

**DEVELOPING THE HISTORICAL TECHNICAL BASIS FOR THE RADIOLOGICAL
SAFETY REQUIREMENTS OF THE INTERNATIONAL TRANSPORT SAFETY
REGULATIONS**

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ABSTRACT

The International Atomic Energy Agency (IAEA) is responsible for developing safety requirements for the transport of radioactive material. These requirements were first published in 1961 as “Regulations for the Safe Transport of Radioactive Material”, Safety Series No. 6 (the Regulations), and have been revised at regular intervals, in consultation with Member States, and with input from other relevant organizations, as appropriate. The current regular review and revision of the Regulations has been driven by problems, challenges, and the demand for improvements; as well as the need to take into account experiences in transport, newly identified issues, new technologies, best practices, the demand for sustainable transport, and harmonization. After 50 years, 15 editions of the Regulations have been published.

With the passage of time, the scientific and technical heritage of several decades of development in transport safety has begun to fade. The need to capture valuable knowledge which needs to be preserved for future reference has become clear. In general, every requirement in the regulations was developed based on deliberations amongst international experts and an appropriate technical basis. The knowledge bases for these often exist in a decentralized manner in many Member States with mature nuclear programs. Easier access to the existing technical bases for the Regulations could lead to a more comprehensive understanding of the Regulations. Knowledge capture and transfer can contribute to the development of and innovations in transport safety.

This paper provides an overview of international-level efforts that began in 2010 to develop a comprehensive and detailed technical basis document (TecBasDoc) to support the current and future revisions of the Regulations. The draft TecBasDoc has so far resulted from efforts by IAEA staff and a large number of international transport experts. It exceeds 150 pages in length using, to the greatest extent possible, historical documents dating as far back as the 1950s as reference material. The intent of this effort is to record, for those Member States new to transport and for future generations, the scientific and technical heritage of several decades of development that has occurred in transport safety and to capture valuable knowledge so it can be preserved for future reference. The latest effort has involved consultants to the IAEA adapting the draft to reflect guidance from the IAEA’s Transport Safety Standards

Committee (TRANSSC) and delving into the IAEA's archives and other sources of historical documents, searching out many long-sought, older supporting documents. The draft is currently structured into 12 chapters, embodying multiple supporting appendixes.

This paper elaborates on the first chapters of the document, which include (a) General History, (b) Fundamental Safety Principles, (c) Safety Objectives and Principles for Transport, (d) General Safety Requirements, (e) Radiation Protection, and (f) Controls for Transport. Two companion papers at PATRAM 2013 address the status of the TecBasDoc in the topical areas of package testing and criticality control. In all cases, the chapters of the TecBasDoc address how early decisions were made citing well known historical experts and discussing how these initial decisions have been adapted to meet the emerging international safety guidelines.

INTRODUCTION

Capturing the technical bases for the current transport safety regulations and preserving that information for future generations of transport regulators as well as the larger transport community is seen as a priority for the IAEA. Since the Regulations for the Safe Transport of Radioactive Material were first issued by the IAEA in 1961, there have been fourteen revisions, amended editions, or supplements of the Regulations issued (see Table 1), where the latest version, Specific Safety Requirement No. 6 (SSR-6) [1], was issued in October 2012. These revisions have been developed taking into account the world-wide experiences, new issues, new technologies, best practices, lessons-learned from their application, the demand for sustainable transport, and the need for harmonization with other international bodies and between IAEA Member States. Problems, challenges, the demand for improvements, and the need to provide biennial inputs to international dangerous goods model transport regulations, drive the transport community to continuously review and revise the Regulations.

An effort was initiated at the IAEA in 2010 with a view to capturing and documenting, as much as possible, the technical bases for the Regulations. This international-level effort is focused on the development of a comprehensive and detailed technical basis document (TecBasDoc) which will support the current and future revisions of the Regulations. Specifically, the ultimate goal of this effort is to develop a document that provides:

- (a) a narrative history of the development of the regulations,
- (b) the technical bases for the decisions that were made regarding the requirements in the regulations, (where the technical bases could be clearly discerned) and
- (c) the appropriate historical references that support those decisions.

The intent of this TecBasDoc effort is that all of this information will ultimately be made available electronically to the transport safety community, providing the necessary explanations of the “whys” behind the current regulations.

This paper elaborates on the background behind the development of the TecBasDoc, and provides insights into the first chapters of the document, which include (a) General History, (b) Fundamental Safety Principles, (c) Safety Objectives and Principles for Transport, (d) General Safety Requirements, (e) Radiation Protection, and (f) Controls for Transport. It is noted that two companion papers at PATRAM 2013 address the status of the TecBasDoc in the topical areas of package testing and criticality control. In all cases, the chapters of the TecBasDoc address how early decisions were made citing well known historical experts and discussing how these initial decisions have been adapted to meet the emerging international safety guidelines.

Table 1-1. History of issuing transport safety regulatory documents*.

Edition	Regulations	Guidance material Explanatory	Advisory
1961 (1961 edition)	SS-06 (1961)	SS-07 (1961) **	
1964 (1964 revised edition)	SS-06 (1965)		
1967 (1967 edition)***	SS-06 (1967)		
1973 (1973 revised edition)	SS-06 (1973)		SS-37 (1973)
1979 (1973 revised edition (as amended))			SS-37 (Second edition (1973 revised edition (as amended)) (1982))
1985 (1985 Edition)	SS-06 (1985)	SS-07 (Second edition (1985 edition)) (1987)	SS-37 (Third edition (1985 edition)) (1987)
1986 (1985 Edition (Supplement))			
1988 (1985 edition (Supplement))			
1990 (1985 edition (As Amended 1990))	SS-06 (1990)	SS-07 (Second edition (As amended 1990)) (1990)	SS-37 (Third edition (As amended 1990)) (1990)
1996 (1996 edition)	ST-1 (1996)	---	
2000 (1996 edition (Revised))	TS-R-1 (ST-1 Revised) (2000)	TS-G-1.1 (ST-2) (2002)	
2003 (1996 edition (As amended 2003))	TS-R-1 (2004)	---	
2005 (2005 edition)	TS-R-1 (2005)	TS-G-1.1 (Rev.1) (2008)	
2009 (2009 edition)	TS-R-1 (2009)	---	
2012 (2012 edition)	SSR-6		

* Key to the table: SS: Safety Series; ST and TS-R: : Safety Standards Series; TS-G: Safety Guide; SSR: Specific Safety Requirements.

** Notes on Certain Aspects of the Regulations.

*** On 18 April 1966, the IAEA transmitted to its Member States (Reference L/443-1) a "Modification No. 1 to the Regulations" documenting changes of detail; however, these were not published as a separate Safety Series No. 6, but were incorporated into the 1967 edition of Safety Series No. 6.

NOMENCLATURE

BSS	Basic Safety Standards
CSI	Criticality Safety Index
ECOSOC	United Nations Economic and Social Council
IAEA	International Atomic Energy Agency
IP	Industrial Package
LSA	Low Specific Activity
SCO	Surface Contaminated Object

SS6	Safety Series No. 6
SS7	Safety Series No. 7
SS37	Safety Series No. 37
SSR	Specific Safety Requirements
TecBasDoc	Technical Basis Document
TRANSSC	Transport Safety Standards Committee
TI	Transport Index

BACKGROUND

The history of the development of the IAEA Transport Regulations and supporting advisory and explanatory documents bridges more than five decades. The overall historical process can be looked upon as having occurred as a five phase process, which is depicted graphically in Figure 1. A brief description of these five phases is as follows:

- The first phase began in 1957 with the formation of a preparatory commission at the IAEA; continued with a 1959 request by the United Nations Economic and Social Council (ECOSOC) that the IAEA be entrusted with drafting recommendations on the transport of radioactive substances; and, following extensive deliberations by international experts, it ended with the publication in 1961 of the first edition of the Transport Regulations, designated as Safety Series No. 6 (SS6).

It is noteworthy that this first edition included requirements for Type A and Type B packages, where accident test criteria for Type B packages were initially specified qualitatively as essentially the ‘*maximum credible conditions*’; which provided a qualitative specification of “what” was required in the package design. Concurrently, the first edition of Safety Series No. 7 (SS7) was issued, which provided notes by some of the involved experts on some of the considerations that went into the development of the requirements in that first edition.

- The second phase, which spanned the time period from 1962 through 1985, consisted of issuing multiple editions of the Regulations. The concept of testing Type B packages to maximum credible conditions was immediately replaced in 1964 with a specification of a series of accident test conditions; thereby moving from a qualitative specification of “what” was required in the package design to a quantitative specification of “what” was required in the package design. In the 1973 edition of the Regulations, the assignment of individual activity limits for Type A packages by radionuclide, defined as A₁ and A₂ (for special form and other than special form radioactive material,) was introduced; replacing the previous system whereby radionuclides were classified into seven Groups.

In addition to the multiple publications of the Regulations, the first edition of advisory material, specifying “ways” that could be used to satisfy certain regulatory requirements, was issued as SS37. During the latter part of this phase, small changes were made to the Regulations and amended editions of both SS6 and SS37 were issued. Concurrently, a detailed review process was initiated in 1979 with a view to issuing a fully-revised set of Regulations and Advisory material incorporating extensive changes that were determined needed as a result of the review.

- The third phase began in 1985 with the publication of the revised Regulations (SS6), a completely revised SS7 that provided insight into “why” many of the regulatory requirements were

established, and a significantly revised SS37 enhancing the transport community's knowledge on the "hows" of satisfying certain regulatory requirements. Because of the extensive changes that had been made, it was then necessary to issue two supplements to SS6 in 1986 and 1988, and amended versions of SS6, SS7 and SS37 were issued in 1990, correcting editorial problems and incorporating lessons-learned from the initial application of the new Regulations.

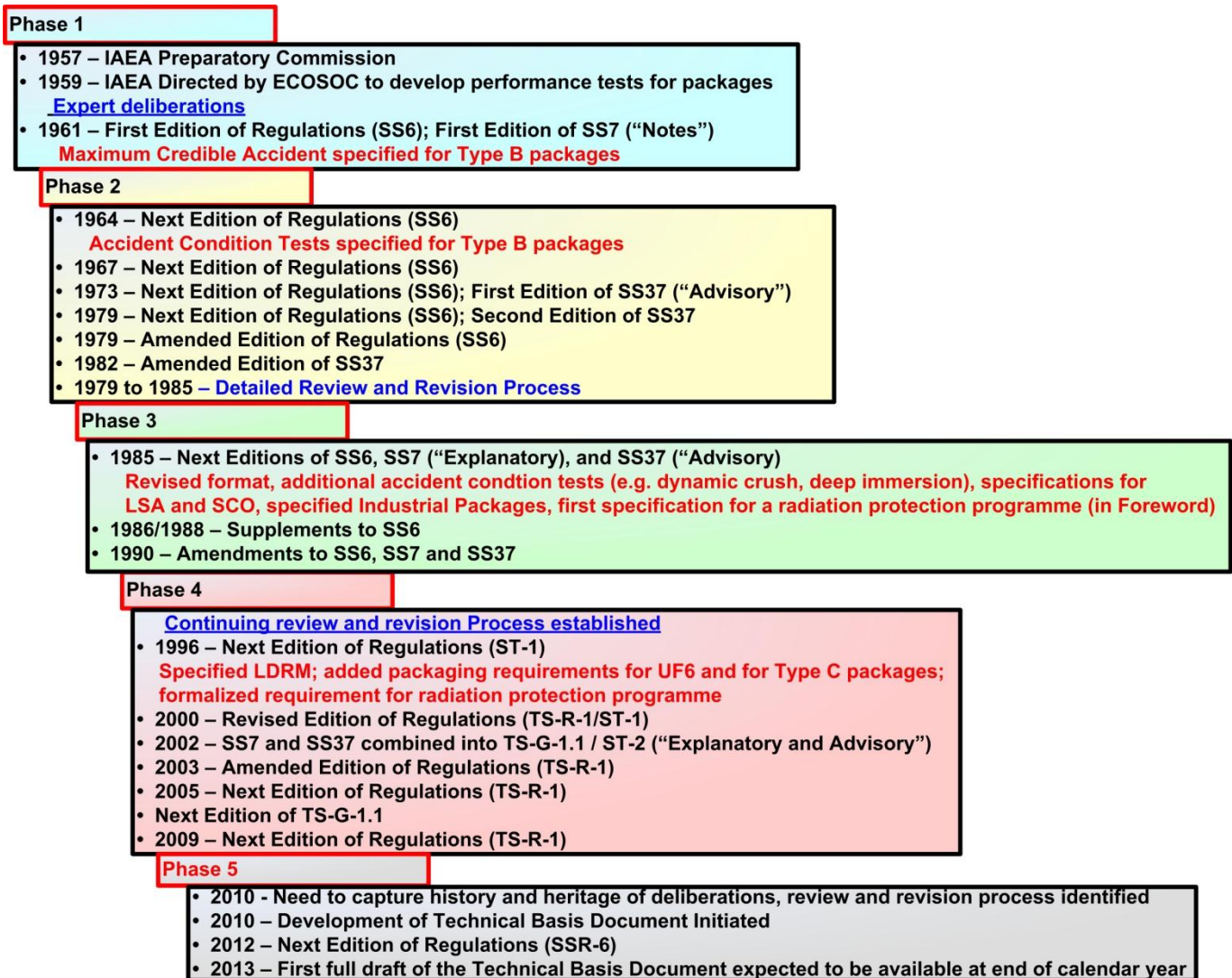


Fig. 1. Graphical depiction of the process of developing the IAEA Transport Regulations and supporting documents.

The 1985 edition of the Regulations resulted in a significantly revised format, the addition of a dynamic crush test and a deep water immersion test for some package designs, the specification of low specific activity (LSA) materials and surface contaminated objects (SCOs) and their carriage in a graded set of industrial packages (IPs), and the requirement – as documented in the Foreword of SS6 – for a radiation protection programme for radioactive material transport activities.

- The fourth phase occurred during approximately the next two decades. A continuing review and – as necessary – revision process was established that resulted in revised or amended editions of the

Regulations in 1996, 2000, 2002, 2003, 2005 and 2009. In order to be consistent with changes in the IAEA's document nomenclature, the designator for the Regulations changed from SS6 to ST-1, and then to TS-R-1.

The 1996 edition also incorporated additional significant changes including adding specific packaging requirements for uranium hexafluoride, the introduction of Type C package design and testing requirements, and a formalizing of the requirements for a radiation protection program in Chapter III. In addition, SS7 and SS37 were combined in 2002 into a single advisory and explanatory document designated at TS-G-1.1, which was updated and re-issued in 2008.

- The fifth phase was initiated in 2010 and continues to this day. In 2010, it was recognized that the scientific and technical heritage of the above-summarized several decades of development in transport safety had begun to fade; and the need to capture valuable knowledge which needs to be preserved for future reference became clear. Efforts were initiated, in parallel with the continuing review and revision process, to a Technical Basis Document (TecBasDoc). This effort has been monitored by the IAEA's Transport Safety Standards Committee (TRANSSC). The first full edition of the TecBasDoc is expected to become available electronically to the transport community at the end of calendar year 2013. Also, the latest edition of the Regulations was issued in 2012, with a new designator of "Specific Safety Requirements No. SSR-6".

The effort to develop the TecBasDoc began with a technical meeting convened in October 2010 in Paris, France, and was followed by a second technical meeting convened in March 2011 in Vienna, Austria. The two meetings focused on identifying the underlying technical bases for the essential safety requirements for transport. Historical documents have been collected and correlations between those documents and the essential safety requirements have been traced in more detail to clarify the technical bases of the transport safety requirements.

A working draft of what will eventually become the TecBasDoc was prepared by a consultant services (CS) meeting in March 2012, after which the document has been further developed and provided to a working group at the TRANSSC 25 meeting in October 2012. This TRANSSC working group provided guidance on the future development of the TecBasDoc.

A consultant services (CS) meeting was then held in December 2012, to incorporate the TRANSSC working group recommendations and further edit and refine the current draft of the TecBasDoc. Also, the effort to collect relevant historic reference material continued during the CS; the IAEA archives were searched, documents pertaining to transport safety were reviewed, and copies of relevant documents were obtained. These documents were scanned and added to an electronic database of references for the TecBasDoc. Proceedings from relevant technical conferences and journals will be reviewed and relevant papers will also become references for the TecBasDoc.

TECHNICAL BASIS DOCUMENT

Prior to initiation of the TecBasDoc effort, a number of papers were prepared addressing various aspects of the historical background of the regulations (e.g. see [2-4]). These papers have been helpful in capturing some of the history behind the development of the regulations for current and newer members of the larger transport community, but technical papers alone are not able to capture the complete breadth and the depth of the "whys" behind the formulation of the many technical requirements in the regulations.

The current draft of the TecBasDoc has been developed over a period of years and comprises well over 150 pages. The document is broken down into 12 chapters as shown in Table 2. In addition, the current draft of the TecBasDoc contains five appendixes as shown in Table 3.

Table 2. Chapter Structure in Current Draft of TecBasDoc as of July 2013.

CHAPTER	TITLE	NUMBER OF REFERENCES CITED
1	Introduction	5
2	General History	22
3	The Fundamental Safety Principles	8
4	Safety Objectives and Principles for Transport	2
5	General Safety Requirements	18
6	Radiation Protection	9
7	Controls for Transport	18
8	Classification of Materials	19
9	Classification of Packages	5
10	Package Design and Testing	105
11	Basis for Nuclear Criticality Safety	99
12	Approval and Statutory Requirements	(not yet developed)

Table 3. Appendix Structure in Current Draft of TecBasDoc as of July 2013.

APPENDIX	TOPIC	NUMBER OF REFERENCES CITED
1	Developing and applying the IAEA Transport Regulations – Implementing an international transport safety regime (7 references)	7
2	The structure of the safety requirements	1
3	The technical basis for applying the graded approach	35
4	Follow-on studies into the adequacy of the accident conditions of transport	40

SUMMARY OF CONTENTS OF THE FIRST SEVEN CHAPTERS OF THE TECHNICAL BASIS DOCUMENT

A summary of the contents of first seven of the above chapters is provided below.

In a second companion document presented at PATRAM 2013 [5], a summary of Chapters 8-10 is provided. In a third companion document presented at PATRAM 2013 [6], a summary of Chapter 11 is provided. Finally, as can be seen from Table 2, Chapter 12, Approval and Statutory Requirements, has not yet been developed; this was an addition recently recommended by TRANSSC.

Chapter 1 – Introduction

The Introduction chapter provides an expanded version of the background that has been summarized above in this paper, including the presentation and discussion of Table 1 above. It specifically notes that, although the TecBasDoc strives to address all issues pertaining to all of the different editions, amendments and supplements of the Regulations, the discussion ties directly to the paragraph structure of the most current, 2012 edition, of the Regulations [1].

In addition to providing an expanded discussion of the background, the Introduction chapter also provides a summary of the Purpose, Scope and Structure of the TecBasDoc. Specifically, it specifies that the purpose of the TecBasDoc is *“to provide a single, comprehensive source of information relative to preserving, as best as could be done in the 2011 – 2013 time frame, knowledge concerning the technical basis for the requirements set forth in the Transport Regulations. To the extent possible, the document looks back into historical documents to define the logic behind the requirements that were initially introduced into the Regulations, and how these requirements have changed with time.”*

Chapter 2 – General History

This chapter considers many early documents that capture the deliberative process and thoughts that resulted from the development of the early editions of the Regulations as illustrated in Phase 1 of Figure 1. It traces the early history of the transport safety regulatory measures that had been established in a number of countries prior to the initial version of the IAEA regulations being issued in 1961.

The chapter elaborates on the history of the involvement of the United Nations in informing *“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”* [7]. It then elaborates on the early specification of package design requirements, the development of the concept of Type A and Type B packages, and determining what was required versus discussing how those requirements were intended to be satisfied.

The chapter elaborates first on the early efforts that resulted in the first edition of the Regulations, which as noted in Figure 1, included specifying a maximum credible accident requirement for the design of Type B packages. Some of this history was captured in the first publication of Safety Series No. 7 [4]. The chapter then discusses the steps taken after the first edition of the Regulations was published that moved

the process into what is summarized in Phase 2 of Figure 1. Many changes occurred as the Regulations matured during the late 1960s and the 1970s. These changes included five key issues:

1. specifying more clearly package design requirements;
2. developing more comprehensively the concept of different types of packages (e.g. Type A, and Type B packages);
3. eliminating the early provisions for applying the concept of a “maximum credible accident” to the package design requirements;
4. emphasizing that the Regulations address “what” was required to satisfy the regulatory requirements, not “how” those requirements were to be satisfied; and
5. establishing clarity in the Regulations and the interpretation thereof by specifying a set of definitions.

Each of these five changes, how they have developed over the years in a manner that has strengthened the understanding and application of the Transport Regulations, and the technical bases thereof, are then summarized in five subsections.

Chapter 3 - The Fundamental Safety Principles

The Fundamental Safety Principles chapter describes the development of “*a common safety philosophy across all areas of application of the IAEA safety standards*”, and how those principles were considered and applied to the area of transport. It ties specifically to the current IAEA Fundamental Safety Principles document [8], listing each of the ten principles and how each relates to and is satisfied by the 2012 edition of the IAEA Transport Regulations SSR-6 [1]. It also addresses the fundamental safety objective [8], which is to protect people and the environment from harmful effects of ionizing radiation, without unduly limiting the operation of facilities or the conduct of activities (such as the transport of radioactive material) that give rise to radiation risks. It notes that, as a result, measures have to be taken:

- to control the radiation exposure of people and the release of radioactive material to the environment;
- to restrict the likelihood of events that might lead to a loss of control over a radioactive source;
- to mitigate the consequences of such events if they were to occur.

Chapter 4 – Safety Objectives and Principles for Transport

The chapter on Safety Objectives and Principles for Transport discusses what is at the heart of the transport regulations, what is required by the regulations to ensure safety, how the regulations protect people and what the overall scope of the regulations is. Specifically, it discusses how the Regulations provide protection to persons, property and the environment by requiring:

- containment of the radioactive contents;
- control of external radiation levels;
- prevention of criticality;
- prevention of damage caused by heat.

It then elaborates on how these are satisfied by

- (a) following a graded approach,
- (b) imposing requirements on both the design and operation of packages as well as on the maintenance of packagings, including consideration of the nature of the radioactive contents; and

(c) requiring administrative controls, including, where appropriate, approval by competent authorities.

This chapter provides a foundation for the elaborated historical discussion which occurs in the following chapters.

Chapter 5 - General Safety Requirements

The General Safety Requirements chapter (which is primarily Section III of the regulations) first discusses the suite of general safety requirements documents that have been developed over the last few years [9-14]; and then elaborates on the general requirements for compliance assurance, radiation protection, quality assurance, and management systems.

The requirements of the interim edition of the Basic Safety Standards (now GSR part 3 [5]) and how those are applied in the transport regulations, is expanded upon in detail. Of the 52 general requirements established therein, it is shown that 33 apply to the transport of radioactive material, and each is discussed in terms of what is required. For example, the first requirement discussed is the application of the principles of radiation protection. Chapter 5 specifies that “parties with responsibilities for protection and safety shall ensure that the principles of radiation protection are applied for all exposure situations”. This specific requirement offers a perfect segue to the next chapter of the TecBasDoc.

Chapter 6 – Radiation Protection

The chapter on Radiation Protection delves into the development of exemption values; the history of the development of the A_1 and A_2 values, elaborating on the initial guidelines used as the basis for developing the A_1 and A_2 values [15]; and then discussing the development of the more complete basis for these values using the Q System [16]. This chapter also makes special note that since the Basic Safety Standards (BSS) document was updated in 2011 [17], the list of radionuclides in the 2012 edition of the Transport Regulations, and their corresponding A_1 and A_2 values, are now outdated. Many of the radionuclides in the 2011 edition of the BSS are not covered in the Regulations. An update is needed to make the activity limits in the Transport Regulations consistent with those in the current BSS, both in terms of radionuclides addressed and dose conversion factors.

The chapter continues by discussing the radiation protection principles that were applied to the three classes of LSA materials, the two classes of SCOs, and the different types of excepted packages. In addition, a section is envisioned but not yet developed on “Consistency of Transport Regulations with the Basic Safety Standards”. Finally, a section has been developed addressing the prevention of excessive radiation levels outside of packages and conveyance.

Chapter 7 – Controls for Transport

The chapter on Controls for Transport discusses primarily Section V of the regulations, which provides the requirements for a variety of topics ranging from what must be done before package shipments, to limits on radiation levels for packages, to the requirements for marking and labeling of packages and placarding of vehicles and freight containers and tanks. The concepts of Transport index (TI) and Criticality Safety Index (CSI) are addressed. Radiation controls for the various modes of transport and for storage and transit are also discussed; and elaboration is provided on consignor’s responsibilities, requirements for storage in transit, customs operations and handling of documents by the carriers.

HISTORICAL REFERENCES

The collecting of historical references has been one of the most challenging aspects of the TecBasDoc effort. While a number of references were readily available in an electronic format, many of the older references exist only in paper and then, often only in the personal collections of individuals who have been working in transport for a significant period of time.

To enhance the collection of historical references, the IAEA archives were tapped to find early documents that might shed some light on some of the decisions made in the early editions of the regulations; however, the archives did not always contain the specific documents that were sought.

The IAEA plans to reach out to the transport community to see if there are copies of several references available that might be able to be converted to an electronic format and made widely available to the larger transport community.

Ultimately, whatever historical documents are captured electronically and are not constrained by copyright issues, the IAEA plans to make them available via the internet.

FUTURE PLANS

While the TecBasDoc has not been completed and the references have not yet been fully sorted and reviewed, a significant portion of the work on this document has been completed. During the remainder of the calendar year, plans are to finalize the document as far as possible and to then make it available to the members of TRANSSC for their review and comment. The document may never see formal publication, but may – instead – be updated periodically, as needed, and made available, in its most current form, to the transport community via the internet. In addition, as noted above, to the extent possible the large array of reference documents that have been and will continue to be captured will be made available electronically via the internet.

CONCLUSIONS

Since the TecBasDoc is considered a “living” document, it will, as needed, be updated periodically to maintain the historical technical bases as the regulations are reviewed and revised in future years. As this document speaks clearly and as comprehensively as possible to the “whys” behind the regulations, consideration may later be given to removal of the “whys” from current IAEA guidance documentation related to the transportation regulations (including TS-G-1.1 [15]), allowing the guidance documents to speak specifically to the “hows” while the TecBasDoc to exclusively speak to the “whys”.

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REFERENCES

- [1] International Atomic Energy Agency, *Regulations for the Safe Transport of Radioactive Material*, 2012 edition, Specific Safety Series No. 6, IAEA, Vienna (2012).
- [2] Pope, R. B., *Historical Background to the Development of Various Requirements in the International Regulations for the Safe Packaging and Transport of Radioactive Material*, Packaging, Transport, Storage & Security of Radioactive Material (RAMTRANS), Vol. 15, No. 1, pp 5 13, London (2004).
- [3] Gibson, R. (Editor), *The safe transport of radioactive materials*, Pergamon Press, London (1966).
- [4] International Atomic Energy Agency, *Regulations for the Safe Transport of Radioactive Materials – Notes on Certain Aspects of the Regulations*, Safety Series No. 7, IAEA, Vienna (1961).
- [5] Pope, R. B., Malesys, P., Bajwa, C. S., and Zhao, Y. K., *Developing the Historical Technical Basis for the Material and Package Classification and the Package Test Requirements of the International Transport Safety Regulations*, PATRAM 2013, San Francisco (2013).
- [6] Mennerdahl, D., *Criticality Safety Basis for the IAEA Transport Regulations*, PATRAM 2013, San Francisco (2013).
- [7] United Nations, *Economic and Social Council resolution 724 of the twenty-eighth session*, E/3290, Geneva, 1959.
- [8] International Atomic Energy Agency, *Fundamental Safety Principles*, Safety Fundamentals No. SF-1, Vienna (2006).
- [9] International Atomic Energy Agency, *Governmental, Legal and Regulatory Framework for Safety*, General Safety Requirements Part 1, No. GSR Part 1, Vienna (2010).
- [10] International Atomic Energy Agency, *Governmental, Preparedness and Response for a Nuclear or Radiological Emergency*, Safety Requirements No. GS-R-2, Vienna (2002).
- [11] International Atomic Energy Agency, *The Management System for facilities and Activities*, Safety Requirements No. GS-R-3, Vienna (2006).
- [12] International Atomic Energy Agency, *Radiation Protection and Safety of Radiation Sources*, International Basic Safety Standards, Interim Edition, General Safety Requirements Part 3, No. GSR Part 3 (Interim), Vienna (2011).
- [13] International Atomic Energy Agency, *International Basic Safety Standards for Protection against Ionizing radiation and for the Safety of Radiation Sources*, Safety Standards, Safety Series No. 115 Vienna (1996).
- [14] International Atomic Energy Agency, *Safety Assessment for Facilities and Activities*, General Safety Requirements Part 4, No. GSR Part 4, Vienna (2009).
- [15] International Atomic Energy Agency, *Advisory Material for the Application of the IAEA Transport Regulations*, Safety Series No. 37, Vienna (1973).
- [16] International Atomic Energy Agency, *Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material*, Safety Standards Series No. TS-G-1.1, IAEA, Vienna (2008).
- [17] International Atomic Energy Agency, *Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards (Interim Edition)*, General Safety Requirements No. GSR Part 3 (Interim), IAEA, Vienna (2011).