

## REGULATORY DEVELOPMENT CHALLENGES AND OPPORTUNITIES FOR THE SAFE AND SECURE TRANSPORT OF NUCLEAR AND OTHER RADIOACTIVE MATERIALS

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### Abstract

Drafting regulations for transport safety and transport security achieve two separate objectives, which can lead to divergent outcomes. With transport safety, the principal goal is to protect the public and the environment from the effects of ionizing radiation; in contrast, the principal goal of transport security is to protect the material from malicious actors. Although many International Atomic Energy Agency (IAEA) Member States may have transport safety regulations for radioactive materials, transport security regulatory development is still in its nascent stages globally. Trying to develop harmonized transport safety and transport security regulations could lead to challenges including differences in terminology used in transport safety versus terminology uses in transport security, roles and responsibilities for the variety of stakeholders involved in transport, and the possible role of multiple competent authorities in governing the transport of dangerous goods, which includes radioactive material. The International Atomic Energy Agency is currently developing a process of a methodology for drafting transport security regulations, but any process must address both safety considerations and security requirements. (As the most vulnerable part of the life cycle of radioactive materials, the need for harmonized transport safety/transport security regulations is essential.) This paper investigates the regulatory elements of the safety–security interface for nuclear and other radioactive material in transport. Examining challenges including use of terms, the role of multiple competent

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authorities, and practical challenges involved in the safe and secure transport of radioactive material, the paper analyzes the need for integrated regulatory development for the safe and secure transport of these materials.

## 1. INTRODUCTION

Transport security can be one of the most complex aspects of radioactive material control, and it is potentially the most vulnerable phase in the life cycle of a radioactive material. The transport of radioactive materials can involve multiple national authorities, including

- Customs,
- modal-specific safety and security such as aviation or maritime authorities,
- transport safety and security,
- licensing/authorization, and
- authorities from different countries (international transport).

Transport may also involve multiple operators, such as

- shipping facility (consignor),
- one or more carriers,
- different modes of transport,
- in-transit stopping and fuelling facilities,
- in-transit storage facilities,
- intermodal transfer facilities,
- receiving facility (consignee), and
- multiple response forces (long and complex shipping route can involve a large number of responding agencies).

After the events of September 11, 2001, the international community began to recognize the impact of malicious intent. The transport security recommendations discussed in this paper were not implemented until around 2008 with the release of the Nuclear Security Series No. 9 (NSS No. 9), as the world started recognizing the need to move beyond safety to include security [1]. The International Atomic Energy Agency's (IAEA's) definition of *nuclear safety* is 'the achievement of proper operating conditions, prevention of accidents or mitigation of accident related consequences for radioactive materials during transport'. The focus of safety is protecting the people and environment from the material to include safety aspects such as labelling, placarding and packaging. The IAEA defines nuclear security as 'the prevention or detection of and response to theft, sabotage, unauthorized removal, illegal transfer or other malicious acts involving nuclear material, radioactive sources and other radioactive substances for radioactive materials in transport'. Security recognizes the importance of protecting people and the environment from those with malicious intent to steal or divert material to produce a radiological dispersal device or radiological exposure device. Note, in some languages 'safety' and 'security' are the same word. Understanding the nuances are critical to ensure effective transport regulations that address both safety considerations and security concerns.

In the most recent, 2018 edition of the IAEA Regulations for the Safe Transport of Radioactive Material (SSR-6) included the following statement in the discussion of safety standards: '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'.

Nuclear security and safety share the same objective of protecting people and the environment from the harmful effects of ionizing radiation. However, the measures that address nuclear safety and security may differ, and sometimes actions taken to strengthen nuclear safety may affect, or conflict with, nuclear security. A well-coordinated approach to managing the interface between nuclear safety and security of radioactive material in transport is vital so that relevant measures are implemented in a manner that does not compromise either nuclear safety or security and that capitalizes on opportunities for mutual enhancement.

The responsibility for nuclear security within a State rests entirely with the State, but as part of an international effort to address the provisions that complement or conflict with each other in the interface between safety and security during transport, the IAEA convened a series of consultancy meetings beginning in October 2016. This effort sought to identify the needs for the transport of low-activity radioactive material with respect to the interface between transport safety and transport security, and to develop a plan for addressing those needs.

Some Member State competent authorities are responsible for both safety and security of radioactive material in transport and provide operators with a single set of national requirements and regulations that address both topics. In other cases, multiple competent authorities issue separate regulations and requirements for safety and security of radioactive material in transport. Because an interface between IAEA safety requirements and security recommendations for the transport of radioactive material exists, national regulations need to avoid conflicts between their transport safety and security requirements. Operator understanding and implementation of regulatory requirements is of crucial importance to providing effective safety and security for both domestic and international shipments. For international shipments, national security requirements may vary among States because the responsibility for establishing a transport security regime is the sole responsibility of the State and these transport security requirements may be based upon threat assessments that may vary State to State. This paper will provide an overview of some of the regulatory development challenges for transport safety and security, provide a unique perspective from the U.S. Nuclear Regulatory Commission (NRC), discuss harmonization of international standards, and outline a methodology and path forward for addressing these challenges.

## 2. REGULATORY DEVELOPMENT CHALLENGES FOR TRANSPORT SECURITY AND SAFETY

Developing regulations and other administrative measures are part of ensuring sustainability for nuclear security within a country. More broadly, a nuclear law regime in a given country should include regulations related to transport security and transport safety. Clearly differentiating between the two is critical when developing safety and security regulations; however, the two must achieve the shared overall goal of protecting material, people, and the environment [2].

Transport safety and security regulations provide rules for protecting both radioactive materials, the people handling the material, and the surrounding environment. Although safety and security share this common goal, they perform different roles during transport of radioactive material. Transport safety focuses on protecting the people from the harmful effects posed by the material and transport security focuses on protecting the material from theft or sabotage and subsequent consequences due to a malicious act involving that material. One of the biggest challenges in regulatory development for a Member State is developing safety and security regulations that do not negatively interfere with one another. Safety should not comprise security or vice versa, and the two must be developed in sync and consider each other [2]. The IAEA has developed a list of regulations for safe transport of radioactive material in its Specific Safety Requirements No. SSR-6 (SSR-6). This publication provides standards for acceptable radioactivity levels that protect the people and environment surrounding the material [3]. Similarly, the IAEA has developed transport security implementing guidance in its NSS No. 9 and Nuclear Security Series No. 26-G publications [1, 22]. NSS No. 9 provides implementing guidance for transport security of radioactive material, and NSS No. 26-G provides implementing guidance for transport security of nuclear materials. From the perspective of developing regulations and associated administrative measures, the IAEA has developed its Nuclear Security Series No. 29-G to assist Member States in creating regulations. This resource provides guidance for developing nuclear security regulations and helps ensure all roles and responsibilities related to security are followed and enforced [4].

Delegation of transport safety and security responsibilities to competent authorities and other agencies presents another challenge for regulatory development. The coordination of roles and responsibilities between the different agencies must be clearly outlined to allow for smooth regulatory transport safety and security framework development. If multiple agencies are involved in regulatory development and the implementation of the written policy, the concept of ‘shared regulatory space’ develops. Shared regulatory space occurs when multiple organizations are appointed overlapping or fragmenting powers from a competent rulemaking authority [5]. In transport safety and security, shared

regulatory space can allow for multiple agencies to take some share of responsibility for transport of nuclear and other radioactive materials.

The concept of shared regulatory space in transport safety and security can be used to visualize how the responsibilities of multiple organizations. For example, when safety and security regulations are developed, one agency can be charged with transport safety and another competent authority can be responsible for physical protection of nuclear and other radioactive material. More complications can arise as more responsibilities are shared among various agencies, especially when modal organizations are involved (e.g., U.S. Coast Guard, Maritime Administrations, Civil Aviation Authorities).

A practical example can be seen in the case of the United States where the U.S. Department of Transportation is the primary competent authority tasked with transport safety of hazardous materials including Class 7 (Radioactive Material) while the U.S. NRC is responsible for transport security of nuclear and other radioactive materials. The next section describes the perspective of the NRC on safety and security for transport of nuclear and other radioactive materials.

### **3. TRANSPORT SAFETY AND TRANSPORT SECURITY: A U.S. PERSPECTIVE**

Although not explicitly detailed in transport security, the concept of safety and security are two pillars of good regulation and risk-informed decision making. The purpose of establishing and maintaining an effective interface between safety and security is to ensure that potential adverse effects from changes to safety and security measures are considered and addressed before implementation. The interface between safety and security is an important element of both programs for ensuring public health and safety. Licensees should address activities that could compete or conflict with the capability of a transport security program to provide high assurance of adequate protection of the common defence and security. Conversely, changes in the transport security program could also adversely affect transport operations; safety-related operator actions; or emergency responses necessary to prevent or mitigate accidents and to protect public health, safety, and the environment. The concept is captured in the NRC's Safety Culture Policy Statement.

The Safety Culture Policy Statement sets forth the U.S. NRC's expectation that individuals and organizations performing regulated activities establish and maintain a positive safety culture commensurate with the safety and security significance of their activities and the nature and complexity of their organizations and functions [6].

This policy statement applies to all licensees; certificate holders; permit holders; authorization holders; holders of quality assurance program approvals; vendors and suppliers of safety-related components; and applicants for a license, certificate, permit, authorization, or quality assurance program approval subject to NRC authority. In addition, the NRC encourages the agreement states (states that assume regulatory authority over their own use of certain nuclear materials), their licensees, and other organizations interested in nuclear safety to support the development and maintenance of a positive safety culture within their regulated communities.

The NRC is continually examining safety and security. Examples of the NRC's thinking of safety and security can be found in papers previously submitted to the IAEA [7].

#### **i. Harmonization with international standards**

The NRC is currently in the process of Harmonization of Transport Safety Requirements with IAEA Standards Rulemaking [8]. The IAEA has established a series of safety guides and standards constituting a high level of safety for protecting people and the environment. IAEA safety guides present international good practices and increasingly reflect best practices to help users striving to achieve high levels of safety. Pertinent to this discussion, IAEA Nuclear Security Series No. 13 (NSS No. 13), "Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5)," [9] issued January 2011 contains recommended operational guidance for nuclear security personnel [9]. The NRC has reviewed NSS No. 13 and has incorporated similar recommendations for analysing potential conflicts between safety and security considerations at nuclear power plants. The NRC rulemaking process is ongoing, and updates can be found at <https://www.regulations.gov/> [10].

## 4. BRIDGING THE REGULATORY INTERFACE BETWEEN TRANSPORT SAFETY AND TRANSPORT SECURITY

### i. Transport safety

Regulations governing the safe transport of radioactive material and multiple associated recommendation and guidance documents have been developed and maintained at both national and international levels for many decades. For example, at the national level, initial transport safety efforts were undertaken in the mid-1900s during the formation of the U.S. Bureau of Explosives to control the transport of radioactive materials in the United States [11]. This led to the U.S. Interstate Commerce Commission initially having jurisdiction, which then issued rudimentary Interstate Commerce Commission regulations in October 1947 that went into effect in January 1948 [12]. Similar efforts resulted in the U.K. [13] with the issuance of Merchant Shipping Act of 1949 with the addition of general rules for radioactive substances in 1957; and in Canada [14] when the Canadian Atomic Energy Control Board issued a circular in 1960 establishing requirements for the safe transport of radioactive material.

At the international level, beginning with the Preparatory Commission in 1957 [15] the United Nations Economic and Social Council directed the International Atomic Energy Agency [16] to undertake the development of its “Regulations for the Safe Transport of Radioactive Material” which resulted in the first edition of those Regulations being issued in 1961 [17]. Although titled ‘Regulations’, this document and its later editions are treated internationally as recommendations.

### ii. Transport security

In contrast, little attention was paid to the secure transport of nuclear and other radioactive material until after the events of September 11, 2001. Before 9/11, for nuclear material, an initial step toward transport security was introduced with the Convention on the Physical Protection of Nuclear Material (CPPNM) [18], which was adopted in October 1979 and entered into force in February 1987. However, the CPPNM only addressed the international transport of nuclear material in a limited fashion. A recommendations publication supplementing the CPPNM was issued as INFCIRC/225, the fourth revision of which was issued in 1999 [9].

After 9/11, an amendment to the CPPNM was adopted in 2005 [19], expanding coverage to domestic transport of nuclear material and in parallel a revision to INFCIRC/225 was issued in 2011 [9.. The Amendment finally entered into force in May 2016. In addition, beginning in 2008 the IAEA has issued several Nuclear Security Series Fundamentals, Recommendations, and Guidance publications for security during the transport of both nuclear and radioactive material.

### iii. Transport safety–security interface

Safety and security provisions have generally been developed independently. Only recently has attention shifted to the interface between safety and security. The first step taken by the IAEA was the issuance in 2016 of a technical document (TECDOC) addressing the management of the interface between nuclear safety and security for research reactors [20].

Based on this initial effort, the IAEA undertook an effort to address the safety–security interface for transport. A series of consultancy meetings were held which developed a technical report on the subject. That technical report is currently in the final stages of publication at the IAEA. In undertaking this task, it was decided to limit the scope of the effort to lower activity radioactive material called ‘normal commercial shipments’ in the technical report. In this way, the effort could serve as a model for later addressing the interface for higher activity material. For the purposes of this initial effort, ‘normal commercial shipments’ of radioactive material was defined as involving radioactive

material in transport that (a) only requires prudent management practice or (b) requires both prudent management practice and basic transport security level measures as specified in IAEA NSS No. 9 [1].<sup>4</sup>

The forthcoming revision to NSS No. 9 recognizes that a Member State should take steps to adequately address the transport safety–security interface. Specifically, the revision defines the following seven fundamental steps:

1. Maintaining a balance between safety and security concerns
2. Providing consistent regulatory requirements for both safety and security
3. Ensuring safety requirements do not compromise security, and security requirements do not compromise safety
4. Coordinating safety and security between responsible authorities
5. Addressing safety and security cultures in an integrated fashion
6. Accounting for safety and security measures during both normal and emergency situations
7. Ensuring that security measures during a response to a nuclear security event do not adversely affect safety

The first and third steps are key to successfully addressing the transport safety–security interface. For example, the IAEA Regulations for the Safe Transport of Radioactive Material [1] states that ‘Safety measures and security measure 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.’ Similar statements are made in many of the IAEA Nuclear Security Series publications.

The fourth step is also critical. Specifically, when there are conflicts between a transport safety measure and a transport security measure, the individual or organization (e.g., the operator) responsible for a shipment needs to resolve that conflict such that safety requirements do not compromise security and security requirements do not compromise safety. The conflict resolution needs to be accomplished in a manner that is coordinated with, completely acceptable to, and approved by the relevant responsible authorities.

Consistent with the forthcoming technical report, when the State authorities and operators responsible for shipping nuclear and other radioactive materials are addressing the safety–security interface, at least 20 issues or tasks need to be considered. Depending upon the risk posed by the material being shipped, the following issues need to be addressed using a graded approach:

1. Considering the general interface between safety and security
2. Ensuring regulations are adequate and compliance is achieved
3. Performing adequate threat assessments
4. Properly managing security-related information
5. Having complete and comprehensive operational controls
6. Addressing the qualifications of carriers
7. Ensuring adequate training of personnel and the proper retention of training records
8. Addressing personnel trustworthiness consistent with State laws and procedures
9. Proving methods for identification involved in shipments
10. Defining safety and security inspection requirements and ensuring such inspections occur
11. Undertaking the design of transport packages to address both safety and security
12. Defining methods for the stowage and retention of packages during transport
13. Specifying requirements for locks and seals for packages, cargo compartment and vehicles
14. Monitoring and tracking of packages and vehicles
15. Providing adequate, well-protected in-transit storage for the radioactive material during its transport
16. Ensuring adequate, redundant and secure communications
17. Providing written instructions and documentation
18. Marking and labelling packages, and placarding vehicles and freight containers
19. Identifying consignees and establishing requirements for authorizing receipt of the material being shipped

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<sup>4</sup> IAEA NSS No. 9 is being replaced by NSS No. 9 Revision 1, which should be published shortly. This effort to address the safety–security interface was based on the draft of the revised publication.

## 20. Providing adequate surveillance of the material during shipment

When addressing these issues, the State and operators will need to have all involved parties consider many factors, including (but certainly not limited to) (a) the radioactivity and physical form of the radioactive contents in a package; (b) the details of the package design that have been established to satisfy the safety requirements specified in relevant transport safety regulations; and (c) the type(s) of conveyance, mode(s) of transport, and routes to be used.

## 5. PROPOSED REGULATORY DEVELOPMENT PROCESS FOR ESTABLISHING TRANSPORT SECURITY REGULATIONS

Recognizing the importance of regulatory development for a robust nuclear security regime, the IAEA sought expert opinion on development of a methodology to support Member States in developing their transport security regulations. In previous regulatory development processes, the primary focus was on the use of model regulations, which the Member State would use to develop and draft its regulation. In many instances, this led to the temptation to copy and paste the model regulation to expedite the drafting the process, and this shortcut led to inconsistencies between the model regulation and the legal framework it was nested within.

Hearing these concerns, the IAEA consulted with legal and technical experts in transport security to develop a more robust regulatory process. During the discussions on this process, it became clear that for regulatory development of a transport security regulation, both legal and technical experts need to be involved [21]. The legal expert can help structure the regulation, cross-referencing to other relevant regulations, and link the regulation to the primary legislation. The technical expert as a transport security professional can provide the substantive requirements, using IAEA recommendation guidance documents, such as Nuclear Security Series Nos. 13 and 26-G.

The process discussed so far at IAEA reflects an adaptive process that is Member-State driven. Currently, there are between nine to twelve steps, starting with a legal inventory that allows the Member State to collect the relevant legal and regulatory developments and then work through the scope of the regulation (the materials to be covered, modes of transport, etc.). The process is adaptable to the needs and requests of the Member State. Throughout the process, the Member State has their legal and technical experts working through the necessary requirements, with assistance from the IAEA and external experts assigned by the Agency.

As currently drafted, the process acknowledges the role of safety. In Step 1, a legal and technical expert within the Member State requesting assistance conducts a legal inventory. During this time, a Member State should determine if a transport safety regulation for nuclear and other radioactive materials already exists. It would be useful for the drafting team to consult the transport safety regulation when drafting the transport security regulation to ensure consistency. If no transport safety regulation exists, the Member State may elect to draft transport safety and transport security at the same time. Additionally, during Step 5 of the process, when the Member State begins to use IAEA guidance to determine the technical requirements to be included in the regulation, recognizing transport safety needs to be part of this process. Likewise, when addressing issues of the safety-security interface, the need for the transport safety regulation is critical.

The methodology developed by the IAEA addresses the process for developing a transport security regulation, but the methodology is adaptive and can be tailored to fully address and bridge the need for developing harmonized transport safety and transport security regulations. First, when a transport safety regulation already exists in a Member State seeking to draft a transport security regulation, there should be close coordination between both the regulatory body responsible for transport safety and the regulatory body responsible for transport security, if they are different. When dealing with other modal requirements, such as those for maritime or aviation transport of nuclear and other radioactive materials, the International Maritime Dangerous Goods Code and the International Civil Aviation Organization Technical Instructions provide modal-specific safety provisions may provide additional requirements.

## 6. CONCLUSION AND FUTURE WORK

Regulatory development is a complex, yet fundamental element of developing a nuclear security regime in a country. It blends together technical and legal expertise with the security requirements to ensure the protection of nuclear and other radioactive material. Developing a regulatory regime is a complex endeavor and adding the transport of nuclear

and other radioactive materials adds to this complexity. Because multiple modes, jurisdictions, and stakeholders are involved, capturing the regulatory requirements for both safety and security of transport is an immense challenge.

This paper begins to unpack the various challenges. Because multiple institutional stakeholders such as government agencies play a role in transport safety and transport security, the use of shared regulatory space as a conceptual framework enables organization and visualization of regulatory overlap. Shared regulatory space can stem from institutional design, but it requires further analysis to understand how to overcome the overlaps and then develop a regulation where transport safety and transport security complement each other.

The IAEA is developing a methodology to develop transport security regulations. While the process is under development, the experts involved are aware of the need for transport safety to be included in such regulatory development, where appropriate, and continue to develop an approach with the integration of safety and security. This paper highlights existing work the IAEA is undertaking with the Safety-Security Interface, where such overlaps can be discussed and subsequently resolved. Going forward, a potential path to integrating regulatory development for transport safety and transport security is to develop an integrated regulation with a transport security section, a transport safety section, and a subsequent third section that discusses the process for interfacing safety with security, both technically and administratively. Such a discussion can hopefully build bridges between safety and security such that the regulatory framework is flexible and adaptive to both important elements of transport of nuclear and other radioactive materials.

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