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Euratom Safeguards Report 2020 - 2021

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EXECUTIVE SUMMARY

The Euratom Treaty, laying the foundation for the peaceful use of nuclear materials and technologies in the Member States of the European Union, establishes a nuclear material supervision system, known as ‘Euratom safeguards’, under the responsibility of the European Commission.

The Treaty, and in particular Article 77, requires the European Commission to ensure non-diversion of civil nuclear materials from their intended uses and compliance with the safeguards obligations assumed by the Euratom Community under international agreements.

The Euratom Community and its Member States are parties to multilateral Safeguards Agreements and their related Additional Protocols with the International Atomic Energy Agency concluded in implementation of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). The European Commission supports the Member States in delivering on their obligations under the NPT Treaty, inter alia, by operating a regional system of accountancy for and control of nuclear materials for the whole European Union.

In addition, the Euratom Community is also a party to bilateral Nuclear Cooperation Agreements with third countries supplying nuclear material to the Euratom Community or using nuclear fuel services in the Community.

The European Commission verifies the correctness, completeness and coherence of the declarations of flows and stocks of nuclear materials provided by the users of nuclear materials as well as the correspondence of the physical reality to the declarations.

This report presents an overview of Euratom safeguards implementation in 2020-2021, including the main findings and conclusions. Under the very particular and unique challenge of COVID-19 during the reported period, the European Commission continued to fulfil its mandate set out in the Euratom Treaty and international agreements.

During the year 2020, the European Commission performed verification activities for 706 registered locations under Euratom safeguards, so-called ‘material balance areas’, and carried out physical inventory verifications in 454 of these areas, holding 99.83% of all civil nuclear materials in the EU and the UK (2020 was the last year of applying Euratom safeguards in the UK). Euratom inspectors verified more than 5500 declarations submitted by users of nuclear materials and performed more than 900 on-site inspections to verify that the physical inventory of nuclear material corresponds to the declarations of the respective users.

During the year 2021, the European Commission performed verification activities for 571 material balance areas and carried out physical inventory verifications in 384 of these areas, holding 99.95% of all civil nuclear materials in the EU. Euratom inspectors verified more than 4500 declarations and performed more than 900 on-site inspections.

As a result of applying Euratom safeguards in the framework of the Euratom Treaty during the reported period, no evidence was found suggesting that nuclear materials were diverted from their intended uses in the EU. The safeguards obligations assumed by the Euratom Community under international agreements were complied with.

1. INTRODUCTION

The Euratom Treaty¹, establishing the European Atomic Energy Community (Euratom), lays down the foundation for the peaceful use of nuclear materials and technologies in the European Union (EU). It gives powers to Euratom for establishing relations with other countries and international organisations to foster progress in the peaceful uses of nuclear energy. The Treaty requires the Community to make certain, by appropriate supervision, that civil nuclear materials² are not diverted to purposes other than those for which they are intended. It further outlines, in its Chapter 7, the system of safeguards, which constitutes the basis for this supervision. The European Commission³ is entrusted with the responsibility of operating this system of safeguards (Euratom safeguards) on behalf of Euratom.

Article 77 of the Euratom Treaty sets forth two obligations for the European Commission in implementing the Euratom safeguards system, namely that the Commission shall satisfy itself that, in the territories of Member States:

- ores, source materials and special fissile materials are not diverted from their intended uses as declared by the users (Article 77 (a));
- the provisions relating to supply and any particular safeguarding obligations assumed by the Community under an agreement concluded with a third State or an international organisation are complied with (Article 77 (b)).

In connection with the latter (Article 77 (b)), there are two types of agreements to consider:

- the bilateral agreements concluded between Euratom and third countries for cooperation in the peaceful use of nuclear energy, including commitments on non-proliferation, safeguards, physical protection and export controls for nuclear materials (Nuclear Cooperation Agreements);
- the multilateral Safeguards Agreements in implementation of the Treaty on the Non-Proliferation of Nuclear Weapons concluded between Euratom, the EU Member States and the International Atomic Energy Agency (IAEA), as well as their respective Additional Protocols.

The obligations of the users of nuclear materials (operators⁴) are further stipulated in Commission Regulation (Euratom) No 302/2005 of 8 February 2005 on the application of Euratom safeguards, based on Chapter 7 of the Euratom Treaty. In addition, two Commission Recommendations⁵ facilitate the implementation of the Regulation.

¹ The Euratom Treaty established the European Atomic Energy Community (Euratom) in 1957. Euratom has the same Member States as the European Union and is governed by the same institutions.

² ‘Nuclear materials’ means ores, source materials or special fissile materials as defined in Article 197 of the Euratom Treaty. According to Article 84 of the Euratom Treaty, “The safeguards may not extend to materials intended to meet defence requirements which are in the course of being specially processed for this purpose or which, after being so processed, are, in accordance with an operational plan, placed or stored in a military establishment.”

³ The Directorate-General for Energy is the service within the European Commission responsible for the implementation of Euratom safeguards.

⁴ Article 78 (1) of the Euratom Treaty describes the operators: “Anyone setting up or operating an installation for the production, separation or other use of source materials or special fissile materials or for the processing or irradiated nuclear fuels ... “

⁵ Commission Recommendation of 15 December 2005 (2006/40/Euratom) and Commission Recommendation of 11 February 2009 (2009/120/Euratom).

The withdrawal of the UK from the EU on 31 January 2020 had a particular impact on Euratom safeguards during the reported period. 2020 was the last year of applying Euratom safeguards in the UK (the transition period ended on 31 December 2020), as well as of the validity of the trilateral Agreement for safeguards in the implementation of the Treaty on the Non-Proliferation of Nuclear Weapons concluded between the IAEA, Euratom and the UK (and its respective Additional Protocol). Since 2021, the cooperation on nuclear safeguards between Euratom and the UK has been based on a new bilateral Nuclear Cooperation Agreement⁶.

The COVID-19 pandemic posed significant challenges for the implementation of Euratom safeguards during the reporting period, in particular the travel restrictions and access limitations to some installations. Despite the challenges, the European Commission continued to fulfil its respective safeguards mandate in compliance with national rules and regulations for public health⁷. This included amongst others remote data transmission and collection of data from operators and reporting activities towards the IAEA. The verification activities continued, considering risks and priorities to ensure that nuclear materials were not diverted from their intended use, and that all international safeguards obligations were fulfilled.

To illustrate how the European Commission meets its obligations, this report outlines the implementation of Euratom safeguards in the years 2020 and 2021.

An overview of the European Commission activities during the reporting period and the resulting findings and conclusions regarding the implementation of Article 77 (a) and Article 77 (b) are presented in sections 2 and 3 of the report respectively. More detailed information is provided in the annex of this report.

The data presented in the report are extracted from databases⁸ of the European Commission.

⁶ This agreement, signed on 30 December 2020 and applied provisionally as of 1 January 2021, entered into force on 1 May 2021. Pursuant to this agreement, the Community shall notify transfers, retransfers and inventories of items subject to the agreement, which includes nuclear equipment and technology exchanged with the UK.

⁷ As addressed in Article 195 of the Euratom Treaty.

⁸ IT databases developed by the European Commission for internal use only - IMIS (Inspection Management Integrated System) for figures relating to the planning and management of Euratom safeguards inspections and CMF3 (Comptabilité Matière Fissile) for accountancy figures relating to flows and stocks of nuclear materials and declarations.

2. EURATOM SAFEGUARDS ACTIVITIES UNDER ARTICLE 77 (A) OF THE EURATOM TREATY

2.1. Euratom safeguards activities

Article 77 (a) stipulates that “the Commission shall satisfy itself that in the territories of Member States ores, source materials and special fissile materials are not diverted from their intended uses as declared by the users”. The Euratom safeguards supervision system for meeting this obligation involves:

- ensuring the **compliance** of operators with respect to Euratom safeguards provisions,
- monitoring and evaluating the **performance** of the operators’ nuclear material accounting and control system, and
- verifying the **non-diversion** of nuclear material, confirming the credibility of the operators’ declarations⁹.

The European Commission verifies the correctness, completeness and coherence of the operators’ declarations of flows and stocks of nuclear materials submitted under Commission Regulation (Euratom) No 302/2005 and the correspondence of the physical reality to the declarations. This verification is performed by Euratom inspectors¹⁰ both at their headquarters in Luxembourg and on-site at the various nuclear installations by using an effective and efficient combination of:

- independent physical verifications, performed on-site by means of advanced technologies for measurement, containment and surveillance of nuclear materials, and/or at the headquarters using remote data transmission;
- evaluation of the fitness for purpose of the operator’s nuclear materials accountancy and control systems, using audit methodologies.

Euratom safeguards are applied to registered material balance areas (MBAs)¹¹ in all EU Member States where nuclear materials were used and/or produced (active MBAs). Their number decreased after the departure of the UK from the EU (end of 2020). The total MBAs’ number changes due to registration of new MBAs, or cessation of use of nuclear materials in existing ones.

More than 290 users of very small amounts of nuclear materials with limited reporting obligations, located in 12 EU Member States¹², have been grouped in one virtual material balance area, the so-called ‘Catch all MBA’ (CAM). The total amount of nuclear materials

⁹ Declarations required by Commission Regulation (Euratom) No 302/2005 (such as inventory change reports, material balance reports, physical inventory listings, special reports, advanced notifications).

¹⁰ The term ‘Euratom inspector’, according to Article 81 of the Euratom Treaty, refers to inspectors performing on-site inspections, nuclear material accountants, nuclear cooperation agreement officers and safeguards technology officers.

¹¹ A Material Balance Area (MBA) is an area inside or outside an installation such that, for the purpose of establishing the material balance:

(a) the quantity of nuclear material in each transfer into or out of each material balance area can be determined;

and

(b) the physical inventory of nuclear material in each material balance area can be determined when necessary in accordance with specified procedures.

¹² Austria, Belgium, Denmark, Finland, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain and Sweden.

used by all members of CAM is less than one effective kilogram¹³, i.e., even though CAM consists of a significant number of users, when weighted by the amounts of nuclear materials held, they represent a negligible percentage of all civil nuclear materials in the EU. Therefore, for the purpose of providing representative statistical data, CAM is considered as one material balance area.

In 2020, more than 616 000 tons of nuclear materials were under Euratom safeguards in the EU and the UK (about 20% of these materials in the UK). 706 active material balance areas, including CAM, were subject to Euratom safeguards verification activities and conclusions¹⁴. 949 on-site inspections were performed by Euratom inspectors. Physical inventory verifications were carried out in 454 material balance areas holding 99.83% of all civil nuclear materials in the EU and UK. In general, physical inventory verifications do not take place every year in material balance areas with very small amounts of nuclear materials.

In 2021, more than 503 000 tons of nuclear materials were under Euratom safeguards in the EU. 571 active material balance areas, including CAM, were subject to Euratom safeguards verification activities and conclusions¹⁴. 903 on-site inspections were performed by Euratom inspectors. Physical inventory verifications were carried out in 384 material balance areas holding 99.95% of all civil nuclear materials in the EU.

The basic types of performed inspections are the following:

- **Planned inspections:** These inspections are announced to the operators in advance to allow them to plan their operational schedule. The majority of Euratom inspections are planned inspections, as in many types of nuclear installations (e.g., in nuclear power reactors) there is limited technical feasibility to divert nuclear materials from the intended use. Some of the planned inspections were performed jointly with the IAEA.
- **Unannounced and short notice inspections:** These types of inspections are performed either without previous notification to the concerned operator (unannounced inspections), or with short notice notification (48 hours or less). In the years 2020 and 2021, there were respectively 82 and 62 inspections of these types. Some of the unannounced and short notice inspections were performed on request of and together with inspectors from the IAEA. Additionally, some unannounced inspections were performed alone by IAEA inspectors without prior notification also to the European Commission.

More detailed information about the Euratom verification activities is presented in the Annex.

In 2020, the European Commission completed the assessment of the techniques proposed in a project for recycling of uranium from the production of medical radioisotopes. Based on that

¹³ 'Effective kilogram' is a special unit used in safeguarding nuclear material, obtained by taking:

(a) for plutonium, its weight in kilograms;

(b) for uranium with an enrichment of 0,01 (1 %) and above, its weight in kilograms multiplied by the square of its enrichment;

(c) for uranium with an enrichment below 0,01 (1 %) and above 0,005 (0,5 %), its weight in kilograms multiplied by 0,0001;

and

(d) for depleted uranium with an enrichment of 0,005 (0,5 %) or below, and for thorium, its weight in kilograms multiplied by 0,00005.

¹⁴ Some material balance areas were subject to limited or no verification activities during the reported period.

assessment and in accordance with Article 78 of the Euratom Treaty, a **Commission decision on approval of the techniques to be used for the chemical processing of irradiated materials** at the project's conceptual design phase, prior to commencement of construction works, was adopted in the beginning of 2020.

In addition, the European Commission worked in close consultation with operators and relevant EU Member States on establishing Particular Safeguard Provisions, which specify any requirements and procedures to be applied by individual operators in addition to the provisions of Commission Regulation (Euratom) No 302/2005. **Four Commission Decisions laying down Particular Safeguard Provisions** were adopted¹⁵ and entered into force in 2020-2021.

2.2. Findings

The Commission draws annual conclusions evaluating the findings of its safeguards activities and considering all other safeguards relevant information available, including, where applicable, information provided by the IAEA or Member States' authorities.

The safeguards conclusions target three different dimensions:

- the risk of diversion (a case of potential diversion) of nuclear material from its intended uses as declared by the users;
- the management of nuclear material by the operators in accordance with the requirements for implementing an effective nuclear material accounting and control system;
- the fulfilment of all other safeguards requirements, such as providing access to nuclear material and to related data.

In 2020, the safeguards verifications implemented in 706 active material balance areas resulted in:

- **positive safeguards conclusions** for 630 material balance areas;
- **positive safeguards conclusions with observations** for 60 material balance areas;
- **negative safeguards conclusions** for 15 material balance areas, though none indicated a case of potential diversion of nuclear materials from their intended use;
- **no conclusion** for one material balance area for technical reasons.

In 2021, the safeguards verifications implemented in 571 material balance areas resulted in:

- **positive safeguards conclusions** for 529 material balance areas;
- **positive safeguards conclusions with observations** for 39 material balance areas;
- **negative safeguards conclusions** for 3 material balance areas, though none indicated a case of potential diversion of nuclear materials from their intended use.

¹⁵ Pursuant to Article 6 of Commission Regulation (Euratom) No 302/2005.

The distinction between cases with negative safeguards conclusions and positive safeguards conclusions with observations is based on the severity of the issue of non-compliance with Euratom safeguards requirements, its repetitive nature and the impact on safeguards.

The Commission requested corrective actions in cases of non-compliance with Euratom safeguards requirements, including of poor performance of an operator's nuclear material accounting and control system, and monitored their implementation¹⁶.

The issues that led to negative safeguards conclusions for 2020 in the EU were completely or partially resolved in 2021. In the remaining three cases, recurrent issues led to negative safeguards conclusions also for 2021. They continue to be closely followed up by the Commission until the necessary corrections or improvements are made.

On 10 June 2021, the **Commission adopted a Decision**, based on Article 83 of the Euratom Treaty, **to issue a warning** on an operator for the infringement of the Euratom safeguards provisions. In line with the Decision, the operator provided the Commission with a report, describing the measures taken to rectify the infringements, within the specified deadline.

The Commission also identified the following **good practices** from operators or Member States' authorities, allowing to improve the effectiveness and efficiency of safeguards implementation:

- In the context of the COVID-19 pandemic and related travel restrictions, Member States' authorities and operators supported Euratom inspectors to comply with specific national rules and measures.
- For a successful deployment of new safeguards instrumentation and techniques, some operators offered possibilities of equipment testing or hosted safeguards trainings in their premises.
- In several Member States, remote data transmission has been implemented, allowing a significant gain in inspection effectiveness and efficiency while ensuring a strong data security and minimizing the level of intrusiveness in the installation's processes and operation.

3. EURATOM SAFEGUARDS ACTIVITIES UNDER ARTICLE 77 (B) OF THE EURATOM TREATY

Article 77 (b) stipulates that "the Commission shall satisfy itself that in the territories of Member States the provisions relating to supply and any particular safeguarding obligations assumed by the Community under an agreement concluded with a third State or an international organisation are complied with".

During the reporting period, the European Commission verified compliance with the provisions relating to supply and any particular safeguards obligations assumed by Euratom under the following agreements:

- Agreements with Australia, Canada, Japan, Kazakhstan, South-Africa, Ukraine, the UK⁶, the USA and Uzbekistan for cooperation in the peaceful use of nuclear energy, including commitments on non-proliferation, safeguards, physical protection and export controls for nuclear materials (Nuclear Cooperation Agreements).

¹⁶ The issues identified in the UK in 2020 were not followed anymore in 2021.

- The three multilateral agreements for safeguards (Safeguards Agreements) in implementation of the Treaty on the Non-Proliferation of Nuclear Weapons concluded between the IAEA, Euratom and:
 - the non-nuclear-weapon EU Member States and its respective additional protocol¹⁷;
 - France and its respective additional protocol¹⁸;
 - the UK and its respective additional protocol, in force until the end of 2020¹⁹.

3.1. Euratom safeguards activities

Euratom safeguards activities under the Nuclear Cooperation Agreements with third countries

The European Commission maintains a system of accounting for and control of all items subject to the Nuclear Cooperation Agreements. The system is implemented in the framework of the Euratom Treaty and in conformity with the Safeguards Agreements with the IAEA. The activities performed under Article 77 (a) of the Treaty are the basis on which compliance with this provision is established. In addition, for compliance under Article 77 (b), the European Commission verifies whether operators respect the principles for accounting and tracking of nuclear materials subject to particular safeguard obligations²⁰.

All nuclear materials subject to particular safeguard obligations entered into by Euratom in an agreement concluded with a third country remained subject to both Euratom safeguards and IAEA safeguards in accordance with the respective agreements. These agreements were implemented in line with their respective administrative arrangements.

A total of 527 transfers of nuclear material subject to the agreements took place in 2020, while 727 nuclear material transfers were processed by the Commission in 2021²¹. The European Commission verified that all transfers and retransfers to/from relevant third countries were confirmed by the operators' reports and reconciled with information from these countries.

The Nuclear Cooperation Agreements with Australia, Canada, the USA and Japan require the parties to exchange annual balances of nuclear materials and other items subject to the Agreements. In 2020 and 2021 the European Commission provided in time the necessary balances for years 2019 and 2020, respectively, and in turn received annual balances from the partners.

In 2020, the European Commission authorized 5 requests for exchange of obligations²² on nuclear material between EU operators, while 12 similar requests were authorized in 2021.

¹⁷ OJ L 51, 22.02.1978, p. 1 (also published by the IAEA as INFCIRC/193) and OJ L 67, 13.03.1999, p. 1 (also published by the IAEA as INFCIRC/193/Add8).

¹⁸ IAEA documents INFCIRC/290 and INFCIRC/290/Add1.

¹⁹ IAEA documents INFCIRC/263 and INFCIRC/263/Add1.

²⁰ As provided for in Article 17 of Commission Regulation (Euratom) No 302/2005.

²¹ The increase of nuclear material transfers (~38%) in 2021 is due to the entry in force of the Euratom/UK Agreement probably combined with the economic recovery that followed the COVID-19 pandemic in 2020.

²² Obligation exchanges are transfers of obligation codes from one batch of nuclear material to another batch of equivalent amount, chemical and physical species; obligation exchanges are possible as long as the original obligation codes are maintained and the overall amount and quality of nuclear material subject to the

Permission to manage nuclear materials in an obligation pool²³ has been granted to some installations with complex industrial process. The monitoring of obligation pools is based on the principles of equivalence and proportionality in accordance with the Nuclear Cooperation Agreements as well as specific rules agreed with the operator.

Evolution in the implementation of the Nuclear Cooperation Agreements or in the technical characteristics of the installations may explain that pool arrangements, which once were found appropriate, need to be revised. In this regard, improvements were introduced in two obligation pools in 2020 and 2021. These improvements were related to procedures for waste accountancy.

Euratom safeguards activities under the Safeguards Agreements between Euratom, the EU Member States and the IAEA

The Safeguards Agreements define the procedures to be implemented in the Member States party to the relevant agreements in the framework of the IAEA safeguards system. The IAEA, in its verification, takes due account of the effectiveness of the Euratom safeguards system in accordance with the provisions of the Safeguards Agreements. The European Commission works closely together with the IAEA, a cooperation exemplified by the joint inspections of nuclear installations underpinned by the joint management and use of common instruments and tools.

The Treaty on the Non-Proliferation of Nuclear Weapons makes a distinction between non-nuclear-weapon States and nuclear-weapon States.

The Safeguards Agreement between the non-nuclear-weapon EU Member States, Euratom and the IAEA provides for close cooperation and arrangements for coordinated implementation of safeguards. In 2020-2021, the European Commission concluded²⁴ with the IAEA four Facility Attachments. These facility specific documents, which form a special part of the Subsidiary Arrangements, concluded on the basis of Article 39 of the Safeguard Agreement, reflect the individual requirements and procedures agreed in the Particular Safeguard Provisions (see section 2.1).

Whereas the Euratom safeguards activities were performed on all nuclear materials in peaceful use in France and the UK²⁵, IAEA safeguards inspections were only carried out in a limited number of civil nuclear installations in these States in accordance with the separate Safeguards Agreements voluntarily concluded by them, Euratom and the IAEA.

The European Commission activities related to joint Euratom/IAEA inspections and provision of information under the Safeguards Agreements are presented in the Annex.

The European Commission also undertook reporting to the IAEA on a voluntary basis of certain additional information concerning:

agreements is not reduced as a result (zero impact on the total inventory in the jurisdiction of the party where the exchange takes place).

²³ If the supplier so stipulates, full obligation accounting at an individual material balance area (MBA) level may not be required and MBAs (or certain materials within MBAs) may be grouped together. The technique of obligation accountancy for such groups is termed pool accountancy and is guided by the principles of equivalence and proportionality, as they are stipulated in the Agreements.

²⁴ According to Article 101(3) of the Euratom Treaty.

²⁵ 2020 was the last year of applying Euratom safeguards in the UK.

- production, inventories and international transfers of nuclear material and on exports of certain relevant equipment and non-nuclear material²⁶.
- its activities with americium and neptunium and the corresponding holdings.

3.2. Findings

Eight issues of different nature concerning the obligations assumed by Euratom under international agreements remained open at the end of 2021. Five of them concern incorrect accounting methods applied by operators that could imply a distortion on the stocks by obligation, while three of them concern the exchange of information with third countries. All open issues continue to be closely followed up by the Commission until the necessary corrections or improvements are made.

4. CONCLUSION

As a result of applying Euratom safeguards in the framework of the Euratom Treaty during the reported period, no evidence was found suggesting that nuclear materials were diverted from their intended uses in the EU. The safeguards obligations assumed by the Euratom Community under international agreements were complied with.

²⁶ IAEA documents INFCIRC/415.

ANNEX: BACKGROUND INFORMATION

EURATOM SAFEGUARDS VERIFICATIONS

The quality of verification activities depends inter alia on the competencies of Euratom inspectors, the internal quality control procedures, the efficiency of inspections and the technologies used for verification.

Euratom Inspectors

In 2020-2021, verification activities were performed by more than 120 Euratom inspectors from the Directorate-General for Energy, the Euratom Safeguards Directorate in particular.

An extensive and targeted training program is available to Euratom inspectors to assure a high level of technical skill and expert judgement. This program was appropriately modified during the COVID-19 pandemic period so that it remained available and operational albeit in remote attendance format.

In 2020, 37 safeguards relevant training courses were organised covering all the mandatory training needs, approximately two thirds of which in online format via virtual platforms. There were 311 individual participations to these courses by 133 staff members of the Euratom Safeguards Directorate.

In 2021, 41 safeguards relevant training courses were organised covering all the mandatory training needs, approximately half of which in online format. There were 251 individual participations to these courses by 115 staff members of the Euratom Safeguards Directorate.

Euratom Safeguards Quality Control Procedures

The Euratom Safeguards Directorate has a Quality Management System, which ensures that all safeguards activities are documented. Physical verification activities are recorded in inspection reports, analysed and the results are communicated to the operators.

When the safeguards assessment criteria are not met, observations are recorded and communicated to the operator, often accompanied by requests for corrective and/or preventive actions. These observations are followed up by the inspectors during subsequent inspections.

In 2020, 866 letters were sent to operators, transmitting the results of inspection activities. 114 of them contained observations as a result of identified non-conformities with the assessment criteria.

In 2021, 727 letters were sent to operators, transmitting the results of inspection activities. 74 of them contained observations as a result of identified non-conformities with the assessment criteria.

Technologies

The European Commission uses state-of-the-art measurement, analysis as well as containment and surveillance technologies such as:

- non-destructive techniques to determine the quantities and the characteristics of nuclear materials,
- destructive techniques for the determination of the characteristics of samples of nuclear materials with a high level of accuracy,
- conventional measurement methods for the determination of mass, volume and density,
- measurement systems that operate in unattended mode and collect data from a range of sensors,
- special Information Technology (IT) tools for the analysis of such data,
- fixed camera surveillance installations,
- laser-based scanning technologies for the detection of movement of materials or of changes in installations,
- seals for nuclear material containments.

These technologies can be coupled to remote data transmission, allowing a significant gain in inspection effectiveness and efficiency while ensuring a strong data security and minimizing the level of intrusiveness in the installation's processes and operation. The remote transmission of data, implemented in installations in several Member States, is expected to gain further importance in the coming years.

In addition, the European Commission operates an analytical laboratory for safeguards purposes on the site of the reprocessing plant in La Hague, France.²⁷

The European Commission's Joint Research Centre (JRC) performs the analysis of samples in the on-site laboratory at La Hague, the in-field analysis of samples taken during physical inventory verification campaigns at selected uranium fuel fabrication plants as well as the destructive analysis of samples taken in nuclear installations and sent to the JRC. The JRC also provides the relevant reference materials to ensure traceable and credible measurements. These analytical results form a vital part of the safeguards conclusions.

The JRC further provides research and development of above-mentioned safeguards technologies as well as relevant training for Euratom inspectors.

Most of the technologies used by Euratom inspectors are also approved by the IAEA, whereas some internal measurement instruments have exclusively been developed and approved in-house at the European Commission (or on its behalf).

Coverage by material balance areas

Full scope safeguards verification activities, i.e., coherence checks, physical verifications and material balance evaluation, have been applied to:

- 454 material balance areas (MBAs), which represent 64% of the MBAs²⁸, holding 99.83 % of the relevant nuclear material present in the EU and the UK in 2020;

²⁷ The European Commission operated an analytical laboratory for safeguards purposes on the site of the reprocessing plant in Sellafield, the UK, by the end of 2020.

²⁸ For this calculation, the Catch-all MBA (grouping more than 290 users holding very small amounts of nuclear materials) is counted as one MBA.

- 384 material balance areas (MBAs), which represent 67% of the MBAs²⁸, holding 99.95 % of the relevant nuclear material present in the EU in 2021.

The coverage of MBAs holding 99.83% or 99.95% of all relevant nuclear materials in the EU does not de facto imply that all these materials were physically verified, as the radiation protection constraints, inaccessibility of the material, or undue operational burden on the operator render such an approach unmanageable. However, the combination of accountancy and physical verifications with video surveillance and sealing did not indicate any suspicion of diversion of the material.

Installations with a higher perceived risk of diversion of nuclear materials were inspected more intensely and more frequently. Physical verification inspections do not take place every year in installations with very small amounts of nuclear materials.

A summary of the inspection activities performed in the years 2020 and 2021 is presented below in Tables 1 and 2 respectively.

Table 1. Summary of inspection activities carried out by Euratom inspectors in 2020.

²⁹ Installation type	Number of person-days of inspection	Number of on-site inspections	Number of MBAs covered	³⁰ Average number of person-days of inspection per MBA
Enrichment plants, fuel fabrication plants and associated installations	1175	216	94	12.5
Power reactors	531	318	137	3.9
Reprocessing plants and associated installations	791	117	63	12.6
Storages, research centres and small installations	498	298	412	1.2

The higher number of average person-days of inspection per MBA in reprocessing, enrichment and fabrication plants is due to the fact that these installations hold nuclear materials in bulk form, making verifications more difficult. Moreover, the design of these installations is more complex, and they hold significant amounts of nuclear materials, or possess the capability to produce them.

To provide sufficient confidence in the verification results, these installations were inspected more comprehensively. Due to the amount and/or the limited accessibility of nuclear materials during operational use or storage, the verification in bigger installations was performed by random sampling. The sampling approach was complemented by containment (seal checks), surveillance (video analysis) controls and unattended measurement systems to verify the operator declarations.

²⁹ An installation can have more than one material balance area.

³⁰ The difference between the 2020 and 2021 figures can be explain by the impact of COVID-19 restrictions in 2020.

Table 2. Summary of inspection activities carried out by Euratom inspectors in 2021.

²⁹ Installation type	Number of person-days of inspection	Number of on-site inspections	Number of MBAs covered	³⁰ Average number of person-days of inspection per MBA
Enrichment plants, fuel fabrication plants and associated installations	1153	197	61	18.9
Power reactors	500	312	119	4.2
Reprocessing plants and associated installations	461	59	18	25.6
Storages, research centres and small installations	680	335	373	1.8

Coverage by type of nuclear materials

In 2020, the verification activities performed by Euratom inspectors spanned over 706 active³¹ MBAs in the EU and the UK, holding on 31 December 2020³² the stocks of nuclear materials indicated below in Table 3.

In 2021, the verification activities performed by Euratom inspectors spanned over 571 active³¹ MBAs in the EU, holding on 31 December 2021³³ the stocks of nuclear materials indicated below in Table 3.

Table 3. Stocks of nuclear material types under Euratom safeguards at the end of the years 2020 and 2021.

Type of Nuclear Material	Quantity in 2020 (tons)	Quantity in 2021 (tons)
Depleted Uranium (DU)	456 596	364 470
Natural Uranium (NU)	53 957	46 480
Low Enriched Uranium (LEU)	98 316	84 929
High Enriched Uranium (HEU)	9	9
Plutonium	987	837
Thorium	6 348	6335

³¹ Material balance areas where nuclear materials are used and/or produced.

³² As from accountancy declarations available by 16 February 2021.

³³ As from accountancy declarations available by 20 January 2022.

Full scope safeguards verification activities were not applied in 16 MBAs in 2020 and in 7 MBAs in 2021, holding 0.6 significant quantity³⁴ or more of nuclear material. The quantities of nuclear material types in these MBAs are indicated below in Table 4.

Table 4. Quantities of nuclear material types in installations holding 0.6 significant quantity or more of nuclear material where full scope safeguards verification activities were not applied in the years 2020 and 2021.

Type of Nuclear Material	Quantity in 2020 ³⁵	Quantity in 2021
Depleted Uranium (DU)	20 tons (<0.01%)	15.2 tons (<0.01%)
Natural Uranium (NU)	508 tons (0.94%)	18.7 tons (0.04%)
Low Enriched Uranium (LEU)	437 tons (0.44%)	112 tons (0.13%)
High Enriched Uranium (HEU)	7 kg (0.08%)	8 kg (0.09%)
Plutonium	5 tons (0.56%)	774 kg (0.09%)
Thorium	361 kg (<0.01%)	5 tons (0.08%)

³⁴ Significant quantity is the approximate amount of a given type of nuclear material that is required for the manufacturing of a nuclear explosive device.

³⁵ Due to the restriction related to COVID-19 pandemic, physical inventory verifications in some MBAs were postponed from 2020 to Q1/2021 and not reflected in those figures.

EURATOM SAFEGUARDS ACTIVITIES UNDER THE SAFEGUARDS AGREEMENTS BETWEEN EURATOM, ITS MEMBER STATES AND THE IAEA

IAEA activities under the Safeguards Agreements in force apply to all nuclear material in the Non-Nuclear-Weapon States (NNWS) of the EU and to a small number of specifically selected installations in the Nuclear-Weapon States (NWS) France and the UK. The European Commission and IAEA verification activities strongly complemented each other. This required close day-to-day cooperation both for defining safeguards approaches and for their practical implementation. The background information below illustrates the implementation of the respective Euratom obligations.

Coverage

In 2020, the Safeguards Agreements applied to 614 material balance areas (MBAs) in the EU and the UK. The number of MBAs decreased to 514 in year 2021, due to the end of the agreement with the UK. The distribution of MBAs depending on their status and specific Safeguards Agreement with the IAEA is shown below in Table 5.

Table 5. Status of MBAs under IAEA safeguards in the years 2020 and 2021.

MBAs	Active ³¹		Closed down	
	2020	2021	2020	2021
NNWS	371	375	97	100
France ³⁶	38	38	1	1
UK ³⁷	73		34	

In addition, 443 users of very small amounts of nuclear materials (293 active and 150 closed down) were members of the virtual ‘Catch all MBA (CAM)’³⁸ in 2020. In 2021, the number of the CAM members was 453 (291 active and 162 closed down).

In 2020, 526 inspections in the NNWS and in a small number of designated installations in the UK and France were carried out together with the IAEA. In 2021, 540 inspections in the NNWS and in a small number of designated installations in France were carried out together with the IAEA. These joint inspections were performed as agreed under the New Partnership Approach applying the principle of One-Job-One-Person. Table 6 below presents the joint inspection effort by nuclear installation types.

³⁶ MBA’s list established by the French national authorities in the framework of its voluntary safeguards agreement INFCIRC/290.

³⁷ MBA’s list established by the British national authorities in the framework of its voluntary safeguards agreement INFCIRC/263.

³⁸ A material balance area comprising holders of very small amounts of nuclear material with limited reporting obligations located in 12 NNWS.

Table 6. Joint Euratom/ IAEA inspections in nuclear installations in the years 2020 and 2021.

Installations	Reprocessing	Enrichment, Fabrication	Power reactors	Storage & others	Total
Joint Euratom/ IAEA Inspections in 2020	11	61	218	236	526
Joint Euratom/ IAEA Inspections in 2021	4	58	217	261	540

Provision of information

To meet European Commission obligations stemming from the Safeguards Agreements, the European Commission verified and provided to the IAEA the following information and requests in 2020-2021:

- Approximately 4 440 accountancy reports³⁹ (2 522 for the EU non-nuclear-weapons States, as well as 1 918 for the UK and France) corresponding to approximately 1.63 million accountancy records in 2020, and 3 512 accountancy reports (2 612 for the EU non-nuclear-weapons States, as well as 900 for the UK⁴⁰ and France) corresponding to approximately 1.14 million accountancy records in 2021. The IAEA's requests for clarifications and corrections of accountancy reports were dealt with in a timely manner;
- Advance notifications of imports and exports of nuclear material and items received and processed by the EC:
 - in 2020: 1120 advance notifications, among which 1116 concerned transfers of nuclear material and 4 concerned transfers of nuclear equipment;
 - in 2021: 1342 advance notifications⁴¹, among which 1224 concerned transfers of nuclear material, 30 concerned transfers of nuclear equipment and 88 concerned nuclear technology transfers;
- In 2020: 16 new registrations of installations (facilities and LOFs)⁴², 24 operational status changes and 12 other types of changes. In 2021: 19 new registrations of facilities and LOFs, 21 operational status changes and 7 other types of changes;
- 15 requests for exemption from IAEA safeguards in 2020, and 26 such requests in 2021;
- 13 requests for termination of IAEA safeguards in 2020, and 11 such requests in 2021;
- 77 Basic Technical Characteristics (BTCs)/ Design Information Questionnaires (DIQs)⁴² in 2020 and 112 BTCs/DIQs in 2021;

³⁹ Inventory Change Report (ICR), Physical Inventory Listing (PIL), Material Balance Report (MBR).

⁴⁰ Some accountancy reports for 2020 were provided in early 2021.

⁴¹ The year 2021 also includes the transfers to and from the UK (230 in total) following the entry into force of the Euratom/UK Agreement.

⁴² IAEA terminology.

- Reapplication of IAEA safeguards on previously exempted nuclear materials performed in 2020 and 2021.

The European Commission provided the IAEA with 429 declarations under the Additional Protocols in 2020 and 421 such declarations in 2021.

The total number of registered sites under the Additional Protocol to the Safeguards Agreement with NNWS amounted to 189 at the end of year 2020 and to 188 at the end of 2021.

Complementary Accesses

Under the Additional Protocols, the IAEA has the right to access locations it considers necessary for verifying the absence of undeclared nuclear material and activities. The minimum notification time before such a ‘Complementary Access’ (CA) is either 24 hours, or 2 hours if announced during an inspection. In 2020, 31 CAs took place, among which 23 were triggered at installations declared as ‘sites’. In 2021, 33 CAs took place, among which 21 were triggered at installations declared as ‘sites’.

In 2020, 23 of those CAs were performed with 24-hour notification time and 8 with 2-hour notification time. In 2021, 30 CAs were performed with 24-hour notification time and 3 with 2-hour notification time. The European Commission was represented in 26 CAs in 2020, 30 CAs in 2021, assisting both IAEA and operators in clarifying their rights and duties.

The IAEA, in its statement following each CA, concluded that it was able to carry out all planned activities and there was no indication of undeclared activities.

Requests of amplifications and clarifications

In 2020, the IAEA submitted to the European Commission 16 requests for amplification and clarification under the Additional Protocols. All of them were answered. In 2021, the IAEA submitted to the European Commission 33 requests for amplifications and clarifications: 32 requests were answered; for the remaining one, the corresponding State authority was contacted and the answer was pending at the end of 2021.