Conflicts and Synergies with International Packaging and Transport Safety, Security, and Safeguards

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ABSTRACT

In recent years, it has been recognized that steps, including evaluations or other actions, are needed to ensure that safety, security and safeguards (the 3S disciplines) during the transport of nuclear material work together, and that conflicts are identified and avoided to the maximum extent possible. In the United States (U.S.), a series of training courses on transport security for nuclear and other radioactive material has been convened at Argonne National Laboratory under the auspices of the U.S. Department of Energy Packaging Certification Program. These courses have focused on both international and domestic U.S. transport, and have recently included information on the interactions among transport 3S disciplines focused only on nuclear material shipments in the U.S. In preparation for a future training course on international transport security, the assessment of the transport 3S disciplines was expanded to address the interactions of the 3S disciplines for international transport. The goal was to gain a better understanding of the synergies and conflicts, addressing multiple areas including regulatory compliance, design, operations, and economics during transport. With a better understanding, steps such as evaluations or other actions, can be taken by stakeholders to maximize 3S synergies and identify and resolve 3S conflicts. A two-phased approach was taken to expanding the international 3S assessment. First, a limited number of international reference documents were reviewed to identify a methodology for gaining the desired comprehensive understanding, which was documented in a paper presented at the Waste Management 2021 Symposia in Phoenix, AZ. Second, a detailed assessment was undertaken with a view to providing a much more comprehensive look at the interactions, interfaces, synergies, and potential conflicts for the international transport 3S disciplines.

This paper provides the details of a comprehensive overview of the second, more detailed evaluation, considering relevant International Atomic Energy Agency (IAEA) requirements, recommendations, and guidance documents for the nuclear material transport 3S disciplines. It lists 25 3S discipline-related topics for consideration and, for each topic, looks at the potential for conflicts and synergies. Of the 25 topics, the detailed 3S assessment identified potential conflicts with 13 of them, and suggested methods for resolving those 13 conflicts are provided. The methodology framework presented in this paper is most effective when applied early in the planning and design phases for transporting packages of nuclear material; and can also be effectively applied when new requirements, recommendations, or guidance for safety, security, or safeguards are issued or when new technology is implemented, such as the ARG-US remote monitoring systems for tracking and monitoring nuclear and other radioactive materials in nuclear fuel cycle facilities and during transportation.

1. INTRODUCTION

Since the September 11, 2001 attacks, a growing and significant emphasis has been placed worldwide on the need for enhanced security during the transport of nuclear as well as other radioactive material and the other classes of dangerous goods.

Commensurate with this increased attention to transport security, it has become apparent that, for the transport of nuclear material, a better understanding is needed concerning the interactions, interfaces, synergies, and potential conflicts among three key disciplines, which are (1) transport safety, (2) transport security, and (3) transport safeguards which are sometimes known as the 3S disciplines (or the “3Ss”). The need to consider the third discipline, safeguards, applies only to nuclear material, since the safeguards discipline applies only to nuclear material.

During the transport of nuclear material, international requirements, recommendations and guidance relating to the 3S disciplines must be simultaneously satisfied. The established international standards for the 3S disciplines for nuclear materials during transport is the focus of this paper.

The significance of the need to understand the interactions among the 3S disciplines may be better understood by recognizing that the worldwide transport of nuclear material is an integral and significant part of the commercial nuclear fuel cycle. Considering just the "back end" of the nuclear fuel cycle, through the end of 2013, more than 370,000 tonnes of used nuclear fuel had been discharged from nuclear power plants worldwide, with about one-third of this (i.e., ~120,000 tonnes) having been reprocessed.[1] Thus, through 2020, about 300,000 t HM are stored at or away from reactors, in wet and dry storage facilities, awaiting recycling or disposal in a repository.[2] In addition, reprocessing results in the recovery of fissile nuclides (small quantities of plutonium and approximately 96 percent of the original uranium[3]) that are either reformulated into fresh nuclear fuel or stabilized for storage and ultimate disposal. All of this nuclear material has been or will be transported in the public domain.

All nuclear material transport stakeholders, including package designers, operators, carriers, shippers, first responders, and government authorities, could potentially benefit from a better understanding of where the 3S disciplines are synergistic and where they may conflict, and how to address such conflicts. Integrating the transport 3S disciplines is both a necessity and a challenge because when one of the three becomes a primary concern, the other two are typically affected and can produce new issues if conflicts are not identified and addressed. The challenge has been characterized as demonstrating that "3S can provide more with less."[4]

For decades emphasis has been placed on safety, both at facilities and during transport. Security had less emphasis placed on it until the September 11, 2001 terrorist attacks in the U.S., but since then security has been given almost equal priority with safety.[5] It has been recognized that nuclear transport safety cannot be isolated from nuclear transport security, and similarly that these two cannot be isolated from nuclear transport safeguards.[6,7,8] Specifically, with respect to applying safeguards to the transport of nuclear material, as more nuclear material has been put into use by more countries, safeguards requirements for transport have received greater attention. It is noted that, in this paper, the term "safeguards" refers to the application of international safeguards requirements imposed by the IAEA to a State's system of accounting for and controlling all nuclear material, and "international safeguards" are based on information concerning nuclear material and features of facilities relevant to such material.

To address the interactions and interfaces between the nuclear material transport 3S disciplines, efforts were initially undertaken at Argonne National Laboratory, supported by the U.S. Department of Energy Packaging Certification Program, to develop the fundamental principles and systematic methodology for addressing 3S interactions with a view to determining synergies and conflicts[6] and to look at those interactions and interfaces at the U.S. domestic level.[7] This effort considered the 3S interactions within the United States (U.S.). In particular, the U.S. regulatory requirements explicitly considered were as follows: (a) For transport safety, Title 10 of the Code of Federal Regulations, Part 71 (10 CFR 71), *Packaging and Transportation of Radioactive Material,*[9] (b) for transport security, Title 10 of the Code of Federal Regulations, Part 73 (10 CFR 73), *Physical Protection of Plants and Materials;*[10] and (c) for transport safeguards, Title 10 of the Code of Federal Regulations, Part 74 (10 CFR 74), *Material Control and Accounting of Special Nuclear Material;*[11] and Part 75 (10 CFR 75), *Safeguards on Nuclear Material—Implementation of US/IAEA Agreement.*[12]

This effort, looking at the interfaces with the 3S disciplines in the U.S., concluded, among other things, that the 3S comprehensive approach is valuable for better understanding and meeting the combined objectives for safety, security, and safeguards; that conflicts between the 3S disciplines can be identified and resolved; and that the interfaces between the three disciplines should be applied early in the package design and transport planning process and continued during transport operations.

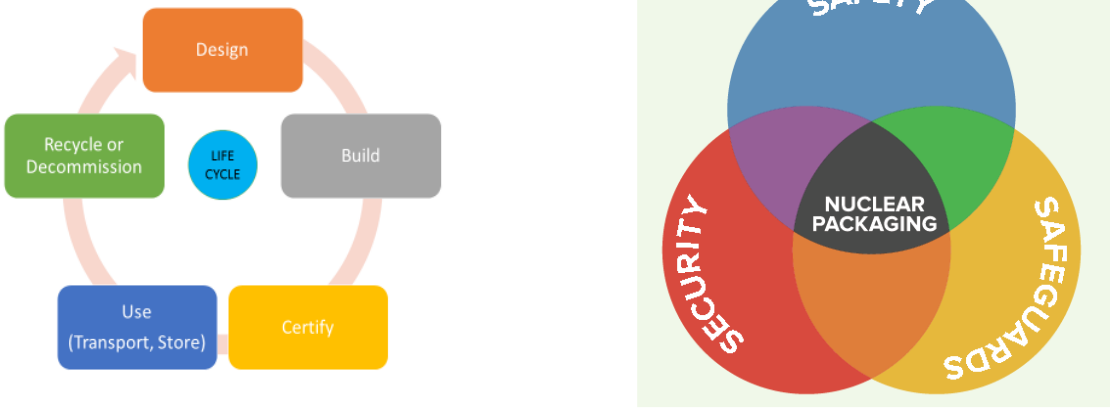
Having considered the 3S disciplines at the U.S. level, it was then decided to expand that consideration to the international arena. This paper provides a comprehensive overview of that effort, with a focus on considering the relevant international requirements, recommendations and guidance documents emanating from the IAEA.

2. BACKGROUND: ASSESSING THE STATUS OF THE 3S DISCIPLINES

Although the principles, applications, regimes, cultures, etc., of the three disciplines in the nuclear industry are well understood individually, the three have to a great extent not been treated collectively. A number of published papers have addressed two of the 3S requirements as pairs: for example, safety and security, security and safeguards, and safeguards and safety. These pairwise relationships sometimes lead to conflicts, sometimes to synergies, and

sometimes to both. Integration of the 3S disciplines has the potential to provide an infrastructure that provides the most cost-effective and resource-efficient design and operation of a nuclear material transport system by fully understanding synergies and/or conflicts and working with all the 3S requirements to optimize their application.

Figure 1(a) depicts the life cycle for nuclear and other radioactive material packaging. Figure 1(b) depicts the separate disciplines of safety, security, and safeguards, their "2S" paired disciplines (depicted in magenta, green and orange), and the 3S united disciplines (depicted in black) for nuclear packaging and the transport of nuclear material.



(a) (b)

Figure 1. (a) Life cycle of packaging of nuclear and other radioactive material and (b) the 3S, three 2S, and three 1S aspects of nuclear packaging

Figures 1(a) and 1(b) together show that packaging is always required for nuclear material during its life cycle of storage, transportation, and disposal. Indeed, safety, security, and safeguards must be maintained at all times during the entire life cycle of the nuclear material. Thus, safety by design, security by design, and safeguards by design for nuclear packaging and transport, when fully integrated, can provide balance and strength to each of the three disciplines.

The following summarizes a number of views on the need for integrating pairs or all three of the disciplines. It is built upon a similar discussion presented by Sanders et al. at PATRAM-2019,[7] but expands upon those arguments in accordance with additional information that has become available since PATRAM-2019.

As noted in the foreword of IAEA Nuclear Security Series No. 11,[13] which was issued in 2009 and was developed in response to a resolution at the IAEA 2002 General Conference, this implementing guide adopted an integrated approach to nuclear terrorism that includes physical protection and material accountancy for the transport of nuclear material, and the promotion of adherence by States to relevant international instruments. The 2009 edition of this guide was superseded by Revision 1 in 2019.[14] These two documents deal with the integration of safety, including radiation protection, and security measures, including measures for the transport of nuclear and other radioactive material (i.e., a 2S approach).

Recently, the IAEA fostered a series of consultants' meetings which looked at how best to interface transport safety and transport security for both nuclear and other radioactive materials[15] (again, a 2S approach). The results of this effort will be the issuance by the IAEA of a technical report (TRS No. 1001, anticipated to be titled *Managing the Interface Between Safety and Security for Normal Commercial Shipments of Radioactive Material*), and a set of workshop materials to facilitate training on this 2S transportation issue in developing countries. The technical report and workshop materials include discussion of the 2S interface for consignments of nuclear materials having low activities.

The most frequent approach to interactions among the 3S disciplines has been to address safety and security only (i.e., 2S), where security sometimes has included material control and accounting (MCA). At the 2018 IAEA General

Conference, a resolution was passed that acknowledged the distinctions between safety and security, affirmed the importance of addressing their interfaces, and encouraged the IAEA to strive to ensure the consistency of the terminology.[16] In what follows in this paper, it is shown that a number of discrepancies still exist in the terminology used in the three disciplines.

It is also common to address the interactions between security and MCA, but not their interactions with safety. For example, for security purposes, detailed information about the transport of nuclear material should be protected as sensitive information until the movement is complete; however, this protection should not conflict with notification requirements for MCA.[17] Other 2S pairings can also exhibit gaps, including the following:

- Interactions between security and safety should address interactions with MCA. For example, it is recognized that nuclear security and safety considerations for transport of nuclear material should work in concert. In assessing the potential for sabotage, the safety features of the package and conveyance and the nuclear security measures to prevent unauthorized removal should work in concert. Facilities can benefit from a safety and security culture built and maintained for the management of safety-security interfaces.[18]
- Interactions between physical protection and MCA should address interactions with safety. An in-depth defense of materials should take into account the ability of the physical protection system and the MCA system to protect against both insider and external threats. These two disciplines together should also deter and detect the protracted theft of nuclear material by an insider.[19]

When building the capacity for nuclear security, there will be direct interfaces with nuclear safety and nuclear MCA. In 2S interactions, basic capabilities may be the same: for example, using equipment to detect and identify nuclear and other radioactive material. Multiple professional competencies, based on education and experience, may be maintained by staff. It is most effective and efficient if the management system, procedures, and personnel take maximum advantage of shared capabilities, equipment, and resources and work together to achieve goals.[20]

An IAEA publication[21] addressed interactions between nuclear material control (MCA) and nuclear security (2S) in production, processing, use, storage and movement (although nuclear material control should continue during off-site movement of nuclear material). Using the appropriate administrative and technical measures ensures that nuclear material is not misused or removed without proper authorization. Control of nuclear material should be coordinated among all organizational units involved. Physical protection measures and MCA measures should be coordinated and should complement each other, recognizing the same technical measures may serve both disciplines. The operator should assess and manage the interfaces to prevent adverse effects, and activities should be mutually supportive, to the extent possible.

The IAEA Safety Standards Series has addressed both safety and security by noting that safety measures and security measures must be designed and implemented in an integrated manner so that security measures do not compromise safety, and safety measures do not compromise security.[22,23] The Standards Series extended this approach to 3S discipline interactions in *Principal Technical Requirement No. 8, Interfaces of Safety with Security and Safeguards*, which states that 3S measures should be designed and implemented in an integrated manner so they do not compromise one another.[24]

The IAEA Nuclear Security Series also notes that for new nuclear facilities, site selection and design should take physical protection into account as early as possible and address the interface between physical protection, safety, and MCA to avoid conflicts and to ensure that all three elements support each other. More specifically, the safety features of the design of the transport package, container, and conveyance should be taken into account when deciding what additional physical protection measures are needed to protect the material against sabotage.[5] Subsequent reports in this series further note the importance of addressing all 3S disciplines.[25,26,27]

Interfaces among safety, security, and safeguards, including MCA, should be coordinated during each phase of development of a nuclear power program, taking into account related requirements for each. In particular, the management system has a key role to play in reinforcing the interfaces and taking into account their commonalities and differences. For new facility site selection and design, 3S interfaces should be considered as early as possible to avoid any conflicts and to ensure complementarity. Consignors and carriers should develop an integrated transport security plan.[28] Safety in the transport of radioactive material relies primarily on the performance of packages. It is the consignor's responsibility to ensure the appropriate selection of the packaging and the mode of transport.

Although focused on safety, some IAEA standards recognize the importance of integrating 3S disciplines at the national authority level.[29,30] U.S. NRC regulations 10CFR73.55 and 10CFR73.58 address the safety and security (2S) interface at nuclear power reactors, including a review of the security program with an audit of the effectiveness of safety and security interface activities. For the transport of spent nuclear fuel, 10CFR73.38(b) sets a performance objective for personnel which requires that they do not constitute an unreasonable risk to public health and safety or the common defense and security. Regulation 10CFR73.38(c)(ii) also addresses safety and security. When potential conflicts are identified, the licensee must communicate them to appropriate licensee personnel and take compensatory actions to maintain safety and security.[31]

In addition, the U.S. NRC provides guidance for managing the safety-security interface (2S) by nuclear power plant licensees, an important element for achieving the objectives of both safety and security. The licensee should address activities, including the handling, storage and preparation for transport of spent nuclear fuel, that could compete or conflict. Procedures should be reviewed and should provide a means for resolving conflicting or competing safety and security interests. The licensee should also provide training to managers involved in the process of facilitating the interface between safety and security.[32]

Recognizing the need to achieve a better understanding of the interactions and interfaces among all of the 3S disciplines related to the transport of radioactive material, including the transport of those materials associated with the nuclear fuel cycle, Argonne National Laboratory has developed a training series on Nuclear and Other Radioactive Materials Transport Security, which includes a module on how to address the interactions of safety, security, and safeguards requirements.[33,34] Training materials include a preliminary discussion of the interfaces between the 3S disciplines for transportation of nuclear and other radioactive materials in the U.S.

The preceding illustrates that multiple efforts have been made to address and better understand the interfaces between two and sometimes all three of the 3S disciplines, some for transport and others for facilities. It also illustrates the need for a comprehensive assessment of the 3S interfaces for the transport of nuclear material from the international perspective. It has been recognized that totally independent 3S systems are likely to introduce conflicts and duplication. Thus, a comprehensive assessment of the 3S disciplines needs to fully take into account potential conflicts and synergies. It needs to start with a reconciliation of the threats and objectives for the three disciplines. It is important that the objectives for the 3S systems are compatible and mutually supportive. In defining an approach for analyzing 3S interrelationships, it is helpful to identify a working definition of the corresponding threats and objectives.

The three main aspects of nuclear law for the 3S disciplines are as follows:[35]

- Safety: Unintended conditions or events leading to radioactive releases from authorized use
- Security: Intentional misuse of nuclear or other radioactive materials
- Safeguards: Activities that could lead to the acquisition of nuclear weapons

These three aspects independently address the following three corresponding risks:

- Safety risk: Accident due to system failure, human error, or natural disaster
- Security risk: Terrorism due to sabotage, external attack, or inside malicious act
- Safeguards risk: Diversion or misuse of nuclear material for non-peaceful purpose

Based on those risks, the following become objectives:

- Safety: Protect people and the environment from radiation.
- Security: Protect nuclear and other radioactive materials and facilities from malevolent people.
- Safeguards: Protect people and the environment from malevolent people.

Collectively, the overall objective of the 3S disciplines for the transport of nuclear material is the protection of human life, health, property, and the environment. Thus, each of the 3S disciplines must be designed and implemented in an integrated manner so that the collective and individual objectives are harmonized.

3. METHODOLOGY FOR COMPREHENSIVELY ASSESSING THE INTERNATIONAL ASPECTS OF THE 3S DISCIPLINES FOR NUCLEAR MATERIAL TRANSPORT

The comprehensive assessment, which is elaborated in detail in Sections 4, 5 and 6 was undertaken considering a suite of relevant international regulatory documents relating to transport safety, transport security and transport safeguards. The documents considered are as follows:

1. For transport safety:
   a. IAEA SSR-6 (Rev. 1) – 2018 edition [Recommendations],[23] and
   b. IAEA SSG-26 [Guidance][36];
2. For transport security:
   a. IAEA INFCIRC/225/Rev.5 (IAEA NSS No. 13) [Recommendations],[5]
   b. IAEA NSS No. 20 [Fundamentals],[27]
   c. IAEA NSS No. 26-G [Guidance],[18]
   d. The Convention on the Physical Protection of Nuclear Material (CPPNM),[37] and
   e. The Amendment to the CPPNM.[38]
3. For transport safeguards:
   a. IAEA INFCIRC/153 (Corrected) [Negotiating Basis for Safeguards Agreements],[39] and
   b. IAEA INFCIRC/540 [Model Protocol Additional to Safeguards Agreements].[40]

Also considered for the assessment, as needed, were the IAEA glossaries for each of the 3S disciplines,

For transport safety and security, it is noteworthy that all of the above-noted IAEA references, with the exception for transport security of the CPPNM and its Amendment, are not directly legally-binding; they set forth fundamentals, recommendations, or guidance. The CPPNM and its Amendment become legally binding upon IAEA Member States through States being party to relevant international modal conventions and agreements (fostered by international or regional modal organizations), and also through individual States adopting the measures in those documents into their domestic regulatory documents.

The CPPNM and its Amendment become legally binding upon States when they become party to the Convention and its Amendment. As of 17 April 2021, 162 States were party to the CPPNM,[41] and 125 States were party to its Amendment.[42]

With respect to safeguards, the measures specified in INFCIRC/153 and INFCIRC/540 become legally binding when a State and the IAEA negotiate a Safeguards Agreement based on INFCIRC/153 and INFCIRC/540.

The comprehensive assessment reported herein was undertaken in two phases. First, a limited number of international reference documents were assessed to identify a methodology for gaining the desired comprehensive understanding. Second, a much more detailed assessment was then undertaken with a view to providing a comprehensive look at the interactions, interfaces, synergies, and potential conflicts for the international transport 3S disciplines.

The first portion of the assessment utilized just the following documents:

- for transport safety, IAEA SSR-6 (Rev. 1) (2018 edition) [Recommendations];[23]
- for transport security, the Convention on the Physical Protection of Nuclear Material (CPPNM)[37] and the Amendment to the CPPNM;[38] and
- for transport safeguards, IAEA INFCIRC/153 (Corrected) [Negotiating Basis for Safeguards Agreements][39] and IAEA INFCIRC/540 [Model Protocol Additional to Safeguards Agreements].[40]

The results of that preliminary assessment were presented at the Waste Management 2021 Symposium, convened in Phoenix, AZ, USA, in March 2021.[43] The results of that preliminary assessment served as a foundation, i.e., a starting point, for the much more comprehensive assessment of the 3S interactions for transport that is presented here. That assessment, as summarized below, was performed by identifying multiple topics that are addressed within the international regulatory 3S documents, listing relevant transport safety, security and safeguards measures that are required or recommended and for which guidance is provided and, by comparing these measures, identifying specific potential conflicts, potential resolutions to conflicts, and/or potential synergies for each of the topics.

Hereinafter, the terms "*international regulatory documents*" or "*international regulatory 3S documents*" refer to those

documents issued by the IAEA or for which the IAEA is responsible, which may be:

- required for a State because that State is party to a relevant convention (e.g., the CPPNM[37] and its Amendment[38]); or
- required for safeguards when incorporated by a State into a safeguards agreement based on INFCIRC/153 and INFCIRC/540; or
- identified as "*fundamentals*" (e.g., IAEA NSS No. 20[27]); or
- identified as "*regulations*" (e.g., IAEA SSR-6 (Rev. 1)[23]), which are in fact recommendations; or
- identified as "*recommendations*" (e.g., IAEA NSS No. 13[5]); or
- identified as "*implementing guidance*" or "*guide*" (e.g., IAEA NSS No. 26-G[18]).

In this assessment, twenty-five (25) topics were identified, categorized, and then evaluated. The topics were categorized based upon whether the responsibility for applying the provisions for that topic applies primarily to one of three entities: (1) internationally to the IAEA, (2) nationally to the regulators, or (3) internationally and/or nationally to industry operators. Although the responsibility for applying a given topic may primarily apply to one of the entities, in many cases the responsibility may also apply to one or both of the other entities.
For the purposes of this evaluation:

- The term "regulators" applies to competent authorities, State regulators, regulatory bodies, the State, and in some cases the IAEA itself can be viewed as a regulator. The term may also apply to customs and border control agencies, intelligence agencies, health and environment agencies, national emergency response agencies, ministries of justice and prosecuting authorities, and ministries of foreign affairs depending on how the individual 3S documents use these words and how they are applied at the State level.
- The term "operators" applies to those entities identified as operators, consignors, consignees, shippers, receivers, carriers, licensees, license holders, authorized organizations, and authorized persons depending on how the individual 3S documents use these words.

The topical breakdown, the categorization in terms of the entity's responsibility, and the section of this paper in which each is discussed are listed in Tables 3-1, 3-2 and 3-3. In these tables, "P" denotes primary responsibility, "S" denotes subsidiary responsibility, and "N" denotes no responsibility.

The seven topics identified in Table 3-1 are discussed in detail in Section 4. This includes the basis used for determining that the IAEA has the primary responsibility for applying each of these topics with respect to transport safety, security, and safeguards. It is noteworthy that all three entities have primary responsibility for applying topics 3 and 4; and, for topic 3 (Responsibilities for Applying 3S Provisions), the responsibility of the IAEA is mixed depending upon the specific 3S topic and its relevant documents.

Table 3-1. Categorization of Topics for Primary Responsibility of the IAEA – Discussed in Section 4

Topic No.	Functions Relating to Establishing and Maintaining 3S Regulatory Requirements and Guidance	Entity's Responsibility (P=primary; S=subsidiary, and N = No Responsibility)		
		IAEA	Regulators	Operators
1	Assessment of the Basis of the 3S Requirements	P	N	N
2	Objectives of the 3S Recommendations and Guidance	P	N	N
3	Responsibilities for Applying 3S Provisions*	P & S	P	P
4	Ensuring Development of Appropriate Cultures and Regimes*	P	P	P
5	Applying the Graded Approach Concept	P	S	S
6	Applying the Defense-in-Depth Concept	P	S	S
7	Facilitating Understanding of Regulatory Definitions*	P	S	S

* Potential conflicts identified.

The seven topics identified in Table 3-2 are discussed in detail in Section 5. This includes the basis used for determining that the regulators have the primary responsibility, or in many cases the regulators and operators jointly have primary responsibility, for applying each of these topics with respect to the 3S disciplines listed. it is noteworthy that the national (domestic) regulators have primary responsibility for all seven topics listed, and that this primary responsibility is shared with the operators for six of the seven topics. This illustrates how these two entities need to work closely together in addressing issues related to those topics.

Table 3-2. Categorization of Topics for Primary Responsibility of the Regulators – Discussed in Section 5

Topic No.	Functions Relating to Establishing and Maintaining 3S Regulatory Requirements and Guidance	Entity's Responsibility (P=primary; S=subsidiary, and N = No Responsibility)		
		IAEA	Regulators	Operators
8	Implementing the Roles of Competent Authorities: Issuing Approvals and Facilitating Oversight*	S	P	S
9	Performing Compliance Actions	S	P	P
10	Imposing Provisions for Ensuring Adequate Safety, Security and Safeguards Interfaces*	N	P	P
11	Ensuring Adequate Personnel Training	S	P	P
12	Overseeing Radiation Protection	S	P	P
13	Applying Management Systems, Compliance Assurance, Quality Assurance, and Quality Control*	S	P	P
14	Implementing Transport Operational Controls*	S	P	P

* Potential conflicts identified.

The eleven topics identified in Table 3-3 are discussed in detail in Section 6. This includes identifying that the operators have the primary responsibility for all eleven topics, or in three cases that the regulators and operators jointly share primary responsibility, for applying each of these topics with respect to the 3S disciplines.

Table 3-3. Categorization of Topics for Primary Responsibility of the Operators -Discussed in Section 6

Topic No.	Functions Relating to Establishing and Maintaining 3S Regulatory Requirements and Guidance	Entity's Responsibility (P=primary; S=subsidiary, and N = No Responsibility)		
		IAEA	Regulators	Operators
15	Applying Physical Controls of Nuclear Material	N	S	P
16	Imposing Administrative Requirements and Controls*	S	P	P
17	Implementing Operational Controls, Information Security, and Transport Control Centres (TCCs)*	S	S	P
18	Applying Measures and Controls Based on Characteristics, Radioactivity, Mass Levels, and Risks*	S	S	P
19	Controlling Contamination, Leakage of any Radioactive Material, and Subcriticality of Nuclear Material*	S	S	P
20	Undertaking Inspections*	P	P	P
21	Addressing Radiological Emergencies, Preparedness and Response	S	P	P
22	Facilitating Material Control and Accountability	S	S	P
23	Applying Controls for Small Quantities of Nuclear Material in the International 3S Transport Regulatory Documents*	N	N	P
24	Addressing Subsidiary Hazards Associated with the Other Classes of Dangerous Goods	N	N	P
25	Considering Measures & Functions not Fully Covered in all of the 3S Transport Regulatory Documents	S	S	P

* Potential conflicts identified.

As shown in Tables 3-1 to 3-3, the detailed 3S assessment has identified potential conflicts and has suggested methods for resolving those conflicts with thirteen of the twenty five topics (as identified with asterisks).

Finally, it is worth noting that the recent IAEA 2S evaluation for the transport safety and security interface for low activity radioactive material, *Managing the Interface Between Safety and Security for Normal Commercial Shipments of Radioactive Material*[15] identified potential conflicts (called inconsistencies in that document) for twenty functional tasks. These potential conflicts for such normal commercial shipments considered the provisions set forth in SSR-6[23] for transport safety, and in IAEA NSS No. 9-G[44] and IAEA NSS No.14[45] for transport security. Although the focus of the normal commercial shipments evaluation was on non-nuclear radioactive material, its results are consistent with those discussed in Sections 4, 5 and 6 of this document. Inclusion of NSS No. 9-G and IAEA No. 14 in the current evaluation would not have added any additional synergies or potential conflicts.

4. COMPREHENSIVE EVALUATION OF PRIMARY RESPONSIBILITES OF THE IAEA

This Section provides the results of the detailed consideration of each of the seven topics for which the application of each topic is primarily the responsibility of the IAEA, or in the case of Topics 3 and 4 where the primary responsibility for application lies with all three entities. It includes a detailed comparison of relevant text from the IAEA regulatory documents that served as a basis for determining primary responsibilities, potential conflicts, suggested resolutions to the conflicts when such were identified, and/or potential synergies.

4.1. Topic No. 1 – Basis of the 3S Requirements

In assessing the basis for developing and applying the 3S requirements, it is recognized that the IAEA has the primary responsibility for establishing 3S transport requirements and supporting documents and encouraging their use worldwide. The driving factors behind these efforts were assessed as follows:

- For safety, the IAEA was directed in 1959 by the United Nations Economic and Social Council (ECOSOC)[46] to "*inform the International Atomic Energy Agency of the desire of the Council that the Agency be entrusted with the drafting of recommendations on the transport of radio-active substances*". This resulted in the IAEA issuing and updating its Regulations for the Safe Transport of Radioactive Material, the latest edition of which is SSR-6[23].
- For security, a primary driving factor was the establishment of the CPPNM[38], for which the IAEA is the custodian; and in support of which multiple IAEA Nuclear Security Series documents have been issued.
- For safeguards, the IAEA was given the responsibility under the NPT and IAEA Statute to negotiate legally binding Safeguards Agreements with States. The IAEA then enforces the Agreement on the basis of reports from the State and IAEA inspections at operator facilities following the State regulatory requirements for international safeguards.

Table 4-1 compares the basis for the provisions of the international regulatory documents for the 3Ss considering the above mandates.

Table 4-1. Assessment of the Basis of 3S Requirements in International Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/ Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§101: Background and basis for SSR-6: SSR-6 (Rev. 1) (2018): this IAEA Specific Safety Standards Requirements document establishes standards of safety for the control of the radiation, criticality and thermal hazards to people, property and the environment that are associated with the transport of radioactive material, including the transport of fissile (nuclear) material. These standards are made mandatory through actions by international and regional modal authorities and by individual IAEA Member States.	**CPPNM:** The CPPNM was opened for signature on 3 March 1980. It entered into force on 8 February 1987. As of 20 September 2020, 162 IAEA Member States are party to the CPPNM. **CPPNM-A:** The Amendment to the CPPNM entered into force on 8 May 2016. As of 28 September 2020, 125 IAEA Member States are party to the Amendment.	**Treaty on the Non-Proliferation of Nuclear Weapons/Article III.1**: As party to the Treaty, the State undertakes to accept safeguards, as set forth in a Safeguards Agreement negotiated with the IAEA in accordance with the Statute of the IAEA and the IAEA safeguards system. **IAEA Statute Article III.A(5):** The IAEA is authorized to establish and administer safeguards and to apply safeguards. **153/§1:** INFCIRC/153 is a model Safeguards Agreement undertaken by the State to accept safeguards on all source or special fissionable material. **540/Foreword, para. 1:** INFCIRC/540 is a model Additional Protocol designed for States having a Safeguards Agreement with the IAEA. **540/§1:** The provisions of the Safeguards Agreement shall apply to this Additional Protocol.

From this comparison, the following assessment of the potential for conflicts and potential synergies with respect to the basis of requirements results in the following:

- **Potential Conflicts**: There are no apparent conflicts with respect to the basis of the requirements in the 3S regulatory documents. The fundamental bases for each of the 3S disciplines, from the international perspective, are mutually supportive.

- **Potential Synergies:** There are separate but similar mechanisms in place at the IAEA for developing, implementing, and maintaining the 3S regulatory documents at the IAEA which, in general, complement each other.

4.2. Topic No. 2 – Objectives of the 3S Recommendations and Guidance

Historically, since the formation of the IAEA, the IAEA has worked with representatives from Member States, intergovernmental organizations (IGOs) and non-governmental organizations (NGOs) to develop comprehensive sets of recommendations and guidance intended to implement the 3S disciplines for the transport of nuclear and other radioactive material, and to clearly specify the objectives of each. The development of transport safety provisions has been guided initially by the IAEA's Standing Advisory Group for the Safe Transport of Radioactive Material (SAGSTRAM) which, over time has been restructured as the IAEA's Transport Safety Standards Committee (TRANSSC). The development of security provisions has been guided by the Nuclear Security Guidance Committee (NSGC). The development of safeguards provisions has been guided by the Standing

Advisory Group on Safeguards Implementation (SAGSI). It is noteworthy that this paper does not strive to address objectives or purposes or goals at the State level; the focus is rather on these issues at the international level.

Table 4-2 compares the objectives of the 3S recommendation and guidance documents. It is noted that, because this comparison was looking only at "recommendations" and "guidance",

- for security, this comparison did not consider the national "requirements" resulting from the CPPNM and its Amendment that are imposed on States Party to the Convention and the Amendment, and similarly
- for safeguards, this comparison did not consider the national "requirements" that result from individual States' safeguards agreements with the IAEA.

Table 4-2. Objectives of the 3S Recommendations and Guidance in International Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 {INFCIRC/225/Rev.5}, NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures INFCIRC/153 & INFCIRC/540
SSR-6 & SSG-26/Foreword: These documents provide a comprehensive set of safety standards which are under regular review and serve as a key element for a stable and sustainable global transport safety regime. **SSR-6/§102:** SSR-6 is supplemented by multiple safety guides, including SSG-26, TS-G-1.2 (ST-3), TS-G-1.3, TS-G-1.4, TS-G-1.5, and SSG-33. [NOTE: the first edition of the IAEA Regulations for the Safe Transport of Radioactive Material dates back to SS6, published in 1961. Multiple editions of the Regulations and associated guidance documents have been issued since then.] **SSR-6/§104:** The objective of SSR-6 includes establishing requirements to ensure safety and to protect people, property, and the environment from harmful effects of ionizing radiation during transport of radioactive material. This objective is achieved by: (a) containment of radioactive contents, (b) control of external dose rates, (c) prevention of criticality, and (d) prevention of damage caused by heat. **SSG-26/§722.1:** Additional tests for fissile (nuclear) material packages have been established in part with the objective to introduce a measure of consistency into the transport package testing regime.	**CPPNM/Article 2.1; & CPPNM/A – Articles 1A and 5.1:** The purposes of the Convention are (a) to achieve and maintain worldwide effective physical protection of nuclear material used for peaceful purposes, (b) to prevent and combat offences relating to such material … worldwide, and (c) to facilitate co-operation among States that are Parties to those ends. The Convention applies to nuclear material used for peaceful purposes while in international transport and, for some of the provisions in the CPPNM, to domestic transport. **NSS No. 20/§1.11:** The nuclear security fundamentals are intended to assist Member States in enhancing nuclear security. They include the Fundamentals that appear in the Amendment to the CPPNM. **NSS No. 13/§1.8:** These recommendations have the objective of assisting Member States in implementing a comprehensive transport physical protection regime, addressing obligations and commitments that they have as parties to the Amendment to the CPPNM. [NOTE: NSS No.13 is the fifth revision of INFCIRC/225, reflecting the requirements set forth in the Amendment to the CPPNM.] **NSS No. 26-G/§1.3:** Although NSS No. 13 (i.e., INFCIRC/225/Rev.5) provides recommendations on the physical protection of nuclear material in transport, it does not give detailed guidance on implementation and compliance responsibilities for the transport of nuclear material. Thus, an objective of NSS No. 26-G is to provide additional guidance to assist States' competent authorities and shippers or carriers in fulfilling their physical protection responsibilities in the transport of nuclear material.	**153/Preface:** The IAEA Board of Governors has requested the IAEA Director General to use INFCIRC/153 as the basis for negotiating Safeguards Agreements with individual States. **540/Foreword, para. 1:** This document is a model Additional Protocol which is designed with the objective to strengthen the effectiveness and improve the efficiency of the safeguards system as a contribution to global nuclear non-proliferation objectives. **540/Foreword, para. 2:** The IAEA Board of Governors has requested the IAEA Director General to use INFCIRC/540 as the standard for the Additional Protocol concluded by a State. **153/§2:** The IAEA has the right and obligation to ensure that safeguarded nuclear material is not diverted to nuclear weapons or other nuclear explosive devices. **153/§28:** The objective of safeguards is timely detection of diversion of significant quantities of nuclear material and deterrence of diversion by the risk of early detection. **153/§29:** Use of material accountancy is of fundamental importance; and containment and surveillance are important complementary measures. **153/§30:** The Safeguards Agreement provides that the technical conclusion of the IAEA verification activities shall be a statement, with respect to each material balance area, of the amount of material unaccounted for over a specific period, giving the limits of accuracy of the amounts stated. **153/§§39–40:** Subsidiary Arrangements (General Part and Facility Attachments) shall specify in detail how the procedures laid down in the Safeguards Agreement are to be applied. **540/§1:** The provisions of the Safeguards Agreement shall apply to the Additional Protocol.**540/§13:** Subsidiary Arrangements shall specify how measures laid down in the Protocol are applied.

From this comparison, the following assessment of the potential for conflicts and synergies with respect to the objectives and guidance in international documents results in the following:

- **Potential Conflicts**: There are no apparent conflicts with respect to the objectives for recommendations and guidance for the 3S disciplines. For each of the 3S disciplines, care has typically been exercised by the IAEA in developing recommendation and guidance documents so as not to introduce conflicts within documents for each of the 3S disciplines.

- **Potential Synergies:** The IAEA documents for transport safety, transport security, and transport safeguards each address the need to have sustainable mechanisms for applying the recommendations and guidance. For example:
  - For safety, in the Foreword to SSR-6, it is noted that having a high-quality set of safety standards is a key element for having a stable and sustainable global safety regime.
  - For security, Article 2A, para. 1 of the Amendment to the CPPNM infers that, for security, a security regime for transport is the programme established by a State with the purposes of (a) protecting against theft and other unlawful taking of nuclear material in transport; (b) ensuring the implementation of rapid and comprehensive measures to locate and, where appropriate, recover missing or stolen nuclear material; (c) protecting nuclear material against sabotage; and (d) mitigating or minimizing the radiological consequences of sabotage.
  - For safeguards, the IAEA Board of Governors has requested the IAEA Director General to use INFCIRC/153 and INFCIRC/540 as the basis for negotiating legally binding Safeguards Agreements with States.

4.3. Topic No. 3 – Responsibilities for Applying 3S Provisions

The 3S documents establish responsibilities imposed on both the IAEA and the States for application of the relevant transport provisions therein.

For transport safety, the IAEA has no direct responsibilities with Member States to apply and/or enforce the provisions of the Transport Regulations (SSR-6). It only provides recommendations; whereas it is the responsibility of the States to establish a competent authority and introduce the provisions of the Transport Regulations into the State's legal system. Specifically:

- the IAEA only recommends, it is up to the State to establish a Competent Authority (CA) and regulate based on the IAEA recommendations (SSR-6), except
- for the different modes of transport (road, rail, air, and water), States that are party to the relevant conventions and agreements are bound by those documents which mimic SSR-6 (and for nuclear material, NSS13)

For transport security,

- the IAEA monitors State's compliance with the CPPNM and its Amendment for NM, otherwise
- the IAEA only recommends per the NSS documents; it is up to the State to establish a competent authority and to regulate based (as the State chooses) according to the IAEA guidance.

For transport safeguards,

- the IAEA negotiates a legally binding Safeguards Agreement with the State; and then
- the IAEA enforces the Agreement on the basis of reports from the State and IAEA inspections at operator facilities, which are under the State regulatory requirements for international safeguards.

Table 4-3 compares the responsibilities for applying provisions from the relevant international regulatory documents for the 3S disciplines at the IAEA and the State level.

Table 4-3. Responsibilities for Applying 3S Provisions of the International Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§103: Responsibility for transport safety actions is not assigned in SSR-6. Since responsibility may vary according to the laws and customs of different countries (Member States) and international conventions and agreements, each government has the prerogative to assign responsibilities. **SSR-6/§105:** Management systems – Confidence in compliance with SSR-6 is achieved through the application of management systems and compliance assurance. **SSG-26/§103.1:** When making national or international shipments, it is necessary to consult the regulations for the particular mode of transport to be used for the countries where the shipment will be made since there can be differences with respect to the assignment of responsibilities. **SSG-26/§103.3:** Although the Transport Regulations are non-binding for adoption or implementation by States, the responsibility for adoption and incorporation at the State level is imposed by the Transport Regulations by the international transport regulatory organizations does make compliance mandatory by States. **SSG-26/§103.4:** The State has the responsibility to impose the Transport Regulations based on the presumption that a national infrastructure is put into place thereby enabling the government to discharge its responsibilities for transport safety. **SSG-26/§103.64:** The Transport Regulations are also recommended for adoption by Member States in their national regulations for transport of dangerous goods. **SSG-26/§722.1:** Additional tests for fissile (nuclear) material packages have been established in part to introduce the responsibility for establishing a measure of consistency into the package testing regime with a view to ensuring criticality safety during transport and storage incidental to transport.	**CPPNM-A/§3.A; & NSS No. 20/§1.4:** Responsibility for a transport physical protection regime within a State rests entirely with that State. Recognizing the assignment of responsibilities for nuclear transport security together with nuclear transport safety and applicable transport safeguards is essential. **CPPNM-A/Fundamental Principles C and D; & NSS No.13/§§3.8+, 3.17+, 3.18:** The State is responsible for a legislative framework to govern physical protection. The State should establish or designate a competent authority which is responsible for implementation of the legislative and regulatory framework; is provided with adequate legal authority, competence, and financial and human resources to fulfil its assigned responsibilities; and is responsible for verifying continued compliance with physical protection regulations and license conditions through regular inspections while ensuring corrective actions is taken when needed. **CPPNM-A – Fundamental Principle E; & NSS No.13/§3.22+:** The responsibility for implementing transport physical protection rests with the shippers. **CPPNM-A/§3.B:** Responsibility of a State for ensuring nuclear material is adequately protected extends to the international transport thereof until that responsibility is transferred to another State. **NSS No.13/§3.2+; Fundamental Principle B/§3.3:** The responsibility of a State for ensuring that nuclear material is adequately protected extends to international transport thereof, as appropriate; where a State's responsibility for physical protection should be determined either by the borders of the sovereign territory or the flat of registration of the transport vessel or aircraft, and where a State's responsibility for international transport should extend to the carriage of material on board ships or aircraft registered to that State while in international waters or airspace and until the receiving State acquires jurisdiction. **NSS No.13/§§3.7, 3.8:** Clear lines of responsibility should be established between relevant entities including operators and shippers. If transport is accompanied by armed guards, the responsibility for physical protection measures should be the subject of written arrangements accepted by the States concerned. The point at which responsibility is transferred between States should be stated in advance and in sufficient time. The State should clearly define and assign clear lines of physical protection responsibilities within all levels of involved governmental entities and for operators and, if appropriate, carriers. **NSS No.13/§3.22+; Fundamental Principle E/§3.25:** The responsibilities for implementing the various elements of physical protection within a State should be clearly defined, and should rest with the operators or shippers, who should cooperate and coordinate with State physical protection entities such as response forces.	An IAEA Safeguards Agreement with a State is legally binding on both parties to the agreement (i.e., on both the State and the IAEA), thereby establishing State and IAEA responsibilities. **153/§1:** The Safeguards Agreement should contain a basic undertaking by the State to accept safeguards in accordance with the Treaty on the Non-Proliferation of Nuclear Weapons. **153/§7:** The State has the responsibility to establish a national system of accounting for and control of nuclear material. **153/§31–32:** The IAEA has the responsibility to make full use of the national system, which shall be based on a structure of material balance areas. **153/§34: Starting Point of Safeguards** --- States have the responsibility to notify the IAEA when nuclear material is imported, and the nuclear material shall become subject to safeguards. **153/§§39, 40:** The IAEA and the State have the responsibility to specify in Subsidiary Arrangements, in detail, how agreed-upon procedures are to be applied. **153/§91:** The responsibility of a State for ensuring nuclear material is safeguarded extends to the international transport until that responsibility is transferred to another State. **153/§§92-97:** The IAEA shall be notified of transfers out of and into a State. **540/§1:** Provisions of the Safeguards Agreement shall apply to the Protocol. **540/§2.a(ix), 3.d, §3.g:** The State has the responsibility to provide information to the IAEA regarding exports and imports. **540/§13:** The IAEA and State shall specify in Subsidiary Arrangements how the Protocol is applied.

From this comparison, the following potential conflict and suggested conflict resolution with respect to responsibilities for applying 3S provisions were identified as follows:

- **Potential Conflict:** For transport safeguards, the State's Regulatory State Authority (RSA) is responsible for negotiating a legally binding and enforceable safeguards agreement with the IAEA for assuring the safeguards community that IAEA safeguards provisions for transport are uniformly applied within the State. The RSA also is responsible for promulgating and legally enforcing regulations for operators that conform with the conditions of the safeguards agreement that are negotiated with the IAEA.

For transport safety and security, IAEA safety standards are not enforced internationally by the IAEA, but the State's Competent Authority is responsible for promulgating and legally enforcing transport safety and security regulations for operators generally based upon the IAEA 2S documents. In either case, where the operator accepts credit for adhering to the State's imposed regulations, the operator is typically legally responsible to the Competent Authority for implementing the provisions.

Thus, the States involved in a shipment of nuclear material are responsible for assigning safety and security responsibilities for shipments undertaken within each involved State and for shipments undertaken by conveyances flagged by a State, whereas transport safeguards responsibilities are negotiated between the State and the IAEA.

- **Suggested Conflict Resolution:** Responsibility for applying 3S provisions at the State level must be shared by the State's safety, security and safeguards regulatory bodies and the operators. Conflicts potentially arise where there are gaps in the regulatory process where operators lack understanding and familiarity with the different regulatory requirements for safety, security, and safeguards. Therefore, it is incumbent on the regulatory bodies to (a) resolve as much as possible conflicts between their 3S regulatory provisions, and (b) reach out to operators and ensure that they have the opportunity to understand and effectively implement each of the safety, security, and safeguards disciplines according to the appropriate separate regulations promulgated by those regulatory bodies.

4.4. Topic No. 4 – Ensuring Development of Appropriate Cultures and Regimes

The current assessment has gone far beyond just looking at culture and regime, as is evidenced by the fact that "cultures and regimes" was only one of the twenty-five (25) topics discussed herein. As for the lack of a defined or recognized safeguards culture, this does not pose a significant conflict for interfacing and integrating all the other aspects of the three disciplines. From a cultural standpoint, all the other topical areas of commonality tend to allow transport safeguards to work with transport safety and security. This current assessment of the various topics relating to the 3S disciplines illustrates that, to a great extent, they have been, or, through recognizing areas of conflict, can be externally adapted and internally integrated.

It is noteworthy that, with respect to culture, the issue of an apparent conflict between safeguards and the other 2Ss has been addressed to some extent by Ebel and Kuykendall.[47] With respect to having safeguards consider culture, Ebel and Kuykendall noted the following:

> *"….3S works well for operational functions, but safeguards lose definition as a philosophy when raised to the cultural level. When compared with safety and security, the inclusion of safeguards into the 3S approach may be considered a forced fit, and not a naturally synergistic arrangement for an overarching cultural philosophy."*

For the current assessment, we have gone far beyond just looking at culture, as is evidenced by the fact that culture (and regimes) was only part of one of the twenty-five (25) topics discussed herein (i.e., regimes are part of the same topic).

The lack of a defined or recognized safeguards culture does not pose a significant conflict for interfacing and integrating all the other aspects of the three disciplines. All the other topical areas of commonality tend to allow transport safeguards to work from a cultural standpoint with transport safety and security. This current assessment of the various topics relating to the 3S disciplines illustrates that to a great extent, the disciplines were or—through recognizing areas of conflict—can be externally adapted and internally integrated. The identification of potential conflicts in this paper is a step forward to resolving those conflicts and adding to an integrated safety/ security/ safeguards culture.

As is illustrated in the comparison provided in Table 4-4, significant emphasis has been placed by the IAEA on establishing and maintaining sound safety and security cultures and regimes, whereas the safeguards documents are silent on culture and regime, thereby suggesting the need for the IAEA to define and provide guidance for safeguards culture and regime.

Table 4-4. Ensuring Development of Appropriate Cultures and Regimes

Safety Requirements/ Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6 & SSG-26/Forewords: Regime – A comprehensive set of safety standards under regular review is a key element of a stable and sustainable global transport safety regime. **SSR-6 and SSG-26/Forewords:** Culture – The IAEA's safety services include, for the safe transport of radioactive material, having a sound safety culture in organizations. **SSG-26/§207.7:** Culture – For transport safety, the competent authority should encourage all parties to develop a safety culture that includes: (a) individual and collective commitment to safety by workers, management and regulators; (b) accountability of all individuals for protection and safety, including individuals at senior management level; and (c) measures to encourage a questioning and learning attitude and to discourage complacency with respect to safety. **SSG-26/§302.1:** Culture – The objectives of a radiation protection programme should include enhancing a safety culture in the transport of radioactive material, which includes fissile (nuclear) material. **SSG-26/§722.1:** Regime – Additional tests for fissile (nuclear) material packages have been established in part to introduce a measure of consistency into the transport package safety testing regime. **SSG-26/§722.1:** Regime – Additional tests for fissile (nuclear) material packages have been established in part to introduce a measure of consistency into the package testing regime with a view to ensuring criticality safety during transport and storage incidental to transport.	**CPPNM-A/Fundamental Principle F:** Culture – All organizations involved in implementing physical protection should give due priority to the security culture and to its development and maintenance necessary to ensure its effective implementation in the entire organization. **CPPNM-A/Articles 2and 2A:** Regime – The responsibility for establishment, implementation and maintenance of a physical protection regime within a State Party rests entirely with that State. Each State Party shall establish, implement, and maintain an appropriate physical protection regime applicable to nuclear material under its jurisdiction. **NSS No.20/§§2.1–2.3:** Regime **–** The objective of a State's nuclear security regime is to protect persons, property, society, and the environment from harmful consequences of a nuclear security event. To accomplish this, States should establish, implement, maintain and sustain an effective and appropriate nuclear security regime to prevent, detect and respond to such nuclear security events; where the regime should cover the transport of nuclear material, whether it is under or out of regulatory control, and it should reflect the risks of harm to persons, property, society and the environment. **NSS No. 20/§§3.11, 3.12:** Regime – A nuclear security regime ensures that relevant competent authorities and authorized persons are prepared to respond appropriately, at local, national, and international levels to nuclear security events; and that each competent authority and authorized person and other organizations with nuclear security responsibilities contribute to the sustainability of the regime. **NSS No.13/§§1.9, 3.10:** Regime – A State's nuclear security regime should achieve four physical protection objectives which, for nuclear material during transport, are to: (a) protect against unauthorized removal of the material, (b) locate and recover missing material, (c) protect against sabotage, and (d) mitigate or minimize effects of sabotage. **NSS No. 13/§§3.50, 3.51:** Culture – The State's security culture should encourage all security organizations to establish and maintain their own security culture that should be pervasive in all elements of the transport physical protection regime, which can be accomplished through a security policy issued by executive management. **NSS No.13/§§3.9, 3.10:** Regime – A State should take appropriate measures to establish and ensure implementation of the State's transport physical protection regime. It should define requirements for the physical protection of nuclear material during transport, considering both unauthorized removal and sabotage. **NSS No. 26-G/Foreword and §§1.4, 1.10, 2.1, 3.4, 3.8:** Regime – International cooperation is vital to supporting States in establishing and maintaining effective a nuclear security regime, which needs to include those elements necessary for ensuring the physical protection of nuclear material in transport. A State's nuclear security regime should protect persons, property, society, and the environment from malicious acts involving nuclear material and other radioactive material. Each State should ensure the establishment, implementation, and maintenance of a comprehensive physical protection regime, which should ensure adequate physical protection of nuclear material, not only within its own borders but also on ships and aircraft registered to that State engaged in transport to or from that State while in international waters or airspace and until responsibility is transferred to another State. **NSS No. 26-G/§3.56+; Fundamental Principle F/§§3.58, 3.59, 3.62:** Culture – All organizations involved in implementing physical protection should give due priority to the security culture and to its development and maintenance necessary to ensure its effective implementation in the entire organization. It is important that everybody involved in transport operations be aware of the need to establish and maintain a strong security culture that is integrated into an organization's management system to ensure the management of the safety/security interfaces. **NSS No. 26-G/§3.57:** Culture and regime – Nuclear security culture plays an important role; and a nuclear security regime includes a range of significant elements and activities where the security culture depends upon education, training and awareness of personnel involved in providing security. Human factors should be addressed in enhancing nuclear security culture.	NOTE: The IAEA has not formally established an accepted definition of "safeguards culture." However, the following citations intrinsically relate to safeguards regime and culture. **153/§2:** The Agreement should provide for the IAEA right and obligation to ensure that safeguards will be applied on all source or special fissionable material in all peaceful nuclear activities. **153/§3:** The Safeguards Agreement should provide that the IAEA and the State will cooperate to facilitate the implementation of safeguards. **153/§4:** The Safeguards Agreement should provide that safeguards shall be implemented in a manner designed (a) to avoid hampering economic and technological development and international cooperation; (b) to avoid undue interference in a State's nuclear activities, including operation of facilities; and (c) to be consistent with prudent management practices for economical and safe conduct of nuclear activities. **153/§29:** The Agreement should provide for use of material accountancy as a safeguards measure of fundamental importance, with containment and surveillance as important complementary measures. **153/§44:** Information shall be made available to the IAEA, in particular, on organizational responsibility for material accountancy and control. **153/§49(b**): Information concerning nuclear material customarily used outside facilities shall be provided, including a general description of procedures and organizational responsibility for nuclear material accountancy and control. **153/§79**: Regime – Inspection regimes should be no more intensive than is necessary and sufficient to maintain continuity of knowledge and inventory of nuclear material. **540/Article 15,§a:** The IAEA shall maintain a stringent regime to ensure effective protection against disclosure of commercial, technological and industrial secrets and other confidential information.

From this comparison, the following potential conflict and suggested conflict resolution with respect to ensuring development of appropriate cultures and regimes for the 3S disciplines were identified as follows:

- **Potential Conflict**: Although not a direct conflict, there is a significant difference between transport safety culture and transport security culture, on the one hand, and transport safeguards culture: Unlike safety and security culture, "safeguards culture" is not defined in either INFCIRC/153 nor INFCIRC/540, or in the IAEA Safeguards Glossary.

- **Suggested Conflict Resolution:** Care must be taken when striving for synergy between all 3S disciplines while considering the characteristics of cultures and regimes. Certain elements of transport safety and security cultures exist in common with transport safeguards culture. For example, standards, objectives, commitment, and accountability generally exist for all 3S disciplines. There is general agreement that the establishment and maintenance of appropriate cultures for the 3S disciplines is the responsibility of both the State and the operators. For comparison, however:
    (a) the establishment and maintenance of the transport regimes for the 3S disciplines is the responsibility of the States; whereas
    (b) the establishment and maintenance of transport systems is the responsibility of the operators.

4.5. Topic No. 5 – Applying the Graded Approach Concept

As the transport regulatory documents have been developed, the concept of the graded approach has been extensively used in both safety and security. For transport safety, the graded approach is viewed as "*a process or method in which the stringency of the control measures and conditions to be applied is commensurate, to the extent practicable, with the likelihood and possible consequences of, and the level of risk associated with, a loss of control"*.[48] Similarly, for transport security, the graded approach entails "*The application of nuclear security measures proportional to the potential consequences of a malicious act."*[49] However, the IAEA does not explicitly indicate that it has used the graded approach for safeguards, but a number of the safeguards provisions can be viewed as implicitly using the graded approach.

Table 4-5 compares the manner in which the graded approach is applied, explicitly or implicitly, for the 3S disciplines in the international regulatory documents.

Table 4-5. Applying a Graded Approach in the International 3S Regulatory Provisions

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
IAEA Safety Glossary (2016 Revision): The graded approach for safety is a system of control, such as a regulatory system or a safety system, process, or method in which the stringency of the control measures and conditions to be applied is commensurate, to the extent practicable, with the likelihood and possible consequences of, and the level of risk associated with, a loss of control. **SSR-6/§104:** SSR-6 provides recommended transport safety requirements, which follow a graded approach, that are directed toward the protection of people, property, and the environment from the harmful effects of ionizing radiation during the transport of fissile (nuclear) material. Protection is achieved by requiring (a) containment of the radioactive contents; (b) control of external dose rate; (c) prevention of criticality; and (d) prevention of damage caused by heat. The graded approach for fissile (nuclear) material transport is applied to (a) contents limits for packages and conveyances; (b) performance standards that are applied to package designs depending upon the hazard posed by the fissile (nuclear) material contents; (c) the design and operation of packages; (d) requirements for administrative controls; and (e) planning and preparing for emergency response. **SSR-6/§106 & SSG-26/§§106.2 to 106.4:** The graded approach is applied in SSR-6, which is characterized by three levels of transport operations: (a) routine conditions (incident-free), (b) normal conditions (minor mishaps), and (c) accident conditions. **SSG-26/§722.1:** Additional tests for fissile (nuclear) material packages, following a graded approach, have been established in part to introduce a measure of consistency into the transport package testing regime with a view to ensuring criticality safety during transport and storage incidental to transport.	**IAEA Nuclear Security Series Glossary (November 2015); and NSS No. 20/Definitions:** The graded approach for security is the application of *nuclear security measures* proportionate to the potential consequences of criminal or intentional unauthorized acts involving or directed at *nuclear material,* or other acts determined by the State to have an adverse impact on nuclear security. **CPPNM & CPPNM-A/Categorization Table; & NSS No. 13/§§3.9, 5.6:** The nuclear material categorization table establishes the basis for the graded approach for security, structuring it into Categories I, II and III (and to lower levels of nuclear material, which implicitly establish a fourth category, i.e., a category "below Category III"). The categorization is the basis for the graded approach for protection, where the State should define a set of physical protection objectives and measures for each assigned level of protection. **CPPNM-A/Fundamental Principle H:** Physical protection requirements for the transport of nuclear material should be based on a graded approach, accounting for the (a) current evaluation of the threat, (b) relative attractiveness of the material, (c) nature of the material, (d) potential consequences associated with the unauthorized removal of nuclear material, and (e) potential for sabotage against nuclear material. **NSS No. 20/§3.9:** A transport nuclear security regime uses risk-informed approaches in the allocation of resources for nuclear security systems and nuclear security measures and in the conduct of nuclear-security-related activities that are based on a graded approach. **NSS No. 13/§§3.42+, 3.43, 3.45; Fundamental Principle H:** The physical protection requirements for the transport of nuclear material should be based on a graded approach taking into account the current evaluation of the threat, the relative attractiveness of the material, the nature of the material; and the potential consequences associated with unauthorized removal of the material and with sabotage against the material. The graded approach is used to provide higher levels of protection against events that could result in more serious consequences. The functions of detection, delay, and response should each apply a graded approach for providing appropriate effective protection. **NSS No. 13/§3.52+; Fundamental Principle L/§§3.53, 6.7, 6.58:** The State should establish requirements for protecting the confidentiality of information, the unauthorized disclosure of which could compromise the physical protection of nuclear material in transport. It should specify what information needs to be protected and how it should be protected, following a graded approach. The safety features of the design of the transport safety system should be taken into account when deciding what additional physical protection measures are needed to protect the material against sabotage. **NSS No. 26-G/§§1.10, 3.46:** The baseline guidance follows a graded approach according to the categorization of the nuclear material, outlining mode-independent, mode-specific, and international provisions. Three different approaches are identified for addressing threats, and different approaches are identified for addressing risk, which can be followed by a State using a graded approach (See Fundamental Principle H).	**153/§6(c):** IAEA verification is concentrated on specified stages in the nuclear fuel cycle, which can be viewed as an application of a graded approach implicit to safeguards. **153/§28:** The IAEA implicitly uses a graded approach for safeguards that is based on detection time and significant quantity for each type of nuclear material and risk of early detection of diversion. **153/§§70–73:** The IAEA shall have the right to carry out ad hoc, routine, and special inspections. **153/§§78–82:** The Safeguards Agreement implicitly provides for a graded approach based on number, intensity, duration, timing, and mode of routine inspections depending on nuclear material form and other factors. **540/§§4–9:** Adds complementary access for safeguards inspections, which implicitly applies a graded approach concept for safeguards.

From this comparison, the following assessment of the potential for conflicts and synergies with respect to applying the graded approach results in the following:

- **Potential Conflicts**: There are no apparent conflicts with respect to applying the graded approach within the 3S regulatory documents, although the approach is handled differently in the individual 3S documents.

- **Potential Synergies:** The transport safety and transport security documents each explicitly address how the safety and security measures follow a graded approach. For transport safeguards, a graded approach is not explicitly identified in the documents INFCIRC/153 and INFCIRC/540 or in the IAEA Safeguards Glossary, but a graded approach is implicitly applied by virtue of, for example, safeguards inspections being proportional to the associated safeguards risks. Collectively and individually for each discipline, a graded approach is followed and is beneficial.

4.6. Topic No. 6 – Applying the Defense-in-Depth Concept

As the transport regulatory documents have been developed, the concept of the defense-in-depth has been extensively used in the 3S documents, although only implicitly for safety and safeguards.

For transport safety, the defense-in-depth approach is typically viewed as the "*hierarchical deployment of different levels of diverse equipment and procedures to prevent the escalation of anticipated operational occurrences and to maintain the effectiveness of physical barriers placed between a radiation source or radioactive material and workers, members of the public or the environment, in operational states and, for some barriers, in accident Conditions"*.[50] However, the concept of defense-in-depth is not explicitly noted in the transport safety documents, but the concept is implicitly applied in those documents.
For transport security, the defense-in-depth approach entails the *"combination of multiple layers of systems and measures that have to be overcome or circumvented before nuclear security is compromised";*[50] and it has been explicitly specified in multiple cases.

Similar to transport safety, the IAEA does not explicitly indicate that it has used the defense-in-depth approach for safeguards, but a number of the safeguards provisions can be viewed as implicitly using the graded approach.

Table 4-6 compares the manner in which the concept of defense-in-depth is applied in the provisions of the international regulatory documents for the 3S disciplines.

Table 4-6. Applying the Defense-in-Depth Concept in the International 3S Regulatory Provisions

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
IAEA Safety Glossary (2016 Revision): At the "global level" in the safety arena at the IAEA, the IAEA Safety Glossary specifies that *the objectives of defense in depth are:* *(a) To compensate for human induced events and component failures;* *(b) To maintain the effectiveness of the barriers by averting damage to the facility and to the barriers themselves; and* (c) *To protect workers, members of the public and the environment from harm in accident conditions in the event that these barriers are not fully effective*." The Safety Glossary also specifies for defense in depth that: "*The application of more than one protective measure for a given safety objective, such that the objective is achieved even if one of the protective measures fails*." Thus, although the IAEA transport safety documents are silent on defense in depth, that topic is implicitly applied throughout the transport safety regulations through the application of multiple, overlapping and complementary safety measures as specified in SSR-6.	**IAEA Nuclear Security Series Glossary (November 2015):** At the "global level" in the security arena at the IAEA, the IAEA Security Glossary includes the following description of defense in depth: • "Implementing several layers of defense, including both administrative aspects (procedures, instructions, sanctions, access control rules, confidentiality rules) and technical aspects (multiple layers of protection together with measures for detection and delay) that adversaries would have to overcome or circumvent to achieve their objectives." **CPPNM-A/Fundamental Principle I – Defense in Depth:** The State's requirements for physical protection should reflect a concept of several layers and methods of protection (structural or other technical, personnel and organizational) that an adversary has to overcome or circumvent in order to achieve his objectives. **NSS No. 20/§3.9:** A nuclear security regime uses risk-informed approaches, including in the allocation of resources for nuclear security systems and nuclear security measures and in the conduct of nuclear security-related activities that are based on a graded approach and defense in depth. **NSS No. 13/§3.42 & NSS No. 26-G/§3.51:** The risk of transporting nuclear material can be managed by improving the effectiveness of the physical protection system through implementing defense in depth. Transport security risk may be reduced by using deterrence, enhancing information security, and strengthening physical protection measures by adding defense in depth to increase the resistance of the conveyance and/or package to attack. **NSS No. 13/§§3.44+, 3.45-3.47; & NSS No. 26-G/§§3.51, 3.55/Fundamental Principle I:** The State's requirements for physical protection of nuclear material in transport should reflect a concept of several layers and methods of protection that have to be overcome or circumvented by an adversary (i.e., application of Fundament Principle I, Defense in Depth). The State should incorporate the concept of defense in depth and base its physical protection on the concept of defense in depth when applying the three physical protection functions of detection, delay, and response; and should take into account the capability of the physical protection system to protect against insiders and external threats. **NSS No. 26-G/§3.56:** The State should incorporate the concept of defense in depth in the preventive and protective measures that it requires for protection of nuclear material in transport. Defense in depth requires a designed combination of security equipment, procedures, administrative measures, and features of the transport equipment (including the conveyance, any protective overpacks and packages) that support security. The defense in depth approach should be incorporated in the design of the physical protection system to provide the functions of detection, delay, and response. Each function should be provided by multiple independent measures so that failure of one measure does not lead to loss of that function.	Note: Safeguards documents are silent on the application of "defense in depth." However, the following provisions implicitly apply this principle for international safeguards. **153/§7:** The State shall establish a system of accounting for and control of all nuclear material. **153/§8:** The State shall provide information concerning nuclear material subject to safeguards and features of facilities relevant to safeguarding such material. **153/§9:** The State shall take necessary steps to ensure that IAEA inspectors can effectively discharge their functions. **153/§§31–32:** IAEA shall make full use of the State's system of accounting for and control of all nuclear material; and the State's system shall be based on a structure of material balance areas (which implicitly applies defense-in-depth). **153/§§39–40:** The IAEA and the State shall make Subsidiary Arrangements to permit the IAEA to fulfill its responsibilities. **153/§41:** IAEA shall establish a unified inventory of all nuclear material in the State (which implicitly applies defense-in-depth). **153/§§51–69:** The State shall establish a system of accounting and operating records and a system of accounting reports (which implicitly applies defense-in-depth). **153/§74–75:** IAEA may carry out a range of activities within the scope of inspections (which implicitly applies defense-in-depth). **153/§§93, 96**: IAEA may verify international transfers, in addition to verifying inventories. **540/§2–3:** Reporting of information by the State is in addition to that required in INFCIRC/153. **540/§§4–9:** Inspection access by the IAEA is in addition to that required in INFCIRC/153. **540/§13:** Subsidiary Arrangement measures are in addition to those required in INFCIRC/153. **540/§14:** Communication systems are in addition to those required in INFCIRC/153.

From this comparison, the following assessment of the potential for conflicts and synergies with respect to applying the defense in depth concept results in the following:

- **Potential Conflicts**: There are no apparent conflicts with respect to the application of the defense-in-depth principle in the 3S regulatory documents. Specifically:
  - For transport safety, the concept of defense-in-depth is not explicitly specified in either SSR-6 or SSG-26, but the concept is explicitly addressed in the IAEA Safety Glossary and implicitly applied in the Transport Regulations.
  - For transport security, defense-in-depth is explicitly addressed and embedded in many of the provisions in the IAEA security documents.
  - For transport safeguards, defense-in-depth is not explicitly defined in the IAEA Safeguards Glossary nor explicitly addressed in INFCIRC/153 and INFCIRC/540, but the concept is implicitly applied in the safeguards documents.

- **Potential Synergies**: While not explicitly addressed for transport safety and safeguards, defense in depth is implicit for both safety and safeguards. The concept of defense in depth is applied by the combined application of several layers and methods for safety through multiple, overlapping safety provisions in SSR-6, and for safeguards by the State and by the IAEA.

Thus, the application of the defense-in-depth principle, applying several layers and methods of provisions for each of the three disciplines, i.e., safety, security, and safeguards, is mutually beneficial.

4.7. Topic No. 7 – Facilitating Understanding of Regulatory Definitions

Definitions in the international regulatory documents are important with respect to striving for consistent interpretation of the intent of the provisions set forth in the documents. Four separate areas of potential conflict with respect to definitions in the 3S documents were identified during the comprehensive evaluation.

Sections 4.7.1 through 4.7.4 address, using four separate tables, key definitions in the international 3S regulatory documents and identify potential conflicts that may arise in the use in the 3S disciplines. Definitions in the 3S documents are key because, when States and operators are applying them, a clear understanding is needed of the provisions in each of the 3S documents, and more importantly, among the stakeholders using some or all of the 3S documents.

4.7.1. Definitions of Fissile Nuclides, Fissile Material and Nuclear Material in the International 3S Regulatory Documents

The definitions for fissile nuclides, fissile material and nuclear material as provided or used in the International 3S Regulatory Documents are compared in Table 4-7a.

Table 4-7a. Definitions of Fissile Nuclides, Fissile Material, and Nuclear Material in the International 3S Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§222: Definition of fissile nuclides and fissile (nuclear) material is: • "*Fissile nuclides* shall mean uranium-233, uranium-235, plutonium-239 and plutonium-241. • *Nuclear material* shall mean a material containing any of the *fissile nuclides*. Excluded from the definition of fissile nuclides are the following: (a) *Natural uranium* or *depleted uranium* that is unirradiated; (b) *Natural uranium* or *depleted uranium* that has been irradiated in thermal reactors only; (c) Material with *fissile nuclides* less than a total of 0.25 g; (d) any combination of (a), (b) or (c)."	**NSS No. 13/page 53 & NSS No. 26-G/Glossary:** Definition of nuclear material is" Material listed in" [Table 1, Section 4 of NSS No. 13; and in Table 1 of Section 4 of NSS No. 26-G], "including the material in the footnotes" of the relevant tables. The materials thus listed are: • Unirradiated plutonium, except that with isotopic concentration >80% in plutonium-238; • Unirradiated uranium enriched above natural (with three levels of enrichment and three categories specified); • Unirradiated uranium-233; and • Irradiated fuel (with specific enrichments of uranium and thorium) **NSS No. 20/Definitions:** Definition of nuclear material is "Any material that is either *special fissionable material* or *source material* as defined in Article XX of the IAEA Statute." This includes special fissionable material, uranium enriched in the isotopes 235 or 233, and source material; where source material is "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."	**IAEA Statute Article XX DEFINITIONS include the following:** **§1:** Definition of Special fissionable material is plutonium-239; uranium-233; uranium enriched in the isotopes 235 and 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." **§2:** Definition of uranium enriched in the isotopes 235 or 233 is uranium containing the isotopes 235 or 233 or both in an amount such that the abundance ratio of the sum of these isotopes to the isotope 238 is greater than the ratio of the isotope 235 to the isotope 238 occurring in nature." **§3:** Definition of source material is 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." **153/§112:** Definition of nuclear material is any source, or any special fissionable material as defined in Article XX of the IAEA Statute. The term "source material" shall not be interpreted as applying to ore or ore residue. Any determination by the IAEA Board of Governors under Article XX of the Statute of the IAEA after the entry into force of the Safeguards Agreement which adds to the materials considered to be "source material" or "special fissionable material" shall have effect under the Safeguards Agreement only upon acceptance by the State. **153/§114:** Definition of Shipper/Receiver Difference is 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. **540/§18.h:** Definition of nuclear material is consistent with the definition in **153/§112**. [Notes: • Neptunium and Americium are not covered by the definition of "special fissionable material" in the IAEA Statute and are not subject to safeguards. However, the IAEA Board of Governors in 1999 approved a monitoring scheme that includes annual reporting of inventory of separated Neptunium and Americium and related activities and exports and imports. • The IAEA Safeguards Glossary also contains definitions of the terms referenced above.]

From this comparison, the following potential conflict and suggested conflict resolution with respect to the definitions of fissile nuclides, fissile material, and nuclear material were identified as follows:

Potential conflicts may arise from these definitions, and a suggested conflict resolution was identified as follows:

- **Potential Conflict:** The definition of fissile (i.e., nuclear) material for transport safety is different from, and therefore potentially in conflict with, the definition of nuclear material for transport security and transport safeguards. Since the safety documents use the term "fissile material" whereas the security and safeguards documents use the term "nuclear material," care must be taken when transitioning between and applying the measures from the 3S documents. Throughout this article, the term "*nuclear material*" is used except in the comparison tables where, in the transport safety column, the difference in the definition for safety is emphasized by "*fissile (nuclear) material.*"

- **Suggested Conflict Resolution:** Since the safety documents use the term "fissile material" whereas the security and safeguards documents use the term "nuclear material," care must be taken when striving for synergy between the 3S disciplines. Thus, the definitions in the 3S documents may generally be viewed as being compatible as long as a user takes care and recognizes the subtle differences in the definitions. Also, it is noteworthy that at the 2018 IAEA General Conference, a resolution was passed that acknowledged the distinctions between safety and security, affirmed the importance of addressing their interfaces, and encouraged the IAEA to ensure the consistency of the terminology.[16]

4.7.2. Definitions of Competent Authority in the International 3S Regulatory Documents

The definitions for competent authority (CA) as provided or used in the International 3S Regulatory Documents are compared in Table 4-7b.

Table 4-7b. Definition of Competent Authority in the International 3S Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§207: Definition of Competent Authority is any body or authority designated or otherwise recognized as such for any purpose in connection with these Regulations.	**NSS No. 13 & NSS No. 26-G/Definitions:** Definition of Competent Authority is a governmental organization or institution that has been designated by a State to carry out one or more nuclear security functions.	Neither INFCIRC/153 nor INFCIRC/540, nor the IAEA Safeguards Glossary provide a definition for competent authority.

Although the terminology competent authority ("CA") is defined and used in the transport safety and security documents, the terminology State or Regional Authority responsible for safeguards implementation ("SRA") is often used in safeguards documents, but SRA is not defined or specified in the Safeguards Glossary.

Thus, a potential conflict could arise in the use by States or operators of the terms "competent authority" for transport safety and transport security, and "regulatory state authority" for transport safeguards, and a suggested conflict resolution was identified as follows:

- **Potential Conflict:** The term "competent authority" is not defined in the safeguards documents. For safeguards, the authorities that are held legally responsible are the IAEA and the State or region that is party to the Safeguards Agreement. Thus, the potential for conflict in terminology exists when interfacing safety and security with safeguards.

- **Suggested Conflict Resolution:** Care must be taken when striving for synergy between all 3S disciplines when considering the authorities in States or regions that are responsible for applying the 3S disciplines. Recognition by involved stakeholders that safety and security documents define "competent authority" while safeguards documents use the term State or Regional Authority and do not use the term "competent authority" can assist in avoiding conflicts between the 3S disciplines at the State level.

4.7.3. Definitions of Carrier, Consignee, Consigner, Shipper, Receiver and Operator in the International 3S Regulatory Documents

The definitions for Carrier, Consignee, Consigner, Shipper, Receiver and Operator as provided or used in the International 3S Regulatory Documents are compared in Table 4-7c.

Table 4-7c. Definitions of Carrier, Consignee, Consigner, Shipper and Operator in the International 3S Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§§206, 210, 212: Definitions of Carrier, Consignee and Consignor are: • Carrier is any person, organization or government undertaking the carriage of radioactive material by any means of transport. The term includes both carriers for hire or reward (known as common or contract carriers in some countries) and carriers on own account (known as private carriers in some countries). **[§206]**. • Consignee is any person, organization or government that is entitled to take delivery of a consignment. **[§210]** • Consignor is any person, organization or government that prepares a consignment for transport. **[§212]**	**NSS No. 13 & NSS No. 26-G/Definitions:** Definition of Shipper is a person, organization or government that prepares or offers a consignment of nuclear material for transport (i.e., the consignor). **NSS No. 20 & NSS No. 26-G/Definitions:** Definition of Operator is any person, organization, or government entity licensed or authorized to undertake the operation of a nuclear facility or to perform an associated activity." **NSS No. 26-G/Definitions:** Definition of Carrier is any person, organization or government that is undertaking the carriage of nuclear material by any means of transport. It is noted that the term includes both carriers for hire or reward (known as common or contract carriers in some States) and carriers on own account (known as private carriers in some States).	While the terms "shipper", "receiver", and "operator" are used in safeguards documents, these terms are not assigned definitions. Also, the terms "carrier", "consignee," and "consignor" are not used in either **INFCIRC/153** or **INFCIRC/540.**

From this comparison, the following potential conflict and suggested conflict resolution with respect to the definitions of carrier, consignee, consigner, shipper and operator when applying 3S provisions were identified as follows:

- **Potential Conflict:** The safeguards documents do not define some terms which are defined in the safety and security documents. These include "consignor," "shipper," "consignee," "receiver," and "operator." Also, the security documents do not define "consignor," "consignee," or "receiver."

- **Suggested Conflict Resolution:** It must be recognized that care must be taken when striving for synergy between all 3S disciplines with respect to the use of these terms since they are not defined or typically used for safeguards. Considering just the safety and security documents, again some care must be taken when striving for synergy, since the definitions for "carrier" are essentially the same, and the use of "consignor" and "shipper" is essentially the same. However, it must be recognized that the terms "carrier," "consignor," "consignee," and "operator" are basically interchangeable; and the application of the terms "consignee" (for safety) and "receiver" (for security) are used equivalently, although "consignee" is defined for safety; however, "receiver" is not defined for security but is used within the text of the security documents.

  In resolving these potential conflicts, it must be recognized that the definitions of carrier for safety and security are essentially the same, whereas safeguards documents do not define carrier. Also, from the viewpoint of safety and security,
  (a) the use of the terms "consignor" and "shipper" is essentially the same for the two disciplines,
  (b) the use of the terms "carrier", "consignor", "consignee", and "operator" are essentially the same for the two disciplines, and
  (c) the terms "consignee" and "receiver" are equivalent, although the term "consignee" is defined for safety, whereas the term "receiver" is not defined for security but is used multiple times within the text of the security documents.

4.7.4. Definitions of Consignment, Shipment and Transport in the International 3S Regulatory Documents

The definitions for Consignment, Shipment and Transport as provided or used in the International 3S Regulatory

Documents are compared in Table 4-7d.

Table 4-7d. Definitions of Consignment, Shipment, and Transport in the International 3S Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§§211 & 237: Definitions of Consignment and Shipment are: • Consignment is any package or packages, or load of radioactive material, presented by a consignor for transport. • Shipment is the specific movement of a consignment from origin to destination.	**NSS No. 13 & NSS No. 26-G/Definitions:** Definition of Transport is the International or domestic carriage of nuclear material by any means of transportation, beginning with the departure from a nuclear facility of the shipper and ending with the arrival at a nuclear facility of the receiver.	Neither INFCIRC/153 nor INFCIRC/540, nor the IAEA Safeguards Glossary, provide definitions for consignment, shipment, or transport.

From this comparison, the following potential conflict and suggested conflict resolution with respect to the terms "consignment", "shipment" and "transport" were identified as follows:

- **Potential Conflict:** The terms for "consignment" and "shipment" are defined only in the transport safety documents, whereas neither term is defined in the transport security or safeguards documents. Also, the term "transport" is defined only in the transport security documents.

- **Suggested Conflict Resolution:** Care must be taken when striving for synergy between all 3S disciplines when using the terms "consignment," "shipment," and "transport," especially when considering transport safeguards. For transport safety and transport security, the term "shipment" as used for safety is essentially equivalent to the term "transport" as used for security.

5. COMPREHENSIVE EVALUATION OF PRIMARY RESPONSIBILITIES OF THE REGULATORS

This Section provides the results of the detailed consideration of each of the eight topics for which the application of each topic is primarily the responsibility of the State regulators, or in the case of Topics 9 through 14, where the responsibility for application lies jointly with the Regulators and the Operators. As previously in Section 4, it includes a detailed comparison of relevant text from the IAEA regulatory documents that served as a basis for determining primary responsibilities, potential conflicts, suggested resolutions to the conflicts when such were identified, and potential synergies.

5.1. Topic No. 8 – Implementing the Roles of Competent Authorities: Issuing Approvals and Facilitating Oversight

The State's regulators, including their designated CAs have a primary role in issuing approvals for the 3S disciplines for the transport of nuclear and other radioactive material and in facilitating oversight of the actions taken by operators. The IAEA has a subsidiary role here in providing the requirements, recommendations, and guidance to be used by both the regulators and operators.

For safeguards, the SRAs have a primary role exercising the legal role in approval and oversight of the operator, whereas the IAEA exercises a strong subsidiary legal role in oversight of safeguards at the State level of its commitment under the Agreement. Further effort may ultimately be useful looking at the roles of CAs and SRAs at individual State levels, but such an effort is beyond the scope of this paper.

Table 5-1 compares the basis for applying the provisions of the international regulatory documents with respect to roles of transport regulators including designated competent authorities, for their issuing of approvals and providing oversight for the 3S disciplines.

Table 5-1. Roles of Competent Authorities: Issuing Approvals and Providing Oversight in the International 3S Transport Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§§802, 805–807, 814–816: Competent authorities issue multilateral approvals of package designs and excepted fissile (nuclear) material – Competent authority's multilateral approval of fissile (nuclear) material packages and of excepted fissile (nuclear) material designation shall be required for: (a) package designs containing fissile (nuclear) material, unless excepted by SSR-6 paras 417, 674 or 675; (b) packages containing 0.1 kg or more of uranium hexafluoride, and (c) fissile (nuclear) material itself is excepted from "FISSILE" pursuant to SSR-6 para. 417(f). Each of the preceding approvals by the competent authority shall be documented with the issuance of a certificate of approval. **SSR-6/§§825–826, 829–831:** Competent authorities issue multilateral approvals of shipments of fissile (nuclear) material – Competent authority's multilateral approval of fissile (nuclear) material shipments shall be required for: (a) The shipment of packages containing fissile (nuclear) material if the sum of the CSIs of the packages in a single freight container or in a single conveyance exceeds 50, except for shipments by sea-going vessels if the sum of the CSIs does not exceed 50 for any hold, compartment or defined deck area and a distance of 6 m is maintained between groups of packages or overpacks; and (b) A competent authority may authorize transport through or into its country without shipment approval, by a specific provision in its design approval; and (c) Any shipment of fissile (nuclear) material undertaken under special arrangement. Each of the preceding approvals by the competent authority shall be documented with the issuance of a certificate of approval. **SSR-6/§§832–839:** Competent authorities issue certification of competent-authority approval – Competent authority certificates of approval of fissile (nuclear) material shipments, material designation and special arrangement shipments shall satisfy internationally agreed-upon contents and formats. **SSR-6/§840:** Competent authorities may issue validation certificates – Multilateral approvals of fissile (nuclear) material design or shipment may be accomplished by a competent authority by validating the original certificate issued by the competent authority of the State of origin. Such validation may take the form of an endorsement on the original certificate or the issuance of a separate endorsement, annex, supplement, etc., by the competent authority of the State through or into which the shipment is made.	**CPPNM-A/Fundamental Principles C and D; & NSS No.13/§§3.8+, 3.17+:** Designation of a transport security competent authority – The State is responsible for establishing a legislative framework to govern physical protection; where the State should establish or designate a competent authority that is responsible for implementation of the legislative and regulatory framework, and is provided with adequate authority, competence and financial and human resources to fulfil is assigned responsibilities. **NSS No. 20/§§3.3, 3.11, 3.12:** Roles of competent authorities – A State's legislative and regulatory framework, and associated administrative measures, should govern the nuclear security regime by including, but not be limited to, the following: (a) Establish competent authorities, including regulatory bodies, with adequate legal authority to fulfil their assigned nuclear security responsibilities. (b) Assign the nuclear security responsibilities of each competent authority, including those of the regulatory bodies having nuclear security responsibilities, and provide these authorities with sufficient financial, human and technical resources to fulfil these responsibilities. (c) Establish measures to ensure proper coordination and communication among competent authorities, and between competent authorities and authorized persons, in fulfilling their nuclear security responsibilities. (d) Ensure that regulatory bodies have appropriate independence in their nuclear-security decision making. (e) Be prepared to respond appropriately, at local, national, and international levels to nuclear security events involving transport. (f) Periodically exercise, test and evaluate transport security plans. (g) Contribute to the sustainability of the *regime*. **NSS No. 13/§3.17+ (Fundamental Principle D):** Designation of a transport security competent authority – Specifies that the State should establish or designate a competent authority that is responsible for the implementation of the legislative and regulatory framework and human resources to fulfil its assigned responsibilities for transport security of nuclear material, and to ensure effective independence between the competent authority and those of any other body in charge (of nuclear-material transport security).	**153/Preface:** The IAEA Board of Governors requested the IAEA Director General to use INFCIRC/153 as the basis for negotiating Safeguards Agreements between the IAEA and States. **153/§1**: In accordance with the Treaty on the Non-Proliferation of Nuclear Weapons, States party to the Treaty undertake to accept safeguards in accordance with the terms of the Safeguards Agreement. **153/§2:** The Safeguards Agreement provides for the IAEA's right and obligation to ensure that safeguards will be applied in accordance with the terms of the Safeguards Agreement. **153/§3:** The IAEA and the State shall cooperate to facilitate the implementation of the Safeguards Agreement. **153/§7:** The State shall establish and maintain a system of accounting for and control of all nuclear material subject to the Safeguards Agreement. **153/§31:** In carrying out its verification activities, the IAEA shall make full use of the State's system of accounting for and control of nuclear material. **540/Foreword, para. 2:** The IAEA Board of Governors has requested the IAEA Director General to negotiate Additional Protocols with States. **540/Foreword, para. 5:** Each Additional Protocol requires the approval of the IAEA Board of Governors.

From the comparison provided in Table 5-1, the following potential conflict and suggested conflict resolution with respect to implementing the roles of CAs and SRAs in issuing approvals and facilitating oversight were identified as follows:

- **Potential Conflict:** Although guidance is provided for national authorities' oversight and approvals, there may be conflicts if national legislation and regulatory frameworks do not exist for all three disciplines, or if a State has multiple regulatory authorities overseeing the application of the individual 3S disciplines.

- **Suggested Conflict Resolution:** Care must be taken when striving for synergy between all 3S disciplines when considering the role that State authorities play as a result of national legislation and regulatory frameworks. State authorities should be given the authority, responsibility, and resources for regulating, overseeing, and providing approvals for transportation system design, shipments, and certifications for each of the 3S disciplines. Because State authorities are responsible for their national system of accounting and control for safeguards, it must be recognized that the IAEA enforces legally binding safeguards, which are based on the existence of a State's national system of accounting and control. Furthermore, if properly established, State oversight and approvals for the 3S disciplines can be mutually beneficial to the integration of the three sets of requirements.

5.2. Topic No. 9 – Performing Compliance Assurance

With respect to performing compliance assurance for the 3S disciplines, the State's transport safety and security regulators including their designated CAs have a primary role in compliance, using the IAEA documents as a basis for the application of the national regulations. Also, the operators have a similar primary role in compliance with the regulatory requirements.

For safeguards, the SRAs have the primary role of ensuring that operators comply with State regulator requirements, which reflect the legal requirements under the Safeguards Agreement between the State and IAEA. Ultimately, the operators have the responsibility to comply with the States regulations for the 3S disciplines.

Table 5-2 compares the manner in which activities are addressed in, and requirements for mandatory compliance with, the relevant 3S international regulatory documents.

Table 5-2. Activities Addressed in, and Mandatory Compliance with, Relevant International 3S Transport Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§106: Compliance with international transport safety regulatory documents – IAEA SSR-6 applies to the transport of radioactive material by all modes on land (road and rail), water (inland waterways and maritime), and air; and during all operations and conditions, including design, manufacture, maintenance and repair of packaging, preparation, consigning, loading, storage, shipping, unloading, and receiving. The transport safety provisions set forth in SSR-6 are essentially replicated in the relevant UN Model Regulations (which are recommended), which are issued by the UNECE (UN Economic Commission for Europe), and which are then further essentially replicated and become mandatory in: (a) the relevant international air and maritime regulatory documents [i.e., the International Civil Aviation Organization (ICAO) Technical Instructions (TIs), and the International Maritime Organization (IMO) International Maritime Dangerous Goods (IMDG) Code] – both of which become mandatory upon States Party to the relevant air (Chicago) and maritime (SOLAS) conventions; and in (b) the relevant regional road and inland waterway agreements [i.e., the "European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)" and the "European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN)], both of which are overseen by the UNECE and both of which become mandatory for States Party to those two agreements; and in (c) the relevant regional rail convention [i.e., the "Convention concerning International Carriage by Rail (COTIF)"], which is overseen by OTIF (i.e., the Intergovernmental Organisation for International Carriage by Rail), and which becomes mandatory for the rail transport of dangerous goods via the "Regulation Concerning the International Carriage of Dangerous Goods by RAIL (RID), Appendix C to COTIF" for States Party to the COTIF in Europe, the Mahgreb and the Middle East; and further in individual IAEA Member State regulatory documents.	**CPPNM and CPPNM-A:** Compliance with the CPPNM and CPPNM-A – Compliance with the convention and amendment is required for any State Party to those two documents. **CPPNM-A/Article 2:** Application of/compliance with the CPPNM for domestic transport – This Convention applies to nuclear material in transport used for peaceful purposes, provided, however, that the following shall only apply to such nuclear material while in international transport: (a) Article 3 (protecting at appropriate levels, during international transport, nuclear material within its territory, or on board a ship or aircraft under its jurisdiction insofar as such ship or aircraft is engaged in the transport to or from that State); (b) Article 4 (relating to exports and imports of nuclear material); and (c) Paragraph 4 of Article 5 (relating to international consultations on the design, maintenance and improvement of a State's national system of physical protection). **CPPNM-A/Article 2.1:** Application of/compliance with the CPPNM – The CPPNM applies to nuclear material used for peaceful purposes in transport where some of the CPPNM provisions only apply to international transport. **CPPNM – A/Fundamental Principle B:** Compliance with requirement to extend physical protection to international transport – A State Party to the CPPNM-A has the responsibility for ensuring that adequate protection of nuclear material extends to the international transport thereof, until that responsibility is properly transferred to another State, as appropriate. **NSS 20/§§1.2, 1.3, 1.12:** Compliance with both transport safety and transport security measures – Nuclear security and safety have in common the aim of protecting persons, property, society and the environment. Security and safety measures must be designed and implemented in an integrated manner. Nuclear security, safety and safeguards are essential. NSS No. 20 applies to nuclear material whether under or out of regulatory control. **NSS No. 13/:** Compliance with NSS No. 13 for physical protection during transport – As with the transport safety provisions set forth in SSR-6, the transport security provisions for nuclear material set forth in NSS No. 13 (i.e., in INFCIRC/225/Rev.5) become mandatory through the application of specific recommendations imposed in the UN Model Regulations as they are applied through the relevant international conventions (ICAO and IMO) and regional agreements (ADR and ADN) and regional convention (RID) as discussed in the left column of this table for compliance with SSR-6. **NSS No. 13/§§1.12, 1.13, 1.16:** Compliance with NSS No. 13 for physical protection during transport – The recommendations provided apply to the physical protection of nuclear material during transport, specifically addressing the risks of unauthorized removal with the intent to construct a nuclear explosive device or with the intent of subsequent dispersion of the nuclear material, or the risk of sabotage. It also includes actions to be undertaken to locate and recover nuclear material that has become lost, is missing, or has been stolen. **NSS 26-G/§1.9:** Measures for compliance with both transport safety and transport security measures have to complement each other– Nuclear security and safety considerations for the transport of nuclear material should work in concert to enable compliance with IAEA SSR-6 as well as with international obligations for nuclear security of nuclear material and other relevant IAEA safety standards and nuclear security guidance.	**153/§1**: In accordance with Article III.1 of the Treaty on the Non-Proliferation of Nuclear Weapons, the State accepts safeguards on all source and special fissionable material in all peaceful nuclear activities. **153/§2:** The IAEA has the right and obligation to apply safeguards in accordance with the Safeguards Agreement to all source and special fissionable material in all peaceful nuclear activities. **540/§1:** The provisions of the Safeguards Agreement shall apply to the Additional Protocol.

From this comparison, the following assessment of the potential for conflicts and synergies with respect to the activities addressed in, and mandatory compliance with the relevant international regulatory documents results in the following:

- **Potential Conflicts**: There are no apparent conflicts with respect to specific required activities and in implementing mandatory compliance with those requirements in the 3S regulatory documents. More specifically, where at the State level CAs and SRAs oversee transport safety, transport security and transport safeguards:
  (a) Compliance with transport safety provisions in SSR-6 is legally mandatory when SSR-6 is adopted into the relevant international modal regulatory documents and/or adopted by a State into its regulations.
  (b) Compliance with the transport security provisions in CPPNM and CPPNM-A is legally mandatory for States that are party to these documents.
  (c) Compliance with transport safeguards provisions in INFCIRC/153 and INFCIRC/540 is legally binding for States that are party to a Safeguards Agreement with the IAEA.
  However, where a State has multiple regulatory authorities (i.e., multiple CAs) overseeing the individual 3S disciplines, the potential exists for conflicts and/or miscommunications.

- **Potential Synergies:** There are potential benefits where a single State authority has the technical expertise needed for the three disciplines of safety, security, and safeguards.

5.3. Topic No. 10 – Imposing Provisions for Ensuring Adequate Safety, Security and Safeguards Interfaces

The States and operators, working together have primary roles with respect to resolving any conflicts between the 3S provisions to ensure adequate safety, security and safeguards as they apply to specific shipments of nuclear material and other radioactive material.

Table 5-3 compares the basis for applying the provisions of the international regulatory documents for the 3S disciplines for ensuring safety, security and/or safeguards interfaces during transport.

Table 5-3. Provisions for Ensuring Safety, Security, and/or Safeguards Interfaces in the International 3S Transport Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/Introduction: Measures for transport safety and security should be coordinated – Safety measures and security measures have in common the aim of protecting human life and health and the environment. Safety measures and security measures must be designed and implemented in an integrated manner so that security measures do not compromise safety and safety measures do not compromise security. **SSR-6/§109:** Measures for transport security – Measures should be taken to ensure that radioactive material is secure in transport to prevent theft or damage. **SSG-26/§108.3:** Measures for transport safety, security and safeguards should be coordinated – The consignor may be required to provide evidence that measures to meet the requirements for safeguards and physical protection associated with shipments of fissile (nuclear) material (as defined in the CPPNM) are complied with. The consignor may also be required to provide evidence that measures to meet any requirements for security of certain shipments of radioactive material are complied with. **SSG-26/§109.1:** Measures for transport security – Additional measures may be required by regulatory agencies to provide appropriate physical protection in the transport of radioactive material and to prevent unlawful acts which constitute the receipt, possession, use, transfer, alteration, disposal or dispersal of radioactive material and which cause, or are likely to cause, death or serious injury to any person or substantial damage to property. **SSG-26/§310.2:** Measure dealing with unplanned events – It is recognized that unplanned situations may arise during transport, such as a package suffering minor damage or in some way not meeting all the relevant transport safety requirements, which will require action to be taken. When there is no immediate health, safety, or physical security concern, a special arrangement may be appropriate. However, special arrangements should not be required to deal with occurrences of non-compliance which may require immediate transport to bring the non-compliant situation under appropriate health and safety controls. In such cases, it is considered that the relevant emergency response procedures and the compliance assurance programmes provide better approaches in most cases for unplanned events of these types. **SSG-26/§582.5:** Measure dealing with packages in temporary storage – Packages should be placed for temporary storage in an isolated, secure place. **SSG-26/§§637.2, 637.3:** Measure for placing a security seal on a package – The type and mass of the package will, in the main, dictate the type of security seal to be used, which should follow a graded approach. The method used to secure the package closure itself should be independent of the security seal.	**CPPNM-A/Fundamental Principle B:** State responsibility for physical protection during international transportation of nuclear material – The State has the responsibility for ensuring that nuclear material is adequately protected during the international transport thereof, until that responsibility is transferred to another State, as appropriate. **CPPNM-A/Fundamental Principle C:** State responsibility for establishing a physical-protection legal framework for the transport of nuclear material – The State is responsible for establishing a legislative and legal framework that provides for a system of inspection of nuclear material during transport to verify compliance with applicable requirements and conditions, and a means of enforcing applicable requirements, etc. **CPPNM-A/Fundamental Principle E:** Shipper and carrier responsibilities for physical protection during transport of nuclear material – Prime responsibility for implementation of physical protection of nuclear material during transport rests with the shipper and/or carrier. **NSS No.20/§§1.2, 1.3:** Measures for transport safety, security and safeguards should be coordinated – Nuclear security and nuclear safety have in common the aim of protecting persons, property, society, and the environment. Security measures and safety measures have to be designed and implemented in an integrated manner to develop synergy between these two areas and also in such a way that security measures do not compromise safety and safety measures do not compromise security. Coordination of nuclear security with nuclear safety and applicable safeguards is essential. **NSS No.20/§3.3 & NSS No.20/§3.3:** Contents of legal and regulatory framework at the State level – Legislative and regulatory frameworks should establish (a) competent authorities and regulatory bodies; (b) responsibilities; (c) measures for coordination and cooperation between involved parties, (d) regulatory-body independence; (e) transport regulations, requirements, and procedures for shippers and carriers; (f) measures to ensure nuclear material is properly accounted for, controlled, and protected; (g) measures to protect sensitive-information confidentiality; (h) responsibilities for authorized persons; (i) designated entities to assume responsibility in the absence of authorized persons; (j) law enforcement systems; (k) measures to ensure that illicit trafficking is prevented, deterred, detected and responded to; and (l) methods for verifying and enforcing measures to ensure compliance {see also Essential Element No. 5). **NSS No.20/§3.11:** Measures for coordinating transport safety and security during emergency response –During response to a nuclear security event, effective coordination and cooperation among all those carrying out response functions and between the security and safety aspects of the response is vital. **NSS No.13/§§3.17, 6.58:** Measures for coordinating transport security with safety and safeguards during transport – The physical protection measures for transport should be additional to, and not substitute for, other measures established for safety, nuclear material accountancy and control, or radiation protection processes. The safety features of the design of the transport safety system should be taken into account when deciding what additional physical protection measures are needed to protect the material against sabotage. **NSS No.26-G/§1.9:** Joint compliance with both transport security and transport safety measures – Nuclear transport security and safety considerations should work in concert to enable compliance with relevant safety and security documents.	**153/§3:** The IAEA and State shall cooperate. **153/§4:** Safeguards shall be implemented to avoid hampering economic and technological development of the State; avoid undue interference in State activities and facility operation; and be consistent with prudent management practices. **153/§5:** The IAEA shall protect commercial and industrial secrets and other confidential information. **153/§6:** The Safeguards Agreement shall take full account of technological developments in the field of safeguards. **153/§44**: The Safeguards Agreement shall provide that other information relevant to the application of safeguards shall be made available to the IAEA; in particular, information on organizational responsibility for material accountancy and control; and information on health and safety procedures. **153/§87:** Inspectors shall avoid hampering construction, commissioning, or operation of facilities or hampering their safety. **540/§15:** The IAEA shall protect commercial, technological, and industrial secrets and other confidential information. **540/Preamble, para. 3:** The IAEA must take into account the need to avoid hampering economic and technological development and international cooperation; must respect health, safety, physical protection and other security provisions and the rights of individuals; and must take every precaution to protect commercial, technological and industrial secrets as well as other confidential information. **540/§7.a:** The IAEA and the State shall make arrangements for managed access to prevent the dissemination of proliferation-sensitive information, to meet safety and physical protection requirements, and to protect proprietary or commercially sensitive information.

From this comparison, the following potential conflict and suggested conflict resolution with respect to ensuring safety, security, and/or safeguards interfaces when applying 3S provisions were identified as follows:

- **Potential Conflict:** The IAEA documents recognize the potential for conflict among safety, security, and safeguards. Transport measures taken to address one discipline may be in conflict with measures taken for the other two disciplines. But typically, the documents for any one of the three 3S disciplines encourages the application of the principle that measures imposed for that 3S discipline should not be in conflict with measures imposed for the other two 3S disciplines.

- **Suggested Conflict Resolution:** Care must be taken when striving to resolve conflicts that may arise between the 3S disciplines when applying IAEA regulatory provisions to any one of the 3S disciplines to ensure that those provisions do not conflict with the regulatory provisions of the other 2S disciplines. The IAEA documents recognize the need to take into account all three disciplines during cooperation and coordination of the safety, security, and safeguards measures so as to avoid conflicts and to protect persons, property, and the environment. The regulators and operators have a dual primary responsibility, working together, to identify and resolve all such conflicts. The common objective for all three disciplines is to protect persons, property, and the environment.

5.4. Topic No. 11 – Ensuring Adequate Personnel Training

The States have primary responsibility for ensuring that training of involved operator personnel is accomplished and is adequate, while the operators have the primary responsibility for ensuring that training is provided directly, or indirectly through secondary sources. In a subsidiary role, the IAEA ensures adequate training for IAEA safeguards staff. Also, the IAEA frequently offers voluntary training on various aspects of the 3S disciplines to Member States' regulators and operators.

Table 5-4 compares the basis for applying the provisions of the international regulatory documents with respect to training for the 3S disciplines.

Table 5-4. Training Provisions in the International 3S Transport Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§311: Radiation training – Workers shall receive training concerning radiation protection, focused on precautions to be observed to restrict their occupational exposure and the exposure of other persons who might be affected by their actions. **SSR-6/§312:** Regulatory training – Persons engaged in the transport of fissile (nuclear) material shall receive training on the transport safety regulations commensurate with their responsibilities. **SSR-6/§§313, 315:** Worker training – Any person directly involved in the transport of fissile (nuclear) material shall receive (a) general awareness training, (b) function-specific training, and (c) safety training. Training shall be provided upon employment and periodically supplemented as deemed appropriate. **SSR-6/§314:** Training records – Records shall be maintained and available for all training. **SSG-6/§§311.1–315.1:** Radiation training – Information and training is an integral part of the system of radiological protection, where the level of instruction provided should be appropriate to the nature and type of work undertaken. Only appropriately trained persons should be engaged in the transport of fissile (nuclear) material.	**NSS No. 20/§3.12:** Nuclear security system training – A nuclear security regime that ensures each competent authority and authorized person and other organizations with nuclear security responsibilities contribute to the sustainability of the regime shall include routinely conducting maintenance training, and evaluation to ensure the effectiveness of the nuclear security systems. **NSS No. 13/§313:** Involved personnel training – The State should ensure that training of guards and response forces is accomplished. **NSS No. 26-G/§3.5:** Involved personnel training – An effective nuclear security culture is dependent on education, training and awareness of people who plan, operate, and maintain physical protection systems. **NSS No. 26-G/§§3.28, 3.36, 3.68:** Nuclear security system training – The State should ensure that evaluations are performed to test the physical protection system, including the training and readiness of guards and/or response forces. Operators, shippers, and carriers should establish sustainability programmes for their physical protection system which should include human resource management and training. Contingency plans should provide for the training of involved security personnel with respect to their assigned actions. The State may specify requirements for inspectors, which could include training. **NSS No. 26-G/§6.37:** Training for Category I, II, and III nuclear material shipments –Appropriate carrier personnel should be provided with consignment-specific transport documents, which should include any Information that has not already been covered in prior training or general instructions. **NSS No. 26-G/§6.37:** Training for Category I and II nuclear material shipments – Operation of the immobilization mechanism and the procedures governing its use should be covered in the training for escorts and for drivers of land vehicles. **NSS No. 26-G/§6.37:** Training for shipments of nuclear material requiring at least basic security level physical protection – Physical protection measures for the transport of these materials should include basic security awareness training for all personnel involved **NSS No. 26-G/§I.15:** Training requirements – A transport security plan should identify the training that needs to be conducted and the exercises that need to be arranged and should specify the schedule that will be followed for each. The training and exercises specified should address all appropriate aspects of physical protection. The results of all training exercises should be documented, and any corrective actions identified during the process should be implemented promptly.	**INFCIRC/153** and **INFCIRC/540** do not address training for the State or for the IAEA. However, the IAEA conducts extensive training for IAEA inspectors to ensure they can carry out their responsibilities.

From this comparison, the following assessment of the potential for conflicts and potential synergies with respect to ensuring adequate personnel training results in the following:

- **Potential Conflicts:** There are no apparent conflicts with respect to the training provisions specified in the transport 3S regulatory documents. The transport safety and transport security documents specify training requirements for involved personnel; however, since there are no safeguards training requirements specified for States, this specification is viewed as not being a conflict.

- **Potential Synergies:** Training for safety and security is synergistic since training for both involves limiting access to nuclear material during use, transport, and nuclear emergencies to ensure both the safety and security of persons. Though the IAEA does not require safeguards training for State or operator personnel, the application of safeguards requirements benefits from the training required by the State and by the operator.

5.5. Topic No. 12 – Overseeing Radiation Protection

The States have primary responsibility for ensuring that radiation protection measures are required of operators, while the operators have the primary responsibility for ensuring that radiation protection measures are implemented during transport. The IAEA has a subsidiary role with respect to radiation protection by ensuring

appropriate measures are included in their relevant regulatory documents, ensuring that the IAEA Agreements require safe and secure conditions be provided for IAEA safeguards inspectors during inspections.

Table 5-5 compares the basis for applying radiation protection provisions of the international regulatory documents for the 3S disciplines.

Table 5-5. Radiation Protection in the International 3S Transport Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SR-6/§302: Radiation protection programme – A radiation protection programme shall be established for the transport of radioactive material. The nature and extent of the measures to be employed in the programme shall be related to the magnitude and likelihood of radiation exposure. **SSR-6/§301:** Radiation doses to persons – Doses to persons shall be below the relevant dose limits. Protection and safety shall be optimized in order that the magnitude of individual doses, the number of persons exposed, and the likelihood of incurring exposure shall be kept as low as reasonably achievable, economic and social factors being taken into account, within the restriction that the doses to individuals are subject to dose constraints. **SSR-6/§303:** Occupational radiation protection – Specifies that, for transport radiation protection, the response to occupational exposures follows a graded approach depending upon the assessed potential effective dose, and when a dose is above specified threshold levels, that monitoring or individual monitoring is conducted, and that appropriate records shall be kept. **SSR-6/§§307, 308:** Periodic radiation dose assessments – It is the responsibility of the competent authority to ensure compliance with the transport safety regulations. As such, the competent authority shall arrange for periodic assessments of the radiation doses to persons due to the transport of radioactive material, to ensure that the transport system provides adequate radiation protection and safety. **SSG-26/§308.2:** Periodic radiation dose assessments – Information on the radiation doses to workers and to members of the public should be collected and reviewed, as appropriate. Reviews should be made if circumstances warrant; where reviews of accident conditions of transport are necessary, in addition to those of routine and normal conditions. **SSR-6/§§617, 648, 659:** Controls on radiation levels external to a package – For routine conditions of transport, normal conditions of transport and accident conditions of transport, strict controls are imposed on the maximum increase in dose rate allowed when a package design is exposed to each of these categories of environments.	**CPPNM-A/Article 1(e):** Intentional release of radioactive substances during transport – Sabotage is any deliberate act directed against nuclear material in transport which could directly or indirectly endanger the health and safety of personnel, the public or the environment by exposure to radiation or release of radioactive substances". **NSS No. 13/§3.17:** Physical protection during transport should complement radiation protection – The recommended physical protection measures for security should be in addition to, and not a substitute for, other measures established for nuclear safety, including radiation protection purposes. **NSS No. 13/§3.44:** Intentional release of radioactive substances during transport – For protection against sabotage, the State should establish thresholds of unacceptable radiological consequences in order to determine appropriate levels of physical protection, taking into account safety and radiation protection. **NSS No. 13/§6.69:** Response forces need knowledge of radiation protection principles – Response forces need to be familiarized with typical transport operations and sabotage targets and have adequate knowledge of radiation protection to ensure that they are fully prepared to conduct necessary response actions with consideration of their potential impact on radiation safety. **NSS No. 26G/§9.9:** Response forces need guidance on radiation protection – The State should provide guidance to response personnel so they can be aware of basic radiation protection measures and actions.	**153/§4(c):** Safeguards shall be consistent with prudent management for safe conduct of nuclear activities. **153/§44:** The State shall make available information on health and safety procedures that the IAEA shall observe and comply with. **153/§87:** Inspectors shall carry out their activities in a manner to avoid affecting their safety. **540/§7.a:** The IAEA and State shall make arrangements for *managed access* in order to meet safety or physical protection requirements.

From this comparison, the following assessment of the potential for conflicts and potential synergies with respect to overseeing radiation protection results in the following:

- **Potential Conflicts:** There are no apparent conflicts with respect to providing radiation protections during the transport of nuclear material. Transport regulatory documents for all three 3S disciplines focus on providing adequate radiation protection for those involved in the transportation activities and for ensuring radiation protection for the public

- **Potential Synergies:** Standards for transport safety address occupational and public radiation protection during transport. Standards for transport security address radiation release during sabotage and response to sabotage. These standards for safety and security are not in conflict. With respect to safeguards, the IAEA is required to carry out its activities in accordance with radiation protection measures established for State nuclear activities, including transport. This requirement assumes that effective radiation safety and security standards are applied by the State during safeguards activities.

5.6. Topic No. 13 – Applying Management Systems, Compliance Assurance, Quality Assurance, and Quality Control

The States and the operators have dual primary responsibility for applying Management Systems, QA and QC for their transport safety and security (in general, the operators more so than the State). For safeguards, although the Safeguards Agreement does not address management systems, compliance assurance, or quality assurance it is noted that the “IAEA shall make full use of the national system, which shall be based on a structure of material balance areas”.

Table 5-6 compares the basis for applying the provisions of the international regulatory documents with respect to the management system, which includes Compliance Assurance, Quality Assurance, and Quality Control, to the 3S disciplines.

Table 5-6. Management Systems, Compliance Assurance, Quality Assurance and Quality Control in the International 3S Transport Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§228: Management systems – A management system consists of a set of interrelated or interacting elements for establishing policies and objectives and enabling the objectives to be achieved. **SSG-26/§228.1:** Quality assurance – Quality assurance is a systematic programme of controls and inspections aimed at providing adequate confidence that the standard of safety prescribed in the transport regulations is achieved in practice. **SSG-26/§§307.2 to 307.5:** Compliance assurance – Compliance assurance includes measures applied by a competent authority that are intended to ensure that the provisions of the Transport Safety Regulations are complied with in practice. An effective compliance assurance programme should include inspections, audits and enforcement actions, and the programme should be conveyed to all involved parties. **SSR-6/§306:** Management systems – A management system shall be implemented to ensure compliance, and facilities shall be available for inspection. **SSG-26/§306.1:** Management systems – A management system is a systematic and documented method to ensure that the required conditions or levels of safety are consistently achieved. Any systematic evaluation and documentation of performance judged against an appropriate standard is a form of management system. A disciplined approach to all activities affecting quality, including, where appropriate, specification and verification of satisfactory performance and/or implementation of appropriate corrective actions, will contribute to transport safety and provide evidence that the required quality has been achieved. **SSR-6/§§307 & 308:** Compliance – It is the responsibility of the competent authority to ensure compliance with the transport safety regulations; as such, the competent authority shall arrange for periodic assessments of the radiation doses to persons due to the transport of *radioactive material*, to ensure that the system of protection and safety is sufficient. **SSR-6/§§501–503:** Ensuring proper controls on packagings – Before the first shipment of a packaging, it must be ensured that the packagings have been manufactured in compliance with regulatory requirements. Prior to each shipment of a packaging, it must be ensured that the packagings contain only approved contents and that the package complies with all relevant transport safety regulatory requirements. **SSR-6/§§504 and 505:** Compliance with package contents – Ensure that packages of fissile (nuclear) material contain only items necessary for use of radioactive material, and that they are not used for other goods unless decontaminated prior to such use. **SSR-6/§309:** Non-compliance – In the event of non-compliance, the appropriate organization shall inform, mitigate, investigate, remedy, and communicate the non-compliance. **SSR-6/§§310 and 434:** Special Arrangements – In the event that full compliance with the transport safety regulatory requirements is impracticable, then transport shall be not be undertaken except under a special arrangement approved by the competent authorities, where the overall level of safety during transport shall be at least equivalent to that which would have been provided if all the applicable requirements in the transport safety regulations had been met; and where multilateral approval by all involved competent authorities shall be required.	**CPPNM-A/Fundamental Principle J; NSS No. 13/§3.51+, & NSS No. 26-G/§§3.59+, 3.60, 3.61:** Quality assurance (QA) – A QA policy and QA programmes should be established and implemented with a view to providing confidence that specified requirements for all activities important to physical protection are satisfied. The State should, within its regulatory framework, require that a shipper or carrier establish and implement a QA policy and programme to ensure that where a physical protection system is designed, implemented, operated or maintained, it is done so to a standard that is capable of effectively responding to the threat(s) identified by the threat assessment or design basis threat (DBT) and that complies with the State's regulations. The QA policy and programmes for physical protection should ensure that a physical protection system is designed, implemented, operated and maintained in a condition capable of effectively responding to the threats the system will face. A QA programme should apply to all physical-protection-related activities (technical, procedural and administrative) and should be reviewed on a periodic basis. **NSS No. 12/§6.68:** Validating Management Systems for transport – The State should ensure that joint exercises are regularly carried out to assess and validate the adequacy of interfaces and response coordination of emergency and security organizations which are part of the management systems, and there should be a method for incorporating lessons learned to improve the management systems. **NSS No. 26-G/§3.61:** Implementing QA for Category I shipments – In the application of a QA programme to all physical-protection-related activities, for the transport of Category I nuclear material, shippers or carriers should ensure that all relevant physical protection measures (such as the tracking system and communications equipment) are operating correctly, and this should then be confirmed to the State's competent authorities before transport commences. **NSS No. 26-G/§3.62:** Integrating QA – QA, as well as safety and security culture, should be integrated into an organization's management system to ensure the management of safety–security interfaces. While the QA programmes for physical protection will be based on concepts similar to those for transport safety, the need to protect the confidentiality of sensitive information will need to be taken into account. This needs to be accomplished while recognizing that QA programmes for safety are influenced by concepts of openness and transparency.	**153/§7:** The State shall establish and maintain a system of accounting for and control of all nuclear material subject to the Safeguards Agreement. **153/§8:** The IAEA shall be provided with information concerning nuclear material subject to safeguards and the features of facilities relevant to safeguarding such material. **153/§31–32:** The IAEA shall make full use of the national system, which shall be based on a structure of material balance areas. **153/§39:** In particular, the IAEA and the State shall make Subsidiary Arrangements that specify in detail, to the extent necessary to permit the IAEA to fulfil its responsibilities under the Safeguards Agreement in an effective and efficient manner, how the procedures laid down in the Safeguards Agreement are to be applied. **153/§42–49:** Design information with respect to existing facilities shall be provided to the IAEA by the State. **153/§55:** The Agreement should provide that the system of measurements for records and reports shall either conform to the latest international standards or be equivalent in quality to such standards. **153/§59–69:** The State shall provide the IAEA with detailed reports with respect to nuclear material subject to safeguards. **153/§70-76:** The IAEA shall have the right to make inspections as provided for in the Safeguards Agreement. **153/§90:** The IAEA shall inform the State of the results of inspections and of and conclusions it has drawn from verification activities in the State. **540/§4–7:** The IAEA shall have complementary access to carry out its activities. **540/§13:** The State and IAEA shall agree on Subsidiary Arrangements to specify how measures laid down in the Additional Protocol are to be applied.

From this comparison, the following potential conflict and suggested conflict resolution with respect to applying management systems, compliance assurance, quality assurance, and quality control were identified as follows:

- **Potential Conflict:** Quality standards are not addressed consistently by the three transport disciplines.

- **Suggested Conflict Resolution:** The 3S documents all require, explicitly or implicitly, a high level of assurance of quality and the quality assurance programs for transport for each of the 3S disciplines differ in scope and content. Thus, care must be taken when striving for synergy between all 3S disciplines to ensure that both quality assurance and quality control are adequate and, when applied for one discipline, do not interfere or conflict with the other disciplines. The safety, security, and safeguards documents all require a high level of assurance of quality. Quality Assurance programs for transport safety and security, and international quality standards for safeguards measurement systems are required and are synergistic.

5.7. Topic No. 14 – Implementing Transport Operational Controls

With respect to operational controls, transport safety and transport security operational controls are a joint responsibility of the regulators and operators where the regulators probably have a lead in these. For safeguards, the State has a primary role whereas the IAEA has a subsidiary role since it relies on the State for being primarily responsible for enforcing safeguards at operator facilities under the Safeguards Agreement between the IAEA and the State.

Table 5-7 compares the basis for applying the provisions of the international regulatory documents with respect to operational controls during transport for the 3S disciplines.

Table 5-7. Transport Operational Controls in the International 3S Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§§517–522: Controls for IF packages – Although a package may be identified as Type IF, it still must be designed and demonstrated to satisfy all fissile (nuclear) material packaging requirements unless it is fissile excepted, where the total activity of fissile (nuclear) material in a conveyance is controlled according to Table 6. **SSR-6/§§244, 523–524A, 573, 575, 579 and Table 10:** Controls on external dose rates – The transport index (TI) provides limits to control radiation exposure during transport. The TI for a non-exclusive use consignment is limited to 10. The TI and the associated surface dose rates for exclusive use consignments are limited according to mode of transport. **SSR-6/§§218, 525–528, 567–569, 686 and Table 11:** Controls on criticality safety – The criticality safety index (CSI) provides control over the accumulation of packages, overpacks or freight containers containing fissile (nuclear) material to ensure criticality safety. The CSI shall not exceed 10 for a package or 50 for groups of fissile (nuclear) material stored while in transit, and for an overpack unless transported under exclusive use; and is limited further according to mode of transport. **SSR-6/§§529–543:** Controls on marking, labeling and placarding – Each package is categorized, marked and labeled according to contents and identified by unique UN numbers to facilitate emergency response. Marking and labelling follow a graded approach. Each package, overpack and freight container transporting fissile (nuclear) material shall have a CSI label to communicate its CSI. Placards are placed on certain road/rail vehicles and on freight containers to communicate the UN number. **SSR-6/§§545–561, 584–588:** Controls on consignors and carriers – Consignors shall not offer any shipment of fissile (nuclear) material for transport unless it is properly categorized, marked, labeled and placarded and a certified transport document is issued and is shown to satisfy all the transport safety regulatory provisions. Consignors provide documented requirements that a carrier shall satisfy, and appropriately notify competent authorities of shipments according to regulatory provisions. Carriers shall not accept a consignment unless it is properly documented and shall maintain records according to regulatory requirements. **SSR-6/§§562–570:** Controls on segregation, storage and stowage of fissile (nuclear) material in transit – Fissile (nuclear) material in transport and in storage incidental to transport shall be segregated from workers, members of the public, undeveloped photographic film, and other dangerous goods, and shall be securely stowed to foster radiation and criticality safety. **SSR-6/§582:** Controls on customs operations – To ensure safety, inspections by customs agents shall only be done by qualified persons. **SSR-6/§583:** Controls on undeliverable packages – Any undeliverable package shall be placed in a safe location and competent authorities notified.	**CPPNM/Annex I, §2:** Operational controls on nuclear material transport – Shipment controls depend on the category of the material being shipped: (a) For Category II and III materials, transportation shall take place under special precautions including prior arrangements among sender, receiver, and carrier, and prior agreement between natural or legal persons subject to the jurisdiction and regulation of exporting and importing States, specifying time, place and procedures for transferring transport responsibility. (b) For Category I materials, transportation shall take place under special precautions identified above for transportation of Category II and III materials, and in addition, under constant surveillance by escorts and under conditions which assure close communication with appropriate response forces. (c) For natural uranium other than in the form of ore or ore-residue; transportation protection for quantities exceeding 500 kilograms uranium shall include advance notification of shipment, specifying mode of transport, expected time of arrival, and confirmation of receipt of shipment. **CPPNM/Annex I, §1:** Operational controls on nuclear material when in storage during transport – Storage controls depend on the category of the material being shipped: (a) For Category III materials, storage shall be within an area to which access is controlled. (b) For Category II materials, storage shall be within an area under constant surveillance by guards or electronic devices, surrounded by a physical barrier with a limited number of points of entry under appropriate control or any area with an equivalent level of physical protection. (c) For Category I material, storage shall be within a protected area as defined for Category II above, to which, in addition, access is restricted to persons whose trustworthiness has been determined, and which is under surveillance by guards who are in close communication with appropriate responses forces. **NSS No. 20/§3.3:** Legislative controls – The legislative and regulatory framework, and associated administrative measures, to govern the nuclear security regime should include the establishment of systems and measures to ensure that nuclear material being transported are appropriately accounted for or registered and are effectively controlled and protected. **NSS No. 13/§6.71; & NSS No. 26-G/§6.47:** Shipment controls using a transport control centre – Carriers should ensure their transport control centre's management is prepared and capable of being informed as soon as there is a malicious attempt, or when an act of sabotage is detected. The role of the transport control centre in the case of a nuclear security event involving the nuclear material in transport should be clarified to ensure effective coordination with the emergency response.	**153/§2:** The IAEA has the right and obligation to apply safeguards in accordance with the Safeguards Agreement to all source and special fissionable material in all peaceful nuclear activities. **153/§7:** The State shall establish and maintain a system of accounting for and control of all nuclear material subject to the Safeguards Agreement. **153/§§31–32:** The IAEA shall make full use of the State system, which shall be based on a structure of material balance areas. **153/§39:** In particular, the IAEA and the State shall make Subsidiary Arrangements that specify in detail, to the extent necessary to permit the IAEA to fulfil its responsibilities under the Safeguards Agreement in an effective and efficient manner, how the procedures laid down in the Safeguards Agreement are to be applied. **540/§13:** The State and IAEA shall agree on Subsidiary Arrangements to specify how measures laid down in the Additional Protocol are to be applied.

From this comparison, the following potential conflict and suggested conflict resolution with respect to implementing operational controls were identified:

- **Potential Conflict:** While not in direct conflict, safeguards requires some additional control measures, for example, regarding records, reporting, and submitting design information. In addition, the transport safety controls related to marking and labeling of packages and placarding of vehicles and freight containers may conflict with the need to limit the transmittal of such information for transport security purposes. In contrast, however, the controls identified for safety and security such as measurements, records and transportation system design generally also contribute to effective safeguards.

- **Suggested Conflict Resolution:** Care must be taken when striving for synergy between all 3S disciplines when applying transport operational controls, since some of the requirements for each of the 3S disciplines may conflict with those of other disciplines. Mechanisms for resolving such conflicts will need to be addressed jointly by operators and competent authorities involved in the transport of nuclear material.

6. COMPREHENSIVE EVALUATION OF PRIMARY RESPONSIBILITIES OF THE OPERATORS

This Section provides the results of the detailed consideration of each of the eleven topics for which the application of each topic is primarily the responsibility of the operators, or in the case of Topics 20 and 21, where the responsibility for application lies jointly with the Operators and the Regulators. As previously shown in Sections 4 and 5, it includes a detailed comparison of relevant text from the IAEA regulatory documents that served as a basis for determining primary responsibilities, potential conflicts, suggested resolutions to the conflicts when such were identified, and potential synergies.

6.1. Topic No. 15 – Applying Physical Controls of Nuclear Material

Operators have a primary role for providing adequate physical controls for both safety and security during the transport of nuclear material, whereas the State and the IAEA have a lesser, subsidiary role. However, State authorities and operators need to be aware that the IAEA is not responsible for the physical control of nuclear material within a State, i.e., the State has sole responsibility for the nuclear material.

Table 6-1 compares the basis for applying the provisions of the international regulatory documents with respect to physical controls of nuclear material for the 3S disciplines.

Table 6-1. Applying Physical Controls of Nuclear Material in the International 3S Transport Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§§607–621, 623–672: Controls on packaging of fissile (nuclear) material for transport – Specific and detailed design, testing and acceptance requirements are imposed on each fissile (nuclear) material package design controlling the package behavior in structural, thermal and immersion tests for normal and accident conditions of transport to ensure adequate containment, shielding, thermal management and criticality safety control. Specific controls on package design and testing are imposed for each type of package (i.e., for excepted packages; empty packages; and Type AF, Type B(U)F, Type B(M)F, Type CF, Type IF, H(U) and H(M). packages). **SSR-6/§637:** Control to indicate package seal integrity during transport – The outside of a package shall incorporate a feature that is not readily breakable and which, while intact, will be evidence that the package has not been opened. **SSR-6/§§564, 576, 638, 809, 836, 838; and SSG-26/§§564.1-565.2, and Appendix IV:** Controls on package retention/stowage during transport and storage during transport – Packages shall be capable of being properly stowed and retained during transport and when placed into storage incidental to transport. **SSR-6/§§673–685; and SSG-26/§§673.1-:** Specific controls on transport and packaging of fissile (nuclear) material – The requirements for packages containing fissile (nuclear) material include additional requirements imposed to ensure that packages with fissile (nuclear) material contents will remain subcritical under normal and accident conditions of transport. All other relevant requirements of the transport safety regulations must also be met. The system for implementing criticality control in transport as prescribed in the transport safety regulations is based on design requirements, specifications, and approval certificates, as well as on classification of the fissile (nuclear) material being transported. **SSR-6/Sections 6 and 7:** Controls on tests for fissile (nuclear) material packages – In addition to satisfying all of the relevant package design, test and acceptance requirements for the radioactive nature of the fissile (nuclear) material being transported, additional requirements are imposed pursuant to the fissile nature of the material. These requirements are specified in §§673–686 and 734–737, which include detailed specifications that must be satisfied in determining CSI, behavior of the confinement system used for criticality control, and methods for determining subcriticality. **SSG-26/§722.1:** Special controls on the additional tests for fissile (nuclear) material packages – Additional controls on package design, testing and acceptance criteria have been established for packages containing fissile (nuclear) material, in part to introduce a measure of consistency into the transport package testing regime with a focus on ensuring criticality safety during transport and during in-transit storage.	**CPPNM/Annex I, §2:** General physical controls on nuclear material transport – Physical shipment controls depend on the category of the material being shipped: (a) For Category II and III nuclear materials, transportation shall take place under special precautions, including prior arrangements among sender, receiver, and carrier, and prior agreement between natural or legal persons subject to the jurisdiction and regulation of exporting and importing States, specifying time, place and procedures for transferring transport responsibility. (b) For Category I nuclear materials, transportation shall take place under special precautions identified above for transportation of Category II and III materials, and in addition, under constant surveillance by escorts and under conditions which assure close communication with appropriate response forces. (c) For natural uranium other than in the form of ore or ore-residue; transportation protection for quantities exceeding 500 kilograms of uranium shall include advance notification of shipment specifying mode of transport, expected time of arrival, and confirmation of receipt of shipment. **NSS No. 13/§§6.6 to 6.43:** Specific physical controls on nuclear material transport – Physical shipment controls should encompass the following sets of security measures, depending upon the category on the material being transported, aggregated on a conveyance basis: (a) The set of common requirements for the transport of all nuclear material specified in paras. 6.6 to 6.10 of NSS No. 13; and (b) The additional set of requirements for the transport of Categories I, II and III nuclear material specified in paras. 6.11 to 6.18 of NSS No. 13; (c) The additional set of requirements for the transport of Categories I and II nuclear material specified in paras. 6.19 to 6.31 of NSS No. 13; and (d) The additional set of requirements for the transport of Category I nuclear material specified in paras. 6.32 to 6.43 of NSS No. 13.	**153/§7:** The State shall establish and maintain a system of accounting for and control of all nuclear material subject to the Safeguards Agreement. **153/§29:** The Safeguards Agreement should provide for the use of material accountancy as a safeguards measure of fundamental importance. **153/§§31–32:** The IAEA shall make full use of the State's system, which shall be based on a structure of material balance areas. **153/§39:** In particular, the IAEA and the State shall make Subsidiary Arrangements that specify in detail, to the extent necessary to permit the IAEA to fulfil its responsibilities under the Safeguards Agreement in an effective and efficient manner, how the procedures laid down in the Safeguards Agreement are to be applied. **153/§91:** Nuclear material that is transferred internationally shall be determined as being the responsibility of the receiving or shipping State; and States shall make suitable arrangements to determine the point at which the transfer of responsibility will take place. **540/§13:** Subsidiary Arrangements shall specify how measures laid down in the Protocol are applied.

From this comparison, the following assessment of the potential for conflicts and potential synergies with respect to applying physical controls of nuclear material results in the following:

- **Potential Conflict:** For the purposes of safety and security, each State is responsible for the physical control of nuclear material for shipments undertaken within each involved State and shipments undertaken by conveyances flagged by a State. There may be variations among the States in the methods used for providing these physical controls. However, generally there are few conflicts between physical controls for safety and for security within a State or for shipments undertaken by conveyances flagged by a State.

- **Potential Synergies:** Physical control by a State during the transport of nuclear material, for purposes of the 3S disciplines, can be mutually beneficial. That control, from the perspective of safety and security, is generally passed on to the operators (i.e., the consignors, carriers, and consignees), although the States' operators have sole responsibility for the nuclear material. The IAEA is responsible, on the basis of independent technical verification, for ensuring that the declared nuclear material is accounted for in order to provide assurance to the international community. Thus, care must be taken when striving for synergy between all 3S disciplines by recognizing the different roles and responsibilities of the different stakeholders with respect to these shipments.

6.2. Topic No. 16 – Imposing Administrative Requirements and Controls

Operators have a primary role with respect to imposing administrative requirements and controls established by the regulators. In comparison, the IAEA has a subsidiary role with respect to administrative requirements and controls.

Table 6-2 compares the basis for applying the provisions of the international regulatory documents with respect to administrative requirements and controls for the 3S disciplines.

Table 6-2. Imposing Administrative Requirements and Controls in the International 3S Transport Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§501: Before a fissile (nuclear) material transport packaging is first used, it shall be confirmed that it has been manufactured in conformity with the design specifications to ensure compliance with the relevant provisions of the SSR-6 and any applicable certificate of approval. It shall be ensured that the effectiveness of its shielding and containment and, where necessary, the heat transfer characteristics and the effectiveness of the confinement system are within the limits applicable to or specified for the approved design; and that the effectiveness of the criticality safety features is within the limits applicable to or specified for the design. **SSR-6/§§502, 503:** Before each shipment of a fissile (nuclear) material transport packaging, it shall be ensured that the contents do not differ from the contents approved in the certificate of compliance and that all relevant requirements specified in the certificate of compliance are satisfied. **SSR-6/§§525, 526, 566, 567:** The criticality safety index (CSI) shall be determined as the sum of the CSIs of all the packages contained in each consignment, freight container or overpack of fissile (nuclear) material. Any package or overpack of fissile (nuclear) material with a CSI exceeding 50 shall only be transported under exclusive use. The CSI for a freight container carrying fissile (nuclear) material shall not exceed the values specified in Table 11 of SSR-6. **SSR-6/§§530–553, 571:** Each package of fissile (nuclear) material shall be appropriately marked and labeled, and each freight container, rail vehicle and road vehicle shall be appropriately placarded; and such marking, labelling and placarding shall be described and certified in a transport document. **SSR-6/§§554–555:** The consignor shall provide transport documents to the carrier, and the carrier shall retain copies of the documents that include a statement of all relevant actions that are required to be taken by the carrier. **SSR-6/§557:** Before the first shipment of any fissile (nuclear) material package, the consignor shall ensure that copies of each applicable competent-authority certificate have been submitted to the competent authority of the State of origin of the shipment and to the competent authority of each State through or into which the consignment is to be transported. **SSR-6/§558:** Before each shipment of fissile (nuclear) material in (a) a Type B(U)F package with activity exceeding $3000A_1$ or $3000A_2$, as appropriate, or 1000 TBq, whichever is the lower; (b) a Type B(U)F package; or (c) a shipment under special arrangement, the consignor shall notify the competent authority of the State of origin of the shipment and the competent authority of each State through or into which the consignment is to be transported. **SSR-6/§§568, 569:** Any group of packages, overpacks and freight containers containing fissile (nuclear) material that is stored in transit in any one storage area shall be so limited that the sum of the CSIs in the group does not exceed 50; and each group shall be stored so as to maintain a spacing of at least 6 m from other such groups. Also, where the sum of the CSIs on board a conveyance or in a freight container exceeds 50, storage shall be such as to maintain a spacing of at least 6 m from other groups of packages, overpacks or freight containers containing fissile (nuclear) material or other conveyances carrying radioactive material.	**NSS No. 20/§3.3:** Administrative measures for transport security include: (a) Establishing competent authorities, assigning authorities and responsibilities, establishing measures to ensure proper coordination and communications, and ensuring that competent authorities have appropriate independence. (b) Establishing security regulations, requirements and procedures, and providing systems and measures for accounting for nuclear material in transport. (c) Ensuring confidentiality of sensitive information. (d) Ensuring that authorized persons have prime responsibility for security of the nuclear material. (e) Establishing verification and enforcement measures to ensure transport security compliance. **NSS No. 13/§§3.4. 3.17:** Ensure that nuclear material in transport is under continuous control of the State, and that physical protection measures are implemented in addition to those measures established for safety, MCA, and radiation protection purposes. **NSS No. 13/§3.21:** Competent authorities should ensure that evaluations based on performance testing are conducted by shippers and/or carriers using applicable administrative measures. **NSS No. 13/§4.17:** During in-transit storage of nuclear material, administrative controls of keys and computerized access lists should be protected against compromise. **NSS No. 26-G/§3.45:** For each category of nuclear material shipped, the physical protection measures applied should either comply with the administrative requirements specified in the State's regulatory framework or should be evaluated against the prevailing threat or State DBT, using an appropriate vulnerability assessment. **NSS No. 26-G/§3.55:** States should use the concept of a graded approach to define the levels of administrative security measures, such as ensuring information security and determining the trustworthiness of individuals. **NSS No. 26-G/§3.61:** A quality assurance programme should apply to all administrative physical-protection-related activities and should be reviewed on a periodic basis. **NSS No. 26-G/§5.14:** The State may assign general responsibilities for administrative actions that may vary from State to State.	**153/§3:** The IAEA and State shall cooperate. **153/§4:** Safeguards shall be implemented to avoid hampering economic and technological development of the State; avoid undue interference in State activities and facility operation; and be consistent with prudent management practices. **153/§5:** The IAEA shall protect commercial and industrial secrets and other confidential information. **153/§6:** The IAEA shall take full account of technological developments in the field of safeguards and make every effort to ensure optimum cost-effectiveness. **153/§9:** The State shall take the necessary steps to ensure that IAEA inspectors can effectively discharge their functions. The IAEA shall secure the consent of the State to the designation of IAEA inspectors. **153/§10:** The Safeguards Agreement should specify the privileges and immunities that shall be granted to the IAEA. INFCIRC/9, Agreement on the Privileges and Immunities of the IAEA, applies. **153/§§11–13:** Safeguards shall terminate on nuclear material subject to its being consumed or diluted or made practicably irrecoverable; or transferred out of the State; or used in non-nuclear activities. **153/§14**: Procedures are identified to be applied if the State intends to use nuclear material in a nuclear activity that does not require the application of safeguards. **153/§15:** The Safeguards Agreement provides that each party shall bear the expenses it incurs. **153/§§16–17:** The Safeguards Agreement addresses third-party liability for nuclear damage; and it addresses settlement of damages in accordance with international law. **153/§§18–19: T**he IAEA Board of Governors (BOG) shall be able to call upon the State to take required action; and the BOG may take action as necessary. **153/§§20–22:** The parties shall consult about any question of interpretation and application of safeguards; and the State shall have the right to present it before the BOG; disputes should be submitted to an arbitral tribunal. **153/§23:** All amendments shall require the agreement of both parties. **153/§24:** Application of safeguards under other agreements may be suspended. **153/§25–26:** The Safeguards Agreement identifies conditions for its entry into force and the duration. **153/§27:** The purpose of Part II of the Safeguards Agreement is to specify procedures to be applied for implementation of safeguards provisions in Part I. **153/§§33–34:** The Safeguards Agreement specifies the starting point of safeguards. **153/§35:** The Safeguards Agreement specifies the termination of safeguards. **153/§§36–38:** The Safeguards Agreement identifies conditions when nuclear material is exempt from safeguards. **153/§§85–86:** The Safeguards Agreement provides what the State and IAEA Director General shall do regarding designation of inspectors. **540/§1:** In the case of conflict between the provisions of the Safeguards Agreement and those of the Additional Protocol, the provisions of the Additional Protocol shall apply. **540/§11:** The IAEA Director General shall notify the State of approved inspectors. **540/§12:** The State shall provide visas. **540/§15:** The IAEA shall maintain a stringent and effective confidential information protection regime. **540/§16:** The Annexes to the Additional Protocol shall be an integral part thereof. **540/§17:** The Additional Protocol shall enter into force when notified that the State's statutory and constitutional requirements have been met.

From this comparison, the following potential conflict and suggested conflict resolution with respect to imposing administrative requirements and controls were identified:

- **Potential Conflict:** While administrative requirements for Safeguards Agreements are standardized, specific methods of application may vary from State to State, depending on State-specific circumstances. Therefore, the IAEA must implement its safeguards requirements to be consistent with these circumstances, in particular, concerning the interfaces with transport safety and security. Administrative requirements and assignment of responsibilities for transport safety and security may vary from State to State. Thus, operators involved in international shipments of nuclear material need to be aware of the potential for administrative safety and security conflicts arising. The administrative requirements for transport safety as related to marking and labeling of packages and relating to placarding of vehicles and freight containers may conflict with the need to limit the transmittal of such sensitive information for transport security purposes. Mechanisms for resolving such conflicts will need to be addressed jointly by operators and competent authorities involved in the transport of nuclear material.

  It should be recognized that, for purposes of safeguards, administrative controls are identified and standardized by the IAEA documents INFCIRC/153 and INFCIRC/540 for Safeguards Agreements between the IAEA and a State. Safeguards Agreements contain provisions to ensure the consistency of transport safeguards with transport safety and security. This consistency is beneficial to implementation of all three disciplines.

- **Suggested Conflict Resolution:** Care must be taken when striving for synergy between all 3S disciplines when considering the administrative requirements and controls associated with the transport of nuclear material, both within a State and internationally. Administrative controls are widely standardized in safeguards documents and include measures to ensure consistency with safety and security. However, in their method of application, practices may vary from State-to-State depending on circumstances, particularly regarding availability and sensitivity of information, as well as the manner in which a State applies the IAEA safety and security regulatory documents. Such potential conflicts will need to be recognized and mechanisms for resolving such conflicts will need to be addressed jointly by those operators and competent authorities who are involved in the transport of nuclear material, and this may involve interacting with stakeholders in more than one State.

6.3. Topic No. 17 – Implementing Operational Controls, Information Security, and Transport Control Centres (TCCs)

Operators have primary responsibility with respect to implementing operational control and TCCs for both safety and security, whereas the regulators have a subsidiary responsibility to establish requirements with respect to operational controls. However, competent authorities (the State) may issue safety and security approvals for various nuclear material shipments, whereas the State needs to establish and maintain a system of accounting for and controlling all nuclear material subject to safeguards, including during transport. In a subsidiary capacity, the IAEA gives advance notice to the State before arrival of safeguards inspectors at facilities or material balance areas outside facilities. The operator may also have proprietary or commercially sensitive information that the operator wishes to control.

Table 6-3 compares the basis for applying the provisions of the international regulatory documents related to Transport Controls, Transport Communications, and implementation of Transport Control Centres (TCCs) for the 3S disciplines.

Table 6-3. Implementing Operational Controls, Information Security, and Transport Control Centres (TCCs) in the International 3S Transport Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§§501–503: Controls on packagings – Before a first shipment of packagings, it must be ensured that the packagings have been manufactured in compliance with regulatory requirements. Prior to each shipment of a packagings, it must be ensured that packagings contain only approved contents and that the package complies with all relevant transport safety regulatory requirements. **SSR-6/§§530-537, 547:** Controls through communications with markings of packages – The types of materials and method of packaging are communicated to those involved in transport with markings on packages. **SSR-6/§§538-542, 547:** Controls through communications with labelling of packages – The types of materials, radiation levels, and hazards posed by a package of fissile (nuclear) material are communicated to workers and emergency responders with labels on packages. **SSR-6/§§543–544, 547, 561, 571, 572:** Controls through communications with placarding – Placards are used on specific road and rail shipments and on freight containers transporting fissile (nuclear) material to communicate the types of materials and emergency response procedures to follow. The information on placards is primarily directed to emergency responders to facilitate actions needed in the event of an incident or accident. **SSR-6/§§546–553, 561:** Controls through communications with documentation on a consignment – Proper communications between consignors, carriers, consignees and potential emergency responders is facilitated with a properly described and certified transport document. **SSR-6/§§554–556:** Controls through communications with carriers –In the transport documents, consigners provide a statement regarding actions, if any, that are required to be taken by the carrier. **SSR-6/§§557–560:** Controls through communications with competent authorities – Before the first shipment of any package requiring competent-authority approval, the consignor ensures that copies of each applicable competent authority certificate have been submitted to the competent authority of the country of origin of the shipment and to the competent authority of each country through or into which the consignment is to be transported. For many fissile (nuclear) material shipments, the consignor notifies the competent authority of the country of origin of the shipment and the competent authority of each country through or into which the consignment is to be transported. **SSR-6/§§802, 805–807, 814–816, 825–826, 829–831:** Competent authority's controls – Competent authority shall issue multilateral approval or otherwise authorize most (a) fissile (nuclear) material package designs, (b) packages containing 0.1 kg or more of uranium hexafluoride, (c) fissile (nuclear) material itself that is excepted from "FISSILE," (d) shipments of fissile (nuclear) material, and (e) any shipment of fissile (nuclear) material undertaken under special arrangement; and also may authorize transport through or into its country of fissile (nuclear) material shipments where such approvals or authorizations shall be documented with the issuance of a certificate of approval.	**NSS No. 26-G/Glossary:** Transport control centre (TCC) – A TCC is a facility that provides for the continuous monitoring of a transport conveyance location and security status and for communication with the transport conveyance, shipper/receiver, carrier and, when appropriate, its guards and the response forces. **NSS No. 13/§6.71; & NSS No. 26-G/§6.47:** TCC – Carriers should ensure their TCC's management is prepared and capable of being informed as soon as there is a malicious attempt, or when an act of sabotage is detected. **NSS No. 13/§§3.52+, 3.53; Fundamental Principle L:** Controls on confidentiality of information – The State should establish requirements for protecting the confidentiality of information, the unauthorized disclosure of which could compromise the physical protection of nuclear material in transport. It should specify what information needs to be protected and how it should be protected, following a graded approach. **NSS No. 26-G/§5.37; Fig. 3:** Communications, command and control – The shipper and/or carrier need to define shipping parameters for communications, command and control and tracking arrangements. **NSS No. 26-G/§§6.45, 6.54:** Controls for Category I, II and III shipments – Information concerning the location of the shipment should be properly controlled but should be readily available to the shipper and/or carrier and should be provided to the receiver when appropriate. Guards and/or response forces should be sufficient to deal with nuclear security events consistent with the category of nuclear material being transported, and physical protection measures should include communication from the conveyance capable of summoning appropriate responders. **NSS No. 26-G/§§6.38, 6.47, 6.48:** Controls for Category I and II shipments – Written instructions detailing physical protection responsibilities should be appropriately classified and provided in advance of the shipment to all responsible personnel. Consideration should be given to establishing a TCC or other central point of communication to monitor and coordinate voice and/or digital communications between personnel involved with a specific shipment or group of shipments to monitor positional tracking, and to facilitate command and control. Physical protection measures should include the provision of continual, two-way voice communication between the conveyance, any guards accompanying the shipment, the designated response forces and, where appropriate, the shipper and/or receiver. The role of the TCC in the case of a nuclear security event involving nuclear material in transport should be clarified to ensure effective coordination with the emergency response. **NSS No. 26-G/§§6.3, 6.35, 6.44, 6.49, 6.50, 6.52, 6.58:** Controls for Category I shipments – There should be a TCC for the purpose of tracking the current position and security status of the shipment of nuclear material, alerting response forces in the case of an attack and maintaining continual, secure, two way voice communication with the shipment and the response forces. The TCC should be protected so that its function can continue in the presence of the threat. The conveyance, guards, communications capabilities, the TCC and the response forces should be integrated into a physical protection system that can prevent adversaries from removing the nuclear material or hijacking the conveyance. Engineered alarm or intrusion detection systems should be applied to conveyances to the extent practicable, and should be redundant, and capable of being monitored from the TCC. Continual two-way communication systems between the conveyance, TCC, guards accompanying the shipment, designated response forces and, where appropriate, the shipper and/or receiver should be redundant, diverse and secure. Guards providing surveillance should do so under conditions that ensure close communication with response forces. The guards or conveyance crew should be instructed to report frequently, and upon arrival at the destination, each overnight stopping place and place of handover of the shipment by secure two-way voice communications to the TCC.	**153/§7:** The State shall establish and maintain a system of accounting for and controlling all nuclear material subject to safeguards, including during transport. **153/§8:** The IAEA shall be provided with information concerning nuclear material subject to safeguards and the features of facilities relevant to safeguarding such material. **153/§§42–48:** Design information with respect to existing facilities shall be provided to the IAEA by the State. **153/§§59–69:** The state shall provide the IAEA with detailed reports with respect to nuclear material subject to safeguards. **153/§§83–84:** The IAEA shall give advance notice to the State before arrival of inspectors at facilities or material balance areas outside facilities. **153/§§91–97:** The point at which a State's responsibility for safeguarded nuclear material that is being internationally transferred changes is when the nuclear material reaches its destination **540/§2.a(iv):** The State shall provide the IAEA with a description of the scale of operations for each location engaged in activities specified in Annex I to the Protocol. **540/§14:** The State shall permit and protect free communications by the IAEA, including attended and unattended transmission of information generated by IAEA containment and surveillance or measurement devices. **540/Annex I §(xi):** Activities referred to in Article 2.a(iv) of the Protocol include the manufacture of flasks for the transportation or storage of irradiated fuel.

From this comparison, the following potential conflict and suggested conflict resolution with respect to implementing operational controls, information security, and TCCs were identified:

- **Potential Conflict:** While safety and security standards for control of information are necessary for packages containing nuclear and other material, transport safety requirements specify that detailed information be provided for handlers and emergency responders; and transport security requirements specify limiting the access to such information to reduce the likelihood that those with malicious intent will recognize what is being transported; while transport safeguards requirements specify the availability of the information for verification of nuclear material in containers. The transport safety requirements related to marking and labeling of packages and placarding of vehicles and freight containers may conflict with the need to limit the transmittal of such information for transport security purposes. Mechanisms for resolving such conflicts will need to be addressed jointly by operators and competent authorities involved in the transport of nuclear material. To meet its obligations under the Safeguards Agreement, the IAEA may require access to information that the operator deems proprietary or commercially sensitive.

- **Suggested Conflict Resolution:** Care must be taken when considering the extent to which shipment information is made available. For example, the transport safety requirements related to marking and labeling of packages and placarding of vehicles and freight containers may conflict with the security need to limit the transmittal of such potentially sensitive information for transport security purposes. Mechanisms for resolving such conflicts will need to be addressed jointly by operators and competent authorities involved in the transport of nuclear and other radioactive material. The operator may choose to allow IAEA access to sensitive information by allowing onsite observation of the information onsite by the IAEA rather than submitting the information in a report to the IAEA. It must be recognized when resolving these issues, that the proper and controlled communication of information regarding nuclear material is important for each of the 3S disciplines, and much of the nuclear and other radioactive material information needed is the same for all three disciplines. Also, requirements imposed by security of information for use by TCCs must be applied considering the requirements of the other two disciplines.

6.4. Topic No. 18 – Applying Measures and Controls Based on Characteristics, Radioactivity, Mass Levels, and Risks

Operators have primary responsibility with respect to measures and controls based on characteristics, radioactive, mass levels and risks based on characteristics for both safety and security, whereas the regulators and the IAEA have a subsidiary role in establishing requirements. For safeguards, a Safeguards Agreement should provide for the IAEA the right and obligation to ensure that safeguards will be applied on all source or special fissionable material in all peaceful nuclear activities The IAEA’s safeguards role is secondary where it addresses ‘What’ and the State and operator address ‘How’.

Table 6-4 compares the basis for applying the provisions of the international regulatory documents with respect to measures and controls based on characteristics, radioactivity, mass-levels, and risks during transport for the 3S disciplines.

Table 6-4. Applying Measures and Controls Based on Characteristics, Radioactivity, Mass-levels, and Risks in the International 3S Transport Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§401 & Tables 1 and 3: Controls with UN Numbering – Each transport package of fissile (nuclear) material is assigned a specific UN Number which controls multiple aspects of the shipping safety environment. **SSR-6/§§402–407 & Tables 2 and 4:** Controls on form of radioactivity – Each radionuclide of fissile (nuclear) material is assigned an activity value based on whether the material being shipped is in special form or other than special form, which controls the type of package in which the fissile (nuclear) material is placed for transport. **SSR-6/§§408–420 & Table 1:** Controls on Material Classification – A fissile (nuclear) material shall be classified pursuant to Table 1 as "FISSILE." In addition, each radioactive material is classified as LSA, SCO, special form, low-dispersible radioactive material, fissile (nuclear) material and/or uranium hexafluoride; where (a) any fissile (nuclear) material may fall into one or more of these material classifications, and (b) each material classification governs the type of package and operational controls imposed on a shipment. **SSR-6/§§421–420, 813, 832 & Table 4:** Controls on Package Classification – Each package containing fissile (nuclear) material is to be classified according to the required package type, where the contents in each package shall not exceed specified limits. Package types are: (a) excepted package; (b) empty package; (c) Type AF package, (d) Type B(U)F, (d) Type B(M)F, (e)Type CF, and (f)Type IF package. Any package that contains fissile (nuclear) material that is not excepted shall require multilateral approval. Any package containing fissile UF_6 shall be in one of the preceding classifications, and any package containing non-fissile or fissile excepted UF6 shall be classified as H(U) or H(M).	**CPPNM/Article 4, §§1, 2, 3:** Controls on export, import and transit of nuclear material – Each State Party shall not export or authorize the export of, nor import or authorize the import of, nuclear material unless the State Party has received assurances that such material will be protected during the international nuclear transport at the levels described in the categorization table in Annex I of the CPPNM. A State Party shall not allow the transit of its territory, by land or internal waterways, or through its airports or seaports, by nuclear material between States that are not parties to this Convention unless the State Party has received assurances, as far as practicable, that this material will be protected during international nuclear transport at the levels described in the CPPNM categorization table. **CPPNM/Article 4, §4:** Controls on international segments of transport of nuclear material – Each State Party shall apply, within the framework of its national law, the levels of physical protection described in Annex I of the CPPNM to nuclear material being transported from a part of that State to another part of the same State through international waters or airspace. **CPPNM-A/Article 5, §§4, 5:** Controls/cooperation on international and domestic transport – States Parties shall co-operate and consult, as appropriate, with each other with a view to obtaining guidance on the design, maintenance and improvement of systems of physical protection of nuclear material in international transport. A State Party may consult and co-operate, as appropriate, with other States Parties with a view to obtaining their guidance on the design, maintenance and improvement of its national system of physical protection of nuclear material in domestic transport. **CPPNM/Annex I & Annex II:** Levels of physical protection for international transport of nuclear material – Annex I of the CPPNM establishes the levels of physical protections for international transport of nuclear material, while Annex II of the CPPNM provides the basis for categorizing the material into three categories (Categories I, II and III). Nuclear material not falling in at least Category III shall be protected in accordance with prudent management practice. **CPPNM-A/Fundamental Principle H:** Physical protection requirements are categorized – Physical protection requirements should be based on a graded approach, taking into account the current evaluation of the threat, the relative attractiveness, the nature of the material and potential consequences associated with unauthorized removal of nuclear material and with sabotage against nuclear material or nuclear facilities. **NSS No.13/§§6.1, 6.5:** Levels of protection of nuclear material in transport plans – The levels of protection specified for transport are based on how the nuclear material might be used in the construction of a nuclear explosive device; while also considering that the material is radioactive material which needs to be protected against unauthorized removal since it could have significant radiological consequences if dispersed or used otherwise for malicious purposes. In addition to the categorization of the nuclear material provided by the Annexes in the CPPNM and its Amendment, the total amount of nuclear material on or in a single conveyance for transport should be aggregated to determine the appropriate categorization for identifying adequate physical protection (and safety) requirements.	**IAEA Statute Article XX** defines "special fissionable material" and "source material" for use in Safeguards Agreements and Additional Protocols. [See Topic 13 above.] **153/§2:** The Agreement should provide for the IAEA the right and obligation to ensure that safeguards will be applied on all source or special fissionable material in all peaceful nuclear activities. **153/§28:** The objective of safeguards is timely detection of diversion of significant quantities of nuclear material and deterrence of diversion by the risk of early detection. **153/§81:** For applying IAEA safeguards, the Safeguards Agreement includes criteria to be used for determining the actual number, intensity, duration, timing and mode of routine inspections of any facility. **540/Preamble, para. 4**: The frequency and intensity of activities described in the Additional Protocol shall be kept to the minimum consistent with the objective of strengthening the effectiveness and improving the efficiency of IAEA safeguards. **IAEA Safeguards Glossary** defines "significant quantity" as the approximate quantity of nuclear material involved in the manufacture of a nuclear explosive device. Tables show specific quantities and specific conversion times for different nuclear material.

From this comparison, the following potential conflict and suggested conflict resolution with respect to applying measures and controls based on characteristics, radioactivity, mass levels, and risks were identified:

- **Potential Conflict**: Specific classification of material characteristics, quantities, and risks vary for safe, secure, and safeguarded nuclear material during transport. Although different for each of the 3S disciplines, classification serves an important function for each of the 3S disciplines.

- **Suggested Conflict Resolution:** Care must be taken when striving for synergy between all 3S disciplines when considering the manner by which the nuclear material is classified for shipment by the 3S disciplines. It must be recognized that:
  (a) the primary focus for the 3S disciplines is on special fissionable material and source material, but
  (b) the methods of classification of the nuclear material for each of the 3S disciplines differ, and
  (c) the classifications serve an important function for each of the 3S disciplines but must be undertaken so as not to conflict with each other.

6.5. Topic No. 19 – Controlling Contamination, Leakage of any Radioactive Material, and Subcriticality of Nuclear Material

The operators have a primary role with respect to controlling contamination, leakage and subcriticality, whereas the regulators and the IAEA have subsidiary roles in such controls.

Table 6-5 compares the basis for applying the provisions of the international regulatory documents with respect to controlling contamination, leakage and subcriticality of nuclear material for the 3S disciplines.

Table 6-5. Controlling Contamination, Leakage of any Radioactive Material, and Subcriticality of Nuclear Material

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§§508–509, 513–514: Controls on contamination – Non-fixed contamination shall be kept as low as reasonably achievable and shall not exceed limits specified in §508. However, §§513 and 514 allow some exceptions from the §508 limits for freight containers and conveyances with specific contents and if transported under special arrangement. **SSR-6/§§511–513:** Controls on leakage – Packages found to be damaged and leaking in excess of allowable regulatory limits shall have access restricted and shall be removed to an interim location and not forwarded until repaired or reconditioned and decontaminated. Conveyances and equipment used regularly for the transport of radioactive material shall be periodically checked to determine the level of contamination. **SSR-6/§§617, 648, 659:** Controls on release of fissile (nuclear) material – For routine, normal and accident conditions of transport, strict requirements are imposed on the package design to control the maximum amount of material that can be released, based on the radioactive nature of the fissile (nuclear) material, when a package design is exposed to each of these categories of environments. **SSR-6/§632:** Controls on release of uranium hexafluoride – Packages containing in excess of 0.1 kg of UF_6 must withstand, without leakage, exposure to mechanical and thermals tests. **SSR-6/§§673, 674:** Controls on criticality safety in the event of release of fissile (nuclear) material – For routine, normal and accident conditions of transport, strict requirements are imposed on criticality control for fissile (nuclear) material by requiring that the package retain its fissile (nuclear) material contents and satisfy other criticality safety assessment conditions; and if material escapes from the containment system, then the most critical arrangements must be assessed. **SSG-26/§510.2:** Controls on leakage from damaged packages – Vehicles containing damaged packages which appear to be leaking, or appear to be severely dented or breached, should be detained and secured until they have been declared safe by a qualified person.	**NSS No. 26-G/§§8.18, 8.18, 8.19, 8.22:** Contamination, source terms and exposure pathways for vulnerability assessments – For any radioactive material, including nuclear material, when performing vulnerability assessments, it must be recognized that the main exposure pathways due to a release of the material in an act of sabotage are the same as for any nuclear or radiological emergency, including the following: (a) Direct radiation dose from unshielded localized material (such as a sealed source); (b) Direct radiation dose from dispersed material; and (c) Internal radiation dose from material that is inhaled during, or shortly after, a successful sabotage event, ingested with food or water contaminated by the release from the sabotage event, or ingested inadvertently owing to contamination of hands. The radiological impact is directly linked to the source term of the nuclear material released to the environment. The two principal determinants of the amount released from a shipment subjected to sabotage are: (a) Radionuclide content of the shipment and of individual packages; and (b) The fraction of the contents that potentially could be released as a result of the sabotage. The source term used for the vulnerability assessment should be compared to the source term used in the development of the contingency plans. Guidance should be defined regarding appropriate dose criteria, consistent with IAEA preparedness and response for a nuclear or radiological emergency, at which protective and other response actions are planned to be taken immediately to prevent severe radiological effects in the event of a nuclear emergency resulting from sabotage of nuclear material in transport.	**153/§4(c):** Safeguards shall be consistent with prudent management for safe conduct of nuclear activities. **153/§44:** The State shall make available to the IAEA supplementary information on the health and safety procedures that the IAEA shall follow and with which the inspectors shall comply at the facility. **153/§87:** IAEA inspectors shall carry out their activities in a manner designed to avoid affecting their safety. **540/Preamble, para. 3:** The IAEA must take into account, in the implementation of safeguards, the need to respect health, safety, physical protection and other security provisions that are in force. **540/§7.a:** The IAEA and the State shall make arrangements for managed access under the Additional Protocol in order to meet safety and physical protection requirements.

From this comparison, the following potential conflict and suggested conflict resolution with respect to controlling contamination, leakage of any radioactive material, and subcriticality of nuclear material were identified:

- **Potential Conflict:** Controls for contamination by or release of nuclear material, and the potential for criticality are required for safety and security whether the cause is accidental or intentional. It is essential that there be no conflicts in these control requirements. Clandestine removal of nuclear material in transport, e.g., theft, is of concern for all three of the disciplines. Although the IAEA imposes legally binding requirements for nuclear material control for safeguards purposes within a State, it does not legally impose controls for transport safety within a State or on operators and, with the exception of some security provisions arising from the application of the CPPNM and its Amendment, it does not legally impose controls for transport security within a State or on operators. Thus, the potential exists for conflicts arising as different entities impose 3S requirements on operators.

- **Suggested Conflict Resolution:** The transport of nuclear material or other radioactive material can include the possibility of accidental failure of packaging and transportation operations or possible intentional actions by those with malicious intent which could lead to contamination by or leakage of the package contents, and/or to criticality of nuclear material being transported. The relevant IAEA regulatory documents indicate that those involved in the physical transport of nuclear material (i.e., operators) need to respect safety and security provisions during normal and accident conditions. Each State is required to respect safety and security requirements when implementing IAEA safeguards provisions. However, since the IAEA does not impose requirements for safety and security within a State, care must be taken by operators when striving for synergy between the 3S disciplines with respect to preventing or minimizing contamination, leakage, and criticality events.

6.6. Topic No. 20 – Undertaking Inspections

All 3S disciplines require or recommend inspections. It was chosen to place inspections under operators having a primary role since the materials, equipment and operations used by the operators are generally what is to be inspected, by themselves and possibly by national regulators and the IAEA. Thus, it was recognized that the regulators play a primary role in inspections and – at least for safeguards – the IAEA plays a primary role also. Inspections, including evaluations or other related actions, can be used by stakeholders to maximize 3S synergies and minimize the need to identify and resolve 3S conflicts.

Table 6-6 compares the basis for applying the provisions of the international regulatory documents with respect to inspection requirements for the 3S disciplines.

Table 6-6. Undertaking Inspections

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§302: Program documents related to required radiation protection programmes for transport of fissile (nuclear) material shall be available, on request, for inspection by the relevant competent authority. **SSR-6/§306:** The manufacturer, consignor or user of fissile (nuclear) material transport packages shall be prepared to provide facilities for inspection during manufacture and use of these packages. **SSR-6/§503:** Before each shipment of any fissile (nuclear) material package, it shall be ensured by inspection and/or appropriate tests that all closures, valves and other openings of the containment system through which the radioactive contents might escape are properly closed and, where appropriate, sealed, demonstrating compliance with the transport safety requirements. **SSR-6/§582:** Where customs inspections operations are required for shipments of fissile (nuclear) material, the inspections shall be carried out only in a place where adequate means of controlling radiation exposure are provided and in the presence of qualified persons. **SSR-6/§713:** Any specimens used to demonstrate compliance with fissile (nuclear) material package test requirements shall be inspected before the testing in order to identify and record faults or damage.	**CPPNM-A/Fundamental Principle C, NSS No. 13/§3.8+, and NSS No. 26-G/§§3.24+, 3.28:** The State shall establish and maintain a legislative and regulatory framework that shall include a system of inspection of nuclear material transport to verify compliance with applicable requirements and conditions of the license or other authorizing document, and to establish a means to enforce applicable requirements and conditions, including effective sanctions. **NSS No. 13/§3.20:** The State is responsible for verifying continued compliance with the physical protection regulations and license conditions of nuclear material shipments through regular inspections. **NSS No. 13/§4.34:** For Category I and II shipments of nuclear material, the guards accompanying the shipments should conduct random patrols that include visually inspecting the physical protection components of the shipment. **NSS No. 13/§4.57:** Operators involved in the in-transit storage of nuclear material should ensure that any missing or stolen material is detected in a timely manner by means that include periodic inspections. **NSS No. 26-G/§§3.34–3.39:** The State's competent authorities are responsible for verifying, through an established inspection regime and regular inspections, compliance with physical protection regulations and applicable license conditions throughout all transport of nuclear material. Inspections should be performed by qualified and suitably trained personnel designated by the State and may include both announced and unannounced inspections. Unannounced inspections may need particularly careful consideration. If inspections discover non-compliance or other issues, the findings should be graded on the basis of their potential consequences and acted upon commensurately with this grading. The number and nature of inspections conducted should be determined on the basis of the category of nuclear material, its relative attractiveness to potential adversaries, the number of shipments the shipper or carrier has completed and their general level of compliance, the threat assessment, and any other relevant factors. **NSS No. 26-G/§5.20:** The shipper or carrier of nuclear material should conduct inspections of the conveyance prior to commencing transport, after any stops (scheduled and unscheduled) and on arrival at its destination. **NSS No. 26-G/§5.26:** Using a graded approach, conveyances, equipment, and personnel involved in a shipment of nuclear material should undergo a thorough inspection before departure. **NSS No. 26-G/§§6.39, 6.61:** Shipper or carrier personnel involved in the shipment of Category I, II or III nuclear material should undertake periodic inspections and security searches at appropriate times—including after loading but before dispatch and during transport—verifying that all specified physical protection measures on the conveyances are effective and that there has been no tampering with the load or conveyances. The receiver should inspect the integrity of the shipment upon its arrival. **NSS No. 26-G/§6.41:** Inspections should be made of shipments of Category I or II nuclear material before dispatch of each consignment to confirm the integrity of the locks and seals on the package, freight container, compartment and conveyance. **NSS No. 26-G/§6.41:** Inspections should be made of shipments of Category I nuclear material, including all equipment, stores, personal effects and other goods loaded onto the conveyance.	**153/§6:** The Safeguards Agreement shall take full account of technological developments in the field of safeguards. **153/§9**: The IAEA shall secure consent of the State for designated inspectors. **153/§29**: The Safeguards Agreement provides for the use of material accountancy as a safeguards measure of fundamental importance, with containment and surveillance as important complementary measures. **153/§§46–48**: Design information provided to the IAEA shall be used to identify features relevant to the application of safeguards by the IAEA to facilitate verification; determine material balance areas to be used for IAEA accounting purposes; to select Strategic Points; to establish procedures for verification of the quantity and location of nuclear material; and to select combinations of containment and surveillance methods and techniques and their Strategic Points. "Strategic Point" is defined in 153§116. **153/§§70–73:** The IAEA shall have the right to make ad hoc, routine, and special inspections. **153/§74–75:** The Safeguards Agreement identifies the scope of inspections and the inspection activities within this scope. **153/§76–77:** The Safeguards Agreement identifies the access for inspection purposes. **153/§§78–82:** The Safeguards Agreement specifies the number, intensity, duration, timing, and mode of routine inspections. **153/§§83–84:** The Safeguards Agreement includes criteria to be used for determining the actual number, intensity, duration, timing, and mode of routine inspections. **153/§87:** Inspectors shall avoid hampering construction, commissioning or operation of facilities or hampering their safety. **153/§88:** The State shall facilitate services for performance of inspections. **153/§89:** The State has the right to accompany, but not impede, inspectors. **540/§§2–3:** Expands information reported by the State. **540/§§4–9:** Adds complementary access for safeguards inspections, expands inspector (complementary) access to sites and locations, and expands inspector activities. **540/§14:** The Safeguards Agreement shall permit and protect free communications by IAEA inspectors and IAEA Headquarters.

From this comparison, the following potential conflict and suggested conflict resolution with respect to undertaking inspections were identified:

- **Potential Conflict:** Transport safety and security inspections by an independent international body are not required for States, and therefore transport safety and security inspections may not be uniform from State to State, depending upon the individual State requirements for inspections, and the individually perceived risks to safety and security in each State. In contrast, the IAEA has the legal right and responsibility to conduct safeguards inspections using a variety of technologies in a State party to a Safeguards Agreement. In conducting inspections, the IAEA is required to adhere to the safety and security regulations of that State.

- **Suggested Conflict Resolution:** Care must be taken when striving to avoid conflicts between all 3S disciplines when considering the different requirements and stakeholders involved with respect to inspection of shipments of nuclear material and other radioactive material. The involved stakeholders should strive to jointly address the inspection requirements and apply them in a manner such that their inspection activities do not introduce conflicts between or within the 3S disciplines.

6.7. Topic No. 21 – Addressing Radiological Emergencies, Preparedness, and Response

The States and the operators both have primary responsibilities with respect to having adequate emergency preparedness and response. The IAEA has a subsidiary role from the perspective of safeguards. However, the IAEA has its Incident and Emergency Centre (IEC) which can serve as a global focal point for international emergency preparedness, communication and response to nuclear and radiological incidents and emergencies. For example, if a State that is involved in a radiological emergency concludes that any unusual circumstances require extended actions or access by the IAEA, the involved State and the IAEA shall promptly make arrangements to enable the IAEA to discharge its responsibilities. In such cases, upon request by the State, the IAEA and the State shall make arrangements for managed access in order to meet safety or physical protection requirements”.

Table 6-7 compares the basis for applying the provisions for radiological emergencies, preparedness, and response of the international regulatory documents for the 3S disciplines.

Table 6-7. Addressing Radiological Emergencies, Preparedness and Response in the International 3S Transport Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
IAEA Safety Glossary: Emergency plan – An emergency plan is a description of the objectives, policy and concept of *operations* for the response to an *emergency* and of the *structure*, authorities and responsibilities for a systematic, coordinated and effective response. The *emergency plan* serves as the basis for the development of other plans, *procedures* and checklists. **SSR-6/§304:** Radiological emergency – Specifies that in the event of a radiological emergency during transport, relevant national and international provisions shall be observed to protect people, property and the environment. **SSR-6/§304:** Nuclear or radiological doses to persons – Also specifies that in the event of a nuclear or radiological emergency during transport, *consignors* and *carriers* shall establish, in advance, arrangements for preparedness and response in a manner that is consistent and coordinated with the national and/or international emergency arrangements and emergency management system. **SSR-6/§305:** Emergency preparedness and response – Specifies that arrangements for preparedness and response shall be based on the graded approach and shall consider the identified hazards and their potential consequences, including the formation of other dangerous substances that may result from the reaction between the contents of a *consignment* and the environment in the event of a nuclear or radiological emergency. **SSG-26/§304.1:** Accident response – Advance planning and preparation are required to provide a sufficient and safe response to such accidents. The response, in most cases, will be similar to the response to radiation accidents at fixed-site facilities. **SSG-26/§305.1:** Subsidiary hazards – It must be recognized that hazards other than radioactivity may exist, including pyrophoricity, corrosivity or oxidizing potential; or, if released, the contents of a package may react with the environment (air, water, etc.), in turn producing hazardous substances. The potential for such phenomena must be acknowledged so as to ensure proper protection from chemical (i.e., non-radioactive) hazards. **SSG-26/§305.2:** Subsidiary hazards – It must also be recognized that, in the event that the containment system of a package is damaged in an accident, air and/or water may reach and, in some cases, chemically react with the contents. For some radioactive material, these chemical reactions may produce caustic, acidic, toxic or poisonous substances which could be hazardous to people and to the environment. Thus, the potential for such additional phenomena must be acknowledged so as to ensure proper protection from chemical (i.e., non-radioactive) hazards. **SSG-26/§307.8:** Emergency planning and preparedness – A compliance assurance programme should include activities pertaining to emergency planning and preparedness and to emergency response when needed. These activities should be incorporated into the appropriate national emergency plans. The appropriate competent authority should also ensure that consignors and carriers have adequate emergency plans.	**NSS No. 26-G/Glossary:** Contingency plan – A contingency (emergency) plan consists of predefined sets of actions for response to unauthorized acts indicative of attempted unauthorized removal or sabotage, including threats thereof, designed to effectively counter such acts. **CPPNM-A/Fundamental Principle K; & NSS No. 26-G/§§3.70, 3.71:** Contingency plans – Contingency (emergency) plans are needed to respond to malicious acts including unauthorized removal of nuclear material or sabotage of nuclear material or attempts of sabotage thereof. Involved transport personnel should be trained, prepared and appropriately exercised by all license holders and authorities concerned to carry out contingency (emergency) plans. The goal of contingency plans is to ensure a timely and effective response at all levels in the event of a nuclear security event involving the transport of nuclear material. **NSS No. 13/§6.37:** Emergency contact information – For the transport of Category I, II and III nuclear material, drivers or operators of all conveyances used should be given emergency contact information for the areas through which they will be passing. **NSS No. 13/§6.22:** Transport security plan contents – For the transport of Category I and II nuclear material, a transport security plan should cover many topics, including accident procedures, reporting procedures for emergencies and, as appropriate, contingency plans. **NSS No. 13/§§6.60, 6.62:** Establishing State emergency plans – A State's physical protection regime should take into account emergency plans, which should include defining the roles and responsibilities of involved stakeholders in protecting emergency personnel. **NSS No. 13/§§6.63 to 6.65:** Establishing stakeholder contingency plans – Contingency plans should be established by carriers and other relevant entities which should (a) include a description of objectives, policies and concepts of operations for responding to sabotage or attempted sabotage, (b) include methods for coordinating measures for preventing further damage and securing the nuclear transport and emergency personnel; and (c) be clearly documented and made available to all relevant organizations. **NSS No. 13/§§6.66 to 6.68:** Exercising contingency plans – Involved stakeholders should conduct individual and joint exercises to assess and validate contingency plans, to properly train potentially involved individuals including response forces who need to be familiarized with typical operations and sabotage targets, and to apply lessons learned to improve the plans.	**I** **NFCIRC/153** and **INFCIRC/540** do not require emergency plans and security plans. **153/§4(c):** Safeguards shall be consistent with prudent management for safe conduct of nuclear activities. **153/§44:** The State shall make available information on health and safety procedures that the IAEA shall observe and comply with. **153/§76(d):** In the event the State concludes that any unusual circumstances require extended limitations on access by the IAEA, the State and the IAEA shall promptly make arrangements to enable the IAEA to discharge its responsibilities. **153/§87:** Inspectors shall carry out their activities in a manner to avoid affecting their safety. **540/Preamble, para. 3:** The IAEA must take into account, in the implementation of safeguards, the need to respect health, safety, physical protection and other security provisions in force and the rights of individuals. **540/§7.a:** Upon request by the State, the IAEA and the State shall make arrangements for *managed access* in order to meet safety or physical protection requirements.

From this comparison, the following assessment of the potential for conflicts and synergies with respect to addressing radiological emergencies, preparedness, and response results in the following:

- **Potential Conflicts:** There are no apparent conflicts with respect to the handling of radiological emergencies that may arise during the transport of nuclear material. Although the safeguards regulatory documents do not specifically address radiological emergencies, the IAEA is required to address such issues.

- **Potential Synergies:** Emergency planning for transport safety and contingency planning for transport security set forth essentially the same set of actions should an emergency caused occur by an accident or a malicious event. While radiological emergency plans are not required for safeguards, the IAEA is required to carry out its activities in accordance with a State's plans for radiological emergencies.

6.8. Topic No. 22 – Facilitating Material Control and Accountability (MCA)

Although materials control and accountability is primarily the purpose of and a function of safeguards, it is recognized that there is an interface between transport safeguards and transport security in this respect. For example, IAEA NSS No. 13 (INFCIRC/225/Rev.5) specifically notes the following:

- "*The physical protection system should be assisted by nuclear material accountancy and control measures to deter and detect the protracted theft of nuclear material by an insider during transport*"; and
- "*Defense in depth should take into account the capability of the system for nuclear material accountancy and control in order to protect against both insider and external threats during the transport of nuclear material*".

Table 6-8 compares the basis for applying the provisions of the international regulatory documents with respect to materials control and accountability for the 3S disciplines, with a focus on transport safeguards and transport security.

Table 6-8. Facilitating Materials Control and Accountability

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
No MCA provisions are provided for in the transport safety regulations.	**NSS No. 13/§§3.17, 3.19:** Materials accountancy and control – The recommended physical protection measures for security should be in addition to, and not a substitute for, other measures established for nuclear safety and material accountancy and control purposes. The State's competent authority for transport security should have access to information from the State's system for nuclear material accountancy and control. **NSS No. 13/§3.36:** Legislative materials accountancy and control – The physical protection system should be assisted by nuclear material accountancy and control measures to deter and detect the protracted theft of nuclear material by an insider during transport. **NSS No. 13/§§3.44+, 3.47:** Materials accountancy and control – Defense in depth should take into account the capability of the system for nuclear material accountancy and control in order to protect against both insider and external threats during the transport of nuclear material. **NSS No. 13/§4.10, 5.19:** Protecting materials accountancy and control information – Computer-based systems used for nuclear material accountancy and control should be protected against compromise. **NSS No. 13/§4.11:** Managing the materials accountancy and control interfaces – The operator should assess and manage the transport physical protection interface with safety and nuclear material accountancy and control activities to ensure that they do not adversely affect each other and are mutually supportive thereof. **NSS No. 13/§4.57:** Inputs to the materials accountancy and control system – The operator should ensure that, for any missing or stolen nuclear material, the absence is detected in a timely manner, including through the use of the nuclear material accountancy and control system.	**153/§7:** The State shall establish and maintain a system of accounting for and control of all nuclear material subject to the Safeguards Agreement. **153/§29:** The Safeguards Agreement should provide for the use of material accountancy as a safeguards measure of fundamental importance. **153/§§31–32:** The IAEA shall make full use of the national system, which shall be based on a structure of material balance areas. **153/§39:** In particular, the IAEA and the State shall make Subsidiary Arrangements that specify in detail, to the extent necessary to permit the IAEA to fulfil its responsibilities under the Safeguards Agreement in an effective and efficient manner, how the procedures laid down in the Safeguards Agreement are to be applied. **153/§44**: Information relevant to the application of safeguards shall be made available to the IAEA with respect to each facility; and in particular, including information on organizational responsibility for material accountancy and control. **153/§49(b**): Information concerning nuclear material customarily used outside facilities shall be provided to the IAEA, including a general description of procedures and organizational responsibility for nuclear material accountancy and control. **153/§§51–58:** In establishing a national system of accounting for and control of nuclear material, the State shall arrange that accounting and operating records shall be kept with respect to each material balance area. **153/§§59–69:** The State shall provide the IAEA with accounting and special reports with respect to nuclear material subject to safeguards. **INFCIRC/540** requires the State to provide information in addition to material control and accounting information that is required by **INFCIRC/153.**

From this comparison, the following assessment of the potential for conflicts and potential synergies with respect to facilitating material control and accountability results in the following:

- **Potential Conflicts**: There are no apparent conflicts with respect to MCA while:

(a) both the transport security and transport safeguards regulatory documents specify MCA provisions, and
(b) the transport safety regulatory documents do not specify MCA measures.

- **Potential Synergies:** Security relies on many of the same MCA measures required for safeguards. Based on a State's national system for MCA, IAEA safeguards provide additional nonproliferation assurances to the world beyond the assurances provided by the State's national system for MCA; and such assurances do not in general conflict with transport safety measures.

6.9. Topic No. 23 – Applying Controls for Small Quantities of Nuclear Material in the International 3S Transport Regulatory Documents

For specific small quantities and types of nuclear material, safeguards may be terminated or reduced, or nuclear material may be exempted from safeguards. Similarly, application of many of the fissile material requirements for transport safety are avoided through the definition of "fissile excepted" and are not classified as fissile (nuclear) material. For transport security, it is recommended that nuclear material falling below Category III and natural uranium "should be protected in accordance with prudent management practice".

Table 6-9 compares the basis for applying controls for small quantities of nuclear material in the international regulatory documents for the 3S disciplines.

Table 6-9. Controls for Small Quantities of Nuclear Material in the International 3S Transport Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§§516–519: Controls for excepted package – Surface dose rates on packages of excepted quantities of fissile (nuclear) material, including fissile (nuclear) material in Type IF packages, are controlled by regulatory provisions. **SSR-6/§§417, 606, 622, 636, 619–621:** Controls on excepted fissile (nuclear) material – Fissile (nuclear) material excepted from classification as "FISSILE" shall be subcritical while packages shall satisfy additional fissile (nuclear) material design requirements, depending on package contents and mode of transport.	**CPPNM & CPPNM-A/Categorization Table; & NSS No. 13/§§3.9, 5.6:** Basis for nuclear material below Category III – The nuclear material categorization table establishes the basis for the graded approach for security, structuring it into Categories I, II and III (and to lower levels of nuclear material, which implicitly establish a fourth category, i.e., "below Category III"). The categorization is the basis for application of the graded approach for protection, through which the State should define a set of physical-protection objectives and measures for each assigned level of protection. **CPPNM/Annex I & Annex II:** Controls for transport of nuclear material below Category III – Annex I of the CPPNM establishes the levels of physical protection for international transport of nuclear material, while Annex II of the CPPNM provides the basis for categorizing the material into the three named categories (i.e., Categories I, II and III). Nuclear material not falling in at least in Category III, and natural uranium should be protected in accordance with prudent management practice.	The **IAEA Safeguards Glossary** defines a "small quantity protocol" on the basis that the State has less than specified minimal quantities of nuclear material or no nuclear material in a facility; implementation of most of the provisions of Part II of INFCIRC/153 are held in abeyance in this case. 153/§11: Safeguards shall terminate on nuclear material that has been consumed or diluted in such a way that is no longer usable. 153/§13: Safeguards may be terminated on nuclear material used in non-nuclear activities. 153/§35: Pursuant to paragraphs 11 and 13, safeguards may be terminated. 153/§36: Certain types, quantities, and uses of nuclear material may be exempted from safeguards. **153/§37-38:** De minimis quantities of nuclear material shall be exempted from safeguards. If exempted nuclear material is processes or stored with safeguarded nuclear material, safeguards shall be re-applied. **153/§§49–50:** Information concerning nuclear material customarily used outside facilities shall be provided to the IAEA. **153/§79:** In the case of facilities and material balance areas outside facilities with a content or annual throughput of nuclear material not exceeding five effective kilograms, routing inspections shall not exceed one per year. **153/§§92–94:** The IAEA shall be notified of any intended transfer of nuclear material out of the State by successive shipments to the same State, with each shipment less than one effective kilogram but exceeding in total one effective kilogram. **153/§§95–96:** The IAEA shall be notified of the expected transfer into the State of nuclear material required to be subject to safeguards by successive shipments, with each shipment less than one effective kilogram but exceeding in total one effective kilogram. **153/§104:** "Effective kilogram" is defined for different types of nuclear material. **540/§2.a(ii):** The State shall provide to the IAEA information on the basis of expected gains in effectiveness or efficiency in safeguards for facilities and locations outside facilities. **540/§5.a(iii):** The State shall provide the IAEA with access to any decommissioned facility or decommissioned location outside facilities. **540/§18.j:** "Location outside facilities" means any installation or location, which is not a facility, where nuclear material is customarily used in amounts of one effective kilogram or less.

From this comparison, the following potential conflict and suggested conflict resolution with respect to applying controls for small quantities of nuclear material in the international 3S transport regulatory documents were identified:

- **Potential Conflict:** Depending on the type and quantity of nuclear material being transported, there may be conflicts among the three disciplines.

- **Suggested Conflict Resolution:** Care must be taken when striving for synergy between all 3S disciplines when shipping small quantities of nuclear material. The 3S regulatory documents address small-quantity-related requirements in different ways. Thus, competent authorities and operators need to work jointly to ensure that all 3S requirements are satisfied when shipping small quantities of nuclear material.

6.10. Topic No. 24 – Addressing Subsidiary Hazards Associated with the Other Classes of Dangerous Goods

The need for applying provisions addressing any subsidiary risks that may be posed by the nuclear material being transported or by other materials being transported on the same conveyance with nuclear material only arises for transport safety. However, personnel involved with the transport security and safeguards should be aware of such risks and ensure that safety and security are not compromised by those risks.

Table 6-10 compares the basis for applying the provisions of the international regulatory documents with respect to subsidiary risks for the 3S disciplines with a focus only on transport safety.

Table 6-10. Addressing Subsidiary Hazards Associated with the Other Classes of Dangerous Goods

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§110 Scope: Measures for subsidiary hazards of fissile (nuclear) material in transport – SSR-6 specifies that, for shipments of fissile (nuclear) material having any subsidiary hazards (as delineated for the other eight classes of dangerous goods), the relevant transport regulations for those dangerous goods shall apply in addition to those for fissile (nuclear) material. In addition, if the fissile (nuclear) material is transported with other dangerous goods, the relevant transport regulations for those dangerous goods shall apply in addition to those for fissile (nuclear) material. **SSR-6/§§506–507**: Measures for segregating fissile (nuclear) material from other dangerous goods – Ensure consignments of fissile (nuclear) material are properly segregated from other dangerous goods. In addition to the radioactive and fissile properties, any other dangerous properties of the contents of the package shall be taken into account in the packing, labeling, marking, placarding, storage and transport to ensure compliance with the relevant transport regulations. **SSR-6/§§110, 507, 618**: Measures for other dangerous properties of fissile (nuclear) material in transport – For nuclear material having other dangerous properties (e.g., uranium hexafluoride), the package design shall take into account those properties, and shall also take into account other relevant regulations for the transport of the other classes of dangerous goods.	Subsidiary risks are not explicitly addressed in any of the relevant international transport security documents.	International safeguards documents apply only to nuclear material and associated risks, and do not apply to any subsidiary risks that may exist with materials other than nuclear material.

From this comparison, the following assessment of the potential for conflicts and potential synergies with respect to addressing subsidiary hazards associated with the other classes of dangerous goods results in the following:

- **Potential Conflict:** There are no apparent 3S discipline conflicts with respect to subsidiary hazards of materials being transported, since only the regulatory documents for transport safety take into consideration the hazards posed by the nuclear material being transported that may be associated with other classes of dangerous goods.

- **Potential Synergies:** There are no 3S discipline synergies with respect to subsidiary hazards since neither security nor safeguards deals with this topic.

6.11. Topic No. 25 – Considering Measures & Functions not Fully Covered in all of the 3S Transport Regulatory Documents

A review of the relevant 3S documents was conducted for measures and/or functions that are part of at least one of the 3S disciplines but may not be addressed within the other 3S disciplines. For example, issues such as routing undertaken for security are specifically avoided in the transport safety documents. Similarly, some nuclear and other radioactive material may be excluded from the provisions for transport safety but could possibly still be of significance for transport security or safeguards.

Table 6-11 compares provisions with respect to measures & functions not fully covered in all of the 3S transport regulatory documents.

Table 6-11. Considering Measures & Functions not Fully Covered in all of the 3S Transport Regulatory Documents

Safety Requirements/Measures (SSR-6 [Rev. 1]) & Guidance (SSG-26)	Security Requirements/Measures (NSS No. 13 [INFCIRC/225/Rev. 5], NSS Nos. 20 & 26-G, & the CPPNM & Its Amendment)	Safeguards Requirements/Measures (INFCIRC/153 & INFCIRC/540)
SSR-6/§108: Controls for transport security not addressed – In addition, SSR-6 does not specify controls such as routing or physical protection instituted for other reasons. **SSG-26/§108.1:** Measures for shipment routing not addressed for transport safety – Although the Transport Regulations provide for the requisite safety in transport without the need for specified routing, the regulatory authorities in some Member States have imposed routing requirements. **SSG-26/§108.3:** Some measures for transport security and safeguards not addressed for transport safety – The consignor may also be required to provide evidence that measures to meet the requirements for safeguards and physical protection associated with shipments of fissile (nuclear) material as defined in the CPPNM are complied with. Furthermore, the consignor may also be required to provide evidence that measures to meet any requirements for transport security are also complied with. **SSR-6/§107:** Some radioactive (fissile) materials are excluded from transport safety regulatory controls – SSR-6 does not apply to radioactive material that is integral to the means of transport; that is transported not on public roads or railways; that is implanted in a live animal, contaminating a person, in consumer products having regulatory approval, or in natural materials and ores within certain activity limits; or to non-radioactive solid objects containing radioactive substances within specified limits. One specific fissile (nuclear) material excluded is depleted-uranium counterweights in aircraft wings; another is any nuclear-powered propulsion system.	**CPPNM-A/Article 2.4:** Armed forces activities during an armed conflict not addressed for transport security – The Convention does not govern the activities of armed forces during an armed conflict, inasmuch as they are governed by other rules of international law; and the Convention shall not be construed as lawful authorization to use or threaten to use force against a nuclear material that is being transported for peaceful purposes. **CPPNM-A/Article 2.5:** Nuclear material transported for military purposes not addressed for transport security – The Convention does not apply to nuclear material that is used (i.e., transported) for military purposes. **NSS 20/§1.14:** Transport security measures may be extended by a State beyond civil purposes – For nuclear material under regulatory control, the Essential Elements in this document pertain only to material used for civil purposes. However, Member States may decide whether or not to extend the publication's use to other purposes. **NSS No. 13/§1.17:** Transport safety measures not addressed in transport security documents – This document does not provide safety requirements with respect to the transport of nuclear material but does take safety considerations into account. **NSS No. 13/§1.18:** Transport security measures may be extended by a State beyond civil purposes – Although this document is intended to be used for physical protection of nuclear material transported for civil purposes, States may decide to extend the use of the document to other purposes.	**153/§11:** Safeguards terminate if nuclear material has been consumed or diluted so that it is no longer usable or is practicably irrecoverable. **153/§12:** Safeguards terminate on a transfer from a State when the recipient State of a transfer assumes responsibility. **153/§13:** Safeguards may terminate when nuclear material is used in non-nuclear activities such as alloys and ceramics. **153/§14:** Safeguards are not applied to nuclear material used in a non-proscribed military activity, used only for peaceful purposes, and not used for production of nuclear weapons or explosive devices. **153/§24:** The application of IAEA safeguards in the State under other agreements with the IAEA may be suspended. **153/§33–35:** Safeguards shall not apply to nuclear material in mining or ore-processing facilities; and safeguards may be terminated pursuant to paragraphs 11 and 13. **153/§36–38**: Exemption may apply to nuclear material in non-nuclear activities or in de minimis quantities; or for plutonium with 80% Pu-238; or special fissionable material in gram quantities in sensors. **540/§1:** The provisions of the Safeguards Agreement shall apply to the Additional Protocol to the extent that they are relevant to and compatible with the provisions of the Additional Protocol.

From this comparison, the following assessment of the potential for conflicts and potential synergies with respect to the consideration of measures and functions that are not fully covered in all of the 3S transport regulatory documents results in the following:

- **Potential Conflicts**: There are no apparent conflicts with respect to the activities and functions that are not addressed in the 3S regulatory documents. That is, the IAEA documents for transport safety, transport security, and transport safeguards avoid potential conflicts by being mutually exclusive.

- **Potential Synergies:** IAEA documents for safety, security, and safeguards are mutually exclusive. In particular, under Safeguards Agreements, the IAEA does not apply requirements for safety or security. Moreover, the IAEA does not apply safeguards to certain nuclear material under specific conditions. Hence, there are no conflicts for these situations. Similarly, the safety and security documents prescribe that measures which are undertaken for one of the 3S disciplines should not be in conflict with measures imposed for the other two 3S disciplines.

7. SUMMARY

The first phase of the international 3S disciplines for the transport of nuclear material resulted in a series of synergy opportunities and conflict risks. The risks of conflicts and proposed methods for overcoming those risks were summarized in Section 3 of this paper.

The opportunities for synergies were discussed for each of the 25 topics elaborated in Section 4. It is noteworthy that the potential synergies identified in the first phase of the assessment,[43] which considered a limited number of international regulatory documents in assessing the 25 topics, and which were structured around specific packaging and transport activities for the 3S disciplines, still apply. Those potential synergies, or opportunities for synergies, have been included here, but have been expanded upon as a result of the second-phase assessment, as follows:

- States' legislation, laws and regulations — When a State applies the international 3S regulatory documents based on well-thought-out legislation, laws and regulations for the nuclear material transportation 3S disciplines, it can develop a regulatory structure in a synergistic manner, establishing robust 3S cultures and regimes while taking into account the requirements of all three disciplines, and also striving toward commonality and avoidance of duplication or conflict within its regulatory bodies.

- Application of the graded approach and defense in depth — All three of the transport safety, security and safeguards regulatory documents apply, either explicitly or implicitly in a synergistic fashion, providing both a graded approach and a defense-in-depth process for the establishment of the 3S measures. This allows stakeholders to model their individual regulations and systems in a cost-effective manner while ensuring a high level of compliance with the intent of the 3S regulatory documents.

- Application for license — Where licensing regulations require submittal of information to the national authority(ies) for all 3S disciplines, duplication of submitted information may result. The submittal of this information offers an opportunity for 3S synergy by sharing information and avoiding duplication of effort.

- Definitions — There are multiple instances where key definitions in the 3S regulatory documents differ, but recognizing those differences, involved stakeholders—including especially the State authorities responsible for issuing 3S regulations—can acknowledge and "work around" those differences in a synergistic manner.

- Information — Availability, integrity, and confidentiality of information (e.g., transport plans, records and reports) are important to each 3S discipline. Protection of sensitive information is necessary. Only non-sensitive information should be shared. The sharing of sensitive information must be limited to those who have a demonstrated need to know. By understanding the limitations that one of the 3S disciplines poses on information control, the sharing of sensitive information can be better synergized between all three disciplines, and potential information-sharing conflicts can thereby be avoided.

- Package design — Robust design, testing, and manufacture, primarily governed by transport safety regulatory requirements, can synergistically support the application of the 3S disciplines through the sharing of package design information with the security and safeguards disciplines in a controlled fashion. Where design information is needed for each of the 3S disciplines, synergies may be realized through recognizing the requirements and limitations of each of the 3S disciplines, thereby avoiding duplication of effort.

- Design changes — The potential for 3S conflicts with respect to design changes in the transport package or in the transport security system may be avoided, and can be synergistic, when the 3S stakeholders work together to facilitate design changes, especially if this is done early in a transport program. Upgrading transport monitoring and tracking capability, for example by installing and using Argonne ARG-US remote monitoring systems technology[50, 51, 52] can synergistically benefit all three 3S disciplines.

- Certificate of Compliance for Package Design — Package design information, governed primarily by transport safety regulatory requirements, is relevant to all 3S disciplines. Synergies may be gained by sharing design information rather than duplicating it for each discipline, keeping in mind sensitivity of information. Again, this sharing of information is best accomplished early in a transport program.

- Transport conveyance — The type of transport conveyance is more relevant for safety and security, than for safeguards, and proper early interfacing between the transport safety and security disciplines can facilitate synergy in this area. Also, the potential for conflict with the transport conveyance for safeguards is low, since access is required before shipment and after receipt of shipment, but not during transport.

- Package tie-downs — Tie-downs for transport can be synergistic for safety and security. The tiedowns required for safety can also provide a level of defense in depth for security; and the potential for conflict with tiedowns for safeguards is low, since access is required before shipment and after receipt of shipment, but not during transport.

- Inspection — There is the potential for safety and security inspections to conflict with safeguards inspections, since access to packaged material is needed for safeguards inspections. However, joint inspection of a package and its contents, joint use of surveillance and seals, and properly planned information sharing can be 3S synergistic by reducing multiple independent accesses and duplication of information such as material type, amount, and location.

- Unattended monitoring — Continuous monitoring during both storage while in transit and stopping of the transport conveyance for rest, refueling or border crossing can be synergistic for all 3S disciplines if the monitoring is properly coordinated, information and use of surveillance by personnel or technical means is shared, and the planning for and use of sealing equipment is shared.

- Seals — Joint use of seals for ensuring the integrity of the contents of a package can be 3S synergistic.

- Radiation protection — By coordinating the handling, loading, and inspection activities for a shipment of nuclear material, 3S synergy can be attained, which can assist in avoiding the potential of unnecessary exposure of workers associated with the shipment, and satisfy the radiation protection goal, inherent in all the 3S regulatory documents, of protecting persons, property and the environment. The control of contamination by release of nuclear material and the control of criticality are required for both safety and security, and any such contamination, release or criticality event is also of concern for the material control and accounting aspects of safeguards; thus, the 3S stakeholders both domestically and internationally need to work synergistically toward preventing such events.

- Records and reports — Records and reports for packages, nuclear material contents, and inspections can be 3S synergistic when the information is shared and not independently duplicated.

- Advance notification — Advance notification is synergistic when non-sensitive information is shared.

- Transportation plans — Transportation plans for both safety and security can benefit from joint 3S reviews regarding design as well as handling, operational and transport procedures, and operational controls, with the goal of identifying and implementing potential 3S beneficial synergies.

- Accident/emergency planning and response — In the event of an accident or incident during transport, all 3S disciplines come into play for the emergency response teams. A safe, secure design synergistically helps reduce potential damage to the package and prevent sabotage or theft of the nuclear material and, as a result, can also help preserve the integrity of the nuclear material and related data for safeguard purposes. Jointly sharing physical access control and information during an emergency can also be 3S synergistic.

- Training — Training is essential for each of the 3S disciplines. Cross-training in the 3S disciplines can be synergistic when 3S disciplines are jointly, rather than separately, addressed.

- Quality assurance and quality control — Quality assurance procedures and quality control for the design, manufacture, handling, shipping, storing, and inspection are 3S synergistically beneficial.

8. CONCLUSIONS

In conclusion, this detailed, comprehensive assessment of international 3S interactions for specific requirements and measures has utilized an expanded suite of international transport safety, security, and safeguards regulatory documents. The results of this assessment have demonstrated the following:

1. The 3S approach is valuable for meeting the combined objectives for safety, security, and safeguards.

2. The methodology framework presented in this paper is most effective when applied early in the planning and design phases for transporting packages of nuclear material; and can also be effectively applied when new requirements, recommendations, or guidance for safety, security, or safeguards are issued or when new technology is implemented, such as the ARG-US remote monitoring systems for tracking and monitoring nuclear and other radioactive materials in nuclear fuel cycle facilities and during transportation.[45,46,47]

3. The benefits of the 3S approach apply to all stakeholders, including designers, manufacturers, carriers, consignors, and government regulators.

4. Retrofitting, modifications, delays and added costs can be avoided by having all involved stakeholders jointly and systematically address the 3S disciplines.

5. Certain 3S functions must remain independent, but the involved stakeholders should strive to resolve any conflicts resulting from such independencies.

6. Possible benefits can be derived from the many synergies identified in the assessment, including those synergies that can be gained through access to material or access to information that can be shared.

7. Training and demonstration of the 3S approach, such as through the Argonne National Laboratory Transport Security training courses, and application of the 3S approach can help stakeholders identify 3S synergies and conflicts and provide mechanisms for resolving the conflicts.

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10. KEYWORDS: transport safeguards; transport safety; transport security; IAEA safeguards, safety and security; synergy and conflicts of safeguards, safety and security, nuclear packaging

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12. REFERENCES

1. International Atomic Energy Agency. 2018. *Status and Trends in Spent Fuel and Radioactive Waste Management*, IAEA Nuclear Energy Series No. NW-T-1.14, Vienna, Austria.
2. Nuclear Industry Summit. 2016. *Report of Working Group 2: Securing the Use, Storage, and Transport of Radiological and Strategic Nuclear Materials*.
3. https://www.wnti.co.uk/nuclear-transport-facts/facts-figures.aspx, accessed October 2, 2020.
4. Varjoranta, T. 2012. Finland's Integrated Approach to Safety, Security, and Safeguards, *Proceedings of the IAEA Technical Meeting on Safety, Security and Safeguards: Interfaces and Synergies in the Development of a Nuclear Power Programme*.
5. International Atomic Energy Agency. 2011. *Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities* (INFCIRC/225/Revision 5), IAEA Nuclear Security Series No. 13, Vienna, Austria.
6. Sanders, K.E., Pope, R. B., Liu. Y. Y., and Shuler, J. M. 2015. Interfaces among Safety, Security, and Safeguards (3S)—Conflicts and Synergies, *Proceedings of the 56th INMM Annual Meeting*.
7. Sanders, K.E., Pope, R. B., Liu. Y. Y., and Shuler, J. M. 2019. A Comprehensive Assessment of the International Functional Interactions Between Transport Safety, Security, and Safeguards (the 3Ss)—Identifying

Conflicts and Synergies, *Proceedings of the 19th International Symposium on the Packaging and Transportation of Radioactive Materials, PATRAM 2019.*

8. Karanam, R.L. 2017. Holistic Approach to Nuclear Safety, Security and Safeguards: Opportunities and Challenges, *Proceedings of the IAEA International Conference on Physical Protection of Nuclear Material and Nuclear Facilities*.
9. U.S. Nuclear Regulatory Commission. 2020. *Packaging and Transportation of Radioactive Material*, 10 CFR 71, Washington, DC, USA.
10. U.S. Nuclear Regulatory Commission. 2020. *Physical Protection of Plants and Materials*, 10 CFR 73, Washington, DC, USA.
11. U.S. Nuclear Regulatory Commission. 2020. *Material Control and Accounting of Special Nuclear Material*, 10 CFR 74, Washington, DC, USA.
12. U.S. Nuclear Regulatory Commission. 2020. *Safeguards on Nuclear Material-Implementation of US/IAEA Agreement*, 10 CFR 75, Washington, DC, USA.
13. International Atomic Energy Agency. 2009. *Security of Radioactive Sources*, Implementing Guide, IAEA Nuclear Security Series No. 11, Vienna, Austria.
14. International Atomic Energy Agency. 2019. *Security of Material in Use and Storage and of Associated Facilities,* Implementing Guide, IAEA Nuclear Security Series No. 11-G (Rev. 1), Vienna, Austria.
15. Ladsous, D., Shannon, M., Pope, R., and Bajwa, C. 2019. *IAEA Guidance on Managing the Interface between Safety and Security for Normal Commercial Shipments of Radioactive Material*, Proceedings of the 19th International Symposium on the Packaging and Transportation of Radioactive Materials, PATRAM 2019.
16. International Atomic Energy Agency. 2018. *IAEA General Conference Resolution GC(62)/RES/7*, *Nuclear Security*, Vienna, Austria.
17. International Atomic Energy Agency. 2015. *Use of Nuclear Material Accounting and Control for Nuclear Security Purposes at Facilities*, Implementing Guide, IAEA Nuclear Security Series No. 25-G, Vienna, Austria.
18. International Atomic Energy Agency. 2015. *Security of Nuclear Material in Transport,* Implementing Guide, IAEA Nuclear Security Series No. 26-G, Vienna, Austria.
19. International Atomic Energy Agency. 2018. *Physical Protection of Nuclear Material and Nuclear Facilities (Implementation of INFCIRC/225/Revision 5)*, Implementing Guide, IAEA Nuclear Security Series No. 27-G, Vienna, Austria.
20. International Atomic Energy Agency. 2018. *Building Capacity for Nuclear Security*, Implementing Guide*,* IAEA Nuclear Security Series No. 31-G, Vienna, Austria.
21. International Atomic Energy Agency. 2019. *Establishing a System for Control of Nuclear Material for Nuclear Security Purposes at a Facility during Use, Storage, and Movement*, Technical Guidance Reference Manual, IAEA Nuclear Security Series No. 32-T, Vienna, Austria.
22. International Atomic Energy Agency. 2006. *Fundamental Safety Principles*, Safety Fundamentals, IAEA Safety Standards Series, SF-1, Vienna, Austria.
23. International Atomic Energy Agency. 2018. *Regulations for the Safe Transport of Radioactive Material—2018 Edition*, Specific Safety Requirements, IAEA Safety Standards Series No. SSR-6 (rev. 1), Vienna, Austria.
24. International Atomic Energy Agency. 2016. *Safety of Nuclear Power Plants: Design*, IAEA Safety Standards Series No. SSR-2/1 (rev. 1), Vienna, Austria.
25. International Atomic Energy Agency. 2011. *Nuclear Security Recommendations on Radioactive Material and Associated Facilities,* Recommendations, IAEA Nuclear Security Series No. 14, Vienna, Austria.
26. International Atomic Energy Agency. 2011. *Nuclear Security Recommendations on Nuclear and Other Radioactive Material Out of Regulatory Control*, Recommendations, IAEA Nuclear Security Series No. 15, Vienna, Austria.
27. International Atomic Energy Agency, 2013*. Objective and Essential Elements of a State's Nuclear Security Regime,* Nuclear Security Fundamentals, IAEA Nuclear Security Series No. 20, Vienna, Austria.
28. International Atomic Energy Agency. 2013. *Establishing the Nuclear Security Infrastructure for a Nuclear Power*

Programme, Implementing Guide, IAEA Nuclear Security Series No. 19, Vienna, Austria.

29. International Atomic Energy Agency. 2016. *Governmental, Legal and Regulatory Framework for Safety,* General Safety Requirements*,* IAEA Safety Standards Series No. GSR Part 1 (Rev. 1), Vienna, Austria.
30. International Atomic Energy Agency. 2015. *Milestones in the Development of a National Infrastructure for Nuclear Power*, IAEA Nuclear Energy Series No. NG-G-3.1 (Rev. 1), Vienna, Austria.
31. U.S. NRC. 2020. *Physical Protection of Plants and Materials*, NRC 10CFR73, Washington, DC, USA.
32. U.S. NRC. 2015. *Managing the Safety/Security Interface*, Regulatory Guide 5.74 (Rev. 1), Washington, DC, USA.
33. Pope, R.B., Y.Y. Liu, and J.M. Shuler. 2017. *Transport of Nuclear and Other Radioactive Material: Training on Security*, Proceedings of the IAEA International Conference on Physical Protection of Nuclear Material and Nuclear Facilities.
34. Pope, R.B., Liu, Y. Y., and Shuler, J.M. 2019. *Nuclear and Other Radioactive Material Transport Security,* Proceedings of the 19th International Symposium on the Packaging and Transportation of Radioactive Materials, PATRAM 2019.
35. Cherf, A. 2012. *Legal Framework of Safety, Security, and Safeguards*, Proceedings of the IAEA Technical Meeting.
36. International Atomic Energy Agency. 2014. *Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2012 Edition)*, Specific Safety Guide, IAEA Safety Standards Series No. SSG-26, Vienna, Austria.
37. International Atomic Energy Agency. 1980. *The Convention on the Physical Protection of Nuclear Material*, INFCIRC/274/Rev.1, Vienna, Austria.
38. International Atomic Energy Agency. 2016. *Amendment to the Convention on the Physical Protection of Nuclear Material*, INFCIRC/274/Rev.1/Mod.1, Vienna, Austria.
39. International Atomic Energy Agency. 1972. *The Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-proliferation of Nuclear Weapons*, INFCIRC/153 (Corrected), Vienna, Austria.
40. International Atomic Energy Agency. 1998. *Model Protocol Additional to the Agreement(s) between State(s) and the International Atomic Energy Agency for the Application of Safeguards*, INFCIRC/540 (Corrected), Vienna, Austria.
41. https://www-legacy.iaea.org/Publications/Documents/Conventions/cppnm_status.pdf, accessed 17 April 2021.
42. https://www-legacy.iaea.org/Publications/Documents/Conventions/cppnm_amend_status.pdf, accessed 17 April 2021.
43. Sanders, K.E., Pope, R.B., Liu, Y.Y., and Shuler, J.M. 2021. *Assessing the Functional Interactions Among Nuclear Material International Transport Safety, Security, and Safeguards (3S)—Conflicts and Synergies*, Proceedings of the Waste Management 2021 Symposium.
44. International Atomic Energy Agency. 2020, *Security in the Transport of Radioactive Material*, IAEA Nuclear Security Series No. 9-G, Rev. 1, Vienna, Austria.
45. International Atomic Energy Agency. 2011, "*Nuclear Security Recommendations on Radioactive Material and Associated Facilities*", IAEA Nuclear Security Series No. 14, Vienna, Austria.
46. United Nations, *Economic and Social Council resolution 724 of the twenty-eighth session*, E/3290, Geneva, 1959.
47. Ebel, P.E., and. Kuykendall, T.A. 2020. *The Case for a 2S Approach to Coordination of Nuclear Safety and Nuclear Security Culture*, Proceedings of the INMM 61st Annual Meeting.
48. International Atomic Energy Agency. 2007. *IAEA Safety Glossary—Terminology Used in Nuclear Safety and Radiation Protection—2007 Edition*, Vienna, Austria.
49. International Atomic Energy Agency. 2015. *Nuclear Security Series Glossary—Version 1.3 (November 2015),* Vienna, Austria.
50. Liu, Y.Y., Lee, H., Craig, B., and Shuler, J.M. 2018. *Smart Drum Technology for Radioactive and Other Hazardous Materials*, Waste Management Symposia, Phoenix, Arizona, March 18–22, 2018.

51. Liu, Y.Y., Craig, B., and Shuler, J.M. 2018. *ARG-US Remote Monitoring Systems for Enhancing Security of Radioactive Material*, IAEA International Conference on the Security of Radioactive Material: The way Forward for Prevention and Detection, Vienna, Austria, December 3-7, 2018.
52. Liu, Y.Y., Craig, B., and Shuler, J.M. 2020. *Real-Time Monitoring of Nuclear Cargo Conveyance Using ARG-US TRAVELER*, IAEA International Conference on Nuclear Security: Sustaining and Strengthening Efforts, Vienna, Austria, February 10-14, 2020.