COMMISSION OF THE EUROPEAN COMMUNITIES

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Report on the Operation of Euratom Safeguards

(presented by the Commission)

EXPLANATORY MEMORANDUM

1. It is recalled that following the nuclear affairs in 1988 the Council's Atomic Questions Group had requested that the Commission should prepare a detailed report on Euratom Safeguards.

2. The European Parliament in resolution of 6 July 1988 published in the O.J. N° C235/70 of 12-09-1988 "calls on the Euratom Safeguards Directorate to submit a comprehensive annual report to parliament which would be available to the public".

3. Consequently the Commission presented a first comprehensive report (SEC {90} 452) final with particular reference to 1988.

4. During the discussions in the Council and in response to questions from the Parliament the Commission re-confirmed its intention to prepare such an operations report on a biennial basis.

5. The aim of the present report is to provide a comprehensive survey for the period 1989 - 1990.

Report on the Operation of Euratom Safeguards

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I. *INTRODUCTION*

Scope of this report

1. In its Report (SEC(90)452) final hereinafter referred to as the "1988 Report" the Commission presented a first comprehensive report with particular reference to 1988 on the operations of Euratom safeguards and the Commission invited the Council and the European Parliament to note its content.

2. During the discussions in the Council and in response to questions from Parliament the Commission re-confirmed its intention to prepare such an operations report on a biennial basis.

3. The aim of the present report covering 1989 and 1990 is to provide a comprehensive survey on the operation of Euratom safeguards in the civil nuclear fuel cycle including research and other related activities of the European Community. The survey includes the safeguards findings with particular reference to 1989 and 1990, the issues under discussion or consultation with operators or under consultation with national authorities, a survey on the available resources and an indication of the trends in and challenges to safeguards during the years to come.

4. The report is addressed to the Council and to the European Parliament, which are invited to note its contents.

Safeguards

5. The word safeguards, in the framework of the Euratom Treaty, means the set of measures performed to enable the Commission to satisfy itself that nuclear material is not diverted from its intended and declared uses (particularly to unlawful non-peaceful applications) (Article 77a)) and that obligations arising from International Agreements concluded by the Community (Article 77b)) are complied with. Examples of the latter undertakings are (in addition to peaceful pledge) restrictions on retransfers outside the Community and certain controls on heavy water, equipment and tritium.

6. Safeguards are therefore not, as is sometimes mistakenly believed, concerned with nuclear safety nor with the protection of people and of the environment from the hazards of ionizing radiation nor with physical protection. **Nuclear safety** relates to the safe design and operation of nuclear facilities. **Radiation protection** controls relate to health and safety, environmental protection, safe handling procedures for nuclear materials etc. **Physical protection** relates to the security measures taken to protect material from theft or other misuses. Safeguards may take advantage of such measures in designing verification schemes but they are, in themselves, quite independent. Whereas physical protection is mainly the responsibility of the Member States, the Commission is responsible for the applciation of safeguards pursuant to Chapter VII of the Treaty.

7. Chapter VII of the Treaty provides for safeguards to be applied to all civil nuclear materials stored, used or transported within the Community. The activities involved include therefore the main fuel cycle activities of uranium mining, conversion, enrichment, fabrication, power reactor operation, reprocessing and waste storage and disposal insofar as ores, source or special fissile materials are concerned. Also included are the full range of other activities which use source or special fissile materials, viz: research and development, laboratories, service activities for the nuclear industry (e.g. analytical laboratories), research reactors and the use of nuclear materials in non-nuclear activities.

8. The Euratom Treaty provides for the application of safeguards to all civil nuclear material as a fundamental function of Community law, establishing to this end a direct relation between the Commission and operators whereas the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) provides for the application of safeguards by the International Atomic Energy Agency (IAEA) in the non-nuclear weapon States of the Community. Member States are also associated in the implementation of Euratom Safeguards within the limits set out by the Treaty and its implementing Regulation. IAEA safeguards also apply in nuclear weapon States following "voluntary offers" by those States. IAEA safeguards are exclusively aimed at ensuring, as appropriate, non-explosive or peaceful use of safeguarded material and apply worldwide on a contractual basis, through safeguards agreements and entailing a direct relation only between the IAEA and its Member States. In the Community, the Safeguards Agreements concluded by Euratom, the Member States and the IAEA ensure the necessary coordination between the two safeguards systems.

<u>Legal bases</u>

9. The obligations and responsibilities of the Commission of the European Communities in the field of safeguards are set out in Articles 77 to 85 of Chapter VII of the Euratom Treaty. <u>It is European law</u>.

10. The provisions of Articles 77 to 85 of the Treaty specify:

Art. 77: In essence, the Commission shall satisfy itself that the nuclear materials are not diverted from their intended uses as declared by the users and that the provisions relating to supply and any particular safeguarding obligations assumed by the Community under an agreement concluded with third countries or with an international organization (e.g. the International Atomic Energy Agency (IAEA)) are complied with. Pursuant to this article, Euratom Safeguards also monitor, and report on, the implementation of Chapter VI of the Treaty.
It may be mentioned in this context that as of 3 October 1990 the Commission mandate under Chapter VII was extended to the new "Bundesländer" following German unification (cf. para.40)

Art. 78: The declaration by operators of the basic technical characteristics of the installations as well as the need for Commission approval of techniques to be used for the chemical processing of irradiated materials.
In this context it may be mentioned that the Commission gave interim approval in 1990 relating to a large-scale reprocessing plant.

Art. 79: Requirements on operators to maintain a system of nuclear materials accounting, including recording and reporting. Obligation on the Commission to promulgate a Regulation;

Art. 80: Deposit of excess special fissile materials not in use;

Art. 81: Inspections; right of access; procedures in case of opposition;

Art. 82: Recruitment of inspectors. Follow-up procedures involving Member States in case of infringement;

Art. 83: Sanctions in case of infringements by operators;
It may be mentioned in this context that the Commission imposed in 1990 a sanction on a Community undertaking following an infringement.

Art. 84: Scope of safeguards and exclusion for materials intended to meet defence requirements;

Art. 85: Adaptation by the Council of the procedures for applying safeguards.

11. Commission Regulation (Euratom) No 3227/76 of 19.10.1976 (O.J. E.C. No L363 of 31.12.1976) as amended by Commission Regulation (Euratom) No 220/90 of 26.01.1990 (O.J.E.C. L22 of 27.01.90), specifies general obligations on operators with respect to the provision of basic technical characteristics, recording, reporting, advance notification of transfers. The regulation also specifies the requirement to adopt Particular Safeguards Provisions (PSP) for each installation.

12. The Community has concluded agreements in the nuclear field with the U.S., Canada and Australia. To verify the implementation of the undertakings included therein, the Commission acting through its Euratom Safeguards Directorate tracks relevant material under specific safeguarding obligations, each identified by an appropriate code ("flag").

13. The Community has concluded three Safeguards Agreements with the IAEA based on model agreement INFCIRC/153, but including a protocol regulating the interface between the Euratom and IAEA safeguards systems:

    13.A. Agreement[1)] between the Community, its Non-Nuclear Weapon States (NNWS) and the IAEA;

    13.B. Agreement[2)] between the Community, the United Kingdom (UK) and the IAEA;

    13.C. Agreement[3)] between the Community, France and the IAEA.

Means

14. In order to fulfill the mandate of Article 77 of the Treaty, the Commission has, since 1958, deployed a corps of Euratom safeguards inspectors. The funds are provided through budget chapter B.4200.

15. In accordance with the legal provisions referred to above the Euratom safeguards inspectors of the Safeguards Directorate DG XVII-E ("DCS") perform inspections in the nuclear installations and perform relevant headquarters accountancy evaluation and follow-up.

16. Inspections and accountancy supported by appropriate logistics are the main pillars of Euratom safeguards; no adequate verification can be carried out unless these operate effectively.

1) Published in IAEA document INFCIRC/193
2) Published in IAEA document INFCIRC/263
3) Published in IAEA document INFCIRC/290

II. SAFEGUARDS OPERATION

Number of Material Balance Areas (MBAs) and stocks of nuclear material

17. In the "1988 Report" the Commission had presented the number of installations under Euratom safeguards.

This presentation resulted, however, in a certain lack of transparency:

17.A. A large installation comprising several balance areas (MBA's) counted as one installation in the same way as an installation holding tiny quantities of nuclear material;

17.B. The large number of Locations Outside Facilities[1)], carriers, intermediaries etc. accounted for 47% of all installations under safeguards where less than 2% of the cumulative inspection effort was spent.

18. In order, thus to avoid the above disadvantages of presentation, the previous table II.1 has been split into two parts.

Table II.1.1. presents the number of material balance areas (MBA) under Euratom safeguards. It may be noted that an MBA is the basic safeguards entity i.e. an area such that a) each transfer into or out of and b) the physical inventory of nuclear material can be determined.

Table II.1.2. presents the number of LOFs, Carriers, intermediaries etc. including those "installations" which are, for purposes of IAEA safeguards, combined into 1 accounting and reporting unit referred to as CAM (see Glossary attached).

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1) Locations outside facilities (LOF) are MBAs holding less than 1 effective kilogram but more than the upper limit for CAM facilities (see Glossary attached). For the definition of an effective kilogram cf. Regulation 3227/76, quoted under paragraph 11 above, Article 36 (o).

Table II.1.1.
MBAs under Euratom Safeguards
(Status 1990-12-31)

Type	Member States												COM	EUR	IAEA 1)
	B	DK	D	E	F	GR	IRL	I	L	NL	P	UK			
Research laboratories	4	1	10	1	12	.	.	2	.	2	.	23	3	58	23
Mines	.	.	9	2	.	.	.	1	.	.	13	.	.	25	0
Concentration	1	1	2	2	1	.	.	.	.	.	1	.	.	8	0
Transformation	.	.	.	.	1	.	.	.	.	.	.	.	.	1	0
Enrichment	.	.	2	.	1	.	.	.	.	2	.	3	.	8	6
Fuel Preparation	.	.	.	.	3	.	.	.	.	.	.	4	.	7	0
Fuel Fabrication	3	1	7	2	6	.	.	2	.	.	.	3	.	24	15
Reprocessing	.	.	1	.	5	.	.	2	.	.	.	6	.	14	3
Research Reactors	3	2	14	3	12	1	.	7	.	2	1	5	1	51	34
Zero Energy Critical assemblies	2	.	11	.	2	.	.	.	.	.	.	3	.	18	13
Power Reactors	7	.	29	10	57	.	.	4	.	2	.	20	.	129	52
Storage	2	2	18	.	14	.	.	6	1	.	1	23	4	71	35
T O T A L Euratom	22	7	103	20	114	1	0	24	1	8	16	90	8	414	--
T O T A L IAEA	21	6	89	16	1	1	0	23	1	8	2	5	8	---	181

It may be noted that the above table comprises the additional MBAs put under Euratom and IAEA safeguards following German unification on 3 October 1990.

1) Under IAEA routine inspection.

Table II.1.2.

LOFs, Intermediaries, Carriers and other installations holding less than 1 effective kg.

Type	Member States													EUR	IAEA
	B	DK	D	E	F	GR	IRL	I	L	NL	P	UK	COM		
LOFs equal/above CAM limit	3	4	39	.	10	2	2	15	.	10	1	19	3	108	79
LOFs below CAM limit, CARRIERS, INTERMEDIARIES, WASTE CONDITIONING AND OTHERS	3	3	39	2	35	.	.	10	2	4	2	120	1	221	41
T O T A L Euratom	6	7	78	2	45	2	2	25	2	14	3	139	4	329	---
T O T A L IAEA	5	6	69	2	0	2	2	18	0	13	1	0	2	---	120

19. The above tables II.1.1. and II.1.2. give also the summary of the MBAs under IAEA routine inspection. MBAs under IAEA safeguards in NWS are inspected by the IAEA if designated to this effect by the latter, pursuant to the provisions of the Agreements INFCIRC/263 and INFCIRC/290.

20. Among the MBAs listed in table II.1.1. there are 60 MBAs, located in France and the United Kingdom, referred to as "mixed" MBAs. At these MBAs, civil and non-civil material are handled, processed or stored together either simultaneously or sequentially.

Stocks of nuclear material

21. The following table II.2 gives the stocks of civil nuclear material by the end of 1988, 1989 and 1990 for the MBAs listed in tables II.1.1. and II.1.2.

Table II.2

Stocks of nuclear material as on 31 December:				
Material Category	Cat	1988	1989	1990
Uranium Depleted[1]	D	107 600 t	112 600 t	124 400 t
Natural[1]	N	46 400 t	47 000 t	44 000 t
Low Enriched[1]	L	27 400 t	28 900 t	32 000 t
High Enriched[2]	H	12 t	13 t	13 t
Plutonium[2]	P	151 t	170 t	203 t*)
Thorium[1]	TH	1 500 t	2 100 t	2 600 t
Total effective kg[3]		179 000	199 000	231 000

[1]) Rounded to nearest 100 t.

[2]) Rounded to nearest t.

[3]) Art. 36(o) of Regulation 3227/76.

*) It may be noted that on 31.12.90 approximately 30% of the Plutonium stock was in the form of fresh (i.e. reprocessed) Plutonium.

22. The following table II.3 gives the distribution (rounded to the nearest 0.1%) of the stocks (end 1990) as a function of the MBA type.

Table II.3

Distribution of Stocks (end) 1990
(rounded to the nearest 0.1 %)
as per installation type and element category.

Type	Element Category					
	D	N	L	H	P	T
Research Laboratories	0.8	~0	~0	2.2	0.3	1.3
Research Reactors & Critical Assemblies	~0	0.3	~0	44.3	1	0.6
Enrichment	30.7	8.9	56.9	~0	~0	~0
Fuel Concentration, Fuel Conversion/Fabrication	2.3	52.3	2.9	14.2	6.3	0.4
Reprocessing	0.2	~0	1.0	0.9	0.5	~0
Power Reactors	1.9	15.9	20.3	18.4	21.6	0.3
Storage	63.5	18.4	18.9	20.0	70.2	0.4
LOFs, Mines, others	0.6	4.2	~0	~0	0.1	97.0

Safeguards approaches and implementation - Introductory remarks

23. Pursuant to Article 79 of the Treaty and to Articles 9 to 23 of Regulation 3227/76, the operators of all installations must establish a nuclear materials accounting system including recording and reporting thereby documenting the movements and disposition of the nuclear material.

    In other words, the up-to-date inventory of nuclear material by:

    - category of material[1)]
    - safeguards obligation and
    - material balance areas (MBA)

    as established by the operator needs to be made available for verification by inspectors, as well as the flow of nuclear materials. Verification relates to the set of activities independently performed by inspectors to establish the correctness of these records on flow and inventory in comparison with the physical reality leading to acceptance or rejection of the operators declarations.

24. There are several, basically different, safeguards verification techniques, certain of which are **quantifiable** and others which are **non-quantifiable**. In this context reference is made to paragraphs 22 and 23 of the "1988 Report" where the basic methodology is outlined and examples are given.

25. There is no change in principle of the safeguards methodology which continues to be based on the safeguards goals comprising a triptych of characteristic quantities to be detected, of characteristic times describing the maximum response times of the safeguards system and characteristic probabilities describing both the risk of a false alarm and the risk of non-detection of the amounts within the specified time.

26. As far as, however, the safeguards concepts and approaches, developed to implement the above goals, are concerned, in particular because of the increased availability and use of Plutonium in the commercial fuel cycle of the Community, necessitated in 1989 and 1990 and continue to necessitate the further improvement of safeguards efficiency and the related refinement of safeguards concepts and procedures. A summary of the main developments is reported below.

1) Art. 21 of Regulation 3227/76.

27. Improvements of the efficiency in safeguarding Uranium have been achieved and are expected to be further achieved gradually through the introduction of improved instruments and equipment and through rationalization measures adapted specifically to the intermittent inspection regime which is applied at the installations in this part of the fuel cycle including the output of the mines, concentration, conversion, fabrication and enrichment installations (the latter require slightly different approaches due to the inherent commercial and non-proliferation sensitivity of the technology used).

Developments to be mentioned are the progressive introduction of new containment and surveillance (C/S) equipment, e.g. using front end motion detection, improved methods used for item verification, shifting from destructive assay (DA) to non destructive assay (NDA) and, last but not least, improved on-site data acquisition, handling and evaluation. The implementation of "Random" inspections - while mathematically quite elegant - continues to be tested by Euratom in an operational production plant with, so far, inconclusive results.

28. Thus, in the Uranium part of the fuel cycle as well as for LWR LEU, no significant changes in the concepts and approaches can be reported but rather gradual increases of efficiency.

29. For LWR-using fresh MOX*) the safeguards concepts continue to be based on the item verification techniques, i.e. based on the verification of the integrity and identity of distinguishable fuel elements using NDA, C/S and video surveillance techniques from fabrication and during all phases of reactor operations. These concepts have been implemented requiring, however, still considerable inspection effort. It is expected that this inspection effort can be reduced when either the time interval between fresh MOX*) arrival and core loading can be reduced to not more than a few weeks or, alternatively, the equipment allowing conclusive underwater measurement will become fully operational.

30. For safeguards of MOX fabrication installations and of reprocessing plants paragraph 101 of the Operations Report covering 1988 (SEC(90)452 final) indicated the forecast that the throughputs of recycled Plutonium was expected to increase significantly in the late 1980's and early 1990's.
This has become industrial reality, i.e.:

- A large scale reprocessing plant commenced operation in 1989;
- Two further large scale reprocessing plants are under construction and, based on present plans, will commence operation in 1992 and 1994 respectively;
- Two large scale MOX fabrication plants are under construction and will commence operation, based on present schedules, in 1992 and 1993 respectively.

*) MOX = MIXED OXIDE (U+Pu oxide)

31. At these new plants continual inspection is maintained or foreseen. Following consultations with Community operators and, when appropriate, with the IAEA, modern safeguards systems have been developed and are progressively being implemented.

32. Under the aspect of safeguards concepts no significant new developments can be reported since the well-known concepts such as:
 - verification of the technical characteristics of the plant during the construction phases;
 - verification of the continued validity of the Basic Technical Characteristics (BTC) to be provided pursuant to Regulation 3227/76;
 - verification of all input and output streams and of the physical inventory;
 - verification of, at least monthly,of the hold-ups using various techniques or Follow-up and Balancing Of Mixes (FBOM)
 - maintenance of the continuity of knowledge in the input and product stores

 are being used or envisaged for the new plants.

33. As far, however, as the approaches are concerned the main feature of the safeguards systems for the new plutonium plants is a significant shift from inspector attended operation to unattended measurement, monitoring or surveillance operation.

 This is caused, inter alia, by

 a) the need to minimize radiation exposure of plant personnel and inspectors;

 b) the need to minimize stoppage for routine safeguards purposes of automated production, and

 c) the requirement to use identical or similar components in all plants so as to minimize development costs and to maximize standardization.

34. The effect is, on the one hand, a transition from operational costs, i.e. manpower, travelling, subsistence, etc. to investment costs which, albeit expensive initially, is expected to "pay off" within a limited break even time. On the other hand, these systems are also expected to minimize repetitive inspectors work thereby further contributing to enhanced safeguards effectiveness.

Safeguards approaches and implementation - Verification techniques

35. The following table II.4 provides an indication of the verification techniques deployed. Table II.5 provides the typical frequency of inspection and the Euratom inspection effort spent at the various types of installations. Table II.6 provides the inspection effort spent in the Community Member States.

Table II.4

Verification technique	Type(s) of installation
verification and periodic reverification of Basic Technical Characteristics (BTC)	all types
audit of accounts	all types
item counting and identification	all types
measurement and sampling - weighing	- research laboratories, research reactors & critical assemblies - concentration, conversion - enrichment, fabrication and reprocessing plants - (certain) power reactors - (certain) storage installations - others
- non-destructive assay (NDA)	- research laboratories, research reactors & crit. assemblies - concentration, conversion - enrichment, fabrication and reprocessing plants - power reactors - storage installations
- sample taking for destructive assay (DA)	- research laboratories - concentration, conversion - enrichment, fabrication and reprocessing plants - storage installations
- participation in calibration exercises of equipment	- research laboratories - concentration, conversion - enrichment, fabrication and reprocessing plants - storage installations
- appropriate measurements (NDA and/or DA) on a low sampling basis	- LOF etc.

Table II.4

(cont.)

Verification technique	Type(s) of installation
containment, surveillance and monitoring	
- seals	- research laboratories, research reactors & critical assemblies - concentration, conversion - enrichment, fabrication and reprocessing plants - power reactors - storage installations
- camera/video surveillance	- research laboratories, res. reactors & crit. assemblies - enrichment, fabrication and reprocessing plants - power reactors - storage installations
- independent monitoring of key data (tank levels, temperatures and other operator data)	- enrichment - fabrication plants - reprocessing plants
- following detailed process operations and flows within the plant	- fabrication plants - reprocessing plants
- monitoring/logging systems	- enrichment plants - power reactors - research reactors & critical assemblies - reprocessing plants - storage installations

Table II.5

Typical inspection effort per type of installation

Type of installation	Typical frequency of inspection ranging From	To	Inspection effort - man-days Euratom 1988	1989	1990
Research laboratories	1/a	12/a	366	439	313
Research reactors & critical assemblies	2/a	6/a	368	385	342
Mines and concentration plants	0/a	2/a	14	21	12
Enrichment plants	12/a	1/week	678	655	677
Conversion and fabrication (uranium natural, LEU)	12/a	1/week	977	1105	1102
Conversion and fabrication (HEU and MOX)	12/a	continuous	1424	1350	1322
Reprocessing	12/a (when not operating)	continuous	1705	1771	2275
Power reactors	2/a	24/a	879	1060	921
Storage installations	1/a	daily	849	516	537
Other	0*)	4/a	104	115	63
			7367	7417	7564

*) Holders of small amounts of depleted and natural uranium or thorium used for non-nuclear purposes are inspected on a sampling basis or when discrepancies following declarations (also from other operators) need to be resolved.

Table II.6

Cumulated Inspection Effort per Country
(Expressed in mandays / year and %)

COUNTRY	Mandays 1989	Mandays 1990	% 1990
BELGIUM	594	627	8,3
DENMARK	21	18	0,24
GERMANY	2237	2170*)	28,7*)
GREECE	6	4	0,05
SPAIN	170	147	1,9
FRANCE	2013	2408	31,8
IRELAND	2	2	0,03
ITALY	165	155	2,1
LUXEMBOURG	0	0	0
THE NETHERLANDS	137	129	1,7
PORTUGAL	7	6	0,08
UNITED KINGDOM	1967	1812	24,0
COM	98	86	1,1
TOTAL	7417	7564	100,0

*) Including effort spent in the new "Bundeslaender" after German unification on 03.10.90.

36. In relation to tables II.5 and II.6 it may be noted that the frequency and intensity of inspections are also influenced by the established quantified inspection goals which depend on the strategic value, amounts and types of nuclear material, on the probabilities of detection and the detection times. These quantified inspection goals are reviewed from time to time so as to take account of new safeguards concepts and of the progress in research and development.

37. The safeguards approaches for "mixed" MBA's (see para. 20) differ from those applied elsewhere in respect of their objective:
- For installations handling civil material exclusively the objective set out in Article 77 of the Treaty applies to all nuclear material in inventory or throughput[1].
- For installations handling or storing civil and non-civil material simultaneously or sequentially the objective set out in Article 77 of the Treaty applies equally to this civil material, a key condition being that there should be no net loss in quantity and quality of the civil material in a plant.

38. Whenever **discrepancies** are detected:

- within the operator's accounting system
- between two operators
- between operator's records, reports and inspection findings

they are followed up immediately. Anomalies are unresolved discrepancies or prima facie evidence of an irregularity discovered as a result of records/reports examination or other inspection activities which may lead to the belief that the terms of the Treaty or other legal instruments have not been respected. The resolution of anomalies requires a sequence of actions normally additional to the safeguards measures indicated in table II.4. Anomalies once fully established, i.e. unresolvable, would be considered by the Commission as a presumed infringement of the Treaty.

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1) Plus, where applicable, to the equipment.

Safeguards approaches and implementation - Findings

39. The following paragraphs of this chapter provide findings resulting from the application of the safeguards measures in 1989 and 1990.

40. Upon German unification on 3 October 1990, Euratom responsibility for safeguards extended to all nuclear material at the installations in the new "Bundesländer". Prior to this date a task force was established and there was a series of visits by specialists in accounting/reporting, operations and health physics to the former German Democratic Republic (GDR). Furthermore, a seminar for all operators was organized in September 1990 to prepare for the implementation of Euratom Safeguards. There were also consultations at various levels with the IAEA and with representatives of both the Federal Republic of Germany and of the former GDR to ensure a smooth transition (in the application of IAEA safeguards) from the GDR/IAEA agreement to the Euratom (10 NNWS)[1)]/IAEA agreement. Preparation and consultation on the Particular Safeguard Provisions (PSP) and the Facility Attachments (FA) commenced in 1990 and should be finished in 1992.

41. The first inspection in the new "Bundesländer" took place on 4 October 1990. The application of Euratom safeguards at the nuclear power stations and at the intermediate irradiated fuel store in the new "Bundesländer" has been progressively implemented. Before the end of 1990 all the inventories at the above installations were either verified or, where operational conditions did not permit, "frozen" for verification at a later stage. In addition, Euratom containment/surveillance equipment had been installed and was operational. Relating to the research centers and research reactors the necessary initial and routine inspections were performed and important discrepancies between the book stocks and the physical reality were detected. The appropriate follow-up actions by Euratom resulted in explanations for these discrepancies and in the correction of the books and declarations where appropriate. It is expected that these follow-up activities can be finalized in 1991.

Relating to the installations comprising small amounts of nuclear material and to Uranium mines and concentration plants the application of Euratom safeguards commenced in 1990 with the aim to have Community standards applied by 1992.

1) Non Nuclear Weapons States

Research laboratories, research reactors & critical assemblies

42. The safeguards measures applied at these installations are described in table II.4, the inspection effort spent is described in table II.5.

43. Following the reports of the inspectors, 69 (14%) statements after inspection or separate communications were dispatched containing particular observations requiring follow-up.

44. These communications and direct consultations with operators or government authorities aim at further improving safeguards implementation relating, inter alia, to:

- the promptness and correctness of records and declarations;
- the inventories of difficult to access nuclear materials;
- the definition of safeguards measures to be applied to nuclear materials contained in wastes and discards.

Mines and concentration plants

45. The safeguards measures applied at these installations are described in table II.4 and the inspection effort spent is described in table II.5.

46. Following the reports of the inspectors, 8 (47%) statements after inspection or separate communications were dispatched containing particular observations requiring follow-up.

Enrichment plants

47. The safeguards measures applied at these installations are described in table II.4, the inspection effort spent is described in table II.5.

48. Following the reports of the inspectors, 29 (12%) statement after inspection or separate communications was dispatched containing particular observations requiring follow-up.

49. In relation to centrifuge enrichment plants it may be noted:

49.A. In 1983 an international project, referred to as the Hexapartite Safeguards Project, provided recommendations on how commercial centrifuge enrichment plants should be safeguarded while minimizing the risk of dissemination of sensitive technology.

49.B. These recommendations to the IAEA included, apart from the "classical" safeguards measures listed in table II.4 above, "Limited Frequency Unannounced Access" (LFUA) to the cascade areas during which inspectors can satisfy themselves that the plants are operating as declared by the operator. Euratom observes these recommendations for the inspections conducted together with the IAEA. As to the inspections in the enrichment plant in which the Commission operates alone, these recommendations are applied as adjusted to the particular plant design.

49.C. In 1990 Euratom was informed that significant changes in the enrichment technology were about to take place requiring adaptations of the safeguards approaches for such plants. The necessary consultations with plant operators, government authorities and the IAEA have been initiated and continue.

50. The above mentioned communications and consultations with operators or government authorities continue, thus, in order to further improve safeguards implementation relating, inter alia, to:

- the use of non-destructive inspection instruments inside the cascade area and the application of Containment and Surveillance (C/S) devices;

- further improvement of the Non Destructive Assay (NDA) measurements for the depleted uranium tails;

- measures to verify conclusively that there has been no net loss of civil material in certain installations relating, in particular, to procedures for the taking of the physical inventory.

Conversion plants, fuel preparation plants and fabrication plants processing natural uranium and/or low enriched uranium

51. The safeguards measures applied at these installations are described in table II.4, the inspection effort spent is described in table II.3.

52. Following the reports of the inspectors, 16 (8%) statements after inspection or separate communications were dispatched containing particular observations requiring follow-up.

53. These communications and direct consultations with operators or government authorities aim at further improving safeguards implementation relating, inter alia, to:

    53.A. Take account of certain technological developments which have strongly influenced the safeguards activities at these facilities, e.g. the availability of modern instrumentation based on neutron and/or gamma techniques. These modern instruments are being progressively introduced in the field and will lead to more effective safeguards.

    53.B. Testing and implementation of inspection schemes providing for random and/or short notice inspections.

54. In application of Article 83.c of the Treaty one fabrication installation was placed under Commission administration during 1990 for a period of four months in order to ensure that the operator would establish and perform the proper procedures relating to material accountancy, control and to declarations. The Commission had imposed this sanction following an export of low enriched Uranium in containers recorded and handled as empty. The action was successfully terminated at the end of 1990 following the verification by the administrators that appropriate procedures had been developed, established and fully implemented in the plant operation.

Conversion/fabrication plants processing highly enriched uranium and/or plutonium

55. The safeguards measures applied at these installations are described in table II.4, the inspection effort spent is described in table II.5. It should be noted that for these installations the safeguards approach usually results in a continuous inspection regime.

56. Following the reports of the inspectors, 24 (8%) statements after inspection or separate communications were dispatched containing particular observations requiring follow-up.

57. These communications and direct consultations with operators or government authorities aim at further improving safeguards implementation relating, inter alia, to:

57.A. the further refinement of modern safeguards approaches such as the follow-up and balancing of mixes (FBOM), notably with respect to reducing the high cost of safeguards implementation;

57.B. the testing and implementation of further advanced safeguards approaches;

57.C. comprehensive verification measurements by modern instrumentation such as unattended measuring stations and advanced C/S equipment;

57.D. physical inventory taking procedures;

57.E. progressive resolution of issues related to the "mixed" character of certain plants;

57.F. replacement of a large number of transports of samples by on-site analysis.

Reprocessing plants

58. The safeguards measures applied at these installations are described in table II.4, the inspection effort spent is described in table II.5. It should be noted that for these installations the safeguards approach usually results in a continuous inspection regime during the operation of the installations.

59. Following the reports of the inspectors, 48 (42%) statements after inspection or separate communications were dispatched containing particular observations requiring follow-up.

60. These communications and direct consultations with operators or government authorities aim at further improving safeguards implementation relating, inter alia, to:

60.A. Fully transparent records/reports systems;

60.B. In-process monitoring and/or C/S applications;

60.C. Comprehensive verification measurements by modern instrumentation;

60.D. Progressive resolution of issues related to the "mixed" character of certain plants;

60.E. Replacement of a large number of transports of samples by on-site analysis.

61. As referred to in para. 30 above the main developments in 1989 and 1990 related to the preparations for and the coming on stream of three reprocessing plants of large throughput and complexity. This entailed:

61.A. Obtaining detailed technical characteristics, of detailed drawings, flow-sheets, process parameters etc.

61.B. Development of relevant safeguards approaches;

61.C. Intensive consultations with operators and government authorities;

61.D. Working out of relevant specifications and planning of contracts for the safeguards system to be installed;

61.E. Verification of BTC and of tank calibration prior to start up;

61.F. Commencement of BTC verification (for one plant in construction stage);

61.G. Preparation for final Commission approval under Article 78.2 of the Treaty (for one plant);

61.H. Commission interim approval under Article 78.2 of the Treaty (for one plant);

61.I. Implementation of safeguards at one plant following the start-up thereof.

62. Apart from the problems due to the unprecedented complexity of such new plants, the activities reported in para. 61 above for the new reprocessing plants do not give rise to particular observations.

Power reactors and storage installations

63. The safeguards measures applied at these installations are described in table II.4, the inspection effort spent is described in table II.5.

64. Following the reports of the inspectors, 61 (5%) statements after inspection or separate communications were dispatched containing particular observations requiring follow-up.

65. These communications and direct consultations with operators or government authorities aim at further improving safeguards implementation relating, inter alia, to:

65.A. Step by step replacement of film cameras by modern video equipment;

65.B. Introduction, where applicable, of monitoring and logging systems;

65.C. Re-measurement of nuclear materials under effective containment and surveillance systems;

65.D. Introduction of NDA measurements on fresh fuel stored under water.

66. It should be reported that during 1989 and 1990 considerable resources in terms of both equipment and manpower were invested in applying safeguards in light water reactors using fresh MOX fuel. The inspection scheme involves using containment/surveillance (C/S) equipment to the maximum extent, however the inspection manpower spent is still too high. Efforts to further improve the C/S equipment with the aim of achieving a better balance between equipment and manpower are ongoing.

Locations outside facilities (LOF) and other installations

67. The safeguards measures applied at these installations are described in table II.4, the inspection effort spent is described in table II.5.

68. At such installations which include those where uranium or thorium is being used for non-nuclear purposes (e.g. shielding, aircraft counter weights, production of lamps, catalysts, ceramics) and those installations at the backend of the fuel cycle (not including, of course, reprocessing), safeguards, in specific instances, may rely more on the verification of Basic Technical Characteristics (BTC), than on other concepts. The discussion, however, to which intensity such measures are to be performed has not yet been concluded but considerable progress was achieved in so far as:

- the coverage, at least accounting-wise, of such installations has been further extended;
- discussions with government authorities have resulted in the design of a scheme which will take full advantage of the existing systems at national level thereby saving Euratom resources in line with the subsidiarity principle.

69. On the other hand, it should be mentioned that at these installations operators frequently are not aware of their safeguards obligations, including nuclear materials accounting. This is why Euratom continues to spend a considerable effort in administration and other follow-up measures to ensure full adherence to the legal requirements. This resulted in 35 % (21% in 1988) of the communications to operators of such installations requiring follow-up.

70. As far as waste treatment and disposal installations are concerned, the discussions on the implementation of relevant safeguards techniques to be applied are still ongoing.

III. ACCOUNTANCY

General

71. Following the provisions of the Treaty and Regulation 3227/76, a nuclear material accounting system is established at all installations as described above. Reports are submitted according to the legal provisions to the Euratom Safeguards Directorate (DCS). Where appropriate, and following processing by Euratom, accounting reports are submitted to the IAEA, pursuant to the Verification Agreements.

72. At the installations the nuclear material accounting system comprises the records and reports required in Regulation 3227/76 and in the Particular Safeguard Provisions. These records must be complete, consistent with each other and with the physical reality, and must be reflected in the reports provided to DCS headquarters. Relating to these accounting reports the following table provides the number of records transmitted to DCS.

Year	Records providing for Inventory Changes	Records providing for Physical Inventories and material balances	Total
1988	213 958	207 240	421 198
1989	204 668	201 322	405 990
1990	297 435	285 193	582 628

The audits of these operation declarations are carried out during inspections to check the above, and any remarks arising are addressed to the operators and followed up for actions. A particularly important task is the physical inventory exercise where the books and physical inventories are verified, compared and any difference identified and investigated.

73. The activities at DCS headquarters comprise the independent updating of accounts by installation based on the reports received pursuant to Regulation 3227/76, consistency checks between inspection findings and accountancy reports provided by the operators, control of external obligations and transit accountancy.

Accounting system

74. The accounting system for nuclear material follows the classical rules of bookkeeping with respect to the nuclear materials under safeguards, the basic objective being that at all times the book inventories reflect the physical reality as closely as possible in terms of amounts and timing.

75. All nuclear material accounting systems must provide for periodic exercises to take and verify the physical inventory. The frequency depends on the detection times which in themselves depend on the nature and amounts of materials involved in the flows and inventory in the installation. The normal frequency for "wash-out" type of inventory takings is once per year whereas the time interval of "snapshots" of the physical inventory in large plutonium plants may be as short as 2-4 weeks. The timing may depend on operational constraints. The objective of the exercise is to compare the physical and book situations and make adjustments as necessary to ensure that the books continue to reflect the reality as closely as possible. Each exercise leads to an evaluation to assess the acceptability of any book/physical inventory difference in relation to the activities performed.

76. The comparison between inspection findings and records/reports for activities between physical inventories is a further important element of the chain which leads to the decision whether or not the operator's accounts can be accepted by the safeguards inspectors or whether follow-up within the appropriate time intervals has to be performed. The necessity for such follow-up is frequent and requires in certain cases long term follow up activities until a satisfactory resolution of the discrepancies is established.

External obligations

77. The control of external obligations is a further check, concerning the adherence to the provisions of the Community's nuclear agreements with the USA, Canada and Australia and/or to the contractual provisions requiring peaceful use only. The checks are based on accountancy tracking by obligation (sometimes referred to as flag control) and encompass particular exports and imports and preparation of annual reports (balance sheets) as required for the third States. Important items are the administrative procedures and inspection activities related to approval and follow-up of exchanges of safeguarding obligations.

78. All such exchanges of safeguarding obligations are approved and carried out according to a set of technical criteria which guarantee that only equivalent amounts of nuclear materials are exchanged. Equivalence must be obtained on the level of physical form, on the total element and isotopes involved. A condition of performing any exchange of safeguarding obligations is that the obligation involved with the most stringent constraints shall not lose in quality or quantity.

79. International "flag swaps" are exchanges of safeguarding obligations where one quantity of material is located outside the Community and the other inside. During the 1989 - 1990 period, no such exchanges were performed. A reluctance to permit such flag swaps on the part of some supplier countries has been experienced since in some cases there was some confusion between safeguarding obligation and physical origin of the nuclear material. Origin is not tracked by DCS as it is not a concept relevant to safeguards since, inter alia, origin of nuclear material can no longer be verified after the material has entered the fuel cycle.

80. Internal "flag swaps" are exchanges of safeguarding obligations where quantities of nuclear material exchanged are subject to Euratom safeguards.

The following table gives the data on internal flag swaps:

Year	Applications	Approved	Not-approved	Withdrawn
1988	33	25	3	5
1989	27	24	1	2
1990	36	34	0	2

81. As regards problems with respect to certain parts of Chapter VI of the Treaty, the role of Euratom safeguards is restricted to monitoring and reporting.

Transit accounting

82. In the Euratom system, receivers are obliged to report movements in exactly the same way as the shipper. Transit accounting is the cross check at the level of the reports received from operators that in fact the nuclear materials are reported as having been received as shipped. As far as shipments and receipts inside the European Community are concerned, the Safeguards Directorate follows up each transfer automatically until the official confirmation of the receipt is available. This may involve physical verifications, and any discrepancy between shipper reports and receiver reports automatically triggers a follow-up action which may lead to an anomaly. All discrepancies must be resolved or justified. If justified, the receiver is nevertheless obliged to report the movement in the same way as the shipper accompanied by an appropriate shipper-receiver difference report.

83. The response time of the Euratom safeguards system to such differences in reports on transit is less than a month for plutonium and highly enriched uranium. This detection mechanism of diversions is of fundamental importance. It may be reported that in 1989 and 1990 all open transit differences were resolved after appropriate follow-up action.

84. A further feature of this activity is the contribution to the worldwide IAEA system of nuclear material control. The Community record has always been good in this respect and this exercise has allowed Euratom to observe that certain countries outside the Community do not report on time or with the necessary precision. The Commission continues to help the IAEA in solving problems of this type.

Concluding remark

85. The above controls and audits provide the necessary verifications whether the relevant provisions of the Euratom Treaty, the agreements with third country suppliers and the safeguards agreements with IAEA are being complied with. As regards accountancy of safeguards obligations, balance sheets and exchanges of safeguarding obligations, no particular observations apply for the period considered in this report. The usual follow-up required in the cases of late submission of reports, incomplete records and reports and/or of discrepancies took place.

IV. RESOURCES

Inspection manpower resources

86. The development of the staff of the Euratom Safeguards Directorate is displayed in the following table IV.1. This table also displays the inspection effort spent and the amounts of nuclear material under safeguards.

Table IV.1

Year	Staff DCS	Index	Operational inspectors	Index	Inspection mandays spent	Index	Nuclear material under safeguards in eff. kg (by 1000)	Index
1982	179	100	108	100	4 489	100	78	100
1983	180	101	120	111	5 116	114	90	115
1984	177	99	131	121	6 047	135	105	134
1985	188	105	125	116	6 225	139	121	155
1986	202	113	134	124	6 196	138	139	177
1987	212	118	139	129	6 814	152	158	202
1988	228	127	155	144	7 364	164	179	229
1989	230	128	157	145	7 417	165	199	255
1990	227	127	163	151	7 564	169	231	296

87. The following additional remarks should be taken into account when considering table IV.1:

87.A. Inspection effort is calculated through an internationally accepted definition (reference for example: Art. 98 L of the Verification Agreement), i.e. "... a man-day being a day during which a single inspector has access to a facility at any time for a total of not more than eight hours".

87.B. In addition to the inspection effort spent by Euratom, the IAEA spent the following inspection effort in the Community:

year	1983	1984	1985	1986	1987	1988	1989	1990
man-days of inspection in the Community	2781	2545	3070	3442	3854	3591	3565	3615

87.C. The increase (in effective kg) of nuclear materials is dominated by plutonium. Currently most plutonium under safeguards is in store either in the form of irradiated fuel awaiting reprocessing or in oxide form in containers.

88. While it would be misleading to link safeguards effectiveness exclusively to inspection effort spent it is nevertheless a fact that the increase in nuclear materials has been accompanied by an increase in inspection manpower and by an increase in the average "productivity" of the inspectors.

Inspection manpower resources until 1995

89. In view of the continuing increase in the number of nuclear installations within the European Community and, in particular, the corresponding increase of civil nuclear material to be safeguarded, the need should be recognized to continue to augment the number of nuclear safeguards inspectors within the years to come.

90. More specifically, the reasons for the additional manpower requirements are:

90.A. To meet the challenge posed by three large reprocessing plants and two large MOX fabrication plants, unprecedented in scale scheduled to start operations between 1989 and 1993 (One such plant started in 1989).

90.B. To ensure that the safeguards coverage will keep pace with the growth of the nuclear industry in the Community and in particular with the increasing use of plutonium in MOX for nuclear electricity generation purposes;

90.C. To further improve safeguards at complex installations, particularly at installations where both civil and non-civil nuclear material are handled either simultaneously or sequentially.

91. Accordingly, the Commission informed the Council in 1989 that a total of 99 inspection posts will be needed in the period to 31.12.1995. It should be noted that it is necessary to recruit persons with a suitable technical background, i.e. with a degree from university or an advanced technical school combined with experience gained in the nuclear field. On the other hand, any newly recruited inspector needs specific training and must undergo a security enquiry in all the Member States; this implies that an inspector becomes operational after about one year.

Operational credits

92. Budget chapter B4.2 provides the credits for the operation of Euratom safeguards excluding staff cost and excluding cost for the computer main frames:

92.A. Budget line B4 2000: missions
92.B. Budget line B4 2010: training, meetings and experts
92.C. Budget line B4 2020: procurement of instruments, sample analysis transport, temporary staff, technical and scientific studies, informatics software and PCs.
92.D. Budget line B4 2021: large plutonium processing plants. The Commission has introduced this budget line in view of the significant investments necessary. (Ref. para. 30-34 above).

In addition, budget line AO 1420 provides for costs associated with radioprotection of inspectors.

93. The following credits were made available over the last five years (in MECU):

	1987	1988	1989	1990	1991
B4 2000	1,910	2,010	2,100	2,250	2,350
B4 2010	0,130	0,130	0,130	0,120	0,105
B4 2020	2,051	2,060	2,500	3,800	2,300
B4 2021	/	/	/	/	2,600
Total	4,091	4,200	4,730	6,170	7,355
AO 1420	0,052	0,065	0,114	0,155	0,140
consumed resources (%)	95,12	93,77	99,81	99,99	--

Instruments, methods and techniques

94. The Safeguards Directorate at present possesses the following equipment used either at nuclear installations or at headquarters.

EURATOM EQUIPMENT 12/90

A. Gamma equipment		B. Neutron equipment	
1	NIS PITMAN } hand held	2	SAM II/SNAP
7	HM4 } syst.	4	Cercueil (pins)
10	SAM II (2 channel syst.)	1	Octagon (waste)
2	Enrichment meters	13	HLNCC (Pu)
6	Pu meters	7	NCC (fuel elements)
24	Davidson MCA's	5	AWCC (HEU, LEU)
7	Silena Ciceros	5	Phonid (LEU, HEU)
4	Gamma & Neutron Measurement stations	3	CIND (UF6 cyl.)
		4	UFBR (FBR ass., Pu cyl.)
2	MTR scanners	4	Inventory sample counter
2	5-10 Canberras	1	Sigma (THTR pebbles)
1	5-1500 Canberras	6	Hexagones

C. C/S equipment		D. "Other" equipment	
86	Minolta camera units	6	ION-1 FORK (spent fuel)
6	Ministar TV systems	1	UF6 mass spectrometer
14	MIVS TV systems	1	UO2 mass spectrometer
21	EUR video systems (TLR)	1	Potentiometer (U-factor)
19	VACOSS seals		Various reference materials
10	Night vision devices	11	Ultrasonic thickness gauges
1	Pebble sampling device	11	Load cells
		1	Portable K-edge
		1	K-edge densitometer

Total: about 310 INSTRUMENTS at the end of 1990 - (250 end of 1988)

95. The application of technical measures for nuclear materials verification and containment/surveillance has largely increased over the last few years. This is illustrated in Fig. 1 attached for the years 1984 to 1990. The figures show (in percent) the number of inspections where sample taking, optical surveillance, non destructive assay (NDA) or use of seals is involved.

96. The use of technical measures per type of installation is illustrated in Figs. 2-5 for NDA equipment (Fig. 2), optical surveillance (Fig. 3), sample taking (Fig. 4) and use of seals (Fig. 5). The figures are self-explanatory.

97. 787 and 882 samples were taken by inspectors in the field in 1989 and 1990 respectively. 215 and 359 samples were analysed on site using analytical equipment or our portable mass spectrometers. 397 and 497 samples were transported to the Commission laboratories at Karlsruhe, Ispra and Geel, where a total of 1139 and 1335 chemical analysis were carried out.
The mean time for transport was 62 and 53 days (140 in 1988), the mean time for analysis 46 days (50 days in 1988). The total delay time is decreasing but is still unacceptably high .
An analysis of the reasons for delay shows that transportation is a significant cause. The main reason for these long transportation times is the need to fully comply with transport regulations of radioactive material. In order to overcome this problem and also for reasons of cost effectiveness, Euratom has proposed to install two on-site laboratories at La Hague (France) and Sellafield (UK). The first steps for implementing this solution at Sellafield (design, safety aspects, contracts,...) have already been taken. The commissioning of this laboratory should commence by 1992.
Moreover, instruments are coming into routine use which allow the measurements of most of such safeguards samples on site thereby reducing the need for transports to a minimum.

98. About 18,000 seals were placed each year by inspectors during 1989 and 1990 of which about 3000 seals were placed each year on nuclear materials exported from the Community. About 14,000 and 18,000 seals were removed and verified in 1989 and 1990 at headquarters. In addition about 7500 paper seals, and 40 new fibre optic seals were used and field tested in nuclear installations.

99. During 1990 (1989), 718 (803) films from optical surveillance units were developed, reviewed and evaluated at DCS headquarters in Luxembourg. The reliability of the optical surveillance units was better than 99.8%. From the new video systems introduced in installations, about 400 (300) video tapes were replaced, reviewed and evaluated.

100. Equipment for Non Destructive Assay (NDA) was used for nuclear material verifications in almost 800 inspections in 1989 and 1990, equivalent to about 37% of the total number of inspections.

101. Large plant-installed measurement and surveillance systems were discussed, designed and installed in collaboration with the plant operators concerned for reprocessing and plutonium storage facilities.

Informatics

102. The following main systems are presently in operation (apart from a multitude of individual applications):

102.A. Accounting System (CMF - Comptabilité Matières Fissiles): ADP (Automatic Data Processing) and verification of operator reports (approximately 600.000 lines per year). Reports to IAEA on magnetic tapes based on operator's reports but in a different format. Production of numerous reports for statistical purposes and for assisting the accounting unit in its checks.

102.B. Seals: ADP of approximately 18000 seals/year from fabrication, issue, placing, breaking, through to final verification.

102.C. Destructive Analysis: Storage and retrieval of data, both administrative and technical, related to the taking of samples for destructive analyses.

102.D. Inspection planning and follow-up: Input and storage of the scheduling of each inspection. Communication to IAEA of a subset of the plan. After the inspection, the system generates the necessary follow-up actions.

102.E. Management: List of personnel, management of missions, productions of mission statistics, presence list etc.

102.F. NUMSAS (Nuclear Material Statistical Analysis System): System to evaluate differences found in material balances.

103. Personal computers have become an indispensable tool to assist inspectors in the field as well as for purposes of headquarters evaluations. Particular attention is given to ensure compatibility between the hardware as well as between applications at the installations. The PCs are integrated with the main-frame computer through a LAN (Local Area Network).

104. The following list gives a survey of the hardware available and used exclusively for safeguards:

- Siemens 7560, 1.7 mips and 32 terminals
- 2 UNIX computers (Olivetti 3B2 and NCR600) for office automatization including word processing etc. with 37 work stations
- 88 personal computers.
- 1 UNIX computer (NCR 600) for access to the public packet switching data network (x25). Ciphered faxes can be transmitted with this network.
- 2 Ciphered faxes to exchange confidential documents with the IAEA.

105. Relating to software the main components are the following:

- Operating system BS2000 allowing batch and on-line processing
- Database management system ADABAS including query language NATURAL
- Database management system dBASE III and oracle, for the operation of the personal computers and other software for PC's as MS WORD, LOTUS 123 and others.

106. It is expected that the development of informatics will proceed in further decentralizing hardware while maintaining an integrated architecture permitting strict software compatibility and, of course, assuring strict data security.

Support from the Joint Research Center (DG XII-JRC)

107. DG XII-JRC supports the Euratom safeguards directorate by performing and financing a number of essential activities in the R&D field:

107.A. Development of instruments, methods and techniques as well as analysis of safeguards samples: Cost about 3,5 Mio ECU per annum.

107.B. Radiation protection (dosimetry and expertise) of the safeguards inspectors.

107.C. Training of safeguards personnel at ISPRA, mainly at the recently established PERLA laboratory.

108. The support by DG XII-JRC to the safeguards directorate is coordinated by a rigorous project management. The total number of such projects amounted to 23 (1989) and 38 (1990).

109. The continuation of the support by DG XII-JRC to the Euratom Safeguards Directorate in an effective and efficient manner is essential.

Fig. 1 Usage of Technical Measures

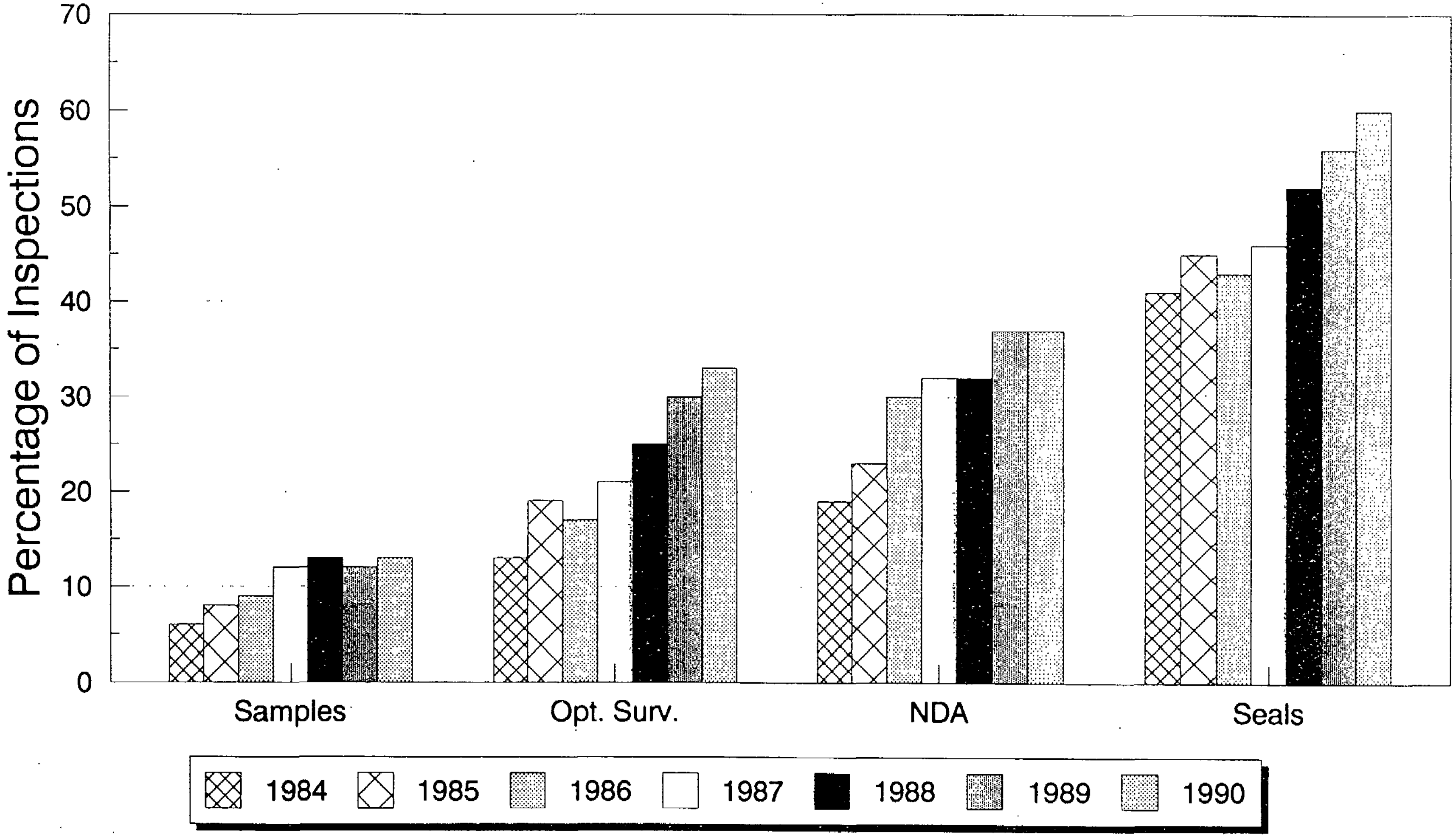


Fig. 2 Usage of NDA Equipment

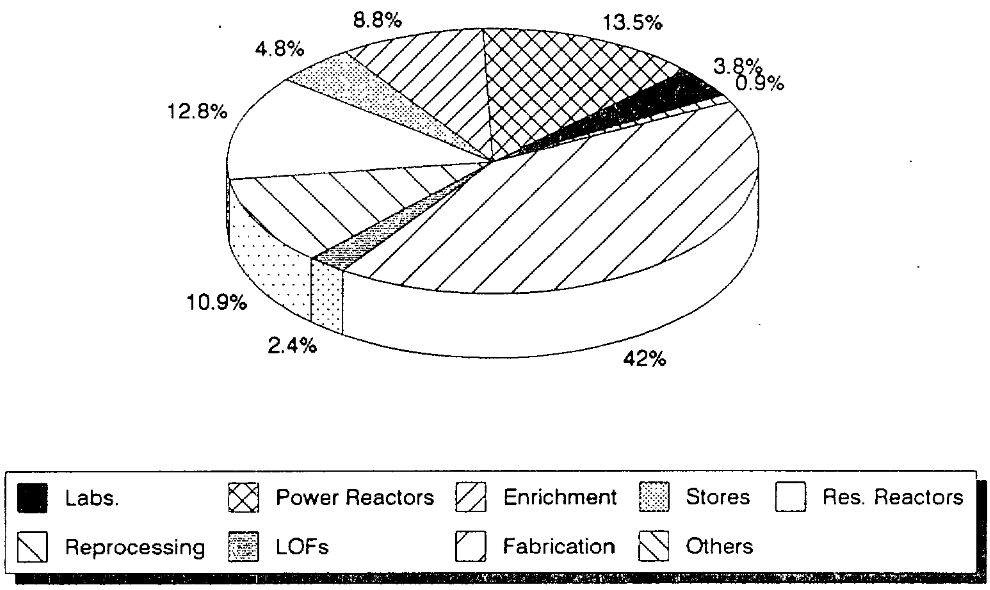


Fig. 3 Usage of Optical Surveillance

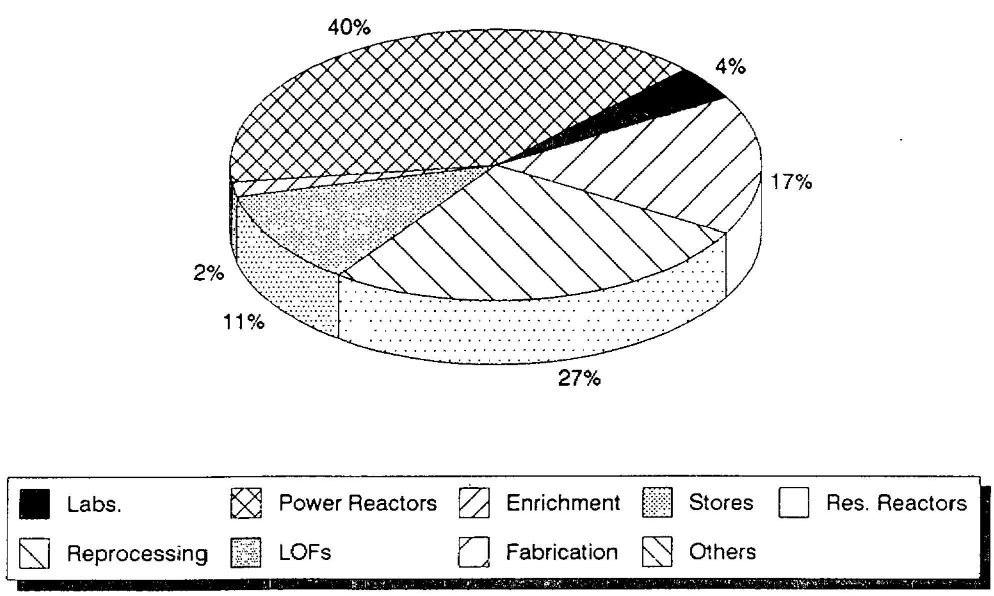


Fig. 4 Taking of Samples

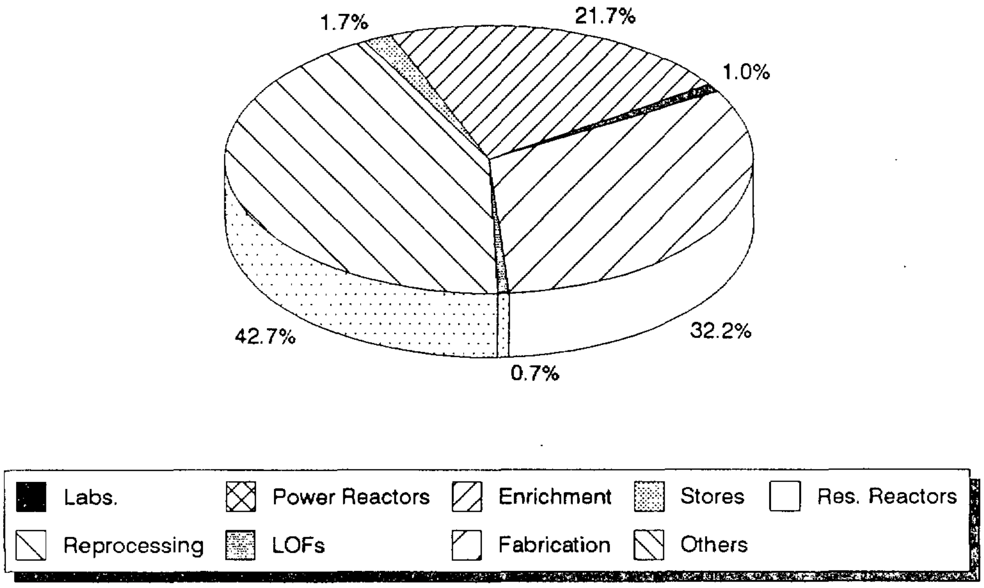
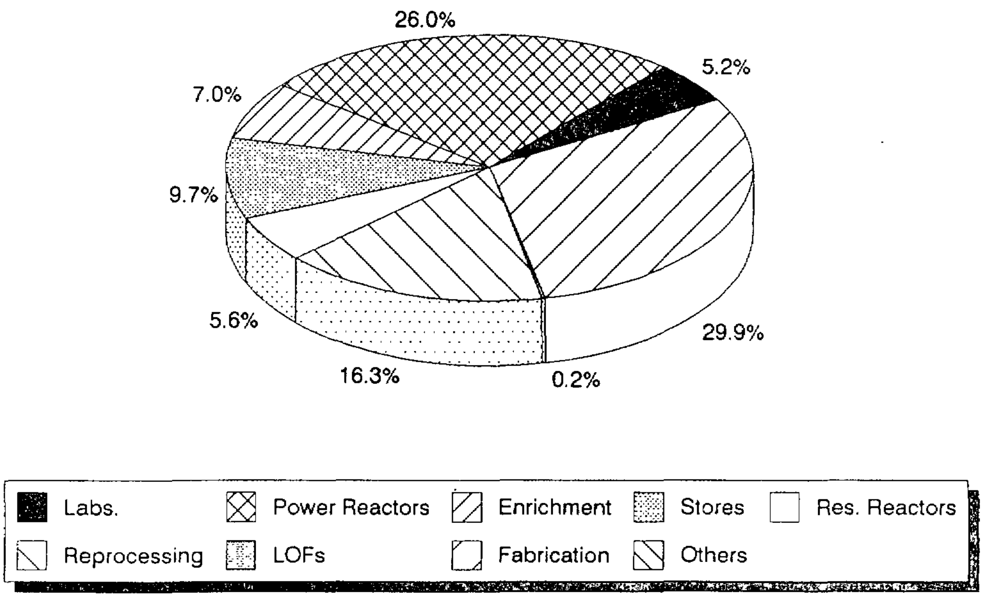


Fig. 5 Usage of Seals



V. RELATIONS WITH THE INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)

110. The IAEA, a member of the UN family of specialized agencies, is the international Agency responsible on a worldwide basis, inter alia, for carrying out safeguards under the Non-Proliferation Treaty or other agreements relating to the peaceful use of nuclear energy. As already described before (para. I.13) three Verification Agreements have been concluded between the Community, its Member States and the IAEA. They establish the responsibilities of Euratom, its Member States and the IAEA.

111. The structure of the relations with the IAEA may be summarized as follows:

111.A. Participation of the IAEA in Euratom inspections. This is a daily operational task. At about 50 % of all Euratom inspections IAEA inspectors participate.

111.B. Reporting of the nuclear material movements and inventories pursuant to the provisions of the Verification Agreements and support to the IAEA system of world wide accounting for the transit of nuclear materials.

111.C. Meetings of the Liaison Committees pursuant to Art. 25 of the Protocol to the Safeguards Agreements. The purpose of these meetings is to discuss, coordinate, negotiate general issues relating to or influencing IAEA safeguards in the Community.

111.D. Negotiations of documents of a technical/legal nature called the **Facility Attachments** (F.A.) or installation **attachments**. This requires a major negotiation effort on all sides. Some 50 Attachments, including the attachments for new installations and existing attachments in need of revision, still need to be negotiated, about 200 being already in force.

111.E. Numerous contacts and working groups, participation in seminars, common training activities;

111.F. Collaboration with the IAEA in the development, testing and implementation of instruments, methods and techniques.

112. A number of developments took place in 1989 and 1990 which continue to give raise to extended discussions and negotiations on the implementation of the three Safeguards Agreements.

113. These developments include:

113.A. Due to the declared intent of several countries outside the European Community that they aim for the establishment of "regional" safeguards systems and have, reportedly, indicated their objectives to negotiate for the same terms as Euratom in the Verification Agreements, the IAEA is in a delicate position, since notably these countries in their actual negotiations are reported to link their acceptance of full scope IAEA safeguards with the acceptance, a priori, of a regional system. The political discussion of "regional" safeguards systems is expected to be relevant for the relations between the IAEA and Euratom.

113.B. The IAEA has developed a set of "Safeguards Criteria for 1991-95" and a document was officially provided to Euratom on 26 November 1990 during the High Level Liaison Committee (HLLC). The Commission services undertook to analyze these criteria with respect to safeguards methodology, compliance with the Verification Agreements and accompanying understandings (e.g.. Observation and Joint Teams), compliance with facility attachments concluded as well as with basic Community policy such as on the unity of the European nuclear market. The analysis of the criteria was completed in 1991 and the Commission services are in a process of consultation with the IAEA within the framework of the HLLC.

113.C. The experience of Euratom in the design and implementation of safeguards systems for the large plutonium processing plants show that their features require a shift from classical human-interference inspections to fully automated and largely unattended systems leading to concepts and approaches Euratom considers essential to perform high quality safeguards. As one of these plants will be jointly safeguarded by Euratom and the IAEA the negotiations on the safeguards concepts and, notably, the operations have not yet led (end 1990) to a consensus.

114. Further issues to be discussed with the IAEA include:

114.A. Maintenance of a steady progress in the early conclusion of Facility Attachments;

114.B. The implementation of IAEA safeguards in the Nuclear Weapon States.

114.C. A continual review of safeguards approaches in view of improved instrumentation and advances in processing technology, notably, for large fuel cycle installations processing Uranium.

115. It is clear that the Commission continues to support the worldwide role and responsibilities of the IAEA in the safeguards field. For its part, the Commission trusts the IAEA to maintain its relationship with the Community on the basis of the responsibilities laid down in the three Safeguards Agreements which were of course concluded on the basis of Euratom Treaty obligations.

116. A certain duplication in the application of safeguards procedures is however unavoidable, but:

- as a consequence of the collaboration between Euratom and the IAEA, the effectiveness of safeguards in the Community Non Nuclear Weapons States is, when taken together, superior to any other region in the world; as a typical example the implementation of Euratom safeguards for the new "Laender" of Germany can be mentioned;

- the IAEA can participate in the implementation of the NPT in safeguarding activities (which Euratom needs to perform) of an intensity and depth which it may not perform elsewhere.

117. The Commission's collaboration with the IAEA in the safguards field is one of the key elements in the consistently high level of the Community's non-proliferation credentials.

VI. *TRENDS IN SAFEGUARDS OPERATION*

118. Safeguards up to 1995 can be characterized both through the way it will cope with the increased availability and use of plutonium in the commercial fuel cycle of the Community and through the desirability to continue to improve the effectiveness and efficiency of the safeguards operation in general.

119. Reference is made in this respect to the trends as described in paragraphs 101 to 106 of the Operations Report for 1988 as well as to paragraphs 23 to 34 of the present report.

120. A new type of installation is presently under design and may enter pilot plant stage, i.e. plants to "compact" irradiated LWR fuel elements for the purpose of later "final" disposal. It is expected that such pilot plants might become operational between 1995-2000; relevant safeguards concepts and approaches are presently being discussed with operators and with the IAEA.

121. From a technical point of view, the trend reported in paragraph 106 of the "1988 Report" can be confirmed as presenting a continuing challenge to safeguards in two respects.

122. For security and health physics reasons, installations are designed and operated, in which the nuclear material which is subject to safeguards is more and more inaccessible (massive transport/storage containers not designed for routine opening; heavily shielded, secure storage of sensitive nuclear material). Developments now being applied include advanced measurement instrumentation and sophisticated C/S systems including monitoring/logging systems designed to react to and record events which might be of interest to safeguards. These developments will need to be continued to keep pace with design changes and adapted to specific situations.

123. The main fuel cycle facilities, i.e. fabrication and reprocessing plants are developed to operate in a fully automated (and remotely controlled) mode. This trend continues to cause the departure from established safeguards/inspection practice,i.e. the need for Euratom :

- to further increase the involvement of safeguards experts in the design/construction work at a stage long before commissioning;
- to further increase the emphasis on the activities related to authentication for safeguards purposes of plant design, operators measurement procedures and accounting;
- to further increase the importance of verification and re-verification of the basic technical characteristics;
- to continue in safeguards operations to try to limit the need for additional manpower, in line with the manpower provisions made by the Commission (ref. para. 91), through the development and implementation of automated, largely unattended measurement systems where feasible.

VII. SUMMARY

124. The effectiveness of Euratom safeguards depends as outlined in this report on the manner in which the inspection service is organized and motivated, on the promptness and the extent to which operators and Member State authorities fulfill the responsibilities and on the resources made available to the Commission.

125. Relating to the mandate, the intensity and depth of Euratom safeguards, the Commission has been entrusted with extensive responsibilities. However, the budgetary appropriations made available largely determine the discharge of these responsibilities as well as the ability to make progress in the way indicated in this report.

126. As the use of recycled plutonium has now reached routine commercial application, Euratom safeguards continues to give the necessary priority to the control of the large plutonium fuel cycle facilities. The necessary human and financial resources have been determined for these plants. In order to keep the human inspection resources at a level consistent with the Commission's forward planning, the implementation of automated, unattended safeguards systems will continue.

ANNEX 1

EURATOM SAFEGUARDS

Glossary of abbreviations currently used in Safeguards

AGR	Advanced Gaz-cooled Reactor
AECB	Atomic Energy Control Board (Canada)
AERE	Atomic Energy Research Establishment (Harwell)
AIEA	Agence Internationale de l'Energie Atomique (see IAEA)
AQG	Atomic Questions Group (see GQA)
ARIE 1	Actual Routine Inspection Effort (for Euratom)
ARIE 2	Actual Routine Inspection Effort (for IAEA)
ASO	Australian Safeguards Office
AWCC	Active Well Coincidence Counter
BCMN	Bureau Central de Mesures Nucléaires (see CBNM) (Geel Belgium)
BHF	Bulk Handling Facility
BMFT	Bundesministerium für Forschung und Technologie
BNFplc	Brith Nuclear Fuels plc
BSAM	Brookhaven Stablized Assay Meter
BTC	Basic Technical Characteristics (see CTF)
BWR	Boiling Water Reactor
CAM	Catch-all MBA (=Very small installations)
CBNM	Central Bureau for Nuclear Measurements (Geel Belgium)
CCAM	Commission Consultative des Achats et de Marchés
CCR	Centre Commun de Recherche (see JRC)
CCTV	Closed Circuit Television
CEA	Commissariat à l'Energie Atomique
CERT	Comité Energie, Recherche et Technologie du P.E.
CMF	Comptabilité Matières Fissiles
COPO	Coopération Politique
COREPER	Comité des Représentants Permanents
CRP	= COREPER
C/S	Containment and Surveillance
CTC	Communication to Council
CTF	Caractéristiques Techniques Fondamentales (see BTC)
CTI	Comité Technique Interministériel pour l'Euratom
CVD	Cerenkov Viewing Device
DA	Destructive Analysis (see also NDA)
DCS	Direction Contrôle de Sécurité (see ESD)
DGM	Director General Meeting
DI	Design Information
DOE	Department of Energy (UK)
DPC	Dispositions Particulières de Contrôle (see PSP)
DUCA	Determination of Uranium 235 Content Apparatus
ECSAM	European Commission Safeguards Analytical Measurement Committee
EDAN	Etat doté d'Armements Nucléaires (see NWS)
EDF	Electricité de France
eKg	Effective Kilogram
ENDAN	Etat Non-Doté d'Armements Nucléaires (see NNWS)

ENEA	Comitato Nazionale per l'Energia Nucleare e l'Energia Alternativa
EP	European Parliament
ESA	Euratom Supply Agency (see SA)
ESARDA	European Safeguards Research and Development Association
ESD	Euratom Safeguards Directorate (see DCS)
ESP	Etat des Stocks Physiques (see PIL)
EUR	Euratom
FA	Facility Attachment
FANT	Facility Attachments Negotiating Teams
FBOM	Follow-up and Balancing Of Mixes
FBR	Fast Breeder Reactor
GFK	Gesellschaft für Kernforschung mbh (Karlsruhe)
GQA	Groupe des Questions Atomiques (see AQG)
HEU	Highly Enriched Uranium
HLLC	High Level Liaison Committee (Art. 25 Protocol VA)
HLNCC	High Level Neutron Coincidence Counter
HSP	Hexapartite Safeguards Project
IAEA	International Atomic Energy Agency (see AIEA)
IAEO	Internationale Atomenergie-Organisation (see IAEA)
ICR	Inventory Change Report (see RVS)
ICT	Isotopic Correlation Technique
IMD	Inspector Mission Day
IMS	Integrated Monitoring System
INMM	Institute of Nuclear Materials Management (USA)
IPSN	Institut de Protection et de Sûreté Nucléaire, Fontenay-aux-Roses
ISM	- Inter-Service Meeting - Informatics Systems Manager
JRC	Joint Research Centre (see CCR)
JT	Joint Team
JTWG	Joint Technical Working Group
KFA	Kernforschungsanlage Jülich
KMP	Key Measurement Point (see PMP)
LASL	Los Alamos Scientific Lab (USA)
LEMUF	Limits of Error of MUF
LEU	Low Enriched Uranium
LFUA	Limited Frequency Unannounced Access
LII	List of Inventory Items (see LOI)
LOI	Liste des Objets en Inventaire (see LII)
LLLC	Lower Level Liaison Committee (Art. 25 Protocol VA)
LOF	Location Outside Facility (Holding less than 1 eKg)
LOVER	LOcal VERification
LWR	Light Water Reactor
MBA	Material Balance Area (see ZBM)
MBP	Material Balance Period
MBR	Material Balance Report (see RBM)
MD	Man-day(s)
MDC	Material Description Code
MEB	Multi Element Bottle
MIS	Management Information System
MOX	Mixed Oxide
MTR	Material Testing Reactor
MUF	Material unaccounted For

NCC	Neutron Coincidence Collar
NDA	Non Destructive Analysis (see also DA)
NM	Nuclear Material
NMACT	Nuclear Material Accounting Control Team (UK)
NMTR	Nuclear Material Transfert Report
NNPA	Nuclear Non-Proliferation Act
NNWS	Non-Nuclear Weapon State (see ENDAN)
NPT	Non-Proliferation Treaty (see TNP)
NRTA	Near Real Time Accountancy
NUMSAS	Nuclear Material Statistical Accountancy System
NVD	Night Vision Device
NWS	Nuclear Weapon State (see EDAN)
OJOM	One Job-One Man
OTTO (list)	Other Than Through Observation
PE	Parlement Européen (see EP)
PICF	Physical Inventory Control and Follow-up
PIL	Physical Inventory Listing
PIT	Physical Inventory Taking
PIV	Physical Inventory Verification
PMP	Point de Mesure Principal (see KMP)
PSEP	Particular Safeguards Evaluation Procedures
PSP	Particular Safeguards Provisions (see DPC)
PWR	Pressurized Water Reactor
RBM	Rapport de Bilan Matières (see MBR)
RCD	Réunion des Chefs de Division
R&D	Research and Development
RFS	Rapid Feedback System
RM	Reference Material
RMS	Resource Management System
RRCS	Rapport sur les Réalisations du Contrôle de Sécurité
RVS	Rapport de Variation de Stocks (see ICR)
SA	-Supply Agency (see EAS) -Subsidiary Arrangements
SAGSI	Standing Advisory Group for Safeguards Implementation
SAM	Stabilized Assay Meter
SEAM	Safeguards Effectiveness Assessment Methodology
SGHWR	Steam Generating Heavy Water Reactor
SIC	Summary Inventory Changes
SICDB	Safeguards Information centre Data Base (ADABAS data base)
SIR	Safeguards Implementation Report (IAEA)
SMS	Safeguards Management System
SOM	Senior Officers Meeting
SP	Strategic Point
SPI	Summary Physical Inventory
SQ	Significant Quantity
SRD	Shipper/Receiver Difference
SSAC	State System of Accountancy and Control
THTR	Thorium Hochtemperatur Reaktor
TLD	Thermoluminescence Dosimetry
TNP	Traité de Non-Prolifération (see NPT)
TO (list)	Through Observation (see also OTTO)
UFBR	Universal Fast Breeder Reactor Counter
UKAEA	United Kingdom Atomic Energy Authority
VA	Verification Agreement(s)

VDC	Variable Dead-time Counter
WGAR	Working Group on Accountancy and Reporting
WGGC	Working Group on inspection Goals and acceptance Criteria
WPDE	Working Party on Data Evaluation
WPIA	Working Party on Informatics and Accountancy
WPIP	Working Party on Planning of Inspections
WPIT	Working Party on Instruments and Techniques
WPSA	Working Party on Safeguards Approaches
WWTP	Working Party on Working conditions, Training and Procedures
ZBM	Zone de Bilan Matière (see MBA)

CHAPTER VII

SAFEGUARDS

Article 77

In accordance with the provisions of this Chapter, the Commission shall satisfy itself that, in the territories of Member States,

(a) ores, source materials and special fissile materials are not diverted from their intended uses as declared by the users;

(b) 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 78

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 of irradiated nuclear fuels shall declare to the Commission the basic technical characteristics of the installations, to the extent that knowledge of these characteristics is necessary for the attainment of the objectives set out in Article 77.

The Commission must approve the techniques to be used for the chemical processing of irradiated materials, to the extent necessary to attain the objectives set out in Article 77.

Article 79

The Commission shall require that operating records be kept and produced in order to permit accounting for ores, source materials and special fissile materials used or produced. The same requirement shall apply in the case of the transport of source materials and special fissile materials.

Those subject to such requirements shall notify the authorities of the Member State concerned of any communications they make to the Commission pursuant to Article 78 and to the first paragraph of this Article.

The nature and the extent of the requirements referred to in the first paragraph of this Article shall be defined in a regulation made by the Commission and approved by the Council.

Article 80

The Commission may require that any excess special fissile materials recovered or obtained as by-products and not actually being used or ready for use shall be deposited with the Agency or in other stores which are or can be supervised by the Commission.

Special fissile materials deposited in this way must be returned forthwith to those concerned at their request.

Article 81

The Commission may send inspectors into the territories of Member States. Before sending an inspector on his first assignment in the territory of a Member State, the Commission shall consult the State concerned; such consultation shall suffice to cover all future assignments of this inspector.

On presentation of a document establishing their authority, inspectors shall at all times have access to all places and data and to all persons who, by reason of their occupation, deal with materials, equipment or installations subject to the safeguards provided for in this Chapter, to the extent necessary in order to apply such safeguards to ores, source materials and special fissile materials and to ensure compliance with the provisions of Article 77. Should the State concerned so request, inspectors appointed by the Commission shall be accompanied by representatives of the authorities of that State; however, the inspectors shall not thereby be delayed or otherwise impeded in the performance of their duties.

If the carrying out of an inspection is opposed, the Commission shall apply to the President of the Court of Justice for an order to ensure that the inspection be carried out compulsorily. The President of the Court of Justice shall give a decision within three days.

If there is danger in delay, the Commission may itself issue a written order, in the form of a decision, to proceed with the inspection. This order shall be submitted without delay to the President of the Court of Justice for subsequent approval.

After the order or decision has been issued, the authorities of the State concerned shall ensure that the inspectors have access to the places specified in the order or decision.

Article 82

Inspectors shall be recruited by the Commission.

They shall be responsible for obtaining and verifying the records referred to in Article 79. They shall report any infringement to the Commission.

The Commission may issue a directive calling upon the Member State concerned to take, by a time limit set by the Commission, all measures necessary to bring such infringement to an end; it shall inform the Council thereof.

If the Member State does not comply with the Commission directive by the time limit set, the Commission or any Member State concerned may, in derogation from Articles 141 and 142, refer the matter to the Court of Justice direct.

Article 83

1. In the event of an infringement on the part of persons or undertakings of the obligations imposed on them by this Chapter, the Commission may impose sanctions on such persons or undertakings.

These sanctions shall be, in order of severity:

(a) a warning;

(b) the withdrawal of special benefits such as financial or technical assistance;

(c) the placing of the undertaking for a period not exceeding four months under the administration of a person or board appointed by common accord of the Commission and the State having jurisdiction over the undertaking;

(d) total or partial withdrawal of source materials or special fissile materials.

2. Decisions taken by the Commission in implementation of paragraph 1 and requiring the surrender of materials shall be enforceable. They may be enforced in the territories of Member States in accordance with Article 164.

By way of derogation from Article 157, appeals brought before the Court of Justice against decisions of the Commission which impose any of the sanctions provided for in paragraph 1 shall have suspensory effect. The Court of Justice may, however, on application by the Commission or by any Member State concerned, order that the decision be enforced forthwith.

There shall be an appropriate legal procedure to ensure the protection of interests that have been prejudiced.

3. The Commission may make any recommendations to Member States concerning laws or regulations which are designed to ensure compliance in their territories with the obligations arising under this Chapter.

4. Member States shall ensure that sanctions are enforced and, where necessary, that the infringements are remedied by those committing them.

Article 84

In the application of the safeguards, no discrimination shall be made on grounds of the use for which ores, source materials and special fissile materials are intended.

The scope of and procedure for the safeguards and the powers of the bodies responsible for their application shall be confined to the attainment of the objectives set out in this Chapter.

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.

Article 85

Where new circumstances so require, the procedures for applying the safeguards laid down in this Chapter may, at the request of a Member State or of the Commission, be adapted by the Council, acting unanimously on a proposal from the Commission and after consulting the Assembly. The Commission shall examine any such request made by a Member State.