COMMISSION OF THE EUROPEAN COMMUNITIES

Brussels, 26.07.2001
COM(2001) 436 final

REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL

Operation of the Euratom Safeguards Office 1999-2000

REPORT FROM THE COMMISSION
TO THE EUROPEAN PARLIAMENT AND THE COUNCIL

Operation of the Euratom Safeguards Office 1999-2000

1. EXECUTIVE SUMMARY

The task of the Euratom Safeguards Office is to ensure that within the European Union nuclear material is not diverted from its intended use and that safeguarding obligations assumed by the Community under an agreement with a third state or an international organisation are complied with.

This document describes the role and the legal basis of the Euratom Safeguards Office and reports on its operation for the period 1999–2000. It also provides some information on current developments and includes an outlook for the future.

As a result of its activities in 1999 and 2000, and subsequent evaluations, the Euratom Safeguards Office did not find any indication that nuclear material had been diverted from its intended peaceful use. Small discrepancies found during inspections or the material balance evaluation were rectified or are still being investigated with the operators concerned.

2. NUCLEAR MATERIAL SAFEGUARDS

2.1. What is Nuclear Material Safeguards?

Safeguards is the set of measures performed by the controlling authority to verify that nuclear material and equipment are not diverted from their intended (peaceful) uses, e.g. are not used to produce nuclear weapons. The aim is to allow the use of nuclear energy whilst ensuring that civil nuclear material remains in peaceful nuclear programmes.

Nuclear materials include all substances containing one or more isotopes of thorium, uranium, or plutonium. The relative safeguards significance of these materials depends on their physical form, chemical and isotopic composition, concentration and their status as fresh or irradiated material. Unirradiated plutonium and high–enriched uranium[1] (HEU) are considered as having the highest strategic value for safeguards. Nuclear activities comprise the mining and conversion[2] of uranium, its enrichment[3], fabrication[4] into fuel elements for electricity generation in nuclear

[1] HEU is uranium enriched to more than 20 % uranium–235.
[2] A chemical process for converting uranium into uranium hexafluoride as feed material for an enrichment plant.
[3] An isotope separation process for increasing the abundance of uranium–235 in uranium.
[4] The manufacturing of fuel assemblies for use in nuclear power reactors.

power reactors, reprocessing[5], storage of nuclear materials, and final disposal of nuclear waste.

Nuclear material safeguards should not be confused with nuclear safety, physical protection or ensuring the protection of human beings and of the environment from the hazards of ionising radiation.

2.2. The Legal Basis of Euratom Safeguards

The Treaty establishing the European Atomic Energy Community, commonly called the Euratom Treaty, constitutes the legal basis of Euratom Safeguards. It covers all civil nuclear materials in the European Union from the moment they are mined (in the European Union) or arrive, in any form, from outside the European Union. The responsibilities and rights of all parties are specified in Chapter VII of the above Treaty. The obligation to implement the Treaty provisions is given to the European Commission.

The Treaty specifies that:

– The Commission shall satisfy itself that in the territories of the Member States nuclear materials are not diverted from their intended uses and that particular safeguarding obligations assumed by the Community under an agreement concluded with a third state or an international organisation are complied with (Art. 77).

– Operators of nuclear installations shall declare to the Commission their Basic Technical Characteristics[6](BTC) (Art. 78§1);

– The Commission must approve the techniques for the chemical processing of irradiated materials (Art. 78§2)

– The Commission shall require that operating records be kept and produced for nuclear materials used, produced or transported (Art. 79);

– The Commission may send inspectors that at all times have access to all places, data and persons dealing with materials, equipment or installations subject to safeguards (Art. 81);

– The Commission may impose sanctions in the event of an infringement of the safeguards obligations (Art. 83) and Member States shall ensure that they are enforced;

– No discrimination on the grounds of use is permitted and safeguards may not extend to materials intended to meet defence requirements (Art. 84).

The nature and the extent of the requirements referred to in Articles 78§1 and 79 are defined in the Euratom Regulation No. 3227/76 and subsequent amendments. These

---

5 Separation of uranium and plutonium in spent fuel from highly radioactive fission products.

6 The Basic Technical Characteristics is a declaration by the plant operator to the Commission that contains information on the design, operation and accountancy system of the installation that is of safeguards relevance.

documents define mainly the obligations of operators of nuclear installations towards the Commission.

2.3. World-wide safeguards and the role of the United Nations

World–wide safeguards are the responsibility of the International Atomic Energy Agency (IAEA), an organisation of the United Nations. It performs its activities under the Non–Proliferation Treaty (NPT) to which all European Union Member States have adhered. All nuclear material and activities in the 13 Non–Nuclear Weapon States of the European Union are subject to IAEA safeguards as established in the Safeguards Agreement between the IAEA, the Community, and the Member States, also referred to as the Verification Agreement. The United Kingdom and France, the two Nuclear Weapon States of the European Union, have submitted their civil nuclear material to IAEA safeguards under separate Safeguards Agreements between the IAEA, the Community and the UK and France respectively. In these Member States, the IAEA conducts safeguards inspections in only a limited number of installations: those that have been designated by the IAEA for this purpose and selected from a list submitted by each State. Within the European Union, IAEA safeguards are implemented in close co-operation with Euratom safeguards. All Safeguards Agreements with the IAEA stipulate that the IAEA shall make full use of the Euratom safeguards system and shall avoid unnecessary duplication of Euratom safeguards activities. The mechanism of this co–operation is detailed in a series of understandings and working arrangements (see also 6.4).

3. SCOPE AND SURVEY OF EURATOM SAFEGUARDS

Persons and undertakings holding nuclear material (operators) have to provide the Commission with the Basic Technical Characteristics (BTC) of their installation following a detailed questionnaire. The information required includes a description of the nuclear material used and how it is handled, as well as the system of nuclear material accountancy control. Any changes to the BTC must be communicated to the Commission.

The operators must establish and maintain a system of nuclear material accounts when they start handling such material. Features of this material accounting system are that all parts of the installation in which nuclear material may be found, have to be allocated to a series of Material Balance Areas[7] (MBA). The operators also have to notify regularly their programme of activities, including the programme for the taking of physical inventories. In addition, operators have to notify in advance certain transfers, imports, and exports of nuclear material.

Commission inspectors of the Euratom Safeguards Office (ESO) are deployed in order to verify that the operators fulfil the safeguards obligations of the Treaty and the implementing Commission Regulation. They conduct inspections at the nuclear installations in order to check:

---

7 An area in a nuclear installation defined in such a way that the nuclear material quantity in each transfer into or out of this area can be determined, and the physical inventory of nuclear material in this area can be determined when necessary, in order that the material balance for safeguards purposes can be established.

- the operators’ declaration of the BTC;
- the operators’ nuclear material accountancy and operating records;
- the consistency of these records with the reports on inventory changes and physical inventory takings, made periodically to the Commission; and,
- the consistency of physical reality with these records and reports.

The Euratom Safeguards Office has an appropriate infrastructure to support its inspection activities. It handles all accounting reports and notifications from operators, processes them, and provides the basic data the inspectors need for verification. It also provides logistical support in making measurement instruments, seals, cameras, and other devices available to the inspectors, and in analysis of samples taken for the inspectors.

For the verification and control of the material, the Euratom Safeguards Office can draw on a range of technological resources. Non-destructive assay (NDA) instruments are available for direct measurements of the quantity of plutonium and uranium in different forms. Many such instruments are permanently installed at nuclear installations. For calibration purposes, special reference materials prepared for Euratom, are used. For certain bulk products, such as uranium hexafluoride and input and output solutions in reprocessing plants, samples are routinely taken and sent for analysis either to the Joint Research Centre's laboratories or to the Euratom on–site laboratories (see also 5.1). Finally, containment and surveillance measures ensure that the continuity of knowledge relating to specific nuclear material or a place of work is maintained. To this end, optical surveillance units are installed which, for example, take photographs at determined intervals. The images are extracted periodically, and the records reviewed. Extensive use is made of seals, particularly for material that may stay unchanged between verifications. The Euratom Safeguards Office operates a secure computer system for the storage, retrieval, and analysis of reported data, for the preparation of the reports for the IAEA, for on-site evaluation of measurement results, and for the verification and evaluation of operators' data.

The Euratom Safeguards Office does not itself conduct any research but relies on the support provided by the Commission's research facilities at the Joint Research Centre. It should also be noted that an increasing proportion of instrumentation and equipment used for safeguards purposes is now available from commercial sources, thereby reducing the related R&D costs and resulting in an increased efficiency.

All inspection activities and results are evaluated. A first assessment and evaluation is made during inspections, mostly to confirm the consistency of data and absence of major discrepancies. A more detailed evaluation is carried out at headquarters including the checking of containment and surveillance data, the evaluation and statistical analysis of measurement results, and the evaluation of material balances.

The results of such evaluations can show up discrepancies that require explanation. In such cases, the Euratom Safeguards Office will initiate follow-up actions. They range from requesting the operator to explain apparent anomalies, stepping up inspection frequency and intensity, or changing the inspection strategy. If problems persist, the option of proposing sanctions may be considered.

4. 1999/2000 INSPECTION ACTIVITIES AND RESULTS

4.1. Nuclear Material Quantities

The European Union area contains the full range of nuclear fuel cycle activities, although they are not evenly dispersed throughout the Member States. The nuclear material inventories in the installations under safeguards are constantly increasing (see Table 1). The increase in plutonium stocks during the last decade by more than 150 percent to about 530 tonnes at the end of 2000 is of special safeguards interest because of the sensitive nature of this material. During the same period, the uranium inventory in the European Union increased by more than 50 percent to about 313000 tonnes at the end of 2000.

The nuclear installation operators report all nuclear material inventories and flows to the Euratom Safeguards Office. They amount to about 1,5 million accountancy lines per year, the large majority of which is received by electronic means. All these data are checked for internal and external consistency (transit matching) and compliance with Co-operation Agreements (see also paragraph 6.5). All errors and inconsistencies revealed during the period 1999-2000 could be corrected after consultation with the operators involved.

Accountancy reports are sent to the IAEA in fulfilment of the obligations, undertaken by the European Union in the framework of its Safeguards Agreements with the IAEA. During the period covered by this report, reporting to the IAEA was accomplished within the deadlines required by the Agreements.

4.2. Inspection Effort, Distribution and Results

During the reporting period the Euratom safeguards activities were dominated by activities in the large plutonium processing installations, such as reprocessing facilities and plants for the fabrication of Mixed Oxide Fuel[8] (MOX). Of the total of 17000[9] person days spent during inspections in the reporting period more than 60 percent were performed in these installations (see also Table 2). Another important share of the Euratom inspection effort was spent in installations for the enrichment of uranium and the subsequent fabrication of fuel elements with low enriched uranium, which made up almost 20 percent of the overall inspection effort. More than 15 percent was spent in safeguarding nuclear power reactors. Installations for the dry storage of spent fuel, research centres, research reactors and small installations account for the remaining 5 percent of the effort spent.

4.2.1. Reprocessing Facilities

At reprocessing facilities, spent fuel assemblies received from power reactors are processed chemically to separate uranium and plutonium from the highly radioactive fission products. The separated nuclear materials can be re-introduced in the nuclear fuel cycle. The modern facilities in Sellafield, UK (THORP) and La Hague, France

---

[8] Mixed Oxide Fuel is nuclear reactor fuel consisting of a mixture of the oxides of uranium and plutonium.

[9] This represents an average of about 70 days of inspection per year and per operational inspector.

(UP2, UP3) are characterised by a high throughput[10] and highly automated and encapsulated processes.

Physical Inventory Verifications involving a run down of the installations are carried out annually. They normally coincide with the interval between reprocessing campaigns and/or major maintenance outages. Continuous inspections and automated unattended safeguards systems are required to verify the nuclear material flows in (spent fuel) and out (mainly uranium and plutonium oxide) of the facilities.

At THORP, the trial period has now ended and safeguards implementation has entered a routine phase. The collection and evaluation of data from the installed safeguards instrumentation were brought up to date. All activities necessary for granting the approval under article 78§2 of the Euratom Treaty (see also 2.2) were finalised and it is expected that formal approval will be granted by the Commission in early 2001.

The Sellafield site also has some older reprocessing facilities for the treatment of so-called Magnox-fuel from specific British–designed reactors. These facilities were inspected routinely with satisfactory results.

All main plutonium input and output flows and inventories of the UP2/800 and UP3 reprocessing plants at La Hague were verified and allowed the ESO to confirm the operator’s declarations. The ESO was able to draw satisfactory safeguards conclusions but in a number of cases not within the required detection time[11] due to delays in the declaration by the operator of certain results of chemical analyses. The operator has initiated actions to improve the situation.

The basic technical characteristics of the new UP2/800 plutonium conditioning unit « R4 » have been evaluated in depth during the reference period: studies of engineering drawings, on site verifications of main circuits, and verification of the calibration of 10 tanks have been carried out.

The reprocessing plant at Dounreay in the United Kingdom did not operate during the reporting period because of an earlier accidental shutdown. Difficulties were experienced by the inspectors in verifying the physical inventory in this installation. A series of measures were agreed between the Euratom Safeguards Office and the operator, and eventually implemented, which enabled the Euratom Safeguards Office to conclude a successful Physical Inventory Verification in October 2000.

4.2.2. Installations for the Fabrication of Mixed Oxide Fuel (MOX)

In MOX Fuel Fabrication Plants, the plutonium oxide produced in reprocessing installations is used in a mixture with uranium oxide to fabricate MOX fuel elements for subsequent use in nuclear power plants. Of the four existing plants in the European Union, the MELOX plant at Marcoule, France and the new Sellafield

---

[10] The total annual throughput of these three facilities adds up to over 3000 tonnes of fuel containing more than 20 tonnes of plutonium.

[11] Detection time is the maximum time that may elapse between diversion of nuclear material and its detection by the safeguards authorities. Typically, the detection time for un–irradiated plutonium or high enriched uranium is one month.

MOX plant (SMP) represent the most modern installations of this kind, including fully automated systems with process and stored material practically inaccessible.

MOX fuel fabrication plants are important for safeguards as they handle separated plutonium. Inspections are carried out on a continuous basis in order to verify receipts and shipments of plutonium, and to meet the timeliness goals for plutonium of one month. One annual PIV is normally carried out. In order to reduce the disruption to plant activities, and dose uptake by inspectors and facility staff, use is made of automated measuring equipment and containment and surveillance (C/S) measures wherever possible. As much as possible of the plutonium in the facilities is kept under C/S to reduce the requirement for monthly re-measurement of the material.

In the MELOX MOX fuel fabrication plant a specially adapted safeguards system provides continuous assurance of non-diversion. The inspection scheme was upgraded and the unattended verification equipment was expanded to accommodate the recent increase in the plant's production capacity and the extension of its production lines. Preparations were started with the IAEA to verify jointly the shipments of finished MOX fuel assemblies to Japan.

The Sellafield MOX fabrication plant (SMP) is expected to enter into operation (plutonium commissioning) in mid 2001. All safeguards instrumentation, which is of a highly sophisticated and automated nature, has been installed and is being commissioned. The Basic Technical Characteristics (BTC) have been verified.

The results of the safeguards inspections in the MOX-Demonstration-Facility (MDF), also located in Sellafield, were satisfactory. This facility was definitively closed down at the end of the reporting period but nuclear material still remains in the plant.

In the MOX fabrication installation in Cadarache, the ESO recently implemented a new safeguards approach. This implementation has been successful and has now reached a routine phase.

The Belgian MOX fabrication facilities at Dessel were inspected by the Euratom Safeguards Office and the IAEA with good results. During the reporting period, the implementation of the New Partnership Approach (NPA) with the IAEA was completed in this area. In this context, the technical equipment installed was upgraded and complemented in order to cover all inspection activities envisaged.

For the safeguarding of fresh MOX fuel destined for Japan in transit at La Hague, a new common safeguards approach was worked out and successfully implemented with the IAEA. During the reporting period, two campaigns took place on material originating from FBFC, Belgium.

The safeguards measures to be implemented during the decommissioning phases of the fuel fabrication plant at the Hanau site in Germany were established and new safeguards equipment was installed.

4.2.3. Enrichment Facilities

Modern Light Water Reactors need fuel with about 3 to 5 percent of the fissionable uranium isotope U235. As natural uranium contains only 0.7 percent of this nuclide, an enrichment process is needed to achieve the desired concentration. Gaseous uranium hexafluoride (UF_6) is used as the process medium. In the European Union, two companies offer this service for civil customers: URENCO and EURODIF. URENCO operates three centrifuge plants at Almelo (NL), Capenhurst (UK) and Gronau (D). EURODIF has a diffusion plant at Tricastin, France. Theoretically, all enrichment plants can be used for the production of high-enriched uranium. Therefore, they are of high relevance and strategic importance for safeguards.

The routine application of Safeguards at centrifuge enrichment plants is always conducted together with the IAEA and involves one Physical Inventory Verification (PIV) per year. In addition, there are intermittent inspections at approximately monthly intervals to cover the verification of the throughput. A further number of unannounced inspections are carried out to check that the sensitive process areas have not been re-configured to produce uranium at a higher enrichment than declared.

In the EURODIF enrichment plant, the setting up of a full safeguards approach that meets the Euratom requirements was progressed and its MBA structures revised.

At the three URENCO facilities, which have undergone significant expansions in production capacity over the last two years, High Performance Trace Analysis[12] (HPTA), a new and powerful particle analysis technique has been applied. Developed in close collaboration with the IAEA (which calls the method Environmental Sampling), this method is used to provide timely detection of enrichment at levels beyond declared and in particular, the clandestine production of high enriched uranium. During 1999-2000, a large number of swipe samples were collected at these installations and analysed in order to establish a baseline database for future reference. This method, which is also used within the restricted access zone of the process, considerably enhances the safeguards effectiveness in such plants.

4.2.4. *LEU[13] Fuel Fabrication Plants, HEU[1] Fuel Fabrication Plants, Conversion Facilities*

At LEU Fuel Fabrication Plants, fuel assemblies are produced from low enriched uranium (LEU) for subsequent use in nuclear power plants. Conversion facilities are often co-located with this installation type and are needed to convert the enriched UF_6 produced in the enrichment facilities back to uranium oxide or to produce UF_6 from natural uranium oxide before enrichment. In HEU Fuel Fabrication Plants, fuel elements for research reactors using high-enriched uranium (HEU) are manufactured.

In the European Union, LEU Fuel Fabrication Plants are operational in Belgium, France, Germany, Spain, Sweden, and the UK. In these plants, the ESO normally performs a Physical Inventory Verification (PIV) each year. This involves a comprehensive verification of all material while production is stopped. Itemised lists of the inventory are verified for completeness as well as correctness, and the

12 High Performance Trace Analysis, or Environmental Sampling, is a safeguards technique that includes the taking and subsequent analysis of swipe samples taken inside or outside nuclear installations. It allows the confirmation of past and present nuclear activities in the area that has been sampled through the analysis (mainly particle analysis) of the traces of nuclear material collected on the swipe.

13 LEU is uranium enriched up to and including 20 % uranium–235.

verification includes the taking of samples for detailed analysis in laboratories, in addition to measurement of items by inspectors using portable instrumentation. Intermittent inspections (7-11 per year), concentrating mainly on the verification of inputs and outputs, take place between the PIVs.

While the LEU Fuel Fabrication Plants in France were inspected more intensively than in the past, the ESO has not yet achieved a level of control of similar installations elsewhere in Europe. Significant progress has been made, particularly in the computerised data treatment and the preparation of an unattended station for the measurements of product fuel assemblies.

Regarding the HEU Fuel Fabrication Plant in France, a main issue remains the common use of parts of the installation for defence and civil purposes. Although normally the production campaigns are clearly separated, the information flow and the access granted to the inspectors are limited in certain cases by security requirements imposed by the defence authorities. This prevented ESO from drawing full safeguards conclusions for this plant. Discussions continue with the French authorities to resolve this problem.

Progress was made in setting up a full safeguards approach that meets the Euratom requirements in a French conversion and storage plant, including a revision of the MBA structure. Access problems in certain areas of the plant were successfully resolved.

The nuclear fuel for the UK electricity-generating reactors is manufactured in Springfields. The last few years and especially 1999/2000 have been characterised by the migration of AGR (Advanced Gas Cooled Reactor) fuel production from very old manufacturing facilities to the new Oxide Fuel Complex (OFC), a unit that consolidates the complete process from conversion to fuel element assembly. OFC has become the focal point of safeguards activities at the Springfields site. Considerable progress has been achieved in equipping some of the most inaccessible areas with automated measuring systems in order to achieve safeguards objectives while attaining important inspection resource savings.

4.2.5. *Nuclear Power Reactors*

Most of the nuclear power reactors operated in the European Union are of the Light Water Reactor type (LWR), i.e. the reactors are cooled and moderated with normal water. In addition, the UK operates MAGNOX and Advanced Gas Cooled Reactors (AGR) which are moderated with graphite and cooled with CO_2 gas. The operation of LWRs using LEU is characterised by long periods (12-18 months) of continuous operation. These periods, when the in-core fuel is inaccessible, are followed by outages typically lasting 2-4 weeks when about one third of the (used) core fuel is exchanged for fresh fuel from Fuel Fabrication Plants.

LWRs are inspected during this outage period when all the fuel is accessible for verification. In situ verification techniques, involving expeditious testing for attributes of fuel, are employed, on fuel discharged from the core. When such verifications do not lead to conclusive results, other more intrusive techniques, which may involve handling of the spent fuel, may be used. In addition to these direct verification techniques, cameras are installed and seals are used at some LWRs in order to facilitate oversight of the fuel and fuel handling activities. Intermittent inspections, to the extent that resources permit, are carried out typically at quarterly intervals between outages.

A number of LWRs use MOX fuel elements to consume the plutonium produced under their reprocessing contracts. Inspections dedicated to verify these fuel elements in the Non Nuclear Weapon States have been assigned a higher priority over the past two years with the result that safeguards implementation in these installations was significantly improved.

4.2.6. Installations for the Dry Storage of Spent Fuel

A number of EU Member States have adopted a policy that will, in time, include the direct disposal of spent fuel at geological repositories. Before these disposal sites are operational, the spent fuel is stored under water in storage ponds or in shielded storage casks under dry conditions. Storage installations can be located away from the reactor at dedicated central facilities or at the reactor site itself.

As nuclear material becomes inaccessible for direct verification after loading in shielded storage casks, all spent fuel elements being transferred to these casks are systematically verified. Thereafter, the knowledge on the material is kept by containment and surveillance measures such as sealing, video surveillance etc. This activity is very time consuming and especially delicate in terms of planning. The ESO therefore started the installation of unattended measurement stations that significantly reduce inspector resource requirements.

Many spent fuel storage ponds are now at the limit of their capacity. Alternative solutions have therefore been implemented such as outside reactor storage in concrete bunkers or on-site dry storage installations, all of which require adequate safeguards measures.

4.2.7. Other Installations

Routine safeguards started on large quantities of nuclear material that was brought under Euratom safeguards through the Strategic Defence Review programme of the British government.

The development of the new Research Reactor FR2 in Germany was followed and a safeguards approach was developed. This facility is an important scientific resource but does not represent a particular safeguards issue, even if it is operated with HEU.

Deficiencies in the internal nuclear material follow-up in a Research Centre in Sweden resulted in the refusal by the ESO to accept the 2000 Physical Inventory Taking (PIT). The problem was resolved by a review of the operator’s working procedures following recommendations made by the ESO and a successful repetition of the PIV shortly afterwards.

The 2000 Physical Inventory Taking (PIT) of a waste store in the United Kingdom was also refused by the ESO. The operator took the necessary corrective actions and repeated the Physical Inventory Taking; a new PIV is expected early in 2001.

An important verification problem appears in some installations (e.g. in Cadarache and Sellafield) where old plutonium-holding materials are stored. Difficulties of access and handling due to radiation protection and safety reasons, do not permit full routine safeguards activities to be performed. However, the *status quo* was preserved by containment and surveillance systems.

4.3. Concluding remarks

The verification activities by the Euratom Safeguards Office during the reporting period did not give any indication that nuclear material, which had been declared and placed under Euratom safeguards, had been diverted from its intended uses.

The Euratom Safeguards Office has put a lot of effort into clarifying shortcomings in some operators' nuclear material accountancy. Operators receive systematic feedback from the ESO verification activities, which, in turn, has resulted in improvements in the quality of nuclear material accountancy in the various installations.

In a number of cases, discrepancies found during inspections or the material balance evaluation, in particular "Material Unaccounted For" MUF[14] figures, required intensive follow-up by all concerned. There is no alternative to conscientious investigation and continuous dialogue with the operator in such cases.

Safeguards instrumentation, very often unattended or even with remote data transmission, is increasingly used to improve the safeguards effectiveness in the different installations. These tools require still a large amount of human intervention for installation, maintenance, or troubleshooting.

Electronic equipment, related software, as well as evaluation tools have reached an adequate level of maturity for inspection use. Their implementation has significantly helped rationalising inspection planning and reporting.

5. LOGISTICS AND TECHNICAL ACTIVITIES

5.1. Safeguards Techniques and Logistics

Safeguards techniques and logistics cover the technical means by which the inspectors assure themselves that the physical quantities of nuclear material correspond to the accountancy values (see also 3).

Some of the equipment is mobile and transported from headquarters for inspection use. Examples include sealing devices, radiation detectors, and surveillance systems. In addition, the ESO has a large inventory of equipment (including computers) that is installed in many nuclear facilities in the European Union. For all types of equipment, routine activities include procurement and maintenance.

During the period of this report all safeguards equipment was upgraded to prepare for the Y2K transition.

---

14 MUF is the difference between the physical inventory and the book inventory of nuclear material in an installation.

The priorities in the area of logistics are to save inspection manpower, to improve the reliability of the equipment and cost-effectiveness by the use of modern technology. The most important projects during the reporting period were:

– Implementation of digital video surveillance systems. The use of commercial standards will reduce the ESO's dependence on systems developed only for Safeguards, and an improvement on reliability is intended. This will reduce investment and support costs.

– Development of a new transponder seal. The aim is to replace the ageing copper/brass seal, with an electronic device that can be verified in-situ.

– Commissioning and start–up of two on-site laboratories (Sellafield in the UK and La Hague in France) for the analysis of samples taken by inspectors. The aim is to reduce the number of transports of radioactive samples and to make the results available to the inspectors in a shorter time. An important milestone was reached in September 1999 with the inauguration of the On Site Laboratory at Sellafield for the handling and analysis of the samples taken for safeguards purposes at THORP. This was a culmination of a major financial investment by the ESO and an important collaboration between the ESO, the ITU[15], and the operator BNFL. This was followed in June 2000 by a similar inauguration of the *Laboratoire Sur Site* at La Hague for the UP2 and UP3 plants together with COGEMA and SGN, the engineering subsidiary of COGEMA.

– Implementation of unattended data acquisition systems for radiation monitoring and measurement systems. The use of 24 hour monitoring systems reduces the need for inspectors to be present in radiation-controlled areas. The new data acquisition and review systems are based on commercial standards.

– Remote Data Transmission to the ESO headquarters. Having operational or inspection data available in Luxembourg should reduce the need to send inspectors in the field and might reduce the amount of on-site maintenance required.

5.2. Safeguards Evaluation Methodology

Safeguards relies heavily on the analysis of measured data in order to obtain results from which conclusions can be drawn. However, these data are subject to errors. During the reporting period, tools were implemented to assess the inspectors' and operators' measurement error uncertainties based on Destructive Analysis (DA)[16] results. Procedures were put in place to evaluate Near Real Time Material Accountancy[17] (NRTMA) data from the THORP reprocessing plant. Methods were

---

15 The Institute for Transuranium Elements (ITU) is an institute of the Commission's Joint Research Centre (JRC).

16 Destructive Analysis is a qualitative and quantitative determination of a characteristic of a sample of the item being measured. It requires sample taking and changes the physical form of the sample, and aims at establishing the total quantity and composition of nuclear material present in the items being measured.

17 Near Real Time Material Accountancy is a form of material accountancy for bulk handling facilities in which verification of flow is supplemented by physical inventories taken at frequent intervals, using in–process instrumentation that does not interfere with process operations. The objective of near real time

developed to evaluate shipper-receiver differences and volume determinations of in process tanks.

Computerised statistical tools were developed for in–field use for the statistical evaluation of MUF, for the re–verification of scale calibration parameters and tank calibrations at reprocessing plants.

5.3. Information Systems

The Euratom Safeguards Office replaced its information systems by modern client-server systems. The new information systems cover three main areas: nuclear materials accountancy, inspection, and administrative and technical support.

Development effort in 1999 went into making information systems Y2K proof. In addition, work started on several new information systems for inspection support, handling of DA samples, and seals management.

5.4. Training

Nuclear Safeguards Inspectors are qualified professionals recruited from a wide spectrum of fields. They typically have scientific, technical or accounting backgrounds coming from various areas of industry and research.

Safeguards however is a highly specialised area that requires a lot of specific training. A training profile and programme is established for every new ESO staff member upon arrival. The Euratom Safeguards Office provides over 60 professional and technical training courses to inspectors per year. These courses are held at Luxembourg headquarters, at the JRC establishments, at nuclear installations or in specialised training institutes, and of course on the job during inspection.

6. CO-OPERATION AND LIAISON

6.1. European Parliament

During the reporting period, the Euratom Safeguards Office had no legislative dossiers. Its relation to the European Parliament was therefore defined by providing replies to Parliamentary Questions, dealing mainly with safety and safeguards aspects of large-scale plutonium processing plants in the European Union. Illicit trafficking of nuclear material was another important issue addressed in parliamentary questions. In addition, a number of questions were related to organisational matters and performance of the Euratom Safeguards Office itself.

6.2. Member States

While the Euratom Treaty stipulates that the Commission through the Euratom Safeguards Office deals directly with nuclear material operators, the ESO considers regular contacts with Member States authorities as essential for the smooth implementation of safeguards in the respective States. In addition, discussions took

---

material accountancy is to improve the sensitivity and timeliness of detection using statistical tests specifically tailored to the sequential nature of the data.

place with a number of Member States to prepare for the implementation of the measures of the Additional Protocol[18] that do not involve nuclear material.

The Atomic Questions Group of the Council was briefed at regular intervals on the progress made in the preparation of the implementation of the Additional Protocol, the revision of the Subsidiary Arrangements[19] and the IAEA Safeguards Implementation Reports for the Member States of the European Union.

6.3. Enlargement

The Euratom Safeguards Office does not expect major problems in the field of safeguards with the accession of the new European Union Member States. All accession candidates have signed the Non-Proliferation Treaty (NPT) and are already inspected by the International Atomic Energy Agency (IAEA).

However, in line with the Euratom Treaty plant operators, and not government authorities, are required to submit reports about nuclear material inventories and changes directly to the Commission and have to set up accountancy systems in line with Commission Regulation 3227/76 (see 2.2). The screening exercise carried out in 1998 and 1999 and a number of discussions between the ESO and the applicant countries revealed that technical assistance might be required to prepare for accession in order to implement the Euratom safeguards *acquis*. To this end a project was set up that will provide plant operators in the applicant countries with a solution for implementing the Euratom Nuclear Material Accountancy (NMA) System, including local validation and transmittal of encrypted NMA reports to the Euratom Safeguards Office.

6.4. IAEA

6.4.1. Routine Co-operation

The IAEA and the Euratom Safeguards Office co-operate in the 13 Non Nuclear Weapon States following the arrangements laid down under the New Partnership Approach (NPA) as agreed in 1992 between the European Commission and the IAEA (see also 2.3). Co-operation in the UK and France is performed under the so-called Joint-Team arrangements. Under the NPA and the Joint Team arrangements, inspection activities of the IAEA and the Euratom Safeguards Office are executed jointly. Inspection activities carried out by the Euratom Safeguards Office are taken into account by the IAEA in drawing its own conclusions and vice-versa.

---

[18] Protocol Additional to the Agreement between the Republic of Austria; the Kingdom of Belgium, the Kingdom of Denmark, the Republic of Finland, the Federal Republic of Germany, the Hellenic Republic, Ireland, the Italian Republic, the Grand Duchy of Luxembourg, the Kingdom of the Netherlands, the Portuguese Republic, the Kingdom of Spain, the Kingdom of Sweden, the European Atomic Energy Community and the IAEA in implementation of Article III, (1) and (4) of the Treaty on the non–proliferation of nuclear weapons. (Protocol Additional to INFCIRC/193)

[19] Subsidiary Arrangements constitute a document containing a set of technical and administrative procedures designed to implement the safeguards procedures laid down in the Safeguards Agreements with the IAEA; they deal with matters such as design review, records requirements, reporting requirements and inspections.

During the period covered by this report, new common IAEA/Euratom safeguards approaches were implemented in a MOX fuel fabrication and assembly plant, and two dry storage installations for spent fuel assemblies.

Technical support activities are an important component of the co–operation of the ESO with the IAEA. They include common planning of inspections, common training of inspectors, sharing the analysis of samples for destructive analysis, the common use of safeguards instruments and software and an important common R&D programme. As an example, major common R&D projects exist in the areas of measurements on spent fuel, next generation digital surveillance systems including remote monitoring, new electronic seals to replace copper brass seals, and stratification and sampling software

The smooth co-operation of the IAEA and the ESO under the NPA resulted in a significant improvement of the IAEA safeguards effectiveness in the European Union over the reporting period as can be concluded from the IAEA 1998 and 1999 Safeguards Implementation Reports. The main problem areas have been addressed and actions are underway to resolve outstanding problems.

6.4.2. Co-operation in the field of Strengthened Safeguards

A number of elements of the new strengthened safeguards system, which was developed by the IAEA after the crisis in Iraq in the early nineties, have been implemented or their implementation is being prepared in the European Union.

For example, field trials for the use of remote monitoring were conducted in a spent fuel storage facility and a power reactor. Also, safeguards approaches for large research reactors were agreed between the IAEA and the ESO that include measures to detect undeclared production of plutonium. A new common safeguards scheme was implemented in a LEU Fuel Fabrication Plant that includes the routine use of short notice random inspections as a method to cover statistically all flow of nuclear material through the installation.

Environmental sampling, or High Performance Trace Analysis (HPTA), is considered by the IAEA and the ESO as a method that, when properly implemented, can enhance significantly the effectiveness of safeguards in Enrichment Plants and potentially also in Hot Cells. The IAEA and the ESO intend to use this method on a routine basis in Centrifuge Enrichment Plants (see also 4.2.3).

6.4.3. Preparation for the implementation of the Additional Protocol and Integrated Safeguards

The full implementation of the "Additional Protocol" (AP) will provide the IAEA with the necessary legal authority to verify the absence of undeclared activities in States. The ratification process of this Additional Protocol was initiated in all EU Member States. It has been completed in The Netherlands, Spain, Germany, Greece, Sweden, and Finland. The Additional Protocol will enter into force in the European Union only after all signatories have ratified. Some States have asked the Commission to act on their behalf as the interface with the IAEA in the implementation of the AP measures that do not relate to nuclear material[20]. The Euratom Safeguards Office started the necessary preparatory work for the implementation of the Additional Protocol and detailed discussions with the Member States concerned have commenced. In order to ensure a smooth implementation of the Additional Protocol, field trials were set up at two sites one in Finland and the other in the Netherlands

By integrating the measures of the Additional Protocol and classical nuclear material accountancy measures, a more effective and efficient safeguards system could be established: the so–called Integrated Safeguards system. The Euratom Safeguards Office actively assisted the IAEA in the development of such a system, which might have an impact on Euratom safeguards.

6.5. Third Countries

Three of the Community's nuclear co-operation agreements, namely the ones with the United States of America, Canada and Australia, require dedicated control activities at the Euratom Safeguards Office in order to fulfil the commitments accepted under these Agreements. These commitments are implemented through routine exchanges of notifications and other relevant information on imports/exports of nuclear material subject to one of these Agreements. They also provide for the respect of the associated export controls. For the period covered by this report, the three co-operation agreements were implemented to the satisfaction of all Parties involved.

The Euratom Safeguards Office actively participated in the on–going negotiation of a nuclear co-operation agreement between Euratom and Japan. The progress achieved during the negotiation rounds that took place in 1999 and 2000 gives hope for a successful conclusion of the agreement in the near future.

Following the interest expressed by the Member States for the conclusion of a nuclear co-operation agreement with China, the Euratom Safeguards Office participated in a fact-finding mission to Peking. The outcome of the mission confirmed the mutual interest for the conclusion of such an agreement. It is expected that a negotiation mandate will be given by the Council to the Commission during 2001.

In addition, regular contacts took place between the Euratom Safeguards Office and the United States Departments of State and of Energy on technical safeguards issues. During these contacts, information was exchanged on the implementation of safeguards, technical and conceptual developments, as well as non-proliferation issues. Also in the field of R&D, extensive contacts exist between the US and the ESO, in the form of a number of task sheets for the development of various safeguards techniques.

---

[20] These measures include the provision of information on nuclear fuel cycle related R&D, a description of each building on each nuclear site, information on nuclear fuel cycle related operations, information regarding specified equipment and non-nuclear material, complementary and managed access to any place in a state.

Regular contacts took also place between the Euratom Safeguards Office and ABACC, the Argentine and Brazil Regional Safeguards Organisation. These contacts involved participating and lecturing in training courses and workshops.

7. VARIOUS PROJECTS

7.1. Illicit Trafficking of Nuclear Material

No serious cases involving illicit trafficking of nuclear material were detected nor reported in the European Union during the period 1999–2000. This seems to be the result of the combined effect of improved detection and prevention capabilities in the Eastern European countries and of a better knowledge of the risks by the potential smugglers.

Some minor cases involving the discovery of small quantities of nuclear material with insignificant strategic value occurred. In most cases, the co–operation with the Member State authorities was excellent, a standard procedure was adopted to bring the material under safeguards, and to have it properly accounted for.

The Euratom Safeguards Office continued to play an active role in experts groups where prevention and detection mechanisms and communication and intervention procedures were discussed. The Euratom Safeguards Office provided expertise when requested, worked in close co–operation with the IAEA and maintained informal contact with the national authorities, Europol and other dedicated interagency groups.

The Euratom Safeguards Office also participated, together with the Institute for Transuranium elements (ITU) of the JRC, in the work of the Nuclear Smuggling International Technical Working Group (ITWG) created in 1995 under the auspices of the G8. In particular, the Euratom Safeguards Office organised, together with a US laboratory, a successful interlaboratory comparison exercise aiming at developing forensic methods for better route and origin attribution of seized material.

7.2. Co-operation with the Russian Federation

Co–operation between the Euratom Safeguards Office and the Russian Federation in the field of safeguards began in 1993. The Euratom Safeguards Office assisted the Russian authorities in developing and implementing computerised nuclear material accountancy and control systems, preparing and implementing of physical inventory takings by operators and national inspectors, delivery of safeguards instrumentation, establishing seals management procedures and databases, as well as organising safeguards training and conferences.

In 2000, the decision was taken to streamline the Commission's assistance programmes and, as a consequence, the co-operation programme between the European Commission and the Russian Federation in the area of safeguards will in the future be fully implemented in the framework of the Tacis programme, with a continued strong involvement of the JRC.

8. RESOURCES

8.1. Staff

The Euratom Safeguards Office employs a team of inspectors plus appropriate administrative and logistical support in its headquarters in Luxembourg.

At the end of 2000, the Euratom Safeguards Office counted 274 permanent posts: 75 A–grades, 148 B–grades, 50 C–grades, and 1 D–grade. Of these posts, 211 are allocated to staff having the nuclear inspectors statute. This includes operational inspectors and support inspectors, all in the A and B categories.

8.2. Budget

Article 174 of the Euratom Treaty specifically mentions the necessity to include provisions in the Commission's budget for operational expenditure relating to safeguards. In virtue of this legal basis there are - apart from the general budget appropriations for salaries, offices, IT equipment, telecommunications etc. (budget part A) - some specific appropriations in the operating budget (budget part B and in particular sub-chapter B4-2) which are foreseen for expenditure such as inspection mission cost, purchase of technical equipment, contracts for services, transport, training, etc. Other credits concern the ESO co-operation with Russia and enlargement. The ESO itself manages the part B budget lines administratively. Table 4 shows the evolution of the specific safeguards budget lines over the past years.

9. CONCLUSIONS

The Euratom Safeguards Office performs safeguards on all civil nuclear material in the European Union. Its legal basis and scope is defined in the Treaty establishing the European Atomic Energy Community signed in 1957. It has the necessary infrastructure for data handling, evaluation and inspection support. Co-operation with the IAEA assures effective and efficient safeguards under NPT in the European Union.

The period under review was characterised by a steady increase in quantity and sensitivity of nuclear material under safeguards in the European Union. To cope with such an evolution, the Euratom Safeguards Office streamlined, improved, modernised and upgraded, on a regular basis, its methods, equipment and systems (including information technology).

As a result of its activities in 1999 and 2000, and subsequent evaluations, the Euratom Safeguards Office did not find any indication that nuclear materials were diverted from their intended peaceful uses. The “Material Unaccounted For” (MUF), which is one of the indicators of diversion was acceptable for nearly all installations. Small discrepancies found during inspections or the material balance evaluation were rectified or are still being investigated with the operators concerned.

Table 1 – Quantities of Nuclear Material under Euratom Safeguards

	End 1990 [Tonnes]	End 1995 [Tonnes]	End 1999 [Tonnes]	End 2000 [Tonnes]
Plutonium	203	406	506	531
Uranium				
Total	200 400	269 100	309 600	312 900
HEU	13	11	10	10
LEU	32 000	46 700	54 000	55 300
NU	44 000	51 400	55 200	53 800
DU	124 400	171 000	200 400	203 800
Thorium	2 600	4 600	4 500	4 500

Table 2 – ESO Inspection Effort

Person days of inspection in:	1999	2000
NNWS	2 412	2 113
France	3 492	3 426
UK	2 871	2 895
Total	8 775	8 434

Table 3 – ESO Staff Situation End 2000

	A–Grades	B–Grades	C–Grades	D–Grades	Total
Direction	4	10	13	1	28
Inspection 1	22	40	7	0	69
Inspection 2	22	45	6	0	73
Accountancy and Control	6	18	6	0	30
Basic Concepts	14	27	15	0	56
Informatics	6	8	3	0	17
Total	74	148	50	1	273

Table 4 – ESO Evolution of the Specific Safeguards Budget (in thousands Euro)

Budget Line	1991	1993	1995	1997	1999	2000
Missions and Training (B4 2000)	2 455	3 500	4 200	4 687	5 400	5 700
Instruments (B4 2020)	2 300	2 000	3 200	3 900	4 400	4 400
Large Pu Installations (B4 2021)	2 600	5 000	10 000	7 200	6 600	6 600
Co-operation with Russia (Various Lines)	/	/	1 800	2 000	1 400	Phasing Out
TOTAL	**7 355**	**10 500**	**19 200**	**15 787**	**16 400**	**16 700**
Radiation protection (part of A0 1420)	140	255	285	200	200	220