The Meaning of "Control" in "SSAC"

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Abstract

This paper considers historical, legal and technical bases for including "control" of nuclear material as part of a State's system of accounting for and control of nuclear material (SSAC) and its role in the fulfillment of safeguards obligations. Nuclear material control is a set of technical and administrative measures that a regulatory body and operators engage in to ensure that nuclear material is not misused or removed from its assigned location without proper authorization and accounting. Each non-nuclear-weapon State party to the *Treaty on the Non-Proliferation of Nuclear Weapons* (NPT) is required to conclude a safeguards agreement with the International Atomic Energy Agency (IAEA); this is done based on Information Circular 153. During the negotiation of the text of INFCIRC/153 in the early 1970s, States considered proposals for including specific requirements for the control of nuclear material but these proposals were ultimately rejected on the basis that the monitoring of such "physical security" measures was not within the IAEA's safeguards mandate. Instead, each safeguards agreement relies on the State maintaining its SSAC and the IAEA applying predominantly accountancy measures to verify *findings* of the State's system, including that nuclear material has not been removed from its declared location or misused. The IAEA's safeguards guidance documents have recognized that measures taken by the State to control nuclear material remain crucial to effective safeguards implementation. Over time, the IAEA has also developed guidance in the field of nuclear security, which came to encompass nuclear material control. Although issued by the IAEA under the heading of security (and separately from the IAEA's recommendations in the field of safeguards), recent publications on control in the Agency's Nuclear Security Series are directly relevant to assisting States to meet their safeguards commitments effectively. Notwithstanding the dichotomy between nuclear safeguards and nuclear security in the IAEA's guidance documents and its departmental structure, nuclear material control represents a shared set of tools for supporting States' implementation of both safeguards and security. Practitioners in safeguards and security should be aware of this confluence and be able to manage potential areas of conflict.

Introduction

This paper traces the historical, legal and technical basis for including "control" of nuclear material in the fulfillment of States' safeguards obligations. Using official records of the Safeguards Committee of the IAEA Board of Governors that were derestricted in 2016, this paper explains the original thinking when the content of comprehensive safeguards agreements was

drafted in the early 1970s with regard to the scope of responsibilities for SSACs, particularly those related to "control". It then discusses the recommendations provided by the IAEA with respect to control, and the current guidelines, which have emerged as the international community and the IAEA have emphasized the importance of strengthening both security and safeguards. This paper shows how nuclear material control has developed as a component of both nuclear security and nuclear safeguards in parallel.

Nuclear material control is a set of technical and administrative measures that a regulatory body and operators engage in to ensure that nuclear material is not removed from its assigned location, modified, or used without proper approval and accounting.[1] These measures include (but are not limited to):

- Licensing procedures with the licensee accepting ongoing custodial responsibilities for nuclear material
- Access authorization procedures in coordination with the physical protection system (including procedures for authorizing activities involving nuclear material or associated equipment, data, or records)
- Physical barriers for preventing, detecting, and delaying unauthorized access
- Containment and surveillance for maintaining continuity of knowledge over nuclear material
- Nuclear material monitoring, including the use of unique identification labels for items and statistical evaluation of inputs/outputs from each unit involved in the (bulk) processing of nuclear material
- Measurement quality control

Nuclear material control supports the objectives of safeguards as well as nuclear security. In recent years, the IAEA Department of Nuclear Safety and Security has developed guidance on material control in the context of security. Here, the "purpose of nuclear material control is to preclude unauthorized use of nuclear material."[2] Control of nuclear material is part of the State system for "nuclear material accounting and control" (NMAC), which supports physical protection systems by providing information on nuclear material, tracking material inventories, and ensuring the integrity of tracking measures.[3] The IAEA also issued guidelines for SSACs (INF/2) in 1980, using the term "control" similarly to mean "administrative or management control over the possession, use and transfer (including import and export) of nuclear material, and over the organization, functions and performance of nuclear material accounting systems within the State."[4] More recent guidance documents from the Department of Safeguards cover some aspects of nuclear material control,[5] such as licensing, but they have tended to be less definitive than the guidance from the Department of Nuclear Safety and Security. Effective nuclear material controls remains essential to safeguards implementation and both sets of guidance documents are important for assisting States to meet their safeguards obligations.

I. The Negotiations on Provisions Related to SSACs and Control Measures in INFCIRC/153

After the NPT entered into force, the IAEA's Board of Governors established Committee 22 to advise, "as a matter of urgency", on the safeguards agreement that each non-nuclear-weapon State party of the NPT must conclude with the IAEA.[6] Forty-eight States took part in the Committee's work and negotiated the text of a document that became the basis for safeguards agreements with non-nuclear-weapon States: INFCIRC/153.

During the negotiations of what became the text of INFCIRC/153, the IAEA Secretariat prepared an "initial outline" with a proposal to include a paragraph related to the State system of control:

> In order to ensure the effective implementation of safeguards the Agreement should provide that the State maintain a system of materials *control* in respect of nuclear material subject to safeguards; such a system should include appropriate measures to ensure that safeguarded nuclear material is protected against *unauthorized removal*.[7]

Japan's representative proposed that the paragraph on the State system of material control should include:

> The Agreement should provide that the State's system of accounting for and control of nuclear material shall meet the following requirements:
> (a) The system shall be generally compatible with the technical objective and the procedure laid down in the Agreement so as to facilitate verification by the Agency of findings of the system; and
> (b) The application of appropriate measures of physical protection to the nuclear material subject to safeguards.[8]

This proposal was not accepted because a number of delegations (including Canada, France, Sweden and the United Kingdom) expressed the opinion that "physical security was a matter for States" and the IAEA did not have an operational role to play.[9] In particular, the US delegation argued: "The responsibility for control of nuclear materials should in fact rest with the State, and the system which it instituted for that purpose should enable the Agency to verify by itself the results of control..."[10]

There was also a proposal to include a measure to be established by each State as part of its National System of Accounting for and Control of Nuclear Material and included in paragraph 32 (Part II) of INFCIRC/153:

> (i) Appropriate measures to ensure the *physical security* for nuclear material subject to safeguards under this agreement.[11]

This sub-paragraph was not included in INFCIRC/153 because several delegations argued that "physical security" of nuclear material was the exclusive responsibility of the State, and that it was beyond the scope of the IAEA to monitor any such measure.[12] Instead, the IAEA Secretariat indicated that it "expected that States will maintain a materials control system", including measures to ensure physical protection, in the interest of security, and concluded that the Agency

ought not to "interfere in the internal legislation of the State governing the establishment and operation of the State's materials control system."[13]

As a result of the negotiations, paragraph 7 of INFCIRC/153 (Part I) stipulates that States shall establish and maintain a national system of accountancy and control of nuclear material subject to safeguards (the SSAC) and that *such safeguards* shall be applied in such a manner as to enable the IAEA to verify the findings of the SSAC in ascertaining that there has been no diversion of nuclear material from peaceful uses. Paragraph 32 (Part II) includes procedures for the SSAC, all of them focused on accountancy matters. As can be inferred from the negotiations, the drafters considered "control of nuclear material" as a physical protection measure. The drafters, however, decided not to include any provision expressly related to physical security in INFCIRC/153, as it was clear that this measure is the exclusive responsibility of the States and therefore does not need to be regulated by the safeguards agreement.

During the negotiation of INFCIRC/153, some delegations expressed their wish that physical security would be addressed elsewhere.[14] This indeed happened in 1972 when the IAEA issued a booklet entitled "Recommendations for the Physical Protection of Nuclear Material", which later became the basis for INFCIRC/225.[15] The IAEA became a crucial source of guidance on physical security, quite distinct from its role under safeguards agreements. Over time, the concept of "physical security" evolved to meet changing threat perceptions. Both the concept and the IAEA's guidance gradually broadened out into the field of "nuclear security", as it is known today, of which physical protection is a core component along with NMAC, information security, and security culture. As explained in the third section of this paper, the IAEA's Department of Nuclear Safety and Security has recently begun developing specific guidance on the measures to be applied to control nuclear material.

II. How "Control" Gets into Safeguards

INFCIRC/153 does not contain detailed provisions on the activities to be performed within the SSAC to control nuclear material or specific procedures to enable the IAEA to directly monitor measures taken by a State for nuclear material control.[16] The IAEA safeguards system is for the exclusive purpose of verifying compliance with safeguards agreements.

That being said, INFCIRC/153 necessarily implies that control has an impact on safeguards. As part of the SSAC, the effectiveness of a State's nuclear material control may impact the frequency and intensity of IAEA inspections in the State.[17] The existence of a system of nuclear material control in each State is also necessarily implied by specific aspects of the records and reports systems required under INFCIRC/153 and the subsidiary arrangements. For example, paragraph 68(b) of INFCIRC/153 provides that the State must make "special reports" if "containment has unexpectedly changed from that specified in the Subsidiary Arrangements to the extent that unauthorized removal of nuclear material has become possible." Similarly, paragraph 68(a) provides for special reports if "any unusual incident or circumstances" lead the

State to believe that loss may have occurred, implying that accounting information is not the only required source of information on potential loss or diversion. Indeed, the structure of material balance areas (MBAs) that forms the basis of the SSAC (as required under paragraph 32) implies control of the movement of nuclear material, which is practically essential for reporting.

Control works with accounting to enhance the timeliness and effectiveness of detection of any loss or diversion of nuclear material. Accounting information could provide evidence of a loss of material, for example through inconsistencies discovered by comparing existing accounting records and a physical inventory taking.[18] However, accounting information has limited utility on its own because of limitations on the frequency, intensity and precision of material measurements/inventories, as well as the potential for human/clerical and other errors in accountancy. It would be impossible to achieve timely detection of all potentially important loss or diversion scenarios with adequate probability if accountancy were undertaken without control. Control measures could suggest a loss of material or unauthorized removal, for example by damage to containment structures and physical barriers (doors, locks, tamper indicating devices, etc.), violation of employee electronic access authorization conditions, alarms at portal monitors, or unusual activity shown in surveillance camera images. Conversely, a lack of effective controls on nuclear material and processing/handling equipment can result in a State failing to report nuclear activities to the IAEA or otherwise being unable to meet its obligations under its safeguards agreement.[19]

Paragraph 46(b)(ii) of INFCIRC/153 stipulates "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". These control measures are a primary means of continuously confirming the integrity of nuclear material stores and monitoring material flows (i.e. maintaining continuity of knowledge).[20] Control measures are especially useful for ensuring that nuclear material remains within the boundaries of a facility and that transfers only take place at key measurement points.[21] For this reason, the IAEA has written in its guidelines for SSACs that "States may use containment and surveillance measures to provide assurance, largely independent from that provided by nuclear material accounting, that there has been no unauthorized use or removal of nuclear material from a facility." [22] Accountancy may subsequently be used in part to verify the successful outcome of containment and surveillance, as for instance where calculation of shipper-receiver difference is used to verify that controls were not violated during the transport of nuclear material.[23]

The IAEA's recommendations on State safeguards infrastructure also recognize national licensing programs as a control measure in support of safeguards.[24] Without a mechanism for the State to control where nuclear material is produced, processed, stored or transferred, it would be impossible for the State to determine its inventories of nuclear material for the purposes of safeguards reporting. For example, in order for a State to meet its obligations under Modified Subsidiary Arrangements Code 3.1.2, it should have a process for authorizing construction and for acquiring preliminary design information for new facilities.[25]

The IAEA's guidelines, INF/2, also affirm that an SSAC may serve a "national objective, to account for and control nuclear material in the State and to contribute to the detection of possible losses, or unauthorized use or removal of nuclear material".[26] This is in addition to and distinct from the "international objective, to provide the essential basis for the application of IAEA safeguards".[27]

These guidelines, that were followed by many States establishing their SSACs at the time, correspond to a great extent to the understandings discussed during the negotiations of INFCIRC/153, namely that control, being a national objective, is the exclusive responsibility of States and that control measures should allow for the detection of losses or unauthorized use or removal of nuclear material. More recently, the IAEA Secretariat has published a number of guidelines addressing safeguards practices and providing advice on safeguards-related matters. These publications, which are managed by the Department of Safeguards, are part of the IAEA's "Services Series" and they are referenced later in this paper.

On the other hand, the IAEA's Department of Nuclear Safety and Security has been primarily responsible for developing the Agency's guidelines on NMAC, as part of its Nuclear Security Series (NSS). These publications are meant to provide guidance on how to implement international legal documents on nuclear security, such as the *Convention on the Physical Protection of Nuclear Material* and its amendment and United Nations Security Council Resolution 1540. As discussed in the next section of this paper, the IAEA's recommendations in its NSS follow to a great extent the understandings of States at the INFCIRC/153 negotiating table and the original SSAC guidelines from 1980. Many of the recommendations in the NSS are useful in assisting States to meet the safeguards obligations in INFCIRC/153.

III. Control as a Common Set of Tools, Useful for Nuclear Safeguards and Security

Within a State, safeguards and security tend to share a common national infrastructure, including the same facility personnel, regulators, equipment, analytical techniques, and administrative processes.[28] The overlap between the tools, methods and resources used for nuclear material control in support of safeguards implementation and those used in security is increasingly being realized by proponents of the 3S Concept.[29] In 2006, the IAEA Director General wrote that "security and safeguards objectives are *jointly attained by* measures to enhance the *control* of and accounting for nuclear material".[30] A well designed SSAC can support physical protection, particularly by facilitating the discovery of anomalies that might result from various plausible unauthorized removal scenarios (e.g., protracted theft of bulk material with substitution), thereby helping to address traditional vulnerabilities of physical protection systems to circumvention by insiders.[31] Conversely, effective physical protection and access control support the SSAC.

The IAEA's "Guidance for States Implementing Comprehensive Safeguards Agreements and Additional Protocols" indicates that in order for the State authority to provide timely, complete

and correct safeguards information to the IAEA, the authority must establish a system to control the use and movements of nuclear material.[32] This system need not be created from scratch. As the IAEA's Nuclear Material Accounting Handbook points out, a facility's "nuclear material control group" may be constituted of its safeguards implementation officer and nuclear material accountants.[33] At the same time, the Implementing Guide developed by the Department of Nuclear Safety and Security on "Use of Nuclear Material Accounting and Control for Nuclear Security Purposes at Facilities" recommends that a facility NMAC system "be designed to meet all legal obligations associated with a safeguards agreement, as well as the nuclear security objectives".[34] This Implementing Guide also points out that facility NMAC records and reports are used for both nuclear security and compliance with safeguards agreements.[35] In other words, the IAEA acknowledges that a facility should have a single accounting and control system for both safeguards and security.[36]

Nuclear material control represents a common set of tools for supporting both safeguards and security, in the sense that it helps regulators and operators both ensure *and* demonstrate that nuclear material has not been moved, stolen, lost or diverted. However, the purposes for which these tools are applied, and the criteria against which the results are evaluated, may differ between safeguards and security. For example, criteria for classifying quantities of nuclear material may differ between security and safeguards.[37] Depending on the State's threat assessment for nuclear security purposes, a State may also choose to set target probabilities for detection of theft of nuclear material that are different from the detection probabilities used by IAEA safeguards inspectors for establishing sampling plans.[38]

Awareness of the overlap in nuclear material control between safeguards and security is also important since differences and potential conflicts may need to be managed by inspectors, regulators, and operators. For example, "MBAs" may be defined both for safeguards purposes and for security purposes but the latter are often smaller and more process-specific to ensure that the exact location of nuclear material can be determined quickly.[39] INFCIRC/153 takes into consideration that a facility or LOF may set up smaller MBAs for security purposes by providing that a number of MBAs in use at a facility or at distinct sites may be combined into one MBA for the purposes of IAEA safeguards.[40] This allows the State to optimize the specificity of its NMAC for security purposes, while simplifying reporting to the IAEA for safeguards. Similarly, measures set up to control access to material (e.g., an operator's tamper indicating device) could interfere with an IAEA inspector's access. Sometimes separate safeguards and security systems will need to operate in parallel, as for instance where a single container has both a tamper indicating device applied by the facility and a seal applied by the IAEA.

Conclusions

From the outset of the NPT safeguards agreement, it was clear for its drafters that nuclear material control is the exclusive responsibility of the States and each State should implement control measures to prevent unauthorized removal of nuclear material. The control measures to

be implemented by States relate to what was called at the time "physical security". The specific measures to be implemented by States are now part of the IAEA's guidance on "nuclear security", developed by the Department of Nuclear Safety and Security. Although labeled as measures for security purposes, they are largely useful for States in fulfilling obligations arising from comprehensive safeguards agreements. Since the responsibility to promote nuclear security belongs to the Department of Nuclear Safety and Security in the IAEA, it is natural that guidance for implementing such measures including nuclear material control comes from this Department. The IAEA is currently drafting guidance specifically on nuclear material control for its Nuclear Security Series, [41] which operators and State authorities should use with the objective of strengthening implementation of both safeguards and security.

The IAEA has no mandate under INFCIRC/153 to directly monitor measures taken by States regarding control of nuclear material. The IAEA does, however, verify the findings of the State's system (including its nuclear material control) when the Agency checks accountancy reports to ensure, for example, that no nuclear material has been diverted. The IAEA, in its verification, also takes into account the technical effectiveness of the State's system. Many of the characteristics of effective nuclear material control for an SSAC are the same as the characteristics of a good national nuclear security system. Indeed, it would be impossible for a State or an operator to fulfill its safeguards obligations, including its accounting and reporting obligations, without having nuclear material control. Each State should approach nuclear material control with the aim of meeting both its legal obligations under its safeguards agreement and its national nuclear security objectives.

Notes and References

[*] This paper represents the views of the authors. It does not represent the views of any institution.

[1] "Establishing a System for Control of Nuclear Material for Nuclear Security Purposes at a Facility during Storage, Use, and Movement", IAEA Draft Technical Guidance NST033 (August 2015) (IAEA Nuclear Security Series, in preparation).

[2] *Use of Nuclear Material Accounting and Control for Nuclear Security Purposes at Facilities*: Implementing Guide, IAEA Nuclear Security Series 25-G (2015), para 4.108. Note that "nuclear material" has the same definition in the context of nuclear security as it does in the context of nuclear safeguards, see *Objective and Essential Elements of a State's Nuclear Security Regime*, IAEA Nuclear Security Series 20 (2013), p. 12; "The Structure and Content of Agreements between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons", IAEA Doc INFCIRC/153 (Corrected) (June 1972), para 112.

[3] *Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities*: Recommendations, IAEA Nuclear Security Series 13 (INFCIRC/225/Rev.5, 2011) paras 3.36, 4.58.

[4] *Guidelines for States' Systems of Accounting for and Control of Nuclear Materials*, IAEA Safeguards Information Series INF/2 (1980), para 1.34. This guideline was prepared by the IAEA Secretariat with the contribution of a number of experts provided by Member States.

[5] *Safeguards Implementation Practices Guide on Establishing and Maintaining State Safeguards Infrastructure*, IAEA Services Series 31 (2015).

[6] The Committee was open to all IAEA Member States, see David Fischer, *The History of the International Atomic Energy Agency: The First Forty Years* (1997) p. 254.

[7] "Safeguards Agreements in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons: Note by the Director General", IAEA Doc GOV/COM.22/3 (May 29, 1970) p. 11 (Board of Governors document derestricted February 15, 2016) (emphasis added); International Energy Associates, "Review of the Negotiating History of the IAEA Safeguards Document INFCIRC/153", Final Report prepared for the Arms Control and Disarmament Agency (June 30, 1984) Vol II, p. 314.

[8] "Part II of Safeguards Agreements: The Suggestions in Document GOV/COM.22/62: Proposals by Japan", IAEA Doc GOV/COM.22/67 (December 9, 1970) p. 2 (Board of Governors document derestricted February 15, 2016); "Review of the Negotiating History of INFCIRC/153", Vol II, pp. 384-385 (see also p. 315).

[9] "Part II of Safeguards Agreements: The Provisions on International Transfers Suggested in Document GOV/COM.22/62/Rev.1, paragraphs 47-49", IAEA Doc GOV/COM.22/119 (December 9, 1970) p. 2; "Safeguards Committee (1970): Official Record of the Fifty-First Meeting Held at Headquarters, Vienna on Wednesday, 4 November 1970", IAEA Doc GOV/COM.22/OR.51 (August 17, 1973) p. 4 (Board of Governors documents derestricted February 15, 2016); "Review of the Negotiating History of INFCIRC/153", Vol II, p. 523.

[10] "Safeguards Committee (1970): Official Record of the Eighth Meeting Held at Headquarters, Vienna, on Tuesday, 23 June 1970" IAEA Doc GOV/COM.22/OR.8 (December 21, 1970) p. 4 (Board of Governors document derestricted February 15, 2016); "Review of the Negotiating History of INFCIRC/153", Vol I, p. 315. A similar interpretation is adopted in Reinhard H. Rainer and Paul C. Szasz, *The Law and Practices of the International Atomic Energy Agency 1970-1980: Supplement 1 to the 1970 edition of Legal Series No. 7*, IAEA Legal Series 7-S1 (December 1993) pp. 305-306.

[11] "Part II of Safeguards Agreements: The Suggestions in Document GOV/COM.22/62: Amendments Proposed Jointly by Canada, the Federal Republic of Germany, Japan and the United Kingdom of Great Britain and Northern Ireland", IAEA Doc GOV/COM.22/82 (December 9, 1970) p. 2 (Board of Governors document derestricted February 15, 2016); "Review of the Negotiating History of INFCIRC/153", Vol II, p. 386. Similarly, in negotiating the provisions on design information to be made available to the IAEA, the Committee did not accept a proposal by the Secretariat to expressly include information on "measures taken for physical protection" that may be relevant to the application of safeguards: "Agreements between States and the Agency Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons: Structure and Content of Part II: Suggestions by the Director General", IAEA Doc GOV/COM.22/62 (September 17, 1970) p. 9.

[12] "Safeguards Committee (1970): Official Record of the Thirty-Seventh Meeting Held at Headquarters, Vienna, on Friday, 16 October 1970", IAEA Doc GOV/COM.22/OR.37 (May 31, 1972) p. 17 (Board of Governors document derestricted February 15, 2016); "Review of the Negotiating History of INFCIRC/153", Vol II, p. 389.

[13] GOV/COM.22/3, p. 11.

[14] See, e.g., "Safeguards Committee (1970): Provisional Record of the Fifty-Fourth Meeting, Held at Headquarters, Vienna, on Friday, 6 November 1970", IAEA Doc GOV/COM.22/OR.54 (November 13, 1970) p. 6 (Board of Governors document derestricted February 15, 2016); "Review of the Negotiating History of INFCIRC/153", Vol I, p. 269 and Vol II, p. 532; David Fischer, *The History of the International Atomic Energy Agency: The First Forty Years* (1997) pp. 230, 256. During the negotiations of INFCIRC/153, delegations noted that the IAEA was already authorized to provide guidance to States on "physical security" and nuclear material control under article III.A.1 of the *IAEA Statute*: "Safeguards Committee (1970): Official Record of the Fifty-Second Meeting Held at Headquarters, Vienna, on Thursday, 5 November 1970", IAEA Doc GOV/COM.22/OR.52 (September 3, 1973) p. 7.

[15] *The Physical Protection of Nuclear Material*, INFCIRC/225 (September 1975) p. ii. For the current version of this document, see INFCIRC/225/Rev.5.

[16] INFCIRC/153 paragraph 74(c) covers verification of the functioning of "control equipment" during inspections but this appears to be limited to the IAEA's own seals and the containment structures to which they attach.

[17] INFCIRC/153, paras 7, 81(b).

[18] "Physical inventory" has substantially the same definition in the comprehensive safeguards agreements, the *Safeguards Glossary*, and the IAEA's recommendations on NMAC for security. See INFCIRC/153, para 113; *IAEA Safeguards Glossary* (2001 ed, 2002) para 6.41; NSS 25-G, p. 63.

[19] For the example of the failures by Egypt to report to the IAEA in accordance with its obligations under its safeguards agreement prior to 2005, see "Implementation of the NPT Safeguards Agreement in the Arab Republic of Egypt: Report by the Director General", IAEA Doc GOV/2005/9 (February 14, 2005); IAEA, "Safeguards Statement

for 2008" (2009) para 44; Mohamed ElBaradei, *The Age of Deception: Nuclear Diplomacy in Treacherous Times* (New York: Metropolitan Books, 2011) pp. 217-218.

[20] See INF/2, paras 2.4.11, 3.3.3, 3.4.1.

[21] Measures used for flow control impact the procedures for physical inventories, see INF/2, para 3.4.5.

[22] INF/2, para 1.2.4. The IAEA SSAC Advisory Service missions include a review of performance of the SSAC with respect to recommendations in these IAEA guidelines, thereby incorporating the guidance on control measures: *ISSAS Guidelines: Reference Report for IAEA SSAC Advisory Service*, IAEA Services Series 13 (2005), p. 2.

[23] See François Lanave, "The French Centralized Accountancy for Nuclear Materials: A Strong Contributor for Nuclear Security" (Paper presented to IAEA International Conference on Nuclear Security, CN-244-119, Vienna, December 7, 2016).

[24] Services Series 31, pp. 23, 55, 71.

[25] "Subsidiary Arrangement to the Agreement between the Government of […] and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons" IAEA Department of Safeguards Doc SG-FM-1170 (original March 12, 1974, 5th revision, November 2, 2011) Code 3.1.2.

[26] INF/2, para 1.2.1(a).

[27] INF/2, para 1.2.1(b).

[28] INF/2, pp. 5, 17; *Guidance for States Implementing Comprehensive Safeguards Agreements and Additional Protocols*, IAEA Services Series 21 (2016), p. 9; Services Series 31, p. 3; W.I. Zidan and W.A. El-Gammal, "Study of State Systems of Accounting and Control of Nuclear Materials in Some Countries" (2008) 40(2) *Isotope and Radiation Research* 255-275.

[29] See Carlton Stoiber, Abdelmadjid Cherf, Wolfram Tonhauser, and Maria de Lourdes Vez Carmona, *Handbook on Nuclear Law: Implementing Legislation* (2010) p. 4; M. Suzuki et al, "Investigating 3S Synergies to Support Infrastructure Development and Risk-Informed Methodologies for 3S by Design" (Paper presented to Symposium on International Safeguards: Preparing for Future Verification, CN-184/64, Vienna, November 4, 2010).

[30] "Nuclear Security – Measures to Protect against Nuclear Terrorism: Report by the Director General" IAEA Doc GC(50)/13 (August 16, 2006) para 94 (emphasis added).

[31] B.B. Cipiti and M.J. Parks, "Integration of Materials Accountancy and Process Monitoring Data with Physical Protection" (Paper presented to IAEA International Conference on Nuclear Security, CN-244-013, Vienna, December 7, 2016). See generally, INFCIRC/225/Rev.5, paras 3.19, 3.26, 3.28.

[32] Services Series 21, p. 11.

[33] *Nuclear Material Accounting Handbook*, IAEA Services Series 15 (2008), p. 20.

[34] NSS 25-G, para 3.9. Although the guidance documents in the NSS are developed primarily by staff from the Department of Nuclear Safety and Security, staff from other departments and external experts often contribute to the drafting process.

[35] NSS 25-G, para 4.34.

[36] Similarly, the IAEA's guidelines for SSACs note that, in verifying that the operator is meeting the requirements of the SSAC, a national authority (through its audits and inspections) may periodically analyze possible pathways for unauthorized use or theft of nuclear material and formulate control measures to reduce these possibilities: INF/2, para 2.5.2. See also Services Series 31, p. 27.

[37] Contrast the definition of "significant quantity" in Table II of *IAEA Safeguards Glossary*, para 3.14 and the categorization of nuclear material in Table 1 of NSS 13, p. 20.

[38] See definition of "detection probability" in *IAEA Safeguards Glossary*, para 3.16.

[39] NSS 25-G, para 4.13.

[40] INFCIRC/153, para 46(b)(iii). The security MBAs must fit within the boundaries of the safeguards MBA.

[41] IAEA Draft Technical Guidance NST033.