safety, the Vienna Convention on Civil Liability for Nuclear Damage, the Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage, the Convention for Supplementary Compensation for Nuclear Damage or the Convention on Third Party Liability in the Field of Nuclear Energy of 29 July 1960, as amended by the Additional Protocol of 28 January 1964 and by the Protocol of 16 November 1982"*. The latter encompass the *"signature and ratification of, and compliance with the Convention on Assistance in the Case of a Nuclear Accident and Radiological Emergency and the Convention on Early Notification in a Nuclear Accident, to demonstrate that appropriate information will be given to the affected population in the event of a radiological emergency and that adequate protective and corrective measures, including the preparation and testing of emergency plans, will apply in the event of a radiological emergency in order to control the release and mitigate its effects"*. Finally, the Recommendation invites the competent authorities of the Member States to cooperate, with a view to exchanging information on its application.

Under Council Directive 2006/117/Euratom, the Commission is required to report on the implementation of this directive to the Council, the European Parliament and the European Economic and Social Committee, based on the Member States' reports to the Commission.

[140] OJ L 338, 17.12.2008, p. 69.

The first such report from the Commission (for the period 2009-2011) and the second report (for the period 2015-2017) were published respectively in 2013[141] and in 2017[142]. The Commission adopted the third and latest report[143], covering the period 2015-2017, on 17 December 2019.

The third report provides an overview of shipments of spent fuel and radioactive waste in the Community; of the recent trends and challenges on import, export and transit of spent fuel and radioactive waste, reported refusals and failed shipments, as well as proposed actions. This is the first Commission report under this Directive to include details on the actual number of shipments.

In the period 2015-2017 Member States reported no shipment failures, two refusals to grant consent with their underlying justification, and one reshipment due to the unsuitability of some radioactive waste for a processing site.

Commission Recommendation 2009/527[144] has been developed for the improvement of the system of transmission of documents and information under directive 2006/117. This Recommendation prompts the competent authorities of the Member States: to cooperate in order to ensure the smooth operation of the automatic consent procedure laid down in Article 9(2) of Directive 2006/117; to take the necessary measures in order to ensure that all information regarding shipments covered by that directive is handled with due care and is protected against any misuse; and to apply general security measures to all information which is processed by them, when applying Directive 2006/117.

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141 https://ec.europa.eu/energy/sites/ener/files/documents/1st_report_shipment_dir_final_en.pdf

142 https://ec.europa.eu/energy/sites/ener/files/documents/1_en_act_part1_v7_2.pdf

143 COM/2019/633 final

144 Commission Recommendation of 7 July 2009 for a secure and effective system of transmission of documents and information relating to the provisions of Council Directive 2006/117/Euratom, OJ L 177, 08.07.2009.

I.2 COUNCIL DIRECTIVE 2011/70/EURATOM

Council Directive 2011/70/Euratom requires that radioactive waste shall be disposed of in the Member State in which it was generated, unless at the time of shipment an agreement, taking into account the criteria established by the Commission in accordance with Article 16(2) of Council Directive 2006/117/Euratom, has 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. Prior to a shipment to a third country, the exporting Member State shall inform the Commission of the content of any such agreement and take reasonable measures to be assured that:

- the country of destination has concluded an agreement with the Community covering spent fuel and radioactive waste management or is a party to the Joint Convention;

- the country of destination has radioactive waste management and disposal programmes with objectives representing a high level of safety equivalent to those established by this directive;

- the disposal facility in the country of destination is authorised for the radioactive waste to be shipped, is operating prior to the shipment, and is managed in accordance with the requirements set down in the radioactive waste management and disposal programme of that country of destination.

The above provisions do not apply to shipment of spent fuel of research reactors to a country where research reactor fuels are supplied or manufactured, taking into account applicable international agreements.

The directive does not affect the right of a Member State or an undertaking in that Member State to return radioactive waste after processing to its country of origin where:

- the radioactive waste is to be shipped to that Member State or undertaking for processing; or

- other material is to be shipped to that Member State or undertaking with the purpose of recovering the radioactive waste.

Finally, the directive does not affect the right of a Member State or an undertaking in that Member State to which spent fuel is to be shipped for treatment or reprocessing to return to its country of origin radioactive waste recovered from the treatment or reprocessing operation, or an agreed equivalent.

Section J
DISUSED SEALED SOURCES
(Article 28 of the Joint Convention)

ARTICLE 28. DISUSED SEALED SOURCES

1. Each Contracting Party shall, in the framework of its national law, take the appropriate steps to ensure that the possession, remanufacturing or disposal of disused sealed sources takes place in a safe manner.

2. A Contracting Party shall allow for re-entry into its territory of disused sealed sources if, in the framework of its national law, it has accepted that they be returned to a manufacturer qualified to receive and possess the disused sealed sources.

The BSS Directive sets up a system of notification or authorisation of practices with radioactive sources. As a matter of principle, the production, processing, handling, use, holding, storage, transport, import to and export from the Community and disposal of radioactive substances is subject to notification.

As regards high-activity sealed sources (HASS), Council Directive 2003/122/Euratom on the control of high-activity sealed radioactive sources and orphan sources[145], has been repealed and replaced by corresponding provisions in the BSS Directive. The BSS Directive introduces new activity limits for HASS definition, which correspond to the lower limits of the IAEA Category 3 sources. This way the definition of HASS in the EU is harmonised with the IAEA regulations.

[145] OJ L 346, 31.12.2003, p. 57.

In order to facilitate the return of disused sealed sources to suppliers, manufacturers or recognised installations based in another country, Council Directive 2006/117/Euratom expressly excludes such shipments from the administrative authorisation system.

Council Directive 2011/70/Euratom does not prevent repatriation of disused sources to a supplier or manufacturer. Once the disused sources are considered as radioactive waste according to the directive, they fall within its scope and should be managed according to its provisions.

Council Regulation No 1493/93/Euratom establishes a mechanism for controlling shipments of radioactive substances, in particular radioactive sources, between Member States.

Section K
GENERAL EFFORTS TO IMPROVE SAFETY

This section provides an opportunity to give a summary of safety issues of concern identified earlier and of planned future actions to address those issues, including, where appropriate, measures of international co-operation.

This section should also summarize
(a) measures taken to address Suggestions and Challenges identified at previous Review Meetings; and
(b) strong features in its current practices, possible areas for improvement, major Challenges that the Contracting Party has identified for itself and how the Contracting Party plans to address these issues.

This section should:
− for those countries hosting, having hosted, or planning to host international peer review missions and follow-up missions, include a description of policies, plans and schedules for such peer review missions;
− include the measures taken by the Contracting Party to voluntarily make public the reports on their international peer review missions.

This section should include information on the actions taken to enhance openness and transparency in the implementation of the obligations under the Convention.

This section summarises safety issues of concern identified earlier and outlines future actions to address those issues, including where appropriate, measures of international co-operation. The section identifies both measures taken to address suggestions and challenges identified at previous Review Meetings and strong features in current practices, possible areas for improvement, major challenges and the plans to address these issues.

The main suggestions and challenges identified during the 6th Review meeting were:

- ***Euratom facilitation of continued implementation by Members States of Council Directive 2011/70/Euratom;***
- ***Achievement of dedicated milestones for ongoing decommissioning activities at JRC sites;***
- ***Completion of the transfer of the license of the Ispra-1 reactor to the Italian operator and start of the related decommissioning work.***

This Section mentions also other safety issues and initiatives, concentrating amongst other on the international dimension.

K.1 IMPLEMENTATION OF COUNCIL DIRECTIVE 2011/70/EURATOM

In the last three years, EU Member States have made a number of steps towards full implementation of Council Directive 2011/70/Euratom, so demonstrating that they have been taking reasonable actions to ensure that no undue burden is passed to future generations and that radioactive waste and spent fuel is managed safely. Experience in decommissioning and waste management is progressively being gained, thus creating better conditions for setting effective policies to ensure safe and timely decommissioning and waste disposal. However, more needs to be done and Member States need to further accelerate in addressing key challenges.

Primarily, Member States, which have not yet done so, should take a swift decision on their policies, concepts and plans for the disposal of radioactive waste, in particular intermediate-level waste and high-level waste. Several Member States consider the option of shared solutions.

Another key challenge remains ensuring that adequate funds will be available for the costs of national programmes.

The European Commission noted different stages of implementation of the national programmes. In most Member States, further work is needed in developing and implementing clear key performance indicators to monitor progress in effective and transparent ways, and to ensure timely accomplishments. The European Commission has launched a study to support better definition of key performance indicators.

The ongoing review and update of the national programmes taking into account the outcomes of self-assessments and international peer review results remain of high importance in building stakeholders' trust and confidence in the management of these materials in the EU. Significant steps towards conducting and planning the self-assessment and international peer reviews have been taken so that competent authorities, national frameworks and national programmes benefit from best practice and international safety standards in the field. The European Commission consistently encourages Member States to share outcomes of these reviews, engage in transparent dialogue with stakeholders, and facilitate the exchange of best practices and knowledge at EU and international level.

K.1.1 Reporting

In the past, one aspect of the former Community Plans of Action was the requirement for continuous analysis by the Commission of the situation regarding radioactive waste management in the EU. The results of this analysis had to be presented periodically to the Council.

Until 2011, seven so-called "situation reports", describing the status of radioactive waste management in the EU***, were adopted.*** The fifth[146] and sixth[147] reports concentrated on the aspect of waste inventories and disposal sites, together with waste management policies and practices. In addition, in the seventh report[148] the likely evolution of waste quantities up to 2040, as well as the disposal capacities up to 2070, were included.

The 2010 inventory information provided by Member States was used in the preparation of the Commission's report under the Directive and therefore the 7th situation report was the last report in its series. ***Reporting on the status of radioactive waste management in the Community is now combined with the reporting provided for under the Directive.***

In 2018, EU Member States submitted to the Commission their second national reports on the implementation of the Directive. On the basis of these documents, the Commission has released its second report[149] to the Council and European Parliament on progress made with the implementation of the Directive as well as an inventory of spent fuel and radioactive waste present in the EU's territory.

The situation reports, as well as the first and second reports of the Commission on the implementation of the Directive, have shown the continual increase in inventories of high-level waste and spent fuel in line with nuclear power generation.

K.1.2 Redressing of non-compliant measures and addressing challenges

The European Commission has reviewed the national programmes and national reports of 27 Members States (and the UK). On that basis, as it is mentioned above, it has prepared a report to the Council and European Parliament (as per Article 14(2) of the Directive) adopted in 2019.

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146 Fifth Situation Report - Radioactive Waste Management in the Enlarged EU, EUR20653EN, 2003.

147 COM (2008) 542 final, available at: http://ec.europa.eu/energy/nuclear/waste_management/waste_management_en.htm.

148 Report from the Commission - Seventh Situation Report on Radioactive Waste and Spent Fuel Management in the EU, SEC (2011) 1007 final.

149 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(2019)632 final of December 2019. https://ec.europa.eu/energy/en/topics/nuclear-energy/radioactive-waste-and-spent-fuel

In order to ensure the correct transposition and implementation of Council Directive 2011/70/Euratom, the Commission has taken a strict approach when assessing Member States' transposing legislations and national programmes. The Commission is now following up the infringement procedures initiated in 2018 and 2019 against several Member States for incorrect transposition of the Directive and failure to adopt a national programme compliant with the requirements of the Directive.

The European Commission aims also to assist Members States to address the common challenges and needs with respect to the management spent fuel and radioactive waste.

The Commission has carried out studies: on the market for decommissioning nuclear facilities in the EU; on financial risks of decommissioning and the back end of the fuel cycle; and on benchmarking of spent fuel and radioactive waste reporting. In a joint effort with Finnish presidency of the European Council, the European Commission organised also a workshop[150] on the management of spent fuel and radioactive waste arising from non-energy uses of nuclear and radiation technologies.

The Commission is also assisting Member States with the aid of the international tool ARTEMIS on peer reviews of the national framework, competent authorities and/or programme; and working with the IAEA on the inventory reporting tools. Through the ENSREG the Commission is also discussing specific topics of interest of the EU regulatory bodies, and revised the ENSREG Guidelines for reporting under Article 14(1) of the Directive 2011/70/Euratom.

150 https://ec.europa.eu/energy/sites/ener/files/samira_workshop_final_agenda.pdf

K.2 EURATOM RESEARCH PROGRAMMES[151]

Euratom makes a major contribution to the safety of radioactive waste management through its research activities under the Euratom Treaty. The legal basis for research activities in the field of nuclear science and technology is to be found in Title I, Article 2(a), which provides that *"In order to perform its task, the Community shall, as provided in this Treaty: (a) promote research and ensure the dissemination of technical information"*, as well as in the provisions of Title II, Chapter 1, entitled *"Promotion of research"* and especially Article 7 which foresees the adoption of Community research and training programmes. ***Article 8 provides the legal basis for the creation of the Joint Research Centre.*** As laid down in the Euratom Treaty, Euratom research and training programmes are established by the Council, on a proposal from the Commission, and following consultation of the Euratom Scientific and Technical Committee (STC). The Commission is responsible for the implementation of these programmes.

A distinction is made between "direct actions" and "indirect actions". Direct actions are research activities pursued in the research establishments of ***the European Commission's Joint Research Centre*** and paid for entirely from the EU budget. Indirect actions are conducted in research centres, universities or undertakings, with financial assistance from the EU and on conditions laid down by the rules governing participation in the various programmes.

[151] For additional information on Euratom Research and Training Programmes, see Appendix

The ongoing Euratom Research and Training Programme (2014-18)[152] and its biannual (2019-2020) extension complements Horizon 2020[153] in the field of nuclear research and training. The general objective of the Euratom Programme is to pursue nuclear research and training activities with an emphasis on continuous improvement of nuclear safety, security and radiation protection, notably to potentially contribute to the long-term decarbonisation of the energy system in a safe, efficient and secure way. Specific objectives of the Programme include contributing to the development of safe, longer term solutions for the management of ultimate nuclear waste, including final geological disposal as well as partitioning and transmutation.

For fission research, the Programme is fully in line with the post-Fukushima reorientation towards safety aspects agreed in 2011. The budget for indirect actions in fission research and radiation protection amounts to EUR 315 million for the period 2014 – 2018. ***Complementing the Horizon 2020 Framework Programme for Research and Innovation for the period 2019-2020, the budget for indirect actions for nuclear fission, safety and radiation protection amounts to EUR 151 million.***

As in the past, implementation of the indirect actions is ensured via calls for proposals announced in the Official Journal of the EU and on the Participant Portal website[154]. The submitted proposals are evaluated by independent experts from the various fields covered by the call. Successful proposals are funded mainly by a shared-cost mechanism, whereby an EU grant is awarded covering part of the overall project budget, with the project consortium partners contributing the balance of the funding.

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152 Council Regulation (Euratom) N°1314/2013 of 16 December 2013 on the Research and Training Programme of the European Atomic Energy Community (2014-2018) complementing the Horizon 2020 Framework Programme for Research and Innovation

153 Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decision No 1982/2006/EC

154 http://ec.europa.eu/research/participants/portal4/desktop/en/home.html

One call was announced in 2018 and another one in the following biannual (2019-2020) period. To ensure seamless funding of Euratom research and training activities, a new Council Regulation (Euratom) 2018/1563[155] has been adopted keeping the main provisions of and repealing the former Council Regulation (Euratom) No 1314/2013. The biannual (2019-2020) Euratom programme is still remain an integral part of Horizon 2020, allocating budget for both direct and indirect actions, setting R&D objectives and identifying R&D support instruments. This approach ensures the continuity throughout the full 7-year H2020 period and therefore greater coherence with the Horizon 2020 timeline. This is all the more important in view of remaining consistent with relevant Union policies in fields relating to research and innovation in general and in all nuclear safety aspects in particular.

An overview of activities in the field of radioactive waste management under the Euratom FP7 and FP7+2 is provided in Table I.1 of the Appendix. ***Respectively, Table I.2 summarises the status of implementation of 15 on-going projects co-financed under the Euratom Research and Training Programme (2014-18) and its biannual (2019-2020) extension complements, Horizon 2020.***

The nuclear activities of JRC (direct actions) are governed by a specific set of objectives established in the Euratom Research and Training Programme:

a) ***improving nuclear safety, including: nuclear reactor and fuel safety, waste management, including final geological disposal as well as partitioning and transmutation; decommissioning, and emergency preparedness;***

b) ***improving nuclear security, including: nuclear safeguards, non-proliferation, combating illicit trafficking, and nuclear forensics;***

c) ***increasing excellence in the nuclear science base for standardisation;***

d) ***fostering knowledge management, education and training; and***

e) ***supporting the policy of the Union on nuclear safety and security.***

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155 Council Regulation (Euratom) 2018/1563 of 15 October 2018 on the Research and Training Programme of the European Atomic Energy Community (2019–2020) complementing the Horizon 2020 Framework Programme for Research and Innovation, and repealing Regulation (Euratom) No 1314/2013

Therefore, JRC notably contributes to the nuclear safety research needed for the safe, secure and peaceful use of nuclear energy and other non-power applications, to provide a scientific basis to relevant Union policies and, where necessary, to react within the limits of its mission and competence to nuclear incidents and accidents, due to its experienced and competent staff and unique scientific infrastructure. To that effect, JRC will continue to carry out research and assessment, provide references and standards and deliver dedicated training and education in the field of fuel cycle safety and radioactive waste management. Synergies with relevant cross-cutting initiatives will be sought as appropriate, with the aim of optimizing human and financial resources and to avoid duplication of nuclear research and development in the European Union. The JRC activities in these areas will be conducted taking into account relevant initiatives at the regional, Member State or at European Union level, within the perspective of shaping the European Research Area.

To ensure that direct actions are in line with and complement the research and training needs of Member States, JRC is continuously interacting with the main research and scientific institutions in the EU, and actively participating in several technological platforms and associations. In a few cases, JRC also participates as part of the consortia in indirect actions, which allows JRC scientist to engage in top level scientific research, maintaining and further developing JRC's scientific excellence. At the same time, the members of the consortia can have access to unique research infrastructure.

JRC areas of research relevant for safety of spent fuel and high level radioactive waste, cover all stages of spent fuel management since it is removed from the reactor: cooling in the spent fuel pool; handling, transport, storage (with particular emphasis on long-term storage); retrieval, handling and transportation after storage; disposal in a deep geological formation, and long term safety aspects thereafter.

In the area of radioactive waste management, JRC focuses in non-destructive analyses techniques for the characterisation of waste packages; standardisation of free release measurements, development of novel techniques for mapping contamination, and for decontamination in high activity environments, methods for hard to measure nuclides, etc.

The JRC is very active in standardisation, and is a reference entity in reference measurements and data; basic and pre-normative research; and inter-laboratory comparisons, also applied to the field of spent fuel and radioactive waste management. The JRC develops materials standards, and manufactures reference materials. JRC is a major European provider of nuclear data and standards for nuclear energy applications.

The JRC has also relevant research activities in the areas of nuclear safety, nuclear science applications, nuclear security and nuclear safeguards.

K.3 MEMORANDUM OF UNDERSTANDING BETWEEN EURATOM AND THE IAEA

A Memorandum of Understanding (MoU) was signed by the Commission and the IAEA on 17 September 2013 for a partnership between them on nuclear safety cooperation[156].

Parties agreed to consult and, subject to the availability of funds, cooperate in specific areas, which include:

- "Safe management of spent fuel and radioactive waste"; and
- "Provision of IAEA peer reviews of radioactive waste and spent fuel management of the IAEA Member States which are Member States of Euratom, that so request, in accordance with IAEA Safety Standards and in line with 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".

The MoU, which was initially agreed for a period of four years, was extended in 2017 for another four-year-period.

156 https://ec.europa.eu/energy/sites/ener/files/documents/20130917_ec_iaea_mou_nuclear.pdf

Under this Memorandum the Commission has supported the IAEA in developing the ARTEMIS peer review service. ***Article 14 of Council Directive 2011/70/Euratom requires Member States to invite periodically (at least every 10 years) international peer review of their national framework, competent regulatory authority and/or national programme, with the aim of ensuring that high safety standards are achieved in the safe management of spent fuel and radioactive waste.***

In 2011, the Commission concluded with the IAEA an Agreement to provide a contribution for the implementation of the action entitled "EC-IAEA Cooperation in the Field of Nuclear Safety – Integrated Regulatory Review Services in the EU". In 2014, the Commission on behalf of the EU signed an agreement with the IAEA for "EC-IAEA Cooperation in the Field of Nuclear Safety and Waste Management" aimed at supporting the ARTEMIS peer review service and in this way to provide a tool for Member States international peer reviews required by the Council Directive 2011/70/Euratom. ***After the renewal of both agreements, these peer review services continue to benefit from EU's financial support. By April 2020, 8 ARTEMIS peer reviews have been performed in EU Member States, while additional 16 are currently planned over 2020-2023.***

The scope of the project covers development of self-assessment questionnaires, guidance, workshops with Member States proposed to EU Member States, as well as an electronic platform. Two workshops took place in 2016 (for EU Member States) and 2017 (for IAEA Member States).

Member States can request that ARTEMIS peer reviews are combined with those from IAEA's Integrated Regulatory Review Service (IRRS). The first such combined mission took place in Spain in October 2018. Initial feedback from the mission was presented at a workshop for EU Member States in Luxembourg in November 2018. At the request of several Member States, IAEA is currently carrying out a review, through an internal task-force, to investigate the IRRS-ARTEMIS interface, with a view to increasing efficiency, minimising duplication and improving coordination. In parallel, several MS have set up a sub-group of ENSREG WG1 to coordinate discussions with IAEA on the IRRS-ARTEMIS interface.

In July 2017, the EU and IAEA launched a project on development of a harmonised reporting set and tool for spent fuel and radioactive waste inventories of EU Member States. This project aims to assist Member States and reduce the burden on reporting such data to international organisations such as IAEA, Joint Convention, Commission and NEA to OECD.

K.4 EURATOM LOANS

Financial support in the form of loans is available for all Member States[157] and certain non-Member States[158]. All projects must have obtained approval from the competent national authorities, in particular the safety authorities.

Member States are granted loans to finance investment projects relating to the industrial production of electricity in nuclear power stations and to industrial fuel cycle installations. Although most are related to electricity production, many have included direct or indirect references to the safety of spent fuel and radioactive waste management.

Projects supported in non-Member States in Europe must give priority to improving the level of safety and efficiency of nuclear power stations and fuel cycle installations which are in service or under construction. Support is also given to projects that relate to the decommissioning of installations where upgrading of safety levels is not technically or economically justified and which would pose a hazard if abandoned. Such measures are eligible for financial support only where no provision was made during the operational life of the installation.

With regard to upgrading the safety of nuclear installations, Euratom loans have in the last decade been granted to projects such as the safety upgrade of the Kozloduy Power Plant Units 5 and 6 in Bulgaria, the safety upgrade of Khmelnitsky Power Plant Unit 2 and Rovno Power Plant Unit 4 in Ukraine, and the Complex (consolidated) Safety Upgrade Program of Power Units of Nuclear Power Plants also in Ukraine.

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157 Council Decision 77/270/Euratom empowering the Commission to issue Euratom loans for the purpose of contributing to the financing of nuclear power stations, OJ L 88, 06.04.1977, p. 11, as amended and supplemented (the "Establishing Decision").

158 Council Decision 94/179/Euratom to authorise the Commission to contract Euratom borrowings in order to contribute to the financing required for improving the degree of safety and efficiency of nuclear power stations in certain non-Member countries, OJ L 84, 29.03.1994, pp. 41-43, as amended and supplemented (the "Scope Extension Decision").

K.5 FINANCIAL SUPPORT FOR MEASURES CONNECTED WITH DECOMMISSIONING IN BULGARIA, LITHUANIA, AND SLOVAKIA

Upon accession, Bulgaria, Lithuania and Slovakia committed to close down and subsequently decommission eight older Soviet design nuclear power units before the end of their scheduled operational lifetime. The EU agreed to assist financially the three Member States to decommission the concerned power reactors.

The EU assistance has been implemented since the pre-accession stage and ***was continued in the Union's 2014-2020 Multiannual Financial Framework.*** Indeed, in 2013 two Council Regulations 2013/1368/Euratom and 2013/1369/EU established a new legal base, providing continued support to the decommissioning programmes.

The Regulations establish a programme for the implementation of Union financial support for measures aimed at the decommissioning of units 1 to 4 of the Kozloduy nuclear power plant in Bulgaria (the 'Kozloduy programme'), units 1 and 2 of the Bohunice V1 nuclear power plant in Slovakia (the 'Bohunice programme'), and units 1 and 2 of the Ignalina nuclear power plant in Lithuania (the 'Ignalina programme').

For the next 2021-2027 Multiannual Financial Framework, the Commission has adopted two proposals[159] for continued support for decommissioning activities in Bulgaria, Slovakia and Lithuania. In particular, the proposed funding will enable Bulgaria and Slovakia to complete the decommissioning of the concerned reactors, and help Lithuania to proceed safely and steadily with the decommissioning of the Ignalina nuclear power plant, a first-of-a-kind process on an unprecedented scale that involves retrieving a large amount of radioactive graphite. The Council is expected to adopt in 2020 new Regulations based on those proposals.

The general objective of the Kozloduy, Bohunice and Ignalina programmes is to assist the Member States concerned in implementing the steady process towards the decommissioning end state in accordance with their respective decommissioning plans, whilst maintaining the highest level of safety.

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159 COM(2018) 466 and COM(2018) 467.

K.6 DECOMMISSIONING ACTIVITIES AT JRC SITES

The implementation of the JRC Decommissioning and Waste Management Programme has continued steadily during the reporting period.

In JRC-Ispra, the civil works of the grouting facility have been concluded. The commissioning of electromechanical installations is still on-going. The grouting facility is intended to immobilise low and intermediate solid waste into standardised 5.2 m^3 prismatic containers (IP-2 containers). A dedicated design in conformity with the Italian UNI standards has finalised its qualifications phase, and has also received the declaration of conformity with the waste acceptance criteria of the future disposal facility. Formal approval by the Italian Safety Authorities is still pending. The interim storage facility for conditioned waste has been commissioned and authorised for conditioned very-low-level and low-level waste. An extension of the license for storing unconditioned very low-level waste was approved in 2019.

Following the latest shipment in 2015 more than 95% of the non-irradiated material has been shipped off site. A centralised transit safe area is under commissioning to collect the irradiated nuclear material present on site and to allow for its repackaging in dual-purpose dry casks planned for after 2019 (the alternative solution of reprocessing the irradiated material is being explored)

At JRC-Karlsruhe, the current decommissioning activities are related to disused installations, obsolete nuclear materials and wastes, such as the dismantling of disused obsolete glove boxes and clean-up of hot cells. The construction of the new state of the art building (wing M) is progressing. With this new building which will host JRC's research and training activities with nuclear material, the preparation for decommissioning of older, obsolete buildings (scheduled after 2020) has commenced.

At JRC-Geel no important decommissioning projects have taken place. The facility Global Decommissioning Plan has been updated and cost calculations have been reviewed. Neither materials nor waste from the refurbishment of the accelerator remains on-site.

At JRC-Petten an update of the decommissioning plan and cost estimation for the HFR was prepared at the end of 2017.

During the reporting period the governance structure put in place for the management of the JRC Decommissioning and Waste Management Programme has continued its work. The Department of Nuclear Decommissioning coordinates the development and implementation of the multi-site D&WM programme. The overall Decommissioning and Waste Management strategy as well as the cost estimation and waste inventory are updated regularly.

Aiming at reducing the risks on the Italian liabilities linked to previous common nuclear research activities at the JRC-Ispra site, the risks on the long-term waste storage capacities on the site and on the waste acceptance criteria, Euratom signed on 27 November 2009 an Agreement with the Italian Government in order to:

- ***regularise the historical liabilities on the site by transferring the responsibility for the Ispra-1 reactor decommissioning to the Italian Government;***
- ***formalise the transfer of all waste on the JRC-Ispra site to the future Italian national repository by the end of the D&WM programme;***
- ***limit the risk of later waste reconditioning which could be the result of changes in Italian waste acceptance criteria.***

Following the implementation of this Agreement, the research reactor Ispra-1 has been transferred to the Italian entity in charge of radioactive waste management and decommissioning (SoGIN).

K.7 INSTRUMENT FOR NUCLEAR SAFETY COOPERATION

The EU contributes significantly to the promotion of nuclear safety, including radioactive waste management, also through actions undertaken under the Instrument for Nuclear Safety Cooperation, established by Council Regulation No 237/2014 of 13 December 2013[160]. Within the framework provided by this Instrument, the Union engages in cooperation with non-EU countries, amongst others in the field of the promotion of nuclear safety culture, safe management of radioactive waste and safeguarding of nuclear materials. Concrete actions are aimed to address problems related to the safe management of radioactive waste of all types and of nuclear material, including environmental remediation of former uranium mines.

The Commission is responsible for the implementation of these actions with the non-EU countries concerned. The Annual Action Programmes, also containing projects in the field of radioactive waste management, are elaborated by the Commission, based on the Strategy and Multi-annual Indicative Programme established by the European External Action Services, taking into account the opinion of a committee of appointed representatives from the Member States. In 2018 the Commission proposed a follow-up instrument to the INSC for the next Multiannual Financial Period 2021-2027, which is currently under negotiation at inter-institutional level, and is designed to keep funding levels at the same level as in the past.

K.8 EU STRESS TESTS (POST-FUKUSHIMA)

Europe's response to the events at the Fukushima (Daiichi) I Nuclear Power Plant, initiated by the Tōhoku earthquake and tsunami on 11 March 2011, was immediate. The European Council of 24/25 March 2011 requested that the safety of all EU nuclear plants should be reviewed on the basis of a comprehensive and transparent risk and safety assessment ("stress tests"). These stress tests were defined as targeted reassessments of the safety margins of nuclear power plants, developed by ENSREG, with the participation of the Commission.

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160 Council Regulation No 237/2014 of 13 December 2013 establishing an Instrument for Nuclear Safety Cooperation. OJ L L77, 15.03.2014, p. 109. This Euratom Regulation will be applied from 2014 to 2020.

Specifications on the stress tests defined three main areas to be assessed: extreme natural events, response of the plants to prolonged loss of electric power and/or loss of the ultimate heat sink and severe accident management. As such, the main aim of stress tests was to assess the safety and robustness of nuclear power plants with regard to the preliminary lessons learned from Fukushima. For this purpose, they went beyond the safety evaluations made during the licencing process and periodic safety reviews.

All EU Member States that operated nuclear power plants at the time, plus Lithuania, participated in the nuclear stress test exercise. Several countries decided –in addition to the agreed requirements– to include not only operating nuclear power plants but also decommissioned plants or other nuclear facilities.

The follow-up of the nuclear power reactors stress tests

Following the implementation of risk and safety assessments (stress tests) launched in the aftermath of the 2011 Fukushima nuclear accident, the Commission in collaboration with European Nuclear Safety Regulators Group (ENSREG) is continuing to follow the implementation of the measures taken by EU Member States in order to continue improving the safety of nuclear power plants. Already in November 2015, ENSREG issued a statement where it indicated that delays were encountered by several countries in safety upgrades implementation.

Member States committed to provide updates of the planned national actions every two years until complete implementation of their national action plans. The most recent updates were provided during 2017-2018. ENSREG performed an assessment of these updated national plans in 2018-2019. At the moment of the preparation of this Report, three Member States have completed their national action plans and reported to ENSREG, while others have scheduled further specific safety upgrades after 2020.

The Commission also continued to support the stress test of NPPs in EU neighbouring countries. In 2011, several non-EU countries indicated their willingness to undertake the Stress Tests including a peer review. The need for a consistent approach towards nuclear safety by all countries making use of nuclear energy was reinforced by shared vision that highlights the potential cross-border nature of nuclear accident.

Two countries, Switzerland and Ukraine, directly participated to the full process of the stress tests with the other EU countries in 2012 and to the National Action Plan peer reviews in 2013 and 2015. The stress tests peer review exercise took place in Armenia from 20 to 24 June 2016 and in Belarus from 12 to 16 March 2018.

Both in Armenia and Belarus, all parties worked together constructively during these peer reviews and with the full commitment to ensure full transparency and to improve nuclear safety. The exercise allowed for a comprehensive technical evaluation in line with the EU stress test scope.

Following the Armenian 2016 peer review a National Action Plan was published in 2017 to address the findings. There was no peer review of the initial, which was subsequently updated in October 2019. The following month ENSREG performed a peer review of its implementation. The report is currently undergoing ENSREG's approval procedure and publication is expected in February 2020.

The peer review report regarding Belarus, endorsed by ENSREG in July 2018, was made public and presented to relevant stakeholders and the civil society. While it acknowledges the advanced passive safety features of the Ostrovets reactor, it makes substantive recommendations that necessitate follow-up and implementation measures. The Commission and ENSREG called upon Belarus to swiftly prepare and present a National Action Plan to address the peer review findings and recommendations, in line with the practice followed for previous stress tests within the EU and with third countries. Belarus finally published its National Action Plan and submitted it to ENSREG in August 2019. ENSREG has proposed that its Chair write to provide feedback from ENSREG experts on the National Action Plan and to invite Belarus to request a peer review of the plan.

All information related to these peer review exercises is available on the ENSREG Website.

K.9 IMPLEMENTATION OF COUNCIL DIRECTIVE 2009/71/EURATOM

The European Council of 24/25 March 2011 mandated the Commission *"to review the existing legal and regulatory framework for the safety of nuclear installations"* and propose any improvements that may be necessary.

Thus, in October 2013, the Commission proposed to amend the 2009 Nuclear Safety Directive. The amendment of the Nuclear Safety Directive was adopted on 8 July 2014 and entered into force on 14 August 2014[161].

The amendment, amongst other:

- introduces new EU-wide safety objective;
- sets up a system of European topical peer reviews;
- strengthens the role and independence of national regulators;
- increases transparency on nuclear safety matters;
- includes new provisions for on-site emergency preparedness and response.

The definition of "nuclear installations", covered by the Nuclear Safety Directive, encompasses spent fuel storage facilities, as well as storage facilities for radioactive waste that are on the same site and are directly related to a nuclear power plant, an enrichment plant, a nuclear fuel fabrication plant, a reprocessing plant or a research reactor facility.

The Member States were required to bring into force the laws, regulations and administrative provisions necessary to comply with the Nuclear Safety Directive by 15 August 2017. ***The Commission is currently assessing the compliance of national transposition measures with the provisions of the Directive.***

[161] OJ L 219/42, 25.07.2014

The full and effective transposition and implementation of the Nuclear Safety Directive's requirements represent a priority for the Commission.

In line with the transposition deadline, the Member States have communicated to the Commission their national transposing measures. During the reporting period, the Commission services launched the compliance assessments of the national transposition measures notified by the EU Member States in respect to amended Nuclear Safety Directive.

To ensure that Member States fully comply with the Directive, formal steps were taken with a number of Member States where completeness gaps were identified. The Commission initiated several infringement procedures to enforce the complete transposition of the Directive. The conformity evaluations of the transposing measures are ongoing.

K.10 PROMOTION OF OPENNESS AND TRANSPARENCY

To ensure openness and transparency, the outcomes of any peer review shall be reported to the Commission and the other Member States, and may be made available to the public where there is no conflict with security and proprietary information (Article 14 of Council Directive 2011/70/Euratom).

In another Article directly referring to transparency (Article 10), Council Directive 2011/70/Euratom requires Member States to ensure also 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 informs the public in the fields of its competence. In addition, Member States must ensure 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.

Via the three-yearly reporting requirement, the Directive also foresees a unique platform for the Commission to enhance transparency and to present updated and transparent information on the implementation of Council Directive 2011/70/Euratom. The second report of the Commission, adopted on 17 December 2019, presents a comprehensive overview of the situation and progress achieved in the different Member States, in an independent, comprehensive and easy to understand way.

Moreover, openness and transparency are promoted through discussions at international fora (such as ENSREG, ENEF, specific events, workshops with Member States) and by way of asking the stakeholders' opinion, where appropriate.

Furthermore, since the first Communication to the European Parliament and the Council in 1999, the Commission updates periodically the status of the D&WM Programme for JRC nuclear installations**.** Additionally, the Programme is peer reviewed regularly by a panel of independent experts from the Member States having major competences in the nuclear field, in the so-called "Nuclear Decommissioning and Waste Management Expert Group". The Expert Group meets twice per year in the JRC nuclear sites and monitors the Programme's progress, giving advice on the strategy and future technical challenges.

JRC-Ispra, following the advice of the European Parliament, set up in 2006 a dedicated web site (in two languages: English and Italian) to inform the local community and the international research staff working at JRC-Ispra premises about the relevant progress of the D&WM Programme and other significant events organised in this framework.

Alternatively every second year, the JRC-Ispra site, including its nuclear facilities, is open to the general public (JRC Open Day) and to the scholars (JRC School Day) having applied to visit its laboratories. During these visits, conferences are held and information is given on subjects like radioactivity, nuclear waste and the decommissioning programme. Moreover, Communication channels with the mayors of the villages surrounding the site, the local and regional authorities and the local press have been established and are regularly implemented.

In addition to the formal authorisation and licencing processes, an informal dialogue with the Italian national authorities and other relevant nuclear stakeholders has been established, in particular with the Italian nuclear inspectorate and the operator of the Italian nuclear facilities undergoing decommissioning (SoGIN).

K.11 PRIORITIES AND OUTLOOK

The priorities of Euratom stem from its mandate as established in the Euratom Treaty. Accordingly, Euratom intends to continue working to ensure the highest levels of nuclear safety in the EU and will continue supporting Member States in their efforts to safely and responsibly manage their radioactive waste and spent fuel and implement the relevant Euratom legislative framework in their national legal order. ***Euratom will also continue to support research and development in the area of radioactive waste management and spent fuel management in the EU, and collaborate in research initiatives internationally.***

As indicated above, the EU nuclear legal framework has undergone significant changes in the last decade with the adoption of legislation on nuclear safety, radioactive waste and spent fuel management and radiation protection. ***Member States are at different stages of implementation of their spent fuel and radioactive waste management activities under Council Directive 2011/70/Euratom. In the last three years Member States have made a number of steps towards demonstrating that they have been taking reasonable actions to ensure that no undue burden is passed to future generations and that radioactive waste and spent fuel is managed safely***. However, additional effort, action and improvement are needed in a number of areas, in particular with respect to:

1. policies, concepts, plans, research and site selection for intermediate-level waste and high-level waste (including spent fuel) disposal; deciding on the development of geological disposal facilities, and specifically on their location, is a complex, long-term process in which continuous efforts towards transparency and public participation play an essential role;

2. ***practical measures towards defining the conditions for shared solutions;***

3. ***projections of inventories for spent fuel and radioactive waste (including consistently decommissioning and institutional waste, as well as waste from remediation activities);***

4. ***key performance indicators for effective and transparent monitoring of progress of implementation of national programmes;***

5. *cost assessments and financing mechanisms;*

6. *human resources;*

7. *research and training in radioactive waste management and decommissioning.*

Euratom also intends to take further its international cooperation initiatives, to pursue synergies with the IAEA and other international organisations to enhance safe and responsible management of radioactive waste and spent fuel at international level, by continuing working together in the areas of peer review of national programmes, and harmonisation of reporting of inventories.

Euratom remains committed to fulfilling the terms of the Joint Convention for the Safe Management of Radioactive Waste and the Safe Management of Spent fuel.

APPENDIX - EURATOM RESEARCH

Overall objectives

The overall focus of each Euratom Research and Training Programme (hereinafter "Programme") is on nuclear safety and radiation protection, and there is a large degree of continuity in most research fields (including in the area of radioactive waste management), because of the long-term nature of the required research effort. The management of spent fuel, high-level waste and other long-lived radioactive waste remains the only aspect of the fuel cycle that has yet to reach the level of industrial maturity and full implementation. Safety considerations related to the absence of an operational final disposal facility led a number of Member States to consider radioactive waste management a topic of concern, ***hence Member States support efforts for substantial research. Three Euratom Member States are conducting activities to possibly start operations of three first-of-a-kind geological repositories in the next decade.*** Research and development in this field is supported by the Euratom Programmes in order to offer to other Member States the necessary technical knowledge to develop national programmes and ***in support to the implementation of final disposal.***

Solutions for ultimate radioactive waste disposal, together with safe interim storage of spent fuel are also considered as an integral element of the overall safety of nuclear reactors by reducing the inventory of spent fuel in wet storage at the nuclear power plants, ***following the Fukushima accident. Accordingly. The Euratom Programme is emphasising the need of more research in this field.***

Last but not least, it is clear that the objective of protection of man is at the core of any nuclear activity and it is the primary goal of designing safe solutions for radioactive waste management. A better knowledge of the risks arising from exposures to ionising radiation in the low-dose and low-dose-rate ranges and protracted exposures is also sought by the Euratom Programme. ***With this aim, support is provided to low-dose research being organised within the framework of the European Joint Programme for Radiation Protection Research (CONCERT) for the period 2015 - 2020.***

Recently, a coordinated effort on research on nuclear waste is organised within the framework of the European Joint Programme on Radioactive Waste Management (EURAD) for the period 2019 - 2024.

Euratom Framework Programme 2007-2013 (FP7), the ***Euratom Research and Training Programme (2014-18) and its biannual (2019-2020) extension complements Horizon 2020***

Euratom FP7 covered research in both fusion and fission (including radiation protection) and specific direct research actions carried out by the JRC in the area of nuclear security and safeguards. The total Euratom support for research in the field of fission and radiation protection (indirect actions) was EUR 355 million over the seven years 2007-2013.

In the area of geological disposal, the clear emphasis of Euratom FP7 was on implementation-oriented research and technological development, such as investigation and demonstration of technologies and safety of disposal of spent fuel and long-lived radioactive wastes in geological formations. Other objectives were to underpin the development of a common European view on the main issues related to the management and disposal of waste. Investigation of ways to reduce the amount and/or hazard of the waste by partitioning and transmutation and/or other techniques, in particular as part of advanced nuclear fuel cycles and systems (Generation-IV) included in the radioactive waste management activity area during Euratom FP7, has been transferred to the activity area 'Reactor Systems' during last two years of Euratom FP7 (2012-2013).

Table I.1, below, summarises the final status of projects launched during Euratom FP7, in the field of radioactive waste management in general and geological disposal in particular. Only the major projects, involving collaborative research activities, are listed, excluding smaller coordination and support actions, including education and training. Indirect actions of Euratom FP7 were implemented through competitive annual calls for research proposals. In total, seven (7) calls have been completed and all the selected projects launched.

Table I.1 - Euratom FP7 & FP7+2 (2007 – 2013) – Summary of major radioactive waste management projects

Project acronym and title	Coordinator	EU contribution / total cost (EUR million)	Start date & duration
ACSEPT Actinide recycling by separation and transmutation	CEA (FR)	6 / 23.8	01/01/08 4 years (y)
RECOSY Redox phenomena controlling systems	FZK-INE (DE)	3.50 / 6.2	01/04/08 4 y
CARBOWASTE Treatment and Disposal of Irradiated Graphite and other Carbonaceous Waste	FZJ (DE)	6 / 12.3	01/04/08 5 y
FORGE Fate of Repository Gases	BGS (UK)	6 / 11.6	01/02/09 4 y 8 months
MODERN Monitoring Developments for safe Repository operation and staged closure	Andra (FR)	2.8 / 5.1	01/05/09 4½ y
CATCLAY Processes of Cation Migration in Clayrocks	CEA (FR)	0.82 / 1.55	01/06/10 4 y
PEBS Long-term performance of Engineered Barrier Systems (EBS)	BGR (DE)	2.8 / 6.5	01/03/10 4 y
CROCK Crystalline rock retention processes	KIT (DE)	1.06 / 1.8	01/01/11 2½ y

Project acronym and title	Coordinator	EU contribution / total cost (EUR million)	Start date & duration
SKIN Slow processes in close-to-equilibrium conditions for radionuclides in water/solid systems of relevance to nuclear waste management	ARMINES (FR)	1.2 / 2	01/01/11 3 y
REDUPP Reducing Uncertainty in Performance Prediction	SKB (SE)	0.9 / 1.6	01/04/11 3 y
LUCOEX Large Underground Concept Experiments	SKB (SE)	4.4 / 9.35	01/01/11 4 y
IPPA Implementing Public Participation Approaches in Radioactive Waste Disposal	Karita Konsult (SE)	1.6 / 2.4	01/01/11 3 y
INSOTEC International Socio-Technical Challenges for implementing geological disposal	Univ. of Antwerp (BE)	2.0 / 3.25	01/03/11 3 y
BELBAR Bentonite Erosion: effects on the Long term performance of the engineered Barrier and Radionuclide Transport	SKB (SE)	2.6 / 5.0	01/03/12 4 y

Project acronym and title	Coordinator	EU contribution / total cost (EUR million)	Start date & duration
FIRST-NUCLIDES Fast / Instant Release of Safety Relevant Radionuclides from Spent Nuclear Fuel	FZK-INE (DE)	2.5 / 4.74	01/01/12 3 y
DOPAS Full Scale Demonstration of Plugs and Seals	POSIVA (FI)	8.7 / 15.74	01/09/12 4 y
CAST CArbon-14 Source Term	RWM (UK)	4.5 / 14.73	01/10/13 4½ y

[1] All projects are shared-cost (Euratom contributing on average 50%) and involve large multi-partner consortia, with partners from several Member States. Projects were also open to organisations from third countries, though normally such partners did not receive funding from the Euratom programme.

The research on radioactive waste management continues under the current Euratom Research and Training Programme (2014-18) and its biannual (2019-2020) extension Horizon 2020 Euratom Research and Training Programme (2014-18). Table I.2 summarises the status of implementation of fifteen (105) on-going projects co-financed under the Euratom Work Programmes 2014-2015 and 2016-2017.

Table I.2 - ***Euratom WP 2014-2015 & WP 2016-2017Euratom Research and Training Programme (2014-18) and its biannual (2019-2020) extension, Horizon 2020 – Summary of radioactive waste management projects***

Project acronym and title	Coordinator	EU contribution / total cost (EUR million)	Start date & duration

Project acronym and title	Coordinator	EU contribution / total cost (EUR million)	Start date & duration
JOPRAD Towards a Joint Programming on Radioactive Waste Disposal	ANDRA (FR)	1.1 / 1.8	01/06/15 2½ y
SITEX-II Sustainable network for Independent Technical Expertise of radioactive waste disposal - Interactions and Implementation	IRSN (FR)	1.2 / 1.5	01/06/15 2½ y
MIND Development of the safety case knowledge base about the influence of microbial processes on geological disposal of radioactive wastes	SKB (SE)	4.2 / 4.7	01/06/15 4 y
Cebama Cement-based materials, properties, evolution, barrier functions	KIT (DE)	3.9 / 6.0	01/06/15 4 y
MODERN 2020 Monitoring Developments for safe Repository operation and staged closure	ANDRA (FR)	6.0 / 9.7	01/06/15 4 y
DISCO Modern Spent Fuel Dissolution and Chemistry in Failed Container Conditions	SKB (SE)	4.0 / 4.7	01/06/17 4 y
BEACON Bentonite Mechanical Evolution	SKB (SE)	3.8 / 4.1	01/06/17 4 y

Project acronym and title	Coordinator	EU contribution / total cost (EUR million)	Start date & duration
CHANCE Characterization of conditioned nuclear waste for its safe disposal in Europe	ANDRA (FR)	4.0 / 4.3	01/06/17 4 y
INSIDER Improved Nuclear Site characterisation for waste minimization in D&D operations under constrained EnviRonments	CEA (FR)	3.8 / 4.2	01/06/17 4 y
THERAMIN Thermal treatment for radioactive waste minimisation and hazard reduction	VTT (FI)	3.9 / 4.0	01/06/17 4 y
EURAD ***European Joint Programme on Radioactive Waste Management***	***ANDRA (FR)***	***32.5 / 60***	***01/06/19*** ***5 y***
PREDIS ***PRE-DISposal management of radioactive waste***	***VTT (FI)***	***14.0 / 23.8***	***01/09/20*** ***4 y***
INNO4GRAPH ***INNOvative tools FOR dismantling of GRAPHite moderated nuclear reactors***	***EDF (FR)***	***3.0 / 3.8***	***01/09/20*** ***3 y***

Project acronym and title	Coordinator	EU contribution / total cost (EUR million)	Start date & duration
PLEIADES ***PLatform based on Emerging and Interoperable Applications for enhanced Decommissioning processES***	***CEA (FR)***	***2.8 / 4.3***	***01/10/20*** ***3 y***
LD-SAFE ***Laser Dismantling Environmental and Safety Assessment***	***ONET (FR)***	***2.8 / 4.0***	***01/07/20*** ***4 y***

Within the Euratom Research and Training Programme, the JRC activities cover radioactive waste management, including interim spent fuel storage, geological disposal conditions, partitioning and transmutation, decommissioning applications related to damaged sites, conditional and environmental issues. Scientific aspects related to the back-end of the fuel cycle, including nuclear reference materials, nuclear data, actinide science and non-nuclear applications (e.g. medical applications of radioisotopes), and knowledge management, training and education issues are also addressed.

Within its project "safety of spent and damaged fuels", the JRC provides data relative to the evolution and behaviour of fuels and waste forms under extended interim storage and disposal conditions, and on the analysis of key radionuclides which are relevant for long-term modelling and safety assessment of repositories in view of their implementation. Special attention is paid to corrosion behaviour of high burn-up fuels, mixed oxide fuel and fuel containing additives. JRC has developed new research facilities to investigate these phenomena on pressurised segments from spent fuel rods as well as analytical methods to determine isotopes present in low concentration.

Another important contribution is in safety studies linked to the development of "closed" Generation-IV type fuel cycles under project "safety of advanced nuclear systems and innovative fuel cycles", where specially adapted partitioning schemes are tested with the goal of demonstrating the recycling of minor actinides in view of a minimisation of the long-term radio-toxicity of waste. Demonstration and safety assessment of the recycling of actinides is achieved using aqueous and dry separation techniques, and by performing post-irradiation examination on fuel compounds which incorporated minor actinides.

Under project "Decommissioning and Remediation of Damaged Reactors: their cores and sites", research is also carried out in support to decommissioning of damaged facilities, in which degraded or severely damaged fuel is present. Basic data are being measured and a special focus is given to the understanding of the underpinning mechanisms involved in the processes applied. The work of JRC encompasses research activities for decommissioning of contaminated structures and remediation of contaminated sites, and the improvement of non-destructive analysis techniques to characterise the nuclear materials.

Under project "innovative technologies and standardisation of practices in decommissioning", JRC is also carrying out R&D activities aiming at providing scientific and technical support for nuclear decommissioning and waste management. The scope of work encompass the development of standards, innovative technologies for waste and site characterisation, and application of safeguards in nuclear decommissioning.. Activities include improvement of nuclear site characterization (taking also into account constraints in the site), development of standard material and methods for decommissioning and environmental remediation. The activities include also R&D on Destructive and Non-Destructive Analysis techniques for in-situ waste characterization using gamma-ray spectrometry and neutron coincidence counting, imaging techniques such as tomography, gamma imaging and 3D laser verification methodologies.

Under the project "accelerator based nuclear data measurements and associated applications in nuclear technology", the JRC contributes to the production of libraries of nuclear data related to the creation of neutrons and the interaction of neutrons with materials. Such libraries form an essential input when evaluating safety and risks related to the generation of nuclear power and the nuclear fuel cycle, including radioactive waste and spent fuel. The development of innovative nuclear systems and new concepts of nuclear power production also relies heavily on complete and consistent nuclear data libraries. JRC research focuses on nuclear data of importance for nuclear power production, intermediate storage and disposal of spent nuclear fuel, nuclear waste management and decommissioning, as well as nuclear safeguards and security. The production of nuclear data libraries is a very complex process that is based on a combination of nuclear models and experiments. The experiments are predominantly carried out at the accelerator facilities GELINA and MONNET installed at JRC Geel.

Project "knowledge for nuclear safety policy support" aims at becoming a central point for information and knowledge in support to the development and implementation of EU nuclear safety and radiation protection policies.