IAEA SAFEGUARDS GLOSSARY

2001 Edition

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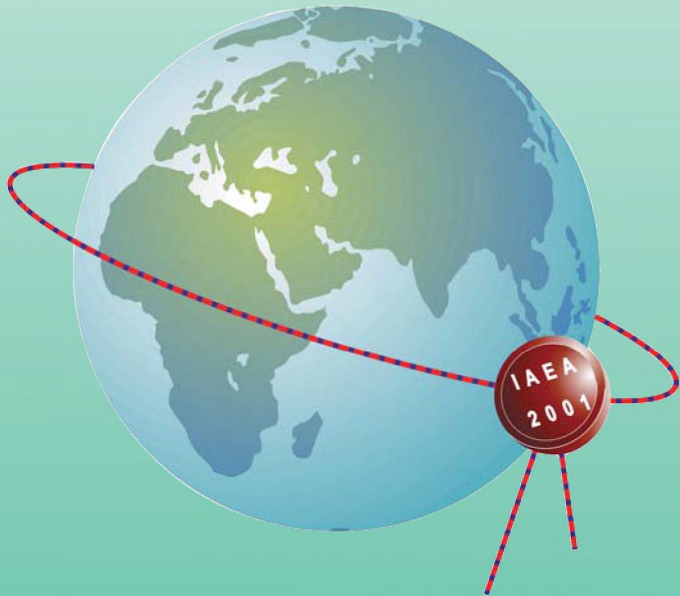

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The Agency's Statute was approved on 23 October 1956 by the Conference on the Statute of the IAEA held at United Nations Headquarters, New York; it entered into force on 29 July 1957. The Headquarters of the Agency are situated in Vienna. Its principal objective is "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world''.

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FOREWORD

IAEA safeguards have evolved since their inception in the late 1960s. In 1980 the IAEA published the first IAEA Safeguards Glossary (IAEA/SG/INF/1) with the aim of facilitating understanding of the specialized safeguards terminology within the international community. In 1987 the IAEA published a revised edition of the Glossary (IAEA/SG/INF/1 (Rev.1)) which took into account developments in the safeguards area as well as comments received since the first edition appeared.

Since 1987, IAEA safeguards have become more effective and efficient, mainly through the series of strengthening measures approved by the IAEA Board of Governors during 1992–1997, the Board's approval, in 1997, of the Model Protocol Additional to the Agreement(s) between State(s) and the International Atomic Energy Agency for the Application of Safeguards (issued as INFCIRC/540 (Corrected)), and the work, begun in 1999, directed towards the development and implementation of integrated safeguards. The IAEA Safeguards Glossary 2001 Edition reflects these developments.

Each of the 13 sections of the Glossary addresses a specific subject related to IAEA safeguards. To facilitate understanding, definitions and, where applicable, explanations have been given for each of the terms listed. The terms defined and explained intentionally have not been arranged in alphabetical order, but their sequence within each section corresponds to the internal relationships of the subject treated. The terms are numbered consecutively within each section and an index referring to these numbers has been provided for ease of reference. The terms used have been translated into the official languages of the IAEA, as well as into German and Japanese.

The IAEA Safeguards Glossary 2001 Edition has no legal status and is not intended to serve as a basis for adjudicating on problems of definition such as might arise during the negotiation or in the interpretation of safeguards agreements or additional protocols.

The IAEA Safeguards Glossary 2001 Edition appears as a publication in the International Nuclear Verification Series. Other publications appearing in this series are as follows:

IAEA/NVS/1	Safeguards Techniques and Equipment (1997)
IAEA/NVS/2	The Evolution of IAEA Safeguards (1998).

NOTE ON THE IAEA DOCUMENTS REFERRED TO IN THE GLOSSARY

[ST] Statute of the International Atomic Energy Agency, 1956.

[9] INFCIRC/9/Rev. 2. Agreement on the Privileges and Immunities of the IAEA, 1967.

[39] GC(V)/INF/39. The Agency's Inspectorate, 1961.

[66] INFCIRC/66/Rev. 2. The Agency's Safeguards System (1965, as Provisionally Extended in 1966 and 1968), 1968.

[140] INFCIRC/140. Treaty on the Non-Proliferation of Nuclear Weapons, 1970.

[153] INFCIRC/153 (Corrected). The Structure and Content of Agreements between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons, 1972.

[179] GOV/INF/179. The Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean, 1967 (Tlatelolco Treaty).

[207] INFCIRC/207. Notification to the Agency of Exports and Imports of Nuclear Material (USSR, UK, USA), 1974.

[209] INFCIRC/209/Rev. 2. Communications of 15 November 1999 Received from Member States Regarding the Export of Nuclear Material and of Certain Categories of Equipment and Other Material, 2000.

[225] INFCIRC/225/Rev. 4 (Corrected). The Physical Protection of Nuclear Material and Nuclear Facilities, 1999.

[254] INFCIRC/254/Rev. 4/Part 1. Communications Received from Certain Member States Regarding Guidelines for the Export of Nuclear Material, Equipment and Technology, 2000; INFCIRC/254/Rev. 4/Part 2. Communications Received from Certain Member States Regarding Guidelines for Transfers of Nuclear-Related Dual-Use Equipment, Materials, Software and Related Technology, 2000.

[267] INFCIRC/267. The Revised Guiding Principles and General Operating Rules to Govern the Provision of Technical Assistance by the Agency, 1979.

[274] INFCIRC/274/Rev. 1. Convention on the Physical Protection of Nuclear Material, 1980.

[322] INFCIRC/322. Communication Received from the Resident Representative of Italy on Behalf of the European Community, 1985.

[331] INFCIRC/331/Add. 1. South Pacific Nuclear Free Zone Treaty, 1987 (Rarotonga Treaty).

[395] INFCIRC/395. Agreement between the Republic of Argentina and the Federative Republic of Brazil for the Exclusively Peaceful Use of Nuclear Energy, 1992 (Guadalajara Declaration).

[411] INFCIRC/411. Amendments to the Treaty for the Prohibition of Nuclear Weapons in Latin America, 1993.

[512] INFCIRC/512. The Text of the Cairo Declaration Adopted on the Occasion of the Signing of the African Nuclear-Weapon-Free Zone Treaty, 1996 (Treaty of Pelindaba).

[540] INFCIRC/540 (Corrected). Model Protocol Additional to the Agreement(s) between State(s) and the International Atomic Energy Agency for the Application of Safeguards, 1997.

[548] INFCIRC/548. Communication Received from the Permanent Mission of Thailand Regarding the Treaty on the Southeast Asia Nuclear Weapon-Free Zone, 1998 (Treaty of Bangkok).

[549] INFCIRC/549. Communication Received from Certain Member States Concerning Their Policies Regarding the Management of Plutonium, 1998.

[SCT] IAEA/SG/SCT/5. Statistical Concepts and Techniques for IAEA Safeguards, Fifth Edition, 1998.

[STR-327] International Target Values 2000 for Measurement Uncertainties in Safeguarding Nuclear Material, 2000, Safeguards Technical Report.

[IAEA/NVS/1] Safeguards Techniques and Equipment, 1997.

[IAEA/NVS/2] The Evolution of IAEA Safeguards, 1998.

CONTENTS

1. LEGAL INSTRUMENTS AND OTHER DOCUMENTS RELATED TO IAEA SAFEGUARDS

Safeguards applied by the International Atomic Energy Agency (IAEA) are an important element of the global nuclear non-proliferation regime. This section provides information on legal instruments and other documents in the area of nuclear non-proliferation that establish the bases of the IAEA safeguards system or are otherwise closely linked to the application of IAEA safeguards. These include the Statute of the IAEA, treaties and supply agreements calling for the verification of non-proliferation undertakings, the basic safeguards documents, safeguards agreements and their relevant protocols, and guidelines related to the implementation of IAEA safeguards.

1.1. Statute of the International Atomic Energy Agency

The Statute of the IAEA [ST] was approved in October 1956 by the United Nations Conference on the Statute of the IAEA and entered into force in July 1957, as amended. According to Article II, the IAEA shall "seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world. It shall ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose." By Article III.A.5, the IAEA is authorized to "establish and administer safeguards designed to ensure that special fissionable and other materials, services, equipment, facilities, and information made available by the Agency or at its request or under its supervision or control are not used in such a way as to further any military purpose; and to apply safeguards, at the request of the parties, to any bilateral or multilateral arrangement, or at the request of a State, to any of that State's activities in the field of atomic energy". Under this Article, the IAEA concludes agreements with the State or States concerned which refer to the application of safeguards. Articles XII.A and XII.B deal with the rights and responsibilities of the IAEA with respect to the application of safeguards and provide, inter alia, for IAEA inspection in the State or States concerned. Article XII.C refers to actions which may be taken by the IAEA in possible cases of non-compliance with safeguards agreements.

TREATIES AND SUPPLY AGREEMENTS

1.2. Treaty on the Non-Proliferation of Nuclear Weapons (Non-Proliferation Treaty, NPT)

The cornerstone of the nuclear non-proliferation regime. The Treaty was opened for signature in 1968, and entered into force in 1970; as of 31 December 2001, it is in force in 187 States. In 1995, the Treaty was extended indefinitely. Pursuant to Article I, each nuclear weapon State party to the NPT undertakes not to transfer, to any recipient whatsoever, nuclear weapons or other nuclear explosive devices or control over such weapons or devices directly or indirectly; and not in any way to assist, encourage or induce any non-nuclear-weapon State to manufacture or otherwise acquire such weapons or devices or control over such weapons or devices.

Pursuant to Article II, each non-nuclear-weapon State party to the NPT undertakes not to receive the transfer, from any transferor whatsoever, of nuclear weapons or other nuclear explosive devices or control over such weapons or devices directly or indirectly; not to manufacture or otherwise acquire such weapons or devices; and not to seek or receive any assistance in the manufacture of such weapons or devices. Pursuant to Article III.1, each non-nuclear-weapon State party to the NPT undertakes to accept IAEA safeguards on all source or special fissionable material in all peaceful nuclear activities within the territory of such State, under its jurisdiction, or carried out under its control anywhere. Pursuant to Article III.2, each State party to the NPT undertakes not to provide source or special fissionable material, or equipment or material especially designed or prepared for the processing, use or production of special fissionable material, to any non-nuclear-weapon State for peaceful purposes, unless the source or special fissionable material is subject to the safeguards required by Article III.1. Article III.4 requires each non-nuclear-weapon State party to the NPT to conclude a safeguards agreement with the IAEA, either individually or together with other States, within 18 months of the date on which the State deposits its instruments of ratification of or accession to the Treaty. Article IV affirms the right of all parties to the NPT to develop research, production and use of nuclear energy for peaceful purposes and to facilitate and participate in the fullest possible exchange of equipment, materials and information for the peaceful uses of nuclear energy.

Pursuant to Article VI, each of the parties undertakes to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control. Article IX.3 defines a nuclear weapon State as one which manufactured and exploded a nuclear weapon or other nuclear explosive device prior to 1 January 1967. There are five such States: China, France, the Russian Federation (the Soviet Union when the Treaty entered into force), the United Kingdom and the United States of America. The text of the Treaty is reproduced in [140].

1.3. Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (Tlatelolco Treaty)

The Treaty establishing the first regional nuclear-weapon-free zone (NWFZ). The Treaty was opened for signature in 1967 and entered into force in 1969; as of 31 December 2001, it is in force in 38 States in this zone. The Treaty prohibits the testing, use, manufacture, production or acquisition by any means, as well as the receipt, storage, installation, deployment and any form of possession, of any nuclear weapons by States in the zone. Pursuant to Article 13 of the Treaty, each party undertakes to conclude a multilateral or a bilateral agreement with the IAEA for the application of safeguards to its nuclear activities. The Treaty has two protocols. Pursuant to Additional Protocol I, each State outside the Treaty zone which has de jure or de facto jurisdiction over territories within the limits of the zone undertakes to apply to those territories the statute of denuclearization, as established by the Treaty. As of 31 December 2001, this Protocol has been ratified by 32 States. Pursuant to Additional Protocol II, each of the nuclear weapon States defined by the NPT undertakes to respect the statute of denuclearization in the region and not to use or threaten to use nuclear weapons against the Contracting Parties to the Treaty. As of 31 December 2001, this Protocol has been ratified by China, France, the Russian Federation, the United Kingdom and the United States of America. The text of the Tlatelolco Treaty is reproduced in [179], with amendments published in [411].

1.4. South Pacific Nuclear Free Zone Treaty (Rarotonga Treaty)

The Treaty establishing a nuclear-weapon-free zone (NWFZ) in the South Pacific region. The Treaty entered into force in 1986; as of 31 December 2001, it is in force in 16 States of this zone. The Treaty requires its parties to renounce the manufacture, acquisition, possession or control of any nuclear explosive devices, and to prevent the stationing or testing of any such devices. Each State party to the Treaty undertakes to conclude a comprehensive safeguards agreement with the IAEA required in connection with the NPT, or an agreement equivalent in its scope and effect; and not to provide source or special fissionable material, or equipment or material especially designed or prepared for the processing, use or production of special fissionable material for peaceful purposes to any non-nuclear-weapon State unless subject to the safeguards required by Article III.1 of the NPT, or to any nuclear weapon State unless subject to applicable safeguards agreements with the IAEA. The Rarotonga Treaty has three protocols. Protocols 1 and 2 contain provisions similar to those in the two protocols to the Tlatelolco Treaty. Protocol 3 to the Rarotonga Treaty requires each nuclear weapon State party not to test any nuclear explosive device in the region. The text of the Treaty is reproduced in [331].

1.5. Treaty on the Southeast Asia Nuclear Weapon-Free Zone (Bangkok Treaty)

The Treaty establishing a nuclear-weapon-free zone (NWFZ) in the Southeast Asia region. The Treaty was opened for signature in 1995, and entered into force in 1997; as of 31 December 2001, it is in force in nine States of the zone. The Treaty requires its parties not to develop, manufacture, acquire, possess, control, station, transport, test or use nuclear weapons anywhere, and not to allow in their respective territories any other State to develop, acquire, possess, control, station, test or use such weapons. Each State party to the Treaty undertakes to conclude an agreement with the IAEA for the application of 'full scope' (comprehensive) safeguards to its peaceful nuclear activities, and not to provide source or special fissionable material, or equipment or material especially designed or prepared for the processing, use or production of special fissionable material, to any non-nuclear-weapon State except under conditions subject to the safeguards required by Article III.1 of the NPT, or to any nuclear weapon State except in conformity with applicable safeguards agreements with the IAEA. An Annex to the Bangkok Treaty provides for fact finding missions to States party in order to clarify and resolve a situation which may be considered ambiguous or which may give rise to doubts about compliance with the provisions of the Treaty; the Annex contemplates the involvement of IAEA inspectors in any such mission. A protocol to the Treaty contains provisions similar to those in Additional Protocol II to the Tlatelolco Treaty. The text of the Bangkok Treaty is reproduced in [548].

1.6. African Nuclear-Weapon-Free Zone Treaty (Pelindaba Treaty)

The Treaty establishing a nuclear-weapon-free zone (NWFZ) in Africa. The Treaty was opened for signature in 1996; as of 31 December 2001, it is in force in 13 States. The Treaty requires its parties not to conduct research on, develop, manufacture, stockpile, acquire, possess or have control of any nuclear explosive device anywhere, and to prohibit the stationing or testing of any such device. Each State party to the Treaty is required to declare any capability for the manufacture of nuclear explosive devices; to dismantle and destroy any such device that it has manufactured prior to the coming into force of the Treaty; and to destroy or convert to peaceful uses the manufacturing facilities, subject to the IAEA's verification of the dismantling, destruction or conversion. Each State party to the Treaty undertakes to conclude a comprehensive safeguards agreement with the IAEA required in connection with the NPT or equivalent in scope and effect to such an agreement; and not to provide source or special fissionable material, or equipment or material especially designed or prepared for the processing, use or production of special fissionable material for peaceful purposes to any non-nuclear-weapon State unless subject to a comprehensive safeguards agreement with the IAEA. There are three protocols to the Pelindaba Treaty: Protocols I and III contain provisions similar to those in the two protocols to the Tlatelolco Treaty; and Protocol II contains provisions similar to those in Protocol 3 of the Rarotonga Treaty. The text of the Pelindaba Treaty is reproduced in [512].

1.7. Agreement between the Republic of Argentina and the Federative Republic of Brazil for the Exclusively Peaceful Use of Nuclear Energy (Guadalajara Declaration)

The Agreement by which both States party undertake to prohibit and prevent in their territories and to abstain from carrying out, promoting or participating in, the testing, use, manufacture or acquisition of any nuclear weapon or other nuclear explosive device; and to establish the Common System of Accounting and Control of Nuclear Materials and the Brazilian–Argentine Agency for Accounting and Control of Nuclear Materials (ABACC) to verify, inter alia, that the nuclear materials in all nuclear activities of the parties are not diverted to the purposes prohibited by the Agreement. The Agreement entered into force in 1991; it is reproduced in [395].

1.8. Treaty Establishing the European Atomic Energy Community (Euratom Treaty)

The Treaty entered into force in January 1958. The States party are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and the United Kingdom. In accordance with Article 77 of Chapter VII of the Treaty, the European Commission will 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; and (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 organization are complied with.

1.9. Bilateral co-operation agreement

An agreement providing for co-operation in the field of peaceful uses of nuclear energy which is usually concluded between a supplier State and a receiver State and which covers conditions for the supply of nuclear and other specified material, equipment and technology. Such an agreement may contain undertakings not to use the supplied items so as to further any military purpose or not to use them for nuclear weapons, other military purposes or other nuclear explosive devices. The agreement may also contain undertakings of the receiver State to submit to IAEA safeguards a range of facilities, equipment and nuclear and other material, as identified in each individual case.

1.10. Project and supply agreement

Article III.A.5 of [ST] contemplates the application of IAEA safeguards to assistance provided by or through the IAEA. A project and supply agreement with a State that has a comprehensive safeguards agreement (CSA) generally provides that the safeguards requirements of the project and supply agreement shall be met by the application of safeguards pursuant to the safeguards agreement. A project and supply agreement with a State that does not have a CSA contains a safeguards annex that provides for the application of safeguards based on [66].

1.11. Revised supplementary agreement relevant to safeguards

An agreement requiring that, where technical assistance is provided by or through the IAEA in any of the sensitive technological areas specified in the Annex to [267], safeguards shall be applied pursuant to an existing applicable safeguards agreement with the IAEA, or, if there is no such agreement, pursuant to a safeguards agreement to be concluded before the provision of the technical assistance. If the State concerned has a comprehensive safeguards agreement, this requirement is considered to be met. Otherwise a safeguards agreement based on [66] must be concluded (except in the unlikely event that an INFCIRC/66-type safeguards agreement is applicable).

BASIC SAFEGUARDS DOCUMENTS

1.12. The Agency's Inspectorate

The document [39, Annex], referred to in INFCIRC/66-type safeguards agreements as the Inspectors' Document, which was adopted by the IAEA Board of Governors in 1961. It is used only in connection with INFCIRC/66-type safeguards agreements and addresses aspects of inspection activities, including the procedure by which inspectors are to be designated to Member States; the method of announcing and carrying out inspections and visits; the conduct of inspections, rights of access, inspection procedures and the obligation to report to the State on the results of each inspection; and the privileges and immunities of inspectors. The provisions of this document acquire legally binding force only when and to the extent they are incorporated, by reference or otherwise, into safeguards agreements. The document in itself does not constitute an agreement.

1.13. The Agency's Safeguards System (1965, as Provisionally Extended in 1966 and 1968)

The document [66], also known as the Safeguards Document, which was designed to facilitate and standardize as far as possible the content of safeguards agreements with the IAEA. The document, approved by the IAEA Board of Governors initially in 1965, covered reactors of all sizes, thereby replacing earlier corresponding documents that covered only small research and experimental reactors. It was subsequently extended in 1966 and 1968 to cover reprocessing plants, and conversion and fuel fabrication plants, respectively. The provisions of this document acquire legally binding force only when and to the extent they are incorporated, by reference or otherwise, into INFCIRC/66-type safeguards agreements.

1.14. The Structure and Content of Agreements between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons

The document [153] providing for the application of IAEA safeguards on all nuclear material in all peaceful nuclear activities in a State, which was approved by the IAEA Board of Governors in 1971. It serves as the basis for the negotiation of comprehensive safeguards agreements (CSAs) between the IAEA and non-nuclear-weapon States party to the NPT, as well as for negotiation of other CSAs not concluded pursuant to the NPT. The document also provides the technical elements of the voluntary offer agreements which the five nuclear weapon States have concluded with the IAEA.

1.15. Model Protocol Additional to the Agreement(s) between State(s) and the International Atomic Energy Agency for the Application of Safeguards

The document [540], also known as the Model Additional Protocol, providing for those measures for strengthening the effectiveness and improving the efficiency of IAEA safeguards which could not be implemented under the legal authority of safeguards agreements. It was approved by the IAEA Board of Governors in 1997. The IAEA uses the Model Additional Protocol for negotiation and conclusion of additional protocols and other legally binding agreements as follows:

(a) With States and other parties to comprehensive safeguards agreements, containing all of the measures provided for in this document as the standard;

(b) With nuclear weapon States, incorporating those measures from this document that each such State has identified as capable of contributing to the non-proliferation and efficiency aims of the Model Additional Protocol when implemented with regard to that State, and as consistent with that State's obligations under Article I of the NPT;

(c) With other States that are prepared to accept measures provided for in this document in pursuance of safeguards effectiveness and efficiency objectives.

1.16. Agreement on the Privileges and Immunities of the IAEA

The Agreement between the IAEA and Member States granting, inter alia, certain privileges and immunities to the IAEA, representatives of Member States and IAEA officials, including safeguards inspectors, as necessary for the effective exercise of their functions. The Agreement also provides for the recognition and acceptance of the United Nations laissez-passer issued to IAEA officials as a valid travel document. Safeguards agreements concluded with States that are not IAEA Members States or which are not party to the Agreement provide for the granting to inspectors of the same privileges and immunities as those specified in the Agreement. The Agreement is reproduced in [9].

SAFEGUARDS AGREEMENTS, ADDITIONAL PROTOCOLS THERETO AND UNDERTAKINGS RELATED TO SAFEGUARDS IMPLEMENTATION

1.17. Safeguards agreement

An agreement for the application of safeguards concluded between the IAEA and a State or a group of States, and, in certain cases, with a regional or bilateral inspectorate, such as Euratom and ABACC. Such an agreement is concluded either because of the requirements of a project and supply agreement, or to satisfy the relevant requirements of bilateral or multilateral arrangements, or at the request of a State to any of that State's nuclear activities. Specific types of safeguards agreements are defined (see Nos 1.18–1.21).

1.18. INFCIRC/153-type safeguards agreement

An agreement concluded on the basis of [153]. Such agreements include all types of comprehensive safeguards agreement (see No. 1.19) and voluntary offer agreement (see No. 1.21).

1.19. Comprehensive safeguards agreement (CSA)

An agreement that applies safeguards on all nuclear material in all nuclear activities in a State. CSAs can be grouped as follows:

(a) A safeguards agreement pursuant to the NPT, concluded between the IAEA and a non-nuclear-weapon State party as required by Article III.1 of the NPT. Such a safeguards agreement is concluded on the basis of [153]. The agreement is comprehensive as it provides for the IAEA's right and obligation to ensure that safeguards are applied "on all source or special fissionable material in all peaceful nuclear activities within the territory of the State, under its jurisdiction, or carried out under its control anywhere…" [153, para. 2]. The scope of a CSA is not limited to nuclear material actually declared by a State, but includes any nuclear material that should have been declared to the IAEA. There may be non-peaceful uses of nuclear material which would not be proscribed under the NPT and to which safeguards would not apply during the period of such use (e.g. nuclear propulsion of submarines or other warships).

(b) A safeguards agreement pursuant to the Tlatelolco Treaty or some other nuclear-weapon-free-zone (NWFZ) treaty. The majority of States party to such treaties are also party to the NPT and each has concluded a single safeguards agreement which refers expressly to both the NPT and the relevant NWFZ treaty or which has subsequently been confirmed as meeting the requirements of both treaties.

(c) A safeguards agreement, such as the sui generis agreement between Albania and the IAEA, and the quadripartite safeguards agreement between Argentina, Brazil, ABACC and the IAEA.

1.20. INFCIRC/66-type safeguards agreement

An agreement based on guidelines contained in [66]. The agreement specifies the nuclear material, non-nuclear material (e.g. heavy water, zirconium tubes), facilities and/or equipment to be safeguarded, and prohibits the use of the specified items in such a way as to further any military purpose. Since 1975, such agreements also explicitly proscribe any use related to the manufacture of any other nuclear explosive device. INFCIRC/66-type safeguards agreements can be grouped as follows:

(a) An agreement concluded pursuant to a project and supply agreement between the IAEA and a State that does not have a comprehensive safeguards agreement (CSA), providing for the supply by or through the IAEA of nuclear material, services, equipment, facilities and information to the State and, in that connection, for the application of IAEA safeguards.

(b) A safeguards agreement between the IAEA and one or more States, providing for the application of safeguards to nuclear material, services, equipment or facilities supplied under a co-operation arrangement between States, or, having been subject to such safeguards, retransferred to States without CSAs. Some bilateral co-operation agreements concluded before IAEA safeguards were operational provided for safeguards to be applied by the supplier State; the parties to those agreements later requested the IAEA to apply its safeguards instead. A safeguards agreement transferring the safeguards responsibility to the IAEA came to be known as a safeguards transfer agreement (STA).

(c) A unilateral submission agreement between the IAEA and a State, concluded at the request of that State, for the application of safeguards to some of the State's activities in the field of nuclear energy.

1.21. Voluntary offer agreement (VOA)

An agreement concluded between the IAEA and a nuclear weapon State which, under the NPT, is not required to accept safeguards but which has voluntarily offered to do so, inter alia, to allay concerns that the application of IAEA safeguards could lead to commercial disadvantages for the nuclear industries of non-nuclear-weapon States. Under such an agreement, a State offers, for selection by the IAEA for the application of safeguards, some or all of the nuclear material and/or facilities in its nuclear fuel cycle. A VOA generally follows the format of [153], but the scope is not comprehensive. The IAEA has concluded such a VOA with each of the five nuclear weapon States defined by the NPT (i.e. China, France, the Russian Federation (the Soviet Union when the NPT entered into force), the United Kingdom and the United States of America).

1.22. Additional protocol

A protocol additional to a safeguards agreement (or agreements) concluded between the IAEA and a State, or group of States, following the provisions of the Model Additional Protocol [540] (see No. 1.15). A comprehensive safeguards agreement, together with an additional protocol, contains all of the measures included in [540]. In the case of an INFCIRC/66-type safeguards agreement or of a voluntary offer agreement, an additional protocol includes only those measures from [540] that have been agreed to by the State concerned. Under Article 1 of [540], the provisions of the additional protocol prevail in the case of conflict between the provisions of the safeguards agreement and those of the additional protocol.

1.23. Small quantities protocol (SQP)

A protocol to a comprehensive safeguards agreement (CSA) concluded between the IAEA and a State on the basis that the State has less than specified minimal quantities of nuclear material and no nuclear material in a facility. This protocol holds in abeyance the implementation of most of the detailed provisions of Part II of the CSA until such time as the quantity of nuclear material in the State exceeds the prescribed limits or the State has nuclear material in a facility as defined in [153].

1.24. Suspension protocol

A protocol to a safeguards agreement with a State (or States), which suspends the application of safeguards under that agreement in the State (or States) concerned while, and to the extent that, IAEA safeguards are being applied under a later safeguards agreement (or agreements). Examples are protocols to suspend the application of safeguards under project and supply agreements or under safeguards transfer agreements in States where comprehensive safeguards agreements have come into force.

1.25. Co-operation protocol

A protocol amplifying the provisions of a comprehensive safeguards agreement between the IAEA and a State, or a group of States, and specifying the modalities of the co-operation in the application of safeguards (e.g. arrangements to co-ordinate inspection activities of the IAEA and of the regional (or the State) system of accounting for and control of nuclear material). Such co-operation protocols have been incorporated into the agreements for the application of safeguards in the non-nuclear-weapon States of Euratom, in Argentina and Brazil, and in Japan.

1.26. Subsidiary Arrangements

The document containing the technical and administrative procedures for specifying how the provisions laid down in a safeguards agreement are to be applied. Under an INFCIRC/153-type safeguards agreement, the State party and the IAEA are required to agree on Subsidiary Arrangements. Under an additional protocol to a safeguards agreement (or agreements), if either the

State or the IAEA indicates that Subsidiary Arrangements are necessary, then both parties are required to agree on such Arrangements. Subsidiary Arrangements to safeguards agreements consist of a General Part, applicable to all common nuclear activities of the State concerned, and of a Facility Attachment, prepared for each facility in the State and describing arrangements specific for that facility. In cases where several facilities are located in the same building and/or share a common store or stores (e.g. for multiunit reactor facilities), one facility attachment may cover the whole facility group. Subsidiary Arrangements may also consist of an attachment for a location (or group of locations) outside facilities in the State that are defined as one material balance area.

1.27. Voluntary reporting scheme on nuclear material and specified equipment and non-nuclear material

The scheme established in 1993 for the voluntary reporting by States of nuclear material not otherwise required to be reported to the IAEA under safeguards agreements, and of exports and imports of specified equipment and non-nuclear material (see No. 12.13). States choosing to participate in the scheme do so through an exchange of letters with the IAEA. The list of the specified equipment and non-nuclear material, to be used for the purpose of the voluntary reporting scheme, is incorporated in [540, Annex II].

GUIDELINES AND RECOMMENDATIONS

1.28. Zangger Committee Export Guidelines

The Guidelines agreed upon by a group of States party to the NPT in order to clarify States' commitments under Article III.2 of the Treaty in relation to exports, for peaceful purposes, to non-nuclear-weapon States, of nuclear material and equipment or material especially designed or prepared for the processing, use or production of special fissionable material. The Guidelines were first developed during a series of meetings in 1971 under the chairmanship of Dr. Claude Zangger of Switzerland, and are contained in communications which have been received by the IAEA since 1974 from participating States. The Guidelines consist of a 'trigger list' that includes source and special fissionable material and specified equipment and material especially designed or prepared for the processing, use or production of special fissionable material, whose export requires IAEA safeguards on the source or special fissionable material in question. The Zangger Committee, as it became known, is not a committee of the IAEA. The Guidelines are published in [209].

1.29. Nuclear Suppliers' Group Guidelines

The Guidelines contained in communications received by the IAEA since 1978 from States taking part in the Nuclear Suppliers' Group (NSG). The Guidelines deal with export policies and practices of NSG States with respect to transfers, for peaceful purposes, to non-nuclear-weapon States, of nuclear material, equipment and technology, and of nuclear related dual use equipment, materials, software and related technology. (See also No. 5.34.) The Guidelines currently consist of two parts.

(a) Part 1 contains guidelines for nuclear transfers and incorporates a 'trigger list' that includes source material and special fissionable material, and nuclear reactors and designated types of nuclear plant (e.g. reprocessing plants), equipment especially designed or prepared for such plants and related technology. These guidelines require, as conditions of supply, that the importing State have a comprehensive safeguards agreement in force with the IAEA as well as physical protection and controls on the retransfer of the items.

(b) Part 2 contains guidelines for transfers of nuclear related dual use equipment, materials, software and related technology, and includes a list specifying such dual use items that could make a major contribution to a nuclear explosive device or an unsafeguarded nuclear fuel cycle activity. The basic principle agreed by the adhering States is that they should not authorize transfers of the dual use items "for use in a non-nuclear-weapon State in a nuclear explosive activity or an unsafeguarded fuel cycle activity, or…in general when there is an unacceptable risk of diversion to such an activity…". The Guidelines also stipulate that suppliers, in considering transfers of dual use items, should take into account, inter alia, whether the recipient State "has an Agency safeguards agreement in force applicable to all its peaceful nuclear activities".

The NSG Guidelines are published in [254, Parts 1 and 2]. In addition, a communication from the European Community on a common policy in connection with the Guidelines, received by the IAEA in 1985, is reproduced in [322].

1.30. Guidelines for the Management of Plutonium

Guidelines contained in communications received by the IAEA in 1997 from certain Member States regarding policies adopted by these States, with a view to ensuring that holdings of plutonium are managed safely and effectively in accordance with international commitments, including their obligations under the NPT (and, for States that are members of the European Community, also under the Euratom Treaty), and with their safeguards agreements with the IAEA. The Guidelines describe, inter alia, the nuclear material accountancy system, physical protection measures and international transfer procedures applicable to the plutonium subject to the Guidelines. They further specify the information to be published by the participating States in respect of plutonium management, including annual statements of their holdings of civil unirradiated plutonium and of their estimates of plutonium contained in spent civil reactor fuel. The Guidelines are published in [549].

1.31. Physical protection recommendations

IAEA recommendations for the physical protection of nuclear material and nuclear facilities, revised and published in 1999 and reproduced in [225]. The Convention on the Physical Protection of Nuclear Material, for which the IAEA is depository, establishes international standards, inter alia, for the protection of international shipments of nuclear material and promotes international co-operation in the exchange of physical protection information. The Convention entered into force in 1987; the text is reproduced in [274].

Note: Physical protection comprises those measures that the States themselves apply to prevent or deter the theft of nuclear material during use, storage and transport, and to preclude the sabotage of nuclear facilities by subnational entities.

2. IAEA SAFEGUARDS: PURPOSE, OBJECTIVES AND SCOPE

Safeguards are applied by the IAEA to verify that commitments made by States under safeguards agreements with the IAEA are fulfilled. It is therefore necessary to define the objectives of safeguards in technical terms relevant to each type of safeguards agreement so that safeguards can be applied in an effective manner. What follows is an explanation of terms used in connection with safeguards objectives and with the scope of application of safeguards relevant to the safeguards agreement and additional protocols.

2.1. Objectives of IAEA safeguards

Under a comprehensive safeguards agreement (CSA), safeguards are applied to verify a State's compliance with its undertaking to accept safeguards on all nuclear material in all its peaceful nuclear activities and to verify that such material is not diverted to nuclear weapons or other nuclear explosive devices. In this regard, the technical objective is specified: "the timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons or of other nuclear explosive devices or for purposes unknown, and deterrence of such diversion by the risk of early detection" [153, para. 28]. To address fully the verification of a State's compliance with its undertaking under a CSA, a second technical objective is pursued, viz. the detection of undeclared nuclear material and activities in a State (see No. 2.5). The implementation of measures under additional protocols based on [540] significantly strengthens the IAEA's capability to achieve this objective (see No. 3.6).

For an INFCIRC/66-type safeguards agreement, the objective is to ensure that the nuclear material, non-nuclear material, services, equipment, facilities and information specified and placed under safeguards are not used for the manufacture of nuclear weapons or any other nuclear explosive devices or to further any military purpose. To achieve this, the IAEA applies essentially the same technical objective in regard to detection of diversion of the nuclear material specified and placed under safeguards, as well as the detection of any misuse of the non-nuclear material, services, equipment, facilities or information specified and placed under safeguards. This is also the case for the nuclear material and/or facilities to which safeguards are applied under a voluntary offer safeguards agreement concluded between a nuclear weapon State and the IAEA.

2.2. Non-compliance

Violation by a State of its safeguards agreement with the IAEA. Examples would be:

(a) Under an INFCIRC/153-type safeguards agreement, the diversion of nuclear material from declared nuclear activities, or the failure to declare nuclear material required to be placed under safeguards;

(b) Under an INFCIRC/66-type safeguards agreement, the diversion of the nuclear material or the misuse of the non-nuclear material, services, equipment, facilities or information specified and placed under safeguards;

(c) Under an additional protocol based on [540], the failure to declare nuclear material, nuclear activities or nuclear related activities required to be declared under Article 2;

(d) Under all types of agreement, violation of the agreed recording and reporting system, obstruction of the activities of IAEA inspectors, interference with the operation of safeguards equipment, or prevention of the IAEA from carrying out its verification activities.

In the event of non-compliance, pursuant to Article XII.C of [ST], the IAEA Director General shall report to the IAEA Board of Governors, which would call upon the recipient State or States to remedy forthwith any non-compliance which it finds to have occurred, and would inform all members and the Security Council and General Assembly of the United Nations.

2.3. Diversion of nuclear material

A particular case of non-compliance (see No. 2.2) that would include:

(a) Under an INFCIRC/153-type safeguards agreement, the undeclared removal of declared nuclear material from a safeguarded facility; or the use of a safeguarded facility for the introduction, production or processing of undeclared nuclear material, e.g. the undeclared production of high enriched uranium in an enrichment plant, or the undeclared production of plutonium in a reactor through irradiation and subsequent removal of undeclared uranium targets;

(b) Under an INFCIRC/66-type safeguards agreement, the use of the nuclear material specified and placed under safeguards in such a way as to further any military purpose.

2.4. Misuse

A particular case of non-compliance under an INFCIRC/66-type safeguards agreement (see No. 2.2) that would include the use of the non-nuclear material, services, equipment, facilities or information specified and placed under safeguards to further any proscribed purpose.

2.5. Undeclared nuclear material and activities

The term 'undeclared nuclear material' refers to nuclear material which a State has not declared and placed under safeguards but is required to do so pursuant to its safeguards agreement with the IAEA. For a State that has an additional protocol in force, undeclared nuclear material also covers nuclear material which that State has not declared but is required to do so pursuant to Article 2 of [540]. The term 'undeclared activities' refers to nuclear or nuclear related activities which a State has not declared to the IAEA but is required to do so pursuant to its safeguards agreement or, where applicable, its additional protocol. Examples would include activities involving undeclared facilities or locations outside facilities (see No. 2.6), or the undeclared manufacture of items referred to in Annex 1 of [540].

2.6. Undeclared facility or location outside facilities (LOF)

A nuclear facility or a LOF, including closed-down facilities or LOFs and facilities under construction, about which a State has the obligation to notify the IAEA in accordance with its safeguards agreement and for which no such notification has been given.

2.7. Deterrence of diversion

An objective of the application of IAEA safeguards (see No. 2.1). If a State is considering the acquisition of nuclear material for a nuclear explosive device, then IAEA safeguards may be expected to have a significant deterrent effect through the provision of the risk of early detection. Thus, although essentially non-quantifiable, the level of deterrence may be expected to be higher the greater the IAEA's detection capabilities and the more the State wishes to proceed undetected.

Note: Deterrence by the risk of early detection resulting from IAEA safeguards should not be confused with the deterrence against theft or sabotage that is provided by the physical protection of nuclear material and facilities at the national level (see No. 1.31).

2.8. Assurance of non-diversion of nuclear material

Assurance that nuclear material placed under safeguards has remained in peaceful nuclear activities or has been otherwise adequately accounted for. Safeguards under all types of agreement are designed to provide the international community with credible assurance of non-diversion of nuclear material from declared activities. To this end, the IAEA conducts and evaluates verification activities on nuclear material placed under safeguards (see No. 12.20) and reports the results in the safeguards conclusion on non-diversion, drawn annually for each State with a safeguards agreement in force (see Nos 12.25 and 13.10).

2.9. Assurance of the absence of undeclared nuclear material and activities

Assurance that a State with a comprehensive safeguards agreement (CSA) and an additional protocol in force does not possess undeclared nuclear material and activities (see No. 2.5). In addition to providing assurance of non-diversion of nuclear material from declared activities (see No. 2.8), safeguards implemented under a CSA with an additional protocol in force are designed to provide the international community with credible assurance of the absence of undeclared nuclear material and activities in a State. To this end, the IAEA conducts a comprehensive State evaluation, including the evaluation of all information available on a State's nuclear programme and related activities, and carries out activities under the additional protocol (see No. 12.20). Where such evaluation and verification activities allow the IAEA to draw a conclusion of the absence of undeclared nuclear material and activities, and where a conclusion of non-diversion of nuclear material has also been drawn, this is reflected in the safeguards conclusion, drawn annually for a State with both a CSA and an additional protocol in force, that all of the nuclear material in that State had been placed under safeguards and remained in peaceful nuclear activities or was otherwise adequately accounted for (see Nos 12.25 and 13.10).

SCOPE OF IAEA SAFEGUARDS

2.10. Coverage of IAEA safeguards

The scope of application defined by the relevant safeguards agreement. Under a comprehensive safeguards agreement (CSA), safeguards are applied on "all source or special fissionable material in all peaceful nuclear activities within the territory of the State, under its jurisdiction or carried out under its control anywhere…" [153, para. 2]. Thus such agreements are considered comprehensive (or 'full scope'). The scope of a CSA is not limited to the nuclear material declared by a State, but includes all nuclear material subject to IAEA safeguards. Under an INFCIRC/66-type agreement, safeguards are applied only to the items specified in the agreement, which may include nuclear material, non-nuclear material, services, equipment, facilities and information. Under a voluntary offer agreement with a nuclear weapon State, safeguards are applied to the nuclear material and/or facilities specified in the agreement.

2.11. Starting point of IAEA safeguards

The expression often used to refer to the point in a nuclear fuel cycle from which full safeguards requirements specified in comprehensive safeguards agreements start to apply to nuclear material. Under para. 34(c) of [153], the application of full safeguards requirements specified in the agreement begins when any nuclear material of a composition and purity suitable for fuel fabrication or for being isotopically enriched leaves the plant or the process stage in which it has been produced, or when such nuclear material, or any other nuclear material produced at a later stage in the nuclear fuel cycle, is imported into a State. However, under paras 34(a) and 34(b) of [153], when the State exports to a non-nuclear-weapon State, or imports, any material containing uranium or thorium which has not reached the stage of the nuclear fuel cycle described in para. 34(c) of [153], the State is required to report such exports and imports to the IAEA, unless the material is transferred for specifically non-nuclear purposes. Furthermore, under Article 2.a.(vi) of [540], the State is required to provide the IAEA with information on source material which has not reached the composition and purity described in [153, para. 34(c)]. That information is to be provided both on such material present in the State, whether in nuclear or non-nuclear use, and on exports and imports of such material for specifically non-nuclear purposes.

2.12. Termination of IAEA safeguards

Safeguards in a given State normally continue on nuclear material (and subsequent generations of nuclear material produced therefrom) until the material is transferred to another State which has assumed the responsibility therefor, or until the material has been consumed or has been diluted in such a way that it is no longer usable for any nuclear activity relevant from the point of view of safeguards, or has become practicably irrecoverable. Under paras 13 and 35 of [153] and para. 27 of [66], safeguards may be terminated for material transferred to non-nuclear use, such as the production of alloys or ceramics. Paragraph 26 of [66] provides that termination is also possible in the case of the substitution of material not under safeguards for safeguarded material. Under Article 2.a.(viii) of [540], the State is to provide the IAEA with information regarding the location or further processing of intermediate or high level waste containing plutonium, high enriched uranium or ^{233}U on which safeguards have been terminated. (See also No. 6.25.)

2.13. Exemption from IAEA safeguards

Under para. 37 of [153] and para. 21 of [66], a State may request exemption for nuclear material up to certain specified limits. Under para. 36 of [153], a State may also request exemption for nuclear material related to the intended use (e.g. in gram quantities as a sensing component in instruments; in non-nuclear activities, if the material is recoverable; or of plutonium with an isotopic concentration of ^{238}Pu exceeding 80%). Paragraphs 22 and 23 of [66] also provide for exemptions related to reactors. Under para. 38 of [153], if exempted nuclear material is to be processed or stored together with safeguarded material, reapplication of safeguards on the exempted material is required. Under Article 2.a.(vii(a)) of [540], the State is to provide the IAEA with information on the nuclear material that has been exempted from safeguards under paras 36(b) or 37 of [153]. (See also No. 6.24.)

2.14. Non-application of IAEA safeguards

Refers to the use of nuclear material in a non-proscribed military activity which does not require the application of IAEA safeguards. Nuclear material covered by a comprehensive safeguards agreement may be withdrawn from IAEA safeguards should the State decide to use it for such purposes, e.g. for the propulsion of naval vessels. Paragraph 14 of [153] specifies the arrangements to be made between the State and the IAEA with respect to the period and circumstances during which safeguards will not be applied. Any such arrangement would be submitted to the IAEA Board of Governors for prior approval.

2.15. Suspension of IAEA safeguards

Under INFCIRC/66-type agreements, this may be agreed upon between a State and the IAEA for limited periods and for limited quantities of nuclear material while the material is transferred for the purpose of processing, reprocessing, testing, research or development [66, para. 24]. Under para. 25 of [66], safeguards on nuclear material in irradiated fuel which is transferred for reprocessing may be suspended if the State, with the agreement of the IAEA, has substituted therefor nuclear material otherwise not subject to safeguards.

2.16. Substitution

A provision available under paras 25 and 26 of [66] to achieve suspension or termination of IAEA safeguards on specific quantities of nuclear material by submitting to safeguards nuclear material not otherwise subject to safeguards, in an amount and of a quality at least equal to those of the material on which safeguards are being suspended or terminated. Substitution is not available under comprehensive safeguards agreements because all nuclear material in all peaceful nuclear activities in the State is subject to safeguards.

3. SAFEGUARDS APPROACHES, CONCEPTS AND MEASURES

Approaches to safeguards implementation are designed to allow the IAEA to meet the applicable safeguards objectives. What follows is an explanation of the basic concepts underlying the development and application of safeguards approaches at the level of the facility and the State, and the measures available to the IAEA under safeguards agreements and under additional protocols.

3.1. Safeguards approach

A set of safeguards measures (see No. 3.6) chosen for the implementation of safeguards in a given situation in order to meet the applicable safeguards objectives (see No. 2.1). The safeguards approach takes into account the specific features of the safeguards agreement (or agreements) and, where applicable, whether the IAEA has drawn a conclusion of the absence of undeclared nuclear material and activities in the State (see No. 12.25). Safeguards approaches are developed for each facility under safeguards (see No. 3.3). In addition, safeguards approaches may be developed for generic facility types (see No. 3.2) and, mainly under integrated safeguards (see No. 3.5), for the State as a whole (see No. 3.4).

3.2. Model (generic) facility safeguards approach

The recommended approach for a particular facility type developed for a postulated reference plant. The approach specifies the IAEA inspection goals (see No. 3.22) and safeguards activities for that reference plant, taking into account relevant diversion assumptions; available safeguards measures (see No. 3.6), including the technical capabilities of those measures; facility design information (see No. 3.28) and facility practices (see No. 3.27); the capabilities of the State system of accounting for and control of nuclear material (SSAC) (see No. 3.33); and the IAEA's experience in safeguards implementation. Model safeguards approaches are developed for most of the common facility types.

3.3. Facility safeguards approach

The approach selected for safeguards implementation at a specific facility, developed by adapting the model approach (where such exists) to account for actual conditions at the facility as compared with the reference plant. The provisions for implementing the facility safeguards approach are incorporated in the Subsidiary Arrangements (see No. 1.26).

3.4. State level safeguards approach

A safeguards approach (see No. 3.1) developed for a specific State, encompassing all nuclear material, nuclear installations and nuclear fuel cycle related activities in that State. A State level safeguards approach defines the application of safeguards measures at each facility and location outside facilities in the State and, where an additional protocol is in force, the safeguards measures (see No. 3.6) that would enable the IAEA to draw and maintain a conclusion of the absence of undeclared nuclear material and activities in that State (see No. 12.25).

3.5. Integrated safeguards

The optimum combination of all safeguards measures available to the IAEA under comprehensive safeguards agreements and additional protocols (see No. 3.6) to achieve maximum effectiveness and efficiency in meeting the IAEA's safeguards obligations within available resources. Integrated safeguards are implemented in a State only when the IAEA has drawn a conclusion of the absence of undeclared nuclear material and activities in that State (see No. 12.25). Under integrated safeguards, measures may be applied at reduced levels at certain facilities, compared with the measures that would have been applied without this conclusion.

3.6. Safeguards measures

Methods available to the IAEA under safeguards agreements and additional protocols based on [540] to achieve the applicable safeguards objectives (see No. 2.1). Paragraph 29 of [153] provides for the use of nuclear material accountancy as the safeguards measure of fundamental importance (see No. 6.1), with containment and surveillance as important complementary measures (see No. 8.6). These measures are applied for verifying that nuclear material inventories and flows are as declared by the State (and, under INFCIRC/66-type safeguards agreements, that non-nuclear material, services, equipment, facilities and information specified and placed under safeguards are not being used to further any proscribed purpose). Additional measures aimed at strengthening the effectiveness and improving the efficiency of safeguards were approved by the IAEA Board of Governors during 1992–1997. From a legal perspective, these measures may be categorized as follows: (a) measures that can be implemented under the existing legal authority of safeguards agreements (e.g. environmental sampling at locations to which IAEA inspectors have access during inspections and visits (see Nos 9.1 and 11.14)); and (b) measures that can only be implemented under the legal authority of additional protocols (e.g. complementary access (see No. 11.25)).

3.7. Diversion strategy (diversion path)

A (hypothetical) scheme which a State could consider to divert nuclear material (see No. 2.3) or to misuse items subject to IAEA safeguards (see No. 2.4). Diversion strategies are postulated for purposes of developing safeguards approaches (see No. 3.1). Diversion strategies would include: the undeclared removal of nuclear material from a safeguarded facility or the use of a safeguarded facility for the introduction, production or processing of undeclared nuclear material (e.g. the undeclared production of high enriched uranium in an enrichment plant, or the undeclared production of plutonium in a reactor through irradiation and subsequent removal of undeclared uranium targets). In developing safeguards approaches, the IAEA assumes that a diversion strategy would include one or more concealment methods (see No. 3.9).

3.8. Acquisition strategy (acquisition path)

A (hypothetical) scheme which a State could consider to acquire nuclear material usable for manufacturing a nuclear explosive device. An acquisition strategy could include a diversion strategy (see No. 3.7) and could involve the use of an undeclared facility (see No. 2.6) or undeclared nuclear material (see No. 2.5). Acquisition strategies are postulated for purposes of developing State level safeguards approaches (see No. 3.4).

3.9. Concealment methods

Actions taken within a given diversion strategy (see No. 3.7) or a given acquisition strategy (see No. 3.8) to reduce the probability of detection by IAEA safeguards activities. Such actions may begin before the removal of material and may be continued over a considerable time. Examples would include:

- Tampering with IAEA containment and surveillance measures (see No. 8.6) or with nuclear material accounting activities (see No. 6.2);
- Falsifying records, reports and other documents by overstating decreases to inventory (e.g. shipments, measured discards) or by understating increases to inventory (e.g. receipts or production) (see No. 6.14), or by presenting false facility operational data;

- For bulk handling facilities, diversion into MUF (material unaccounted for), diversion into SRD (shipper/receiver difference) or diversion into D (operator–inspector difference) (see Nos 10.4, 10.5 and 10.6, respectively);
- Borrowing nuclear material from other facilities in the State to replace the diverted nuclear material for the duration of an IAEA inspection;
- Replacing diverted nuclear material or other missing items with material or items of lower strategic value (e.g. dummy fuel assemblies or elements);
- Creating obstacles to access by IAEA inspectors so as to reduce the possibility of their detecting a diversion of nuclear material.

3.10. Diversion rate

The amount of nuclear material which could be diverted in a given unit of time. If the amount diverted is 1 SQ or more (see No. 3.14) of nuclear material in a short time (i.e. within a period that is less than the material balance period (see No. 6.47)), it is referred to as an 'abrupt' diversion. If the diversion of 1 SQ or more occurs gradually over a material balance period, with only small amounts removed at any one time, it is referred to as a 'protracted' diversion.

3.11. Diversion path analysis

The analysis of all possible diversion paths or diversion strategies for nuclear material at a facility (see No. 3.7). A diversion path analysis may be part of the development of a model safeguards approach for a common facility type (see No. 3.2), and may also be carried out for a specific facility. The purpose of a diversion path analysis is to determine whether a proposed set of safeguards measures (see No. 3.6) would provide sufficient detection capability with respect to a specific diversion path or diversion strategy.

3.12. Acquisition path analysis

The analysis of all plausible acquisition paths or acquisition strategies for a State (see No. 3.8) to acquire nuclear material usable for the manufacture of a nuclear explosive device. An acquisition path analysis may be part of the development of a State level safeguards approach (see No. 3.4). The purpose of an acquisition path analysis is to determine whether a proposed set of safeguards measures (see No. 3.6) would provide sufficient detection capability with respect to a specific acquisition path or acquisition strategy.

3.13. Conversion time

The time required to convert different forms of nuclear material to the metallic components of a nuclear explosive device. Conversion time does not include the time required to transport diverted material to the conversion facility or to assemble the device, or any subsequent period. The diversion activity is assumed to be part of a planned sequence of actions chosen to give a high probability of success in manufacturing one or more nuclear explosive devices with minimal risk of discovery until at least one such device is manufactured. The conversion time estimates applicable at present under these assumptions are provided in Table I.

TABLE I. ESTIMATED MATERIAL CONVERSION TIMES FOR FINISHED PU OR U METAL COMPONENTS

Beginning material form	Conversion time
Pu, HEU or ^{233}U metal	Order of days (7–10)
PuO_2, $Pu(NO_3)_4$ or other pure Pu compounds; HEU or ^{233}U oxide or other pure U compounds; MOX or other non-irradiated pure mixtures containing Pu, U ($^{233}U + ^{235}U \geq 20\%$); Pu, HEU and/or ^{233}U in scrap or other miscellaneous impure compounds	Order of weeks (1–3)[a]
Pu, HEU or ^{233}U in irradiated fuel	Order of months (1–3)
U containing <20% ^{235}U and ^{233}U; Th	Order of months (3–12)

[a] This range is not determined by any single factor but the pure Pu and U compounds will tend to be at the lower end of the range and the mixtures and scrap at the higher end.

TABLE II. SIGNIFICANT QUANTITIES

Material	SQ
Direct use nuclear material	
Pu[a]	8 kg Pu
^{233}U	8 kg ^{233}U
HEU ($^{235}U \geq 20\%$)	25 kg ^{235}U
Indirect use nuclear material	
U ($^{235}U < 20\%$)[b]	75 kg ^{235}U (or 10 t natural U or 20 t depleted U)
Th	20 t Th

[a] For Pu containing less than 80% ^{238}Pu.

[b] Including low enriched, natural and depleted uranium.

3.14. Significant quantity (SQ)

The approximate amount of nuclear material for which the possibility of manufacturing a nuclear explosive device cannot be excluded. Significant quantities take into account unavoidable losses due to conversion and manufacturing processes and should not be confused with critical masses. Significant quantities are used in establishing the quantity component of the IAEA inspection goal (see No. 3.23). Significant quantity values currently in use are given in Table II.

3.15. Detection time

The maximum time that may elapse between diversion of a given amount of nuclear material and detection of that diversion by IAEA safeguards activities. Where there is no additional protocol in force or where the IAEA has not drawn a conclusion of the absence of undeclared nuclear material and activities in a State (see No. 12.25), it is assumed: (a) that all facilities needed to clandestinely convert the diverted material into components of a nuclear explosive device exist in a State; (b) that processes have been tested (e.g. by manufacturing dummy components using appropriate surrogate materials); and (c) that non-nuclear components of the device have been manufactured, assembled and tested. Under these circumstances, detection time should correspond approximately to estimated conversion times (see No. 3.13). Longer detection times may be acceptable in a State where the IAEA has drawn and maintained a conclusion of the absence of undeclared nuclear material and activities. Detection time is one factor used to establish the timeliness component of the IAEA inspection goal (see No. 3.24).

3.16. Detection probability

The probability, if diversion of a given amount of nuclear material has occurred, that IAEA safeguards activities will lead to detection. The detection probability is usually denoted as $1 - \beta$, with β being the non-detection probability (see No. 10.28). The detection probability for safeguards activities involving nuclear material accountancy can be quantified, and the accountancy detection probability $1 - \beta_a$ is preselected as an input parameter for establishing sampling plans. The values of $1 - \beta_a$ currently in use are 90% for ‘high’ and 20% for ‘low’ probability levels.

3.17. False alarm probability

The probability, α, that statistical analysis of accountancy verification data would indicate that an amount of nuclear material is missing when, in fact, no diversion has occurred (see No. 10.27). For nuclear material accountancy purposes, α (or the associated critical region (see No. 10.32)) is preselected as one of the input parameters for designing sampling plans and performing statistical tests. It is usually set at 0.05 or less, in order to minimize the number of discrepancies (see No. 3.25) or false anomalies (see No. 3.26) that must be investigated.

3.18. Inventory

The amount of nuclear material present at a facility or a location outside facilities (LOF). In the context of IAEA safeguards, the term ‘inventory’ is defined as the larger of: the maximum (running) inventory calculated from State reports (see Nos 12.5–12.8); or throughput, which is the estimated amount of material processed during the material balance period. This inventory is used for establishing the frequency and intensity of routine inspections for a facility or an LOF (see No. 11.16), as provided for in paras 79 and 80 of [153].

3.19. Annual throughput

“the amount of nuclear material transferred annually out of a facility working at nominal capacity” [153, para. 99]. Paragraph 84 of [66] defines throughput as “the rate at which nuclear material is introduced into a facility operating at full capacity”.

3.20. IAEA timeliness detection goal

The target detection times applicable to specific nuclear material categories (see No. 4.24). These goals are used for establishing the frequency of inspections (see No. 11.16) and safeguards activities at a facility or a location outside facilities during a calendar year, in order to verify that no abrupt diversion (see No. 3.10) has occurred. Where there is no additional protocol in force or where the

IAEA has not drawn and maintained a conclusion of the absence of undeclared nuclear material and activities in a State (see No. 12.25), the detection goals are as follows:

— One month for unirradiated direct use material,
— Three months for irradiated direct use material,
— One year for indirect use material.

Longer timeliness detection goals may be applied in a State where the IAEA has drawn and maintained a conclusion of the absence of undeclared nuclear material and activities in that State.

3.21. Safeguards Criteria

As currently defined, the set of nuclear material verification activities considered by the IAEA as necessary for fulfilling its responsibilities under safeguards agreements. The Criteria are established for each facility type and location outside facilities (LOF), and specify the scope, the normal frequency and the extent of the verification activities required to meet the quantity and the timeliness components of the inspection goal at facilities and LOFs (see Nos 3.23 and 3.24). In addition, the Criteria specify verification activities to be carried out in a co-ordinated manner across a State. The Criteria are used both for planning the implementation of verification activities and for evaluating the results therefrom (see Nos 12.20 and 12.23).

3.22. IAEA inspection goal

Performance targets specified for IAEA verification activities at a given facility as required to implement the facility safeguards approach (see No. 3.3). The inspection goal for a facility consists of a quantity component (see No. 3.23) and a timeliness component (see No. 3.24). These components are regarded as fully attained if all the Safeguards Criteria (see No. 3.21) relevant to the material types (see No. 4.23) and material categories (see No. 4.24) present at the facility have been satisfied and all anomalies involving 1 SQ or more of nuclear material have been resolved in a timely manner (see No. 3.26). (See also Nos 12.23 and 12.25.)

3.23. Quantity component of the IAEA inspection goal

Relates to the scope of the inspection activities at a facility that are necessary for the IAEA to be able to draw the conclusion that there has been no diversion of 1 SQ or more of nuclear material over a material balance period and that there has been no undeclared production or separation of direct use material at the facility over that period.

3.24. Timeliness component of the IAEA inspection goal

Relates to the periodic activities that are necessary for the IAEA to be able to draw the conclusion that there has been no abrupt diversion (see No. 3.10) of 1 SQ or more at a facility during a calendar year.

3.25. Discrepancy

An inconsistency found in the facility operator's records, or between facility records and State reports (see No. 6.48), or between these records and inspector observations or indications resulting from containment and surveillance measures (see No. 8.6). Discrepancies that cannot be resolved (i.e. ascribed to innocent causes or otherwise satisfactorily explained) may lead to the determination that declared nuclear material is unaccountably missing. A discrepancy involving 1 SQ or more of nuclear material is classified as a possible anomaly (see No. 3.26).

3.26. Anomaly

An unusual observable condition which might result from diversion of nuclear material (see No. 2.3) or misuse of safeguarded items (see No. 2.4), or which frustrates or restricts the ability of the IAEA to draw the conclusion that diversion or misuse has not occurred (see No. 12.25). Examples of possible anomalies would be:

— Denial or restriction of IAEA inspector access for inspection (see No. 11.14);
— Unreported safeguards significant changes to facility design or operating conditions (see No. 3.28);
— A discrepancy involving 1 SQ or more of nuclear material (see No. 3.25);
— A significant departure from the agreed recording and reporting system (see No. 6.1);
— Failure of the facility operator to comply with agreed measurement standards or sampling methods (see No. 6.1);
— (For bulk handling facilities) a negative conclusion resulting from the evaluation of MUF (material unaccounted for), SRD (shipper/receiver difference) or other statistics (see No. 10.1);
— IAEA seals on equipment detached by non-IAEA staff, lost or showing signs of tampering (see Nos 8.5 and 8.12);
— Evidence of tampering with IAEA equipment (see No. 8.12).

3.27. Facility practices

A set of "prudent management practices required for the economic and safe performance of nuclear activities" [153, para. 4(c)] as applied by the facility operator. These practices include features which are relevant for the implementation of the facility safeguards approach (see No. 3.3), such as material identification and measurement procedures, record keeping, inventory taking frequencies and procedures, designation of measurement points and storage arrangements.

3.28. Design information

"information concerning nuclear material subject to safeguards under the agreement and the features of facilities relevant to safeguarding such material" [153, para. 8]; similarly in [66, para. 32]. Design information includes the facility description; the form, quantity, location and flow of nuclear material being used; facility layout and containment features; and procedures for nuclear material accountancy and control. This information is used by the IAEA, inter alia: to design the facility safeguards approach (see No. 3.3), to determine material balance areas (see No. 6.4) and select key measurement points and other strategic points (see No. 6.5), to develop the design information verification plan (see No. 3.31) and to establish the essential equipment list (see No. 3.32). Design information for existing facilities should be provided by the State during discussion of the Subsidiary Arrangements (see No. 1.26); in the case of new facilities, such information is to be provided by the State as early as possible before nuclear material is introduced into a new facility. Further, the State is to provide preliminary information on any new nuclear facility as soon as the decision is taken to construct, or to authorize the construction of, the facility, and to provide further information on the safeguards relevant features of facility design early in the stages of project definition, preliminary design, construction and commissioning. Facility design information is to be provided for any safeguards relevant changes in operating conditions throughout the facility life cycle (see No. 5.29). Under an INFCIRC/66-type safeguards agreement, the State is to provide design information on principal nuclear facilities to enable the IAEA to perform the design review at as early a stage as possible [66, para. 31]. Design information is submitted to the IAEA by the State using the IAEA design information questionnaire (DIQ).

3.29. Design information examination (DIE)

Activities carried out by the IAEA to determine that the State has provided all relevant descriptive and technical information needed, inter alia, to design a safeguards approach for a specific facility (see No. 3.3).

3.30. Design information verification (DIV)

Activities carried out by the IAEA at a facility to verify the correctness and completeness of the design information provided by the State (see No. 3.28). An initial DIV is performed on a newly built facility to confirm that the as-built facility is as declared. A DIV is performed periodically on existing facilities to confirm the continued validity of the design information and of the safeguards approach. The IAEA's authority for performing a DIV is a continuing right throughout all phases of a facility's life cycle until the facility has been decommissioned for safeguards purposes (see Nos 5.29 and 5.30).

3.31. Design information verification plan (DIVP)

A document prepared by the IAEA identifying the design information verification activities (see No. 3.30) required for each phase of a facility's life cycle (see No. 5.29).

3.32. Essential equipment list (EEL)

A list of equipment, systems and structures essential for the declared operation of a facility. The EEL is facility specific and is established during the design information examination (see No. 3.29); it identifies those items that may influence the facility's operational status, function, capabilities and inventory. The list is maintained and updated as part of the design information verification plan (DIVP) implementation (see No. 3.31).

3.33. State system of accounting for and control of nuclear material (SSAC)

Organizational arrangements at the national level which may have both a national objective to account for and control nuclear material in the State and an international objective to provide the basis for the application of IAEA safeguards under an agreement between the State and the IAEA (see No. 6.1). Under a comprehensive safeguards agreement, the State is required to establish and maintain a system of accounting for and control of nuclear material subject to safeguards under the agreement. The system "shall be based on a structure of material balance areas, and shall make provision...for the establishment of such measures as:

(a) A measurement system for the determination of the quantities of nuclear material received, produced, shipped, lost or otherwise removed from inventory, and the quantities on inventory;
(b) The evaluation of precision and accuracy of measurements and the estimation of measurement uncertainty;
(c) Procedures for identifying, reviewing and evaluating differences in shipper/ receiver measurements;
(d) Procedures for taking a physical inventory;
(e) Procedures for the evaluation of accumulations of unmeasured inventory and unmeasured losses;
(f) A system of records and reports showing, for each material balance area, the inventory of nuclear material and the changes in that inventory including receipts into and transfers out of the material balance area;
(g) Provisions to ensure that the accounting procedures and arrangements are being operated correctly; and
(h) Procedures for the provisions of reports to the Agency" [153, para. 32].

INFCIRC/66-type safeguards agreements do not explicitly call for States to establish and maintain a system of accounting for and control of nuclear material, but the fact that [66] calls for agreement between the IAEA and the State on a "system of records" and a "system of reports" implies the need for an appropriate organizational arrangement at the State level.

3.34. Regional system of accounting for and control of nuclear material (RSAC)

Organizational arrangements that are made by a number of States in a region to institute a regional authority that fulfils for each of the States the functions that otherwise need to be performed by an SSAC for a single State (see No. 3.33).

3.35. New partnership approach (NPA)

An approach for implementing safeguards in the non-nuclear-weapon States members of Euratom, agreed between the IAEA and Euratom in 1992. The approach provides for common use of safeguards equipment, joint scheduling of inspections and special arrangements for inspection work and data sharing by the two organizations. The NPA enables the IAEA to economize on safeguards equipment and inspection efforts deployed in the relevant States while maintaining its ability to perform independent verification.

3.36. Safeguards quality assurance

In the context of IAEA safeguards, a management tool for ensuring a systematic approach to all of the activities affecting the quality of the safeguards implementation. To this end, the IAEA applies quality control techniques to, for example, the implementation of containment and surveillance measures, inspection documentation and safeguards information processing. In addition, quality audits are used to independently determine that each activity has been satisfactorily performed or that necessary corrective actions are being taken, and to identify opportunities for continuous improvement.

4. NUCLEAR AND NON-NUCLEAR MATERIAL

Nuclear material is necessary for the production of nuclear weapons or other nuclear explosive devices. Under comprehensive safeguards agreements, the IAEA verifies that all nuclear material subject to safeguards has been declared and placed under safeguards. Certain non-nuclear materials are essential for the use or production of nuclear material and may also be subject to IAEA safeguards under certain agreements.

4.1. Nuclear material

Any source material (see No. 4.4) or special fissionable material (see No. 4.5) as defined in Article XX of [ST]. See also [153, para. 112], [66, para. 77] and [540, Article 18.h].

4.2. Nuclide

A species of atom characterized by the number of protons (atomic number) and the number of protons and neutrons together (mass number).

4.3. Isotope

One of two or more atoms of the same element that have the same number of protons in their nucleus but different numbers of neutrons. Isotopes have the same atomic number but different mass numbers. Isotopes of an element are denoted by indicating their mass numbers as superscripts to the element symbol, e.g. ^{233}U or ^{239}Pu, or as numbers following the name or symbol of the element, e.g. uranium-233 or Pu-239. Some isotopes are unstable to the extent that their decay needs to be considered for nuclear material accountancy purposes (e.g. ^{241}Pu has a half-life of 14.35 years).

4.4. Source material

"uranium containing the mixture of isotopes occurring in nature; uranium depleted in the isotope 235; thorium; any of the foregoing in the form of metal, alloy, chemical compound, or concentrate; any other material containing one or more of the foregoing in such concentration as the Board of Governors shall from time to time determine; and such other material as the Board of Governors shall from time to time determine" [ST, Article XX.3]. According to para. 112 of [153], "the term source material shall not be interpreted as applying to ore or ore residue. Any determination by the Board under Article XX of the Statute of the Agency after the entry into force of this Agreement which adds to the materials considered to be source material or special fissionable material shall have effect under this Agreement only upon acceptance by the State"; see also [540, Article 18.h]. However, ore concentrate is considered to be source material. (See also No. 2.11.)

4.5. Special fissionable material

"plutonium-239; uranium-233; uranium enriched in the isotopes 235 or 233; any material containing one or more of the foregoing; and such other fissionable material as the Board of Governors shall from time to time determine; but the term 'special fissionable material' does not include source material" [ST, Article XX.1]. See also [153, para. 112] and [540, Article 18.h]. (See also No. 4.4.)

4.6. Fissionable material

In general, an isotope or a mixture of isotopes capable of nuclear fission. Some fissionable materials are capable of fission only by sufficiently fast neutrons (e.g. neutrons of a kinetic energy above 1 MeV). Isotopes that undergo fission by neutrons of all energies, including slow (thermal) neutrons, are usually referred to as fissile materials or fissile isotopes. For example, isotopes ^{233}U, ^{235}U, ^{239}Pu

and ^{241}Pu are referred to as both fissionable and fissile, while ^{238}U and ^{240}Pu are fissionable but not fissile.

4.7. Fertile material

A nuclear material which can be converted into a special fissionable material through capture of one neutron per nucleus. There are two naturally occurring fertile materials: ^{238}U and ^{232}Th. Through the capture of neutrons followed by two beta decays, these fertile materials are converted to fissionable ^{239}Pu and ^{233}U, respectively.

4.8. Uranium

A naturally occurring radioactive element with atomic number 92 and symbol U. Natural uranium contains isotopes 234, 235 and 238; uranium isotopes 232, 233 and 236 are produced by transmutation.

4.9. Natural uranium

Uranium as it occurs in nature, having an atomic weight of approximately 238 and containing minute quantities of ^{234}U, about 0.7% ^{235}U and 99.3% ^{238}U. Natural uranium is usually supplied in raw form by uranium mines and concentration (ore processing) plants as uranium ore concentrate, most commonly the concentrated crude oxide U_3O_8, often called yellow cake (see No. 5.16).

4.10. Depleted uranium

Uranium in which the abundance of the isotope ^{235}U is less than that occurring in natural uranium, e.g. uranium in spent fuel from natural uranium fuelled reactors and tails from uranium enrichment processes.

4.11. Enriched uranium

Uranium having a higher abundance of fissile isotopes than natural uranium. Enriched uranium is considered a special fissionable material (see No. 4.5).

4.12. Low enriched uranium (LEU)

Enriched uranium containing less than 20% of the isotope ^{235}U. LEU is considered a special fissionable material (see No. 4.5) and an indirect use material (see No. 4.26).

4.13. High enriched uranium (HEU)

Uranium containing 20% or more of the isotope ^{235}U. HEU is considered a special fissionable material (see No. 4.5) and a direct use material (see No. 4.25).

4.14. Uranium-233

An isotope of uranium which is produced by transmutation of ^{232}Th through irradiating thorium fuel in a reactor. Uranium-233 is considered a special fissionable material (see No. 4.5) and a direct use material (see No. 4.25).

4.15. Plutonium

A radioactive element which occurs only in trace amounts in nature, with atomic number 94 and symbol Pu. As produced by irradiating uranium fuels, plutonium contains varying percentages of the isotopes 238, 239, 240, 241 and 242. Plutonium containing any ^{239}Pu is considered a special fissionable material (see No. 4.5) and, except for plutonium containing 80% or more of ^{238}Pu, a direct use material (see No. 4.25).

4.16. Mixed oxide (MOX)

A mixture of the oxides of uranium and plutonium used as reactor fuel for the recycling of plutonium in thermal nuclear reactors (‘thermal recycling’) and for fast reactors. MOX is considered a special fissionable material (see No. 4.5) and a direct use material (see No. 4.25).

4.17. Thorium

A radioactive element with atomic number 90 and symbol Th. Naturally occurring thorium consists only of the fertile isotope ^{232}Th, which through transmutation becomes the fissionable ^{233}U.

4.18. Americium

A radioactive element with atomic number 95 and symbol Am. Isotopes of americium, which are formed by neutron capture or by the decay of ^{241}Pu, are fissionable and may have the potential to be used in a nuclear explosive device. While not defined under the IAEA Statute [ST] as source material or special fissionable material (see Nos 4.4 and 4.5), information on separated americium is collected by the IAEA under voluntary arrangements with relevant States. Americium has sometimes been referred to as an ‘alternative nuclear material.’

4.19. Neptunium

A radioactive element with atomic number 93 and symbol Np. The isotope ^{237}Np is both fissionable and fissile; it is formed during the irradiation of fuel in reactors and may be separated from high level waste and reprocessing streams. While not defined under the IAEA Statute [ST] as source material or special fissionable material (see Nos 4.4 and 4.5), separated neptunium is monitored by the IAEA under voluntary arrangements with relevant States. Neptunium has sometimes been referred to as an ‘alternative nuclear material.’

4.20. Enrichment

“the ratio of the combined weight of the isotopes uranium-233 and uranium-235 to that of the total uranium in question” [153, para. 105], [66, para. 73], usually stated as a percentage. Although this definition deals with the combined weight of the two fissile uranium isotopes, in practice they are rarely mixed and are normally accounted for separately. The term ‘enrichment’ is also used in relation to an isotope separation process by which the abundance of a specified isotope in an element is increased, such as the production of enriched uranium or heavy water, or of plutonium with an increase in the fissile isotope.

4.21. Depletion

Any process by which the abundance of a specified isotope (e.g. a fissile isotope) in an element is reduced, such as the stripping process in an enrichment plant, the burnup of nuclear fuel in a reactor or radioactive decay (e.g. the decay of ^{241}Pu contained in spent fuel).

4.22. Transmutation

The conversion of one nuclide into another through one or more nuclear reactions, and more specifically, the conversion of an isotope of one element into an isotope of another element through one or more nuclear reactions. For example, ^{238}U is converted into ^{239}Pu by neutron capture followed by the emission of two beta particles.

4.23. Material type

Classification of nuclear material according to the element contained and, for uranium, the degree of enrichment. The types are: plutonium; high enriched uranium; ^{233}U; depleted, natural and low enriched uranium; and thorium.

4.24. Material category

Categorization of nuclear material according to its irradiation status and suitability for conversion into components of nuclear explosive devices. The categories are: unirradiated direct use material, irradiated direct use material and indirect use material.

4.25. Direct use material

Nuclear material that can be used for the manufacture of nuclear explosive devices without transmutation or further enrichment. It includes plutonium containing less than 80% ^{238}Pu, high enriched uranium and ^{233}U. Chemical compounds, mixtures of direct use materials (e.g. mixed oxide (MOX)), and plutonium in spent reactor fuel fall into this category. Unirradiated direct use material is direct use material which does not contain substantial amounts of fission products; it would require less time and effort to be converted to components of nuclear explosive devices than irradiated direct use material (e.g. plutonium in spent reactor fuel) that contains substantial amounts of fission products.

4.26. Indirect use material

All nuclear material except direct use material. It includes: depleted, natural and low enriched uranium, and thorium, all of which must be further processed in order to produce direct use material.

4.27. Material form

Classification of nuclear material according to its physical form; material can be either in item form or in bulk form. Material is in item form as long as it consists of individually identifiable units (e.g. fuel assembly, bundle, pin, plate or coupon) that are kept intact during their stay in a material balance area. Bulk material is material in loose form, such as liquid, gas or powder, or in a large number of small units (e.g. pellets or pebbles) that are not each individually identified for nuclear material accountancy purposes.

4.28. Improved nuclear material

As defined in para. 74 of [66], nuclear material that has been altered in such a way that "either:

(a) The concentration of fissionable isotopes in it has been increased; or
(b) The amount of chemically separable fissionable isotopes in it has been increased; or
(c) Its chemical or physical form has been changed so as to facilitate further use or processing".

4.29. Strategic value

A relative measure of the suitability of a nuclear material for conversion into components of nuclear explosive devices. (See also Nos 4.25 and 4.26.)

4.30. Effective kilogram (ekg)

A special unit used in the safeguarding of nuclear material. As defined in para. 104 of [153] and para. 72 of [66], the quantity of nuclear material in effective kilograms is obtained by taking:

(a) For plutonium, its weight in kilograms;
(b) For uranium with an enrichment of 0.01 (1%) and above, its weight in kilograms multiplied by the square of its enrichment;
(c) For uranium with an enrichment below 0.01 (1%) and above 0.005 (0.5%), its weight in kilograms multiplied by 0.0001;
(d) For depleted uranium with an enrichment of 0.005 (0.5%) or below, and for thorium, its weight in kilograms multiplied by 0.00005.

4.31. Feed material

Nuclear material introduced at the start of a process operation, e.g. UF_6 as the feed to an enrichment process or to a UO_2 conversion process, or UO_2 as the feed to a fuel fabrication operation.

4.32. Intermediate product

Nuclear material in an intermediate process stage, e.g. green (unsintered) pellets in a fuel fabrication operation.

4.33. Product

Nuclear material processed to the point of being ready for shipment from a facility, e.g. UF_6 from an enrichment plant or fuel assemblies from a fuel fabrication operation.

4.34. Scrap

Rejected nuclear material removed from the process stream. Clean scrap comprises rejected process material that can be reintroduced into the process stream without the need for purification; dirty scrap requires separation of the nuclear material from contaminants, or chemical treatment to return the material to a state acceptable for subsequent processing.

4.35. Waste

Nuclear material in concentrations or chemical forms which do not permit economic recovery and which is designated for disposal. Disposal methods depend on the radioactivity level of the waste and normally include conditioning of the waste into a suitable form, e.g. vitrification of high level liquid waste or mixing of hulls and medium level waste with cement. For safeguarded nuclear material contained in waste, arrangements for termination of safeguards (see No. 2.12) should be agreed between the State and the IAEA before disposal.

4.36. Hold-up

Nuclear material deposits remaining after shutdown of a plant in and about process equipment, interconnecting piping, filters and adjacent work areas. For plants in operation, the hold-up is the amount of nuclear material contained in the process. It is also referred to as in-process inventory (see No. 6.56).

4.37. Fuel element **(fuel assembly, fuel bundle)**

A grouping of fuel rods, pins, plates or other fuel components held together by spacer grids and other structural components to form a complete fuel unit which is maintained intact during fuel transfer and irradiation operations in a reactor.

4.38. Fuel component

Any of the components of fuel elements containing nuclear material sealed in metal cladding (e.g. subassemblies and fuel rods, pins or plates), as defined in the Subsidiary Arrangements for batch definition and reporting purposes.

4.39. Pellet

A cylindrical compact of nuclear material, generally oxide, highly compressed and subsequently sintered to a ceramic state. In reactor fuel fabrication, uranium oxide or mixed oxide pellets are normally loaded into Zircaloy tubes to form a fuel rod.

4.40. Specified non-nuclear material

For safeguards purposes, non-nuclear material that can be used for the production of special fissionable material (see No. 4.5). Under Article 2.a.(ix) of [540], States are to provide the IAEA with certain information on exports and, when requested, with the confirmation of imports of such materials in quantities exceeding the limits indicated in the relevant items contained in the List of Specified Equipment and Non-nuclear Material for the Reporting of Exports and Imports according to Article 2.a.(ix) of [540, Annex II] (see No. 12.14). The non-nuclear materials specified include nuclear grade graphite, and deuterium and heavy water (see Nos 4.41 and 4.42). Similar information may be provided to the IAEA by States participating in the voluntary reporting scheme (see No. 1.27). Specified non-nuclear material may also be subject to IAEA safeguards under INFCIRC/66-type safeguards agreements.

4.41. Nuclear grade graphite

Graphite having a purity level better than 5 parts per million boron equivalent and with a density greater than 1.5 g/cm^3 for use in a nuclear reactor in quantities exceeding 3×10^4 kg (30 metric tonnes) for any one recipient country in any period of 12 months. Such graphite is listed in Annex II of [540]. (See also No. 4.40.)

Note: Boron equivalent (BE) for graphite expresses the quality of the graphite as a neutron moderator in terms of a concentration of naturally occurring boron that corresponds to the same capture level for thermal neutrons as the combined impurities in the graphite.

4.42. Deuterium and heavy water

The isotope of hydrogen with mass number 2, ^{2}H, is commonly called deuterium (symbol D); it occurs naturally with an abundance in water of about 150 parts per million. The highly enriched form of water (heavy water, more than 99.5% D_2O) is used as a moderator in natural uranium fuelled reactors. Deuterium, heavy water and any other deuterium compound in which the ratio of deuterium to hydrogen atoms exceeds 1:5000 for use in a nuclear reactor in quantities exceeding 200 kg of deuterium atoms for any one recipient country in any period of 12 months are listed in Annex II of [540]. (See also No. 4.40.)

4.43. Zircaloy

Alloy consisting of zirconium and small amounts of other metals (Sn, Fe, Cr, Ni), used as a cladding material for reactor fuel, especially in light water reactors. Zirconium metal and alloys in the form of tubes or assemblies of tubes, and in quantities exceeding 500 kg in any period of 12 months, especially designed or prepared for use in a nuclear reactor and in which the relation of hafnium to zirconium is less than 1:500 parts by weight are listed in Annex II of [540]. (See also Nos 4.40 and 5.33.)

5. NUCLEAR AND NUCLEAR RELATED ACTIVITIES AND INSTALLATIONS

Safeguards agreements between a State (or States) and the IAEA define conditions under which safeguards will be applied at nuclear installations in the State (or States). In addition, States may have arrangements with the IAEA requiring the submission to the IAEA of information on nuclear related activities and on the export and/or import of specified equipment.

5.1. Nuclear fuel cycle

A system of nuclear installations and activities interconnected by streams of nuclear material. The characteristics of the fuel cycle may vary widely from State to State, from a single reactor supplied from abroad with fuel, to a fully developed system. Such a system may consist of uranium mines and concentration (ore processing) plants, thorium concentration plants, conversion plants, enrichment (isotope separation) plants, fuel fabrication plants, reactors, spent fuel reprocessing plants and associated storage installations. The fuel cycle can be 'closed' in various ways, for example by the recycling of enriched uranium and plutonium through thermal reactors (thermal recycle), by the re-enrichment of the uranium recovered as a result of spent fuel reprocessing or by the use of plutonium in a fast breeder reactor.

5.2. Nuclear fuel cycle related research and development activities

"those activities which are specifically related to any process or system development aspect of any of the following: conversion of nuclear material, enrichment of nuclear material, nuclear fuel fabrication, reactors, critical facilities, reprocessing of nuclear fuel, processing (not including repackaging or conditioning not involving the separation of elements, for storage or disposal) of intermediate or high level waste containing plutonium, high enriched uranium or uranium-233, but do not include activities related to theoretical or basic scientific research or to research and development on industrial radioisotope applications, medical, hydrological and agricultural applications, health and environmental effects and improved maintenance" [540, Article 18.a]. (See also No. 12.14.)

5.3. Installation

A facility or location outside facilities (LOF) under [153] and [540] (or 'other location' under [66]). For IAEA planning and reporting of safeguards implementation, each installation is uniquely identified by a corresponding installation code, which is used, inter alia, to identify separately each of the installations in a group covered by the same Facility Attachment or the same LOF Attachment (see No. 1.26).

5.4. Categorization of installations

A classification of nuclear and non-nuclear installations used for IAEA planning and reporting of safeguards implementation. The categories are as follows:

A: Power reactors,
B: Research reactors and critical assemblies,
C: Conversion plants,
D: Fuel fabrication plants,
E: Reprocessing plants,
F: Enrichment (isotope separation) plants,

G: Separate storage facilities,
H: Other facilities,
I: Locations outside facilities,
J: Non-nuclear facilities or locations (for INFCIRC/66-type safeguards agreements only).

5.5. Reactor

"any device in which a controlled, self-sustaining fission chain reaction can be maintained" [66, para. 80]. Reactors are the most numerous type of nuclear facility where safeguards are applied. Depending on their power level and purpose, reactors are subdivided into power reactors, research reactors and critical assemblies (see Nos 5.6–5.15).

5.6. Power reactor

A reactor intended to produce electrical power, power for propulsion, or power for district heating, desalination or industrial purposes. The design of IAEA safeguards approaches for power reactors depends considerably on whether they are refuelled during shutdown or during operation.

5.7. Off-load refuelled power reactor

A reactor refuelled while it is shut down, the facility's generators are disconnected from the electric grid and/or no heat is produced for utilization. Periods when off-load refuelled reactors are shut down for refuelling usually provide an opportunity for the IAEA to verify fuel in the reactor cores.

5.8. Light water reactor (LWR)

An off-load refuelled power reactor which is both moderated and cooled by ordinary (light) water. LWR fuel assemblies usually consist of Zircaloy clad fuel rods containing uranium oxide pellets of low enrichment, generally less than 5% ^{235}U, or mixed oxide (MOX) having a low plutonium content, generally less than 5%. There are two types of LWR: boiling water reactors (BWRs) and pressurized water reactors (PWRs). In a BWR, the heat generated is extracted by allowing the water to boil as it passes through the reactor core, the steam raised being passed directly to the turbine. In a PWR, the reactor vessel is operated at a pressure sufficient to suppress the boiling of the water; the steam required for the turbine is produced in the secondary circuit by passing the primary coolant water through heat exchangers (steam generators).

5.9. On-load refuelled power reactor (OLR)

A reactor that does not have to be shut down for refuelling and is refuelled while producing power for electricity generation and/or heat utilization. Refuelling on-load influences the design of IAEA safeguards approaches for OLR facilities in respect of core fuel verification.

5.10. Heavy water reactor (HWR)

A reactor using heavy water as the moderator. A prominent example is the Canadian deuterium uranium (CANDU) type reactor, which is moderated and cooled by heavy water and is fuelled with natural uranium. The fuel bundles, located in horizontal pressure tubes, consist of Zircaloy tubes filled with uranium oxide pellets. CANDU reactors are refuelled on-load and, for safeguards purposes, are treated as item facilities (see No. 5.27). There are also HWRs that operate with a pressure vessel (similar to LWRs (see No. 5.8)) and those where light water is used as coolant.

5.11. Graphite moderated reactor

A reactor using nuclear grade graphite as the moderator and gas or light water as the coolant. Magnox type power reactors are carbon dioxide cooled and natural uranium fuelled, with the fuel cladding of a magnesium alloy (hence the name Magnox). Advanced gas cooled reactors (AGRs) are cooled with carbon dioxide and fuelled with low enriched uranium oxide, clad in stainless steel. Reactors of the

RBMK type (the acronym in Russian for 'reactor of high power, boiling') are power reactors that use graphite as the moderator and boiling light water as the coolant. The fuel is low enriched uranium oxide, clad in Zircaloy and contained in vertical pressure tubes. Magnox type power reactors, AGRs and RBMK type reactors are treated, for safeguards purposes, as item facilities (see No. 5.27). In high temperature gas cooled reactors (HTGRs), fuel can be in the form of pebbles made of oxide or carbide nuclear material particles embedded in a matrix of graphite; reactors with pebble type fuel are treated, for safeguards purposes, as bulk handling facilities (see No. 5.28).

5.12. Fast reactor

A reactor that, unlike thermal reactors, operates mainly with fast neutrons (neutrons in the energy range above 0.1 MeV) and does not need a moderator. Fast reactors are generally designed to use plutonium fuels and can produce, through transmutation of ^{238}U, more plutonium than they consume, i.e. they can be operated as breeder reactors with a conversion ratio greater than unity.

5.13. Research reactor

A reactor used as a research tool for basic or applied research or for training. Some reactors are used for radioisotope production. The fission heat is generally removed by the coolant at low temperature and is usually not used. A wide variety of research reactors exist, such as swimming pool reactors and high flux reactors. Most research reactors are treated, for safeguards purposes, as item facilities (see No. 5.27). Examples are:

(a) Materials testing reactor (MTR) - a high enriched uranium fuelled and water cooled thermal reactor used to produce a neutron flux for testing material properties and other applications. The fuel assemblies usually consist of an array of aluminium clad plates containing a uranium–aluminium alloy.

(b) TRIGA reactor - a water cooled research reactor normally fuelled with uranium enriched to just less than 20% ^{235}U in a uranium–zirconium hydride mixture to form a solid, homogeneous fuel rod, clad in Zircaloy.

5.14. Critical assembly

An installation used for research and consisting of a configuration of nuclear material which, by means of appropriate controls, can sustain a chain reaction. It is distinguishable from a research reactor or a power reactor in that it normally has no special provisions for cooling, is not shielded for high power operation, has a core designed for flexibility of arrangement, and uses fuel in a readily accessible form which is frequently repositioned and varied to investigate various reactor concepts. Depending on fuel design, a critical assembly may be classified, for safeguards purposes, as an item facility (see No. 5.27) or as a bulk handling facility (see No. 5.28).

5.15. Subcritical assembly

An installation similar to a critical assembly but physically incapable of sustaining a chain reaction because of the limited mass of nuclear material and limitations on its distribution or configuration. Subcritical assemblies are used in reactor physics research and for training.

5.16. Uranium mine and concentration (ore processing) plant

Installations, respectively, for mining uranium ore and for refining it to produce uranium ore concentrate, most commonly into concentrated crude oxide, U_3O_8 (often called yellow cake). According to paras 34(a) and 34(b) of [153], uranium mining and ore processing are activities which are not required to be declared, although certain imports and exports of ore concentrate are required to be reported to the IAEA. However, according to Article 2.a.(v) of [540], the State shall provide the IAEA with information specifying the location, the operational status and the estimated annual production capacity of uranium mines and concentration plants and thorium concentration plants, and the current annual production of such mines and concentration plants for the State as a whole. Further, the State shall provide, upon request by the IAEA, the current annual production of an individual mine or concentration plant. The provision of this information does not require detailed nuclear material accountancy.

5.17. Conversion plant

An installation for converting the chemical composition of nuclear material so as to facilitate its further use or processing, in particular to provide feed material for isotope separation and/or reactor fuel fabrication. To produce material for isotope separation, natural uranium ore concentrates or uranium oxides from reprocessing are converted into uranium hexafluoride (UF_6). To produce material for fuel fabrication, the following conversions are carried out: U_3O_8 or UF_6 to uranium dioxide (UO_2); U or Pu nitrate to oxide; and U or Pu oxides to metal. Operations to convert UF_6 to UO_2 normally are performed in conversion sections of uranium fuel fabrication plants, while conversions of U or Pu nitrates to oxides normally are performed in conversion sections of reprocessing plants or in mixed oxide (MOX) fuel fabrication plants.

5.18. Fuel fabrication plant

An installation for manufacturing fuel elements or other reactor components containing nuclear material. The associated conversion, storage and analytical sections are usually included as parts of the fabrication plant. For safeguards purposes, fuel fabrication plants are further categorized according to the nuclear material handled: natural uranium, depleted uranium, low enriched uranium (LEU), high enriched uranium (HEU), thorium, mixed plutonium–uranium oxide (MOX) and plutonium.

5.19. Scrap recovery plant

An installation in which scrap consisting of or containing nuclear material is treated by separating unwanted material and converting the nuclear material to forms usable for processing, usually by dissolution, solvent extraction and precipitation of the material. Scrap recovery sections of other installations, especially fuel fabrication plants, are treated as parts of those installations.

5.20. Enrichment plant (or isotope separation plant)

An installation for the separation of isotopes of uranium to increase the abundance of ^{235}U. The main isotope separation processes used in enrichment plants are gas centrifuge or gaseous diffusion processes operating with uranium hexafluoride (UF_6) (which is also the feed material for aerodynamic and molecular laser processes). Other isotope separation processes include electromagnetic, chemical exchange, ion exchange, and atomic vapour laser and plasma processes.

5.21. Reprocessing plant

An installation for the chemical separation of nuclear material from fission products, following dissolution of spent fuel. The installation may also include the associated storage, head-end (cutting and dissolution) operations, conversion and analytical sections, a waste treatment facility, and liquid and solid waste storage. Reprocessing involves the following steps: fuel receipt and storage, fuel decladding and dissolution, separation of uranium and plutonium and possibly other actinides (e.g. americium and neptunium) from fission products, separation of uranium from plutonium, and purification of uranium and plutonium. Once purified, uranium nitrate and plutonium nitrate may be converted, respectively, to UO_2 and PuO_2 powder at the reprocessing plant.

5.22. Storage facility

An installation designed to store nuclear material.

5.23. Heavy water production plant

A non-nuclear installation for the production of heavy water (deuterium oxide). Heavy water production plants, and equipment especially designed or prepared therefor, can be subject to safeguards under INFCIRC/66-type safeguards agreements. Under [540], the production or upgrading of heavy water or deuterium, and the export of such specified non-nuclear material and the equipment for its production, are to be declared to the IAEA. (See also Nos 4.42 and 5.33.)

5.24. Facility

"a reactor, a critical facility, a conversion plant, a fabrication plant, a reprocessing plant, an isotope separation plant or a separate storage installation; or any location where nuclear material in amounts greater than one effective kilogram is customarily used" [153, para. 106], [540, Article 18.j]. Under [66], two kinds of facility are defined (in paras 78 and 81, respectively).

5.25. Location outside facilities (LOF)

"any installation or location, which is not a facility, where nuclear material is customarily used in amounts of one effective kilogram or less" [540, Article 18.j]. This term also applies under para. 49 of [153], where LOF is described as a location containing "nuclear material customarily used outside facilities". The corresponding term under para. 66 of [66] is 'other locations', which is used in INFCIRC/66-type safeguards agreements to refer to installations where nuclear material outside of principal nuclear facilities is held, e.g. source material stored elsewhere than in a sealed storage facility.

5.26. Facility type

Used as the basis for IAEA planning and reporting of safeguards implementation. A facility type may consist of one or more installations, with the main category of installations (see No. 5.4) defining the facility type.

5.27. Item facility

A facility where all nuclear material is kept in item form and the integrity of the item remains unaltered during its residence at the facility. In such cases, IAEA safeguards are based on item accountancy procedures (e.g. item counting and identification, non-destructive measurements of nuclear material and the verification of the continued integrity of the items). Examples of item facilities are most reactors and critical assemblies (critical facilities), and storage installations for reactor fuel.

5.28. Bulk handling facility

A facility where nuclear material is held, processed or used in bulk form. Where appropriate, bulk handling facilities may be organized for safeguards purposes into multiple material balance areas (MBAs), for instance by separating activities relating only to the storage and assembly of discrete fuel items from those involving storage or processing of bulk material. In a bulk MBA, flow and inventory values declared by the facility operator are verified by the IAEA through independent measurements and observation. Examples of bulk handling facilities are plants for conversion, enrichment (or isotope separation), fuel fabrication and spent fuel reprocessing, and storage facilities for bulk material.

5.29. Facility life cycle

For safeguards purposes, a set of phases over the lifetime of a nuclear facility, starting with the decision to construct, or authorize the construction of, the facility and ending when the IAEA and the State agree that the facility is decommissioned (see No. 5.31). The following comprise the facility life cycle phases: pre-construction, construction, commissioning, operating, maintenance or modification, shut down, closed down (see No. 5.30) and decommissioned. It is possible for parts of a facility to be in different life cycle phases.

5.30. Closed-down facility (or closed-down location outside facilities)

"an installation or location where operations have been stopped and the nuclear material removed but which has not been decommissioned" [540, Article 18.d].

5.31. Decommissioned facility (or decommissioned location outside facilities)

"an installation or location at which residual structures and equipment essential for its use have been removed or rendered inoperable so that it is not used to store and can no longer be used to handle, process or utilize nuclear material" [540, Article 18.c].

5.32. Geological repository

Underground installation for the disposal of nuclear material, such as spent fuel, usually located more than several hundred metres below ground level in a stable geological formation that ensures long term isolation of radionuclides from the biosphere. In the operating phase the repository will include a reception area which may be above or below ground, as well as container handling and emplacement areas underground. After the final closure, the backfilling of all emplacement areas in the repository will have been completed and all surface activities ceased.

5.33. Specified equipment

Under Article 2.a.(ix) of [540], States are to provide the IAEA with certain information on exports and, when requested, with the confirmation of imports of equipment and non-nuclear material specified in the List of Specified Equipment and Non-nuclear Material for the Reporting of Exports and Imports According to Article 2.a.(ix) [540, Annex II] (see No. 12.14). The list identifies such items that are especially designed or prepared for use in nuclear installations or for the production of heavy water. Similar information may be provided to the IAEA by States participating in a voluntary reporting scheme (see No. 1.27). Specified equipment may be subject to IAEA safeguards under INFCIRC/66-type safeguards agreements.

5.34. Nuclear related dual use item

An item which has a technical use in both nuclear and non-nuclear applications, and is subject to certain conditions of supply because such items could make a major contribution to a nuclear explosive activity. Dual use items are recognized as possible process indicators in the evaluation of the nuclear related significance of information on a State's activities (see No. 12.20). A list of nuclear related dual use items, including equipment, materials and related technology, is incorporated in the Nuclear Suppliers' Group Guidelines (see No. 1.29) and is published in [254, Part 2].

6. NUCLEAR MATERIAL ACCOUNTANCY

Nuclear material accountancy within the framework of IAEA safeguards begins with the nuclear material accounting activities by facility operators and the State system of accounting for and control of nuclear material (SSAC), implemented in accordance with the provisions of the safeguards agreement between the IAEA and the State (or group of States). The IAEA applies nuclear material accountancy, complemented by containment and surveillance (C/S) measures, to independently verify the correctness of the accounting information generated by these activities.

6.1. Nuclear material accountancy

The practice of nuclear material accounting as implemented by the facility operator and the State system of accounting for and control of nuclear material (SSAC) (see No. 3.33), inter alia, to satisfy the requirements in the safeguards agreement between the IAEA and the State (or group of States); and as implemented by the IAEA, inter alia, to independently verify the correctness of the nuclear material accounting information in the facility records and the reports provided by the SSAC to the IAEA. Nuclear material accountancy may include the following:

FACILITY LEVEL

(a) Dividing operations involving nuclear material into material balance areas (MBAs) (see No. 6.4);
(b) Maintaining records on the quantities of nuclear material held within each MBA;
(c) Measuring and recording all transfers of nuclear material from one MBA to another or changes in the amount of nuclear material within MBAs due to, for example, nuclear production (see No. 6.17) or nuclear loss (see No. 6.22);
(d) Determining periodically the quantities of nuclear material present within each MBA through the taking of the physical inventory (see No. 6.41);
(e) Closing the material balance over the period between two successive physical inventory takings and computing the material unaccounted for (MUF) (see No. 6.43) for that period;
(f) Providing for a measurement control programme to determine the accuracy of calibrations and measurements (see No. 6.33) and the correctness of recorded source data (see No. 6.9) and batch data (see No. 6.8);
(g) Testing the computed MUF against its limits of error for indications of any unrecorded nuclear loss or accidental gain (see Nos 6.22 and 6.18);
(h) Analysing the accounting information to determine the cause and magnitude of mistakes in recording unmeasured losses, accidental losses and unmeasured inventory (hold-up) (see No. 4.36).

STATE AUTHORITY LEVEL

(a) Preparing and submitting nuclear material accounting reports to the IAEA, as appropriate (see, for example, Nos 12.4–12.8);
(b) Ensuring that nuclear material accounting procedures and arrangements are adhered to;
(c) Providing for IAEA inspector access and co-ordination arrangements, as necessary, to enable the IAEA to carry out its verification activities;

(d) Verifying facility operators' nuclear material accountancy performance, as provided for in the SSAC regulations.

IAEA LEVEL

(a) Independently verifying nuclear material accounting information in facility records and State reports, and conducting activities as provided for in the safeguards agreement (see, for example, Nos 6.48–6.55);
(b) Determining the effectiveness of the SSAC (see No. 3.33);
(c) Providing statements to the State on the IAEA's verification activities (see, for example, Nos 13.2–13.8).

6.2. Nuclear material accounting

Activities carried out to establish the quantities of nuclear material present within defined areas and the changes in those quantities within defined periods. Elements of nuclear material accounting include: establishment of accounting areas, record keeping, nuclear material measurement, preparation and submission of accounting reports, and verification of the correctness of the nuclear material accounting information.

6.3. Near real time accountancy (NRTA)

A form of nuclear material accountancy for bulk handling material balance areas in which itemized inventory and inventory change data are maintained by the facility operator and made available to the IAEA on a near real time basis so that inventory verification can be carried out and material balances can be closed more frequently than, for example, at the time of an annual physical inventory taking by the facility operator (see No. 6.41). When the in-process inventory (see No. 4.36) cannot be determined by measurement, NRTA requires that an estimate, including its uncertainty, be made of the inventory in each equipment item, on the basis of adequately documented techniques.

6.4. Material balance area (MBA)

As defined in para. 110 of [153], "an area in or outside of a facility such that:

(a) The quantity of nuclear material in each transfer into or out of each 'material balance area' can be determined; and
(b) The physical inventory of nuclear material in each 'material balance area' can be determined when necessary, in accordance with specified procedures, in order that the material balance for Agency safeguards purposes can be established".

Paragraph 46(b) of [153] provides that design information made available to the IAEA shall be used: "To determine material balance areas to be used for Agency accounting purposes and to select those strategic points which are key measurement points and which will be used to determine the nuclear material flows and inventories; in determining such material balance areas the Agency shall, inter alia, use the following criteria:

(i) The size of the material balance area should be related to the accuracy with which the material balance can be established;

(ii) In determining the material balance area advantage should be taken of any opportunity to use containment and surveillance to help ensure the completeness of flow measurements and thereby simplify the application of safeguards and concentrate measurement efforts at key measurement points;

(iii) A number of material balance areas in use at a facility or at distinct sites may be combined into one material balance area to be used for Agency accounting purposes when the Agency determines that this is consistent with its verification requirements; and

(iv) If the State so requests, a special material balance area around a process step involving commercially sensitive information may be established".

6.5. Strategic point

"a location selected during examination of design information where, under normal conditions and when combined with the information from all 'strategic points' taken together, the information necessary and sufficient for the implementation of safeguards measures is obtained and verified; a 'strategic point' may include any location where key measurements related to material balance accountancy are made and where containment and surveillance measures are executed" [153, para. 116].

6.6. Key measurement point (KMP)

"a location where nuclear material appears in such a form that it may be measured to determine material flow or inventory. 'Key measurement points' thus include, but are not limited to, the inputs and outputs (including measured discards) and storages in material balance areas" [153, para. 108].

6.7. Batch

"a portion of nuclear material handled as a unit for accounting purposes at a key measurement point and for which the composition and quantity are defined by a single set of specifications or measurements. The nuclear material may be in bulk form or contained in a number of separate items" [153, para. 100]. Examples are: a fuel assembly, a cylinder with UF_6, several drums of UO_2 powder from the same production run and a number of fuel rods with the same specifications. Items included in the same batch are items containing nuclear material of the same element concentration and enrichment. Definitions of items and batches handled at a facility are included in the Subsidiary Arrangements (see No. 1.26).

6.8. Batch data

"the total weight of each element of nuclear material and, in the case of plutonium and uranium, the isotopic composition when appropriate. The units of account shall be as follows:

(a) Grams of contained plutonium;
(b) Grams of total uranium and grams of contained uranium-235 plus uranium-233 for uranium enriched in these isotopes; and
(c) Kilograms of contained thorium, natural uranium or depleted uranium.

For reporting purposes the weights of individual items in the batch shall be added together before rounding to the nearest unit" [153, para. 101].

6.9. Source data

"those data, recorded during measurement or calibration or used to derive empirical relationships, which identify nuclear material and provide batch data. 'Source data' may include, for example, weight of compounds, conversion factors to determine weight of element, specific gravity, element concentration, isotopic ratios, relationship between volume and manometer readings and relationship between plutonium produced and power generated" [153, para. 115].

6.10. Identity data (or identification data)

Those data needed to uniquely characterize an item, batch (see No. 6.7) or stratum (see No. 6.37). Examples are a material balance area (see No. 6.4), nuclear material type (see No. 4.23), batch identification, material description (see No. 6.13), and type and date of an inventory change (see No. 6.14).

6.11. Element code

A single-letter code used in fixed format (i.e. column delimited) for accounting reports, under an INFCIRC/153-type safeguards agreement, to characterize the relevant nuclear material (e.g. natural uranium (see No. 4.9), depleted uranium (see No. 4.10), enriched uranium (see No. 4.11) and unified uranium (see No. 6.12)).

6.12. Unified uranium

A category of uranium, used for nuclear material accounting and reporting purposes under INFCIRC/153-type safeguards agreements, where all uranium (natural, depleted and enriched) is included in a single (unified) account. The material balance area and the SSAC must account for and report grams of total uranium and grams of contained ^{235}U plus ^{233}U regardless of the enrichment for the batch of nuclear material. The use of a unified uranium account is a point of negotiation in the Subsidiary Arrangements (see No. 1.26).

6.13. Material description

Description of a nuclear material batch in an accounting report under an INFCIRC/153-type safeguards agreement (see No. 12.4). Nuclear material batches are described by four parameters: physical form, chemical composition, containment or type of container, and irradiation status and quality.

6.14. Inventory change

"an increase or decrease, in terms of batches, of nuclear material in a material balance area" [153, para. 107]. Such a change shall involve one of the following:

(a) Increases: import (see No. 6.15), domestic receipt (see No. 6.16), nuclear production (see No. 6.17), accidental gain (see No. 6.18), retransfer from retained waste (see No. 6.20) and de-exemption of nuclear material from IAEA safeguards (see No. 6.19);
(b) Decreases: export (see No. 6.15), domestic shipment (see No. 6.21), nuclear loss (see No. 6.22), other loss (see No. 6.26), measured discard (see No. 6.23), transfer to retained waste (see No. 6.20), exemption of nuclear material from IAEA safeguards (see Nos 6.24 and 2.13), and termination of IAEA safeguards on nuclear material transferred to non-nuclear use (see Nos 6.25 and 2.12).

According to para. 39(a) of [66], an inventory change is any receipt, transfer out or use of all safeguarded nuclear material.

6.15. Import and export

International transfer of nuclear material subject to IAEA safeguards into and out of a State. The responsibility for material which is transferred internationally is defined under para. 91 of [153] and the requirements for notification of the IAEA by the responsible States are provided under paras 92–96 of [153].

6.16. Domestic receipt

According to para. 107 of [153], the receipt from other material balance areas within a State, receipt from a non-safeguarded (non-peaceful) activity or receipt at the starting point of safeguards (see No. 2.11).

6.17. Nuclear production

According to para. 107 of [153], the generation of special fissionable material through irradiation of fertile material in a reactor. (See also No. 4.5.)

6.18. Accidental gain

Unforeseen nuclear material that is present in a material balance area, except when detected in the course of a physical inventory taking by the facility operator (see No. 6.41).

6.19. De-exemption

"reapplication of safeguards on nuclear material previously exempted therefrom on account of its use or quantity" [153, para. 107].

6.20. Retained waste

"nuclear material generated from processing or from an operational accident, which is deemed to be unrecoverable for the time being but which is stored" [153, para. 107]. This wording defines the nuclear material considered as retained waste; the actual inventory change used in accounting records and reports is termed 'transfer to retained waste' (see No. 6.14). Material transferred to retained waste is stored at the material balance area (MBA) and continues to be subject to IAEA safeguards, but is not included in the inventory of the MBA.

6.21. Domestic shipment

"shipments to other material balance areas or shipments for a non-safeguarded (non-peaceful) activity" within a State [153, para. 107].

6.22. Nuclear loss

"loss of nuclear material due to its transformation into other element(s) or isotope(s) as a result of nuclear reactions" [153, para. 107]. Nuclear loss also includes burnup of nuclear material in a reactor and decay (e.g. of ^{241}Pu) during storage.

6.23. Measured discard

"nuclear material which has been measured, or estimated on the basis of measurements, and disposed of in such a way that it is not suitable for further nuclear use" [153, para. 107].

6.24. Exemption (of nuclear material)

"exemption of nuclear material from safeguards on account of its use or quantity" [153, para. 107]. (See also No. 2.13.)

6.25. Termination (of IAEA safeguards)

Termination of safeguards on nuclear material pursuant to para. 35 of [153]. (See also No. 2.12.)

6.26. Other loss

"for example, accidental loss (that is, irretrievable and inadvertent loss of nuclear material as the result of an operational accident) or theft" [153, para. 107].

6.27. Arithmetical correctness

Absence of arithmetical mistakes, inter alia: the absence of errors of addition, subtraction, multiplication and division, and in recording the determination of batch results from source data; and the absence of errors in the summation and recording of item quantities to obtain batch, stratum and account totals.

6.28. Adjustment

"an entry into an accounting record or a report showing a shipper/receiver difference or material unaccounted for" [153, para. 98]. The scope of this term has been extended to include rounding adjustments.

6.29. Correction

"an entry into an accounting record or a report to rectify an identified mistake or to reflect an improved measurement of a quantity previously entered into the record or report. Each correction must identify the entry to which it pertains" [153, para. 103].

6.30. Accounting records

A set of data kept at each facility or location outside facilities (LOF) showing the quantity of each type of nuclear material present, its distribution within the facility (or LOF) and any changes affecting it. Accounting records contain "in respect of each material balance area:

(a) All inventory changes, so as to permit a determination of the book inventory at any time;
(b) All measurement results that are used for determination of the physical inventory; and
(c) All adjustments and corrections that have been made in respect of inventory changes, book inventories and physical inventories" [153, para. 56]. See also [153, para. 57].

6.31. Operating records

A set of data kept at each facility on the operation of the facility in connection with the use or handling of nuclear material. The operating records of a reactor show, for example, the integrated thermal power produced by the reactor for a given period and the associated data of the reactor operation for that period as needed to determined the nuclear production and nuclear loss, and the location of each fuel element at any time. Operating records contain "in respect of each material balance area:

(a) Those operating data which are used to establish changes in the quantities and composition of nuclear material;
(b) The data obtained from the calibration of tanks and instruments and from sampling and analyses, the procedures to control the quality of measurements and the derived estimates of random and systematic error;
(c) A description of the sequence of the actions taken in preparing for, and in taking, a physical inventory, in order to ensure that it is correct and complete; and
(d) A description of the actions taken in order to ascertain the cause and magnitude of any accidental or unmeasured loss that might occur" [153, para. 58].

6.32. Supporting document

A record containing identity data (see No. 6.10), source data (see No. 6.9) and batch data (see No. 6.8) for each accounting transaction, such as shipping documents, weight (volume) records, laboratory records, charge/discharge records and power production records.

6.33. Measurement system

Procedures, personnel and equipment used for determining the quantities of nuclear material received, produced, shipped, lost or otherwise removed from inventory, and the quantities on inventory, as provided for in paras 32(a) and 32(b) of [153]. This system should provide for:

(a) Identification of key measurement points (see No. 6.6) and the characteristics of the nuclear material to be measured,
(b) Specification of the measurement performance desired,
(c) Specification of the measurement technique(s) employed,
(d) Specifications for measurement equipment,
(e) Equipment maintenance provisions and procedures,
(f) Operator's qualifications and provisions for training,
(g) Calibration standards and procedures,
(h) Routine measurement and data analysis procedures,
(i) Procedures for controlling measurement quality and maintaining performance at the desired level,
(j) Procedures for generating sample plans and obtaining representative samples,
(k) Procedures for combining measurements and measurement uncertainties so as to calculate material unaccounted for (MUF) and MUF uncertainty (σ_{MUF}) (see Nos 6.43 and 10.1).

Paragraph 55 of [153] provides that the system of measurements on which the facility records are based "shall either conform to the latest international standards or be equivalent in quality to such standards."

6.34. Traceability

The ability to relate a measurement result or a standard value to stated reference standards, usually provided by a nationally or internationally recognized organization through an unbroken chain of comparisons. The associated uncertainties should be known and available.

TABLE III. EXPECTED MEASUREMENT UNCERTAINTY δ_E (RELATIVE STANDARD DEVIATION) ASSOCIATED WITH CLOSING A MATERIAL BALANCE

Bulk handling facility type	δ_E
Uranium enrichment	0.002
Uranium fabrication	0.003
Plutonium fabrication	0.005
Uranium reprocessing	0.008
Plutonium reprocessing	0.010
Separate scrap storage	0.04
Separate waste storage	0.25

6.35. International standards of accountancy

Values of the measurement uncertainty δ_E expected for closing a material balance. These values, which are based on operating experience at the various types of bulk handing facility, are considered achievable under the condition of normal operation. For calculating the international standard for the uncertainty of a material balance, the standard from Table III (expressed as a relative standard deviation) is multiplied by the throughput. The δ_E values can be used along with the International Target Values (see No. 6.36) to determine whether a facility's measurement system meets international standards.

6.36. International Target Values (ITV)

Target values for random and systematic measurement uncertainty components for destructive analysis (DA) (see No. 7.13) and non-destructive assay (NDA) (see No. 7.24) measurements performed on nuclear material. The values are expressed as per cent relative standard deviations, and are values for uncertainties associated with a single determination result; for example, this may be the result reported by one laboratory on one sample (independent of the analytical scheme applied internally in the laboratory), or the result of an NDA measurement performed on a single item. The values are based on actual practical measurement experiences and are intended to be used as a reference for routinely achievable measurement quality by facility operators, SSACs and the IAEA. The values are periodically updated to reflect currently achievable measurement capabilities and to incorporate newly developed measurement techniques and instruments. The currently used set of values (ITV 2000) was published as [STR-327].

6.37. Stratum

A grouping of items and/or batches having similar physical and chemical characteristics (e.g. isotopic composition) made for the purpose of facilitating statistical sampling. The desired end result of stratification is that the items in a particular stratum are more like one another with respect to certain characteristics relevant for verification measurement and safeguards data analysis purposes than they are like the items in the other strata. In practice, a stratum may contain dissimilar materials as long as the facility operator used one method for measurement and the inspector used one method for verification (not necessarily the same). Stratification simplifies verification, making it possible to formulate the sampling plans needed to verify a material balance and to calculate its uncertainty (σ_{MUF}) (see No. 6.43). The operator and the IAEA should co-operate in defining strata so that the purposes of stratification are met.

6.38. Account

A record of debit and credit entries chronologically posted to a ledger to cover transactions involving a particular type or stratum of nuclear material within a material balance area.

6.39. Account balance

Determined for a particular type or stratum of nuclear material, e.g. UF_6 cylinders or trays of pellets, and defined as the book inventory at any time, or the algebraic sum of the inventory at the beginning of a defined period and the inventory changes during the period, equalling the book inventory for that particular material at the end of the period.

6.40. Book inventory (of a material balance area)

"the algebraic sum of the most recent physical inventory of that material balance area and of all inventory changes that have occurred since that physical inventory was taken" [153, para. 102].

6.41. Physical inventory

"the sum of all the measured or derived estimates of batch quantities of nuclear material on hand at a given time within a material balance area, obtained in accordance with specified procedures" [153, para. 113]. The physical inventory is determined by the facility operator as a result of a physical inventory taking and is reported to the IAEA in the physical inventory listing (see No. 12.8). The physical inventory is verified by the IAEA during a physical inventory verification inspection (see No. 6.52). The ending physical inventory for a material balance period is also the beginning physical inventory for the next material balance period.

6.42. Material balance component

The combination of all strata in one term of the material balance equation, i.e. the MUF (material unaccounted for) equation (see No. 6.43). For example, arriving UF_6 cylinders, UO_2 powder in drums and any other increases in the inventory of the material balance area (MBA) (such as receipts of scrap for recovery from another MBA) are combined to form the component 'increases'.

6.43. Material unaccounted for (MUF)

This is calculated for a material balance area (MBA) over a material balance period using the material balance equation, commonly written as:

MUF = (PB + X – Y) – PE

where

PB is the beginning physical inventory,

X is the sum of increases to inventory,

Y is the sum of decreases from inventory,

PE is the ending physical inventory.

Because book inventory is the algebraic sum of PB, X and Y, MUF can be described as the difference between the book inventory and the physical inventory. For item MBAs, MUF should be zero, and a non-zero MUF is an indication of a problem (e.g. accounting mistakes) which should be investigated. For bulk handling MBAs, a non-zero MUF is expected because of measurement uncertainty and the nature of processing. The operator's measurement uncertainties associated with each of the four material balance components (see No. 6.42) are combined with the material quantities to determine the uncertainty of the material balance σ_{MUF}.

6.44. Cumulative MUF

The algebraic sum of the MUFs for a material balance area over time (see No. 6.43).

6.45. Shipper/receiver difference (SRD)

"the difference between the quantity of nuclear material in a batch as stated by the shipping material balance area and as measured at the receiving material balance area" [153, para. 114].

6.46. Cumulative SRD

The algebraic sum of the shipper/receiver differences for a material balance area over time (see No. 6.45).

6.47. Material balance period (MBP)

Under an INFCIRC/153-type safeguards agreement, the term is used to refer to the time between two consecutive physical inventory takings (PITs) (see No. 6.41) as reflected in the State's material balance report (see No. 12.7). Under an INFCIRC/66-type safeguards agreement, the term is used to refer to what more accurately should be called the book balance period, since the beginning and the ending dates of the period are not necessarily linked to PITs.

6.48. IAEA examination of records

A set of inspection activities which under [153] are denoted as examination of records and under [66] as auditing activities. Facility records are examined with the intent to establish a correct set of data upon which to base the verification of the flow and the inventory of nuclear material. Examination of records consists of all or some of the following activities: examination of accounting records, examination of operating records, reconciliation of accounting with operating records, updating of the book inventory (see No. 6.49), and comparison of facility records with State reports and/or notifications to the IAEA.

6.49. IAEA updating of the book inventory

An inspection activity through which the inspector establishes the book inventory of a material balance area (MBA), i.e. the amount of nuclear material that should be present in the MBA. The updating is based on the book inventory value established at the previous inspection and uses facility records and supporting documents covering the intervening period. The book inventory value is the basis for verification of the inventory of nuclear material actually present in the MBA as of the date to which the book inventory has been updated.

6.50. IAEA inventory change verification

An inspection activity carried out to verify a recorded increase or decrease of the inventory of nuclear material in a material balance area. Verification of inventory changes, as components of the material balance, is essential for the IAEA's verification of the overall material balance and the determination of the inspector's estimate of MUF (see No. 10.2). The verification is based on the inventory change data in the facility records and supporting documents, and involves the use of IAEA accountancy verification methods (see No. 6.56). It may include the use of containment and surveillance measures (see No. 8.6), for example in respect of receipts of material previously verified at the shipping facility and sealed by the IAEA. Under [153], the verification of inventory changes is performed at flow key measurement points (see No. 6.6).

6.51. IAEA inventory verification

An inspection activity carried out to confirm that the amount of nuclear material actually present at a given time within a material balance area (MBA) is in agreement with the operator's recorded book inventory of nuclear material for the MBA. Under [153], the verification of inventory is performed at inventory key measurement points (see No. 6.6). There are two types of inventory verification: physical inventory verification and interim inventory verification (see Nos 6.52 and 6.53, respectively).

6.52. IAEA physical inventory verification (PIV)

An inspection activity that follows closely, or coincides with, the physical inventory taking by the operator (see No. 6.41) and closes the material balance period. The basis for a PIV is the list of inventory items prepared by the operator. The data are correlated with the physical inventory listing reports submitted by the State to the IAEA (see No. 12.8).

6.53. IAEA interim inventory verification

An inspection activity that does not coincide with the ending date of a material balance period and does not necessarily have to include all nuclear material present in the material balance area. Under [153], verification is made for purposes of timely detection or, for example, for re-establishment of the inventory of nuclear material within an area covered by surveillance after a failure of surveillance.

6.54. IAEA verification of nuclear material flows within an MBA

An inspection activity carried out under [153] at strategic points other than key measurement points or at strategic points for containment and surveillance (see No. 6.5). Examples are the verification of the transfer of fresh mixed oxide fuel assemblies into the core of a light water reactor, and sampling of pellets at the rod loading stations of fuel fabrication plants for the purpose of bias defect verification (see No. 10.7).

6.55. IAEA verification of operator's measurement system

An inspection activity carried out to enable the IAEA to independently estimate the operator's measurement errors and thus determine whether the estimates are in agreement with the facility design information supplied to the IAEA (see No. 3.28) and conform to the international standards of accountancy (see No. 6.35). Methods used for this purpose include observation of the calibration of the operator's measuring equipment (see No. 7.1), observation of the operator's measurement of standards provided by the IAEA and the taking of samples for destructive analysis (see Nos 7.7 and 7.13).

6.56. IAEA accountancy verification methods

Methods used by the IAEA to independently verify nuclear material accounting information. Examples are: identification, weighing, volume determination, sampling and analysis, variables test by non-destructive assay (NDA) (bias defects) (see, for example, Nos 7.24 and 10.7), variables test by NDA in the attributes mode (partial defects) (see, for example, Nos 7.24 and 10.7), criticality check for verification, and attributes test by NDA (gross defects) (see, for example, Nos 7.24 and 10.7). In addition, there are some facility specific methods (e.g. the method for in-process inventory verification in the case of near real time accountancy (see No. 6.3) and item counting (see No. 6.57)) that can be specified for use as verification methods.

6.57. Item counting

An IAEA verification activity involving the counting of items in a batch, stratum or material balance component for the purpose of verifying the correctness of the operator's records with respect to the number of items present.

7. NUCLEAR MATERIAL MEASUREMENT TECHNIQUES AND EQUIPMENT

Nuclear material verification depends on techniques and equipment for sampling, measurement and analysis of nuclear material. Physical standards are required for calibration of measurement equipment and provide a basis for determining the accuracy of measurements. For more information on this subject see [IAEA/NVS/1].

7.1. Calibration

The set of actions used during set-up and periodic validation of the performance of an instrument or measurement system, specifically to establish a correlation between instrument output and final (reportable) results. Through calibration, the systematic error (see No. 10.16) can be minimized and the accuracy of an instrument or measurement system established. Calibration is normally performed for an instrument on reference materials (see No. 7.2) so that the instrument can be properly tuned using well characterized material. The result of the calibration(s) may be recorded in a document, called a calibration certificate, and is sometimes expressed as a calibration factor or a set of calibration factors, for example in the form of a calibration curve. The calibration process should include an estimation of the associated uncertainty.

7.2. Reference material

A material or substance which is homogeneous and for which one or more values are well established. The material can be used for calibration of an apparatus, for assessment of a measurement method, or for assignment of values to materials. ‘Certified reference material’ is reference material accompanied by a certificate issued by a recognized organization and stating the value(s) and associated uncertainty.

7.3. Primary standard

A certified reference material that is designated or acknowledged to be of high metrological quality (i.e. traceable to a primary unit of measurement) and whose value is accepted without reference to other standards.

7.4. Secondary standard

A standard whose value is assigned by comparison with a primary standard of the same quantity. It may be a sample, selected from production material or artificially prepared to be similar to production material, which is characterized against primary standards and documented to be accurate to within a stated uncertainty in the parameters of interest. Such samples are used, for example, to check measurement reproducibility and accuracy under conditions as close as possible to those encountered with real production materials.

7.5. Bulk measurement

Determination of the mass of material subject to IAEA safeguards verification, such as solid materials or solutions in containers and solutions in tanks. For materials where only volume measurement is possible, the mass can be calculated by using the measured density of the material. In the context of IAEA safeguards, bulk measurement is necessary in connection with sampling and is done just before samples are taken. The sample related bulk data collected on-site by the IAEA inspector concomitantly with the sampling include the mass (or volume and density) of the sampled items or batches as declared by the facility operator and verified by the inspector.

7.6. Matrix

The non-nuclear part of nuclear material. In some cases, the matrix material can influence considerably the response of the measuring equipment and therefore the measurement results. For example, the presence of hydrogen or fluorine in a matrix can impact on results obtained through the use of a neutron coincidence counting technique (see No. 7.30).

7.7. Sample

A part or quantity selected from a larger group of items or quantity of material for inspection or analysis. The term has two meanings:

(a) In statistical sampling, a sample is a subset of items selected by some deliberate process from a defined group (population) of items and evaluated to gain information about the whole group (population).

(b) In material sampling for analysis, a sample is a small quantity of material taken from one item or container for measurement. A composite sample is obtained by taking several quantities from one or more containers, mixing them together and then selecting one or more aliquots for measurement.

7.8. Random sampling

The process of selecting samples in such a manner that all items in a population have the same probability of being selected. The selections should be made by using random number lists or random number generators, not by haphazard or subjective means.

7.9. Systematic sampling

The process of selecting samples in a repeated pattern, such as every 11th item or at fixed time intervals, from a continuing process. The selection of the first item determines the selection of all other items; therefore the first item must be selected at random unless it is known that the variability from item to item is negligible. Systematic sampling can result in bias if the population characteristics vary systematically in the sequence or vary in a cyclic manner.

7.10. Representative sample

A sample which is typical in respect of certain specified characteristics of the population or material from which the sample is collected. For example, in statistical sampling, selecting only large units from a mixed population of large and small units would give a sample that is typical of the large units; however, it would be a non-representative sample of the mixed population. To obtain a representative sample of this mixed population, the population should first be divided into two separate groups (strata) (see No. 6.37) of large and small items and these groups sampled separately. In material sampling, homogenization of material (e.g. solutions) prior to sampling may be required to obtain a representative sample.

7.11. Calorimetry

A method used for determining the amount of Pu in a sample by measuring its thermal power emission and converting this measurement to Pu quantity by using the abundances of Pu isotopes and of Am measured separately, and standard values of the thermal emission rates of the Pu isotopes and Am.

7.12. Assay

A measurement which establishes the quantity and composition of nuclear material present in the items being measured; the term is also used as a synonym of ‘analysis’. There are two methods used: destructive analysis (see No. 7.13) and non-destructive assay (see No. 7.24).

7.13. Destructive analysis (DA)

Determination of nuclear material content and, if required, of the isotopic composition of chemical elements present in the sample. Destructive analysis normally involves destruction of the physical form of the sample. In the context of IAEA safeguards, determination of the nuclear material content of an item sampled usually involves:

(a) Measurement of the mass of the sample;
(b) The taking of a representative sample;
(c) Sample conditioning (if necessary) prior to shipment to the Safeguards Analytical Laboratory for analysis (see No. 7.33);
(d) Processing of the sample to the chemical state required for the analysis (e.g. dissolution in nitric acid);
(e) Determination of the concentration of the nuclear material (U, Pu, Th) present in the sample (i.e. elemental analysis) using, inter alia, techniques described in Nos 7.14–7.18;
(f) Determination of the isotopic abundance ratios of U or Pu isotopes (i.e. isotopic analysis) using, inter alia, techniques described in Nos 7.20–7.23.

7.14. Chemical titration

A method of chemical analysis whereby an unknown amount of an element or compound is made to react with an exactly measured amount of reagent of known composition, leading to the completion or characteristic end point of a well known stoichiometric chemical reaction. Titration methods are designated, inter alia, according to the mode of detection of the end point, e.g. potentiometric and spectrophotometric titration. The Safeguards Analytical Laboratory uses potentiometric titration for the determination of U and Pu content in milligram to gram size samples of non-irradiated nuclear materials (see No. 7.33).

7.15. Controlled potential coulometry

An electrochemical method for measurement of element concentration whereby the element to be analysed is selectively oxidized or reduced at a metallic electrode maintained at a controlled potential. The number of electrons (coulombs) used in the electrolysis is measured. The method is used at the Safeguards Analytical Laboratory to determine Pu (see No. 7.33).

7.16. Gravimetric analysis

A technique whereby the element to be analysed is quantitatively separated and transformed to a well defined and very pure chemical compound which is accurately weighed and related to the stoichiometric quantity of the element to be analysed in the compound. At the Safeguards Analytical Laboratory, ignition gravimetry is used for determining U and Pu concentrations in oxides by converting them to stoichiometric U_3O_8 for U and PuO_2 for Pu (see No. 7.33).

7.17. Isotope dilution mass spectrometry (IDMS)

Measurement of the total U or Pu in a sample by introducing a known quantity of a tracer isotope normally absent or of low abundance in the sample (e.g. ^{233}U for U, ^{242}Pu or ^{244}Pu for Pu), measuring the abundances of all isotopes present in the sample with a mass spectrometer, and then determining the unknown by multiplying the isotope ratios observed by the quantity of tracer. This technique is generally used for highly radioactive reprocessing dissolver solutions.

7.18. K-edge densitometry

A technique for measuring the U or Pu concentration in solutions by determining the ratio of the transmission of photons whose energies closely bracket the K-electron absorption edge of the U or Pu. Hybrid instruments combining K-edge densitometry and X ray fluorescence analysis are used for determining U and Pu concentrations in mixed solutions, including highly radioactive spent fuel solutions.

7.19. Resin bead technique

Used to selectively absorb (isolate from fission products) U and Pu onto a resin bead (or beads) in preparation for isotopic analysis by thermal ionization mass spectrometry: one resin bead containing nanogram amounts of U and Pu is placed on a metal filament for the analysis. This method is suited to the measurement of reprocessing dissolver or highly active waste solutions.

7.20. Mass spectrometry

A technique of isotopic analysis whereby small quantities of a sample are ionized, formed into a beam and passed through a strong magnetic field which deflects the ions according to their masses, thereby producing a mass spectrum on a fixed detector. The intensities of the deflected beams of ions of different masses are measured to yield the isotopic ratios (see Nos 7.21 and 7.22).

7.21. Gas mass spectrometry

A technique whereby gas samples (typically UF_6) are introduced and multiple detectors are used to simultaneously collect ions of different masses and provide measurements of isotopic ratios with high precision.

7.22. Thermal ionization mass spectrometry (TIMS)

A technique (also called surface ionization mass spectrometry) whereby picogram to microgram quantities of a sample are deposited on a metallic filament which is then heated to 1600–2000°C in a high vacuum; this results in ionization of the sample. The ion beams from the different isotopes present in the sample are separated in a mass spectrometer and collected either sequentially in a single detector or simultaneously in a set of multiple detectors to yield isotopic ratios. The technique is extensively used at the Safeguards Analytical Laboratory (see No. 7.33). Highly accurate results require that sample cross-contamination be minimized.

7.23. Alpha spectrometry

Measurement of the energy spectrum of alpha particles to determine the abundance of alpha emitting isotopes such as ^{238}Pu in the material measured. At the Safeguards Analytical Laboratory, the technique is used in parallel with isotope dilution mass spectrometry for the analysis of spent fuel samples (see No. 7.33).

7.24. Non-destructive assay (NDA)

A measurement of the nuclear material content or of the element or isotopic concentration of an item without producing significant physical or chemical changes in the item. It is generally carried out by observing the radiometric emission or response from the item and by comparing that emission or response with a calibration based on essentially similar items whose contents have been determined through destructive analysis (see No. 7.13). There are two broad categories of NDA:

(a) Passive analysis (assay), in which the measurement refers to spontaneous emissions of neutrons or gamma rays or to the total decay energy;
(b) Active analysis (assay), in which the measurement refers to a stimulated emission (e.g. neutron or photon induced fission).

7.25. Gamma ray spectrometry

Measurement of the energy spectrum and intensity of gamma rays incident upon a detector for the purpose of establishing the total amount of the source isotopes in the item measured and the identity and abundance of the contributing isotopes; this is done by referencing the measured spectrum to those obtained from standards in known quantities under well defined geometrical configurations. The energy resolution of the method depends on the detector used: when a high resolution detector, such as a Ge detector, is used, neighbouring gamma ray energy lines are usually well separated. High resolution gamma ray spectrometry is essential for Pu isotopic analysis and analysis of the spectra of fission products in spent fuel, while gamma ray spectrometry measurements of U enrichment can normally be done with lower resolution, e.g. with sodium iodide (NaI) detectors. There are several types of portable multichannel analyser used by IAEA inspectors for gamma ray spectrometry measurements in the field, and the technique has also been adapted for use in verifying spent fuel in storage pools.

7.26. Gamma ray scanning

Measurement of gamma ray emission as a function of position along an item, e.g. measurement of the gamma ray emission profile along a fuel rod to verify its loading with pellets.

7.27. Scintillation detector

A device which responds to incident gamma rays or neutrons by emitting light scintillations. The most common scintillator for gamma rays is sodium iodide (NaI); for neutrons, a variety of organic and inorganic liquid and solid scintillators can be employed.

7.28. Semiconductor detector

A device which detects gamma rays by means of the induced charge displacement in a semiconducting material, e.g. Ge, cadmium telluride (CdTe) or cadmium zinc telluride (CdZnTe). Semiconductor detectors are characterized by good energy resolution but some (e.g. Ge detectors) require cooling with liquid nitrogen.

7.29. Neutron counting

Measurement of neutron emission from nuclear material, the emission being either spontaneous or induced by irradiation with neutron sources, in order to identify and measure the nuclear material. Detection of neutrons is normally accomplished by utilization of a neutron induced reaction (e.g. with ^{10}B or ^{3}He), resulting in the production of a charged particle which can be detected by its ionizing effect. In an application to verify irradiated fuel assemblies in storage pools, a ‘fork detector system’ is used that combines neutron counting with gamma ray detection.

7.30. Neutron coincidence counting

A technique that detects prompt neutrons from spontaneous or induced fission in a sample and distinguishes them from neutrons from other sources (such as α,n) reactions) by separating detected events that occur closely together in time (correlated events) from those that are randomly distributed in time. The correlated events are counted to produce a measurement result indicative of the amount of fissionable isotopes in the sample. The high level neutron coincidence counter (HLNCC) has been designed to handle high count rates and therefore large samples of Pu. The active well coincidence counter (AWCC) incorporates an isotopic source (e.g. AmLi) that randomly produces neutrons used to interrogate a fissionable sample. The prompt neutrons from the induced fission are then detected to verify large samples of U. The sensitivity of this active non-destructive assay device is higher than that of the passive HLNCC. Various instruments have been developed which incorporate this technology and are adapted for the verification of specific nuclear material items, such as light water reactor fuel assemblies or fast reactor fuel elements.

7.31. Neutron multiplicity counter

A variation on the coincidence counting technique described in No. 7.30. Coincidence counting involves measurement of the total number of neutrons detected (singles rate) and a statistical determination of the number of 2-fold coincidences (doubles rate) by analysing the time history of the detected neutrons. The measurement of large Pu or U samples with neutron coincidence counting requires additional assumptions and mathematical analysis to account for neutron multiplication and to accurately determine nuclear material mass. Multiplicity counting includes circuitry to determine higher order coincidences (e.g. triples rate); this allows the direct measurement of neutron multiplication without additional assumptions. This technique is useful to measure impure nuclear materials where the assumptions required for 2-fold coincidence counting are not met. Multiplicity counters usually have a very high efficiency (>60%) because this is needed to measure 3-fold, or higher order, coincidences with reasonable counting times.

7.32. Cerenkov radiation detection

A method for qualitative verification of irradiated nuclear fuel in storage pools. Irradiated fuel emits fast electrons that induce a characteristic blue glow in water. Electro-optical image intensifiers have been adapted to observe this glow from above a storage pool. They are optimized for ultraviolet radiation and are capable of operating with facility lights turned on. When aligned vertically above the tops of fuel assemblies, a Cerenkov viewing device can distinguish irradiated fuel items from non-fuel items.

7.33. Safeguards Analytical Laboratory (SAL)

The IAEA's laboratory, located in Seibersdorf, Austria, which is responsible for destructive analysis of nuclear material samples as well as for handling and analysis of environmental samples for safeguards purposes. (See also No. 9.12.) The SAL also provides support to both destructive analysis and environmental sampling programmes through the supply of sampling materials, quality assurance and training of IAEA inspectors.

7.34. Network of Analytical Laboratories (NWAL)

A group of laboratories in IAEA Member States that have been approved to analyse safeguards samples and to assist the Safeguards Analytical Laboratory in analysis of nuclear material and environmental samples (see Nos 7.33 and 9.13).

8. CONTAINMENT, SURVEILLANCE AND MONITORING

The IAEA's safeguards approach for a facility is based on nuclear material accountancy as a safeguards measure of fundamental importance, complemented by containment and surveillance (C/S) measures and monitoring. The most desirable combination of C/S measures and monitoring is that which permits the safeguards objectives to be achieved at acceptable costs and with minimum intrusion into routine facility operations. Monitoring devices may perform C/S functions, verify the flow of nuclear material items by counting the items and measuring the amount of nuclear material in them, or use an attributes test with a 'yes/no' result to ensure that no movements of radioactive material occur. Monitors are used in an unattended mode and sometimes with remote data transmission. For more information on this subject see [IAEA/NVS/1].

CONTAINMENT AND SURVEILLANCE

8.1. Containment

Structural features of a facility, containers or equipment which are used to establish the physical integrity of an area or items (including safeguards equipment or data) and to maintain the continuity of knowledge of the area or items by preventing undetected access to, or movement of, nuclear or other material, or interference with the items. Examples are the walls of a storage room or of a storage pool, transport flasks and storage containers. The continuing integrity of the containment itself is usually assured by seals or surveillance measures (especially for containment penetrations such as doors, vessel lids and water surfaces) and by periodic examination of the containment during inspection.

8.2. Surveillance

The collection of information through inspector and/or instrumental observation aimed at detecting movements of nuclear material or other items, and any interference with containment or tampering with IAEA equipment, samples and data. Surveillance may also be used for observing various operations or obtaining relevant operational data. IAEA inspectors may carry out surveillance assignments continuously or periodically at strategic points.

8.3. Containment/surveillance device (C/S device)

An item of equipment used to perform a C/S function and capable of providing its own C/S results (see No. 8.8).

8.4. Optical surveillance device

A device used to provide, for later review, a visual record of activities in a defined field of view; it is used to monitor movements of material or handling of equipment under surveillance during the absence of the inspector. Surveillance systems, often comprising several surveillance devices, are used at spent fuel storage pools and storage areas and on a temporary basis during reactor refuelling. The frequency of recording images is set as needed for the activities of interest to be recorded. It is set in accordance with the estimated time required for the activities that are intended to be recorded by the system, while these activities are in the field of view of the system. The exchange of data storage media items (e.g. tapes or disks) and the evaluation of the recorded information are implemented in accordance with the capacity of the system and the timeliness requirements. Some surveillance systems are used in remote monitoring applications (see No. 8.16). Current surveillance systems use video equipment configured as single or multicamera systems, which provide for fixed interval, random or triggered picture taking, and involve digital data processing; some earlier systems were designed to use automatically triggered film cameras.

8.5. Seal

A tamper indicating device used to join movable segments of a containment in a manner such that access to its contents without opening the seal or breaking of the containment is difficult. A sealing system comprises the containment enclosing the material to be safeguarded, the means of applying the seal (e.g. a metal wire) and the seal itself. All three components must be examined in order to verify that the sealing system has fulfilled its function of ensuring continuity of knowledge of the identity and integrity of the material concerned. Seals in use by the IAEA include metal cap seals with tamper indicating features, as well as ultrasonic and electronic seals with fibre optic loops, and, for short time applications, tamper indicating paper tape seals. Sealing systems may be applied:

(a) On safeguarded material or equipment to maintain the continuity of knowledge of the sealed contents between inventory verifications, and during shipment from one facility to another;
(b) On the operator's equipment (e.g. a crane) to monitor any use that would make possible the undeclared removal of nuclear material;
(c) On IAEA property (equipment, samples, standards, data, etc.) to prevent undetected tampering with it.

8.6. Containment/surveillance measures (C/S measures)

The application of containment and/or surveillance to complement nuclear material accountancy. The use of C/S measures is aimed at verifying information on movement of nuclear or other material, equipment and samples, or preservation of the integrity of safeguards relevant data. In many instances C/S measures cover the periods when the inspector is absent, thus ensuring the continuity of knowledge for the IAEA and contributing to cost effectiveness. Containment/surveillance measures are applied, for example:

(a) During flow and inventory verification, to ensure that each item is verified without duplication and that the integrity of samples is preserved;
(b) To confirm that there has been no change to the inventory previously verified and thus reduce the need for remeasurement;
(c) To ensure that IAEA equipment, working papers and supplies have not been tampered with;
(d) If necessary, to isolate ('freeze') nuclear material that has not been verified until it can be measured.

The indication of an anomaly (see No. 3.26) by C/S measures does not necessarily by itself indicate that material has been removed. The ultimate resolution of C/S anomalies is provided by nuclear material verification. If any C/S measure has been, or may have to be, compromised, the IAEA shall, unless agreed otherwise, be notified by the fastest means available. Examples of compromising might be seals which have been broken inadvertently or in an emergency, or seals of which the possibility of removal after advance notification to the IAEA has been agreed upon between the IAEA and the State.

8.7. System of containment/surveillance measures (C/S system)

A combination of containment and/or surveillance measures (see No. 8.6). Each C/S system is designed to meet a purpose specified in the IAEA's safeguards approach. To increase reliability, a C/S system can include one or several C/S devices (see No. 8.3). Containment/surveillance devices and containment may be used in such a way that each plausible diversion path (see No. 3.7) is covered by at least one device (single C/S). For redundancy purposes, C/S devices may be backed up (duplicated) by a similar device. In a dual C/S system, each plausible diversion path is covered by two C/S devices that are functionally independent and are not subject to a common tampering or failure mode (dual C/S), e.g. two different types of seal, or seals plus surveillance. Dual C/S is normally applied where the verification of nuclear material is difficult to perform, in order to increase confidence in the C/S results and reduce the requirements for periodic reverification.

8.8. Containment/surveillance results (C/S results)

The evaluation of the information provided by a C/S system (see No. 8.7). An 'acceptable' C/S result is obtained when the C/S device (see No. 8.3) has functioned as specified, its data confirm the validity of the operator's declarations and there is no evidence of tampering (see No. 8.12). Where a dual C/S system is used, an acceptable C/S result is obtained when both C/S devices function as specified, their data confirm the validity of the operator's declarations and there is no evidence of tampering. A C/S system may give a 'not acceptable' result caused, for example, by a broken seal or interruption in facility lighting. Such a case requires that follow-up actions be implemented as established in the applicable IAEA safeguards approach (see No. 3.1). 'Inconclusive' C/S results may be caused by a normal operational activity that has been declared to the IAEA in advance by the operator.

8.9. Containment/surveillance technical capability (C/S technical capability)

The anticipated performance of C/S in a specific application; it involves consideration of:

(a) The precise specification of the function of the C/S system (inter alia, which part of the operator's data can be confirmed by the system);
(b) The selection of C/S equipment with sensitivity, tamper resistance, data (image) quality and authentication, and reliability adequate to perform the intended function;
(c) The installation and servicing of the C/S devices in a manner which will maintain their performance at the intended level;
(d) The frequency of review of the C/S data;
(e) Measures for the prevention of false alarms.

8.10. Vulnerability assessment

An assessment of a safeguards system to determine the degree of its vulnerability to attacks by potential adversaries attempting to alter, remove or replace the genuine data handled by the system, or to gain unauthorized access to the data. Vulnerability assessments for IAEA equipment systems operating in an unattended mode are often performed by third-party laboratories.

8.11. Tampering

Interference in an unauthorized and undeclared manner to defeat the integrity of C/S or other safeguards equipment.

8.12. Tamper indication

Physical evidence of tampering with C/S or other safeguards equipment.

8.13. Tamper resistance

Features incorporated into a device (or procedures associated with its use) intended to make tampering more difficult or reduce the probability that tampering could take place without detectable tamper indications. IAEA C/S equipment is designed to have a high degree of tamper resistance. It is installed in sealable tamper indicating enclosures. The enclosure surfaces are coated with a tamper indicating material (e.g. anodized aluminium), the hinges are not accessible when the enclosure is closed, and the cable and ventilation entries are protected against probes or other unauthorized tool insertion.

8.14. Surveillance review system

Equipment used to review surveillance data recorded by surveillance systems. Because of the high number (many thousands) of images to review, the review process is time consuming, and must be arranged so as not to miss any important data. Automatic review systems allow the inspector to define regions of interest in the recorded field of view, and the system then selects for the inspector's examination only those images where some movement is recorded within the defined regions. These review systems shorten the review time considerably and have been also shown to increase the technical capability of surveillance by identifying more reliably all images with safeguards relevant activities.

MONITORING

8.15. Unattended monitoring

A special mode of application of non-destructive assay (see No. 7.24) or C/S measures (see No. 8.6), or a combination of these, that operates for extended periods without inspector intervention. The use of unattended safeguards instruments has long been a part of IAEA safeguards. Optical surveillance used to monitor an area for safeguards relevant activities over extended periods is unattended. Unattended radiation detection sensors are used to monitor the flow of nuclear material in a facility process area. For unattended monitoring, certain criteria must be met, including measures to ensure data authentication (see No. 8.22) and encryption (see No. 8.23).

8.16. Remote monitoring

A technique whereby safeguards data collected by unattended C/S, monitoring and measurement systems are transmitted off-site via communication networks (to IAEA Headquarters, a regional office or another IAEA location) for review and evaluation. The system's internal recording capability is used for backup purposes. Remote monitoring may provide better utilization of equipment, better planning of inspections and a reduction in the inspection effort needed to meet verification requirements. These systems transmit data ranging from equipment state of health data to verification data. The use of redundancy is particularly applicable for unattended C/S and monitoring devices. For data sent over unsecured transmission lines, authentication (see No. 8.22) and encryption (see No. 8.23) are required.

8.17. Monitor

A device used to provide information on the flow of nuclear or other material, or on the status of a nuclear facility or equipment. Examples of monitors are given in Nos 8.18–8.21.

8.18. Core discharge monitor (CDM)

A radiation monitoring system that monitors the charging and discharging of irradiated fuel bundles to and from the core of an on-load refuelled power reactor.

8.19. Spent fuel bundle counter

A radiation monitoring system that counts irradiated fuel bundles as they are discharged to the spent fuel storage bay of an on-load refuelled power reactor.

8.20. Reactor power monitor

Neutron monitoring system placed outside the reactor biological shield to monitor the power level of the reactor.

8.21. Radiation passage monitor

A device used to detect, by the radiation emitted, the passage of nuclear material through openings in a containment. For example, dosimeters, such as thermoluminescent dosimeters, can be used as 'yes/no monitors' to confirm the absence of irradiated fuel removals.

8.22. Authentication

Measures providing the assurance that genuine information has originated from a known source (sensor) and has not been altered, removed or replaced. In the case of digital data, the use of certified authentication algorithms contributes significantly to an adequate level of data authentication in unattended equipment systems.

8.23. Encryption

The rendering of information unintelligible by effecting a series of transformations to the normal representation of the information through the use of variable elements controlled by the application of an encryption key. The use of certified encryption algorithms, complemented by a rigorous enforcement of encryption key security procedures, is meant to provide an adequate level of information security.

8.24. Equipment state of health data

Data on the operating status of equipment, especially information that provides an indication of any (potential) malfunction, limitation on the equipment capacity to operate as planned, or tampering. Receiving state of health data with a sufficient frequency makes it possible to detect failures of equipment or tampering early enough for remedial actions to be implemented to satisfy the timeliness requirements.

9. ENVIRONMENTAL SAMPLING

Environmental sampling is one of the IAEA's safeguards measures which contributes to the assurance of the absence of undeclared nuclear material and activities. Collection of environmental samples combined with ultrasensitive analytical techniques, such as mass spectrometry methods, particle analysis and low level radiometric techniques, can reveal information about past and current activities related to the handling of nuclear material. For more information on this subject see [IAEA/NVS/1].

9.1. Environmental sampling (ES)

In the context of IAEA safeguards, the collection of samples from the environment with a view to analysing them for traces of materials that can reveal information about nuclear material handled or activities conducted. The media sampled include various surfaces (e.g. of equipment and building structures), air, water, sediments, vegetation, soil and biota. The application of ES usually involves two stages: baseline sampling is performed to establish a reference 'environmental signature', and routine sampling is subsequently performed to obtain data that can be compared for consistency with the established baseline environmental signature and the declared operations. Under [540], provision is made for the collection of environmental samples by IAEA inspectors at locations beyond those to which inspectors have access for inspections and visits under safeguards agreements (see No. 11.14).

9.2. Location specific environmental sampling

"the collection of environmental samples (e.g. air, water, vegetation, soil, smears) at, and in the immediate vicinity of, a location specified by the Agency for the purpose of assisting the Agency to draw conclusions about the absence of undeclared nuclear material or nuclear activities at the specified location" [540, Article 18.f].

9.3. Wide area environmental sampling

"the collection of environmental samples (e.g. air, water, vegetation, soil, smears) at a set of locations specified by the Agency for the purpose of assisting the Agency to draw conclusions about the absence of undeclared nuclear material or nuclear activities over a wide area" [540, Article 18.g]. Article 9 of [540] provides that the IAEA shall not seek access to locations specified for wide area environmental sampling until the use of such sampling and the procedural arrangements therefor have been approved by the IAEA Board of Governors and following consultations between the IAEA and the State.

9.4. Swipe sampling

The collection of environmental samples by swiping a surface with a piece of ultraclean medium (such as cloth) to remove from the surface traces of materials present.

9.5. Point sample

An environmental sample taken in one particular area to characterize one source of released material which can be found in a contiguous area adjacent to a release point.

9.6. Composite sample

In environmental sampling, a sample taken in several areas to characterize multiple sources of a released material that is expected to be found in separate areas more than a few metres apart.

9.7. Control sample

A swipe sample taken from the surface of the collector's and assistant's hands which can be used to check for cross-contamination from the sampling team.

9.8. Cross-contamination

Unintended introduction of material to the sample which could lead to false results. Possible sources of cross-contamination are the sampling medium itself, the sampling kit, another sample, the sampling team and/or post-sampling handling, including analysis.

9.9. Baseline environmental signature

Data, derived from the analysis of environmental samples taken at, and in the vicinity of, a location, that characterize nuclear materials handled and activities conducted at that location. Any inconsistencies between the results of the analyses and the declared activities at the location are followed up with the SSAC and the facility operator concerned. The baseline environmental signature is used as a reference to evaluate the analytical results for environmental samples collected subsequently.

9.10. Sampling team

Except for sampling inside hot cells, a team of at least two persons performing swipe sampling: a sampler (collector) and an assistant, working according to the procedures intended to keep the risk of cross-contamination during the sampling process as low as possible. The sampler comes into direct contact with the piece of cloth used to take swipe samples; the assistant does not, except when taking a control swipe sample. In the case of swipe sampling inside hot cells, the facility operator is responsible for the collection, handling and packaging of swipe samples under the direction of the IAEA inspector.

9.11. Sampling kit

A kit of items to be used for taking environmental samples, preassembled in a strictly controlled environment of a clean laboratory to guarantee the absence of unacceptable contamination. There are two types of kit used for swipe sampling:

(a) A standard swipe sampling kit containing several pieces of cotton cloth or other sampling media, intended to be used for point or composite sampling;
(b) A hot cell sampling kit with several sampling tools, intended for sampling inside hot cells.

9.12. IAEA Clean Laboratory for Safeguards

A unit of the Safeguards Analytical Laboratory (see No. 7.33) that provides analytical services to support the environmental sampling programme of the Department of Safeguards of the IAEA. The Clean Laboratory is responsible for the provision and certification of sampling kits and for the receipt, screening and distribution of environmental samples taken by IAEA inspectors. The facility maintains part of its laboratory space at 'Class 100' cleanliness level in order to reduce to an acceptable level the risk of cross-contamination that might lead to incorrect safeguards conclusions.

9.13. Screening measurement

Measurement performed on each environmental sample received at the IAEA Clean Laboratory for Safeguards (see No. 9.12) to determine its radioactivity level and to detect the presence of any actinide elements (primarily uranium and plutonium) and fission or activation products. This is usually performed using the method of gamma ray spectrometry (see No. 7.25). Following the screening measurements, and depending on the sampling objective, samples are distributed to laboratories of the Network of Analytical Laboratories (see No. 7.34) for analyses in bulk and/or particle analysis modes, are subjected to further measurements in the IAEA Clean Laboratory for Safeguards or are archived.

9.14. Bulk analysis

Analysis of environmental samples by methods that measure each sample as a whole, thus providing information about the average composition of the sample.

9.15. Particle analysis

Analysis of environmental samples in which micrometre size particles are removed from the samples for analysis involving the measurement of the size and the morphology of the particles, and their elemental and isotopic composition.

9.16. Fission track analysis

A technique used to isolate particles from an environmental sample by removing particles from the sample, spreading them on a fission track detector material, irradiating the detector with thermal neutrons and etching the fission tracks to identify the location of particles containing fissile isotopes (e.g. ^{239}Pu or ^{235}U). This method can be combined with thermal ionization mass spectrometry (TIMS) (see No. 7.22) to provide the isotopic composition of uranium and plutonium in individual particles.

9.17. Scanning electron microscopy (SEM)

A technique used to analyse particles from an environmental sample by depositing them on a conducting substrate and examining them under high (1000–5000 ×) magnification. The backscattered electron signal can be used to locate particles containing heavy elements. The heavy element particles can subsequently be subjected to a semiquantitative elemental analysis by electron excited X ray fluorescence spectrometry.

9.18. Secondary ion mass spectroscopy (SIMS)

A technique for measuring the isotopic composition of nuclear material in micrometre size environmental particles by mounting them on a conducting substrate and bombarding them in vacuum with energetic ions. This results in the ejection of secondary ions which are analysed by a mass spectrometer to measure the isotopic composition of uranium and plutonium in the particle.

10. STATISTICAL CONCEPTS AND TECHNIQUES FOR NUCLEAR MATERIAL VERIFICATION

Material balance accounting is an integral part of nuclear material verification. A requirement of material balance accounting is that the amounts of nuclear material in all components of the material balance equation are measured. The measurement results are subject to uncertainty due to errors that are inherent in all measurement systems. Statistical concepts and techniques are used to estimate the measurement uncertainty associated with nuclear material amounts and to establish and maintain control over the quality of measurements. They are further used in the formulation of sampling plans for nuclear material accountancy and verification, and as a basis for tests of statistical safeguards significance involved in the formulation of safeguards conclusions by the IAEA. For more information on this subject see [SCT].

10.1. Material balance evaluation

Performed whenever the material balance is closed to determine if any non-zero MUF (material unaccounted for) (see No. 6.43) can be explained by measurement uncertainty or reflects other causes. In the material balance evaluation as performed by a facility operator, the uncertainties associated with the measurement system used to determine the declared amounts of material, which make up each of the four components of the material balance equation (see Nos 6.42 and 6.43), are applied to the item or stratum amounts to determine the uncertainty of the material balance (σ_{MUF}). The material balance evaluation as performed by the IAEA includes:

(a) Evaluation of the operator's declared MUF and of the cumulative MUF (see Nos 6.43 and 6.44, respectively);
(b) Evaluation of the operator–inspector difference (see No. 10.3) for strata verified by the IAEA and for the material balance;
(c) Evaluation of the inspector's estimate of MUF (see No. 10.2);
(d) Evaluation of the shipper/receiver difference (SRD) and of the cumulative SRD (see Nos 6.45 and 6.46, respectively);
(e) Comparison of σ_{MUF} with the international standards of accountancy (see No. 6.35) to determine if the operator's measurement system is adequate for safeguards purposes.

Note: MUF evaluation applies only to bulk handling material balance areas; SRD evaluation applies only to facilities that declare SRDs.

10.2. Inspector's estimate of MUF

In theory, the algebraic sum of the inspector measured amounts of material in the strata that comprise the four components of the material balance equation (see Nos 6.42 and 6.43). In practice, an inspector stratum amount is generally derived from measurement of a random sample of items (see No. 7.8) and is based on the operator stratum amount. For those strata that are not measured by the inspector, the operator's estimate of the stratum amount is accepted for calculation of the inspector's estimate of MUF. The inspector's estimate of MUF provides a higher probability of detecting diversion into D (see No. 10.6) than the 'D statistic' (see No. 10.3). When most of the major strata have been measured by the inspector, the statistic is capable of detecting both diversion into MUF (see No. 10.4) and diversion into D. MUF – D, the difference between the operator's estimate of MUF and the operator–inspector difference D, is an inspector's estimate of MUF.

10.3. Operator–inspector difference

The difference between the facility operator's declared value and the IAEA inspector's measured value for the quantity of nuclear material in an item, batch or stratum. The operator–inspector difference (i.e. the 'D statistic') can be calculated for a material balance by algebraically summing up all of the stratum differences relating to the four components of the material balance equation (see Nos 6.42 and 6.43). Statistically significant operator–inspector differences (see No. 10.26) are indicators of a possible diversion (diversion into D) (see No. 10.6) at both item material balance areas (MBAs) and bulk handling MBAs. They are evaluated at each level (item, batch, stratum and material balance) to determine if the difference can be explained by measurement uncertainty. When the difference cannot be explained by measurement uncertainty, further investigation is necessary to ensure that nuclear material has not been lost or diverted.

10.4. Diversion into MUF

A concealment method (see No. 3.9) in which an amount of declared material M is removed from a material balance area and the accounting records are adjusted to account for the amount M removed. Because the operator's accounting records reflect the removal of M, there is no falsification of these records. This diversion strategy causes an imbalance in the MUF equation, and the diversion amount M shows up as part of a non-zero MUF (see No. 10.1). The diverter assumes that the uncertainty of MUF (δ_{MUF}) (see No. 6.43) would be large enough to hide the removal. This type of diversion may be detected through observation of an unexpectedly large value of MUF. However, if δ_{MUF} is large because measurement quality is poor or because there are large quantities of material accounted for improperly, then the diversion of M can be concealed.

10.5. Diversion into SRD

A concealment method (see No. 3.9) similar to diversion into MUF (see No. 10.4) but involving the transfer of nuclear material between safeguarded material balance areas. Diversion can be detected by statistical evaluation of the shipper/receiver difference (see No. 10.1).

10.6. Diversion into D

A concealment method (see No. 3.9) in which the diverter removes an amount of declared material M but does nothing to the operator's accounting records to hide the diversion. The accounting records are therefore now false (and have thus been falsified). The diversion causes a discrepancy (i.e. defect) (see No. 10.7) between the material declared to be present and the material actually present. The only way to detect the diversion is for the inspector to measure the container(s) from which M was removed and to compare the measured value with the operator's declared value. The scheme is referred to as diversion into D because it can be detected through observation of an unexpectedly large value of the D statistic. Diversion into D can be concealed if measurement quality is poor and the variance of D (δ_D) is large.

10.7. Defect

A difference between the declared amount of nuclear material and the material actually present. For IAEA verification purposes, three levels of defects are considered:

(a) Gross defect refers to an item or a batch that has been falsified to the maximum extent possible so that all or most of the declared material is missing.
(b) Partial defect refers to an item or a batch that has been falsified to such an extent that some fraction of the declared amount of material is actually present.
(c) Bias defect refers to an item or a batch that has been slightly falsified so that only a small fraction of the declared amount of material is missing.

10.8. Sample size

The number of items to be verified in order to be able to draw conclusions about the population from which the sample is taken. In the context of IAEA safeguards the basic formula used for estimating the total number of samples (n) to be selected in each stratum is:

$$n = N(1 - \beta^{1/d})$$

where

N is the number of items in the stratum,

β is the non-detection probability,

d is [M/x], the number of defects in the stratum rounded up to the next integer,

M is the goal amount,

x is the average nuclear material weight of an item in the stratum.

This formula approximates the sample size that would result from application of the hypergeometric probability distribution (sampling without replacement). The total sample size (n) may be allocated among several IAEA accountancy verification methods, specifically methods for detecting gross, partial and bias defects (see Nos 6.56 and 10.7). Allocation of the total sample size among several verification methods and other topics related to sample size are discussed in detail in [SCT, Ch. 6.4.2].

10.9. Mean (μ)

A measure of where the centre of an ordered population or probability distribution tends to be located. The mean is defined in some statistics textbooks as a measure of central tendency.

10.10. Sample mean (x_{av})

For a sample of n items (e.g. individual measurement observations), whose values are denoted by x_1, $x_2, \ldots, x_n$, the sample mean is theaverage value

$$x_{av} = \sum_{i=1}^{n} x_i /n$$

In the case of the normal distribution, this statistic is an unbiased estimate of the population mean (μ).

10.11. Variance (σ^2)

A measure of the dispersion or variability of a population or probability distribution. The variance is the second moment about the mean.

10.12. Sample variance (s^2)

A measure of the dispersion or variability of a sample, calculated as

$$s^2 = \sum_{i=1}^{n} x_i /n\, (x_i - x_{av})^2/(n - 1).$$

The sample variance s^2 is usually taken as an estimate of σ^2, the variance of the population from which the sample has been drawn.

10.13. Standard deviation (σ)

The positive square root of the variance. The standard deviation is expressed in the same units as the mean value for the population or probability distribution. The relative standard deviation, or coefficient of variation, is defined as $\delta = \sigma/\mu$, where μ is the mean of the population or distribution.

10.14. Error

In general, the amount by which the measured value differs from the 'true' value; it is also referred to as uncertainty. All measurements are subject to error. Sources of measurement error include sampling (selecting a limited number of items from a population, or a small amount of material from a container (see Nos 7.8 and 7.9), weighing, volume determination, the analytical technique, instrument calibration (see No. 7.1) and environmental conditions (such as moisture) or background in the case of non-destructive assay measurement (see No. 7.24). In nuclear material accountancy terminology, estimates of error include only those uncertainties attributable to the measurement process, and do not include mistakes (e.g. transcription mistakes). (See also Nos 10.15 and 10.16.)

10.15. Random error

A component of measurement error which occurs, in the course of a number of measurements of the same quantity, in a random way according to some probability distribution, with both positive and negative deviations from the 'true' value. As the number of measurements increases, the mean of these random deviations approaches zero; consequently, the effect of random error can be reduced by repeating measurements. Random error is sometimes referred to as measurement precision: the higher the precision, the smaller the random error.

10.16. Systematic error (bias)

A component of measurement error which remains constant over a series of replicate measurements. The mean of the systematic deviations from the 'true' value is some value other than zero; consequently, the effect of systematic error cannot be reduced by repeating measurements. Systematic error is sometimes referred to as measurement accuracy because it characterizes how close the measurement is to the 'true' value: the higher the accuracy, the smaller the systematic error. Systematic error is often estimated by measuring standards. Sometimes a bias correction is made to adjust for systematic error.

10.17. Residual bias

An unknown systematic error that remains after a bias correction has been applied, i.e. after the measured values have been corrected for the part of the systematic error that can be estimated by calibration or by measuring standards.

10.18. Error propagation

"the determination of the value to be assigned as the uncertainty of a given quantity, using mathematical formulae for the combination of measurement errors. Error propagation involves many considerations and the choice of formula for computing the uncertainty depends on the functional relations of the measurement parameters involved" (from document WASH-1173, Brookhaven National Laboratory, in [SCT, Ch. 5.1]). For example, the uncertainty (σ_{MUF}) of MUF resulting from closing a material balance (see No. 6.43) can be calculated by the application of the error propagation formulas that combine the errors of the individual material balance components (see No. 6.42). The standard deviation of the calculated variance of MUF (or σ_{MUF}) is used to evaluate the statistical significance of MUF (see No. 10.26).

10.19. Limits of error

Limits set around a measured value using estimates of random and systematic measurement uncertainty which have been calculated from data acquired over a long period of time. These limits are the upper and lower bounds of a confidence interval. They are intended to have the same meaning as the 'limits of accuracy' mentioned in para. 30 of [153].

10.20. Confidence interval

An estimate of a statistical parameter presented as an interval along the number line within which the 'true' value of the parameter lies with a specified probability. In the case of the normal distribution, the end points of the confidence interval are the same as the confidence limits.

10.21. Confidence limits

Limits set around a measured value or estimate that express a degree of confidence with regard to the 'true' value of the measured or the estimated amount. For example, a confidence interval can be established for a MUF value (see No. 6.43) by setting the upper limit at MUF + $3\sigma_{MUF}$ and the lower limit at MUF – $3\sigma_{MUF}$, corresponding to the claim that with 99.73% confidence the 'true' value of MUF lies within this interval. Confidence limits of the interval MUF ± $2\sigma_{MUF}$ correspond to 95.45% confidence that the 'true' value lies within the calculated interval.

10.22. Confidence level

Denotes the percentage of instances in which the confidence interval would contain the 'true' value of a statistical parameter if a large number of intervals were to be constructed on the basis of repeated sampling from the population. For example, if the level selected for establishing the confidence intervals were 95%, then 95% of the calculated intervals would be expected to contain the 'true' value. The probability chosen for the confidence level need not be the same as the detection probability.

10.23. Outlier

An observed or measured value that is unusually large or unusually small when compared with a range of values expected under similar conditions. Because a suspected outlier may or may not be representative of the population from which it came, it is prudent to examine the circumstances surrounding the alleged outlier before rejecting it. For example, a mistake might have been made in recording the data. Statistical analytical methods exist for identifying outliers and for treating them for the purposes of data evaluation [SCT, Ch. 4.6.3.7]. One is cautioned that discarding outliers can result in underestimation of variability within the population.

10.24. Performance values

Estimates of measurement error derived by the IAEA from a statistical analysis of historical measurement data, specifically the paired operator–inspector difference data (see No. 10.3) accumulated over a large number of inspections. The estimates are apportioned between the operator and the inspector and are separated into random error (see No. 10.15) and systematic error (see No. 10.16) components. Performance values are established on a facility, stratum and measurement method basis and are used for planning safeguards implementation and for safeguards statistical data evaluation purposes.

10.25. Test of hypothesis

A test to determine whether or not an assumed (or hypothetical) parameter value is reasonable. In general, a hypothesis may refer to a characteristic, such as element concentration, or to a statistic, such as the operator's declared MUF (see No. 6.43) or the operator–inspector difference (see No. 10.3). The test may involve either a two-sided interval or a one-sided interval (e.g. testing only for understatements). A hypothesis may also take the form of a statement, e.g. whether or not the population sampled fits a normal distribution. For example, suppose the hypothesis to be tested (called the null hypothesis) is that the mean value of element concentration of a batch of UO_2 powder is 82.2%, while the alternative hypothesis is that the mean value is either greater or smaller than 82.2%. For this test, limits of error (see No. 10.19) must be set on both sides of the parameter to establish an interval for testing; the areas beyond the interval are called the critical region. One or more samples from the batch in question are analysed for element concentration. If the measured concentration were to lie within the established interval, the null hypothesis would be accepted; if the measured concentration were to lie in the critical region (see No. 10.32), the null hypothesis would be rejected.

10.26. Statistically significant

Describes a conclusion drawn when the null hypothesis is rejected. Safeguards relevant statistics tested include: operator's declared MUF (see No. 6.43), inspector's estimate of MUF (see No. 10.2), operator–inspector difference (see No. 10.3) and shipper/receiver difference (see No. 6.45). For example, suppose the null hypothesis is that the expected value of MUF is zero. An interval is established around the declared MUF value for a given level of confidence and an estimated σ_{MUF}. If zero were to lie within the interval, there would be no reason to reject the null hypothesis that MUF is zero; thus MUF would not be considered statistically significant. However, if zero were to lie outside the interval, there would be sufficient evidence to reject the null hypothesis and to conclude that MUF is not zero; thus MUF would be considered statistically significant.

10.27. Type I error

In a test of hypothesis (see No. 10.25), rejecting a null hypothesis when the null hypothesis is in fact true. The probability α of committing a type I error is called the significance level of the test. Since rejecting a null hypothesis is equivalent to concluding that the hypothesis is false, α is also referred to as the false alarm probability (see No. 3.17). A type I error in the context of IAEA safeguards might result in falsely concluding that nuclear material has been lost when in fact no material has been lost. Therefore the value of α chosen is very small (e.g. 1%).

10.28. Type II error

In a test of hypothesis (see No. 10.25), failing to reject a null hypothesis when the null hypothesis is in fact false; this is commonly designated as probability β. Since in the context of IAEA safeguards, failure to reject a null hypothesis is equivalent to a conclusion that diversion did not occur when in fact it did occur, the probability β of a type II error is commonly referred to as the non-detection probability (see No. 3.16).

10.29. Power of a test

In a test of hypothesis (see No. 10.25), the probability of correctly rejecting a false hypothesis. The power of the test is a function of the 'true' distribution of the population tested. If the overlap of the hypothetical distribution and the 'true' distribution were small, then the power of the test would be high. If the overlap of the two distributions were large, then the power of the test would be low. In the case of a large overlap, more data (i.e. a larger sample size) are required to reduce the overlap and thus increase the power of the test. The power of the test is one minus the probability β of a type II error (see No. 10.28); in the context of IAEA safeguards, $1 - \beta$ is the detection probability (see No. 3.16).

10.30. Attributes test

A statistical test of a characteristic (or attribute) of an item to which the response is either 'yes' or 'no'. For example, seal verification is an attributes test: the seal is inspected and the result should be either that it shows evidence of tampering or it does not. Verification of items by non-destructive assay for radiation emission is also an attributes test: a tested item either emits radiation within a specified range or it does not. A 'no' answer identifies a defect (see No. 10.7).

10.31. Variables test

A statistical test which consists of measuring, on a continuous scale, a quantitative characteristic of an item. Weighing an item and measuring its element concentration by the analysis of a representative sample are examples of variables tests. When the results of such a quantitative measurement are used only to decide whether or not the item measured meets a specified criterion, which is a ‘yes/no’ decision, the test is described as ‘variables in attributes mode’.

10.32. Critical region

The region outside the bound(s) established for a hypothesis test. If the test results were to lie inside the critical region (i.e. outside the bound(s)), the hypothesis would be rejected. The reject limit is the point(s) at which the critical region begins.

11. VISITS, INSPECTIONS AND COMPLEMENTARY ACCESS

Safeguards visits and inspections are carried out by IAEA inspectors at facilities or locations outside facilities (LOFs), in accordance with the provisions of the relevant safeguards agreement. For a State that also has an additional protocol in force, the IAEA may also conduct complementary access in that State, as necessary.

VISITS AND INSPECTIONS

11.1. Visit

The presence of IAEA inspectors at a facility for purposes other than a safeguards inspection (see No. 11.2) or complementary access (see No. 11.25); examples of such purposes are the examination and verification of design information on a facility (see Nos 3.29 and 3.30), fact finding and technical discussions in connection with the development of safeguards approaches (see No. 3.1), and negotiations and discussions with facility and State authorities regarding safeguards implementation matters. Visits are not counted as person-days of inspection (see No. 11.20).

11.2. Inspection

Under an INFCIRC/153-type safeguards agreement, a set of activities carried out by IAEA inspectors at a facility or a location outside facilities to verify that the nuclear material declared and placed under safeguards remains in peaceful nuclear activities or is otherwise adequately accounted for. Three types of inspection may be performed under these agreements: ad hoc, routine and special inspections (see Nos 11.4, 11.5 and 11.13, respectively). Under an INFCIRC/66-type safeguards agreement, inspections are performed to verify that the nuclear material declared and placed under safeguards remains in peaceful nuclear activities or is otherwise adequately accounted for and that the non-nuclear material, facilities, equipment, services and information specified and placed under safeguards are not used to further any proscribed purpose. Initial inspections, routine inspections and special inspections may be performed under such agreements (see Nos 11.3, 11.5 and 11.13, respectively).

11.3. Initial inspection

Paragraph 51 of [66] provides that an initial inspection may be carried out, if so provided in a safeguards agreement, to verify that the construction of a principal nuclear facility is in accordance with the design reviewed by the IAEA. The initial inspection(s) may be carried out as soon as possible after the facility has come under IAEA safeguards, in the case of a facility already in operation; or before the facility starts to operate, in the other cases.

11.4. Ad hoc inspection

An inspection performed by IAEA inspectors at a facility or a location outside facilities before a Subsidiary Arrangement has entered into force (see No. 1.26). Paragraph 71 of [153] provides that the IAEA may make ad hoc inspections in order to:

(a) Verify the information contained in the initial report on the nuclear material subject to safeguards under the agreement;

(b) Identify and verify changes in the situation which have occurred since the date of the initial report;

(c) Identify, and if possible verify the quantity and composition of, nuclear material before its transfer out of or upon its transfer into the State.

11.5. Routine inspection

Paragraph 72 of [153] provides that the IAEA may perform routine inspections at a facility or a location outside facilities in order to:

(a) Verify that reports are consistent with records;
(b) Verify the location, identity, quantity and composition of all nuclear material subject to safeguards under the agreement;
(c) Verify information on the possible causes of material unaccounted for, shipper/receiver differences and uncertainties in the book inventory.

According to para. 49 of [66], routine inspections may include, as appropriate:

(a) Audit of records and reports;
(b) Verification of the amount of safeguarded nuclear material by physical inspection, measurement and sampling;
(c) Examination of principal nuclear facilities, including a check of their measuring instruments and operating characteristics;
(d) Check of the operations carried out at principal nuclear facilities and at research and development facilities containing safeguarded nuclear material.

11.6. Unannounced inspection

An inspection performed at a facility or a location outside facilities for which no advance notice is provided by the IAEA to the State before the arrival of IAEA inspectors. Paragraph 84 of [153] provides that, "as a supplementary measure, the Agency may carry out without advance notification a portion of the routine inspections...in accordance with the principle of random sampling". Paragraph 50 of [66] makes provision for the IAEA to carry out unannounced inspections.

11.7. Short notice inspection

An inspection performed at a facility or a location outside facilities for which less advance notice is provided by the IAEA to the State than that provided for under para. 83 of [153].

11.8. Random inspection

An inspection performed at a facility or a location outside facilities on a date chosen randomly.

11.9. Short notice random inspection (SNRI)

An inspection performed both on short notice (see No. 11.7) and randomly (see No. 11.8). SNRIs are part of a safeguards approach (see No. 3.3) developed for low enriched uranium fuel fabrication plants subject to safeguards, in order to provide improved coverage of domestic transfers of nuclear material. SNRIs may also be used at other facility types where the safeguards approach calls for unpredictably scheduled short notice inspections.

11.10. Limited frequency unannounced access (LFUA)

A part of a safeguards approach (see No. 3.3) developed for gas centrifuge uranium enrichment plants subject to safeguards under an INFCIRC/153-type safeguards agreement and operating at a stated uranium enrichment level of 5% or less. LFUA inspections to cascade areas are designed to permit, together with inspection activities outside cascade areas, the timely detection of diversion of one significant quantity (SQ) of uranium, including the production of one SQ of uranium at an enrichment level higher than that declared, while protecting the sensitive technical information related to the enrichment process. The LFUA regime, inter alia, secures access with short notice for IAEA inspectors to the cascade area of the plant concerned. Inspection activities to be implemented within the cascade area include visual observation, radiation monitoring and non-destructive assay measurements, sampling, and application and verification of seals. The activities to be performed and the frequency of access to the cascade area depend on the design and operation specifics of the plant.

11.11. Simultaneous inspections

Inspections performed by IAEA inspectors simultaneously or within a short period of time at two or more facilities in a State in order to detect possible diversions arranged in collusion between facilities by, for example, the temporary transfer ('borrowing') of nuclear material between facilities so that the same material would be verified twice by the IAEA, once in each of the two facilities inspected. The facilities may be of the same type (e.g. light water reactors (LWRs) using fuel assemblies of the same kind), or they may be linked in the same nuclear fuel cycle (e.g. LWRs, fuel fabrication and reprocessing plants, and spent fuel storage areas).

11.12. Continuous inspection

An inspection regime intended to maintain continuity of knowledge concerning inventory and flow of nuclear material by witnessing key operations, recording measurement and operating data, and verifying the information in order to meet the safeguards objectives. The activities involved may or may not require the continuous presence of an IAEA inspector or inspectors within the facility. According to para. 80 of [153], for facilities handling large amounts of plutonium or high enriched uranium, the inspection effort foreseen may in practice allow for continuous inspection. Provisions for continuous inspections under INFCIRC/66-type safeguards agreements are given in Annexes I and II of [66].

11.13. Special inspection

An inspection is deemed to be special: when it either is additional to the routine inspection effort provided for in paras 78–82 of [153], or involves access to information or locations in addition to the access specified in para. 76 of [153] for ad hoc and routine inspections, or both. Paragraph 73 of [153] provides that the IAEA may make special inspections subject to the procedures for consultations between the State and the IAEA: in order to verify the information contained in special reports, or if the IAEA considers that information made available by the State, including explanations from the State and information obtained from routine inspections, is not adequate for the IAEA to fulfil its responsibilities under the agreement.

According to paras 53 and 54 of [66], the IAEA may carry out special inspections if: the study of a report indicates that such inspection is desirable, or any unforeseen circumstance requires immediate action. The IAEA may also carry out special inspections of substantial amounts of safeguarded nuclear material that are to be transferred outside the jurisdiction of the State in which it is being safeguarded, for which purpose the State shall give the IAEA sufficient advance notice of any such proposed transfer.

11.14. Access for inspection

Paragraph 76 of [153] provides that IAEA inspectors have access as follows:

(a) For the purposes specified in subparas 71(a) and (b) of [153] and until such time as the strategic points have been specified in the Subsidiary Arrangements, IAEA inspectors shall have access to any location where the initial report or any inspections carried out in connection with it indicate that nuclear material is present.

(b) For the purposes specified in subpara. 71(c) of [153], IAEA inspectors shall have access to any location of which the IAEA has been notified in accordance with subparas 92(c) or 95(c) of [153].

(c) For the purposes specified in para. 72 of [153], IAEA inspectors shall have access only to the strategic points specified in the Subsidiary Arrangements and to the records maintained pursuant to paras 51–58 of [153].

(d) In the event of the State concluding that any unusual circumstances require extended limitations on access by the IAEA, the State and the IAEA shall promptly make arrangements with a view to enabling the IAEA to discharge its safeguards responsibilities in the light of these limitations. The IAEA Director General shall report each such arrangement to the IAEA Board of Governors.

According to para. 77 of [153], in circumstances which may lead to a special inspection (see No. 11.13), the State and the IAEA shall consult forthwith. As a result of such consultations, the IAEA may make inspections in addition to the routine inspection effort provided for under paras 78–82 of [153], and may obtain access in agreement with the State to information or locations in addition to the access specified under para. 76 of [153] for ad hoc and routine inspections.

Under INFCIRC/66-type safeguards agreements, para. 9 of [39] provides that IAEA inspectors shall have access to all materials, equipment and facilities to which safeguards are applied.

11.15. Scope of inspection

paragraph 74 of [153] provides that for purposes of ad hoc, routine and special inspections performed under INFCIRC/153-type agreements, "the Agency may:

(a) Examine the records kept;

(b) Make independent measurements of all nuclear material subject to safeguards under the agreement;

(c) Verify the functioning and calibration of instruments and other measuring and control equipment;

(d) Apply and make use of surveillance and containment measures; and

(e) Use other objective methods which have been demonstrated to be technically feasible".

Activities which the IAEA shall be enabled to perform within the scope of inspection are reflected in para. 75 of [153] and in the relevant Subsidiary Arrangements (see No. 1.26). The scope of a routine inspection under an INFCIRC/66-type agreement is described in para. 49 of [66].

11.16. Frequency of inspection

The number of times per year that a facility is to be inspected. Under an INFCIRC/153-type safeguards agreement, the frequency of routine inspections at facilities and locations outside facilities with a content or annual throughput (whichever is greater) not exceeding 5 effective kilograms may not exceed one inspection per year [153, para. 79]. In all other cases, inspection frequency is related to the IAEA timeliness detection goals for the facility considered (see No. 3.20). For inspections under an INFCIRC/66-type safeguards agreement, see para. 57 and Annexes I and II of [66].

11.17. Advance notice of inspections and visits

Provided by the IAEA to the State relative to inspections and visits as provided for under a safeguards agreement. Under an INFCIRC/153-type agreement, for example, advance notice for routine inspections is at least 24 hours for facilities involving plutonium or uranium enriched to more than 5%, and one week in all other cases [153, para. 83(c)]. However, according to para. 84 of [153], the IAEA may carry out without advance notice a portion of the routine inspections (see No. 11.6).

11.18. Inspection activities

Verification activities performed by IAEA inspectors during and in connection with inspections at facilities (see No. 11.2). Under an INFCIRC/153-type safeguards agreement, activities may include nuclear material accounting activities (see, for example, Nos 6.48–6.55), the application of containment and surveillance measures (see No. 8.6), and other activities such as environmental sampling (see No. 9.1). While not an inspection activity, design information examination and verification for a facility (see Nos 3.29 and 3.30), normally performed during visits to the facility, may be performed during inspections.

11.19. IAEA inspector

An IAEA officer appointed by the IAEA Director General and approved by the IAEA Board of Governors to perform safeguards inspections. After approval by the Board, the inspector is proposed to the respective States in which he/she is expected to operate. If the State agrees, the IAEA effects the designation. Simplified designation procedures can be agreed upon by the State and the IAEA, as required under Article 11 of [540]. IAEA inspectors are granted privileges and immunities necessary for the performance of their functions, as foreseen under Articles VI and VII of [9]. (See also No. 1.16.)

11.20. Person-day (man-day) of inspection (PDI)

"a day during which a single inspector has access to a facility at any time for a total of not more than eight hours" [153, para. 109]. This legal definition does not necessarily coincide with a calendar day, and is used to calculate the total amount of inspection effort at facilities compared with the maximum routine inspection effort (see No. 11.24). Where inspection activities require only a small portion of a calendar day, this still constitutes one PDI.

11.21. Person-year (man-year) of inspection

According to para. 109 of [153], 300 person-days (man-days) of inspection. However, the term 'inspector-year' (365 minus weekend days and minus some allowance for leave) is used to reflect the average number of days in a calendar year during which an inspector is available for work.

11.22. Actual routine inspection effort (ARIE)

The estimated annual inspection effort for a facility under an INFCIRC/153-type safeguards agreement, expressed in person-days and included in the Subsidiary Arrangements (see No. 1.26). For estimating ARIE, it is assumed that the facility operates according to its design data. In accordance with para. 81 of [153], due consideration should be given to the following when the ARIE and other elements of a routine inspection at a facility are being established:

(a) The form and accessibility of the nuclear material;
(b) The effectiveness of the SSAC and the extent to which the operator is functionally independent of the SSAC;
(c) The characteristics of the State's nuclear fuel cycle, in particular the number and types of facilities and the characteristics of such facilities relevant to safeguards;
(d) The international interdependence of nuclear activities involved and any relevant IAEA verification activities;
(e) Technical developments in the field of safeguards.

The ARIE is an estimated guideline. Operational conditions and unforeseen situations may require certain deviations from the agreed estimate (see No. 11.23).

11.23. Planned actual routine inspection effort (PLARIE)

The estimated annual routine inspection effort which, in contrast to the ARIE, takes the expected operational status of the facility (e.g. extended shutdowns) into account. The PLARIE for a facility in most cases is smaller than the ARIE. The total PLARIE forecast for all facilities under IAEA safeguards, corrected by a factor that accounts for the total inspection resources available, serves as a basis for human resource allocation.

11.24. Maximum routine inspection effort (MRIE)

The maximum number of person-days of inspection (PDI) per annum allowable for a facility, as provided for under para. 80 of [153]. The limit depends on whichever is the larger of: the inventory, annual throughput or maximum potential annual production of nuclear material of the facility. This largest quantity (L) is measured in effective kilograms (ekg). For all types of nuclear installation with L less than 5 ekg, the limit is one routine inspection per annum. For other facilities, the inspection regime shall be no more intensive than is necessary but shall be sufficient to maintain continuity of knowledge of the flow and inventory of nuclear material. For reactors and sealed stores, the limit is 50 PDI/a. In the case of facilities containing plutonium and uranium enriched to more than 5%, the equation MRIE = $30\sqrt{L}$ PDI/a applies, but the MRIE should not be less than 450 PDI/a. For all other cases, an MRIE equal to $(100 + 0.4L)$ PDI/a is specified.

COMPLEMENTARY ACCESS

11.25. Complementary access

Access provided by the State to IAEA inspectors in accordance with the provisions of an additional protocol (see No. 1.22). According to Article 4 of [540], the IAEA shall not mechanistically or systematically seek to verify the information provided by the State under Article 2 of its additional protocol; however, the IAEA shall have complementary access for three purposes:

- To assure the absence of undeclared nuclear material and activities at sites, mines, concentration plants and other locations where nuclear material has been declared to be present;
- To resolve a question relating to the correctness and completeness of the information provided by the State pursuant to Article 2, or to resolve an inconsistency relating to that information;
- To confirm, for safeguards purposes, the declaration of the decommissioned status of a facility or a location outside facilities where nuclear material was customarily used.

Under Article 8 of [540], the State may offer the IAEA access to locations in addition to those referred to in Articles 5 and 9. Under Article 9, the State shall provide the IAEA with access to locations specified by the IAEA to carry out wide area environmental sampling (see No. 9.3). However, the IAEA shall not seek such access until the use of such wide area environmental sampling and the procedural arrangements therefor have been approved by the IAEA Board of Governors and following consultations between the IAEA and the State. In certain cases where the State is unable to provide the required access, it should make every reasonable effort to satisfy the IAEA's requirements through other means or at alternative locations [540, Articles 5.b, 5.c and 9].

11.26. Managed access

Upon the request of the State, the IAEA and the State shall make arrangements for managed access, arranged in such a way as "to prevent the dissemination of proliferation sensitive information, to meet safety or physical protection requirements, or to protect proprietary or commercially sensitive information. Such arrangements shall not preclude the Agency from conducting activities necessary to provide credible assurance of the absence of undeclared nuclear material and activities at the location in question, including the resolution of a question relating to the correctness and completeness of the information referred to in Article 2 or of an inconsistency relating to that information" [540, Article 7.a]. The State may, when providing information pursuant to Article 2, “inform the Agency of the places at a site or location to which managed access may be applicable” [540, Article 7.b].

11.27. Location

In the context of [540], the term ‘location’ usually means any geographical point or area described in the information supplied by a State or specified by the IAEA. (‘Location outside facilities’ and ‘other location’ have specialized meanings (see No. 5.25).)

11.28. Site

As defined in Article 18.b of [540], that area delimited by the State in the relevant design information for a facility, including a closed-down facility, and in the relevant information on a location outside facilities where nuclear material is customarily used, including a closed-down location outside facilities where nuclear material was customarily used (this is limited to locations with hot cells or where activities related to conversion, enrichment, fuel fabrication or reprocessing were carried out). It also includes all installations, collocated with the facility or location, for the provision or use of essential services, including: hot cells for processing irradiated materials not containing nuclear material; installations for the treatment, storage and disposal of waste; and buildings associated with specified activities identified by the State under Article 2.a(iv) of its additional protocol.

11.29. Place (on a site or location)

In the context of [540], the term ‘place’ usually means a smaller area or point on a site or location.

11.30. Advance notice of complementary access

Given by the IAEA to the State as provided for in Articles 4.b and 4.c of [540] and in connection with the implementation of complementary access under Article 5 of [540]. Advance notice for complementary access is at least 24 hours; except that for access to any place on a site that is sought in conjunction with design information verification visits or ad hoc or routine inspections on that site, the period of advance notice shall, if the IAEA so requests, be at least two hours but, in exceptional circumstances, it may be less than two hours. Advance notice shall be in writing and shall specify the reasons for access and the activities to be carried out during such access.

11.31. Complementary access activities

According to Article 6 of [540], the activities the IAEA inspector(s) may perform for complementary access depend on the type of location and include the following: visual observation; collection of environmental samples; utilization of radiation detection and measurement devices; application of seals and other identifying and tamper indicating devices specified in Subsidiary Arrangements; examination of records relevant to the quantities, origin and disposition of the material; collection of environmental samples; and other objective measures which have been demonstrated to be technically feasible and the use of which has been agreed by the IAEA Board of Governors and following consultations between the IAEA and the State.

12. SAFEGUARDS INFORMATION AND EVALUATION

The IAEA has available a broad range of information about States' nuclear programmes which it uses to perform safeguards State evaluations. These evaluations, and the independent review of their findings, are a key element of planning safeguards activities in a State and are fundamental to the process of deriving safeguards conclusions about the non-diversion of nuclear material placed under safeguards and, where appropriate, about the absence of undeclared nuclear material and activities in a State.

12.1. Safeguards information

Information relevant to IAEA safeguards implementation available to the IAEA from the following major sources:

(a) State supplied information, submitted pursuant to obligations under a safeguards agreement (e.g. nuclear material accounting reports (see No. 12.4) and design information (see No. 3.28)); under an additional protocol (e.g. declarations) (see No. 12.14); and on a voluntary basis (e.g. voluntary reports) (see No. 12.13).

(b) Information obtained by the IAEA through its verification activities conducted under a safeguards agreement (e.g. inspection results, verification of design information) (see No. 3.30), and its activities conducted under an additional protocol (e.g. complementary access) (see No. 11.25).

(c) Open source information (see No. 12.15) and other information available to the IAEA (e.g. through its activities in the areas of nuclear technology and applications such as databases on nuclear safety, nuclear waste and technical co-operation).

(d) Information from third parties, such as voluntarily provided export data and other safeguards relevant information.

12.2. Initial report

Under an INFCIRC/153-type safeguards agreement, an official statement by the State on all nuclear material subject to safeguards, which is to be provided to the IAEA within 30 days of the last day of the calendar month in which the agreement enters into force [153, para. 62]. From the initial report, the IAEA establishes a unified inventory of all nuclear material (irrespective of its origin) for the State and maintains this inventory on the basis of subsequent reports and its verification activities. Under an INFCIRC/66-type safeguards agreement, the first routine report (see No. 12.3) is considered equivalent to an initial report.

12.3. Routine report

Under an INFCIRC/66-type safeguards agreement, the set of accounting reports and operating reports made by the State to the IAEA [66, para. 39]. In accordance with para. 40 of [66], the first routine report is to be submitted as soon as there is any safeguarded nuclear material to be accounted for, or as soon as the nuclear facility to which it relates is in a condition to operate.

12.4. Accounting report

A report made by the State to the IAEA on the status of nuclear material subject to safeguards at a defined area and on the changes in that status since the previous report. Accounting reports are submitted by the State at times specified in the safeguards agreement or in the Subsidiary Arrangements (see No. 1.26). Under an INFCIRC/153-type safeguards agreement, reporting formats agreed between the State and the IAEA are described in Code 10 of the Subsidiary Arrangements.

Such safeguards agreements provide for three types of accounting report: inventory change reports, material balance reports and physical inventory listings (see Nos 12.5, 12.7 and 12.8, respectively). Provision for accounting reports under an INFCIRC/66-type agreement is made in para. 39(a) of [66].

12.5. Inventory change report (ICR)

An accounting report provided by the State to the IAEA "showing changes in the inventory of nuclear material. The reports shall be dispatched as soon as possible and in any event within 30 days after the end of the month in which the inventory changes occurred or were established" [153, para. 63(a)]. Further, "inventory change reports shall specify identification and batch data for each batch of nuclear material, the date of the inventory change and, as appropriate, the originating material balance area and the receiving material balance area or the recipient. These reports shall be accompanied by concise notes" [153, para. 64]. (See also No. 12.6.)

12.6. Concise notes

According to para. 64 of [153], information supplied by the State to the IAEA and accompanying inventory change reports (see No. 12.5) for the purposes of explaining the inventory changes (on the basis of the operating data contained in the operating records) and of describing the anticipated operational programme, particularly the taking of a physical inventory (see No. 6.41).

12.7. Material balance report (MBR)

An accounting report provided by the State to the IAEA "showing the material balance based on a physical inventory of nuclear material actually present in the material balance area. The reports shall be dispatched as soon as possible and in any event within 30 days after the physical inventory has been taken" [153, para. 63(b)]. According to para. 67 of [153], "the material balance reports shall include the following entries, unless otherwise agreed by the Agency and the State:

(a) Beginning physical inventory;
(b) Inventory changes (first increases, then decreases);
(c) Ending book inventory;
(d) Shipper/receiver differences;
(e) Adjusted ending book inventory;
(f) Ending physical inventory; and
(g) Material unaccounted for."

An MBR must be submitted even where there was no nuclear material in the material balance area at the time of the physical inventory taking and where no inventory changes occurred during the relevant material balance period, as long as the material balance area continues to be subject to IAEA safeguards.

12.8. Physical inventory listing (PIL)

A report provided by the State to the IAEA in connection with a physical inventory taking by the operator (see No. 6.41), "listing all batches separately and specifying material identification and batch data for each batch" [153, para. 67]. Such listings are to be attached to each material balance report (see No. 12.7) even where there was no nuclear material in the material balance area at the time of the ending physical inventory taking.

12.9. Operating report

A report by the State to the IAEA on the operation of a facility in connection with the use and handling of nuclear material. Operating reports are submitted for facilities safeguarded under INFCIRC/66-type safeguards agreements; the requirement is provided in para. 39(b) of [66].

12.10. Special report

In accordance with para. 68 of [153], a report by the State to the IAEA on the loss of nuclear material exceeding specified limits or in the event that containment and surveillance measures have been unexpectedly changed from those specified in the Subsidiary Arrangements (see No. 1.26). INFCIRC/66-type safeguards agreements also require special reports to be submitted in the event that a transfer of nuclear material results in a significant change in the inventory of a facility; the requirement is reflected in paras 42 and 43 of [66].

12.11. Notification of transfers

Under an INFCIRC/153-type safeguards agreement, a requirement for the State to inform the IAEA of international transfers of nuclear material, equipment and facilities. Paragraph 92 of [153] provides that any intended transfer out of the State of safeguarded nuclear material in an amount exceeding one effective kilogram, or by successive shipments to the same State within a period of three months each of less than one effective kilogram but exceeding in total one effective kilogram, shall be notified to the IAEA after the conclusion of the contractual arrangements leading to the transfer and normally at least two weeks before the nuclear material is to be prepared for shipping. The advance notification is to enable the IAEA, as necessary, to identify, and if possible to verify, nuclear material prior to the transfer. For transfers into the State, similar provisions for notification are included in paras 95 and 96 of [153]. In addition, the five nuclear weapon States (as defined by Article IX.3 of the NPT) that have a voluntary offer agreement with the IAEA have agreed to provide the IAEA with advance notification of transfers of nuclear material to non-nuclear-weapon States, as indicated in para. 1 of [207]. In the case of an INFCIRC/66-type safeguards agreement, the State is required to inform the IAEA of transfers of safeguarded nuclear material, equipment or facilities within the State to a facility not previously subject to safeguards.

12.12. Confirmation of transfers

Under an INFCIRC/153-type safeguards agreement, a requirement for the exporting State to make arrangements, if the nuclear material will not be subject to IAEA safeguards in the recipient State, for the IAEA to receive confirmation by the recipient State of the transfer [153, para. 94]. Further, the five nuclear weapon States (as defined by Article IX.3 of the NPT) that have a voluntary offer agreement with the IAEA have undertaken to provide the IAEA with such confirmations of transfers from non-nuclear-weapon States, as indicated in para. 2 of [207].

12.13. Voluntary reports on nuclear material, specified equipment and non-nuclear material

Information provided voluntarily to the IAEA by States participating in the voluntary reporting scheme (see No. 1.27). The information includes information on nuclear material not otherwise required to be reported under safeguards agreements, and information on the export and import of specified equipment and non-nuclear material. The list of the specified equipment and non-nuclear material is incorporated in Annex II of [540].

12.14. Declaration pursuant to an additional protocol

Information submitted to the IAEA by a State about its nuclear programme and related activities. Examples of such information are the research and development activities related to the State's nuclear fuel cycle (see No. 5.2), descriptions of buildings on sites, nuclear related manufacturing activities, and exports of specified equipment and non-nuclear material (see Nos 4.40 and 5.33).

12.15. Open source information

Information generally available to the public from external sources, such as scientific literature; official information; information issued by public organizations, commercial companies and the news media; and commercial satellite images.

12.16. Illicit Trafficking Database

An international database maintained by the IAEA in co-operation with participating Member States; it reflects all reported incidents of illicit trafficking in nuclear material and other radioactive sources.

12.17. IAEA Safeguards Information System (ISIS)

A computerized system for processing information in support of safeguards implementation, such as nuclear material accounting information, design information, inspection reports, authority files (defining installations, facilities and material balance areas) and management information.

12.18. IAEA confidentiality regime

The regime for the protection against unauthorized disclosure of all confidential information that the IAEA acquires, including such information coming to the IAEA's knowledge in the implementation of safeguards agreements and of additional protocols. The regime reflects the requirements for the protection of confidential information as provided under Article 15 of [540].

12.19. Safeguards State file

A collection of safeguards relevant information for a State, kept regularly up to date and used by the IAEA for safeguards State evaluations (see No. 12.20).

12.20. Safeguards State evaluation

A continuous process of evaluating all information available to the IAEA about a State's nuclear programme and related activities for the purposes of planning safeguards activities in the State and of drawing conclusions about the non-diversion of nuclear material placed under safeguards and about the absence of undeclared nuclear material and activities in the State (see No. 12.25). Evaluation is performed in three stages.

The first stage involves an initial evaluation of the nuclear programme of a State with a safeguards agreement in force, using all available information, for the purpose of drawing the conclusion about the non-diversion of nuclear material placed under safeguards. This evaluation provides a baseline for subsequent evaluations. The second stage follows the implementation of an additional protocol by a State and the IAEA's receipt of the initial Article 2 declaration; this evaluation is essential for drawing, for the first time, the conclusion about the absence of undeclared nuclear material and activities in a State. The third stage involves the subsequent continuous evaluation (with periodic reports) of the State's nuclear programme, during which earlier evaluation results are reassessed on the basis of any new information received under declarations, from IAEA activities performed within the State and from external sources. This ongoing evaluation is critical for maintaining the IAEA's ability to regularly reaffirm the conclusions of the non-diversion of nuclear material placed under safeguards and of the absence of undeclared nuclear material and activities drawn for the State. In all stages, the evaluation process includes identifying and conducting follow-up activities to address any need for clarification or resolution of questions and inconsistencies.

12.21. Physical model of a nuclear fuel cycle

A detailed overview of the nuclear fuel cycle (see No. 5.1), identifying, describing and characterizing every known technical process for converting nuclear source material to weapon usable material, and identifying each process in terms of the equipment, nuclear material and non-nuclear material involved. The physical model is used by the IAEA, inter alia, for acquisition path analysis (see No. 3.12) and for safeguards State evaluations (see No. 12.20).

12.22. Process indicator

A detectable sign of the existence or development of a particular technical process for accomplishing a nuclear or nuclear related activity in the nuclear fuel cycle (see No. 5.1). Process indicators include specially designed or nuclear related dual use equipment, nuclear and non-nuclear materials, technology, training, research activities, by-products or effluents and other observable features, such as special safety measures. Used by the IAEA for acquisition path analysis (see No. 3.12) and for safeguards State evaluations (see No. 12.20), certain process indicators are sometimes referred to as proliferation indicators.

12.23. Safeguards effectiveness evaluation

A process of evaluating the extent to which the IAEA's implementation of safeguards is able to achieve the safeguards objectives (see No. 2.1). Among the factors considered are the quantitative findings from implementation of nuclear material verification activities, as prescribed by the Safeguards Criteria (see No. 3.21), and the degree to which the IAEA inspection goal has been attained (see No. 3.22). In addition, the evaluation takes into account more qualitative safeguards relevant information available about the State's nuclear and nuclear related activities, including facility design information (see No. 3.28) and IAEA knowledge of facility operations.

12.24. Safeguards State evaluation report

An internal report documenting periodically the findings of the IAEA's safeguards evaluations performed for a State (see No. 12.20). The findings, to be documented in a State evaluation report, are independently reviewed by an IAEA interdepartmental information review committee.

12.25. Safeguards conclusions

Conclusions drawn by the IAEA on the basis of findings from its verification and evaluation activities (see No. 12.20). Safeguards conclusions are drawn for each State with a safeguards agreement in force, and, where appropriate, for a State with a comprehensive safeguards agreement (CSA) and an additional protocol based on [540] in force. These conclusions are reported collectively for States in the annual Safeguards Implementation Report (see No. 13.10).

For each State with a safeguards agreement in force, a conclusion is drawn relating to the non-diversion of nuclear material placed under safeguards (and, under an INFCIRC/66-type safeguards agreement, to the non-misuse of items specified and placed under safeguards). The conclusion also relates to the absence of undeclared production or separation of direct use material at reactors, reprocessing facilities, hot cells and/or enrichment installations under safeguards. Where there is no indication of diversion of the nuclear material (or of misuse of specified items) placed under safeguards or of undeclared production or separation of direct use material at declared facilities, the conclusion is drawn for the year concerned that the nuclear material and other items placed under safeguards remained in peaceful nuclear activities or were otherwise adequately accounted for.

For each State with a CSA and an additional protocol based on [540] in force, a broader conclusion can be drawn for the year concerned that all of the nuclear material in the State had been placed under safeguards and remained in peaceful nuclear activities or was otherwise adequately accounted for. To be able to draw this conclusion, the IAEA must draw the conclusions of both the non-diversion of the nuclear material placed under safeguards (as described above) and the absence of undeclared nuclear material and activities for the State as a whole. The conclusion of the absence of undeclared nuclear material and activities is drawn when the activities performed under an additional protocol have been completed, when relevant questions and inconsistencies have been addressed, and when no indications have been found by the IAEA that, in its judgement, would constitute a safeguards concern.

Note: The term ‘safeguards conclusions’, as used here, refers exclusively to the two conclusions drawn annually for States, as described above. These conclusions differ from the technical safeguards conclusions, which, according to para. 90(b) of [153], are drawn by the IAEA from its nuclear material verification activities for each material balance area over a material balance period and reported to the State concerned in a Statement on Conclusions (90(b) Statement), as defined in No. 13.3.

13. REPORTING ON SAFEGUARDS IMPLEMENTATION

The IAEA uses various mechanisms for reporting to the IAEA policy-making organs, individual Member States and the public on the implementation of safeguards activities pursuant to safeguards agreements and additional protocols.

13.1. Reporting on design information examination and verification

Under an INFCIRC/153-type safeguards agreement, the IAEA sends a formal letter to the State whenever the IAEA has performed design information examination and design information verification in that State (see Nos 3.29 and 3.30). The letter may include, if relevant, a request for any amplification, clarification or correction to the information submitted by the State. Under an INFCIRC/66-type safeguards agreement, para. 32 of [66] stipulates that the IAEA should complete its design review promptly and shall notify the State of its conclusions without delay.

13.2. Statement on Inspection Results (90(a) Statement)

Paragraph 90(a) of [153] provides that the IAEA is obliged to report formally to the State at specified intervals (usually after each inspection) on the activities carried out at each facility and their results, including any discrepancies found and whether they have been resolved. This statement on inspection results, which is referred to as a 90(a) Statement, is provided to a State that has an INFCIRC/153-type safeguards agreement in force; it is of a preliminary nature because evaluation activities may not have been completed.

13.3. Statement on Conclusions (90(b) Statement)

Paragraphs 30 and 90(b) of [153] provide that the IAEA is obliged to report formally to the State on the technical conclusions drawn from its nuclear material verification activities for each material balance area over a material balance period. This statement on conclusions, which is referred to as a 90(b) Statement, indicates, inter alia, the amount of material unaccounted for over a specific period, as verified by the IAEA (see No. 10.1). The statement is made as soon as possible after a physical inventory has been taken by the facility operator and verified by the IAEA and a material balance has been closed. If the issue of the statement is delayed because of a delay in receiving State reports or samples for destructive analysis, the IAEA notifies the State accordingly. This statement is provided to a State that has an INFCIRC/153-type safeguards agreement in force.

13.4. Book inventory statement

Under para. 66 of [153], the IAEA is obliged to provide the State with a semi-annual statement of book inventory subject to IAEA safeguards, for each material balance area (MBA), as based on the inventory change reports (see No. 12.5) for the period covered by each such statement; this statement is provided to a State that has an INFCIRC/153-type safeguards agreement in force. Under an INFCIRC/66-type safeguards agreement, the IAEA provides annual statements of inventory, reflecting the notifications and accounting reports received from the State. Book inventory statements do not imply verification by the IAEA of the data contained therein and are meant, inter alia, to be used by the SSAC to check for any differences with the accounting data maintained by the SSAC.

Note: Nuclear material transferred between two MBAs in the State continues to be listed by the IAEA, with respect to the shipping MBA, as 'material in transit' until it is reported to have been received in the receiving MBA.

13.5. Communication on domestic and international transfers

Prepared and dispatched by the IAEA to a State that has an INFCIRC/153-type safeguards agreement in force, indicating any unmatched shipments and receipts of nuclear material. Issued on a quarterly basis, each 'import communication' contains a list of those shipments to the State (as reported by other States) or those receipts in the State (as reported by the State itself) for which no match has been established. Import communications are meant to facilitate the interaction between the IAEA and the State so as to promptly resolve any unmatched transfers. The IAEA has also established 'de minimis quantities', set at approximately 0.002 significant quantities for each material type, below which any unmatched nuclear material amounts are considered negligible for the purpose of transit matching.

13.6. Statement on domestic and international transfers

Made semi-annually by the IAEA to a State that has an INFCIRC/153-type safeguards agreement in force. This statement covers, inter alia:

(a) Domestic and foreign shipments reported by the State which the IAEA has been unable to match with information on receipts reported by the State (for domestic transfers) or by other States (for exports from the State);

(b) Domestic receipts reported by the State and foreign receipts (imports) reported by other States which the IAEA has been unable to match with shipments reported by the State.

Note: Any nuclear material for which the IAEA has received a report from the shipping material balance area that the export of the material has occurred is placed on the 'export account' for the State until such time as the IAEA has received confirmation that the responsibility for the material has been assumed by the recipient State.

13.7. Statement of timeliness in reporting

The statement, which is also known as the statement on operation of report system, is provided by the IAEA semi-annually to each State that has an INFCIRC/153-type safeguards agreement in force, and includes information on any reporting delays. The statement is provided separately for each of the nuclear material accounting reports (i.e. inventory change report, material balance report and physical inventory listing) (see Nos 12.5, 12.7 and 12.8, respectively).

13.8. Reporting on inspections under an INFCIRC/66-type safeguards agreement

The IAEA provides a State with information, in the form of a letter, after each inspection carried out under an INFCIRC/66-type safeguards agreement. The letter informs the State of the results of the inspection, as foreseen under para. 12 of [39].

13.9. Statements under an additional protocol

Under Article 10 of [540], for a State with an additional protocol in force, the IAEA is obliged to inform the State as follows:

(a) To inform the State of the activities carried out under the additional protocol, including those in respect of any questions or inconsistencies the IAEA had brought to the attention of the State. This statement, which is referred to as a 10(a) Statement, is to be provided within 60 days of the activities being carried out [540, Article 10.a];

(b) To inform the State of the results of activities in respect of any questions or inconsistencies previously brought to the attention of the State. This statement, which is referred to as a 10(b) Statement, is to be provided as soon as possible but in any case within 30 days of the results being established by the IAEA [540, Article 10.b];

(c) To inform the State of the conclusions the IAEA has drawn from its activities under the additional protocol. This statement, which is referred to as a 10(c) Statement, is to be provided annually [540, Article 10.c].

13.10. Safeguards Implementation Report (SIR)

The main vehicle whereby the Director General of the IAEA reports to the IAEA Board of Governors on safeguards implementation in the preceding calendar year. The report includes, inter alia, the Safeguards Statement for the year concerned, in which the safeguards conclusions drawn for all States with safeguards agreements in force and, where applicable, additional protocols in force, are reported; where applicable, it also reports on any case of non-compliance of a State with its safeguards agreement.

13.11. IAEA Annual Report

The report submitted by the IAEA Board of Governors to the General Conference of the IAEA; it is available to the public. The report contains the Safeguards Statement for the year concerned (see No. 13.10), which has been approved by the IAEA Board of Governors; it also provides safeguards related reference material.

TRANSLATIONS OF TERMS

1. Legal Instruments and Other Documents Related to IAEA Safeguards
الصكوك القانونية وسائر الوثائق المتعلقة بضمانات الوكالة الدولية للطاقة الذرية
与原子能机构保障有关的法律文书和其他文件
Instruments juridiques et autres documents concernant les garanties de l'AIEA
Международно-правовые и другие документы, относящиеся к гарантиям МАГАТЭ
Instrumentos jurídicos y otros documentos relacionados con las salvaguardias del OIEA
Gesetzliche Grundlage für die IAEO-Sicherungsmaßnahmen und andere sachbezogene Dokumente
ＩＡＥＡ保障措置に関連する法的文書及びその他の文書

1.1. Statute of the International Atomic Energy Agency
النظام الأساسي للوكالة الدولية للطاقة الذرية
国际原子能机构规约
Statut de l'Agence internationale de l'énergie atomique
Устав Международного агентства по атомной энергии
Estatuto del Organismo Internacional de Energía Atómica
Die Satzung der Internationalen Atomenergie-Organisation
国際原子力機関憲章

1.2. Treaty on the Non-Proliferation of Nuclear Weapons (Non-Proliferation Treaty, NPT)
معاهدة عدم انتشار الأسلحة النووية (معاهدة عدم الانتشار)
不扩散核武器条约（不扩散条约，NPT）
Traité sur la non-prolifération des armes nucléaires (Traité sur la non-prolifération, TNP)
Договор о нераспространении ядерного оружия (Договор о нераспространении, ДНЯО)
Tratado sobre la no proliferación de las armas nucleares (Tratado sobre no proliferación, TNP)
Vertrag über die Nichtverbreitung von Kernwaffen
核兵器の不拡散に関する条約（核不拡散条約、ＮＰＴ）

1.3. Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (Tlatelolco Treaty)
معاهدة حظر الأسلحة النووية في أمريكا اللاتينية ومنطقة البحر الكاريبي (معاهدة تلاتيلولكو)
拉丁美洲和加勒比地区禁止核武器条约（特拉特洛尔科条约）

Traité visant l'interdiction des armes nucléaires en Amérique latine et dans les Caraïbes (Traité de Tlatelolco)
Договор о запрещении ядерного оружия в Латинской Америке и Карибском бассейне (Договор Тлателолко)
Tratado para la Proscripción de las Armas Nucleares en la América Latina y el Caribe (Tratado de Tlatelolco)
Vertrag von Tlatelolco über das Verbot von Kernwaffen in Lateinamerika und der Karibik
ラテンアメリカ及びカリブ諸国における核兵器禁止条約（トラテロルコ条約）

1.4. South Pacific Nuclear Free Zone Treaty (Rarotonga Treaty)
معاهدة انشاء منطقة خالية من الأسلحة النووية في جنوب المحيط الهادئ (معاهدة راروتونغا)
南太平洋无核武器区条约（拉罗汤加条约）
Traité sur la zone dénucléarisée du Pacifique Sud (Traité de Rarotonga)
Договор о безъядерной зоне в южной части Тихого океана (Договор Раротонга)
Tratado sobre la Zona Libre de Armas Nucleares del Pacífico Sur (Tratado de Rarotonga)
Vertrag von Rarotonga über die Kernwaffen-freie Zone im Süd-Pazifik
南太平洋非核兵器地帯条約（ラロトンガ条約）

1.5. Treaty on the Southeast Asia Nuclear Weapon-Free Zone (Bangkok Treaty)
معاهدة انشاء منطقة خالية من الأسلحة النووية في جنوب شرق آسيا (معاهدة بانكوك)
东南亚无核武器区条约（曼谷条约）
Traité sur la zone exempte d'armes nucléaires de l'Asie du Sud-Est (Traité de Bangkok)
Договор о безъядерной зоне в Юго-Восточной Азии (Бангкокский договор)
Tratado sobre el establecimiento de una zona libre de armas nucleares en Asia sudoriental (Tratado de Bangkok)
Vertrag von Bangkok über die Kernwaffen-freie Zone in Südost-Asien
東南アジア非核兵器地帯条約（バンコク条約）

1.6. African Nuclear-Weapon-Free Zone Treaty (Pelindaba Treaty)
معاهدة إنشاء منطقة خالية من الأسلحة النووية في أفريقيا (معاهدة بيليندابا)
非洲无核武器区条约（佩林达巴条约 ）
Traité sur une zone exempte d'armes nucléaires en Afrique (Traité de Pelindaba)
Договор о создании зоны, свободной от ядерного оружия, в Африке (Пелиндабский договор)

Tratado sobre una zona libre de armas nucleares en África (Tratado de Pelindaba)
Vertrag von Pelindaba über die Kernwaffen-freie Zone in Afrika
アフリカ非核兵器地帯条約（ペリンダバ条約）

1.7. Agreement between the Republic of Argentina and the Federative Republic of Brazil for the Exclusively Peaceful Use of Nuclear Energy (Guadalajara Declaration)
الاتفاق المبرم بين جمهورية الأرجنتين وجمهورية البرازيل الاتحادية من أجل قصر استخدام الطاقة النووية على الأغراض السلمية (إعلان غوادالاخارا)
阿根廷共和国和巴西联邦共和国关于核能仅用于和平利用的协定（瓜达拉哈拉宣言）
Accord entre la République argentine et la République fédérative du Brésil pour l’utilisation exclusivement pacifique de l’énergie nucléaire (Déclaration de Guadalajara)
Соглашение между Аргентинской Республикой и Федеративной Республикой Бразилией об исключительно мирном использовании ядерной энергии (Гвадалахарская декларация)
Acuerdo entre la República Argentina y la República Federativa del Brasil para el uso exclusivamente pacífico de la energía nuclear (Declaración de Guadalajara)
Übereinkommen von Guadalajara zwischen Argentinien und Brasilien über die ausschließlich friedliche Nutzung (Anwendung) der Kernenergie
原子力の平和利用限定に関するアルゼンチン共和国及びブラジル連邦共和国との間の協定（グアダラハラ宣言）

1.8. Treaty Establishing the European Atomic Energy Community (Euratom Treaty)
معاهدة إنشاء الجماعة الأوروبية للطاقة الذرية (معاهدة اليوراتوم)
欧洲原子能联营条约（EURATOM 条约）
Traité instituant la Communauté européenne de l’énergie atomique (Traité Euratom)
Договор о создании Европейского сообщества по атомной энергии (Договор о Евратоме)
Tratado por el que se establece la Comunidad Europea de Energía Atómica (Tratado de la EURATOM)
Euratom-Vertrag (Vertrag zur Gründung der Europäischen Atomgemeinschaft)
欧州原子力委員会設立条約（ユーラトム条約）

1.9. Bilateral co-operation agreement
اتفاق تعاوني ثنائي
双边合作协定
Accord bilatéral de coopération

Двустороннее соглашение о сотрудничестве
Acuerdo bilateral de cooperación
Zweiseitiges Kooperationsabkommen
二国間協力協定

1.10. **Project and supply agreement**
اتفاق مشاريع و امدادات
项目和供应协定
Accord de projet et de fourniture
Соглашение о проекте и поставках
Acuerdo de suministro y sobre el proyecto
Vereinbarung über ein Projektvorhaben oder eine Lieferung
プロジェクト及び供給協定

1.11. **Revised supplementary agreement relevant to safeguards**
اتفاق تكميلي منقح متعلق بالضمانات
有关保障的修订补充协定
Accord complémentaire révisé concernant les garanties
Пересмотрениое дополнительное соглашение, относящееся к гарантиям
Acuerdo suplementario revisado sobre la aplicación de salvaguardias
Zusatzabkommen über die Anwendung von Sicherungsmaßnahmen
保障措置に関連する改訂補足協定

1.12. **The Agency's Inspectorate**
موظفو هيئة التفتيش التابعة للوكالة
机构视察人员职责
Corps des inspecteurs de l'Agence
Инспекторат Агентства
Personal de inspección del Organismo
Das Inspektorat der IAEO
機関（ＩＡＥＡ）査察当局

1.13. **The Agency's Safeguards System (1965, as Provisionally Extended in 1966 and 1968)**
نظام ضمانات الوكالة (1965، حسبما مدد مؤقتا في 1966 و 1968)
机构的保障体系（1965 年，1966 年和 1968 年临时扩充）
Le système de garanties de l'Agence (1965, provisoirement étendu en 1966 et 1968)
Система гарантий Агентства (1965 год, с временным продлением в 1966 и1968 годах)
Sistema de salvaguardias del Organismo (1965, ampliado provisionalmente en 1966 y 1968)

Das (ursprüngliche) System der Sicherungsmaßnahmen der Internationalen Atomenergie-Organisation von 1965 (und dessen vorläufige Ergänzungen von 1966 und 1988)
機関（ＩＡＥＡ）保障措置システム（1965 年、1966 年及び 1968 年に暫定的に拡張）

1.14. The Structure and Content of Agreements between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons
هيكل ومحتوى الاتفاقات المعقودة بين الوكالة والدول اللازمة في إطار معاهدة عدم انتشار الأسلحة النووية
根据《不扩散核武器条约》的要求机构与各国之间的协定的结构和内容
Structure et contenu des accords à conclure entre l'Agence et les États dans le cadre du Traité sur la non-prolifération des armes nucléaires
Структура и содержание соглашений между Агентством и государствами, требуемых в связи с Договором о нераспространении ядерного оружия
Estructura y contenido de los acuerdos entre Estados y el Organismo requeridos en relación con el Tratado sobre la no proliferación de las armas nucleares
Dokument über Struktur und Inhalt von Übereinkommen zwischen der IAEO und Staaten gemäß den Erfordernissen des Vertrags über die Nichtverbreitung von Kernwaffen
核兵器の不拡散に関する条約に関連して要求される機関（ＩＡＥＡ）と各国との間の協定の構成及び内容

1.15. Model Protocol Additional to the Agreement(s) between State(s) and the International Atomic Energy Agency for the Application of Safeguards
نموذج بروتوكول إضافي للاتفاق (الاتفاقات) المعقود (المعقودة) بين الدولة (الدول) والوكالة الدولية للطاقة الذرية لتطبيق الضمانات
各国与国际原子能机构关于实施保障的协定的附加议定书范本
Modèle de protocole additionnel à l'accord (aux accords) entre un État (des États) et l'Agence internationale de l'énergie atomique relatif(s) à l'application de garanties
Типовой дополнительный протокол к соглашению(ям) между государством(ами) и Международным агентством по атомной энергии о применении гарантий
Modelo de Protocolo adicional al acuerdo de salvaguardias entre el (los) Estado(s) y el Organismo Internacional de Energía Atómica para la aplicación de salvaguardias
Modell des Zusatzprotokolls zum Übereinkommen zwischen der IAEO und Staaten zur Anwendung von Sicherungsmaßnahmen

保障措置の適用のための国と国際原子力機関との間の協定に追加するモデル議定書

1.16. **Agreement on the Privileges and Immunities of the IAEA**
اتفاق امتيازات وحصانات الوكالة الدولية للطاقة الذرية
原子能机构特权和豁免协定
Accord sur les privilèges et immunités de l’AIEA
Соглашение о привилегиях и иммунитетах МАГАТЭ
Acuerdo sobre Privilegios e Inmunidades del OIEA
Vereinbarung über die Vorrechte und Befreiungen der IAEO
ＩＡＥＡ（国際原子力機関）の特権及び免除に関する協定

1.17. **Safeguards agreement**
اتفاق ضمانات
保障协定
Accord de garanties
Соглашение о гарантиях
Acuerdo de salvaguardias
(Sicherungsabkommen) Übereinkommen über Sicherungsmaßnahmen
保障措置協定

1.18. **INFCIRC/153-type safeguards agreement**
INFCIRC/153 اتفاق ضمانات من النوع
INFCIRC/153 型保障协定
Accord de garanties du type INFCIRC/153
Соглашение о гарантиях на основе документа INFCIRC/153
Acuerdo de salvaguardias tipo INFCIRC/153
Übereinkommen über Sicherungsmaßnahmen nach dem INFCIRC/153-Modell
ＩＮＦＣＩＲＣ／１５３型保障措置協定

1.19. **Comprehensive safeguards agreement (CSA)**
اتفاق ضمانات شاملة
全面保障协定（CSA）
Accord de garanties généralisées (AGG)
Соглашение о всеобъемлющих гарантиях (СВГ)
Acuerdo de salvaguardias amplias (ASA)
(Umfassendes Sicherungsabkommen) Übereinkommen über umfassende Sicherungsmaßnahmen
包括的保障措置協定（ＣＳＡ）

1.20. **INFCIRC/66-type safeguards agreement**
INFCIRC/66 اتفاق ضمانات من النوع

INFCIRC/66 型保障协定
Accord de garanties du type INFCIRC/66
Соглашение о гарантиях на основе документа INFCIRC/66
Acuerdo de salvaguardias tipo INFCIRC/66
Sicherungsabkommen nach dem INFCIRC/66-Modell
ＩＮＦＣＩＲＣ／６６型保障措置協定

1.21. Voluntary offer agreement
اتفاق ضمانات طوعي
自愿提交协定
Accord de soumission volontaire
Соглашение о добровольной постановке под гарантии
Acuerdo de ofrecimiento voluntario
Übereinkommen über die freiwillige Anwendung von Sicherungsmaßnahmen
自発的提供協定

1.22. Additional protocol
بروتوكول اضافي
附加议定书
Protocole additionnel
Дополнительный протокол
Protocolo adicional
Zusatzprotokoll zum Übereinkommen über Sicherungsmaßnahmen
追加議定書

1.23. Small quantities protocol (SQP)
بروتوكول كميات صغيرة
小数量议定书（SQP）
Protocole relatif aux petites quantités de matières (PPQM)
Протокол о малых количествах (SQP)
Protocolo sobre pequeñas cantidades (PPC)
Protokoll betreffend geringe Mengen
少量議定書（ＳＱＰ）

1.24. Suspension protocol
بروتوكول تعليق
暂停实施议定书
Protocole de suspension
Протокол о приостановлении
Protocolo de suspensión
Protokoll über Bestimmungen zur Aufhebung eines Übereinkommens
停止議定書

1.25. Co-operation protocol
بروتوكول تعاون
合作议定书
Protocole de coopération
Протокол о сотрудничестве
Protocolo de cooperación
Protokoll über die Zusammenarbeit
協力議定書

1.26. Subsidiary Arrangements
اتفاقات فرعية
辅助安排
Arrangements subsidiaires
Дополнительные положения
Arreglos subsidiarios
Ergänzende Vereinbarungen
補助取決め

1.27. Voluntary reporting scheme on nuclear material and specified equipment and non-nuclear material
نظام التبليغ الطوعي عن مواد نووية ومعدات محددة وعن مواد غير نووية
关于核材料和规定设备及非核材料的自愿报告机制
Dispositif de déclaration volontaire des matières nucléaires et des équipements et matières non nucléaires spécifiés
Схема добровольной отчетности о ядерном материале и согласованном оборудовании и неядерном материале
Mecanismo de notificación voluntaria de materiales nucleares y equipo y materiales no nucleares especificados
Freiwillige Berichterstattung zu speziellen Ausrüstungen und nicht-nuklearen Materialien
核物質並びに特定の機器及び非核物質に関する自発的報告スキーム（体制）

1.28. Zangger Committee Export Guidelines
المبادئ التوجيهية للتصدير الصادرة عن لجنة تزانغر
桑戈委员会出口准则
Directives du Comité Zangger sur les exportations
Руководящие принципы Комитета Цангера по экспорту
Directrices del Comité Zangger sobre exportaciones
Ausfuhrrichtlinien des Zangger Komitees
ザンガー委員会輸出ガイドライン

1.29. Nuclear Suppliers' Group Guidelines
المبادئ التوجيهية لمجموعة الموردين النوويين

核供应者集团准则
Directives du Groupe des fournisseurs nucléaires
Руководящие принципы Группы ядерных поставщиков
Directrices del Grupo de Suministradores Nucleares
Richtlinien der Nuklearlieferantengruppe
原子力供給国グループガイドライン

1.30. Guidelines for the Management of Plutonium
المبادئ التوجيهية لادارة البلوتونيوم
钚管理准则
Directives relatives à la gestion du plutonium
Руководящие принципы по обращению с плутонием
Directrices para la gestión del plutonio
Richtlinien für die Handhabung von Plutonium
プルトニウム管理ガイドライン

1.31. Physical protection recommendations
توصيات الحماية المادية
实物保护建议
Recommandations relatives à la protection physique
Рекомендации по физической защите
Recomendaciones sobre protección física
Empfehlungen zum physischen Schutz
核物質防護勧告

2. IAEA Safeguards: Purpose, Objectives and Scope
ضمانات الوكالة الدولية للطاقة الذرية: غرضها وغاياتها ونطاقها
原子能机构保障：目的、目标和范围
Garanties de l'AIEA: objet, objectifs et portée
Гарантии МАГАТЭ: Политическая цель, технические цели и сфера охвата
Salvaguardias del OIEA: Finalidad, objetivos y alcance
IAEO-Sicherungsmaßnahmen: Zweck, Ziele und Anwendungsbereich
ＩＡＥＡ保障措置：目的、対象及び範囲

2.1. Objectives of IAEA safeguards
غايات ضمانات الوكالة الدولية للطاقة الذرية
原子能机构保障的目标
Objectifs des garanties de l'AIEA
Цели гарантий МАГАТЭ
Objetivos de las salvaguardias del OIEA
Ziele der IAEO-Sicherungsmaßnahmen
ＩＡＥＡ保障措置の目的

2.2. Non-compliance

عدم الامتثال

违约行为

Non-respect

Несоблюдение

Incumplimiento

Vertragsverletzung

違反

2.3. Diversion of nuclear material

تحريف المواد النووية

核材料转用

Détournement de matières nucléaires

Переключение ядерного материала

Desviación de materiales nucleares

Abzweigung von Kernmaterial

核物質の転用

2.4. Misuse

اساءة الاستخدام

滥用

Utilisation abusive

Использование не по назначению

Uso indebido

Mißbrauch

不正使用

2.5. Undeclared nuclear material and activities

مواد وأنشطة نووية غير معلنة

未申报核材料和核活动

Matières et activités nucléaires non déclarées

Незаявленные ядерные материал и деятельность

Materiales y actividades nucleares no declarados

Nicht-deklariertes Kernmaterial und nicht-deklarierte Tätigkeiten

未申告の核物質及び原子力活動

2.6. Undeclared facility or location outside facilities (LOF)

مرفق غير معلن أو موقع خارج المرافق غير معلن

未申报设施或设施外场所（LOF）

Installation ou emplacement hors installation (EHI) non déclaré

Незаявленная установка или место нахождения вне установок (МВУ)

Instalación o lugar situado fuera de las instalaciones (LFI) no declarado

Nicht-deklarierte Anlage oder nicht-deklarierter Bereich außerhalb von Anlagen
未申告の施設または施設外の場所（ＬＯＦ

2.7. Deterrence of diversion
ردع التحريف
遏制转用
Dissuasion de détournement
Сдерживание переключения
Disuasión de la desviación
Abschreckung der Abzweigung
転用の抑止

2.8. Assurance of non-diversion of nuclear material
توكيد عدم تحريف مواد نووية
核材料不被转用的保证
Assurance quant au non-détournement de matières nucléaires
Уверенность в непереключении ядерного материала
Garantía acerca de la no desviación de materiales nucleares
Bestätigung der Nicht-Abzweigung von Kernmaterial
核物質の転用がないことの保証

2.9. Assurance of the absence of undeclared nuclear material and activities
توكيد عدم وجود مواد وأنشطة نووية غير معلنة
不存在未申报核材料和核活动的保证
Assurance quant à l'absence de matières et d'activités nucléaires non déclarées
Уверенность в отсутствии незаявленных ядерных материала и деятельности
Garantía acerca de la ausencia de materiales y actividades nucleares no declarados
Bestätigung der Abwesenheit nicht-deklarierten nuklearen Kernmaterials und nicht-deklarierter Tätigkeiten
未申告の核物質及び原子力活動が存在しないことの保証

2.10. Coverage of IAEA safeguards
نطاق تطبيق ضمانات الوكالة الدولية للطاقة الذرية
原子能机构保障的范围
Portée des garanties de l'AIEA
Охват гарантиями МАГАТЭ
Alcance de las salvaguardias del OIEA
Anwendungsbereich von IAEO-Sicherungsmaßahmen
ＩＡＥＡ保障措置の範囲

2.11. Starting point of IAEA safeguards
نقطة بداية ضمانات الوكالة الدولية للطاقة الذرية
原子能机构保障的起点
Point de départ de l’application des garanties de l’AIEA
Начальная точка применения гарантий МАГАТЭ
Punto inicial de las salvaguardias del OIEA
Startpunkt der IAEO-Sicherungsmaßnahmen
ＩＡＥＡ保障措置の開始点

2.12. Termination of IAEA safeguards
رفع ضمانات الوكالة الدولية للطاقة الذرية
原子能机构保障的终止
Levée des garanties de l’AIEA
Прекращение гарантий МАГАТЭ
Terminación de la aplicación de las salvaguardias del OIEA
Beendigung der IAEO-Sicherungsmaßnahmen
ＩＡＥＡ保障措置の終了

2.13. Exemption from IAEA safeguards
الاعفاء من ضمانات الوكالة الدولية للطاقة الذرية
原子能机构保障的免除
Exemption des garanties de l’AIEA
Освобождение от гарантий МАГАТЭ
Exención de la aplicación de las salvaguardias del OIEA
Befreiung von den IAEO-Sicherungsmaßnahmen
ＩＡＥＡ保障措置の免除

2.14. Non-application of IAEA safeguards
عدم تطبيق ضمانات الوكالة الدولية للطاقة الذرية
不实施原子能机构的保障
Non-application des garanties de l’AIEA
Неприменение гарантий МАГАТЭ
No aplicación de las salvaguardias del OIEA
Nichtanwendung der IAEO-Sicherungsmaßnahmen
ＩＡＥＡ保障措置の適用除外

2.15. Suspension of IAEA safeguards
تعليق ضمانات الوكالة الدولية للطاقة الذرية
原子能机构保障的中止
Suspension des garanties de l’AIEA
Приостановление гарантий МАГАТЭ
Suspensión de la aplicación de las salvaguardias del OIEA
Suspendierung (Aussetzung) der IAEO-Sicherungsmaßnahmen
ＩＡＥＡ保障措置の停止

2.16. Substitution

الاحلال

替代

Substitution

Замещение

Sustitución

Substituierung (Ersetzung)

置換

3. Safeguards Approaches, Concepts and Measures

النهوج والمفاهيم والتدابير الرقابية

保障方案、概念和措施

Méthodes de contrôle, concepts et mesures

Подходы к применению, концепции и меры гарантий

Enfoques, conceptos y medidas de salvaguardias

Sicherungsmaßnahmen: Konzepte, Ansätze, Einzelmaßnahmen

保障措置アプローチ、概念及び手段

3.1. Safeguards approach

النهج الرقابي

保障方案

Méthode de contrôle

Подход к применению гарантий

Enfoque de salvaguardias

Konzept für Sicherungsmaßnahmen

保障措置アプローチ

3.2. Model (generic) facility safeguards approach

نموذج (عام) للنهج الرقابي الخاص بنوع معين من المرافق

标准的（通用）设施保障方案

Méthode type (générique) de contrôle d'installations

Модельный (обобщенный) подход к применению гарантий на установке

Enfoque modelo (genérico) de salvaguardias para instalaciones

Modell eines (grundlegenden) Konzepts für Sicherungsmaßnahmen in einem Anlagentyp

モデル（一般的）施設保障措置アプローチ

3.3. Facility safeguards approach

النهج الرقابي الخاص بمرفق معين

设施的保障方案

Méthode de contrôle d'une installation

Подход к применению гарантий на [конкретной] установке

Enfoque de salvaguardias para instalaciones
Anlagenspezifisches Konzept für Sicherungsmaßnahmen
施設保障措置アプローチ

3.4. State level safeguards approach
النهج الرقابي الخاص بدولة معينة
国家一级保障方案
Méthode de contrôle au niveau de l'État
Подход к применению гарантий на уровне государства
Enfoque de salvaguardias a nivel de los Estados
Konzept für Sicherungsmaßnahmen auf Staatsebene
国レベル保障措置アプローチ

3.5. Integrated safeguards
الضمانات المتكاملة
一体化保障
Garanties intégrées
Комплексные гарантии
Salvaguardias integradas
Integriertes System von Sicherungsmaßnahmen
統合保障措置

3.6. Safeguards measures
التدابير الرقابية
保障措施
Mesures de contrôle
Меры гарантий
Medidas de salvaguardias
Sicherungsmaßnahmen
保障措置手段

3.7. Diversion strategy (diversion path)
استراتيجية التحريف (مسار التحريف)
转用策略（转用途径）
Stratégie de détournement (voie de détournement)
Стратегия переключения (путь переключения)
Estrategia de desviación (ruta de desviación)
Abzweigungsstrategie (Abzweigungspfad)
転用戦略（転用経路）

3.8. Acquisition strategy (acquisition path)
استراتيجية الاقتناء (مسار الاقتناء)
获取策略（获取途径）
Stratégie d'acquisition (voie d'acquisition)

Стратегия приобретения (путь приобретения)
Estrategia de adquisición (ruta de adquisición)
Beschaffungsstrategie (Beschaffungspfad)
入手戦略（入手経路）

3.9. Concealment methods
أساليب الاخفاء
弄虚作假的方法
Méthodes de dissimulation
Методы сокрытия
Métodos de encubrimiento
Verschleierungsmethoden
隠ぺい手段

3.10. Diversion rate
معدل التحريف
转用速度
Quantité détournée par unité de temps
Интенсивность переключения
Tasa de desviación
Abzweigungsrate
転用速度

3.11. Diversion path analysis
تحليل مسار التحريف
转用途径分析
Analyse des voies de détournement
Анализ путей переключения
Análisis de las rutas de desviación
Abzweigungspfad-Analyse
転用経路分析

3.12. Acquisition path analysis
تحليل مسار الاقتناء
获取途径分析
Analyse des voies d’acquisition
Анализ путей приобретения
Análisis de las rutas de adquisición
Beschaffungspfad-Analyse
入手経路分析

3.13. Conversion time
زمن التحويل
转化时间

Délai de conversion
Время конверсии
Tiempo de conversión
Konversionszeit
転換時間

3.14. Significant quantity (SQ)
كمية معنوية
重要量（SQ）
Quantité significative (QS)
Значимое количество (ЗК)
Cantidad significativa (CS)
Signifikante Menge
有意量（ＳＱ）

3.15. Detection time
زمن الكشف
探知时间
Délai de détection
Время обнаружения
Tiempo de detección
Entdeckungszeit
探知（検知）時間

3.16. Detection probability
احتمال الكشف
探知概率
Probabilité de détection
Вероятность обнаружения
Probabilidad de detección
Entdeckungswahrscheinlichkeit
探知（検知）確率

3.17. False alarm probability
احتمال الانذار الكاذب
假报警概率
Probabilité de fausse alerte
Вероятность ложного сигнала
Probabilidad de falsa alarma
Fehlalarm-Wahrscheinlichkeit
誤警報確率

3.18. Inventory
الرصيد

存量清单
Stock
Инвентарное количество
Inventario
Bestand
在庫

3.19. Annual throughput
الخرج السنوي
年通过量
Débit annuel
Годовая производительность
Caudal anual de material (nuclear)
Jährlicher Durchsatz
年間移転（処理）量

3.20. IAEA timeliness detection goal
زمن الكشف المستهدف طبقا للوكالة الدولية للطاقة الذرية
原子能机构探知及时性指标
Objectif de l’AIEA pour les délais de détection
Цель своевременности обнаружения МАГАТЭ
Meta de oportunidad del OIEA respecto de la detección
IAEO-Ziel für Rechtzeitigkeit der Entdeckung
ＩＡＥＡ適時性探知（検知）目標

3.21. Safeguards Criteria
المعايير الرقابية
保障标准
Critères des garanties
Критерии гарантий
Criterios de salvaguardias
Kriterien für Sicherungsmaßnahmen
保障措置クライテリア

3.22. IAEA inspection goal
هدف التفتيش طبقا للوكالة الدولية للطاقة الذرية
原子能机构视察指标
Objectif des inspections de l’AIEA
Цель инспекций МАГАТЭ
Meta de inspección del OIEA
Inspektionsziel der IAEO
ＩＡＥＡ査察目標

3.23. Quantity component of the IAEA inspection goal
مكون الكمية في هدف التفتيش طبقا للوكالة الدولية للطاقة الذرية
原子能机构视察指标的数量部分
Composante quantitative de l'objectif des inspections de l'AIEA
Количественный компонент цели инспекций МАГАТЭ
Componente de cantidad de la meta de inspección del OIEA
Mengenkomponente des IAEO-Inspektionszieles
ＩＡＥＡ査察目標の量的要素

3.24. Timeliness component of the IAEA inspection goal
مكون التوقيت في هدف التفتيش طبقا للوكالة الدولية للطاقة الذرية
原子能机构视察指标的及时性部分
Composante temporelle de l'objectif des inspections
Компонент своевременности цели инспекций МАГАТЭ
Componente de oportunidad de la meta de inspección del OIEA
Rechtzeitigkeitskomponente des IAEO-Inspektionszieles
ＩＡＥＡ査察目標の適時性要素

3.25. Discrepancy
حالة تضارب
不符合
Écart
Расхождение
Discrepancia
Diskrepanz
不一致

3.26. Anomaly
حالة شاذة
异常
Anomalie
Аномалия
Anomalía
Anomalie
異常

3.27. Facility practices
الممارسات الخاصة بالمرفق
设施运营者的习惯做法
Pratiques de l'installation
Практика работы на установке
Prácticas de gestión de las instalaciones
Betriebspraxis
施設の慣行（実務）

3.28. **Design information**
المعلومات التصميمية
设计资料
Renseignements descriptifs
Информация о конструкции
Información sobre el diseño
Grundlegende technische Merkmale
設計情報

3.29. **Design information examination (DIE)**
فحص المعلومات التصميمية
设计资料的审查（DIE）
Examen des renseignements descriptifs
Изучение информации о конструкции (DIE)
Examen de la información sobre el diseño (EID)
Prüfung der grundlegenden technischen Merkmale
設計情報検査（ＤＩＥ）

3.30. **Design information verification (DIV)**
التحقق من المعلومات التصميمية
设计资料的核实（DIV)
Vérification des renseignements descriptifs
Проверка информации о конструкции (DIV)
Verificación de la información sobre el diseño (VID)
Verifikation (Nachprüfung) der grundlegenden technischen Merkmale
設計情報検認（ＤＩＶ）

3.31. **Design information verification plan (DIVP)**
خطة التحقق من المعلومات التصميمية
设计资料核实计划（DIVP）
Plan de vérification des renseignements descriptifs
План проверки информации о конструкции (DIVP)
Plan de verificaciones de la información sobre el diseño (PVID)
Plan zur Verifikation (Nachprüfung) der grundlegenden technischen Merkmale
設計情報検認計画（ＤＩＶＰ）

3.32. **Essential equipment list (EEL)**
قائمة المعدات الأساسية
重要设备清单（EEL）
Liste des équipements essentiels
Список ключевого оборудования (EEL)
Lista de equipo esencial (LEE)

Liste der wesentlichen Ausrüstungen
必須機器リスト（ＥＥＬ）

3.33. State system of accounting for and control of nuclear material (SSAC)
النظام الحكومي لحصر ومراقبة المواد النووية
国家核材料衡算和控制系统（SSAC）
Système national de comptabilité et de contrôle des matières nucléaires (SNCC)
Государственная система учета и контроля ядерного материала (ГСУК)
Sistema nacional de contabilidad y control de materiales nucleares (SNCC)
Nationales Buchführungs- und Kontrollsystem für Kernmaterial (SSAC)
国内核物質計量管理制度（システム）（ＳＳＡＣ）

3.34. Regional system of accounting for and control of nuclear material (RSAC)
النظام الاقليمي لحصر ومراقبة المواد النووية
地区核材料衡算和控制系统（RSAC）
Système régional de comptabilité et de contrôle des matières nucléaires (SRCC)
Региональная система учета и контроля ядерного материала (РСУК)
Sistema regional de contabilidad y control de materiales nucleares (SRCC)
Regionales Buchführungs- und Kontrollsystem für Kernmaterial (RSAC)
地域核物質計量管理制度（システム）（ＲＳＡＣ）

3.35. New partnership approach (NPA)
نهج الشراكة الجديدة
新伙伴关系方案（NPA）
Nouvelle formule de partenariat (NFP)
Новый принцип партнерства (НПП)
Nuevo enfoque de cooperación (NEC)
Neuer Partnerschaftlicher Ansatz
ニュー　パートナーシップ　アプローチ（ＮＰＡ）

3.36. Safeguards quality assurance
توكيد جودة الضمانات
保障的质量保证
Assurance de la qualité des garanties
Обеспечение качества гарантий
Garantía de calidad de las salvaguardias
Qualitätssicherung bei Sicherungsmaßnahmen
保障措置品質保証

4. Nuclear and Non-Nuclear Material

المواد النووية وغير النووية
核材料和非核材料
Matières nucléaires et non nucléaires
Ядерный и неядерный материал
Materiales nucleares y no nucleares
Nukleares und nicht-nukleares Material
核物質及び非核物質

4.1. Nuclear material

مادة نووية
核材料
Matière nucléaire
Ядерный материал
Materiales nucleares
Kernmaterial (nukleares Material)
核物質

4.2. Nuclide

نويدة
核素
Nucléide
Нуклид
Nucleido
Nuklid
核種

4.3. Isotope

نظير
同位素
Isotope
Изотоп
Isótopo
Isotop
同位体

4.4. Source material

مادة مصدرية
源材料
Matière brute
Исходный материал
Material básico
Ausgangsmaterial
原料物質

4.5. Special fissionable material
مادة انشطارية خاصة
特种可裂变材料
Produit fissile spécial
Специальный расщепляющийся материал
Material fisionable especial
Besonderes spaltbares Material
特殊核分裂性物質

4.6. Fissionable material
مادة انشطارية
可裂变材料
Matière fissile
Расщепляющийся материал
Material fisionable
Spaltbares Material
核分裂性物質

4.7. Fertile material
مادة خصبة
可转换材料
Matière fertile
Материал для воспроизводства
Material fértil
Brutmaterial
親物質

4.8. Uranium
يورانيوم
铀
Uranium
Уран
Uranio
Uran
ウラン

4.9. Natural uranium
يورانيوم طبيعي
天然铀
Uranium naturel
Природный уран
Uranio natural
Natururan
天然ウラン

4.10. Depleted uranium

يورانيوم مستنفد

贫化铀

Uranium appauvri

Обедненный уран

Uranio empobrecido

Abgereichertes Uran

劣化ウラン

4.11. Enriched uranium

يورانيوم مثرى

浓缩铀

Uranium enrichi

Обогащенный уран

Uranio enriquecido

Angereichertes Uran

濃縮ウラン

4.12. Low enriched uranium (LEU)

يورانيوم ضعيف الاثراء

低浓铀（LEU)

Uranium faiblement enrichi (UFE)

Низкообогащенный уран (НОУ)

Uranio poco enriquecido (UPE)

Niedrig angereichertes Uran

低濃縮ウラン（ＬＥＵ）

4.13. High enriched uranium (HEU)

يورانيوم شديد الاثراء

高浓铀（HEU）

Uranium hautement enrichi (UHE)

Высокообогащенный уран (ВОУ)

Uranio muy enriquecido (UME)

Hoch angereichertes Uran

高濃縮ウラン（ＨＥＵ）

4.14. Uranium-233

يورانيوم-233

铀-233

Uranium 233

Уран-233

Uranio 233

Uran-233
ウラン—２３３

4.15. Plutonium
بلوتونيوم
钚
Plutonium
Плутоний
Plutonio
Plutonium
プルトニウム

4.16. Mixed oxide (MOX)
خليط الأكسيدين (موكس)
混合氧化物（MOX）
Mélange d’oxydes (d’uranium et de plutonium) (MOX)
Смешанное оксидное топливо (MOX)
Mezcla de óxidos (MOX)
Mischoxid
混合酸化物（ＭＯＸ）

4.17. Thorium
ثوريوم
钍
Thorium
Торий
Torio
Thorium
トリウム

4.18. Americium
أميريشيوم
镅
Américium
Америций
Americio
Americium
アメリシウム

4.19. Neptunium
نبتونيوم
镎
Neptunium

Нептуний
Neptunio
Neptunium
ネプツニウム

4.20. Enrichment
اثراء
浓缩度
Enrichissement
Обогащение
Enriquecimiento
Anreicherung
濃縮度（濃縮）

4.21. Depletion
استنفاد
贫化
Appauvrissement
Обеднение
Empobrecimiento
Abreicherung
減損（劣化）

4.22. Transmutation
تحويل
嬗变
Transmutation
Трансмутация
Transmutación
Umwandlung
核変換

4.23. Material type
نوع المادة
材料类型
Type de matières
Тип материала
Tipo de material
Materialtyp
物質タイプ

4.24. Material category
فئة المادة
材料类别

Catégorie de matières
Категория материала
Categoría de material
Material-Kategorie
物質区分

4.25. Direct use material
مادة صالحة للاستعمال المباشر
直接使用材料
Matière d’emploi direct
Материал прямого использования
Material de uso directo
Unmittelbar verwendbares Material, Material zum direkten Gebrauch
直接利用(核)物質

4.26. Indirect use material
مادة صالحة للاستعمال غير المباشر
非直接使用材料
Matière d’emploi indirect
Материал косвенного использования
Material de uso indirecto
Nicht unmittelbar (indirekt) verwendbares Material
間接利用(核)物質

4.27. Material form
شكل المادة
材料形态
Forme des matières
Форма материала
Forma de material
Materialbeschreibung
物質形状

4.28. Improved nuclear material
مادة نووية محسنة
改进的核材料
Matière nucléaire améliorée
Улучшенный ядерный материал
Material nuclear mejorado
Verbessertes Kernmaterial
改良核物質

4.29. Strategic value
قيمة استراتيجية

战略价值
Valeur stratégique
Стратегическая ценность
Valor estratégico
Strategische Bedeutung (Strategischer Wert)
枢要値

4.30. **Effective kilogram (ekg)**
كيلوغرام فعال
有效千克（ekg）
Kilogramme effectif
Эффективный килограмм (эф. кг)
Kilogramo efectivo (kge)
Effektives Kilogramm
実効キログラム（ｅｋｇ）

4.31. **Feed material**
مادة تغذية
供料
Matière première
Сырьевой материал
Material de alimentación
Einspeisematerial
供給物質

4.32. **Intermediate product**
ناتج وسيط
中间产品
Produit intermédiaire
Промежуточный продукт
Producto intermedio
Zwischenprodukt
中間製品

4.33. **Product**
ناتج
产品
Produit
Продукт
Producto
Produkt
製品

4.34. **Scrap**
خردة
废料
Rebuts de fabrication
Скрап
Residuos
Schrott
スクラップ

4.35. **Waste**
نفايات
废物
Déchets
Отходы
Desechos
Abfall
廃棄物

4.36. **Hold-up**
مواد نووية مستبقاة خلال الاستخدام
滞留量
Matière retenue en cours de procédé
Остаточный материал
Material retenido
In der Anlage (Apparatur) zurückbleibendes Kernmaterial
ホールドアップ（滞留物）

4.37. **Fuel element** (fuel assembly, fuel bundle)
عنصر وقود
燃料元件
Élément combustible
Тепловыделяющий [топливный] элемент
Elemento combustible
Brennelement
燃料要素

4.38. **Fuel component**
مكون وقود
燃料部件
Composant du combustible
Компонент тепловыделяющего [топливного] элемента
Componente combustible
Brennelement-Komponente
燃料構成要素

4.39. Pellet
قرص وقود
芯块
Pastille
Таблетка
Pastilla
Tablette (Brennstofftablette)
ペレット

4.40. Specified non-nuclear material
مواد غير نووية محددة
规定的非核材料
Matière non nucléaire spécifiée
Согласованный неядерный материал
Materiales no nucleares especificados
Spezifiziertes nicht-nukleares Material
特定非核物質

4.41. Nuclear grade graphite
غرافيت صالح للاستعمال في المفاعلات النووية
核级石墨
Graphite de pureté nucléaire
Ядерно-чистый графит
Grafito de pureza nuclear
Nuklear reiner Graphit
原子炉級黒鉛

4.42. Deuterium and heavy water
الديوتيريوم والماء الثقيل
氘和重水
Deutérium et eau lourde
Дейтерий и тяжелая вода
Deuterio y agua pesada
Deuterium und Schwerwasser
重水素及び重水

4.43. Zircaloy
سبيكة زركونيوم
锆锡合金
Zircaloy
Циркалой
Zircaloy
Zirkaloy
ジルカロイ（ジルコニウム合金）

5. Nuclear and Nuclear Related Activities and Installations

الأنشطة والمنشآت النووية والمتصلة بالمجال النووي

核及核相关活动与装置

Activités et installations nucléaires et liées au nucléaire

Ядерные и относящиеся к ним деятельность и установки

Actividades e instalaciones nucleares y del ámbito nuclear

Kerntechnische und Kerntechnik-bezogene Aktivitäten und Einrichtungen

原子力及び原子力関連活動及び施設物

5.1. Nuclear fuel cycle

دورة الوقود النووي

核燃料循环

Cycle du combustible nucléaire

Ядерный топливный цикл

Ciclo del combustible nuclear

Kernbrennstoffkreislauf

核燃料サイクル

5.2. Nuclear fuel cycle related research and development activities

أنشطة البحث والتطوير ذات الصلة بدورة الوقود النووي

与核燃料循环有关的研究与发展活动

Activités de recherche-développement liées au cycle du combustible nucléaire

Относящиеся к ядерному топлиному циклу научно-исследовательские и опытно-конструкторские работы

Actividades de investigación y desarrollo relacionadas con el ciclo del combustible nuclear

Forschungs- und Entwicklungsarbeiten auf dem Gebiet des Kernbrennstoffkreislaufs

核燃料サイクル関連研究開発活動

5.3. Installation

منشأة

装置

Établissement

Установка

Instalación

Anlage (Einrichtung)

施設物

5.4. Categorization of installations

تصنيف المنشآت

装置类别

Catégorisation des établissements

Категоризация установок
Categorización de las instalaciones
Kategorisierung von Anlagen (Einrichtungen)
施設物の区分

5.5. Reactor
مفاعل
反应堆
Réacteur
Реактор
Reactor
Reaktor
原子炉

5.6. Power reactor
مفاعل قوى
动力堆
Réacteur de puissance
Энергетический реактор
Reactor de potencia
Leistungsreaktor
動力炉（発電炉）

5.7. Off-load refuelled power reactor
مفاعل قوى يعاد تزويده بالوقود أثناء ايقاف تشغيله
停堆换料动力堆
Réacteur de puissance à rechargement à l’arrêt
Энергетический реактор, останавливаемый для перегрузки
Reactor de potencia recargado fuera de servicio
Leistungsreaktor mit Beladung bei Betriebsstillstand
オフロード燃料交換動力炉（発電炉）

5.8. Light water reactor (LWR)
مفاعل ماء خفيف
轻水堆（LWR）
Réacteur à eau ordinaire (REO)
Легководный реактор (ЛВР)
Reactor de agua ligera (LWR)
Leichtwasserreaktor
軽水炉（ＬＷＲ）

5.9. On-load refuelled power reactor (OLR)
مفاعل قوى يعاد تزويده بالوقود أثناء تشغيله
不停堆换料动力堆（OLR）

Réacteur de puissance à rechargement en fonctionnement (RRF)
Энергетический реактор с перегрузкой на мощности (OLR)
Reactor de potencia recargado en servicio (OLR)
Leistungsreaktor mit Beladung bei laufendem Betrieb
オンロード燃料交換動力炉（発電炉）（ＯＬＲ）

5.10. Heavy water reactor (HWR)
مفاعل ماء ثقيل
重水堆（HWR）
Réacteur à eau lourde (REL)
Тяжеловодный реактор (HWR)
Reactor de agua pesada (HWR)
Schwerwasserreaktor
重水炉（ＨＷＲ）

5.11. Graphite moderated reactor
مفاعل مهدأ بالغرافيت
石墨慢化堆
Réacteur modéré au graphite
Реактор с графитовым замедлителем
Reactor moderado por grafito
Graphitmoderierter Reaktor
黒鉛減速炉

5.12. Fast reactor
مفاعل سريع
快堆
Réacteur à neutrons rapides
Быстрый реактор
Reactor rápido
Schneller Reaktor
高速炉

5.13. Research reactor
مفاعل بحوث
研究堆
Réacteur de recherche
Исследовательский реактор
Reactor de investigación
Forschungsreaktor
研究炉

5.14. Critical assembly
مجمعة حرجة

临界装置
Assemblage critique
Критическая сборка
Conjunto crítico
Kritische Anordnung (Kritische Anlage)
臨界集合体

5.15. Subcritical assembly
مجمعة تحت الحرجة
次临界装置
Assemblage sous-critique
Подкритическая сборка
Conjunto subcrítico
Unterkritische Anordnung (Unterkritische Anlage)
未臨界集合体

5.16. Uranium mine and concentration (ore processing) plant
مصنع لاستخراج اليورانيوم ومعالجة خاماته
铀矿开采和浓集（水冶）厂
Mine d’uranium et usine de concentration (de traitement) du minerai
Урановый рудник и завод по обогащению (обработке) руды
Planta de extracción y concentración (tratamiento del mineral) de uranio
Uranabbau und Aufbereitungsanlage
ウラン鉱山及び選鉱（鉱石処理）工場

5.17. Conversion plant
مصنع تحويل
转化厂
Usine de conversion
Завод по конверсии
Planta de conversión
Konversionsanlage
転換工場

5.18. Fuel fabrication plant
مصنع وقود
燃料制造厂
Usine de fabrication de combustible
Завод по изготовлению топлива
Planta de fabricación de combustible
Brennelementfabrik
燃料加工工場

5.19. Scrap recovery plant
مصنع لاستعادة الخردة
废料回收厂
Usine de récupération des rebuts de fabrication
Завод по регенерации скрапа
Planta de recuperación de residuos
Schrottaufarbeitungsanlage
スクラップ回収工場

5.20. Enrichment plant (or isotope separation plant)
مصنع اثراء (أو مصنع لفصل النظائر)
浓缩厂（或同位素分离厂）
Usine d’enrichissement (ou usine de séparation isotopique)
Установка по обогащению (или установка по разделению изотопов)
Planta de enriquecimiento (o planta de separación de isótopos)
Anreicherungsanlage (Isotopentrennanlage)
濃縮工場（または同位体分離工場）

5.21. Reprocessing plant
مصنع اعادة معالجة
后处理厂
Usine de retraitement
Перерабатывающий завод
Planta de reprocesamiento
Wiederaufarbeitungsanlage
再処理工場

5.22. Storage facility
مرفق خزن
贮存设施
Installation d'entreposage
Хранилище
Instalación de almacenamiento
Anlage zur Lagerung (von Kernmaterial)
貯蔵施設

5.23. Heavy water production plant
مصنع لانتاج الماء الثقيل
重水生产厂
Usine de production d’eau lourde
Завод по производству тяжелой воды
Planta de producción de agua pesada
Produktionsanlage für Schwerwasser
重水製造工場

5.24. Facility
مرفق
设施
Installation
Установка
Instalación
Anlage
施設

5.25. Location outside facilities (LOF)
مكان واقع خارج المرافق
设施外场所（LOF）
Emplacement hors installation (EHI)
Место нахождения вне установок （МВУ）
Lugar situado fuera de las instalaciones (LFI)
Ort außerhalb von Anlagen
施設外の場所（ＬＯＦ）

5.26. Facility type
نوع المرفق
设施类型
Type d'installation
Тип установки
Tipo de instalación
Anlagentyp
施設タイプ

5.27. Item facility
مرفق يحتوي على مواد في شكل مفردات
件料操作设施
Installation contenant des matières dénombrables
Установка с материалом в виде предметов [учетных единиц]
Instalación con material en forma de unidades
Anlage zur Handhabung von Kernmaterial in umschlossener Form
アイテム施設

5.28. Bulk handling facility
مرفق يحتوي على مواد في حالة سائبة
散料操作设施
Installation contenant des matières en vrac
Установка с материалом в балк-форме
Instalación de manipulación de materiales a granel
Anlage zur Handhabung von Kernmaterial in offener Form
バルク取扱施設

5.29. **Facility life cycle**
دورة عمر المرفق
设施生命周期
Cycle de vie d'une installation
Жизненный цикл установки
Ciclo de la vida útil de la instalación
Lebenslauf einer Anlage
施設ライフサイクル（耐用年数）

5.30. **Closed-down facility (or closed-down location outside facilities)**
مرفق مغلق (أو مكان خارج المرافق مغلق)
关闭设施（或关闭的设施外场所）
Installation mise à l'arrêt (ou emplacement hors installation mis à l'arrêt)
Остановленная установка (или закрытое место нахождения вне установок)
Instalación cerrada (o lugar fuera de las instalaciones cerrado)
Außer Betrieb genommene Anlage (oder außer Betrieb genommener Ort außerhalb von Anlagen)
閉鎖された施設（または、閉鎖された施設外の場所）

5.31. **Decommissioned facility (or decommissioned location outside facilities)**
مرفق خرج من الخدمة (أو مكان خارج المرافق خرج من الخدمة)
退役设施（或退役的设施外场所）
Installation déclassée (ou emplacement hors installation déclassé)
Снятая с эксплуатации установка (или снятое с эксплуатации место нахождения вне установок)
Instalación clausurada (o lugar fuera de las instalaciones clausurado)
Stillgelegte Anlage (oder stillgelegter Ort außerhalb von Anlagen)
デコミッショニングされた施設（または、デコミッショニングされた施設外の場所）

5.32. **Geological repository**
مستودع جيولوجي
地质处置库
Dépôt géologique
Геологическое хранилище
Repositorio geológico
Geologisches Endlager
地層処分場

5.33. **Specified equipment**
معدات محددة
规定的设备
Équipement spécifié

Согласованное оборудование
Equipo especificado
Spezifizierte Ausrüstung
特定設備 / 機器

5.34. Nuclear related dual use item
مفردات مزدوجة الاستخدام ذات صلة بالمجال النووي
与核有关的两用物项
Article à double usage dans le domaine nucléaire
Относящийся к ядерной деятельности предмет двойного использования
Elemento de doble uso del ámbito nuclear
In der Kerntechnik genutzter Gegenstand (Ausrüstung) mit anderweitiger Verwendbarkeit
原子力関連汎用アイテム

6. Nuclear Material Accountancy
ممارسة حصر المواد النووية
核材料衡算
Contrôle comptable des matières nucléaires
Ведение учета ядерного материала
Contabilidad de materiales nucleares
Kernmaterial-Buchführung
核物質の計量

6.1. Nuclear material accountancy
ممارسة حصر المواد النووية
核材料衡算
Contrôle comptable des matières nucléaires
Ведение учета ядерного материала
Contabilidad de materiales nucleares
Buchführung von Kernmaterial
核物質の計量

6.2. Nuclear material accounting
حصر المواد النووية
核材料衡算活动
Comptabilité des matières nucléaires
Учет ядерного материала
Recuento de materiales nucleares
Bilanzieren von Kernmaterial
核物質の計量活動

6.3. Near real time accountancy (NRTA)

ممارسة الحصر في توقيت مقارب للتوقيت الحقيقي

近实时衡算（NRTA）

Contrôle comptable en temps proche du temps réel

Учет в почти реальном масштабе времени (NRTA)

Contabilidad de materiales en tiempo casi real (NRTA)

Zeitnahe Kernmaterial-Buchführung

ニア　リアル　タイム計量（ＮＲＴＡ）

6.4. Material balance area (MBA)

منطقة لقياس المواد النووية

材料平衡区（MBA）

Zone de bilan matières (ZBM)

Зона баланса материала (ЗБМ)

Zona de balance de materiales (MBA)

Materialbilanzzone (MBZ)

物質収支区域（ＭＢＡ）

6.5. Strategic point

نقطة استراتيجية

战略点

Point stratégique

Ключевое место

Punto estratégico

Strategischer Punkt

枢要点（枢要な箇所）

6.6. Key measurement point (KMP)

نقطة قياس أساسية

关键测量点（KMP）

Point de mesure principal (PMP)

Ключевая точка измерения (КТИ)

Punto clave de medición (KMP)

Schlüsselmeßpunkt

主要測定点（ＫＭＰ）

6.7. Batch

دفعة

批

Lot

Партия

Lote

Charge

バッチ

6.8. Batch data
بيانات الدفعة
批数据
Données concernant le lot
Данные партии
Datos del lote
Chargendaten
バッチ　データ

6.9. Source data
بيانات مصدرية
原始数据
Données de base
Исходные данные
Datos de origen
Primärdaten
ソース　データ

6.10. Identity data (or identification data)
بيانات الهوية
标识数据
Éléments d'identification
Идентификационные данные
Datos de identificación
Daten zur Identifizierung
同定データ

6.11. Element code
رمز العنصر
元素代码
Code matière
Код элемента
Código del elemento
Element-Code
元素コード

6.12. Unified uranium
يورانيوم موحد
合计铀
Uranium unifié
Унифицированный уран
Uranio unificado
Gesamt-Uran
統一ウラン

6.13. **Material description**
وصف المادة
材料说明
Description des matières
Описание материала
Descripción del material
Code zur Materialbeschreibung
物質記述

6.14. **Inventory change**
تغير الرصيد
存量变化
Variation de stock
Изменение инвентарного количества
Cambio en el inventario
Bestandsänderung
在庫変動

6.15. **Import and export**
الاستيراد والتصدير
进出口
Importation et exportation
Импорт и экспорт
Importaciones y exportaciones
Einfuhr und Ausfuhr
輸入及び輸出

6.16. **Domestic receipt**
تسلم محلي
国内收货
Arrivée en provenance de l'intérieur
Внутригосударственное поступление
Entrada nacional
Zugang aus dem Inland
国内受入

6.17. **Nuclear production**
الانتاج النووي
核产出
Production nucléaire
Ядерное производство
Producción nuclear
Erzeugung durch Kernumwandlung
核的生成

6.18. Accidental gain
زيادة عارضة
意外收获
Gain accidentel
Случайное увеличение
Ganancia accidental
Zufälliger Zuwachs
事故增加

6.19. De-exemption
رفع الاعفاء
撤消免除
Levée d'exemption
Повторная постановка под гарантии
Exención anulada
Aufhebung der Befreiung (von der Überwachung)
保障措置再適用

6.20. Retained waste
نفايات مستبقاة
存留废物
Déchets conservés
Сохраняемые отходы
Desechos retenidos
Zwischengelagerter Abfall
保管廃棄（保管廃棄物）

6.21. Domestic shipment
شحن محلي
国内运输
Expédition à destination de l'intérieur
Внутригосударственное отправление
Salida nacional, expedición nacional, envío dentro del territorio nacional
Versand im Inland
国内払出

6.22. Nuclear loss
فقد نووي
核损耗
Perte de matières nucléaires par consommation
Ядерные потери
Pérdida nuclear
Verlust durch Kernumwandlung
核的損耗

6.23. Measured discard
مهملات مقاسة
经测量的废弃物
Rebuts mesurés
Измеренные безвозвратные потери
Descartes medidos
Gemessener Abfall
測定済廃棄

6.24. Exemption (of nuclear material)
اعفاء (مادة نووية)
（核材料）免除保障
Exemption (de matières nucléaires)
Освобождение от гарантий (ядерного материала)
Exención de las salvaguardias (de los materiales nucleares)
Befreiung des Kernmaterials von den IAEO-Sicherungsmaßnahmen
（核物質の）免除

6.25. Termination (of IAEA safeguards)
رفع (ضمانات الوكالة الدولية للطاقة الذرية)
终止（原子能机构保障）
Levée (des garanties de l’AIEA)
Прекращение (гарантий МАГАТЭ)
Terminación (de la aplicación de las salvaguardias del OIEA)
Beendigung der IAEO-Sicherungsmaßnahmen
（ＩＡＥＡ保障措置の）終了

6.26. Other loss
أشكال الفقد الأخرى
其他损耗
Autre perte
Другие потери
Otras pérdidas
Andere Verluste
その他の損耗

6.27. Arithmetical correctness
الصحة الحسابية
运算正确性
Exactitude arithmétique
Арифметическая правильность
Exactitud aritmética
Rechnerische Richtigkeit
算術的正確さ

6.28. Adjustment
تعديل
调整
Ajustement
Уточнение
Ajuste
Angleichung, Rundung
調整事項（調整）

6.29. Correction
تصويب
校正
Correction
Исправление
Corrección
Berichtigung
訂正事項（修正）

6.30. Accounting records
سجلات الحصر
衡算记录
Relevés comptables
Учетная документация
Registros contables
Buchungsbelege
計量記録

6.31. Operating records
سجلات التشغيل
运行记录
Relevés d'opérations
Эксплуатационная документация
Registros operacionales
Betriebsprotokolle
運転記録（操業記録）

6.32. Supporting document
وثيقة داعمة
辅助性文件
Pièce justificative
Подтверждающий документ
Documento de apoyo
Ergänzende Unterlage
関係書類（裏付け文書）

6.33. Measurement system
نظام قياس
测量系统
Système de mesure
Система измерений
Sistema de mediciones
Meßsystem
測定システム

6.34. Traceability
إقتفائية
可追溯性
Traçabilité
Сопоставимость [с эталонами]
Confirmabilidad
Rückverfolgbarkeit
トレーサビリティ

6.35. International standards of accountancy
معايير الحصر الدولية
国际衡算标准
Normes internationales de contrôle comptable
Международные нормы ведения учета
Normas internacionales de contabilidad
Internationale Standards der Materialbilanzierung
計量に関する国際基準

6.36. International Target Values (ITV)
القيم المستهدفة الدولية
国际目标值（ITV）
Valeurs cibles internationales (VCI)
Международные целевые значения погрешностей (ITV)
Valores internacionales objetivo (ITV)
Internationale Richtwerte
国際標準値（ＩＴＶ）

6.37. Stratum
شريحة
材料组
Strate
Страта
Estrato
Stratum
ストラータ

6.38. Account
الحصر
帐户
Compte
Учетная запись
Cuenta
Konto (Material)
計量勘定

6.39. Account balance
محصلة الحصر
帐面平衡
Bilan comptable
Учетный баланс
Balance de cuenta
Fortgeschriebener Buchbestand
計量勘定収支

6.40. Book inventory (of a material balance area)
الرصيد الدفتري (لمنطقة لقياس المواد النووية)
（材料平衡区）帐面存量
Stock comptable (d'une zone de bilan matières)
Зарегистрированное инвентарное количество (в зоне баланса материала)
Inventario contable (de una zona de balance de materiales)
Buchbestand (über einen Materialbilanz-Zeitraum)
（物質収支区域の）帳簿在庫

6.41. Physical inventory
الرصيد المادي
实物存量
Stock physique
Фактически наличное количество
Inventario físico
Realer Bestand
実在庫

6.42. Material balance component
مكون القياس المادي
材料平衡方程分项
Composante du bilan matières
Компонент баланса материала
Componente del balance de materiales

Komponente der Materialbilanz
物質収支の構成要素

6.43. Material unaccounted for (MUF)
مادة غير محصورة
不明材料量（MUF）
Différence d'inventaire (DI)
Количество неучтенного материала (КНМ)
Material no contabilizado (MNC)
Nicht nachgewiesenes Material (MUF)
在庫差（不明物質量または未計量物質）（ＭＵＦ）

6.44. Cumulative MUF
محصلة المواد غير المحصورة
累计不明材料量
DI cumulée
Совокупное количество неучтенного материала
MNC acumulado
Aufsummiertes nicht nachgewiesenes Material
累積ＭＵＦ

6.45. Shipper/receiver difference (SRD)
الفرق بين الشاحن والمتسلم
发货方／收货方差额（SRD）
Écart expéditeur/destinataire (EED)
Расхождение в данных отправителя/получателя (SRD)
Diferencia remitente/destinatario (DRD)
Absender/Empfänger-Differenz
受払間差異（ＳＲＤ）

6.46. Cumulative SRD
محصلة الفروق بين الشاحن والمتسلم
累计发货方／收货方差额
EED cumulé
Совокупное расхождение в данных отправителя/получателя
DRD acumulada
Aufsummierte Absender/Empfänger-Differenzen
累積ＳＲＤ

6.47. Material balance period (MBP)
زمن القياس المادي
材料平衡周期（MBP）
Intervalle entre bilans matières (IBM)
Период баланса материала (MBP)

Período de balance de materiales (MBP)
Materialbilanz-Zeitraum
物質収支期間（ＭＢＰ）

6.48. IAEA examination of records
فحص السجلات من جانب الوكالة الدولية للطاقة الذرية
原子能机构对记录的审查
Examen des relevés par l’AIEA
Изучение документации со стороны МАГАТЭ
Examen de los registros por el OIEA
Überprüfung der Buchungsunterlagen durch die IAEO
ＩＡＥＡによる記録の検査

6.49. IAEA updating of the book inventory
استيفاء الوكالة الدولية للطاقة الذرية للرصيد الدفتري
原子能机构对帐目存量的更正
Mise à jour du stock comptable par l’AIEA
Обновление зарегистрированного инвентарного количества со стороны МАГАТЭ
Actualización del inventario contable por el OIEA
Aktualisierung des Buchbestandes durch die IAEO
ＩＡＥＡによる帳簿在庫の更新

6.50. IAEA inventory change verification
تحقق الوكالة الدولية للطاقة الذرية من التغير في الرصيد
原子能机构对存量变化的核实
Vérification des variations de stock par l’AIEA
Проверка изменения инвентарного количества со стороны МАГАТЭ
Verificación de los cambios en el inventario por el OIEA
Nachprüfung der Bestandsänderungen durch die IAEO
ＩＡＥＡによる在庫変動の検認

6.51. IAEA inventory verification
تحقق الوكالة الدولية للطاقة الذرية من الرصيد
原子能机构对存量的核实
Vérification du stock par l’AIEA
Проверка инвентарного количества со стороны МАГАТЭ
Verificación del inventario por el OIEA
Nachprüfung des (Kernmaterial-) Bestandes durch die IAEO
ＩＡＥＡによる在庫検認

6.52. IAEA physical inventory verification (PIV)
تحقق الوكالة الدولية للطاقة الذرية من الرصيد المادي
原子能机构对实物存量的核实（PIV）

Vérification du stock physique (VSP) par l'AIEA
Проверка фактически наличного количества (PIV) со стороны МАГАТЭ
Verificación del inventario físico (VIF) por el OIEA
Nachprüfung des realen Bestandes durch die IAEO
ＩＡＥＡによる実在庫検認（ＰＩＶ）

6.53. IAEA interim inventory verification
تحقق الوكالة الدولية للطاقة الذرية من الرصيد المؤقت
原子能机构对中间存量的核实
Vérification intermédiaire du stock par l'AIEA
Промежуточная проверка инвентарного количества со стороны МАГАТЭ
Verificación del inventario provisional por el OIEA
Zwischenzeitliche Nachprüfung des (Kermaterial-) Bestandes durch die IAEO
ＩＡＥＡによる中間在庫検認

6.54. IAEA verification of nuclear material flows within an MBA
تحقق الوكالة الدولية للطاقة الذرية من تدفقات المواد النووية داخل منطقة لقياس المواد النووية
原子能机构对材料平衡区内核材料流量的核实
Vérification par l'AIEA des flux de matières nucléaires dans une ZBM
Проверка потоков ядерного материала в пределах ЗБМ со стороны МАГАТЭ
Verificación de los flujos de materiales nucleares en una MBA
Nachprüfung des Kernmaterial-Flusses innerhalb einer Materialbilanzzone (MBZ)
ＩＡＥＡによるＭＢＡ内の核物質の流れの検認

6.55. IAEA verification of operator's measurement system
تحقق الوكالة الدولية للطاقة الذرية من نظام القياس الذي يستخدمه المشغل
原子能机构对运营者测量系统的核查
Vérification par l'AIEA du système de mesure de l'exploitant
Проверка системы измерений оператора со стороны МАГАТЭ
Verificación por el OIEA del sistema de mediciones del explotador
Nachprüfung des betriebseigenen Meßsystems durch die IAEO
ＩＡＥＡによる施設者測定システムの検認

6.56. IAEA accountancy verification methods
الأساليب التي تستخدمها الوكالة الدولية للطاقة الذرية للتحقق من ممارسات الحصر
原子能机构的衡算核实方法
Méthodes de contrôle comptable de l'AIEA

Методы МАГАТЭ по проверке ведения учета
Métodos de verificación contable del OIEA
Methoden zur Nachprüfung der (Kernmaterial-) Buchführung durch die IAEO
ＩＡＥＡの計量検認手法

6.57. Item counting

عدّ البنود
物件计数
Décompte des objets
Подсчет учетных единиц [предметов]
Recuento de partidas
Zählung von einzelnen (Material) Posten
員数勘定

7. Nuclear Material Measurement Techniques and Equipment

تقنيات ومعدات قياس المواد النووية
核材料测量技术和设备
Techniques et équipements de mesure des matières nucléaires
Методы измерений ядерного материала и оборудование для измерений
Equipo y técnicas de medición de materiales nucleares
Methoden und Ausrüstung zur Messung von Kernmaterial
核物質測定技術及び機器

7.1. Calibration

معايرة
校准
Étalonnage
Калибровка
Calibración
Eichung
較正

7.2. Reference material

مادة مرجعية
参考材料
Matière de référence
Эталонный материал
Material de referencia
Referenzmaterial
標準物質（基準物質）

7.3. Primary standard

معيار أولي
一级标准
Étalon primaire
Первичный эталон
Patrón primario
Primärstandard
一次標準

7.4. Secondary standard

معيار ثانوي
二级标准
Étalon secondaire
Вторичный эталон
Patrón secundario
Sekundärstandard
二次標準

7.5. Bulk measurement

قياس المواد السائبة
大批量测量
Mesure de la masse
Балк-измерение [измерение массы, объема]
Medición en masa
Massenmessung
バルク測定

7.6. Matrix

مصفوفة
基质
Matrice
Матрица
Matriz
Matrix
マトリックス

7.7. Sample

عينة
样品
Échantillon
Проба [образец]
Muestra
Probe
試料（サンプル）

7.8. Random sampling

أخذ العينات
随机取样
Échantillonnage aléatoire
Отбор проб на случайной основе
Muestreo aleatorio
Stichprobennahme
ランダム　サンプリング

7.9. Systematic sampling

أخذ العينات منهجيا
系统取样
Échantillonnage systématique
Систематический отбор проб
Muestreo sistemático
Systematische Probennahme
系統的サンプリング

7.10. Representative sample

عينة ممثلة
代表性样品
Échantillon représentatif
Представительная проба
Muestra representativa
Repräsentative Probe
代表サンプル

7.11. Calorimetry

قياس الحرارة
量热法
Calorimétrie
Калориметрия
Calorimetría
Kalorimetrie
熱量分析法（カロリメトリー）

7.12. Assay

قياس
分析
Analyse
Анализ
Análisis
Messung
分析

7.13. Destructive analysis (DA)

قياس متلف
破坏性分析（DA）
Analyse destructive (AD)
Разрушающий анализ (РА)
Análisis destructivo (AD)
Zerstörende Analyse
破壊分析（ＤＡ）

7.14. Chemical titration

معايرة كيميائية
化学滴定法
Titrimétrie
Химическое титрование
Titulación química
Chemische Titration
化学滴定

7.15. Controlled potential coulometry

قياس الشحنة تحت جهد مضبوط
控制电位库仑分析法
Coulométrie à potentiel contrôlé
Кулонометрия с контролируемым потенциалом
Titulación potenciométrica
Potentialkontrollierte Coulometrie
定電位クーロメトリー

7.16. Gravimetric analysis

تحليل تقالي
重量分析
Analyse gravimétrique
Гравиметрический анализ
Análisis gavimétrico
Gravimetrische Analyse
重量分析

7.17. Isotope dilution mass spectrometry (IDMS)

قياس الطيف الكتلي بطريقة التخفيف النظيري
同位素稀释质谱测定法（IDMS）
Spectrométrie de masse à dilution isotopique
Масс-спектрометрия с изотопным разбавлением (IDMS)
Espectrometría de masas por dilución isotópica (IDMS)
Isotopenverdünnungs-Massenspektrometrie
同位体希釈質量スペクトロメトリー（分析法）（ＩＤＭＳ）

7.18. **K-edge densitometry**
قياس الكثافة بطريقة الحد ك
K 电子吸收限密度计
Densitométrie de discontinuité K
Денситометрия с использованием эффекта K-полосы поглощения
Densitometría de discontinuidad K
K-Kanten Densitometrie
K－エッジ　デンシトメトリー

7.19. **Resin bead technique**
تقنية خرز الراتينج
树脂颗粒法
Technique des lits de résine
Осаждение на ионообменную смолу и масс-спектрометрический анализ отдельных зерен смолы
Técnica de perlas de resina
Ionenaustauscher-Korn-Technik
レジン　ビーズ技術

7.20. **Mass spectrometry**
قياس الطيف الكتلي
质谱测定法
Spectrométrie de masse
Масс-спектрометрия
Espectrometría de masas
Massenspektrometrie
質量分析法（質量スペクトロメトリー）

7.21. **Gas mass spectrometry**
قياس الطيف الكتلي للغازات
气相质谱测定法
Spectrométrie de masse en phase gazeuse
Газовая масс-спектрометрия
Espectrometría de masas en fase gaseosa
Gasmassenspektrometrie
ガス質量分析（ガス質量スペクトロメトリー）

7.22. **Thermal ionization mass spectrometry (TIMS)**
قياس الطيف الكتلي بالتأين الحراري
热电离质谱测定法（TIMS）
Spectrométrie de masse à thermo-ionisation
Масс-спектрометрия с термической ионизацией (TIMS)
Espectrometría de masas de ionización térmica (TIMS)

Thermoionisations-Massenspektrometrie
熱電離質量分析法（熱電離質量スペクトロメトリー）（ＴＩＭＳ）

7.23. **Alpha spectrometry**
قياس طيف أشعة الفا
α能谱测定法
Spectrométrie alpha
Альфа-спектрометрия
Espectrometría alfa
Alpha-Spektrometrie
アルファ線スペクトロメトリー

7.24. **Non-destructive assay (NDA)**
قياس غير متلف
无损分析（NDA）
Analyse non destructive (AND)
Неразрушающий анализ (НРА)
Análisis no destructivo (AND)
Zerstörungsfreie Analyse
非破壊分析（ＮＤＡ）

7.25. **Gamma ray spectrometry**
قياس طيف أشعة غاما
γ射线能谱测定法
Spectrométrie gamma
Гамма-спектрометрия
Espectrometría gamma
Gamma-Spektrometrie
ガンマ線スペクトロメトリー

7.26. **Gamma ray scanning**
مسح بأشعة غاما
γ射线扫描
Balayage gamma
Гамма-сканирование
Gammagrafía
Gamma-Scanning
ガンマ線走査

7.27. **Scintillation detector**
كاشف وميضي
闪烁探测器
Détecteur à scintillation
Сцинтилляционный детектор

Detector de centelleo
Szintillationszähler
シンチレーション検出器

7.28. Semiconductor detector
كاشف بشبه موصلات
半导体探测器
Détecteur à semi-conducteur
Полупроводниковый детектор
Detector semiconductor
Halbleiterdetektor
半導体検出器

7.29. Neutron counting
عد النيوترونات
中子计数
Comptage neutronique
Счет нейтронов
Recuento de neutrones
Neutronenzählung (Neutronenmessung)
中性子計数

7.30. Neutron coincidence counting
عد توافق النيوترونات
中子符合计数
Comptage neutronique par coïncidence
Счет нейтронных совпадений
Recuento de coincidencias neutrónicas
Neutronenkoinzidenzzählung
中性子同時計数

7.31. Neutron multiplicity counter
عد تضاعف النيوترونات
中子增殖计数器
Comptage de multiplicité neutronique
Счетчик множественности нейтронов
Contador de multiplicidad neutrónica
Neutronenmultiplizitätszähler
中性子増倍計数器

7.32. Cerenkov radiation detection
كشف اشعاعات تشيرينكوف
切伦科夫辐射探测法
Détection du rayonnement de Tcherenkov

Регистрация черенковского излучения
Detección de la radiación por brillo Cherenkov
Nachweis (Messung) von Cerenkov-Strahlung
チェレンコフ放射線検出

7.33. Safeguards Analytical Laboratory (SAL)
مختبر التحليل الخاص بالضمانات
保障分析实验室（SAL）
Laboratoire d'analyse pour les garanties (LAG)
Аналитическая лаборатория по гарантиям (АЛГ)
Laboratorio Analítico de Salvaguardias (LAS)
Analytisches Laboratorium der IAEO-Abteilung für Sicherungsmaßnahmen
保障措置分析所（ＳＡＬ）

7.34. Network of Analytical Laboratories (NWAL)
شبكة مختبرات التحليل
分析实验室网络（NWAL）
Réseau de laboratoires d’analyse (NWAL)
Сеть аналитических лабораторий (САЛ)
Red de Laboratorios Analíticos (RLA)
Netzwerk von analytischen Laboratorien
分析所ネットワーク（ＮＷＡＬ）

8. Containment, Surveillance and Monitoring
الاحتواء والمراقبة والرصد
封隔、监视和监测
Confinement et surveillance
Сохранение, наблюдение и мониторинг
Contención y vigilancia
Räumliche Eingrenzung, Beobachtung und Überwachung
封じ込め、監視及びモニタリング

8.1. Containment
الاحتواء
封隔
Confinement
Сохранение
Contención
Räumliche Eingrenzung
封じ込め

8.2. Surveillance
المراقبة

监视
Surveillance
Наблюдение
Vigilancia
Beobachtung
監視

8.3. Containment/surveillance device (C/S device)
جهاز خاص بالاحتواء والمراقبة
封隔 / 监视装置（C/S 装置）
Dispositif de confinement/surveillance (dispositif C/S)
Устройство для сохранения/наблюдения (устройство для С/Н)
Dispositivo de contención y vigilancia (dispositivo de C/V)
Gerät zur räumlichen Eingrenzung/Beobachtung
封じ込め / 監視装置（Ｃ / Ｓ装置）

8.4. Optical surveillance device
جهاز مراقبة بصرية
光学监视装置
Dispositif de surveillance optique
Оптическое устройство наблюдения
Dispositivo de vigilancia óptica
System zur optischen Beobachtung
光学監視装置

8.5. Seal
ختم
封记
Scellé
Печать
Precinto
Siegel
シール（封印）

8.6. Containment/surveillance measures (C/S measures)
تدابير خاصة بالاحتواء والمراقبة
封隔 / 监视措施（C/S 措施）
Mesures de confinement/surveillance (mesures C/S)
Меры по сохранению/наблюдению (меры по С/Н)
Medidas de contención y vigilancia (medidas de C/V)
Maßnahmen zur räumlichen Eingrenzung/Beobachtung
封じ込め / 監視手段（Ｃ / Ｓ手段）

8.7. System of containment/surveillance measures (C/S system)
نظام التدابير الخاصة بالاحتواء والمراقبة
封隔 / 监视措施系统（C/S 系统）
Système de mesures de confinement/surveillance (système C/S)
Система мер по сохранению/наблюдению (система по С/Н)
Sistema de medidas de contención y vigilancia (sistema de C/V)
System von räumlichen Eingrenzungs/Beobachtungsmaßnahmen
封じ込め / 監視システム（C / S システム）

8.8. Containment/ surveillance results (C/S results)
نتائج الاحتواء والمراقبة
封隔 / 监视结果（C/S 结果）
Résultats du confinement/surveillance (résultats C/S)
Результаты мер по сохранению/наблюдению (результаты мер по С/Н)
Resultados de contención y vigilancia (resultados de C/V)
Ergebnisse räumlicher Eingrenzungs/Beobachtungsmaßnahmen
封じ込め / 監視の結果（C / S の結果）

8.9. Containment/surveillance technical capability (C/S technical capability)
القدرات التقنية الخاصة بالاحتواء والمراقبة
封隔 / 监视技术能力（C/S 技术能力）
Capacité technique de confinement/surveillance (capacité technique C/S)
Техническая возможность мер по сохранению/ наблюдению (техническая возможность С/Н)
Capacidad técnica de contención y vigilancia (capacidad técnica de C/V)
Technische Leistungsfähigkeit von räumlichen Eingrenzungs/ Beobachtungsmaßnahmen
封じ込め / 監視の技術的能力（C / S の技術的能力）

8.10. Vulnerability assessment
تقييم جوانب الضعف
易损性评定
Évaluation de la vulnérabilité
Оценка уязвимости
Evaluación de la vulnerabilidad
Schwachstellen-Analyse
脆弱性評価

8.11. Tampering
التلاعب
干扰
Manipulation frauduleuse
Вмешательство

Interferencia
Verfälschung
不正変更（タンパー）

8.12. Tamper indication
علامات التلاعب
干扰迹象
Indication de manipulation frauduleuse
Признак вмешательства
Indicación de interferencia
Verfälschungsanzeige
不正変更（タンパー）の徴候

8.13. Tamper resistance
مقاومة التلاعب
抗干扰
Résistance aux manipulations frauduleuses
Противодействие вмешательству
Resistencia a la interferencia
Verfälschungssicherheit
不正変更（タンパー）に対する抵抗性 / タンパー防護

8.14. Surveillance review system
نظام استعراض المراقبة
监视审查系统
Système d'examen des résultats de la surveillance
Система просмотра данных наблюдения
Sistema de examen de la vigilancia
System zur Auswertung von Beobachtungsaufnahmen
監視レビューシステム（監視検査システム）

8.15. Unattended monitoring
رصد غيابي
无人值守监测
Surveillance automatique
Автономный мониторинг
Vigilancia automática
Automatische Überwachung
非立会モニタリング

8.16. Remote monitoring
رصد عن بعد
远程监测
Télésurveillance

Дистанционый мониторинг
Vigilancia a distancia
Fernüberwachung
遠隔モニタリング

8.17. Monitor
جهاز رصد
监测器
Détecteur
Монитор
Monitor
Überwachungsinstrument
モニター

8.18. Core discharge monitor (CDM)
جهاز لرصد تعبئة قلوب المفاعلات وتفريغها
堆芯卸料监测器（CDM）
Moniteur de déchargement du cœur (MDC)
Монитор выгрузки топлива из активной зоны (MBT)
Monitor de descarga del núcleo (CDM)
Überwachungsinstrument für eine Reaktor-Entladung
炉心取出モニター（ＣＤＭ）

8.19. Spent fuel bundle counter
عداد حزم الوقود المستهلك
乏燃料棒束计数器
Compteur de grappes de combustible usé
Счетчик отработавших тепловыделяющих [топливных] сборок
Contador de haces de combustible gastado
Zähler für abgebrannte Brennelemente
使用済燃料バンドル　カウンター

8.20. Reactor power monitor
جهاز لقياس قدرة المفاعلات
反应堆功率监测器
Enregistreur de la puissance d’un réacteur
Монитор мощности реактора
Monitor de potencia de un reactor
Überwachungsinstrument für die Reaktorleistung
原子炉出力モニター

8.21. Radiation passage monitor
جهاز لرصد حركة المواد النووية بالاشعاعات
通道辐射监测器

Détecteur de passage
Радиационный монитор прохождения
Monitor de radiaciones en tránsito
Strahlen-Überwachungsinstrument für Durchgänge
放射線通過モニター

8.22. Authentication
اعتماد (صحة بيانات)
真实性验证
Authentification
Аутентификация
Autenticación
Authentifizierung
オーセンティケーション（認証）

8.23. Encryption
تشفير
加密
Cryptage
Шифрование
Criptografía
Verschlüsselung
暗号化

8.24. Equipment state of health data
بيانات حالة المعدات
设备健全状况数据
Données sur l’état des équipements
Данные о работоспособности оборудования
Datos sobre el estado de funcionamiento del equipo
Daten über die Systembetriebsfähigkeit
機器健全性データ

9. Environmental Sampling
أخذ العينات البيئية
环境取样
Échantillonnage de l’environnement
Отбор проб окружающей среды
Muestreo ambiental
Entnahme von Umwelt-Proben
環境サンプリング

9.1. Environmental sampling (ES)
أخذ العينات البيئية

环境取样（ES）
Échantillonnage de l’environnement
Отбор проб окружающей среды
Muestreo ambiental (MA)
Entnahme von Umwelt-Proben
環境サンプリング（ＥＳ）

9.2. Location specific environmental sampling

أخذ عينات من موقع محدد
针对场所的环境取样
Échantillonnage de l’environnement dans un emplacement précis
Отбор проб окружающей среды в конкретном месте нахождения
Muestreo ambiental específico para los lugares
Ortspezifische Entnahme von Umwelt-Proben
場所特定環境サンプリング

9.3. Wide area environmental sampling

أخذ عينات من منطقة واسعة
大范围环境取样
Échantillonnage de l’environnement dans une vaste zone
Отбор проб окружающей среды на обширной территории
Muestreo ambiental de grandes zonas
Großräumige Entnahme von Umwelt-Proben
広域環境サンプリング

9.4. Swipe sampling

أخذ عينات بالمسح
擦拭取样
Prélèvement d’échantillon par frottis
Отбор мазковых проб
Muestreo por frotis
Wischprobe
スミアサンプリング（スワイプ　サンプリング／拭き取りサンプリング）

9.5. Point sample

أخذ عينات نقطية
点采样
Échantillon ponctuel
Проба с одной точки
Muestra puntual
Punktprobe
ポイント（点）サンプル

9.6. Composite sample

عينة مركبة

混合样品

Échantillon composite

Проба с нескольких точек [композитная]

Muestra compuesta

Zusammengesetzte Probe (Sammelprobe)

混合サンプル（複合サンプル）

9.7. Control sample

عينة مراقبة

对照样品

Échantillon témoin

Контрольная проба

Muestra de control

Kontrollprobe

管理サンプル

9.8. Cross-contamination

تلوث

交叉污染

Contamination croisée

Взаимное загрязнение

Contaminación cruzada

Querkontamination

相互汚染（クロス　コンタミネーション）

9.9. Baseline environmental signature

بيانات بيئية أساسية

环境基准特性

Signature environnementale de base

Реперные признаки окружающей среды

Signatura ambiental de referencia

Anlagenspezifische Umweltmerkmale

ベースライン環境特徴

9.10. Sampling team

فريق أخذ العينات

取样小组

Équipe d’échantillonnage

Группа по отбору проб

Grupo de muestreo

Probenahmegruppe

サンプリング　チーム

9.11. Sampling kit
طقم أخذ العينات
取样盒
Trousse d'échantillonnage
Набор для отбора проб
Juego (kit) de muestreo
Probenahmeausrüstung
サンプリング　キット

9.12. IAEA Clean Laboratory for Safeguards
المختبر النظيف الخاص بالضمانات التابع للوكالة الدولية للطاقة الذرية
原子能机构保障清洁实验室
Salle blanche de l'AIEA pour les garanties
Чистая лаборатория по гарантиям МАГАТЭ
Laboratorio limpio del OIEA para fines de salvaguardias
Kontaminationsfreies Labor der IAEO zur Kernmaterialüberwachung
ＩＡＥＡ保障措置クリーン分析所

9.13. Screening measurement
قياسات الفرز
筛选测量
Scrutation gamma
Предварительное измерение
Medición de selección
Voruntersuchungsmessung
選別測定

9.14. Bulk analysis
التحليل الاجمالي
全分析
Analyse globale
Анализ всей пробы
Análisis volumétrico
Analyse der Probenzusammensetzung
バルク分析

9.15. Particle analysis
التحليل الجسيمي
微粒分析
Analyse de particules
Анализ частиц
Análisis de partículas
Teilchenanalyse
粒子分析

9.16. Fission track analysis
التحليل بطريقة المسارات الانشطارية
裂变径迹分析
Analyse par traces de fission
Анализ треков деления
Análisis por trazas de fisión
Spaltspuranalyse
フィッション　トラック分析

9.17. Scanning electron microscopy (SEM)
الاستجهار بطريقة المسح الالكتروني
扫描电子显微镜（SEM）
Microscopie électronique à balayage
Растровая электронная микроскопия (РЭМ)
Microscopia electrónica de barrido (SEM)
Rasterelektronen-Mikroskopie
走査型電子顕微鏡観察（ＳＥＭ）

9.18. Secondary ion mass spectroscopy (SIMS)
التحليل بطريقة قياس الطيف الكتلي للايونات الثانوية
次级离子质谱法（SIMS）
Spectrométrie de masse à émission d'ions secondaires
Масс-спектрометрия вторичных ионов (SIMS)
Espectroscopia de masas de emisión de iones secundarios (SIMS)
Sekundärionen-Massenspektroskopie
二次イオン質量分析（ＳＩＭＳ）

10. Statistical Concepts and Techniques for Nuclear Material Verification
المفاهيم والتقنيات الاحصائية المتعلقة بالتحقق من المواد النووية
核材料核查的统计学概念和技术
Concepts statistiques et techniques de vérification des matières nucléaires
Статистические концепции и методы проверки ядерного материала
Técnicas y conceptos estadísticos para la verificación de los materiales nucleares
Statistische Verfahren und Techniken zur Kernmaterialüberprüfung
核物質検認のための統計学的概念及び技術

10.1. Material balance evaluation
تقييم حصر المواد
材料平衡评价
Évaluation du bilan matières
Оценка баланса материала
Evaluación del balance de materiales

Materialbilanz-Auswertung
物質収支評価

10.2. Inspector's estimate of MUF
تقدير المفتش للمواد غير المحصورة
视察员对不明材料量的估计
Estimation de la DI par l’inspecteur
Оценка КНМ инспектором
Estimación del MNC hecha por el inspector
Schätzung des MUF durch den Inspektor
査察員によるＭＵＦの推定

10.3. Operator–inspector difference
الفرق بين القيمة المعلنة من المشغل والقيمة المقاسة من المفتش
运营者－视察员差额
Écart exploitant–inspecteur (EEI)
Расхождение в данных оператора и инспектора
Diferencia explotador–inspector
Differenz zwischen Betreiber und Inspektor (D)
施設者　査察員間差異

10.4. Diversion into MUF
التحريف المؤدي لظهور مواد غير محصورة
转为不明材料
Détournement dans la DI
Переключение, связанное с КНМ
Material desviado y declarado como MNC
Abzweigung in den MUF
ＭＵＦへの転用

10.5. Diversion into SRD
التحريف المؤدي لظهور فرق بين الشاحن والمتسلم
转为发货方／收货方差额
Détournement dans l’EED
Переключение, связанное с SRD
Material desviado y declarado como DRD
Abzweigung in die SRD
ＳＲＤへの転用

10.6. Diversion into D
التحريف المؤدي لظهور فرق بين المواد المعلن عن وجودها والمواد الموجودة فعلا
转变为氘

Détournement dans l'EEI
Переключение, связанное с расхождением данных оператора и инспектора
Desviación causante de discrepancia (D)
Abzweigung in den D-Wert
Ｄへの転用

10.7. Defect
الخلل
亏量
Défaut
Дефект
Defecto
Defekt
欠損

10.8. Sample size
حجم العينة
样品量
Taille de l'échantillon
Размер пробы
Tamaño de la muestra
Stichprobenumfang
サンプル　サイズ

10.9. Mean (μ)
الوسط (μ)
平均值（μ）
Moyenne théorique (μ)
Среднее значение (μ)
Media (μ)
Mittelwert (μ)
平均(μ)

10.10. Sample mean (x_{av})
متوسط العينة (x_{av})
样品平均值（x_{av}）
Moyenne échantillon (x_{av})
Среднее значение пробы (x_{av})
Media de una muestra (x_{av})
Mittelwert der Stichprobe (x_{av})
サンプル平均（試料平均）(x_{av})

10.11. Variance (σ^2)

(σ^2) التباين

方差（σ^2）

Variance (σ^2)

Дисперсия (σ^2)

Varianza (σ^2)

Varianz (σ^2)

分散(σ^2)

10.12. Sample variance (s^2)

(s^2)تباين العينة

样品方差（s^2）

Variance de l’échantillon (s^2)

Дисперсия пробы (s^2)

Varianza de una muestra (s^2)

Varianz der Stichprobe (s^2)

サンプルの分散(s^2)

10.13. Standard deviation (σ)

(σ) الانحراف المعياري

标准偏差（σ）

Écart type (σ)

Стандартное отклонение (σ)

Desviación estándar (σ)

Standardabweichung (Streuung) (σ)

標準偏差(σ)

10.14. Error

الخطأ

误差

Erreur

Погрешность

Error

Fehler

誤差

10.15. Random error

خطأ عشوائي

随机误差

Erreur aléatoire

Случайная погрешность

Error aleatorio

Zufälliger Fehler

ランダム誤差

10.16. Systematic error (bias)
خطأ نظامي (تحيز)
系统误差（偏倚）
Erreur systématique (biais)
Систематическая погрешность (смещение)
Error sistemático (sesgo)
Systematischer Fehler (Bias)
系統誤差（システマティック　エラー）（バイアス）

10.17. Residual bias
التحيز المتبقي
残留偏倚
Biais résiduel
Остаточное смещение
Sesgo residual
Verbleibender systematischer Fehler (Restbias)
残留バイアス

10.18. Error propagation
انتشار الخطأ
误差传播
Propagation des erreurs
Определение суммарной погрешности
Propagación de errores
Fehlerfortpflanzung
誤差伝播

10.19. Limits of error
حدود الخطأ
误差限值
Limites d'erreur
Пределы погрешности
Límites de error
Fehlergrenzen
誤差限界

10.20. Confidence interval
فترة الثقة
置信区间
Intervalle de confiance
Доверительный интервал
Intervalo de confianza
Konfidenzintervall
信頼区間

10.21. Confidence limits
حدود الثقة
置信界限
Limites de confiance
Доверительные пределы
Límites de confianza
Konfidenzgrenzen
信頼限界

10.22. Confidence level
مستوى الثقة
置信水平
Niveau de confiance
Доверительный уровень
Nivel de confianza
Konfidenz-Niveau
信頼水準

10.23. Outlier
قيمة خارجة
外围人员
Point aberrant
Выброс [при измерениях]
Valor errático o atípico
Ausreißer
外れ値（異常値）

10.24. Performance values
قيم الأداء
实绩价值
Indicateur de performance
Значения, корректирующие качество измерений
Valores históricos
Meßfehler, welche die Leistungsfähigkeit eines Meßsystems charakterisieren
実績値

10.25. Test of hypothesis
اختبار الفرض
假设检验
Test d'hypothèse
Проверка гипотезы
Comprobación de la hipótesis

Test einer Hypothese
仮説検定

10.26. Statistically significant
معنوي احصائيا
统计学重要性
Statistiquement significatif
Статистически значимый
Estadísticamente significativo
Statistisch signifikant
統計的に有意

10.27. Type I error
خطأ من الطراز الأول
I类误差
Erreur du type I
Погрешность первого рода
Error tipo I
Fehler I. Art
第 I 種の誤り

10.28. Type II error
خطأ من الطراز الثاني
II类误差
Erreur du type II
Погрешность второго рода
Error tipo II
Fehler II. Art
第 II 種の誤り

10.29. Power of a test
قوة الاختبار
检验的功效
Puissance d’un test
Эффективность проверки гипотезы
Potencia de una prueba
Gütefunktion eines Tests
検出力

10.30. Attributes test
اختبار الخصائص
属性检验
Test par attributs

Атрибутивный тест
Prueba de atributos
Test eines qualitativen Merkmales
アットリビユート　テスト（属性試験）

10.31. Variables test
اختبار المتغيرات
变量检验
Test par variables
Количественный тест
Prueba de variables
Test eines quantitativen Merkmales
バリアブル　テスト（計量検定）

10.32. Critical region
المنطقة الحرجة
临界区域
Région critique
Критическая область
Región crítica insesgada, muestra sin distorsión
Kritischer Bereich
棄却域

11. Visits, Inspections and Complementary Access
الزيارات وعمليات التفتيش والمعاينة التكميلية
访问、视察和补充接触
Visites, inspections et accès complémentaire
Посещения, инспекции и дополнительный доступ
Visitas, inspecciones y acceso complementario
Besuche, Inspektionen, erweiterter Zugang
訪問、査察及び補完的なアクセス

11.1. Visit
زيارة
访问
Visite
Посещение
Visita
Besuch
訪問

11.2. Inspection
تفتيش
视察

Inspection
Инспекция
Inspección
Inspektion
查察

11.3. Initial inspection
تفتيش بدئي
初始视察
Inspection initiale
Первоначальная инспекция
Inspección inicial
Erst-Inspektion
冒頭查察

11.4. Ad hoc inspection
تفتيش حسب الاقتضاء
特别视察
Inspection ad hoc
Инспекция для специальных целей
Inspección ad hoc
Ad hoc-Inspektion
特定查察

11.5. Routine inspection
تفتيش روتيني
例行视察
Inspection régulière
Обычная инспекция
Inspección ordinaria
Routine-Inspektion
通常查察

11.6. Unannounced inspection
تفتيش مفاجئ
不通知的视察
Inspection inopinée
Необъявленная инспекция
Inspección no anunciada
Nicht angekündigte Inspektion
無通告查察

11.7. Short notice inspection
تفتيش بإخطار عاجل

临时通知的视察
Inspection à court délai de préavis
Инспекция с краткосрочным уведомлением
Inspección con breve preaviso
Inspektion mit kurzfristiger Vorankündigung
短期通告査察

11.8. Random inspection
تفتيش عشوائي
随机视察
Inspection aléatoire
Инспекция на случайной основе
Inspección aleatoria
Zufällig ausgewählte Inspektion
ランダム査察

11.9. Short notice random inspection (SNRI)
تفتيش عشوائي باخطار عاجل
临时通知的随机视察（SNRI）
Inspection aléatoire à court délai de préavis
Инспекция на случайной основе с краткосрочным уведомлением (SNRI)
Inspección aleatoria con breve preaviso (SNRI)
Zufällig ausgewählte Inspektion mit kurzfristiger Vorankündigung
短期通告ランダム査察（ＳＮＲＩ）

11.10. Limited frequency unannounced access (LFUA)
معاينة مفاجئة محدودة التواتر
有限频度不通知的接触（LFUA）
Accès inopiné à fréquence limitée
Ограниченный по частоте необъявленный доступ (LFUA)
Acceso no anunciado de frecuencia limitada (LFUA)
In der Häufigkeit beschränkter, nicht angekündigter Zugang
頻度限定無通告立入（ＬＦＵＡ）

11.11. Simultaneous inspections
عمليات تفتيش متزامنة
同时视察
Inspections simultanées
Одновременные инспекцин
Inspecciones simultáneas
Gleichzeitige Inspektionen
同時査察

11.12. Continuous inspection
تفتيش مستمر
连续视察
Inspection en continu
Непрерывная инспекция
Inspección continua
Kontinuierliche Inspektion
常時（常駐）査察

11.13. Special inspection
تفتيش خاص
专门视察
Inspection spéciale
Специальная инспекция
Inspección especial
Sonderinspektion
特別査察

11.14. Access for inspection
المعاينة لأغراض التفتيش
视察接触
Accès aux fins d'inspection
Доступ для инспектирования
Acceso con fines de inspección
Zugang zu Inspektionszwecken
査察のためのアクセス

11.15. Scope of inspection
نطاق التفتيش
视察范围
Portée des inspections
Объем инспекции
Alcance de la inspección
Umfang einer Inspektion
査察の範囲

11.16. Frequency of inspection
تواتر التفتيش
视察频度
Fréquence des inspections
Частота инспекций
Frecuencia de las inspecciones
Häufigkeit der Inspektionen
査察の頻度

11.17. Advance notice of inspections and visits
اخطار مسبق بعمليات تفتيش وزيارات
视察和访问的预先通知
Préavis pour les inspections et visites
Предварительное уведомление об инспекциях и посещениях
Aviso anticipado de las inspecciones y visitas
Vorankündigung von Inspektionen und Besuchen
査察及び訪問の事前通告

11.18. Inspection activities
أنشطة التفتيش
视察活动
Activités d’inspection
Инспекционная деятельность
Actividades de inspección
Inspektionstätigkeiten
査察活動

11.19. IAEA inspector
مفتش تابع للوكالة الدولية للطاقة الذرية
原子能机构视察员
Inspecteur de l’AIEA
Инспектор МАГАТЭ
Inspector del OIEA
IAEO-Inspektor
ＩＡＥＡ査察員

11.20. Person-day (man-day) of inspector (PDI)
شخص-يوم (رجل-يوم) تفتيش
视察人•日（PDI）
Journée d’inspecteur
Человеко-день инспекции (ЧДИ)
Día-persona de inspección (DPI)
Inspektions-Personentag (-Manntag)
査察人　日（ＰＤＩ）

11.21. Person-year (man-year) of inspection
شخص-سنة (رجل-سنة) تفتيش
视察人•年
Année d’inspection
Человеко-год инспекций
Año-persona de inspección
Inspektions-Personenjahr (-Mannjahr)
査察人　年

11.22. Actual routine inspection effort (ARIE)
جهد التفتيش الروتيني الفعلي
实际例行视察量（ARIE）
Activité réelle d'inspection régulière (ARIR)
Реальный объем обычной инспекционной деятельности (ARIE)
Actividad real de inspección ordinaria (ARIO）
Tatsächlicher Routine-Inspektionsaufwand
実際通常査察業務量（ＡＲＩＥ）

11.23. Planned actual routine inspection effort (PLARIE)
جهد التفتيش الروتيني الفعلي المخطط
计划的实际例行视察量（PLARIE）
Activité réelle d'inspection régulière prévue (ARIRP)
Запланированный реальный объем обычной инспекционной деятельности (PLARIE)
Actividad real de inspección ordinaria programada (ARIOP)
Geplanter tatsächlicher Routine-Inspektionsaufwand
計画実際通常査察業務量（ＰＬＡＲＩＥ）

11.24. Maximum routine inspection effort (MRIE)
جهد التفتيش الروتيني الأقصى
最大例行视察量（MRIE）
Activité maximale d'inspection régulière (AMIR)
Максимальный объем обычной инспекционной деятельности (MRIE)
Actividad máxima de inspección ordinaria (AMIO)
Maximaler Routine-Inspektionsaufwand
最大通常査察業務量（ＭＲＩＥ）

11.25. Complementary access
معاينة تكميلية
补充接触
Accès complémentaire
Дополннтельный доступ
Acceso complementario
Erweiterter Zugang
補完的なアクセス

11.26. Managed access
معاينة محكومة
受管接触
Accès réglementé
Регулируемый доступ
Acceso controlado

Geregelter Zugang
管理されたアクセス

11.27. Location
مكان
场所
Emplacement
Место нахождения
Lugar
Ort
場所

11.28. Site
موقع
场址
Site
Площадка
Emplazamiento
Standort
サイト

11.29. Place (on a site or location)
موضع
.... （场址或场所的）地点
Endroit (d'un site ou d'un emplacement)
Место (на площадке или в месте нахождения)
Sitio (en un emplazamiento o lugar)
Stelle (eines Standorts oder eines Ortes)
（サイトまたは場所の）箇所

11.30. Advance notice of complementary access
اخطار مسبق بمعاينة تكميلية
补充接触的预先通知
Préavis d'accès complémentaire
Предварительное уведомление о дополнительном доступе
Aviso anticipado de acceso complementario
Vorankündigung für erweiterten Zugang
補完的なアクセスの事前通告

11.31. Complementary access activities
أنشطة المعاينة التكميلية
补充接触活动
Activités au titre de l'accès complémentaire
Деятельность в рамках дополнительного доступа

Actividades de acceso complementario
Tätigkeiten während des erweiterten Zugangs
補完的なアクセスの活動

12. Safeguards Information and Evaluation
المعلومات الرقابية والتقييم الرقابي
保障资料和评价
Informations relatives aux garanties et évaluation des garanties
Информация об осуществлении гарантий и оценка гарантий
Información y evaluación con fines de salvaguardias
Auf Sicherungsmaßnahmen bezogene Information und deren Auswertung
保障措置情報及び評価

12.1. Safeguards information
المعلومات الرقابية
保障资料
Informations relatives aux garanties
Информация об осуществлении гарантий
Información sobre salvaguardias
Informationen über Sicherungsmaßnahmen
保障措置情報

12.2. Initial report
التقرير البدئي
初始报告
Rapport initial
Первоначальный отчет
Informe inicial
Anfangsbericht
冒頭報告

12.3. Routine report
التقرير الروتيني
例行报告
Rapport régulier
Обычный отчет
Informe ordinario
Regelmäßiger Bericht
通常報告

12.4. Accounting report
تقرير الحصر
衡算报告
Rapport comptable

Учетный отчет
Informe contable
Buchungsbericht
計量報告

12.5. Inventory change report (ICR)
تقرير التغير في الرصيد
存量变化报告（ICR）
Rapport sur les variations de stock (RVS)
Отчет об изменениях инвентарного количества (ICR)
Informe de cambios en el inventario (ICR)
Bestandsänderungsbericht
在庫変動報告（ＩＣＲ）

12.6. Concise notes
مذكرات مقتضبة
简明记录
Notes concises
Краткие справки
Notas concisas
Kurzgefaßte Bemerkung
注釈

12.7. Material balance report (MBR)
تقرير حصر المواد
材料平衡报告（MBR）
Rapport sur le bilan matières (RBM)
Материально-балансовый отчет (MBR)
Informe de balance de materiales (MBR)
Materialbilanzbericht
物質収支報告（ＭＢＲ）

12.8. Physical inventory listing (PIL)
قائمة الجرد المادي
实物存量报表（PIL）
Liste des articles du stock physique (PIL)
Список фактически наличного количества (PIL)
Lista del inventario físico (PIL)
Aufstellung des realen Material-Bestands
実在庫明細表（ＰＩＬ）

12.9. Operating report
تقرير التشغيل
运行报告

Rapport sur les opérations
Эксплуатационный отчет
Informe de operaciones
Betriebsbericht
操作報告

12.10. Special report
تقرير خاص
专门报告
Rapport spécial
Специальный отчет
Informe especial
Besonderer Bericht
特別報告

12.11. Notification of transfers
اشعار بعمليات نقل
运输通知
Notification de transferts
Уведомление о передачах
Notificación de transferencias
Mitteilung über Transfers (Einfuhr oder Ausfuhr)
移転の通告

12.12. Confirmation of transfers
تأكيد عمليات نقل
运输确认
Confirmation de transferts
Подтверждение передач
Confirmación de transferencias
Bestätigung von Transfers (Einfuhr oder Ausfuhr)
移転の確認

12.13. Voluntary reports on nuclear material, specified equipment and non-nuclear material
تقارير طوعية عن مواد نووية ومعدات محددة ومواد غير نووية
关于核材料、规定设备和非核材料的自愿报告
Rapports volontaires sur les matières nucléaires et les équipements et matières non nucléaires spécifiés
Добровольные отчеты о ядерном материале, согласованном оборудовании и неядерном материале
Informes voluntarios sobre materiales nucleares y equipo y materiales no nucleares especificados

Freiwilliger Bericht über Nuklearmaterial, spezifizierte Ausrüstung und nicht-nukleares Material
核物質、特定機器及び非核物質に関する自発的報告

12.14. Declaration pursuant to an additional protocol
اعلان بموجب برتوكول اضافي
按照附加议定书申报
Déclaration en application d'un protocole additionnel
Заявление [государства] в связи с дополнительным протоколом
Declaración presentada con arreglo a un protocolo adicional
Erklärung gemäß dem Zusatzprotokoll
追加議定書に基づく申告

12.15. Open source information
معلومات من مصادر مفتوحة
公开来源的资料
Informations provenant de sources librement accessibles
Информация из открытых источников
Información de fuentes de libre acceso
Information aus offenen Quellen
公開情報

12.16. Illicit Trafficking Database
قاعدة البيانات الخاصة بالاتجار غير المشروع
非法贩卖数据库
Base de données sur le trafic illicite
База данных по незаконному обороту
Base de datos sobre tráfico ilícito
Datenbank über illegalen Handel
違法（不法）取引データベース

12.17. IAEA Safeguards Information System (ISIS)
نظام المعلومات الرقابية التابع للوكالة الدولية للطاقة الذرية
原子能机构保障信息系统（ISIS）
Système d'information relatif aux garanties de l'AIEA (SIG)
Информационная система МАГАТЭ по гарантиям (ИСИС)
Sistema OIEA de Información sobre Salvaguardias (ISIS)
Informationssystem der IAEO-Sicherungsmaßnahmen
ＩＡＥＡ保障措置情報システム（ＩＳＩＳ）

12.18. IAEA confidentiality regime
نظام السرية التابع للوكالة الدولية للطاقة الذرية
原子能机构保密制度
Régime de confidentialité de l'AIEA

Режим конфиденциальности в МАГАТЭ
Régimen de confidencialidad del OIEA
IAEO-System zum Schutz vertraulicher Informationen
ＩＡＥＡ機密保護（保持）体制

12.19. Safeguards State file
ملف الضمانات الخاص بالدولة
国家保障档案
Dossier sur l’application des garanties dans un État
Файл по государству для целей гарантий
Archivo de salvaguardias de un Estado
Staats-spezifische Information bezüglich Sicherungsmaßnahmen
保障措置国別ファイル

12.20. Safeguards State evaluation
تقييم المعلومات الرقابية الخاصة بالدولة
国家保障评价
Évaluation des garanties au niveau de l’État
Оценка гарантий в государстве
Evaluación de salvaguardias a nivel de un Estado
Staats-spezifische Auswertung von Sicherungsmaßnahmen
保障措置国別評価

12.21. Physical model of a nuclear fuel cycle
نموذج مادي لدورة الوقود النووي
核燃料循环的物理模型
Modèle physique d’un cycle du combustible nucléaire
Физическая модель ядерного топливного цикла
Modelo físico del ciclo del combustible nuclear
Physikalisches Modell eines Kernbrennstoffkreislaufes
核燃料サイクル物理モデル（核燃料サイクル　フィジカル　モデル）

12.22. Process indicator
مؤشر عملية
工艺指标
Indicateur de procédé
Индикатор процесса
Indicador del proceso
(Prozeßindikator) Hinweis auf einen Prozess
プロセス指標

12.23. Safeguards effectiveness evaluation
تقييم فعالية الضمانات
保障有效性评价
Évaluation de l’efficacité des garanties
Оценка действенности гарантий
Evaluación de la eficacia de las salvaguardias
Auswertung der Wirksamkeit von Sicherungsmaßnahmen
保障措置有効性評価

12.24. Safeguards State evaluation report
تقرير تقييم الضمانات الخاص بالدولة
国家保障评价报告
Rapport d’évaluation des garanties au niveau de l’État
Отчет об оценке гарантий в государстве
Informe sobre las evaluaciones de salvaguardias a nivel de los Estados
Bericht über die staats-spezifische Auswertung von Sicherungsmaßnahmen
保障措置国別評価報告

12.25. Safeguards conclusions
استنتاجات الضمانات
保障结论
Conclusions relatives aux garanties
Выводы в связи с осуществлением гарантий
Conclusiones sobre las salvaguardias
Schlußfolgerungen aus Sicherungsmaßnahmen
保障措置結論

13. Reporting on Safeguards Implementation
تقديم التقارير عن تنفيذ الضمانات
报告保障执行情况
Rapports sur l’application des garanties
Отчетность об осуществлении гарантий
Presentación de informes sobre la aplicación de las salvaguardias
Berichterstattung über die Anwendung von Sicherungsmaßnahmen
保障措置の実施に関する報告

13.1. Reporting on design information examination and verification
تقديم تقرير عن فحص المعلومات الرقابية والتحقق منها
报告设计资料审查和核实情况
Présentation de rapports sur l’examen et la vérification des renseignements
Сообщение об изучении и проверке информации о конструкции
Presentación de informes sobre el examen y la verificación de la información sobre el diseño

Berichterstattung über die Prüfung und Nachprüfung (Verifikation) von Anlagedaten
設計情報の検査及び検認に関する報告

13.2. Statement on Inspection Results (90(a) Statement)

بيان عن نتائج التفتيش (البيان 90(أ))
视察结果说明（报表 90(a)）
Déclaration sur les résultats des inspections (déclaration 90 (a))
Заявление о результатах инспекции (заявление 90 а))
Declaración sobre los resultados de las inspecciones (Declaración con arreglo al apartado a) del párrafo 90)
Erklärung über die Ergebnisse der Inspektionen (Nachprüfungstätigkeiten)
査察結果に関する通報（90(a)通報）

13.3. Statement on Conclusions (90(b) Statement)

بيان عن الاستنتاجات (البيان 90(ب))
结论说明（报表 90(b)）
Déclaration sur les conclusions (déclaration 90 (b))
Заявление о выводах (заявление 90 b))
Declaración sobre conclusiones (Declaración con arreglo al apartado b) del párrafo 90)
Erklärung über die Schlußfolgerungen aus den Inspektionen (Nachprüfungstätigkeiten)
結論に関する通報（90(b)通報）

13.4. Book inventory statement

بيان الجرد الدفتري
帐面存量说明
Déclaration sur le stock comptable
Заявление о зарегистрированном инвентарном количестве
Declaración sobre el inventario contable
Erklärung des Buchbestandes
帳簿在庫通報

13.5. Communication on domestic and international transfers

تبليغ عن عمليات النقل المحلية والدولية
关于国内和国际运输的通报
Communication sur les transferts intérieurs et internationaux
Сообщение о внутригосударственных и международных передачах
Comunicación sobre las transferencias nacionales e internacionales
Mitteilungen betreffend inländische sowie internationale Transfers
国内及び国際移転に関する交信

13.6. Statement on domestic and international transfers

بيان عن عمليات النقل المحلية والدولية

关于国内和国际运输的说明

Déclaration sur les transferts intérieurs et internationaux

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