RADIOACTIVE MATERIAL TRANSPORT SECURITY

- Awareness and application of new recommendations –

Ann-Margret Eriksson
International Atomic Energy Agency
P.O. Box 100, A-1400, Vienna, Austria

Richard R. Rawl
Oak Ridge National Laboratory
P.O. Box 2008, MS-6472, Oak Ridge, TN 37831-6472

Michael E Wangler
International Atomic Energy Agency
P.O. Box 100, A-1400, Vienna, Austria

Abstract

Transport of radioactive material is highly regulated and the transport safety regulations have been in effect for decades. Transport security recommendations for many types of radioactive material have just been developed and applied, and the potential impact on transport operations is significant.

While the security measures and definition of high consequence radioactive material added to the Model Regulations were recognized as a very positive step, the IAEA initiated a review of these provisions to ensure they were technically sound and consistent with other approaches used in nuclear and radioactive material security. A series of consultants meetings and technical meetings were held between October 2003 and January 2006 to review the transport security provisions and develop guidance to assist Member States in implementing appropriate measures. The recommendations of the "Technical Meeting to Review Guidance for Security in the Transport of Radioactive Material", convened during 23-27 January 2006 at the IAEA Headquarters in Vienna, provided a good summary of the conclusions of this series of meetings.

Several significant steps have been taken in defining appropriate security measures to apply during transport and these are reflected in the IAEA guide "Security of Radioactive Material during Transport" that can be subsequently adopted by countries and international transport modal organizations. However, there is still much to be accomplished before transport security is on par with transport safety. This paper briefly describes the development and implementation of security recommendations, some problem areas identified by shippers and carriers, and offers a few suggestions for successfully accomplishing improvements while minimizing the overall impact of new security recommendations.

This paper briefly describes the development and implementation of the IAEA security recommendations, some problem areas identified by shippers and carriers, and offers a few suggestions for successfully accomplishing improvements while minimizing the overall impact of new security requirements.

Security of Radioactive Material during Transport

Security of radioactive material during transport does not have the extensive experience and wide implementation that has been accomplished in transport safety. While the security of nuclear (fissile) material[1] has been addressed since 1979 and guidance material[2] has been available to support implementation, the same situation does not exist for non-fissile radioactive material. Heightened awareness of the need to secure such materials during transport has led to a series of developments aimed at defining and supporting the uniform implementation of transport security requirements.

Recognizing the need for increased security following the events of September 11, 2001, the UN Committee of Experts[3] introduced measures to enhance security for the transport of all dangerous goods in the 12th Revised Edition of the Model Regulations. These security measures were developed with input from many affected parties and reflect what the Committee feels is a balanced approach to security. These requirements are contained in Chapter 1.4 where there are basic security requirements applicable to the transport of all dangerous goods and additional requirements for high consequence dangerous goods. An indicative list of high consequence dangerous goods is provided in the Chapter.

As part of the process to develop the dangerous goods security requirements, the Committee of Experts consulted with the IAEA regarding the definition of high consequence radioactive material. With very little time for consultation with Member States, the IAEA agreed with the definition, based on other provisions within the Transport Regulations.

Beginning with the early versions of the Transport Regulations, there has been a threshold for denoting what constitutes a "large quantity" of radioactive material. In the current Transport Regulations this is 3,000 A_1 for special form material and 3,000 A_2 for non-special form material. So the IAEA agreed that this was a suitable threshold for identifying high consequence radioactive material with the observation that the dangerous goods security requirements should not apply to nuclear (fissile) material that is already subject to physical protection requirements during transport. These recommendations provided the basis for the Class 7 (radioactive material) high consequence definition in Chapter 1.4 of the Model Regulations.

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[1] *The Convention on the Physical Protection of Nuclear Material*, INFCIRC/274/Rev 1, IAEA, Vienna, 1980

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

[3] The official title of the committee is now "Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized system of Classification and Labelling of Chemicals".

initiated a review of these provisions to ensure they were technically sound and consistent with other approaches used in nuclear and radioactive material security. A series of consultants meetings and technical meetings were held between October 2003 and January 2006 to review the transport security provisions and develop guidance to assist Member States in implementing appropriate measures. The recommendations of the "Technical Meeting to Review Guidance for Security in the Transport of Radioactive Material", convened during 23-27 January 2006 at the IAEA Headquarters in Vienna, provide a good summary of the conclusions of this series of meetings.

The draft transport security guidance includes the following recommendations:

1. some radioactive materials, such as excepted packages, and low specific activity materials and surface contaminated objects that can be shipped unpackaged, do not warrant security measures above prudent management practices;
2. two categories of security measures – basic and enhanced, are sufficient for specifying appropriate measures and is consistent with the approach used for other dangerous goods;
3. the threshold for high consequence radioactive material should be revised to take account of analyses done on the consequences of intentional dispersal and developments in the safety and security of radioactive sources; and,
4. while the security requirements in the Model Regulations are an adequate set of baseline measures, there are additional measures that Member States might wish to consider in view of their national Design Basis Threat, situations of increased threat, or for particularly attractive material.

These recommendations result in three groups of security measures as illustrated in Figure 1.

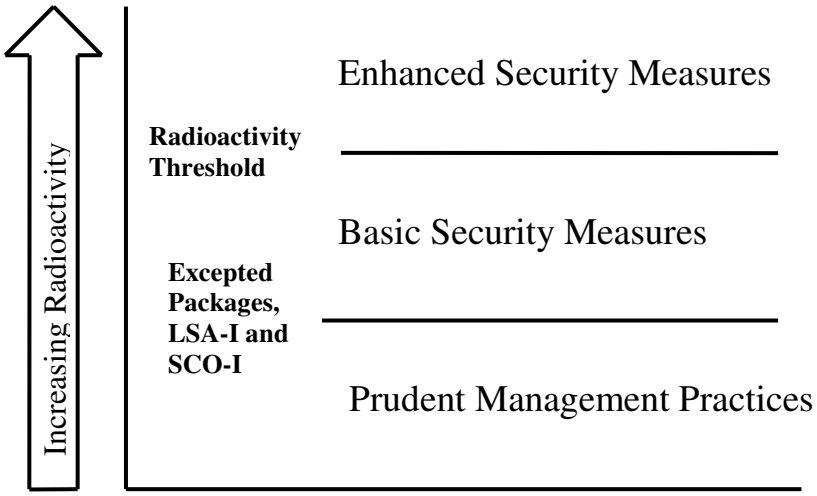

Figure 1. Incremental Security Measures

Exceptions from security requirements

Malicious use of radioactive material could involve exposure to radiation (a radiation exposure device) or dispersal of the radioactive material (a radiological dispersal device or "RDD"). Small quantities of radioactive material and low activity concentration materials would not be very effective in such applications since the consequences of their use would be low. The draft guidance recommends that no transport security measures above prudent management practices should be required for:

- excepted packages
- low specific activity material in category LSA-I that can be shipped unpackaged
- surface contaminated objects in category SCO-I that can be shipped unpackaged

Two categories of security measures

Radioactive materials as they are currently transported present a very wide spectrum of attractiveness for malicious use. Materials and packages with potentially significant but limited consequences such as Type A packages, LSA-II and -III, and SCO-II have some attractiveness. Packages containing high activities such as large sealed sources or bulk quantities of radionuclides (especially in dispersible form) could be very attractive for malicious use. Even with this broad spectrum of attractiveness, it was conclude that two security categories could be used to specify appropriate measures, particularly in light of the desirability to be consistent with the Model Regulations.

Two security categories are recommended, a "basic level" and an "enhanced level". The specific security measures recommended for each level were drawn from the Model Regulations and, where necessary, tailored for application to radioactive material shipments.

At the basic level, the security measures include: security awareness training and periodic retraining; maintenance of training records; using known or identified carriers; and, using properly secured in-transit storage areas.

Enhanced security measures include a requirement that consignors, carriers, and others (including infrastructure managers) adopt, implement, and comply with a security plan that addresses:

- allocation of responsibilities and authority to fulfill these responsibilities
- records of material transported
- review of operations and assessment of vulnerabilities
- clear statement of measures to be used to reduce security risks
- procedures for reporting and dealing with security threats, breaches, and incidents
- testing of security plans and periodic review and update of plans
- security of information including limiting distribution of information

Since the transport of nuclear (fissile) material is already subject to security requirements as specified in the Convention for the Physical Protection of Nuclear Material and the supporting guidance in INFCIRC/225, there is some overlap between the two sets of

recommendations. A comparison of INFCIRC/225 and the draft transport guidance shows that for:

- Category I nuclear material – the security measures of INFCIRC/225, while roughly comparable to the enhanced security measures are more stringent (e.g., requiring escorts)
- Category II nuclear material – the security measures of INFCIRC/225 are roughly comparable to the enhanced security measures
- Category III nuclear material – the security measures of INFCIRC/225 are roughly comparable to the basic security measures

Consequently, if a package containing Category III nuclear material has an activity level exceeding the radioactivity threshold, it must meet additional security measures due to its radiological potential for malicious use.

Threshold for high consequence radioactive material

Extensive discussions were held on how the threshold for high consequence radioactive material should be defined. From a strict security standpoint there are advantages to using a "per conveyance" basis since this best identifies conveyances that are carrying a total quantity of material that should be protected. From an operational standpoint a "per package" basis is much more feasible to implement since this would not require carriers to keep a tally of the activity on the conveyance. It was concluded that the "per package" basis was acceptable and a radioactivity threshold was then defined to identify those packages that should be subject to the enhanced security measures.

Analysis of potential consequences such as denying the use of an area due to dispersed radioactive material was performed. As a benchmark, the radioactivity required for causing the resettlement of 1 km^2 land area was calculated for a set of representative radionuclides. A simple planar distribution model was used to determine the radioactivity required to cause a 1,000 mSv lifetime dose (the criteria recommended by the International Commission on Radiological Protection for resettlement). Using the long term dose conversion factors for deposited radionuclides from IAEA TECDOC-955[4], the radioactivity required to cause resettlement was calculated for a list of representative radionuclides.

The IAEA Code of Conduct on the Safety and Security of Radioactive Sources[5] (the Code) is being implemented by many countries. Eighty six countries have notified the IAEA of their intent to implement the Code[6]. Among other requirements, the Code and its Supplementary Guidance on the Import and Export of Radioactive Sources[7], require

[4] *Generic Assessment Procedures for Determining Protective Actions during a Reactor Accident*, IAEA-TECDOC-955, International Atomic Energy Agency, Vienna, 1997

[5] *Code of Conduct on the Safety and Security of Radioactive Sources*, International Atomic Energy Agency, Vienna, 2004

[6] *List of States that have a made a political commitment with regard to the Code of Conduct on the Safety and Security of Radioactive Sources and the Supplementary Guidance on the Import and Export of Radioactive Sources*, IAEA, http://www.iaea.org/Publications/Documents/Treaties/codeconduct_status.pdf

[7] *Guidance on the Import and Export of Radioactive Sources*, International Atomic Energy Agency, Vienna, 2005

certain measures such as notification and consent prior to the import or export of Category 1 and 2 radioactive sources. The desire to ensure consistency between the transport security measures and the Code was strongly held by many countries. Consequently it was decided to align the radioactivity threshold for the 25 radionuclides contained in the Code with the Category 2 radioactive source threshold.

For radionuclides not included in the Code, it was recommended a multiple of the A_2 values used in the Transport Regulations be used. Based on the dispersion analysis a threshold of 3,000 A_2 was determined to be a reasonable threshold value. As a result, the recommended threshold is: 3,000 A_2 in a single package, except for the following radionuclides which are included in the Code:

Radionuclide	**Transport Security Threshold (TBq)**	**Radionuclide**	**Transport Security Threshold (TBq)**
Am-241	0,6	Pd-103	900
Au-198	2	Pm-147	400
Cd-109	200	Po-210	0,6
Cf-252	0,2	Pu-238	0,6
Cm-244	0,5	Pu-239	0,6
Co-57	7	Ra-226	0,4
Co-60	0.3	Ru-106	3
Cs-137	1	Se-75	2
Fe-55	8000	Sr-90	10
Ge-68	7	Tl-204	200
Gd-153	10	Tm-170	200
Ir-192	0.8	Yb-169	3
Ni-63	600		

Additional security measures

While the basic and enhanced security measures are generally consistent with the Model Regulations, there may be instances when a country feels that the security situation calls for additional measures. Additional measures may be warranted in elevated threat conditions, when the Design Basis Threat for the country indicates this is appropriate, and when the attractiveness of the material is high. The guidance document provides a list of possible additional security measures that countries might wish to consider imposing when appropriate. While country-specific measures might create more difficulty in making international shipments they are clearly warranted under high or elevated threat conditions.

The recommended guidance is generally consistent with the approach in the Model Regulations since it was recognized that establishing a set of unique provisions for radioactive material would be costly and perhaps impractical to implement. Dangerous goods carriers have implemented security measures consistent with the Model Regulations and they would be reluctant to incur the additional cost and complexity of a

unique set of radioactive material transport security measures because in most cases this is a very small part of their business.

These recommendations are being reflected in a new Nuclear Security Series Guide being prepared by the IAEA. A draft has been circulated to Member States for comments and these comments are being addressed. The Guide is expected to be published in early 2008.

Transport Security Compliance Experience

Since the IAEA guidance document has not yet been published, there is no direct experience in complying with those requirements. However, since the security requirements contained in the Model Regulations are reflected in the international modal organization requirements (IMO and ICAO in particular), there is experience in complying with those. Existing modal requirements for high consequence dangerous goods apply to only a few radioactive material shipments due to the relatively high radioactivity threshold. However, there is some experience with shipments related to applications such as teletherapy and irradiators that do meet the definition of high consequence radioactive material.

Several shippers and a carrier were contacted to obtain their input on experience in complying with the security requirements. Shippers of large radioactive sources reported that while additional costs and complications are incurred in meeting the modal security requirements, major compliance problems have largely been avoided. This is credited to carriers being prepared to handle high consequence dangerous goods in general, so security measures for radioactive shipments are not unique.

If countries wish to implement the transport security requirements for radioactive material as seamlessly as possible, the use of the IAEA guidance as a basis for the requirements is a key step. Building on this uniform basis, if steps can be taken to ensure uniform interpretation and application of the requirements, impacts on transport operations can be minimized while encouraging a high level of international and inter-modal compliance.

Implementing Transport Security

A training course has been prepared in cooperation with the USDOE and is being delivered on a bi-lateral and regional basis. The pilot training course was presented in Beijing, China, in May 2007 and provided a technical basis for developing a transport security plan to support a series of shipments. Regulatory authorities and the carrier/consignee participated in the course and development of the transport security plan, resulting in confidence that the plan is consistent with the latest draft international guidance. Lessons learned from this course presentation were used during a Consultancy meeting at the IAEA to improve the course. A second training course will take place in Lima, Peru in October 2007. Following completion of improvements, the course will be available for more widespread application.

The training course is a modular design and can be tailored to suit the needs of the intended audience. It is intended to be presented over a 3-day period and includes the following topics:

- The Need for Transport Security
- International Requirements and Guidance
- IAEA Guidance on Security of Radioactive Material during Transport
- Applying the Performance-based Approach to Defining Security Measures
- Applying the Combined Approach to Defining Security Measures
- Developing the Transport Security Plan
- Transport Security Technologies
- Implementation

The transport security guidance is also being integrated into other security assistance efforts, such as assistance to countries in assessing and upgrading their security infrastructures. The transport security guidance is also used as the basis for an assessment module to be used in several security advisory missions which will assess the transport security situation in Member States. The first pilot assessment module developed with the help of a consultancy meeting at the IAEA HQ in July will be used in an advisory mission to Ecuador in January 2008.

Conclusion

The IAEA draft security guidance for transport of radioactive material is now ready to be published. The guidance is patterned after the Model Regulations but there are some variations and additional measures that countries may wish to impose. The 120 days comment period resulted in several valuable comments that were incorporated in the guide. There were, however, some concerns about the per package approach instead of the per conveyance approach that could not be solved at this point. This issue was extensively discussed at the Technical Meeting and no consensus could be reached at that time. This is an issue that needs to be discussed further when the guidance is going to be revised.