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DEVELOPMENT OF TRAINING COURSE ON TRANSPORT SECURITY OF RADIOACTIVE MATERIALS

R.B. Pope and Y.Y. Liu
Argonne National Laboratory
9700 South Cass Avenue
Argonne, IL 60439, USA

J. M. Shuler
U.S. Department of Energy
1000 Independence Ave., SW
Washington, D.C. 20585, USA

ABSTRACT

Argonne National Laboratory (Argonne), with the support of the U.S. Department of Energy (DOE) Packaging Certification Program (PCP), is developing a week-long training course on security for nuclear and other radioactive materials during transport. The course will focus on United States (U.S.) domestic and international requirements for transport security. A review of applicable U.S. Department of Transportation (DOT) regulations, newly issued U.S. Nuclear Regulatory Commission (NRC) regulations, DOE orders and manuals, and relevant international modal regulatory documents relating to transport security was conducted. The review disclosed that existing International Atomic Energy Agency (IAEA) security training materials could be incorporated into a training course on security requirements for U.S. domestic shippers. Development of training materials for such a course was initiated in late 2012, and plans are underway to convene the first course in early December 2013 at Argonne. The course will also incorporate training and hands-on transport security applications of the ARG-US Radio Frequency Identification (RFID) system for monitoring the state of health of packages of radioactive and other hazardous materials and for tracking the location of the packages and conveyances during transport and in-transit storage. Participants of the course will (1) obtain insight into both U.S. and international security measures needed for transport and for in-transit stopping and storage; (2) gain experience in preparing transport security plans (TSPs) for specific shipments, in performing readiness reviews based on those TSPs, and in identifying needed corrective actions and taking steps to correct deficiencies; and (3) learn by hands-on exercises how to apply the ARG-US RFID system to enhance transport security.

INTRODUCTION

In late 2012, Argonne National Laboratory (Argonne), with the support of the U.S. Department of Energy (DOE) Packaging Certification Program (PCP), Office of Packaging and Transportation, Environmental Management (EM), began developing a week-long training course on security for nuclear and other radioactive materials during transport. The course will focus on U.S. requirements for transport security embodied in regulations issued by the U.S. Department of Transportation (DOT) (e.g., Title 49, Parts 171–177 of the *Code of Federal Regulations* [49 CFR 171–177]) [1]; the U.S. Nuclear Regulatory Commission (NRC) [2, 3] and associated NRC guidance [4, 5]; in orders and manuals issued by DOE (e.g., DOE M 460.2-1A) [6]; and in relevant regulatory documents issued for modal transport, such as those promulgated by the International Civil Aviation Organization (ICAO) [7] and the International Maritime Organization (IMO) [8, 9].

The International Atomic Energy Agency (IAEA) has developed a suite of recommendation and guidance documents on security [10, 11] that includes provisions for security during transport. The documents address requirements emanating from the Convention on the Physical Protection of Nuclear Material [12]. The IAEA has also developed and implemented various training courses on security during transport [13]. These materials will be used to supplement training on security during transport in the U.S.

In addition to lectures and classroom discussions and exercises, the course will incorporate training and hands-on transport security applications of the ARG-US Radio Frequency Identification (RFID) system for monitoring the state of health of packages of radioactive and other hazardous materials and for tracking the locations of the packages and conveyances during transport and in-transit storage. The ARG-US RFID system includes RFID tags, readers, database servers, Web pages, and an operations control center, all of which will be utilized in the course. Mock-ups of DOE-certified Type B transportation packaging will also be utilized to illustrate the proper application of the system in a demonstration vehicle. Application of the ARG-US RFID system has been documented in a companion case study [14] to the international best practice guide on "*Electronic Tracking for the Transport of Nuclear and other Radioactive Materials*" [15] recently published by the World Institute for Nuclear Security (WINS) and the World Nuclear Transport Institute (WNTI), which has been developed with the assistance of Argonne staff.

Participants of the course will (1) obtain insight into both U.S. and international security measures needed for transport and in-transit stopping and storage; (2) gain experience in preparing transport security plans (TSPs) for specific shipments, in performing readiness reviews based on those TSPs, and in identifying needed corrective actions and taking steps to correct deficiencies; and (3) learn by hands-on exercises how to apply the ARG-US RFID system to enhance transport security.

BACKGROUND

Prior to the September 11, 2001 terrorist attacks in the United States, attention was paid to providing security during the transport of some of the most potentially dangerous shipments of radioactive material, i.e., shipments that adversaries may choose to attack. Following 9/11, however, the world recognized that a new level of threat existed. Since then, the United States and the international community have worked together to develop regulations, recommendations, and guidance to address many areas where security was deemed to be insufficient and/or where security improvements were needed. This effort included enhancing requirements for security during the transport of nuclear and other radioactive materials.

At the international level, the IAEA, other international agencies, and many member States of these agencies have worked to develop new requirements, recommendations, and guidance on what is needed to enhance security during the transport of these materials. Support for these efforts from the United States came from many agencies and organizations, including the National Nuclear Security Administration (NNSA) Global Threat Reduction Initiative and various elements of the DOT, NRC, and DOE. As a result, there is now a large body of security requirements, recommendations, and guidelines, as well as security training materials, at the international level.

At the U.S. domestic level, the DOT has issued various new regulations such as 10 CFR Part 172 [1] that specifies requirements for security plans and training for transport of all dangerous goods by all modes. Recently, the NRC has issued transport security requirements for various nuclear and other radioactive materials that are applicable to licensees of the Commission and to licensees of Agreement States [2, 3]. Through DOE M 460.2-1A [6], DOE imposes those DOT and NRC requirements on its shippers.

The proposed training course will draw on materials from applicable, current U.S. and IAEA requirements, recommendations, and guidelines on security for nuclear and other radioactive materials during transport. It will also consider emerging security-related technologies to provide a broad perspective on how shippers should apply technologies to enhance transport security.

SCOPE OF THE COURSE

The training course will address the roles different domestic and international organizations play in establishing transport security provisions. It will cover required and/or recommended security provisions for the transport of all radioactive material, as well as additional requirements that must be met for different materials, including the following:

- Various categories of nuclear material (known internationally as Category I, Category II, Category III, and below Category III nuclear material);
- Category 1 and Category 2 quantities of radioactive materials (known internationally as "radioactive sources");
- Spent nuclear fuel (also called irradiated nuclear fuel, or used nuclear fuel);
- High-level radioactive waste (HLRW); and
- By-product material.

The course also will:

- Address all modes of transport—land (road, rail, and inland waterways), sea (known internationally as "maritime"), and air (covers domestic as well as international shipments; i.e., imports into the U.S., exports from the U.S., and transit through the U.S.).
- Outline, for the transport of all radioactive material, the need for a State (i.e., country) to foster a sound nuclear security regime and methods for effectively implementing a nuclear security culture (responsibility of all organizations involved).
- Identify the need for providing security during transport of nuclear material against unauthorized removal during transport, with the intent to construct a nuclear explosive device.
- Identify the need for providing security during transport of all radioactive materials, including nuclear material, protecting against unauthorized removal for potential dispersal against sabotage.
- Address requirements, recommendations, and guidance for both domestic and international security during the transport of all radioactive material, including nuclear material.
- Employ security levels and security measures specified in relevant domestic and international documents.

Finally, the course will focus on designing an adequate transport security system that:

- Prevents the material from becoming susceptible to malicious acts while in transport;
- Incorporates the concepts of defense in depth and a graded approach; and
- Takes into account:
  - the quantity, physical form, and chemical form of the nuclear and other radioactive material to be transported,
  - the modes of transport (road, rail, water, and air) that are to be used, and
  - the packages that are to be used for the material; and
- Is designed to deter, detect, and delay unauthorized access to address security issues relating to the material in transport as well as during in-transit stopping and storage.

It is assumed that the participants attending the course will have a working knowledge of radioactive material transport safety requirements. Thus, the course will address *only* those safety requirements for transportation that deal with general safety requirements, the types of packages, and the interfaces between safety and security.

OVERVIEW OF U.S. DOMESTIC AND INTERNATIONAL REQUIREMENTS AND GUIDANCE

The following briefly summarizes some of the U.S. requirements and guidance that are covered in the course.

U.S. Domestic Requirements and Guidance

The DOT has issued, in 49 CFR Part 171 [1], regulations addressing requirements and the basis for emergency response information and training requirements. Both of these are relevant to security as well as safety, and for developing, maintaining, and applying TSPs.

The DOT also delineates, in 49 CFR Part 172 [1], detailed requirements for development and implementation of plans to address security for the following Class 7 (radioactive) shipments:

(a) a quantity of uranium hexafluoride (UF_6) requiring placarding,
(b) the IAEA Code of Conduct Category 1 and 2 materials,
(c) Highway Route Controlled Quantities,
(d) NRC-specified radionuclides listed as radioactive materials quantity of concern (RAM-QC), and
(e) specific additional requirements for transport by rail.

In other DOT regulations, additional requirements are delineated for transport of certain radioactive material and other dangerous goods, some of which specify provisions relevant to security. These regulations include:

(a) 49 CFR Part 174 [1] for transport by rail,
(b) 49 CFR Part 175 [1] for transport by air,
(c) 49 CFR Part 176 [1] for transport by water, and
(d) 49 CFR Part 177 [1] for transport by public highway.

The U.S. Coast Guard has promulgated specific requirements for handling dangerous cargoes and for the security of vessels, harbors, and waterfront facilities [16, 17].

In addition, the NRC's recently issued regulations, 10 CFR Parts 37 and 73 [2, 3], and its associated guidance documents [4, 5] also apply to U.S. domestic shipments of nuclear and other radioactive materials. The NRC has also issued modified requirements, some of which relate to transport security, in 10 CFR Parts 20, 30, 32, 33, 34, 35, 36, 39, 51, and 71 [18].

Finally, DOE is developing orders that are anticipated to contain requirements for security similar to those listed above from the DOT, the Coast Guard, and the NRC. DOE already has a manual [6] based on an existing order [19] that specifies requirements for security during transport.

All of these domestic regulations and guidance documents will be covered in the course as they pertain to transport security. The course material will strive to explain how different requirements have changed and are changing with time, such as the DOT requirement for "NRC-specified radionuclides listed as radioactive materials quantity of concern (RAM-QC)," which the NRC no longer uses and is now basically "category 1 and category 2 quantities of radioactive materials."

International Requirements, Recommendations, and Guidance

In parallel with these U.S. domestic efforts, a significant undertaking by the IAEA has resulted in a series of IAEA Nuclear Security Series documents [10] providing recommendations and guidance on security during the transport of nuclear and other radioactive materials. The IAEA, working with various experts, has prepared training materials for two courses: (1) Training for Security during the Transport of All Radioactive Material, and (2) Training for Security during the Transport of Nuclear and Other Radioactive Material. The IAEA is also preparing a master's degree level educational program that includes a transport security element and which will be supplemented by a textbook on that subject. The IAEA course material and textbook have been developed with significant input from, and support of, experts from the United States, including Argonne staff.

These efforts were preceded by issuance of the Convention on the Physical Protection of Nuclear Material (CPPNM) [12], to which the United States is a party. The CPPNM imposes certain requirements on the transport of various categories of nuclear material. The international community has also issued an amendment to the CPPNM [20] which is not yet in effect; it is awaiting ratification by a sufficient number of countries. Once the amendment goes into effect, additional security requirements for the transport of radioactive materials will be in force for those countries party to the amendment.

Shortly after the events of 9/11, the international community, working through the IAEA, developed a Code of Conduct on the Safety and Security of Radioactive Sources [11]. The Code of Conduct is not legally binding, but the United States has agreed to voluntarily follow the recommendations of the Code. To a great extent, 10 CFR Part 37 is structured according to, and goes beyond, the requirements of the Code of Conduct.

Finally, every 2 years, the United Nations Committee of Experts issues an updated version of the "*Recommendations on the Transport of Dangerous Goods*" [21], which is a primary source of recommendations on security that are adopted into national regulations (e.g., in the United States by the DOT), and also become binding upon states party to the Chicago Convention through the ICAO "*Technical Instructions for the Safe Transport of Dangerous Goods by Air*" [7], and to the Safety of Life at Sea (SOLAS) convention through the IMO International Maritime Dangerous Goods Code (IMDG) [8].

The ICAO Technical Instructions and the IMO IMDG Code become binding on U.S. shippers of dangerous goods by air and sea, respectively, since the United States is party to both of those conventions. Chapter 1.4 of the Model Regulations [21] follows a graded approach with respect to the hazard posed by the specific dangerous good being transported; it contains general security provisions that are essentially consistent with the recommendations of the IAEA and the requirements of the CPPNM. Section 7.2.4 of the Model Regulations provides specific additional security provisions for transport by road, rail, and inland waterway.

COURSE CONDUCT

The flow chart in Figure 1 depicts the main topics that will be covered in the transport security training course. The figure illustrates that the course will define the regulatory framework, both domestically and internationally, elaborate on why security during transport is needed, and provide detailed insights into the regulatory requirements set forth in both domestic and international documents. It will also provide examples of how these requirements can be satisfied using guidance documents and experiences with various security-related technologies, and will incorporate methods for participant interaction and appraisal of progress and understanding.

Participants in the training course will gain insight into the security measures needed for transport and in-transit storage in the United States, guidance on how to apply these security measures based on existing NRC and IAEA documents, as well as practical experience in (1) preparing a TSP for specific shipment, (2) performing readiness reviews based on the TSP, (3) identifying corrective actions for deficiencies based on the readiness review, and (4) hands-on exercises applying the ARG-US RFID system to shipments of material requiring a robust set of security measures.

More specifically, the training course will be divided into modules (lectures), in-class discussions, question-and-answer periods, in-class short exercises, practical application team exercises, homework exercises, and a qualifying exam. Short sessions are set aside at the end of each day of the course for recapitulation and discussion of plans for the following day.

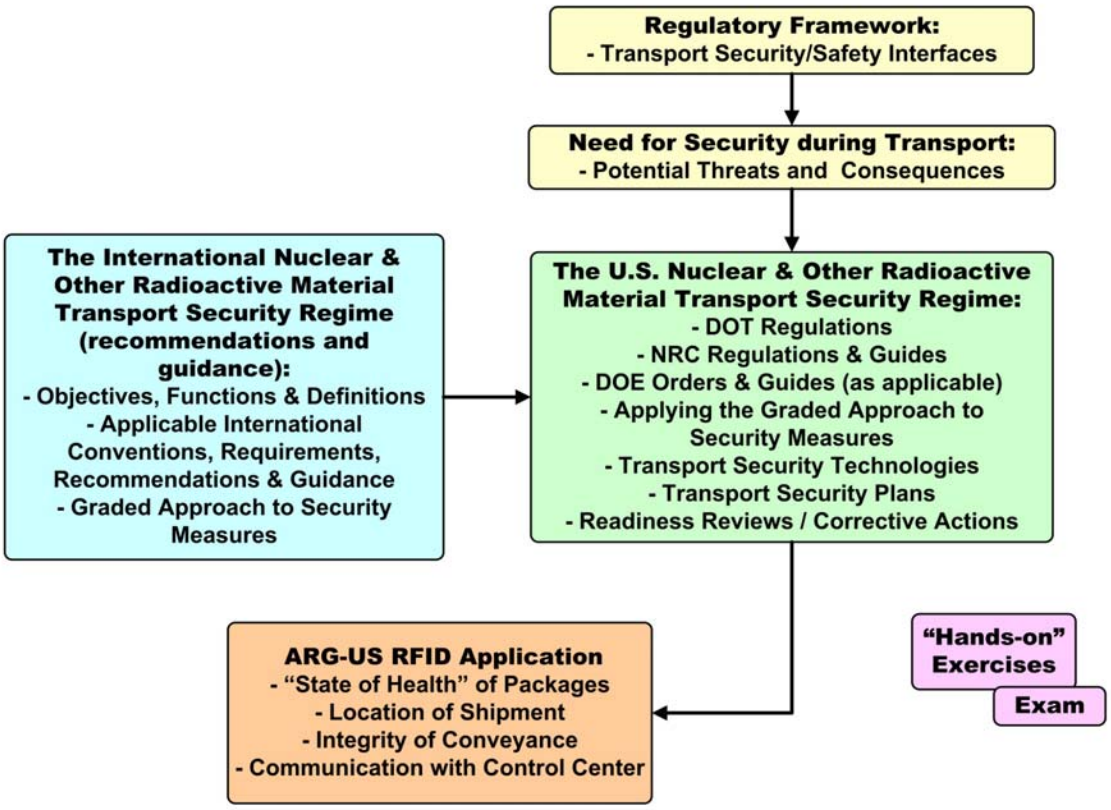

Figure 1. Graphical depiction of transport security training course

COURSE LOCATION

The course will be held at Argonne National Laboratory, Argonne, Illinois, where convenient housing is available at the Argonne Guest House and nearby facilities, with easy access to the lecture hall and the ARG-US training and exercise areas. The first training course on transport security of radioactive materials is scheduled for early December 2013.

COURSE AGENDA

A detailed provisional agenda has been developed for the course. The topics to be covered are listed below.

Day 1

- Introduction/Course Overview
- Background: Domestic and International Transport Safety and Security
- The Need for Transport Security
- Basic Principles and Functions of Transport Security
- Overview of International versus U.S. Domestic Transport Security Requirements, Recommendations, and Guidance
- Overview of International versus U.S. Domestic Transport Security Measures for Radioactive Materials Following the Graded Approach
- Overview of International versus U.S. Domestic Transport Security Measures for Nuclear

Material Following the Graded Approach

- Details of U.S. DOT Hazardous Material Transport Security Requirements
- In-Class Discussion Exercise No. 1: For a given transport scenario, participant groups outline a security system and define security threats for group reports and class critiques.

Day 2

- Details of U.S. NRC 10 CFR Part 37, Transport Security Requirements for By-product Material
- Details of U.S. NRC 10 CFR Part 73, Transport Security Requirements for Special Nuclear Material, Irradiated Nuclear Fuel and HLRW
- Methodologies for Determining Categories for Nuclear Material and Radioactive Material, International versus U.S. Domestic Requirements
- In-Class Discussion Exercise No. 2: Determining Categories for Nuclear Material and Radioactive Material Following U.S. and International Guidelines.
- Transport Security Technologies: Applying the Graded Approach to the Application of Technologies
- In-Class Discussion Exercise No. 3: Determining Security Levels and Relevant Security Measures and Technologies Following U.S. and International Guidelines.
- Comprehensive Review of Security Measures for International Transport
- Review of U.S. NRC Security-Related Regulatory Guides as They Apply to Transport Security
- U.S. DOE/EM Transport Security Requirements for DOE Radioactive Material Other Than Special Nuclear Material

Day 3

- Developing Operational Capabilities for Response Forces along Transport Routes
- Panel: Round-Table Discussion on Ensuring Adequate Response Force Capabilities and Technologies Needed for Proper Command and Control.
- Transport Security Plans (TSPs)
- In-Class Team Exercise No. 1: Development of a Sample TSP
- Plans for Afternoon Session: Questions, Discussion
- Team Presentations of Sample TSP (In-Class Team Exercise No. 1)
- Need for and Structure of Readiness Reviews and Corrective Actions
- Best Practice Guidance on Electronic Tracking for the Transport of Nuclear and Other Radioactive Material
- In-Class Team Exercise No. 2: Development of a Readiness Review Checklist
- Homework Assignment: Teams Discuss Preparation of Readiness Review Checklist for In-Class Team Exercise No. 2 on Day 4.

Day 4

- In-Class Team Exercise No. 2: Development of a Readiness Review Checklist
- Team Presentations of Readiness Review Checklists (In-Class Team Exercise No. 2)
- Overview of ARG-US RFID System for Monitoring and Tracking of Radioactive Material Shipments
- Training on ARG-US RFID System for Monitoring and Tracking of Radioactive Material Shipments

- Demonstration of ARG-US RFID System for Monitoring and Tracking of Radioactive Material Shipments
- Introduction to Hands-on Team Exercise No. 3: Application of ARG-US RFID System and Application of TSP for Performing a Readiness Review and Defining Deficiencies Using the Corrective Action Checklist

Day 5

- Review of Status of Course, Guidance on the Hands-on Team Exercise No. 3
- Staging of Hands-on Team Exercise No. 3: Performing a Readiness Review and Defining Deficiencies Using the Corrective Action Checklist for Mock Shipment of Radioactive Material
- Team Presentations of Hands-on Readiness Review (In-Class Team Exercise No. 3)
- Summary Discussion of Hands-on Exercise No. 3
- Review of Examination Results: Collection of Participant Feedback Surveys
- Presentation of Certificates and Course Closure

POTENTIAL FOR UNIVERSITY GRADUATE-LEVEL CREDIT

An arrangement with U.S. universities is being considered so that participants could obtain college credit after successfully completing the course, as part of the requirements for a graduate certificate program [22].

CONCLUSIONS

Development of a DOE-sponsored training course on transport security of radioactive materials is well underway. The course will draw heavily on materials from applicable current U.S. and IAEA requirements, recommendations, and guidelines on security for nuclear and other radioactive materials during transport, as well as emerging security technologies to provide a broad perspective on how shippers should apply security to the transport of these materials. The course is tailored with information and regulatory documents from the relevant U.S. and international bodies. The objective is to provide comprehensive insights into requirements for shipping nuclear or other radioactive material within the United States, from the United States to another country, from another country to the United States, or transiting the United States from one foreign country to another. The course will include multiple in-class discussions and team exercises on key topics of transport security. Hands-on team exercises on the application of a TSP (with checklists for readiness review and corrective actions) and the ARG-US RFID system are planned for monitoring and tracking of mock-up transportation packaging in a vehicle. These are just some of the unique aspects of the course, which has been designed to enrich the learning of course participants.

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