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MODEL ACADEMIC CURRICULUM IN NUCLEAR SECURITY

DRAFT TECHNICAL GUIDANCE

INTERNATIONAL ATOMIC ENERGY AGENCY

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1. INTRODUCTION

1.1. BACKGROUND

According to Ref. [1], the objective of a State's nuclear security regime is to protect persons, property, society, and the environment from harmful consequences of a nuclear security event." Responsibility rests with the State for meeting this objective by establishing, implementing, maintaining and sustaining a nuclear security regime applicable to nuclear material, other radioactive material, associated facilities and associated activities under a State's jurisdiction.

Such a regime can be facilitated through appropriate training and education at all levels, and in all organizations and facilities involved in nuclear security, to prepare the next generation of professionals with knowledge, expertise and understanding of the importance of nuclear security.

This publication is intended to assist States to develop a model academic curriculum for nuclear security and is complementary to and consistent with the Nuclear Security Recommendations publications:

- Nuclear Security Series (NSS) No. 13 Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5)
- NSS No. 14 Nuclear Security Recommendations on Radioactive Material and Associated Facilities
- NSS No. 15 Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control

The first edition of the current publication, entitled Educational Programmes in Nuclear Security, appeared in 2010. Since that time, the body of knowledge in the field of nuclear security has grown substantially, and the Nuclear Security Series has expanded to cover more topics. The current document, the first revision of this publication, takes into account the IAEA Nuclear Security Series guidance published between 2010 and 2017, as well as feedback from the International Nuclear Security Education Network (INSEN) community and other international experts.

1.2. OBJECTIVE

This publication is intended to provide a model academic curriculum covering the entire spectrum of nuclear security topics for a Master's degree programme or an academic certificate programme in nuclear security.[1]

This guidance is provided for use by university[2] curriculum developers, faculty and instructors from academic and other educational institutions that are implementing or considering educational programmes in nuclear security. It might also be of value to other stakeholders in the educational process in this field, such as decision makers, operators, regulators, law enforcement agencies, other entities responsible for nuclear security and prospective students as an informational resource.

This Model Academic Curriculum in Nuclear Security can also be considered as a resource to facilitate the development by national authorities of a comprehensive national nuclear security human resource development programme with the purpose of developing and maintaining relevant knowledge and skills, and sustaining qualified personnel dealing with current or future nuclear security challenges.

1.3. SCOPE

This Technical Guidance provides a substantive and structural framework for a comprehensive Master's degree programme or academic certificate programme in nuclear security. It is not the intent of this publication to be a substitute for a comprehensive professional training programme in nuclear security.

This curriculum outlines courses and modules that are directly related to nuclear security. It is assumed that students entering a nuclear security graduate programme have obtained prior knowledge and understanding of scientific concepts and principles necessary to successfully complete all academic requirements towards a graduate degree.

[1] A description of the term "nuclear security" can be found in the Nuclear Security Series No. 20 Objectives and Essential Elements of a State's Nuclear Security Regime.

[2] In this publication, the term "university" is taken to mean all higher education establishments accredited by their authorities to grant academic degrees.

All areas of nuclear security as laid out in the IAEA Nuclear Security Series publications are covered by this publication in terms of their contribution to this academic programme, including physical protection of nuclear and other radioactive materials and associated facilities and activities, detection of material out of regulatory control and response to nuclear security events, among other more specific topics.

1.4. STRUCTURE

This publication is divided into four main sections and two Annexes. Section 1 is the introduction. Section 2 describes the structure and possible implementation of the proposed curriculum. Section 3 provides an overview of the recommended Master's programme. Section 4 offers an introduction to the certificate programme. Annex I provides a brief description of each module, respective learning objectives, and an outline of individual modules. Annex II provides an overview of a notional Certificate Programme in Nuclear Security curriculum.

2. ESTABLISHING ACADEMIC CURRICULA IN NUCLEAR SECURITY

The academic curriculum presented in this document is a model that accurately and exhaustively describes the existing body of knowledge in the field of nuclear security at the time of its publication. Institutions and faculty wishing to establish such programmes may choose to use this document in the following ways:

(a) To establish a comprehensive Master's degree programme in nuclear security that encompasses all aspects of the discipline
(b) To establish, or enhance an existing, Master's degree programme in a related discipline with emphasis on nuclear security as a whole, or in part
(c) To offer a specialized diploma or certificate in nuclear security as part of an existing academic programme
(d) To offer a course or module on nuclear security to enhance an existing curriculum

In the remainder of this publication, detailed advice is provided on establishing a Master's of Science degree programme in nuclear security (Section 2) and on establishing a specialized certificate programme in nuclear security (Section 3).[3]

[3] For more general information on establishing academic curricula in the nuclear field, please see IAEA Nuclear Energy Series No. NG-T-6.4 Nuclear Engineering Education: a Competence-Based Approach to Curricula Development, available at http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1626web-52229977.pdf. For a summary of good practices in nuclear education, please see the IAEA Nuclear Energy Series No. NG-T-6.1 Status and Trends in Nuclear Education, available at http://www-pub.iaea.org/MTCD/publications/PDF/P1475_web.pdf.

3. MASTER OF SCIENCE DEGREE PROGRAMME IN NUCLEAR SECURITY

The structure and content of the modules[4] presented in this curriculum are based on the current IAEA Nuclear Security Series guidance and recommendations on nuclear security at the time of this publication, and the experience of implementing graduate degree programmes and courses in nuclear security by institutions-members of the International Nuclear Security Education Network (INSEN).

Given the multidisciplinary nature of the field of nuclear security, the number of universities implementing it in full as outlined in this publication may be fairly small. It will be more useful, therefore, to treat this model curriculum as a comprehensive reflection of the current body of knowledge and expertise in the field of nuclear security, represented here in the form most appropriate for an educational institution to implement in a degree programme.

The following sections outline a model curriculum structure for such a degree programme, notional paths towards a masters' degree in a specialized field, methodology, programme learning objectives, and finally, some issues for universities to consider when implementing such a programme.

3.1. CURRICULUM STRUCTURE

This model curriculum is divided into four sections: prerequisite knowledge; a standalone module NS0. Introduction to nuclear security; core courses; and elective courses. Each of these sections is discussed below.

Prerequisite knowledge

Students participating in a full Masters' of Science degree in nuclear security can be expected to have prior demonstrable knowledge in the following areas:

- NSPR1. Ionizing radiation, safety and radiation protection;
- NSPR2. Methods and instruments for nuclear and other radioactive materials measurements;
- NSPR3. Nuclear energy, nuclear fuel cycle, and nuclear applications; and

[4] The term "module" used in this publication is meant to signify a distinct body of knowledge on a particular topic in nuclear security that can be used to establish a single course within an academic programme, or as a component that can be combined with other similar modules to build a customized course on a broader topic.

— NSPR4. Methods of scientific research.

Universities might include these modules as part of the proposed degree programme in nuclear security, require that incoming students demonstrate relevant competence through previous course work or professional experience, or both.

Standalone module NS0. Introduction to Nuclear Security

This module is designed as an overview of the entire field of nuclear security, presented in a single module that would be suitable for inclusion as an introduction to the field of nuclear security as part of a related academic or degree programme. Examples of such use of this module would include providing students in process of completing a Masters' of Science in Nuclear Engineering or a Master's degree in International Relations with a comprehensive overview of nuclear security in a single course. This course is intended as part of the Master's curriculum introduced in other parts of this document because it provides the same information in a condensed format, and would be otherwise redundant in a comprehensive Master's degree programme on nuclear security. Depending on the nature of the existing academic programme, instructors may wish to emphasize some parts of this module while covering others briefly.

Core modules

With respect to this model curriculum, students participating in a full Masters' of Science programme in nuclear security would be expected to take the following core courses:

— NSC1. International and national legal, regulatory and institutional framework for nuclear security;
— NSC2. Risk-informed approach to nuclear security;
— NSC3. Coordination and cooperation of stakeholders at national and international level;
— NSC4. Nuclear security management at facility level;
— NSC5. Security of sensitive nuclear information;
— NSC6. Nuclear security culture;
— NSC7. Threat assessment;
— NSC8. Physical protection systems design and evaluation;
— NSC9. Physical protection technologies and equipment;

— NSC10. Use of nuclear material accounting and control for nuclear security (NMAC);
— NSC11. Preventing and protecting against insider threat;
— NSC12. Security of nuclear and other radioactive material in transport;
— NSC13.Computer security for a nuclear world;
— NSC14. Detection of criminal or unauthorized acts involving nuclear and other radioactive material out of regulatory control; and
— NSC15. Response to criminal or unauthorized acts involving nuclear and other radioactive material out of regulatory control.

Elective modules

Elective courses are designed to supplement the core courses with specialized knowledge in various areas of nuclear security. The selection of elective courses by the student or the institution may depend on the student's choice to specialize in a particular area of nuclear security or on the design of the academic programme by the institution. This list of elective courses could be supplemented by the university or instructor to include other courses relevant to the degree programme.

These elective courses include:

— NSE1. Interfaces of nuclear security with safety and safeguards;
— NSE2. Legal drafting for nuclear security;
— NSE3. International cooperation on nuclear security;
— NSE4. Developing and implementing Design Basis Threat (DBT);
— NSE5. Vulnerability assessment of physical protection systems;
— NSE6. Nuclear security culture assessment and enhancement;
— NSE7. Designing physical protection systems for nuclear and radiological facilities;
— NSE8. Nuclear material accounting and control for nuclear power plants and research reactors;
— NSE9. Nuclear material accounting and control for facilities that process nuclear material;
— NSE10. Establishing and implementing a transport security plan;
— NSE11. Designing and implementing a national detection architecture (NDA);
— NSE12. Import/export and transit control mechanism and regime;

— NSE13. Nuclear security framework for major public events;
— NSE14. Radiological crime scene management;
— NSE15. Nuclear forensic analysis;
— NSE16. Information/computer security incident response; and
— NSE17. Conducting computer security assessments.

Table 1 outlines the approximate percentage distribution of various types of learning module clusters within a degree programme. These percentages have also been aligned with two common types of academic credit calculation systems found in several parts of the world: the North American credit hour system and the European Credit Transfer and Accumulation System (ECTS). For convenience, a column with estimated student work hours spent on each component of the programme is also provided. The information in the table is not prescriptive, is only meant to provide approximate values of dedicated workload, and can be interpreted by universities designing their degree programmes according to their actual need.

TABLE 1. APPROXIMATE PERCENTAGE DISTRIBUTION OF VARIOUS TYPES OF LEARNING MODULE CLUSTERS WITHIN A MASTER'S DEGREE PROGRAMME.

Courses		**Percentage value of total degree workload**	**Bologna process ECTS**	**US credit hour system**	**Estimated contact hours**	**Estimated total student workload hours**
Core	**Protection**	20	24	7	160	500
	Detection & Response	15	18	4	120	300
	Overlapping topics	20	24	7	160	500
Electives		25	30	8	200	600
Thesis/Final project		20	24	6	160	500
Totals		100	120	33	800	2400

Figure 1 below represents a graphical outline of the structure of the proposed Master's programme curriculum.

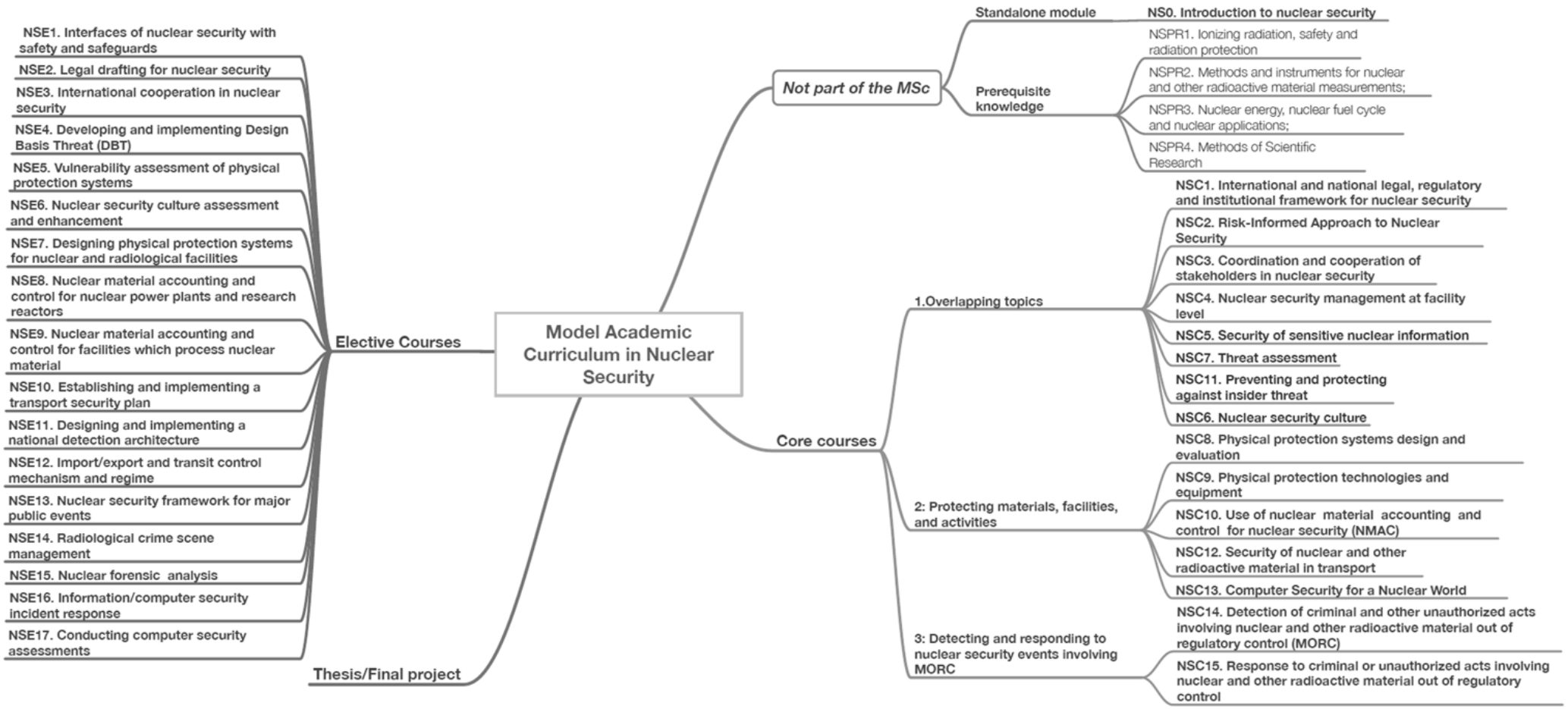

FIG. 1. Structure of the model academic curriculum in nuclear security.

3.2. NOTIONAL PATHS TOWARDS A MASTER'S DEGREE IN NUCLEAR SECURITY IN A SPECIALIZED FIELD

One of the biggest challenges that universities have to overcome on their path towards establishing a new degree programme is to verify that there is long-term demand for graduates with the degree in the proposed discipline, which the job market analysis demonstrates. Given the diversity of educational systems around the world, and of the mechanisms used to evaluate and analyse such demand,[5] it would be impossible for this publication to offer an exact formula that universities can follow to design and implement a successful and, more importantly, sustainable degree programme in nuclear security. Procedures for evaluating, establishing and analysing the need, and then designing and implementing a new degree programme to address it, may be too prolonged and cumbersome for many universities to undertake. Even if universities succeeded in this first step, the proposed curriculum must then be approved and periodically accredited by a government authority or a professional accreditation body, which frequently results in the timeline of establishing such new degree programmes spanning 5 to 10 years.

Instead, many institutions choose a much more flexible path of incorporating the topic of nuclear security, in some format, into the already existing degree programmes that are relevant to nuclear security. This publication proposes a set of notional career pathways towards a degree in one of several commonly-found academic programmes offered by universities worldwide, in which a specialization in nuclear security may be appropriate.

Another factor in favour of a flexible approach to incorporating nuclear security into degree programmes is the multidisciplinary nature of nuclear security as a field of study. Implementation of a comprehensive Master's degree in nuclear security requires input and participation of faculty and experts from a multitude of disciplines, faculties, departments and sometimes even universities. In addition, practical applications of knowledge and expertise received in the course of a Master's degree in nuclear security can be quite broad. Therefore,

[5] National approaches to evaluating and analyzing national needs for graduates with a Master's degree in nuclear security may range from government assessment of the national needs in human resources in nuclear security, which may translate into state funding for establishing and implementing a dedicated degree programme, to a market-based mechanism, in which educational institution make assessment on the basis of a job-market analysis and prospects for the increased student demand for degrees in a specific discipline. In reality, a combination of a number of approaches usually exists within a country.

a more targeted and concentrated programme, utilizing the existing degree framework available in the university and tailored to a specific target group of potential students is likely to be more sustainable.

There exist a range of possible broad areas of expertise and ultimate career paths for students that university officials and faculty members may wish to take into consideration when making decisions about establishing nuclear-security-specific degree programmes within their academic curricula. A clear awareness of these areas of expertise and ultimate career paths may:

(a) Enable university faculty, curriculum developers and administrators to design a programme that best fits the university's existing programmes;
(b) Be used in promotional materials developed by these universities to attract students into the programme; and
(c) Be used by prospective students in making informed decisions about pursuing a career in nuclear security, especially broadening the scope of such a choice for them in situations when nuclear security is frequently assumed to be an exclusively technical field of study.

Figure 2 provides a graphical representation of a range of potential areas of expertise and ultimate career paths relevant to nuclear security.

Table 2 provides a cross-reference of these areas of expertise with relevant core and elective courses as well as potential thesis projects. This table could be used as a tool by university faculty and curriculum developers in designing a programme that merges the existing degree programme with the both the core and elective modules of the proposed model curriculum.

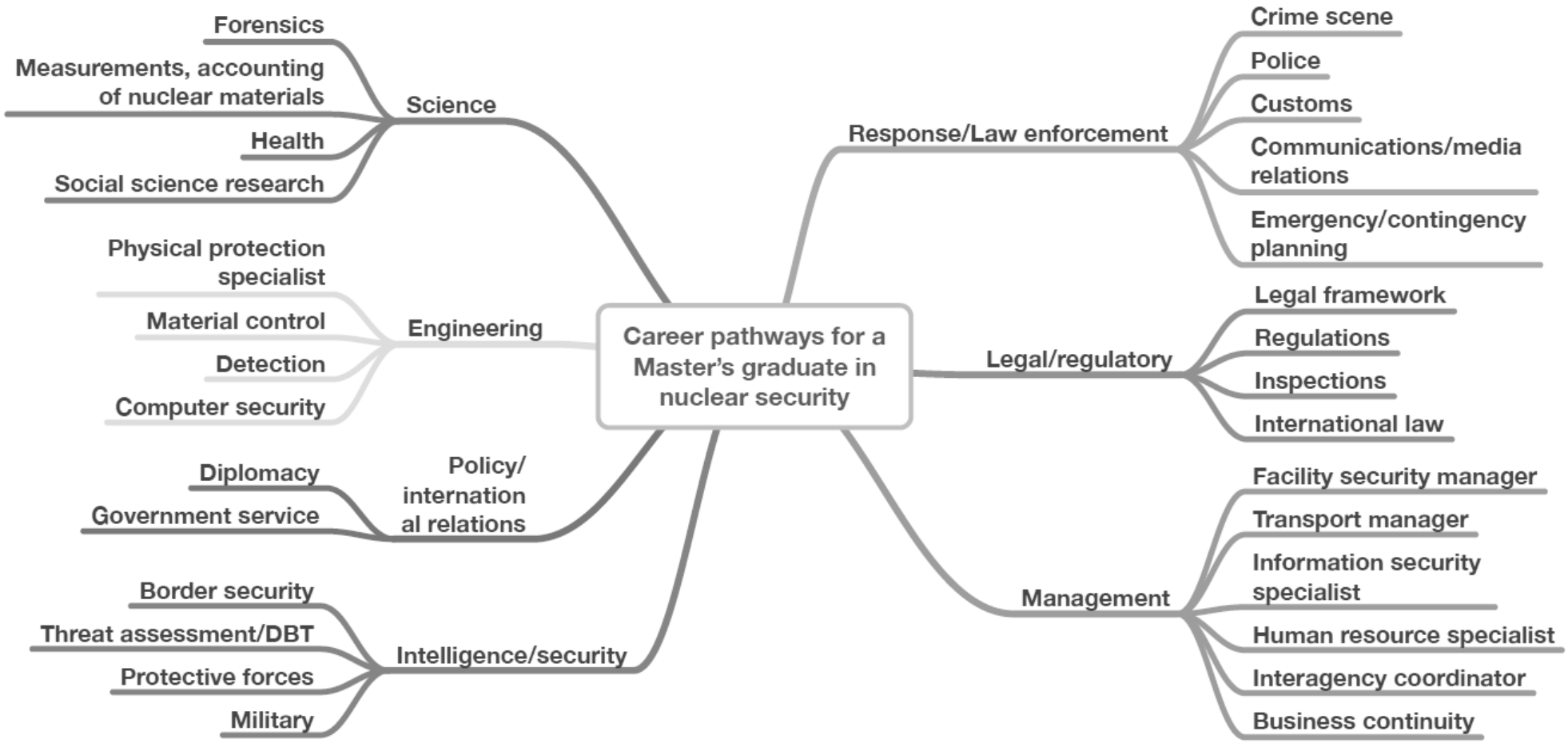

FIG. 2. Notional career pathways for a graduate of the Master's degree programme in nuclear security.

TABLE 2. NOTIONAL PATHS TOWARDS A MASTER'S DEGREE IN NUCLEAR SECURITY AS PART OF A SPECIALIZED FIELD, WITH RECOMMENDED ELECTIVE MODULES

Areas of Expertise	Recommended core modules (55%)	Recommended elective modules (25%)	Recommended thesis/ final project (20%)
Engineering	It is recommended that institutions offering a Master's degree in nuclear security should include all core modules in their curriculum, regardless of the main discipline under which the programme is offered. It would be advisable, however, to balance the load (percentage) of each core module with the intended focus of the programme.	NSE4. Developing and Implementing Design Basis Threat (DBT) NSE5. Vulnerability assessment NSE7. Designing Physical Protection Systems for Nuclear and Radiological Facilities NSE11. Designing and Implementing a National Detection Architecture (NDA) NSE16. Information/Computer Security Incident Response NSE17. Conducting computer security assessments	Optional thesis (for MSc) or final paper/project (for MEng)
Legal/ Regulatory		NSE1. Interfaces of nuclear security with safety and safeguards NSE2. Legal drafting for nuclear security NSE3. International cooperation in nuclear security NSE12. Import/export and transit control mechanism and regime	Thesis/essay
Science		NSE15. Nuclear forensic analysis	Thesis
Policy/International relations		NSE1. Interfaces of nuclear security with safety and safeguards NSE2. Legal drafting for nuclear security NSE3. International cooperation in nuclear security	Thesis for MA; Qualifying exams/Final project for terminal degrees

Areas of Expertise	Recommended core modules (55%)	Recommended elective modules (25%)	Recommended thesis/ final project (20%)
Response/Law enforcement		NSE10. Establishing and Implementing a Transport Security Plan NSE12. Import/export and transit control mechanism and regime NSE13. Nuclear security framework for major public events NSE14. Radiological crime scene management NSE15. Nuclear forensics analysis	Thesis for MA/MSc
Management		NSE1. Interfaces of nuclear security with safety and safeguards NSE3. International cooperation in nuclear security NSE6. Nuclear Security Culture Assessment and Enhancement NSE7. Designing Physical Protection Systems for Nuclear and Radiological Facilities NSE10. Establishing and Implementing a transport security plan NSE11. Designing and Implementing a National Detection Architecture (NDA)	Thesis for MA/MSc; MBA
Intelligence/ security		NSE1. Interfaces of nuclear security with safety and safeguards NSE3. International cooperation in nuclear security NSE4. Developing and implementing Design Basis Threat (DBT) NSE5. Vulnerability assessment NSE10. Establishing and Implementing a Transport Security Plan NSE13. Nuclear security framework for major public events NSE17. Conducting computer security assessments	Thesis for MA/MSc

3.3. METHODOLOGY

In the majority of universities, students are required to be present physically at the universities for lectures, practical exercises and examinations in order to complete graduate degree programmes. There are several factors that make a degree programme in nuclear security a special case, in which the students may not need to be physically present to complete the programme:

(a) The complexity and the multidisciplinary nature of the field of nuclear security, which may require coordination with other departments or instructors;
(b) The availability of technical experts, who may be invited from outside, and who may not be able to accommodate the traditional academic calendar, resulting in the need to offer course content in short 1-2 week long modules.;
(c) The fact that most potential students into the Master's programme in nuclear security may come from the nuclear profession, and are likely already engaged in a full-time career in their field; and
(d) The reality that availability of degree programmes in nuclear security locally or even regionally may be fairly low, requiring students and employers to look for educational opportunities globally.

These challenges are not unique to nuclear security education. To address them in similar situations, many universities offer graduate degree programmes to early- to mid-career professionals that accommodate their limitations with respect to time available and ability to be physically present at the university. Such programmes utilize fully innovations in computer and information technologies, virtual reality, videoconferencing, social media, and other methods of delivering and exchanging information. Some universities offer so-called blended learning options, which include various types of long distance learning, short-term visits to the main campus for examinations and/or practical or laboratory work, various consortia and other arrangements among universities to offer joint degrees and provide recognition of credits and other options. Universities that plan to develop and offer nuclear

security education programmes may wish to consider all of these proven and sustainable possibilities for establishing their programmes.[6]

3.4. PROGRAMME LEARNING OBJECTIVES

Upon completion of a Master's degree programme in nuclear security, graduates should be expected to have at least the following professional attributes:

(a) Conceptual understanding of a national nuclear security regime, its objectives, components, systems and their interaction, as well as measures necessary to establish and sustain it;
(b) Knowledge and understanding of the principles, assumptions, tools and equipment for protecting nuclear materials as well as other radioactive materials, associated facilities, computers and networks, activities and related information;
(c) Awareness and appreciation of the threats posed by nuclear and other radioactive materials out of regulatory controls as well as knowledge of the tools necessary to address them at the national level;
(d) Recognition of the importance of human factor in nuclear security, including security culture and the insider threat;
(e) Awareness and comprehension of international legal framework related to nuclear security, as well as relevant national laws, regulations and procedures; and
(f) Ability to creatively apply the above-listed concepts, attributes, and scientific methods to find and implement solutions to nuclear security challenges at all levels.

3.5. CHALLENGES TO CONSIDER

The universities planning to establish educational programmes in nuclear security, in addition to curriculum development, might need to address two important challenges. The first one is the availability of qualified instructors to cover most, if not all, areas of nuclear security. This issue can be addressed through various options outlined above for different teaching methodology approaches. In addition, the INSEN network serves as an important forum for

[6] A number of INSEN member universities have established and implemented various options described in this section. More detailed and up-to-date information can be obtained from the IAEA Secretariat (Division of Nuclear Security), or an INSEN university in your country.

information exchange, sharing of experience, resources, and good practices in nuclear security education, and faculty development courses, developed and offered by more experienced institutions and academics.

The second challenge is the availability of well-equipped laboratories that are available to be used in the educational settings. Most suitable for this task would be laboratories already available in the department of nuclear physics or engineering. However, few of them have specialized equipment and tools that a comprehensive educational programme in nuclear security may require. One of the options that could help universities address this challenge may be partnering with a national or regional Nuclear Security Support Centre, when available, which in some cases possess a comprehensive inventory of equipment for training needs. In that regard, coordination and cooperation between INSEN and the International Network of Nuclear Security Training and Support Centres becomes an important mechanism to address this challenge.

4. CERTIFICATE PROGRAMME IN NUCLEAR SECURITY

An academic certificate in nuclear security is distinct from a training course in that it is not aimed at teaching the participants a particular skill or to convey the knowledge and expertise on how to perform a certain function as part of their job in the area of nuclear security. Rather, such a programme may be an option for universities and other educational institutions to offer specialized knowledge in this field to students currently enrolled in a degree programme, or to adult learners as a graduate certificate or diploma additional to their existing academic credentials.[7]

It is important, in this context, to differentiate also between an academic certificate and professional certification. In the former, students are provided with a body of knowledge in a field that is generally relevant to their main area of study in order to enhance their overall knowledge with a specialized subject. The latter, on the other hand, offers a professional certification, which is recognized by a government, or a professional accreditation or certification organization, as required for the recipient to perform professional services in that field. An example of such certification would be a license to handle radioactive, explosive, toxic or other hazardous materials. Such certification would invariably be tied to the expected knowledge, skills, and experience expected of, as well as job tasks assigned for, a professional in the field in question.

This publication offers a model outline of a certificate in nuclear security, which a university may use to establish in order to enhance the range of educational services that it offers to students. Fully recognizing that many universities and educational systems treat such programmes differently, and may assign different value to the final certificate, it is not the goal of this publication to provide a standard name for this programme, outline the duration or a number of academic hours necessary for its completion or to specify other requirements that universities may wish to impose on the students. Rather, this publication summarizes the body of knowledge that constitutes nuclear security in terms most appropriate to those of a certificate programme curriculum.

[7] For an example of academic certificate programmes offered by a university, see Graduate Certificates, Harvard Extension School, Harvard University, Boston, MA, USA, https://www.extension.harvard.edu/academics/graduate-certificates.

For an outline of a notional certificate programme in nuclear security, please see Annex II.

ANNEX I:
RECOMMENDED MODULES FOR A MASTER OF SCIENCE ACADEMIC CURRICULUM IN NUCLEAR SECURITY

Where appropriate, practical/laboratory exercises are listed and reference publications are recommended. The references are not exhaustive since they are for the most part limited to relevant international legal instruments (conventions, treaties, resolutions of the UN Security Council, etc.), the IAEA guidance and recommendations as part of the Nuclear Security Series, and similar publications and resources. This allows university curriculum developers from different countries to recommend any other national or international publications considered relevant to course topics.

I-1. PREREQUISITE KNOWLEDGE

To have a full awareness of the importance, scope, principles, design, and implementation of nuclear security measures at various levels, to apply scientific methods in the course of the Master's programme, and ultimately to succeed in this programme, prospective students should have a prior basic understanding of radiation, nuclear fuel cycle, detection and measurements, and scientific research methodology. The purpose of this section is to point to the importance and outline the tentative scope of this prerequisite knowledge. This prerequisite knowledge is represented in proposed modules listed below. These modules provide an introduction to the concepts and principles of ionizing radiation, nuclear safety and radiation protection, methods and instruments for nuclear materials measurement, basics of nuclear energy, fuel cycle, and applications, as well as methods of scientific research.

While these modules are very important to the overall context of the Master's degree in nuclear security, their content covers issues broader than the field of nuclear security, and they are therefore specifically excluded from the recommended model curriculum. Another reason for this exclusion is the fact that many universities have only limited time and number of academic modules which they are able to include into a comprehensive Master's programme. They rely instead on the prospect students' prior academic work in an undergraduate programme, which provides them with the basic scientific knowledge necessary to succeed in a specialized graduate field of study.

It is assumed that a university would ultimately make a decision about the format, scope and level at which this knowledge should be demonstrated by the applicant, as well as whether to offer these modules as part of the planned Master's degree curriculum or require their completion beforehand. Consequently, no outline for these modules is provided as it is assumed that their content (either offered or required) will be determined by the university.

Recommended prerequisite modules:

NSPR1. Ionizing radiation; safety and radiation protection
NSPR2. Methods and instruments for nuclear and other radioactive material measurements
NSPR3. Nuclear energy, nuclear fuel cycle, and nuclear applications
NSPR4. Methods of scientific research

I-2. STANDALONE MODULE

NS0. Introduction to nuclear security

A. Learning objectives

Upon successful completion of this module, students should be able to:

- describe nuclear security main concepts and approaches, using appropriate terminology
- discuss interrelationship of nuclear security with safety and safeguards
- list the essential elements of a state's nuclear security regime
- demonstrate the importance of nuclear security

B. Short description

This is an introductory standalone course designed for inclusion into academic curricula where the primary focus is not nuclear security. It focuses on the basic elements of nuclear security, examines methods for planning, implementing, and evaluating nuclear security activities at the State and facility level, and establishing nuclear security culture and information and computer security measures at different types of nuclear and radiological facilities.

C. Main topics

1. Introduction of nuclear security, its international legal framework and related institutions
   1.1. Goals and objectives
   1.2. Basic definitions
   1.3. Interrelationships of safety, security and safeguards
   1.4. Essential elements of nuclear security
   1.5. Responsibility of the State for nuclear security
   1.6. International binding and non-binding legal instruments
   1.7. International guidance and recommendations on nuclear security
   1.8. International institutions and cooperation
2. Risk-informed approach to nuclear security
   2.1. Concept and assessment of threat
      2.1.1. Nuclear threat throughout history

2.1.1.1. Distinction between threat of nuclear war, and terrorist and other criminal activities involving nuclear material

2.1.1.2. Evolution and assessment of threat throughout 20th and 21st century

2.1.1.3. Concepts, models and instruments of threat assessment

2.1.2. Attributes of potential adversaries

2.1.2.1. Motives and goals

2.1.2.2. Capabilities

2.1.2.3. Opportunities

2.1.2.4. Tactics and methods

2.1.2.5. Resources

2.1.2.6. Examples of adversaries

2.1.2.7. Insider vs outsider threat

2.1.3. Assessment of threats, vulnerabilities and consequences

2.2. Identification and assessment of potential targets and consequences

2.2.1. Four main nuclear and radiological security event scenarios

2.2.1.1. Theft of nuclear weapon;

2.2.1.2. Acquisition of nuclear material and development of an Improvised Nuclear Device (IND);

2.2.1.3. Sabotage of a nuclear facility or transport;

2.2.1.4. Development of a Radiation Dispersal Device (RDD) and/or Radiation Emission Device (RED).

2.2.2. Potential targets

2.2.2.1. Nuclear facilities

2.2.2.2. Facilities using radioactive sources

2.2.2.3. Nuclear activities (e.g., transport)

2.2.3. Nuclear security as part of broader CBRN spectrum

3. Management of nuclear security

3.1. Coordination and cooperation of stakeholders at national and international level

3.1.1. International coordination and cooperation

3.1.2. Interagency coordination and cooperation at the national level

3.1.3. Industry engagement

3.1.4. Communication with the public

3.2. Nuclear security management at facility level

3.3. Information security

3.4. Human factor in nuclear security

3.4.1. Nuclear security culture: concept, assessment and enhancement

3.4.2. Preventing and protecting against insider threat

3.4.2.1. Trustworthiness and reliability programmes

3.4.3. Human resource development and management

4. Protecting materials, facilities, and activities

4.1. Principles and systems for physical protection of a nuclear/radiological facility

4.1.1. Creating a visible security policy;

4.1.2. Clear roles and responsibilities;

4.1.3. Physical protection systems;

4.1.3.1. Design basis threat;

4.1.3.2. Physical protection principles, design and evaluation;

4.1.3.3. Physical protection equipment

4.1.3.4. Response measures and communication in the event of alarms;

4.1.4. Contingency plans and drills.

4.2. Nuclear material accounting and control for nuclear security

4.2.1. Differences between international and domestic NMAC programs

4.2.2. NMAC role in the use, storage, and processing of nuclear materials, and protecting against insiders and outsiders

4.2.3. Managing the NMAC system

4.2.3.1. Organization and structure

4.2.3.2. Roles and responsibilities

4.2.3.3. Quality control

4.2.4. Nuclear material accounting

4.2.4.1. Material balance areas

4.2.4.2. Physical inventory taking of nuclear material

4.2.4.3. Inventory difference accounting

4.2.4.4. Record keeping practices

4.2.5. Nuclear material controls

4.2.5.1. Two-person rule

4.2.5.2. Tamper-indicating devices

4.2.5.3. Physical protection measures for control

4.2.5.4. RPMs and other detection devices

4.2.5.5. Administrative checks

4.2.6. Movement of Nuclear Materials

4.2.6.1. Shipment, receipts, shipper-receiver differences, transfers and relocations

4.2.7. Inventory Control of other Radioactive Material

4.2.7.1. Prudent management practice

4.2.8. Measurements

4.2.8.1. Destructive analysis

4.2.8.2. Non-destructive analysis

4.2.8.3. Measurement statistics and measurement quality control

4.2.9. Detection, investigation, and resolution of Anomalies and irregularities

4.2.10. Assessment and performance testing of the NMAC system

4.3. Security of Nuclear and Other Radioactive Material in Transport

4.3.1. Security of the transport of nuclear materials

4.3.1.1. Objectives and elements of efforts to secure transport of nuclear material

4.3.1.2. Characterization of Nuclear Material for the Application of Security in Transport

4.3.1.3. Physical Protection Regimes for the Transport of Nuclear Materials

4.3.1.4. Measures Against Unauthorized Removal of Nuclear Material in Transport

4.3.1.5. Locating and Recovering Nuclear Material Missing or Stolen During Transport

4.3.1.6. Protecting and Mitigating consequences of Sabotage of Transport

4.3.2. Security of the Transport of Other Radioactive Material

4.3.2.1. Design and Evaluation of Security Measures

4.3.2.2. Security Levels of Other Radioactive Material in Transport

4.3.2.3. Security Measures in the Transport of Other Radioactive Material

5. Detecting and Responding to Nuclear Security Events Involving Material out of Regulatory Control

5.1. Prevention and detection of criminal or unauthorized acts involving nuclear and other radioactive material out of regulatory control

5.1.1. Preventive measures

5.1.2. Detection architecture

5.1.3. Detection by instruments

5.1.4. Information alerts

5.1.5. Initial assessment

5.1.6. Sustainability

5.2. Response to criminal or unauthorized acts involving nuclear and other radioactive material

5.2.1. Assessment of alarms and alerts

5.2.2. Notification of a nuclear security event

5.2.3. Collection and handling of evidence

5.2.4. Nuclear forensics

5.2.5. National response plan

5.2.6. Preparedness

5.2.7. Sustainability

6. Computer security

6.1. Introduction to Computer Security Concepts

6.2. The Cyber Threat

6.3. Computer Security Policy, Programme, and Regulation

6.4. Computer Security Controls in Depth

6.5. The Cyber Insider Threat

6.6. Network Security Basics

6.7. Introduction to Malware and Exploits

6.8. Industrial Control Systems (ICS)

6.9. Security Culture and the Impact of the Human

6.10. Conducting Computer Security Assessments

6.11. Risk Assessment and Management

6.12. Computer Security Management

6.13. Computer Security Incident Response

D. Exercises

Exercises from other respective courses in this curriculum can be used in this module.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

IAEA Publications:

IAEA Nuclear Security Series No. 20 Objective and Essential Elements of a State's Nuclear Security Regime, 2013

IAEA Nuclear Security Series No. 13 Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5), 2011

IAEA Nuclear Security Series No. 14 Nuclear Security Recommendations on Radioactive Material and Associated Facilities, 2011

IAEA Nuclear Security Series No. 15 Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control, 2011

Code of Conduct on the Safety and Security of Radioactive Sources, IAEA/CODEOC/2001, IAEA, Vienna (2001).

IAEA Nuclear Security Series No. 2-G Nuclear Forensics in Support of Investigations, 2015

IAEA Nuclear Security Series No. 7 Nuclear Security Culture, 2008

IAEA Nuclear Security Series No. 8 Preventive and Protective Measures Against Insider Threats, 2008

IAEA Nuclear Security Series No. 9 Security in the Transport of Radioactive Material, 2008

IAEA Nuclear Security Series No. 10 Development, Use and Maintenance of the Design Basis Threat, 2009

IAEA Nuclear Security Series No. 11 Security of Radioactive Sources, 2009

IAEA Nuclear Security Series No. 18 Nuclear Security Systems and Measures for Major Public Events, 2012

IAEA Nuclear Security Series No. 19 Establishing the Nuclear Security Infrastructure for a Nuclear Power Programme, 2013

IAEA Nuclear Security Series No. 21 Nuclear Security Systems and Measures for the Detection of Nuclear and Other Radioactive Material out of Regulatory Control, 2013

IAEA Nuclear Security Series No. 22-G Radiological Crime Scene Management, 2014

IAEA Nuclear Security Series No. 23-G Security of Nuclear Information, 2015

IAEA Nuclear Security Series No. 24-G Risk Informed Approach for Nuclear Security Measures for Nuclear and other Radioactive Material out of Regulatory Control, 2015

IAEA Nuclear Security Series No. 25-G Use of Nuclear Material Accounting and Control for Nuclear Security Purposes at Facilities, 2015

IAEA Nuclear Security Series No. 26-G Security of Nuclear Material in Transport, 2015
IAEA Nuclear Security Series No. 16 Identification of Vital Areas at Nuclear Facilities, 2012

IAEA Nuclear Security Series No. 17 Computer Security at Nuclear Facilities, 2011

IAEA Nuclear Security Series No. 6 Combating Illicit Trafficking in Nuclear and Other Radioactive Material, 2007

Other documents:

International Convention for the Suppression of Acts of Nuclear Terrorism, A/59/766, United Nations, New York (2005). Nuclear Verification and Security of Material, Physical Protection Objectives and Fundamental Principles, GOV/2001/41, IAEA, Vienna (2001).

UNITED NATIONS, Non-proliferation of Weapons of Mass Destruction, United Nations Security Council S/RES/1540, United Nations, New York (2004).

UNITED NATIONS, Security Council Resolution 1373, United Nations, New York (2001).

The Convention on the Physical Protection of Nuclear Material, INFCIRC/274/Rev.1, IAEA, Vienna (1980).

Amendment to the Convention on the Physical Protection of Nuclear Material, GOV/INF/2005/10-GC(49)/INF/6, IAEA, Vienna (2005)

I-3. CORE MODULES

NSC1. International and national legal, regulatory and institutional framework for nuclear security

A. Learning objectives

Upon successful completion of this module the students will be able to:

- Demonstrate understanding of the state responsibility for nuclear security as the basic principle
- Demonstrate the knowledge of the international legal binding and non-binding instruments related to nuclear security
- Know the principal international and national organizations and other entities engaged in nuclear security, and the role they play
- Know the scope of international guidance and recommendations related to nuclear security
- Demonstrate the understanding of the national regulatory infrastructure related to nuclear security

B. Short description

This course is designed to introduce students to the international and national legal, regulatory, and institutional framework for nuclear security. It will address the issues of state responsibility for nuclear security, focus on the existing multilateral treaties and conventions, resolutions of the UN Security Council, IAEA guidance and recommendations related to nuclear security, as well as national legal and regulatory principles and practices. It will also provide an overview of the existing international organizations, institutions, and initiatives related to nuclear security.

C. Main topics

1. The role of law in implementing nuclear security
    1.1. International law
        1.1.1. Introduction to International Legal Framework for Nuclear Security
        1.1.2. Development of International Legal Framework for Nuclear Security

1.1.3. Overview of the International Institutional Framework related to Nuclear Security

1.1.4. Overview of the International Instruments

1.2. National law

1.2.1. Nuclear Security Regime: Objective and Essential Elements

1.2.2. Overview of the National Legal Framework for Nuclear Security

2. Legally binding international instruments

2.1. Treaty-based obligations

2.1.1. The Convention on the Physical Protection of Nuclear Material (CPPNM)

2.1.2. The 2005 Amendment to the CPPNM

2.1.3. International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT)

2.1.4. Other multilateral treaties relevant to nuclear security

2.2. Other legally binding obligations

2.2.1 UNSCR 1540

2.2.2 UNSCR 1373

2.2.3 UNSCR 1970

3. Other relevant treaty-based obligations

3.1. The Convention on the Early Notification of a Nuclear Accident

3.2. Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency

4. Legally non-binding international instruments

4.1. The Code of Conduct on the Safety and Security of Radioactive Sources

4.2. Guidance on the Import and Export of Radioactive Sources

5. IAEA guidance and recommendations

5.1. Fundamentals (NSS 20)

5.2. Recommendations (NSS 13-15)

5.3. Implementing guides

5.4. Technical guidance

6. The International institutional framework

6.1. International Atomic Energy Agency

6.2. Other international agencies and organizations

6.3. Multilateral initiatives

7. National framework
    7.1. National legal framework for nuclear security
    7.2. Codification of international commitments in national law
    7.3. Allocation of responsibilities
    7.4. Regulatory authority and nuclear security-related regulations
    7.5. Responsibilities of other agencies and stakeholders
    7.6. Establishing licensing requirements and penalties for violations (administrative and criminal)
    7.7. Enforcement

D. Exercises

No exercises are proposed for this module.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

Communication Received from Certain Member States Regarding Guidelines for the Export of Nuclear Material, Equipment and Technology, INFCIRC254/Rev. 6/Part 2 and Rev. 7/Part 1, IAEA, Vienna (2005).

Communication Received from Members Regarding the Export of Nuclear Material and of Certain Categories of Equipment and other Material, INFCIRC/209/Rev. 1, IAEA, Vienna (1990).

Convention on International Civil Aviation 1944 (The Chicago Convention), 8th Edition, ICAO, Montreal.

INTERNATIONAL ATOMIC ENERGY AGENCY, Code of Conduct on the Safety and Security of Radioactive Sources, IAEA/CODEOC/2001, IAEA, Vienna (2001).

INTERNATIONAL ATOMIC ENERGY AGENCY, Guidance on the Import and Export of Radioactive Sources, IAEA, Vienna (2005).

INTERNATIONAL ATOMIC ENERGY AGENCY, Handbook on Nuclear Law, IAEA, Vienna (2003).

INTERNATIONAL ATOMIC ENERGY AGENCY, Statute of the International Atomic Energy Agency, IAEA, Vienna (1957, as amended up to 14 August 2007).

International Convention for the Suppression of Acts of Nuclear Terrorism, A/59/766, United Nations, New York (2005).

Nuclear Verification and Security of Material, Physical Protection Objectives and Fundamental Principles, GOV/2001/41, IAEA, Vienna (2001).

INTERNATIONAL MARITIME ORGANIZATION, International Maritime Dangerous Goods Code, including Amendment 30-00, 2000 Edition, IMO, London (2000).

Model Protocol Additional to the Agreement(s) between State(s) and the International Atomic Energy Agency for the Application of Safeguards, INFCIRC/540 (Corrected), Vienna (1997).

Nuclear Security — Measures to Protect against Nuclear Terrorism, Amendment to the Convention on the Physical Protection of Nuclear Material, Report by the Director General, GOV/INF/2005/10-GC(49)/INF/6, IAEA, Vienna (2005).

Physical Protection of Nuclear Materials: Experience in Regulation, Implementation and Operations (Proc. Int. Conf. Vienna, 1997), IAEA, Vienna (1998).

The Convention on the Physical Protection of Nuclear Material, INFCIRC/274/Rev.1, IAEA, Vienna (1980).

Amendment to the Convention on the Physical Protection of Nuclear Material, GOV/INF/2005/10-GC(49)/INF/6, IAEA, Vienna (2005)

Treaty on the Non-Proliferation of Nuclear Weapons, IAEA, INFCIRC/140, IAEA, Vienna (1970).

UNITED NATIONS, Non-proliferation of Weapons of Mass Destruction, United Nations Security Council S/RES/1540, United Nations, New York (2004).

UNITED NATIONS, Security Council Resolution 1373, United Nations, New York (2001).

IAEA Nuclear Security Series Publications: Fundamentals, Recommendations, Implementing Guides, and Technical Guidance, https://www-ns.iaea.org/security/nss-publications.asp.

NSC2. Risk-informed approach to nuclear security

A. Learning objectives

Upon successful completion of this module the students will be able to:

- Describe the evolution of the understanding of threat and risk
- Differentiate between risk and threat
- Identify possible threat scenarios and targets at facility and State level
- Identify the attributes of possible adversaries
- Describe the process and methodologies, analyse, and perform threat and risk assessment (depending on the scope of the module chosen by instructor)

B. Short description

This course is designed to introduce students to the concepts of threat and risk, and the role they play in the assessment, analysis, and design of measures to protect nuclear and other radioactive materials, facilities and activities; and to provide them with analytical tools to perform threat and risk analysis for nuclear security.

C. Main topics

1. Identification and assessment of threat
    1.1. Distinction between threat of nuclear war, and terrorist and other criminal activities involving nuclear material
    1.2. Distinction between facility-level and State-level threats and approaches
    1.3. Evolution and assessment of threat throughout 20th and 21st century
    1.4. Assumptions, methodologies, and factors in threat assessment
        1.4.1. Definition of threats
        1.4.2. Operating assumption for threat assessment
        1.4.3. Range of potential generic threats
        1.4.4. Threat of civil unrest/protest
        1.4.5. List of threat characteristics
        1.4.6. Sources and analysis of threat-related information
        1.4.7. External threats
        1.4.8. Internal threats
        1.4.9. Review of actual, planned and possible threat actions

1.4.9.1. Events, training events, planning for events

1.4.9.2. Flagging events that involve CBRN materials

1.4.9.3. Need for continuous reassessment

1.4.10. Review of known threat entities

1.4.11. Analysis of threat related data

1.4.11.1. List of threat attributes and characteristics

1.4.11.2. Confidence assigned to data and/or analysis

1.4.12. Practical application of threat assessment for malicious acts

1.4.13. Design Basis Threat

1.5. Attributes of potential adversaries

1.5.1. Motives and goals

1.5.2. Capabilities

1.5.3. Opportunities

1.5.4. Tactics and methods

1.5.5. Resources

1.5.6. Examples of adversaries

1.5.7. Insider vs outsider threat

2. Identification and assessment of potential targets and consequences

2.1. Four main nuclear and radiological incident scenarios:

2.1.1. Theft of nuclear weapon

2.1.2. Acquisition of nuclear material and development of an improvised nuclear device (IND)

2.1.3. Sabotage of a nuclear facility or transport

2.1.4. Development of a radiological dispersal device (RDD) and/or radiation emission device (RED)

2.2. Consequences of security breaches that do not result in a nuclear and radiological incident

2.2.1. Reputational

2.2.2. Political

2.2.3. Financial

2.2.4. Social and psychological

2.3. Potential targets

2.3.1. Nuclear facilities

2.3.2. Facilities using radioactive sources

2.3.3. Nuclear activities (e.g., transport)

3. Modelling and calculation of risk

3.1. Relationship between threat and risk

3.2. Risk assessment methodologies

3.2.1. Risk registry

3.2.2. Probabilistic risk assessment

3.2.3. Assessing likelihood of risk scenarios

3.3. Uncertainty analysis

3.4. Use of risk-informed approaches

D. Exercises:

Probabilistic risk calculation exercise

Development of a hypothetical DBT based on scenario information

State-level

Facility-level

Continuous assessment (PDAC methodology)

Developing a list of potential consequences of nuclear and radiological security incident scenarios

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

IAEA Nuclear Security Series No. 20 Objective and Essential Elements of a State's Nuclear Security Regime, 2013

IAEA Nuclear Security Series No. 13 Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5), 2011

IAEA Nuclear Security Series No. 14 Nuclear Security Recommendations on Radioactive Material and Associated Facilities, 2011

IAEA Nuclear Security Series No. 15 Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control, 2011

IAEA Nuclear Security Series No. 8 Preventive and Protective Measures Against Insider Threats, 2008

IAEA Nuclear Security Series No. 10 Development, Use and Maintenance of the Design Basis Threat, 2009

IAEA Nuclear Security Series No. 18 Nuclear Security Systems and Measures for Major Public Events, 2012

IAEA Nuclear Security Series No. 21 Nuclear Security Systems and Measures for the Detection of Nuclear and Other Radioactive Material out of Regulatory Control, 2013

IAEA Nuclear Security Series No. 23-G Security of Nuclear Information, 2015

IAEA Nuclear Security Series No. 24-G Risk Informed Approach for Nuclear Security Measures for Nuclear and other Radioactive Material out of Regulatory Control, 2015

IAEA Nuclear Security Series No. 16 Identification of Vital Areas at Nuclear Facilities, 2012

IAEA Nuclear Security Series No. 17 Computer Security at Nuclear Facilities, 2011

Mary Lynn Garcia, The Design and Evaluation of Physical Protection Systems, Butterworth Heinemann, New York, USA (2001).

Mary Lynn Garcia, Vulnerability Assessment of Physical Protection Systems, Elsevier Butterworth Heinemann, New York, USA (2006).

Carl A. Roper, Joseph A. Grau, Lynn F. Fischer, Security Education, Awareness and Training: From Theory to Practice, (Burlington, MA: Elsevier, 2006).

Julian Talbot, Miles Jakeman, Security Risk Management – Body of Knowledge, Wiley, 2009.

NSC3. Coordination and cooperation of stakeholders at national and international level

A. Learning objectives

Upon completion of this module students will be able to:

- identify various national and international stakeholders in nuclear security and describe their role in nuclear security
- demonstrate skills in establishing and maintaining cooperative relationships among the stakeholders at national and international level
- describe the importance of international cooperation and national commitment in promoting effective nuclear security

B. Short description

This course will provide an overview of cooperation efforts among various national agencies and international coordination in case of nuclear/radiological incidents. Considerable time will be devoted to focusing on cooperation with other competent organizations as the hallmark of nuclear security efforts, especially in cases of combined CBRN incidents or when a dirty bomb is involved. Furthermore, it will be emphasized that nuclear security is and should remain a national responsibility and that some countries still lack the programmes and the resources to respond properly to the threat of nuclear/radiological terrorism. This course will cover international cooperation essential to help countries to strengthen their national capacities and to build regional and global networks for combating transnational threats.

C. Main topics

1. Interagency coordination and cooperation at the national level
    1.1. Roles and responsibilities of nuclear/radiological regulator, operators, and emergency response organizations
    1.2. National coordination of stakeholders across the life cycle of nuclear facilities and infrastructure
        1.2.1. Nuclear power plants
        1.2.2. Radioactive source operators
        1.2.3. Transport
        1.2.4. Storage
        1.2.5. Mining

1.2.6. Fuel fabrication
1.2.7. Reprocessing
1.2.8. Enrichment

1.3. Coordination of national detection measures for materials outside regulatory control
1.3.1. Customs and border security
1.3.2. Policy
1.3.3. Military
1.3.4. Intelligence

1.4. Coordination of response measures to nuclear security events
1.4.1. law enforcement
1.4.2. fire department
1.4.3. hazmat
1.4.4. emergency medical services
1.4.5. nuclear forensics experts

1.5. Establishing and maintaining mechanisms and measures for effective interagency action for nuclear security
1.5.1. Mechanisms
1.5.2. Planning
1.5.3. Implementation
1.5.4. Communication
1.5.5. Periodic exercises

1.6. Public communication for nuclear security events

2. Cooperation with other competent organizations in case of incidents involving radiological dispersal devices
2.1. Explosives and conventional ordnance
2.2. The role of bomb squad
2.3. Mass casualty events
2.4. Related safety and health topics
2.5. Interagency cooperation in protection of first responders, health care workers, clean-up workers and others
2.6. Organizations and authorities involved in RDD response
2.7. Command and management

3. International coordination

3.1. Legal framework for international coordination

3.2. IAEA

3.3. Other institutions and organizations

4. Cooperation with other competent organizations in case of combined CBRN events

4.1. Joint operations in CBRN environments;

4.2. Difference between chemical, biological, radiological or nuclear events;

D. Exercises:

Case study 1: International cooperation for a large scale international exercise in response to a nuclear security event

Case study 2: National coordination in response to a stolen high-level radioactive source

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

IAEA Nuclear Security Series No. 20 Objective and Essential Elements of a State's Nuclear Security Regime, 2013

IAEA Nuclear Security Series No. 13 Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5), 2011

IAEA Nuclear Security Series No. 14 Nuclear Security Recommendations on Radioactive Material and Associated Facilities, 2011

IAEA Nuclear Security Series No. 15 Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control, 2011

IAEA Nuclear Security Series No. 18 Nuclear Security Systems and Measures for Major Public Events, 2012

IAEA Nuclear Security Series No. 21 Nuclear Security Systems and Measures for the Detection of Nuclear and Other Radioactive Material out of Regulatory Control, 2013

IAEA Nuclear Security Series No. 6 Combating Illicit Trafficking in Nuclear and Other Radioactive Material, 2007

IAEA Nuclear Security Series No. 26-G Security of Nuclear Material in Transport, 2015

IAEA Nuclear Security Series No. 22-G Radiological Crime Scene Management, 2014

IAEA Nuclear Security Series No. 19 Establishing the Nuclear Security Infrastructure for a Nuclear Power Programme, 2013

IAEA Nuclear Security Series No. 9 Security in the Transport of Radioactive Material, 2008

INTERNATIONAL ATOMIC ENERGY AGENCY, Joint Radiation Emergency Management Plan of the International Organizations, EPR-JPLAN, IAEA, Vienna (2017).

INTERNATIONAL ATOMIC ENERGY AGENCY, Operations Manual for Incident and Emergency Communication, EPR-IEComm, IAEA, Vienna (2012).

INTERNATIONAL ATOMIC ENERGY AGENCY, IAEA Response and Assistance Framework, EPR-RANET, IAEA, Vienna (2013).

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL LABOUR ORGANIZATION, INTERNATIONAL MARITIME ORGANIZATION, INTERPOL, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, PREPARATORY COMMISSION FOR THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, UNITED NATIONS OFFICE FOR THE CO¬ORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, WORLD METEOROLOGICAL ORGANIZATION, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, IAEA, Vienna (2015).

INTERNATIONAL ATOMIC ENERGY AGENCY, Method for Developing Arrangements for Response to a Nuclear or Radiological Emergency, EPR-Method, IAEA, Vienna (2003).

Measures to Strengthen International Cooperation in Nuclear, Radiation and Transport Safety and Waste Management, GC(49)/RES/9, IAEA, Vienna (2005).

Nuclear Security — Measures to Protect Against Nuclear Terrorism, Progress Report and Nuclear Security Plan for 2006–2009, GC(49)/17, IAEA (2005).

Nuclear Security — Progress on Measures to Protect against Nuclear Terrorism, GOV/INF/2002/11-GC(46)/14, IAEA (2002).

NSC4. Nuclear security management at facility level

A. Learning objectives

Upon successful completion of this module, students will be able to:

- describe the basic principles and processes of successfully managing security at nuclear and radiological facilities
- demonstrate a holistic approach towards nuclear security
- demonstrate knowledge of main international and national guidance and regulations documents
- demonstrate knowledge of the responsibilities of a security manager
- acquire skills for effective and sustainable management of nuclear security measures at a facility, including human resources, physical protection equipment, nuclear material accounting and control, and coordination
- develop and implement contingency plans

These learning objectives will be illustrated with practical examples in the nuclear security environment.

B. Short description

The course will provide a general overview on all topics that relate to the management aspects of security in general, and its application in the nuclear security field. More specifically, the course will cover the following aspects:

- Essential elements of nuclear security
- Basic principles of security management, budgeting and human resource planning, security culture, security awareness and integration with other disciplines
- Setup of a functional security organization, including governance instruments for establishing roles and responsibilities within the nuclear security management activities

C. Main modules

1. Essential Elements of Nuclear Security Management at Facility Level
   1.1. Holistic approach (legal, organisational, physical)
   1.2. Overview of international guidance and national regulations
   1.3. Definition, scope goals and objectives of nuclear security at a facility

1.4. State vs operator responsibilities

1.5. Design and implementation principles

1.6. Human resource management

1.7. Coordination with other stakeholders

1.7.1. Law enforcement/Military

1.7.2. Safety

1.7.3. Local government

1.7.4. Other internal and external parties

1.8. Operations, maintenance and sustainability of physical protection equipment

1.9. Management of nuclear material accounting and control measures

1.10. Contingency planning

2. Understanding Security Management

2.1. The security management process

2.2. Security governance

2.3. Security requirements collection

2.4. Sources for compliance requirements

2.5. Security policy management

2.6. Security situation analysis

2.7. Threat and risk management

2.8. Effectiveness of measures, cost benefit analysis

2.9. Security performance assurance programs

2.10. Incident and emergency management

2.11. Business continuity

3. Nuclear Security Culture

3.1. Security training and education

3.2. Intercultural aspects

3.3. Security awareness

3.4. Characteristics of effective nuclear security culture

3.5. Origins of security culture focus

3.6. Changes in security culture

3.7. Security culture improvement and assessment

4. Organizing Security

4.1. Security strategy

4.2. Organizational models
4.3. Human resource planning and management
4.4. Standard business processes
4.5. Supplier relationship security
4.6. Security (service) level agreements
4.7. Security incident reporting
4.8. Interaction with stakeholders
4.9. Success criteria for security management

5. Protecting Assets
5.1. Implementing Security Management Systems
5.2. Risk Management and Design Basis Threat (DBT)
5.3. Plant security program, including computer security program
5.4. Converging protection measures
5.5. Operational, Safety and Security Layers
5.6. Asset management
5.7. Information Security

D. Exercises

Part of the course will be practical exercises, where students will experience situations facing a security manager. The goal is to understand the conflict of interests that security managers are confronted with in their daily operations.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

INTERNATIONAL ATOMIC ENERGY AGENCY, Code of Conduct on the Safety and Security of Radioactive Sources, IAEA/CODEOC/2001, IAEA, Vienna (2001).

INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Security Culture: Implementing Guide, IAEA Nuclear Security Series No. 7, Vienna (2008).

INTERNATIONAL ATOMIC ENERGY AGENCY, Development, Use and Maintenance of the Design Basis Threat, IAEA Nuclear Security Series No. 10, IAEA, Vienna (2009).

INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities, IAEA Nuclear Security Series No. 13, Vienna (2011).

INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Security Recommendations on Radioactive Material and Associated Facilities, IAEA Nuclear Security Series No. 14, IAEA, Vienna (2011).

INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 15, IAEA, Vienna (2011).

INTERNATIONAL ATOMIC ENERGY AGENCY, Computer Security at Nuclear Facilities, IAEA Nuclear Security Series No. 17, IAEA, Vienna (2012).

INTERNATIONAL ATOMIC ENERGY AGENCY, FUNDAMENTALS OF A STATE'S NUCLEAR SECURITY REGIME: OBJECTIVE AND ESSENTIAL ELEMENTS, IAEA Nuclear Security Series No. 20 (2013)

Mary Lynn Garcia, The Design and Evaluation of Physical Protection Systems, Butterworth Heinemann, New York, USA (2001).

Mary Lynn Garcia, Vulnerability Assessment of Physical Protection Systems, Elsevier Butterworth Heinemann, New York, USA (2006).

Carl A. Roper, Joseph A. Grau, Lynn F. Fischer, Security Education, Awareness and Training: From Theory to Practice, (Burlington, MA: Elsevier, 2006).

Julian Talbot, Miles Jakeman, Security Risk Management – Body of Knowledge, Wiley, 2009.

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INTERNATIONAL MARITIME ORGANIZATION, INTERPOL, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, PREPARATORY COMMISSION FOR THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, UNITED NATIONS OFFICE FOR THE CO¬ORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, WORLD METEOROLOGICAL ORGANIZATION, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, IAEA, Vienna (2015).

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR OFFICE, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS OFFICE FOR THE CO-ORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, Arrangements for Preparedness for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GS-G-2.1, IAEA, Vienna (2007).

INTERNATIONAL ATOMIC ENERGY AGENCY, Method for Developing Arrangements for Response to a Nuclear or Radiological Emergency, EPR-Method, IAEA, Vienna (2003).

NSC5. Security of sensitive nuclear information

A. Learning objectives

Upon the successful completion of this module, students should be able to:

- clearly describe the role of information security in nuclear security
- explain and give examples of information security controls relevant to nuclear and other radioactive material facilities and operations.

B. Short description

The course will provide theoretical and practical knowledge of security methods for the security of sensitive nuclear information. Learning will be supported by theoretical lectures, real-world examples, and practical exercises.

C. Main modules

1. Information security concepts and context
    1.1. What is information
    1.2. Information security principles
        1.2.1. Confidentiality
        1.2.2. Integrity
        1.2.3. Availability
2. Threats against information
    2.1. Threat actors
    2.2. Information compromise and disclosure
    2.3. The insider threat
3. Framework for securing sensitive information
    3.1. Responsibilities
    3.2. Legal and regulatory framework for securing sensitive information in nuclear
    3.3. Preparing national guidance
    3.4. Security policies
    3.5. Information classification schemes
    3.6. Security controls
4. Identifying sensitive information in a nuclear security regime
    4.1. Classification principles

4.2. Forms of information

5. Sharing and disclosing sensitive information
   5.1. Sharing information
   5.2. Disclosing information
6. Management framework for confidentiality
   6.1. Roles and Responsibilities
   6.2. Security policy and procedures
   6.3. Security culture and Training
   6.4. Information security arrangements with third parties
   6.5. Inspections and audits
   6.6. Information security incidents
   6.7. Investigations

D. Exercises

Plan information security measures at a research reactor facility using HEU.

Role play: Develop and implement a role-play of addressing information security violations of an employee at a nuclear facility.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Security Fundamentals: Objective and Essential Elements of a State's Nuclear Security Regime, IAEA Nuclear Security Series No. 20, IAEA, Vienna (2013).

INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities, IAEA Nuclear Security Series No. 13, IAEA, Vienna (2011).

INTERNATIONAL ATOMIC ENERGY AGENCY, Security of Nuclear Information, IAEA Nuclear Security Series No. 23-G, IAEA, Vienna (2015).

NSC6. Nuclear security culture

A. Learning objectives

Upon successful completion of this module, students will be able to:

- Describe the concept of nuclear security culture as a subset of organizational culture
- Describe the model of nuclear security culture as promoted by the IAEA, its components and attributes.
- Identify the individual and organizational indicators that affect culture

B. Short description

This module is designed to introduce students to the concept of nuclear security culture, its origins, main components, and indicators and methodology for its assessment and enhancement. It also explains the role of the IAEA in promoting nuclear security culture globally.

C. Main modules

1. Nuclear security culture as a subset of organizational culture.
   1.1. Definition of organizational culture, of which nuclear security culture is one of its subsets
   1.2. Role of organizational culture
   1.3. Three cognitive levels of organizational culture
   1.4. Process and prerequisites of culture change
   1.5. Role of leadership
2. Human Factor and Nuclear Security
   2.1. Human factor-security-technology-organization interface
   2.2. Role of the human factor in unforeseen circumstances as well as during multiple events
3. Human Factor and Nuclear Security: Perspective on Performance
   3.1. Diverse attitudes toward security
   3.2. Subcultures in nuclear security
   3.3. Types of human fallibility

3.4. Three performance modes: skills, rules, and knowledge

3.5. Tailoring security education and training

4. IAEA and Nuclear Security Culture

4.1. The role of nuclear security in the IAEA programmatic activity

4.2. IAEA Incident and Trafficking Database (ITDB)

4.3. Nuclear security risk scenarios

4.4. IAEA nuclear security fundamentals

4.5. Legal framework for NSC

4.6. Relevant nuclear security series publications

5. IAEA as an NSC Promoter and Coordinator

5.1. Introduce tools for nuclear security and culture capacity building (human resource development, knowledge management, knowledge networks)

5.2. The role of International Network for Nuclear Security Training and Support Centres (NSSC) and International Nuclear Security Education Network (INSEN)

6. Nuclear Security Culture: Concept, Model, Characteristics.

6.1. "Nuclear Security Culture: Implementing Guide" (Nuclear Security Series No. 7, 2008)

6.2. The role of the state, organizations, managers, personnel, the public, and international community in promoting and sustaining NSC

6.3. Characteristics of the model and associated culture indicator

6.4. Beliefs/attitudes and guiding principles

6.5. Characteristics of NSC in the observable sections of the IAEA model

6.5.1. Management systems

6.5.2. Personnel behaviour

7. Safety-Security Interface

7.1. Definitions of nuclear safety culture compared with security culture

7.2. Types of interaction between safety and security in specific work settings

7.3. Safety-security interface: international legal, organizational, and programmatic as well as national and facility based operational

7.4. Synergies and contradictions among elements of safety and security culture

8. Security Culture for Radioactive Sources

8.1. Outline the international legal and management frameworks for radioactive sources

8.2. Special considerations for security culture regarding radioactive sources

8.3. Evaluation methods: basic, intermediate, and comprehensive

9. Nuclear Security Culture as a Tool to Address Insider Threat
   9.1. Definitions and profiles of insider adversaries
   9.2. IAEA guidance on preventing and protecting against insider threat
      9.2.1. References to culture
   9.3. Culture-related measures and relevant indicators to address insider threat

D. Exercises:

Risk Perception Survey

Review and Evaluation of Culture Indicators as an Assessment and Enhancement Tool

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

INTERNATIONAL ATOMIC ENERGY AGENCY (2004) Code of Conduct on the Safety and Security of Radioactive Sources

International Convention for the Suppression of Acts of Nuclear Terrorism, A/59/766, United Nations (2005), New York. Nuclear Verification and Security of Material, Physical Protection Objectives and Fundamental Principles, GOV/2001/41, IAEA (2001), Vienna.

CONVENTION ON THE PHYSICAL PROTECTION OF NUCLEAR MATERIAL (CPPNM), INFCIRC/274/Rev. 1, IAEA (1980), Vienna. AMENDMENT to the CPPNM (2005)

INTERNATIONAL ATOMIC ENERGY AGENCY (2013) Nuclear Security Series No. 20 – Fundamentals – Objectives and Essential Elements of a State's Nuclear Security Regime

INTERNATIONAL ATOMIC ENERGY AGENCY (2011) Nuclear Security Series No. 13 – Recommendations – Nuclear Security Recommendation on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5)

INTERNATIONAL ATOMIC ENERGY AGENCY (2011) Nuclear Security Series No. 14 – Recommendations – Nuclear Security Recommendations on Radioactive Material and Associated Facilities

INTERNATIONAL ATOMIC ENERGY AGENCY (2008) Nuclear Security Series No. 7 – Implementing Guide – Nuclear Security Culture

INTERNATIONAL ATOMIC ENERGY AGENCY (2008) Nuclear Security Series No. 8 – Implementing Guide – Preventive and Proactive Measures against Insider Threats

INTERNATIONAL ATOMIC ENERGY AGENCY (2009) Nuclear Security Series No. 11 – Implementing Guide – Security of Radioactive Sources

INTERNATIONAL ATOMIC ENERGY AGENCY (2013) Nuclear Security Series No. 19 – Implementing Guide – Establishing the Nuclear Security Infrastructure for a Nuclear Power Programme

INTERNATIONAL ATOMIC ENERGY AGENCY (2015) Nuclear Security Series No. 23-G – Implementing Guide – Security of Nuclear Information

INTERNATIONAL ATOMIC ENERGY AGENCY (2011) Nuclear Security Series No. 17 – Technical Guidance – Computer Security at Nuclear Facilities

INTERNATIONAL ATOMIC ENERGY AGENCY (2010) Nuclear Security Series No. 12 – Technical Guidance – Educational Programme

INTERNATIONAL ATOMIC ENERGY AGENCY Safety Standards Series no. GS-R-1 – Legal and Governmental Infrastructure for Nuclear Radiation Waste and Transport Safety Requirements

INTERNATIONAL ATOMIC ENERGY AGENCY (2005) Safety Standards Series No. RS-G-1.9 Safety Guide – Categorisation of Radioactive Sources

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL LABOUR ORGANIZATION, INTERNATIONAL MARITIME ORGANIZATION, INTERPOL, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, PREPARATORY COMMISSION FOR THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, UNITED NATIONS OFFICE FOR THE CO¬ORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, WORLD METEOROLOGICAL ORGANIZATION, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, IAEA, Vienna (2015).

INTERNATIONAL ATOMIC ENERGY AGENCY, Method for Developing Arrangements for Response to a Nuclear or Radiological Emergency, EPR-Method, IAEA, Vienna (2003).

INTERNATIOANL ATOMIC ENERGY AGENCY. (1998). *Developing Safety Culture in Nuclear Activities: Practical Suggestions to Assist Progress.* Vienna, Austria (Safety Report Series No. 11)

INTERNATIONAL ATOMIC ENERGY AGENCY. (2014). *Incident and Tracking Database: 2014 Fact Sheet.* Vienna, Austria. Available from http://www.-ns.iaea.org/downloads/security/itdb-fact-sheet.pdf. [Accessed: 28 June 2015]

INTERNATIONAL ATOMIC ENERGY AGENCY. (2002) *Safety Culture in Nuclear Installation: Guidance for Use in the Enhancement of Safety Culture.* Vienna, Austria. (TECDOC-1329).

INTERNATIONAL ATOMIC ENERGY AGENCY. (2010) *The Interface Between Safety and Security at Nuclear Power Plants.* Vienna, Austria (InSAG-24)

BUNN, M. and SAGAN, S. (2014) *A Worst Practice Guide to Insider Threat: Lessons from Past Mistakes,* Cambridge, Mass: American Academy of Arts and Sciences.

CAMERON, K. and QUINN, R. (2006) *Diagnosing and Changing Organizational Culture,* Rev. Ed. San Francisco, CA: Jossey-Bass.

HOFSTEDE, G., HOFSTEDE, G.J., MINKOV, M. (2010), *Cultures and Organizations: Software of the Mind.* 3d ed. rev. New York: McGraw-Hill USA.

KARTCHNER, K.M. (2009) *Strategic Culture and WMD Decision Making.* In Johnson, J.L., Kartchner, K.M. and Larsen, L.A. (eds.). *Strategic Culture and Weapons of Mass Destruction.* New York: Palgrave Macmillan.

KOTTER, J. (1996). *Leading Change.* Boston, Mass: Harvard Business School Press.

ROPER, C and FISCHER, L. (2005) *Security Education, Awareness, and Training.* Oxford, UK: Elsevier.

SCHEIN, E. (1999) *The Corporate Culture: Survival Guide.* San Francisco, CA: Jossey-Bass.

SCHEIN, E. (2004) *The Corporate Culture and Leadership.* 3rd ed. San Francisco, CA: Jossey-Bass.

U.S. DEPARTMENT OF ENERGY. OFFICE OF INSPECTOR GENERAL. (AUGUST 2012). *Inquiry into the Security Breach at the National Security Administration's Y-12 National Security Complex.* Washington DC: DOE/IG-0868. Available from: http://energy.gov/sites/prod/files/UG0868 [Accessed: 28th June 2015].

VINCENTE, K. (2004) *The Human Factor.* New York: Routledge.

WEICK, K.E. and Sutcliffe, K.M. (2007) *Managing the Unexpected.* 2nd ed. San Francisco, CA: Jossey-Bass.

NSC7. Threat assessment

A. Learning objectives

Upon the successful completion of this module, students will be able to analyse motivations and capabilities of adversaries and have basic information about protection against terrorism. They will be able to describe the methodology and the steps in performing State nuclear threat assessments, and in developing, implementing, and maintaining design basis threat (DBT) policies. They will be able to describe the relationship between DBT policy, risk analysis and protecting against terrorism.

B. Short description

The course will provide a general description of adversaries (their tactics and methods, psychological aspects and adversary organizations), the role of threat information in developing appropriate security measures and counterterrorism methods. It will also focus on detailed study of threat assessments and DBT development and implementation.

C. Main modules

1. Threat assessment
    - 1.1. Definition of threats
    - 1.2. Operating assumption for threat assessment
    - 1.3. Range of potential generic threats
    - 1.4. Threat of civil society
    - 1.5. List of threat characteristics
    - 1.6. Sources and analysis of threat related information
    - 1.7. External threats
    - 1.8. Internal threats
    - 1.9. Review of actual, planned and possible threat actions
        - 1.9.1. Events, training events, planning for events
        - 1.9.2. Flagging events that are CBRN or similar
    - 1.10. Review of known threat entities
    - 1.11. Analysis of threat related data
        - 1.11.1. List of threat attributes and characteristics
        - 1.11.2. Confidence assigned to data and/or analysis

1.12. Practical application of threat assessment for malicious acts

2. Design basis threat
    - 2.1.1. International recommendations for DBT
    - 2.1.2. Audience for DBT
    - 2.1.3. Roles and responsibilities
    - 2.1.4. Screening of output of threat assessment (TA)
        - 2.1.4.1. Capabilities
        - 2.1.4.2. Intentions
    - 2.1.5. Translating specific threats in TA to generic adversary attributes and characteristics
    - 2.1.6. Modifying generic adversary attributes and characteristics based on policy concerns
    - 2.1.7. Assigning which attributes and characteristics are part of DBT, and which are excluded
3. Addressing other remaining credible threat attributes and characteristics that are not included in final DBT
    - 3.1.1. DBT and another alternative threat based approach
    - 3.1.2. Implementing DBT
    - 3.1.3. Maintaining DBT
4. Role of threat analysis in developing adequate security measures
    - 4.1.1. Relationship between protection features and the threat
    - 4.1.2. Graded protection
    - 4.1.3. DBT approach versus alternatives

D. Practical exercises

Case study: Threat assessment for a facility (nuclear or radiological facility).

Case study: DBT development for a State.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested reading

INTERNATIONAL ATOMIC ENERGY AGENCY, Code of Conduct on the Safety and Security of Radioactive Sources, IAEA/CODEOC/2001, IAEA, Vienna (2001).

INTERNATIONAL ATOMIC ENERGY AGENCY, Development, Use and Maintenance of the Design Basis Threat, IAEA Nuclear Security Series No. 10, IAEA, Vienna (2009).

INTERNATIONAL ATOMIC ENERGY AGENCY, Handbook on Physical Protection of Nuclear Material and Facilities, IAEA-TECDOC-1276, Vienna (2002).

Nuclear Security — Measures to Protect against Nuclear Terrorism, Amendment to the Convention on the Physical Protection of Nuclear Material, Report by the Director General, GOV/INF/2005/10-GC(49)/INF/6, IAEA, Vienna (2005).

The Convention on the Physical Protection of Nuclear Material, INFCIRC/274/Rev.1, IAEA, Vienna (1980).

Amendment to the Convention on the Physical Protection of Nuclear Material, GOV/INF/2005/10-GC(49)/INF/6, IAEA, Vienna (2005)

Mary Lynn Garcia, The Design and Evaluation of Physical Protection Systems, Butterworth Heinemann, New York, USA (2001).

Mary Lynn Garcia, Vulnerability Assessment of Physical Protection Systems, Elsevier Butterworth Heinemann, New York, USA (2006).

Julian Talbot, Miles Jakeman, Security Risk Management – Body of Knowledge, Wiley, 2009.

NSC8. Physical protection systems design and evaluation

A. Course objectives

Upon the successful completion of this course, students will be able to present and discuss the fundamental principles of a physical protection, plan and implement the process of physical protection system (PPS) design, and design and evaluate PPSs for different types of nuclear installations and facilities.

B. Short description

The course will provide all important elements of the process of PPS design, such as target identification, PPS evaluation approaches, response and communication, vulnerability assessment, performance testing, operating principles and contingency plan. Definition of system requirements and physical protection system design and evaluation will be described in detail. Some theoretical parts of the course will be supported by practical exercises.

C. Main modules

1. Fundamental principles of physical protection
   - 1.1. Roles and responsibility of international, national, local authorities and operators;
   - 1.2. State threat evaluation;
   - 1.3. Physical protection requirements, graded approach;
   - 1.4. Concept of several layers and methods, defines in depth, balanced protection, no single point failures, redundant equipment;
   - 1.5. Quality assurance;
   - 1.6. Contingency plan;
   - 1.7. Confidentiality.
2. Overview of process of system design and evaluation
   - 2.1. Definition of system objectives and requirements;
   - 2.2. Facility characteristics;
   - 2.3. Target identification;
   - 2.4. Threat assessment and risk management;
   - 2.5. Consequences analysis;
   - 2.6. Design of physical protection system;
   - 2.7. Evaluation of PPS design.

3. Target identification
    3.1. Basic concepts;
    3.2. Techniques for target identification;
    3.3. Target identification for nuclear or radiological facilities;
    3.4. Fault trees and target list for a facility.
4. Approaches to defining security measures
    4.1. Prescriptive based approach;
    4.2. Performance based approach;
    4.3. Combined approach;
    4.4. Additional protective measures.
5. System requirements
    5.1. Categorization of nuclear material and physical protection requirements;
    5.2. Consequences analysis, radiological consequences of sabotage;
    5.3. Risk equation;
    5.4. Threat assessment and DBT;
    5.5. Trade-off and policy factors in use of DBT for PPS design;
    5.6. Maximum adversary threat against which PPS is reasonably assured;
    5.7. PPS effectiveness;
    5.8. Metrics;
    5.9. Performance and prescriptive approaches.
6. Design of physical protection system
    6.1. Effective measures for detection, delay and response;
    6.2. Physical protection plan;
    6.3. PPS functions;
    6.4. Design elements and criteria;
    6.5. Principle of timely detection and critical detection point;
    6.6. Design of PPS.
7. Response and communication
    7.1. Role and arrangement of response forces;
    7.2. Rules of engagement;
    7.3. Communication to response forces;
    7.4. Performance measures;
        7.4.1. Response force time;

7.4.2. Probability of communication;

7.4.3. Probability of neutralization.

8. Vulnerability assessment

8.1. Risk assessment;

8.2. Quantitative and qualitative evaluation analysis;

8.3. Path and scenario analysis;

8.4. System effectiveness;

8.5. Use of evaluation results.

9. Performance tests

9.1. Test strategies and planning;

9.2. Sampling plans;

9.3. Detection and confidence levels.

10. Contingency plan

10.1. Goals of contingency plan;

10.2. Development of contingency plan;

10.3. Guidance to licensee personnel in case of threat, theft or sabotage;

10.4. Identification of required resources;

10.5. Response exercises;

10.6. Communication to the public.

11. Operating principles of PPS

11.1. Implementation of PPS at any stage of its life;

11.2. Inspection and enforcement regime, compliance with license;

11.3. Insurance of required quality and performance.

12. Physical protection inspections at nuclear facilities

12.1. Inspection fundamentals;

12.2. Inspection at site;

12.2.1. Regulatory documentation;

12.2.2. Access to the site;

12.2.3. Access control system operation;

12.2.4. Perimeter detection devices;

12.2.5. Physical barriers;

12.2.6. Internal detecting devices;

12.2.7. Closed circuit TV system;

12.2.8. PPS communication system;

12.2.9. Information collection, processing and display systems;

12.2.10. Functional tests.

D. Exercises

Case study: Identification of physical protection requirements and objectives for a hypothetical nuclear facility.

Case study: Design of a physical protection system according to the previously identified requirements.

Case study: Evaluation of the previously designed physical protection system of the facility.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

IAEA Nuclear Security Series No. 13 Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5), 2011

IAEA Nuclear Security Series No. 14 Nuclear Security Recommendations on Radioactive Material and Associated Facilities, 2011

INTERNATIONAL ATOMIC ENERGY AGENCY, Code of Conduct on the Safety and Security of Radioactive Sources, IAEA/CODEOC/2001, IAEA, Vienna (2001).

INTERNATIONAL ATOMIC ENERGY AGENCY, Handbook on Physical Protection of Nuclear Material and Facilities, IAEA-TECDOC-1276, Vienna (2002).

Nuclear Security — Measures to Protect against Nuclear Terrorism, Amendment to the Convention on the Physical Protection of Nuclear Material, Report by the Director General, GOV/INF/2005/10-GC(49)/INF/6, IAEA, Vienna (2005).

Physical Protection of Nuclear Materials: Experience in Regulation, Implementation and Operations (Proc. Int. Conf. Vienna, 1997), IAEA, Vienna (1998).

The Convention on the Physical Protection of Nuclear Material, INFCIRC/274/Rev.1, IAEA, Vienna (1980).

Amendment to the Convention on the Physical Protection of Nuclear Material, GOV/INF/2005/10-GC(49)/INF/6, IAEA, Vienna (2005)

Mary Lynn Garcia, The Design and Evaluation of Physical Protection Systems, Butterworth Heinemann, New York, USA (2001).

Mary Lynn Garcia, Vulnerability Assessment of Physical Protection Systems, Elsevier Butterworth Heinemann, New York, USA (2006).

Julian Talbot, Miles Jakeman, Security Risk Management – Body of Knowledge, Wiley, 2009.

NSC9. Physical protection technologies and equipment

A. Learning objectives

Upon successful completion of this module students will acquire an in-depth understanding of current technical methods, sensors and instruments in physical protection and will learn how to select the appropriate equipment to satisfy the requirements for different physical protections systems.

B. Short description

In this course, the main focus will be on different physical principles, technical methods and instruments used in physical protection systems. Theoretical study will be combined with intensive demonstrations of the different technical instruments and practical exercises in the laboratories.

C. Main modules

1. Function of physical protection system
    1.1. Deterrence;
    1.2. Detection;
    1.3. Assessment;
    1.4. Delay;
    1.5. Response.
2. Intrusion detection
    2.1. Performance characteristics;
        2.1.1. Probability of detection;
        2.1.2. Nuisance alarm rate;
        2.1.3. Vulnerability to defeat;
    2.2. Sensors classification;
        2.2.1. Active/passive;
        2.2.2. Cover-visible;
        2.2.3. Volumetric line of detection;
        2.2.4. Application.
3. Sensors
    3.1. Sensor application;

3.1.1. Buried line sensors;

3.1.2. Fence associated sensors;

3.1.3. Freestanding sensors;

3.2. Perimeter sensor systems;

3.2.1. Design concept and goals;

3.2.2. Combination and configuration of sensors;

3.2.3. Site specific systems;

3.2.4. Environmental effects and sensor selection;

3.3. Boundary penetration sensors;

3.4. Electromechanical sensors;

3.5. Passive sonic sensors;

3.6. Active infrared sensors;

3.7. Fibber optic cable sensors;

3.8. Interior motion sensors;

3.9. Microwave sensors;

3.10. Passive infrared sensors

3.11. Dual technology sensors;

3.12. Pressure sensors;

3.13. Proximity sensors;

3.14. Other sensors.

4. Integration of physical protection systems

4.1. Selection and integration of different sensors;

4.2. Integration with video assessment systems;

4.3. Integration with access delay systems.

5. Alarm communication and display

5.1. Performance measures;

5.1.1. Probability of assessed detection;

5.1.2. Operator workload;

5.2. Alarm reporting systems;

5.3. Alarm communication systems;

5.3.1. Communication architecture;

5.3.2. Transmission methods;

5.3.3. Communication security;

5.4. Alarm display and ergonomics;

5.5. Alarm processing;

5.6. Additional design considerations.

6. Alarm assessment

6.1. Performance measures;

6.1.1. Probability of assessment;

6.1.2. Light to dark ratio;

6.1.3. Resolution;

6.2. Alarms assessment systems;

6.3. Video alarm assessment system;

6.3.1. Video camera and lens;

6.3.2. Resolution and field of view;

6.3.3. Lighting systems;

6.3.4. Video transmission;

6.3.5. Real time surveillance;

6.4. Additional design considerations;

6.5. Alarm assessment by response force.

7. Entry control

7.1. Performance measures;

7.1.1. Probability of detection;

7.1.2. Nuisance alarm rate;

7.1.3. False alarm rate;

7.1.4. Vulnerability to deceit;

7.1.5. False accept/false reject rates;

7.2. Personal identity verification;

7.3. Personal tracking;

7.4. Credentials;

7.5. Biometric identification and verification;

7.6. Access control.

8. Contraband detection

8.1. Performance measures;

8.1.1. Probability of detection;

8.1.2. False alarm rate;

8.1.3. Vulnerability to deceit;

8.2. Criteria;

8.3. Detectors and scanners;

8.4. Bulk and trace explosive detection;

8.5. Nuclear material detection.

9. Access delay

9.1. Performance measure;

9.1.1. Time to defeat barrier (as a function of barrier material and tools);

9.2. Role of access delay;

9.2.1. After detection;

9.3. Passive/fixed barriers;

9.4. Active/dispensable barriers;

9.5. System configuration.

10. Response force equipment

10.1. Communication equipment;

10.2. Weapon, protection gears;

10.3. Other equipment.

D. Exercises

Case study: Selection of sensors for the research reactor perimeter (according to provided drawings and descriptions).

Case study: Selection of sensors for the research reactor control room, fresh and spent fuel storages (according to provided drawings and descriptions).

Practical exercise: Selection of required equipment, design and evaluation of physical protection system satisfying the described requirements.

E. Laboratory work

Familiarization with sensors. Sensitivity level of selected sensors;

Review of video images. Alarm assessment.

F. Suggested readings

IAEA Nuclear Security Series No. 13 Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5), 2011

IAEA Nuclear Security Series No. 14 Nuclear Security Recommendations on Radioactive Material and Associated Facilities, 2011

INTERNATIONAL ATOMIC ENERGY AGENCY, Code of Conduct on the Safety and Security of Radioactive Sources, IAEA/CODEOC/2001, IAEA, Vienna (2001).

INTERNATIONAL ATOMIC ENERGY AGENCY, Handbook on Physical Protection of Nuclear Material and Facilities, IAEA-TECDOC-1276, Vienna (2002).

Nuclear Security — Measures to Protect against Nuclear Terrorism, Amendment to the Convention on the Physical Protection of Nuclear Material, Report by the Director General, GOV/INF/2005/10-GC(49)/INF/6, IAEA, Vienna (2005).

Physical Protection of Nuclear Materials: Experience in Regulation, Implementation and Operations (Proc. Int. Conf. Vienna, 1997), IAEA, Vienna (1998).

The Convention on the Physical Protection of Nuclear Material, INFCIRC/274/Rev.1, IAEA, Vienna (1980).

Amendment to the Convention on the Physical Protection of Nuclear Material, GOV/INF/2005/10-GC(49)/INF/6, IAEA, Vienna (2005)

Mary Lynn Garcia, The Design and Evaluation of Physical Protection Systems, Butterworth Heinemann, New York, USA (2001).

Mary Lynn Garcia, Vulnerability Assessment of Physical Protection Systems, Elsevier Butterworth Heinemann, New York, USA (2006).

Julian Talbot, Miles Jakeman, Security Risk Management – Body of Knowledge, Wiley, 2009.

NSC10. Use of nuclear material accounting and control for nuclear security (NMAC)

A. Learning objectives

Upon the successful completion of this course, students will be able to define and describe a State system of accounting for and control of nuclear and other radioactive material. After this course, the students will become familiar with international safeguards. They will be able to arrange national nuclear accountancy and control systems at bulk and item facilities, perform national inspections and analyse and report results of physical inventory taking (PIT) as a part of broader State nuclear security measures.

B. Short description

The course will describe a national accountancy and control system, and its function at nuclear and radiological facilities. Special attention will be paid to performance of national inspections and PIT activities. This course will also focus on international safeguards, which will help students to understand the IAEA's function, and international safeguards measures and activities.

C. Main modules

1. Differences between International and Domestic NMAC programs
2. NMAC Role in the Use, Storage, and Processing of Nuclear Materials, and Protecting against Insiders and Outsiders
3. Managing the NMAC system
   - 3.1. Organization and structure
   - 3.2. Roles and responsibilities
   - 3.3. Quality control
4. Nuclear Material Accounting
   - 4.1. Material balance areas
   - 4.2. Physical inventory taking of nuclear material
   - 4.3. Inventory Difference Accounting
   - 4.4. Record Keeping Practices
5. Nuclear material controls
   - 5.1. Two-person rule
   - 5.2. Tamper-indicating devices

5.3. Physical protection measures for control

5.4. RPMs and other detection devices

5.5. Administrative checks

6. Movement of Nuclear Materials

6.1. Shipment, receipts, shipper-receiver differences, transfers and relocations

7. Inventory Control of other Radioactive Material

7.1. Prudent management practice

8. Measurements

8.1. Destructive analysis

8.2. Non-destructive analysis

8.3. Measurement statistics and measurement quality control

9. Detection, investigation, and resolution of anomalies and irregularities

10. Assessment and performance testing of the NMAC system

D. Exercises

Practical exercise to design the nuclear material accounting and control system at a nuclear reactor with associated isotope production hot cell laboratory (MBAs, control of NM production and loss, receipt of target NM, shipment of NM and radioactive sources, frequency of national inspections, PIT).

“Coke can” exercise

“Jelly bean” exercise

Hypothetical facility (Shapash) (3D)

E. Laboratory work

No laboratory work is proposed for this module.

Suggested readings

INTERNATIONAL ATOMIC ENERGY AGENCY, Use of nuclear material accounting and control for nuclear security at facilities, IAEA Nuclear Security Series No. 25-G, IAEA, Vienna (2015).

INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Material Accounting Handbook, IAEA Services Series No. 15, IAEA, Vienna (2008).

INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities, (INFCIRC/225/Revision 5), IAEA Nuclear Security Series No. 13, IAEA, Vienna (2011).

INTERNATIONAL ATOMIC ENERGY AGENCY, Preventive and Protective Measures against Insider Threats, Implementing Guide, IAEA Nuclear Security Series No. 8, IAEA, Vienna (2008).

United Nations Security Council Resolution 1540, Resolution S/RES/1540, United Nations, New York (2004).

The Convention on the Physical Protection of Nuclear Material, INFCIRC/274/Rev.1, IAEA, Vienna (1980); Amendment to the Convention on the Physical Protection of Nuclear Material, Resolution GOV/INF/2005/10-GC (49)INF/6, IAEA, Vienna (2005).

STOIBER, C., BAER, A., PELZER, N., TONHAUSER, W., Handbook on Nuclear Law, IAEA, Vienna (2003).

STOIBER, C., CHERF, A., TONHAUSER, W., DE LOURDES VEZ CARMONA, M. Handbook on Nuclear Law: Implementing Legislation, IAEA, Vienna (2010).

INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Security Culture, Implementing Guide, IAEA Nuclear Security Series No. 7, IAEA, Vienna (2008).

INTERNATIONAL ATOMIC ENERGY AGENCY, International Target Values 2010 for Measurement Uncertainties in Safeguarding Nuclear Materials, Safeguards Technical Report STR-368, IAEA, Vienna (2010).

Center for International & Security Studies at Maryland, Martha Williams, On the Importance of MC&A to Nuclear Security. https://www.files.ethz.ch/isn/177623/on_the_importance_of_mca_to_nuclear_security.pdf

Center for International & Security Studies at Maryland, Jonas Siegel, John Steinbruner, and Nancy Gallagher, Comprehensive Nuclear Material Accounting. http://drum.lib.umd.edu/bitstream/handle/1903/15589/compnucmatacct_cissm_final.pdf;sequence=1

NSC11. Preventing and protecting against insider threat

A. Learning objectives

Upon the successful completion of this module, students will be able to differentiate the capabilities and motivations of potential insider adversaries, and design and develop measures to prevent and protect the facility against this type of threat.

B. Short description

The course will provide a general description of adversaries (their tactics and methods, psychological aspects and adversary organizations), the role of threat information in developing appropriate security measures and counterterrorism methods. It will also focus on detailed study of threat assessments and DBT development and implementation.

C. Main modules

1. Identification of potential insider threats
    1.1. Insider capabilities
        1.1.1. Access
        1.1.2. Authority
        1.1.3. Knowledge
    1.2. Insider motivations
        1.2.1. Ideological
        1.2.2. Financial
        1.2.3. Revenge
        1.2.4. Ego
        1.2.5. Psychological
        1.2.6. Coercion
    1.3. Insider categories
        1.3.1. Passive or active
        1.3.2. Violent or non-violent
2. Situations to be considered in the analysis of insider threats
    2.1. Inside the facility
        2.1.1. Industrial/workforce disputes
        2.1.2. Lack of security culture

2.1.3. Temporary increase in access authorizations (construction, maintenance)

2.2. Outside the facility

2.2.1. Proximity of transportation routes

2.2.2. Type of vicinity (urban or rural)

2.2.3. Local community attitudes towards the facility

2.2.4. Proximity of hostile groups or activities

2.2.5. Presence of discontented groups of population in the vicinity

2.2.6. Political or civil unrest

3. Target identification

3.1. Sabotage targets

3.2. Targets for unauthorized removal

4. Measures against possible insiders

4.1. General approach

4.2. Development of a comprehensive approach

4.3. Preventive measures

4.4. Protective measures

4.4.1. Detection

4.4.2. Delay

4.4.3. Response

4.4.4. Contingency plans

5. Evaluation of preventive and protective measures

5.1. Objectives and overview of the evaluation process

5.2. Evaluation of preventive measures

5.3. Evaluation of protective measures

D. Exercises

Identifying the insider threat at Shapash Nuclear Research Institute (a hypothetical facility)

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

INTERNATIONAL ATOMIC ENERGY AGENCY, Preventive and Protective Measures against Insider Threats, Implementing Guide, IAEA Nuclear Security Series No. 8, IAEA, Vienna (2008).

Joint Statement on Insider Threat Mitigation, 2016 Nuclear Security Summit, Washington, DC, 1 April 2016, http://www.nss2016.org/document-center-docs/2016/4/1/joint-statement-on-insider-threat-mitigation-gb.

PARKER, Clifton, "Insider Threats Biggest Challenge to Nuclear Security," Center for International Security and Cooperation, Stanford University, 9 April 2014, http://cisac.fsi.stanford.edu/news/insider_threats_biggest_challenge_to_nuclear_security_20140409.

SNOW, Catherine, et al, "Review of the July 2013 Nuclear Security Insider Threat Exercise," Oak Ridge National Laboratory, Oak Ridge, TN, USA, ORNL/TM-2013/530, https://www.osti.gov/scitech/servlets/purl/1148348.

NSC12. Security of nuclear and other radioactive material in transport

A. Learning objectives

Upon the successful completion of the course, the students will be able to outline international transport security requirements, use practical guidelines for developing security measures for transportation of nuclear and other radioactive material, and select and implement transport security technologies.

B. Short description

The course is based on the IAEA training courses on transport security prepared and conducted with assistance of IAEA Member States. It will provide a comprehensive description of international transport security and safety requirements and regulations, and practical measures for transport security arrangements, including definitions of security measures, preparation of a security plan and selection of required security technologies.

C. Main modules

1. Characteristics and objectives of transport security
   - 1.1. Aspects of transport security and interface with safety
   - 1.2. Resolving the challenge of balancing transport safety and security requirements
   - 1.3. Types of threats
   - 1.4. Possible consequences
2. International and national requirements and guidance
   - 2.1. International legal instruments and IAEA guidance for nuclear and other radioactive material
     - 2.1.1. CPPNM, UNSCRs
     - 2.1.2. Physical protection of nuclear material (INFCIRC225/Rev5, NSS26-G)
     - 2.1.3. Transport of dangerous goods (IMDG)
     - 2.1.4. Security of radioactive sources (NSS14)
     - 2.1.5. Radioactive material transport security (NSS9)
   - 2.2. State responsibilities
   - 2.3. International institutions relevant to transport security (ICAO, IATA, IMO, UNECE, WNTI)
   - 2.4. Cooperation with other States and the IAEA

2.5. Regional cooperation and regulations on transport of dangerous goods
    2.5.1. UNECE ADR (roadways)
    2.5.2. UNECE ADN (inland waterways)
    2.5.3. MERCOSUR

3. Role of transport safety regulations in nuclear transport security
    3.1. Transport indexes and relevant security levels
    3.2. Safety of radioactive material in transport
    3.3. Package preparation
    3.4. Licensing
    3.5. International transport container database
4. Security of nuclear and other radioactive material during transport
    4.1. Characterizing nuclear and radioactive materials for transport
    4.2. Security levels and categories of packages
    4.3. Customs information database
    4.4. State and operator's responsibilities
    4.5. General security principles for security regime development
    4.6. Activity thresholds for radioactive packages
    4.7. Security provisions (security level, security locks, training, personnel identity, tracking, communication, security plans, notification, etc.)
    4.8. International shipment
5. Transport security plan
    5.1. Objectives and contents of transport security plan;
    5.2. Administrative requirements;
    5.3. Description of security system (planned and alternate routes, communication, positional tracking, etc.);
    5.4. Response planning.
6. Transport security technologies
    6.1. Cargo and escort vehicles;
    6.2. Transport security technologies (e.g. sensors, alarms, communication, delayed access, remote disablement).

D. Exercises

Tabletop exercise: Identification of security measures and preparation of transport security plan for transportation of irradiated high enriched uranium (HEU) fuel assemblies from the storage facility.

Developing Transport Security Plan

Vulnerability Assessment of Transport

Establishing security levels for the transport of radioactive material of various categories

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

IAEA Nuclear Security Series No. 13 Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5), 2011

IAEA Nuclear Security Series No. 6 Combating Illicit Trafficking in Nuclear and Other Radioactive Material, 2007

Convention for the Suppression of Unlawful Acts against the Safety of Civil Aviation, Montreal (1971).

Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation, Rome (1988) and Protocol (2005).

Convention for the Suppression of Unlawful Seizure of Aircraft, The Hague (1970).

Convention on International Civil Aviation 1944, The Chicago Convention, 8th Edition, ICAO, Montreal.

Convention on Offences and Certain Other Acts Committed on Board Aircraft, Tokyo (1963).

INTERNATIONAL ATOMIC ENERGY AGENCY, Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material, IAEA Safety Standards Series No. TS-G-1.1 (ST-2), IAEA, Vienna (2002).

INTERNATIONAL ATOMIC ENERGY AGENCY, Code of Conduct on the Safety and Security of Radioactive Sources, IAEA/CODEOC/2001, IAEA, Vienna (2001).

INTERNATIONAL ATOMIC ENERGY AGENCY, Guidance on the Import and Export of Radioactive Sources, IAEA, Vienna (2005).

INTERNATIONAL ATOMIC ENERGY AGENCY, Handbook on Physical Protection of Nuclear Material and Facilities, IAEA-TECDOC-1276, Vienna (2002).

INTERNATIONAL ATOMIC ENERGY AGENCY, Monitoring for Radioactive Material in International Mail Transported by Public Postal Operators, IAEA Nuclear Security Series No. 3, IAEA, Vienna (2006).

INTERNATIONAL ATOMIC ENERGY AGENCY, Regulations for the Safe Transportation of Radioactive Material, IAEA Safety Standards Series No. TS-R1 (ST-1, RV), IAEA, Vienna (2001).

INTERNATIONAL ATOMIC ENERGY AGENCY, Security in the Transport of Radioactive Material, IAEA Nuclear Security Series No. 9, IAEA, Vienna (2008).

INTERNATIONAL MARITIME ORGANIZATION, International maritime Dangerous Goods Code, including Amendment 30-00, 2000 Edition, IMO, London (2000).

Nuclear Security — Measures to Protect against Nuclear Terrorism, Amendment to the Convention on the Physical Protection of Nuclear Material, Report by the Director General, GOV/INF/2005/10-GC(49)/INF/6, IAEA, Vienna (2005).

Safety of Transport of Radioactive Material, GOV/1998/17, IAEA, Vienna (1998).

The Convention on the Physical Protection of Nuclear Material, INFCIRC/274/Rev.1, IAEA, Vienna (1980).

UNITED NATIONS COMMITTEE OF EXPERTS ON THE TRANSPORT OF DANGEROUS GOODS, Recommendations on the Transport of Dangerous Goods, United Nations, New York (1956).

UNITED NATIONS COMMITTEE OF EXPERTS ON THE TRANSPORT OF

DANGEROUS GOODS, Recommendations on the Transport of Dangerous Goods: Model Regulations, 12th Revised Edition, United Nations, New York (2001).

UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE, European

Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR), ECE/TRANS/140, UNECE, New York and Geneva (2001).

UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE, Regulations

Concerning the International Carriage of Dangerous Goods by Rail (RID), 2001 Edition, UNECE, London (2001).

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL LABOUR ORGANIZATION, INTERNATIONAL MARITIME ORGANIZATION, INTERPOL, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, PREPARATORY COMMISSION FOR THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, UNITED NATIONS OFFICE FOR THE CO¬ORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, WORLD METEOROLOGICAL ORGANIZATION, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, IAEA, Vienna (2015).

INTERNATIONAL ATOMIC ENERGY AGENCY, Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material, IAEA Safety Standards Series No. TS-G-1.2, IAEA, Vienna (2002).

INTERNATIONAL ATOMIC ENERGY AGENCY, Method for Developing Arrangements for Response to a Nuclear or Radiological Emergency, EPR-Method, IAEA, Vienna (2003).

NSC13. Computer security for a nuclear world

A. Learning objectives

Upon the successful completion of this course, students should possess an understanding of computer security relevant to nuclear security. Additionally, the student should be able to explain and give examples of computer security controls used in both information systems and industrial controls systems relevant to nuclear and other radioactive material facilities and operations.

B. Short description

The course will provide theoretical and practical knowledge of security methods for computers and computing systems. Learning will be supported by theoretical lectures, real-world examples, and practical exercises.

C. Main modules

1. Introduction to Computer Security Concepts
    1.1. Computer-based system operation
    1.2. Computer-based systems found in nuclear
        1.2.1. Information technology
        1.2.2. Operational technology
    1.3. Sensitive Information and Sensitive Digital Assets
    1.4. Principles of Confidentiality, Integrity, Availability
    1.5. Computer security control measures
        1.5.1. Technical controls
        1.5.2. Administrative controls
        1.5.3. Physical controls
2. The Cyber Threat
    2.1. Threat actors
    2.2. Types of attacks and common attack vectors
    2.3. Potential impacts of attack
    2.4. The Anatomy of an attack
    2.5. Case Studies of actual attacks
3. The Cyber Insider Threat

3.1. Characteristics of the Insider Threat

3.2. Prevention Methods

3.3. Detection Methods

4. Computer Security Policy, Programme, and Regulation

4.1. Basis for Computer Security in Nuclear

4.1.1. International instruments

4.1.2. IAEA Nuclear Security Series

4.1.3. Regulation

4.2. Policy Development

4.3. Programme Elements

4.4. Models for Computer Security Regulation

5. Computer Security Controls in Depth

5.1. Access Control Principles

5.2. Basics of Biometrics

5.3. Introduction to Encryption

6. Network Security Basics

6.1. Network Architectures and Components

6.2. Network Communication Basics

6.3. Firewalls & DMZ

6.4. Wireless security

6.5. Intrusion Detection Systems (IDS) and Intrusion Prevention Systems (IPS)

6.6. Remote access considerations

7. Introduction to Malware and Exploits

7.1. Indications of compromise

7.2. Types of Malware

7.3. Zero Day Exploits

8. Industrial Control Systems (ICS)

8.1. ICS Architectures and Components

8.2. IT and ICS Differences

8.3. Defence in Depth

8.4. Security Levels and the Zone Model

8.5. Safety and Security Interface

9. Security Culture and the Impact of the Human

9.1. Human Error in Computer Security

9.2. Security Culture

9.3. Social Engineering

9.4. Role of Human Resources in Computer Security

9.5. The Role of Training

10. Conducting Computer Security Assessments

10.1. Assessment Types

10.2. Vulnerability Analysis

10.3. Computer Security Performance Metrics

11. Risk Assessment and Management

11.1. Risk Assessment Principles

11.2. Risk Treatment

12. Computer Security Management

12.1. Management Processes

12.2. Configuration management

12.3. Patch management

12.4. Security in the Computer System Lifecycle

12.5. Security in Supply Management

13. Computer Security Incident Response

13.1. Incident Response Phases

13.2. Computer Emergency Response Team

13.3. Digital Crime Scene Investigation

D. Exercises

Conducting a risk assessment of computer security incident

Designing computer security control system for a nuclear facility

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Security Fundamentals: Objective and Essential Elements of a State's Nuclear Security Regime, IAEA Nuclear Security Series No. 20, IAEA, Vienna (2013).

[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities, IAEA Nuclear Security Series No. 13, IAEA, Vienna (2011).

[3] INTERNATIONAL ATOMIC ENERGY AGENCY, Security of Nuclear Information, IAEA Nuclear Security Series No. 23-G, IAEA, Vienna (2015).

NSC14. Detection of criminal and other unauthorized acts involving nuclear and other radioactive material out of regulatory control

A. Learning objectives

Upon the successful completion of this module students will be able to explain and apply the principles of detection of criminal or unauthorized acts involving nuclear and other radioactive material, which is an important element of a comprehensive nuclear security system. Students will be able to outline the main detection systems and make recommendations for prevention and detection strategies at borders, strategic points and other locations of importance. In addition, students will be able to comprehend the design features, the procedures for performance monitoring and the sustainability of detection systems.

B. Short description

This course will emphasize the need for a robust second line of defines in a State, i.e. effective capabilities to detect and interdict unauthorized movement of nuclear and other radioactive material both at borders and within the State. The course will provide the fundamental components necessary for developing and implementing effective detection strategies and for maintaining detection systems.

C. Main modules

1. Introduction of materials outside regulatory control (MORC)
2. Basis for establishing a national nuclear security detection architecture
   - 2.1. National nuclear security detection strategy
   - 2.2. Legal and regulatory framework
   - 2.3. National capabilities
   - 2.4. International and regional cooperation
3. Design and development of the national nuclear security detection architecture
   - 3.1. Attributes of effective nuclear security detection
   - 3.2. Structural and organizational elements
   - 3.3. Role of information in effective nuclear security detection
   - 3.4. Trustworthiness of personnel
   - 3.5. Role of nuclear security culture
4. Detection by instruments

4.1. Detection instruments

4.2. Data network for detection instruments

4.3. Detection technology investments and operational requirements

4.4. Evaluating detection technologies

4.5. Research and development in detection technology

5. Detection by information alert

5.1. Operational information

5.2. Medical surveillance reports

5.2.1. Reporting regulatory non-compliance

5.2.2. Reporting loss of regulatory control

6. Initial assessment of alarms/alerts

6.1. Initial assessment of alarms

6.2. Initial assessment of alerts

7. Implementation framework

7.1. Roles and responsibilities

7.2. Instrument deployment plan

7.3. Concept of operations

7.4. Education, awareness, training and exercises

7.5. Sustainability

D. Exercises

Demonstration of deployment and operation of radiation detection equipment at land borders, seaports, airports, and other locations of importance.

Tabletop and field exercises: Detection response procedures to be implemented in different cases.

Operation of hand-held devices to locate and identify hidden source in a vehicle.

E. Laboratory work

Familiarization with radiation portal monitors.

Familiarization with hand-held radiation detection equipment.

Field use of spectroscopic techniques.

F. Suggested readings

IAEA Nuclear Security Series No. 15 Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control, 2011

IAEA Nuclear Security Series No. 7 Nuclear Security Culture, 2008

IAEA Nuclear Security Series No. 9 Security in the Transport of Radioactive Material, 2008

IAEA Nuclear Security Series No. 11 Security of Radioactive Sources, 2009

IAEA Nuclear Security Series No. 18 Nuclear Security Systems and Measures for Major Public Events, 2012

IAEA Nuclear Security Series No. 21 Nuclear Security Systems and Measures for the Detection of Nuclear and Other Radioactive Material out of Regulatory Control, 2013

IAEA Nuclear Security Series No. 24-G Risk Informed Approach for Nuclear Security Measures for Nuclear and other Radioactive Material out of Regulatory Control, 2015

IAEA Nuclear Security Series No. 26-G Security of Nuclear Material in Transport, 2015

INTERNATIONAL ATOMIC ENERGY AGENCY, Combating Illicit Trafficking in Nuclear and other Radioactive Material, IAEA Nuclear Security Series No. 6, Vienna (2007).

INTERNATIONAL ATOMIC ENERGY AGENCY, Identification of Radioactive Sources and Devices, IAEA Nuclear Security Series No. 5, IAEA, Vienna (2007).

INTERNATIONAL ATOMIC ENERGY AGENCY, Monitoring for Radioactive Material in International Mail Transported by Public Postal Operators, IAEA Nuclear Security Series No. 3, IAEA, Vienna (2006).

INTERNATIONAL ATOMIC ENERGY AGENCY, Security of Radioactive Sources, IAEA Nuclear Security Series No. 11, IAEA, Vienna (2009).

UNITED NATIONS, Non-proliferation of Weapons of Mass Destruction, United Nations Security Council S/RES/1540, United Nations, New York (2004).

UNITED NATIONS, Security Council Resolution 1373, United Nations, New York (2001).

NSC15. Response to criminal and other unauthorized acts involving nuclear and other radioactive material out of regulatory control

A. Learning objectives

Upon successful completion of this module students will be able to identify and apply the operational requirements and techniques for responding to criminal or unauthorized acts involving nuclear and other radioactive material.

B. Short description

In this course, emphasis will be placed on response to criminal or unauthorized acts involving nuclear and other radioactive material. The course will contain a detailed description of all aspects of response including radiation detection instrumentation and personal protective equipment, characterization of the scene, response management and emergency procedures, radiological assessment, contamination control and medical first aid.

C. Main modules

1. Introduction
    1.1. Regulations overview;
    1.2. Regulator role;
    1.3. Response organizations;
    1.4. National response plan;
    1.5. Crime scene operations;
    1.6. International requirements.
2. Response to alarms
    2.1. Response to instrument alarms;
    2.2. Response to alarm by intelligence gathering and assessment;
    2.3. Response to alarm as a result of nuclear and radioactive material being out of regulatory control;
    2.4. Response to alarm by notification of nuclear security event.
3. Response management
    3.1. Priorities;
    3.2. Response organizations;
    3.3. Prompt response plan;

3.4. Readiness.

4. Emergency preparedness and response
   4.1. Basic elements (responsibilities, management, coordination);
   4.2. Notification and activation
   4.3. Taking mitigating actions and protective actions;
   4.4. Medical emergency preparedness and response
      4.4.1. Priorities;
      4.4.2. Precautions;
      4.4.3. Transfer to the hospital;
      4.4.4. Follow-up.
   4.5. Public communications
      4.5.1. Media relations and strategy;
      4.5.2. Media reception point;
      4.5.3. Communication methods;
      4.5.4. Written press releases;
      4.5.5. Electronic media;
      4.5.6. Needs and operations of press offices.
   4.6. Protection of emergency workers
   4.7. Emergency response plan;
   4.8. Required infrastructure (procedures, tools, logistics, emergency response facilities and locations).
5. Application of detection and personal protective equipment during detection
   5.1. Ambient gamma measurement;
   5.2. Surface contamination measurement;
   5.3. Air contamination measurement;
   5.4. Isotope identification;
   5.5. Dosimeters and dose assessment;
   5.6. Personal protective equipment (PPE);
   5.7. Respiratory protection.
6. Seizure of radioactive material
   6.1. Radiation protection measures;
   6.2. Investigation and collection of evidence;
   6.3. Temporary storage and transport;

6.4. Notification and return under regulatory control.

7. Prosecution
   7.1. Legal provisions under national legislation;
   7.2. Roles and strategies of key national governments agencies;
   7.3. Processes and methods for collecting, documenting and preserving evidence for prosecution.
8. Consequence management for nuclear security
   8.1. Assessment of, search for, and identification and neutralization of RDDs;
   8.2. Dispersion of radioactive material, basics of incident management system including assessment, rescue, recovery and restore;
   8.3. Recovery and return of nuclear and other radioactive material under regulatory control;
   8.4. Interagency cooperation and coordination;
   8.5. Legal parameters and constraints;
   8.6. Managements of mass casualties.

D. Exercises

Personal protective equipment exercise.

Tabletop exercise: Incident response management and emergency procedures.

E. Laboratory work

No laboratory work is foreseen for this module.

F. Suggested readings

IAEA Nuclear Security Series No. 15 Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control, 2011

IAEA Nuclear Security Series No. 2-G Nuclear Forensics in Support of Investigations, 2015

IAEA Nuclear Security Series No. 18 Nuclear Security Systems and Measures for Major Public Events, 2012

IAEA Nuclear Security Series No. 22-G Radiological Crime Scene Management, 2014

IAEA Nuclear Security Series No. 24-G Risk Informed Approach for Nuclear Security Measures for Nuclear and other Radioactive Material out of Regulatory Control, 2015\

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL LABOUR ORGANIZATION, INTERNATIONAL MARITIME ORGANIZATION, INTERPOL, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, PREPARATORY COMMISSION FOR THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, UNITED NATIONS OFFICE FOR THE CO¬ORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, WORLD METEOROLOGICAL ORGANIZATION, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, IAEA, Vienna (2015).

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR OFFICE, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS OFFICE FOR THE CO-ORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, Arrangements for Preparedness for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GS-G-2.1, IAEA, Vienna (2006).

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR OFFICE, PAN AMERICAN HEALTH ORGANIZATION, WORLD HEALTH ORGANIZATION, Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSG-2, IAEA, Vienna (2011).

INTERNATIONAL ATOMIC ENERGY AGENCY, Arrangements for Preparedness for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GS-G-2.1, IAEA, Vienna (2006).

INTERNATIONAL ATOMIC ENERGY AGENCY, Generic procedures for assessment and response during a radiological emergency, IAEA TECDOC 1162, IAEA, Vienna (2000).

INTERNATIONAL ATOMIC ENERGY AGENCY, Communication with the Public in a Nuclear or Radiological Emergency, EPR-Public Communications, IAEA, Vienna (2012).

INTERNATIONAL ATOMIC ENERGY AGENCY, Method for Developing a Communication Strategy and Plan for a Nuclear or Radiological Emergency, EPR-Communication Plan, IAEA, Vienna (2015).

INTERNATIONAL ATOMIC ENERGY AGENCY, Preparation, Conduct and Evaluation of Exercises to Test Preparedness for a Nuclear or Radiological Emergency. EPR-Exercise, IAEA, Vienna (2005).

INTERNATIONAL ATOMIC ENERGY AGENCY, Combating Illicit Trafficking in Nuclear and other Radioactive Material, IAEA Nuclear Security Series No. 6, Vienna (2007).

INTERNATIONAL ATOMIC ENERGY AGENCY, Generic Procedures for Monitoring in a Nuclear or Radiological Emergency, IAEA-TECDOC-1092, Vienna (1999).

INTERNATIONAL ATOMIC ENERGY AGENCY, Identification of Radioactive Sources and Devices, IAEA Nuclear Security Series No. 5, IAEA, Vienna (2007).

INTERNATIONAL ATOMIC ENERGY AGENCY, Manual for First Responders to a Radiological Emergency, EPR-First Responders, IAEA, Vienna (2006).

INTERNATIONAL ATOMIC ENERGY AGENCY, Method for developing Arrangements for Response to a Nuclear or Radiological Emergency, EPR-METHOD 2003, IAEA, Vienna (2003).

INTERNATIONAL ATOMIC ENERGY AGENCY, Monitoring for Radioactive Material in International Mail Transported by Public Postal Operators, IAEA Nuclear Security Series No. 3, IAEA, Vienna (2006).

INTERNATIONAL ATOMIC ENERGY AGENCY, Security of Radioactive Sources, IAEA Nuclear Security Series No. 11, IAEA, Vienna (2009).

INTERNATIONAL ATOMIC ENERGY AGENCY, WORLD HEALTH ORGANIZATION, Generic Procedures for Medical Response During Nuclear and Radiological Emergency, EPR-MEDICAL, IAEA, Vienna (2005).

UNITED NATIONS, Security Council S/RES/1540, United Nations, New York (2004).

UNTED NATIONS, Security Council S/RES/1373, United Nations, New York (2001).

I-4. ELECTIVE MODULES

NSE1. Interfaces of nuclear security with safety and safeguards

A. Learning objectives

After completing this module, students should be able to identify and describe the concepts, objectives and principles of nuclear security as they interact with nuclear safety and safeguards. They should also be able to describe the interfaces between security with safety and safeguards, and the challenges and opportunities that they present.

B. Short description

This course outlines the areas of interface between nuclear security with safety and safeguards, describing the concepts, objectives and principles of the three, and highlighting the challenges and opportunities that they present for the safe and peaceful use of nuclear energy.

C. Main modules

1. Safety, security, and safeguards objectives, fundamentals and concepts
    1.1. Safety, security, and safeguards objectives
    1.2. Safety, security, and safeguards fundamentals
    1.3. Prevention of safety or security events – defence-in-depth
    1.4. Graded approach
    1.5. Safety analysis
    1.6. Threat assessment and security plan
    1.7. Safety and security measures
2. Issues and challenges in the interface between safety and security
    2.1. Areas of interface between safety and security
    2.2. Need for coordination
    2.3. Challenges of safety-security interface
3. Responsibilities for safety and security
    3.1. Role of the state
    3.2. Role of the regulatory body
    3.3. Role of the operating organization

4. Leadership and management of safety and security
    4.1. Integrated management system
    4.2. Safety culture and security culture
    4.3. Optimization of protection
    4.4. Operating procedures
    4.5. Emergency preparedness and response
    4.6. Training of personnel
5. Assessment of the interface between safety and security
    5.1. Periodic safety and security reviews
    5.2. Self-assessment, continuous improvement and feedback from operating experience
6. Concepts and objectives of security and safeguards
    6.1. Verification of State responsibilities under the Nuclear Nonproliferation Treaty
    6.2. Prevention, detection and response to malicious acts involving nuclear and other radioactive materials by non-state actors
7. Interface between security and safeguards
    7.1. Technologies
    7.2. Information
    7.3. Procedures

D. Exercises

Role play: coordinate safety and security response in the event of sabotage of a nuclear facility resulting in the release of radiation

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

The Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons, INFCIRC/153 (Corrected), Vienna (1972).

Model Protocol Additional to the Agreement(s) between State(s) and the International Atomic Energy Agency for the Application of Safeguards, INFCIRC/540 (Corrected), Vienna (1997).

Nuclear Verification and Security of Material, Physical Protection Objectives and Fundamental Principles, GOV/2001/41, IAEA, Vienna (2001).

Fundamental Safety Principles, Safety fundamentals, No. SF-1, IAEA, Vienna (2006).

IAEA Safety Standards, available at https://www-ns.iaea.org/standards/documents/general.asp?s=11&l=90 .

INTERNATIONAL ATOMIC ENERGY AGENCY, Code of Conduct on the Safety and Security of Radioactive Sources, IAEA/CODEOC/2001, IAEA, Vienna (2001).

Communication Received from Certain Member States Regarding Guidelines for the Export of Nuclear Material, Equipment and Technology, INFCIRC254/Rev. 6/Part 2 and Rev. 7/Part 1, IAEA, Vienna (2005).

Communication Received from Members Regarding the Export of Nuclear Material and of Certain Categories of Equipment and other Material, INFCIRC/209/Rev. 1, IAEA, Vienna (1990).

INTERNATIONAL ATOMIC ENERGY AGENCY, Handbook on Nuclear Law, IAEA, Vienna (2003).

UNITED NATIONS, Non-proliferation of Weapons of Mass Destruction, United Nations Security Council S/RES/1540, United Nations, New York (2004).

UNITED NATIONS, Security Council Resolution 1373, United Nations, New York (2001).

The Treaty on the Nonproliferation of Nuclear Weapons

The Interface between Safety and Security at Nuclear Power Plants, INSAG-24, STI/PUB/1472, IAEA, Vienna, 2010

Code of Conduct on the Safety and Security of Radioactive Sources, IAEA, Vienna, 2004.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL LABOUR ORGANIZATION, INTERNATIONAL MARITIME ORGANIZATION, INTERPOL, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, PREPARATORY COMMISSION FOR THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, UNITED NATIONS OFFICE FOR THE CO¬ORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, WORLD METEOROLOGICAL ORGANIZATION, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, IAEA, Vienna (2015).

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR OFFICE, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS OFFICE FOR THE CO-ORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, Arrangements for Preparedness for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GS-G-2.1, IAEA, Vienna (2006).

INTERNATIONAL ATOMIC ENERGY AGENCY, Method for developing Arrangements for Response to a Nuclear or Radiological Emergency, EPR-METHOD 2003, IAEA, Vienna (2003).

NSE2. Legal drafting for nuclear security

A. Learning objectives

Upon successful completion of this module, student will be able to identify basic concepts and substantive elements of a country's comprehensive nuclear law, and in particular its components related to nuclear security. They should also be able to draft laws and regulations that fit within the overall national legal structure and process, and integrate country's obligations under the relevant international legal instruments.

B. Short description

This course provides an overview of the basic components and substantive elements of a comprehensive national nuclear law, with emphasis on nuclear security. It provides students that have general legal or policy background with the knowledge required to be able to develop and draft legal acts and other documents related to nuclear security. Integrate them with the existing national legal structure and process, and ensure that they reflect the country's obligations under the existing international legal instruments related to nuclear security.

C. Main modules

1. Definition, scope and application of nuclear law
2. Overview of main international legal instruments related to nuclear security
    2.1. CPPNM and its Amendment
    2.2. UN Conventions
    2.3. UNSCR Resolutions
    2.4. Codes of Conduct and other non-binding instruments
    2.5. Linking international legal instruments with national obligations
3. National legislation
    3.1. Areas of coverage
        3.1.1. Safety
        3.1.2. Security
        3.1.3. Safeguards,
        3.1.4. Liability
    3.2. Comprehensive v separate

4. Elements of a comprehensive national nuclear law
    4.1. General provisions
        4.1.1. Objective
        4.1.2. Scope
        4.1.3. Prohibitions
        4.1.4. Definitions
    4.2. Specific provisions
        4.2.1. Regulatory body and its functions
        4.2.2. Regulatory activities
            4.2.2.1. Notification
            4.2.2.2. Authorization
            4.2.2.3. Inspection
            4.2.2.4. Enforcement
            4.2.2.5. Penalties
        4.2.3. Radiation protection
        4.2.4. Radioactive sources
        4.2.5. Safety of nuclear facilities
        4.2.6. Emergency preparedness and response
        4.2.7. Mining and processing
        4.2.8. Transport
        4.2.9. Radioactive waste and spent fuel
        4.2.10. Nuclear liability and coverage
        4.2.11. Safeguards
        4.2.12. Export and import control
5. Nuclear security provisions
    5.1. Categorization of nuclear and other radioactive material for the purposes of nuclear security
    5.2. Physical protection measures
    5.3. Accounting and control measures
    5.4. Authorization/licensing requirements
    5.5. Inspections and monitoring of compliance with PP requirements
    5.6. Enforcement
    5.7. Materials outside regulatory control

5.7.1. Detection

5.7.2. Response

5.8. Computer and information security

5.9. Criminal offences

5.10. Jurisdiction and extradition

5.11. International cooperation

D. Exercises

Develop model provisions for a national nuclear law, criminalizing offences in the area of nuclear security

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

In addition to the reference material proposed for course NSC2, the following texts are can be useful:

Handbook on Nuclear Law, IAEA, Vienna, 2003

Handbook on Nuclear Law: Implementing Legislation, IAEA, Vienna, 2010.

INTERNATIONAL ATOMIC ENERGY AGENCY, Convention on Early Notification of a Nuclear Accident and Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, Legal Series No. 14, IAEA, Vienna (1987).

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL LABOUR ORGANIZATION, INTERNATIONAL MARITIME ORGANIZATION, INTERPOL, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, PREPARATORY COMMISSION FOR THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, UNITED

NATIONS OFFICE FOR THE CO¬ORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, WORLD METEOROLOGICAL ORGANIZATION, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, IAEA, Vienna (2015).

NSE3 International cooperation on nuclear security

A. Learning objectives

Upon successful completion of this module, the students will be able to demonstrate knowledge of the principal stakeholders involved in the international cooperation on nuclear security, describe their goals, objectives, challenges and accomplishments.

B. Short description

This course identifies the past and current international cooperative efforts and main actors on nuclear security, including at the international, multilateral and regional levels. The course describes the principal objectives, goals, activities, challenges and accomplishments of these organizations and initiatives.

C. Main modules

1. The need for international cooperation on nuclear security
    1.1. Nuclear security as State prerogative and responsibility
    1.2. Nuclear security as a global problem
    1.3. Need for a cooperative approach to address nuclear security
2. Principal international and multilateral stakeholders in nuclear security
    2.1. The IAEA
        2.1.1. Mission, goals and objectives of the IAEA nuclear security activities
        2.1.2. Evolution of nuclear security activities since 2002
        2.1.3. Understanding and interpretation of the IAEA mandate on nuclear security
        2.1.4. Challenges
    2.2. Other relevant UN organizations and their involvement in nuclear security
        2.2.1. The UN Security Council
        2.2.2. UNSCR 1540 Committee
        2.2.3. UN Office of Drugs and Crime (UNODC)
        2.2.4. UN Office on Disarmament Affairs (UNODA)
    2.3. Other international and multilateral organizations
        2.3.1. OSCE
        2.3.2. INTERPOL and regional police organizations
        2.3.3. World Customs Organization

2.3.4. World Health Organizations

2.3.5. International Maritime Organization

2.3.6. International Civil Aviation Organization

2.3.7. UN International Crime and Justice Research Institute

2.3.8. EC Joint Research Centre

2.4. International and multilateral initiatives

2.4.1. The 2010-2016 Nuclear Security Summit process

2.4.2. Global Initiative to Combat Nuclear Terrorism

2.4.3. The G7 Global Partnership

2.4.4. The Counterterrorism Implementation Task Force

2.4.5. Border Monitoring Working Group

2.5. Non-governmental organizations *(select list, at instructor's discretion)*

2.5.1. World Institute for Nuclear Security

2.5.2. World Nuclear Transport Institute

2.5.3. Nuclear Threat Initiative

2.5.4. Other organizations

2.5.5. Involvement of industry

3. Challenges in international cooperation on nuclear security

3.1. Mandates

3.2. Priorities and commitments

3.3. Coordination of efforts

4. The way forward

D. Exercises

Role play: Identify a set of objectives and priorities towards the development of an IAEA Nuclear Security Plan for a period of 4 years.

Role play: Hold a hypothetical meeting among a number of international agencies where they exchange information on their nuclear security-related activities and work to coordinate them to optimize resources and avoid duplication of effort.

Role play: conduct a mock Nuclear Security Summit, discussing threats and priorities in addressing them in nuclear security activities of individual countries.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

IAEA Publications:

IAEA Nuclear Security Series No. 20 Objective and Essential Elements of a State's Nuclear Security Regime, 2013

IAEA Nuclear Security Series No. 13 Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5), 2011

IAEA Nuclear Security Series No. 14 Nuclear Security Recommendations on Radioactive Material and Associated Facilities, 2011

IAEA Nuclear Security Series No. 15 Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control, 2011

Code of Conduct on the Safety and Security of Radioactive Sources, IAEA/CODEOC/2001, IAEA, Vienna (2001).

IAEA Nuclear Security Series No. 9 Security in the Transport of Radioactive Material, 2008

IAEA Nuclear Security Series No. 21 Nuclear Security Systems and Measures for the Detection of Nuclear and Other Radioactive Material out of Regulatory Control, 2013

IAEA Nuclear Security Series No. 24-G Risk Informed Approach for Nuclear Security Measures for Nuclear and other Radioactive Material out of Regulatory Control, 2015

IAEA Nuclear Security Series No. 26-G Security of Nuclear Material in Transport, 2015
IAEA Nuclear Security Series No. 6 Combating Illicit Trafficking in Nuclear and Other Radioactive Material, 2007

Other documents:

International Convention for the Suppression of Acts of Nuclear Terrorism, A/59/766, United Nations, New York (2005). Nuclear Verification and Security of Material, Physical Protection Objectives and Fundamental Principles, GOV/2001/41, IAEA, Vienna (2001).

UNITED NATIONS, Non-proliferation of Weapons of Mass Destruction, United Nations Security Council S/RES/1540, United Nations, New York (2004).

UNITED NATIONS, Security Council Resolution 1373, United Nations, New York (2001).

The Convention on the Physical Protection of Nuclear Material, INFCIRC/274/Rev.1, IAEA, Vienna (1980).

Amendment to the Convention on the Physical Protection of Nuclear Material, GOV/INF/2005/10-GC(49)/INF/6, IAEA, Vienna (2005)

Global Initiative to Combat Nuclear Terrorism, http://www.gicnt.org/.

Global Partnership Against the Spread of Weapons and Materials of Mass Destruction, https://en.wikipedia.org/wiki/Global_Partnership_Against_the_Spread_of_Weapons_and_Materials_of_Mass_Destruction.

UN Counterterrorism Implementation Task Force (CTITF), https://www.un.org/counterterrorism/ctitf/en.

NSE4. Developing and implementing design basis threat (DBT)

A. Learning objectives

Upon successful completion of this module the students will be able to identify the goals, objectives, and principal elements of the design basis threat, and to develop design basis threat using the required information.

B. Short description

This course provides an overview of the goals, objectives, and main elements of a design basis threat, including the principal stakeholders, procedure for conducting a threat assessment,

C. Main modules

1. Description of a DBT
    1.1. Definition
    1.2. Main themes:
        1.2.1. Insider/outsider adversaries
        1.2.2. Relationship between malicious acts and unacceptable consequences
        1.2.3. Attributed and characteristics
        1.2.4. Design and evaluation
2. Purpose of a DBT
    2.1. Need for a design basis threat
    2.2. Value of a design basis threat
3. Roles and responsibilities
    3.1. State
    3.2. Competent authority(ies) for development, use and maintenance of a design basis threat
    3.3. Intelligence organizations
    3.4. Operators
    3.5. Other organizations
4. Performing a threat assessment
    4.1. Conducting a threat assessment
        4.1.1. Input

4.1.2. Process of analysis

4.1.3. Output

4.2. Decision to use a design basis threat or another threat-based approach

5. Developing a design basis threat

5.1. Input to the design basis threat

5.2. Process

5.2.1. Phase 1: screening the threat assessment

5.2.2. Phase 2: translating data on specific threats into representative adversary attributes and characteristics

5.2.3. Phase 3: modifying representative adversary attributes and characteristics on the basis of policy factors

5.3. Output

5.4. Developing an alternative threat statement

6. Using the design basis threat

7. Maintaining the design basis threat

D. Exercises

Developing a DBT for a hypothetical facility based on a set of pre-determined inputs, including type of facility and material it handles, location, description of potential threats from within and outside the country, and other factors.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

Convention on the Physical Protection of Nuclear Material, INFCIRC/274, and the Amendment of 2005 thereto, IAEA, Vienna (2005).

IAEA Nuclear Security Series No. 20 Objective and Essential Elements of a State's Nuclear Security Regime, 2013

IAEA Nuclear Security Series No. 13 Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5), 2011

IAEA Nuclear Security Series No. 7 Nuclear Security Culture, 2008

IAEA Nuclear Security Series No. 9 Security in the Transport of Radioactive Material, 2008

IAEA Nuclear Security Series No. 10 Development, Use and Maintenance of the Design Basis Threat, 2009

IAEA Nuclear Security Series No. 11 Security of Radioactive Sources, 2009

IAEA Nuclear Security Series No. 19 Establishing the Nuclear Security Infrastructure for a Nuclear Power Programme, 2013

IAEA Nuclear Security Series No. 24-G Risk Informed Approach for Nuclear Security Measures for Nuclear and other Radioactive Material out of Regulatory Control, 2015

IAEA Nuclear Security Series No. 26-G Security of Nuclear Material in Transport, 2015

IAEA Nuclear Security Series No. 16 Identification of Vital Areas at Nuclear Facilities, 2012

IAEA Nuclear Security Series No. 17 Computer Security at Nuclear Facilities, 2011

Mary Lynn Garcia, The Design and Evaluation of Physical Protection Systems, Butterworth Heinemann, New York, USA (2001).

Mary Lynn Garcia, Vulnerability Assessment of Physical Protection Systems, Elsevier Butterworth Heinemann, New York, USA (2006).

Carl A. Roper, Joseph A. Grau, Lynn F. Fischer, Security Education, Awareness and Training: From Theory to Practice, (Burlington, MA: Elsevier, 2006).

Julian Talbot, Miles Jakeman, Security Risk Management – Body of Knowledge, Wiley, 2009.

NSE5. Vulnerability assessment of physical protection systems

A. Learning objectives

Upon the successful completion of this course, students will be able to perform a comprehensive evaluation and propose an optimization of different physical protection systems. Further, they will be able to perform a qualitative and quantitative risk assessment.

B. Short description

The course aims to provide students with knowledge of system analysis, risk management, evaluation and optimization methods and their application for physical protection systems evaluation.

C. Main modules

1. System analysis
    1.1. Fault and event trees
    1.2. Fault tree construction and analysis
    1.3. Data reliability
    1.4. Expert opinion
2. Risk management
    2.1. Risk definitions, acceptable risk
    2.2. Methods of quantitative risk assessment
    2.3. Elements of risk management
    2.4. Decision theory, decision tree
    2.5. Uncertainties
    2.6. Critical path method
    2.7. Expert evaluation of uncertainties
3. Risk management in physical protection
    3.1. Estimating security risk
    3.2. Risk reduction strategies
    3.3. Cost effectiveness and acceptable risk
    3.4. Impact of risk management decisions
4. Evaluation and optimization of physical protection system
    4.1. Adversary path; scenario and path analysis

4.2. Probabilistic and graph-analytical methods in evaluation of physical protection systems
4.3. Insider analysis
4.4. Reliability analysis
4.5. System effectiveness evaluation
4.6. Optimization methods in evaluating the effectiveness of systems
4.7. Uncertainties in evaluations
4.8. Decision making under risk and uncertainties; managing security risk

E. Exercises

Case study: Risk assessment, evaluation of effectiveness and optimization of physical protection system of a large nuclear reactor.

Case study: Evaluation of the physical protection system of a facility or radiological installation.

F. Laboratory work

No laboratory work is proposed for this course.

G. Suggested readings

INTERNATIONAL ATOMIC ENERGY AGENCY (2013) Nuclear Security Series No. 20 – Fundamentals – Objectives and Essential Elements of a State's Nuclear Security Regime

INTERNATIONAL ATOMIC ENERGY AGENCY (2011) Nuclear Security Series No. 13 – Recommendations – Nuclear Security Recommendation on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5)

INTERNATIONAL ATOMIC ENERGY AGENCY, Code of Conduct on the Safety and Security of Radioactive Sources, IAEA/CODEOC/2001, IAEA, Vienna (2001).

Mary Lynn Garcia, *The Design and Evaluation of Physical Protection Systems*, Butterworth Heinemann, New York, USA (2001).

Mary Lynn Garcia, *Vulnerability Assessment of Physical Protection Systems*, Elsevier Butterworth Heinemann, New York, USA (2006).

NSE6. Nuclear security culture assessment and enhancement

A. Learning objectives

Upon successful completion of this module, students are expected to know and perform various methods of nuclear security culture self-assessment at a nuclear facility, as well as design and implement on the basis of the self-assessment results a programme to enhance nuclear security culture.

B. Short description

Based on the existing international guidance and good practices, this course will acquaint the students with the recommended methodologies for the self-assessment of nuclear security culture at nuclear facilities.

C. Main modules

1. Dimensions of nuclear security culture
    1.1. IAEA model of nuclear security culture
    1.2. International legal instruments
2. Self-assessment: concept and practice
    2.1. Purpose and benefits of security culture self-assessment
    2.2. Special considerations for security culture self-assessment
    2.3. Security culture indicators
3. Security culture self-assessment process
4. Methods of self-assessment
    4.1. Surveys
    4.2. Interviews
    4.3. Document review
    4.4. Observations
5. Conducting the analysis
6. Communication of findings and transition into action
7. Nuclear security culture enhancement programme structure.
    7.1. Nuclear Security Culture Enhancement Programme Roles and Responsibilities
8. Key elements of a systematic nuclear security culture enhancement programme
    8.1. Regulatory Basis

8.2. Self-Assessment

8.3. Action Plan

8.4. Nuclear Security Education and Training

8.5. Promotional Products and Training Aids

8.6. Human Resource Elements

8.7. Code of Conduct

8.8. Lessons Learned Programme

8.9. Continuous Improvement of Nuclear Security

8.10. Enhancing Nuclear Security Culture

D. Exercises

Developing a model security culture assessment survey based on a set of proposed indicators.
Conducting a mock assessment interview with a facility manager or staff member.
Developing an action plan for security culture enhancement based on the self-assessment results.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

INTERNATIONAL ATOMIC ENERGY AGENCY (2004) Code of Conduct on the Safety and Security of Radioactive Sources

International Convention for the Suppression of Acts of Nuclear Terrorism, A/59/766, United Nations (2005), New York. Nuclear Verification and Security of Material, Physical Protection Objectives and Fundamental Principles, GOV/2001/41, IAEA (2001), Vienna.

CONVENTION ON THE PHYSICAL PROTECTION OF NUCLEAR MATERIAL (CPPNM), INFCIRC/274/Rev. 1, IAEA (1980), Vienna. AMENDMENT to the CPPNM (2005)

INTERNATIONAL ATOMIC ENERGY AGENCY (2013) Nuclear Security Series No. 20 – Fundamentals – Objectives and Essential Elements of a State's Nuclear Security Regime

INTERNATIONAL ATOMIC ENERGY AGENCY (2011) Nuclear Security Series No. 13 – Recommendations – Nuclear Security Recommendation on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5)

INTERNATIONAL ATOMIC ENERGY AGENCY (2011) Nuclear Security Series No. 14 – Recommendations – Nuclear Security Recommendations on Radioactive Material and Associated Facilities

INTERNATIONAL ATOMIC ENERGY AGENCY (2008) Nuclear Security Series No. 7 – Implementing Guide – Nuclear Security Culture

INTERNATIONAL ATOMIC ENERGY AGENCY (2008) Nuclear Security Series No. 8 – Implementing Guide – Preventive and Proactive Measures against Insider Threats

INTERNATIONAL ATOMIC ENERGY AGENCY (2009) Nuclear Security Series No. 11 – Implementing Guide – Security of Radioactive Sources

INTERNATIONAL ATOMIC ENERGY AGENCY (2013) Nuclear Security Series No. 19 – Implementing Guide – Establishing the Nuclear Security Infrastructure for a Nuclear Power Programme

INTERNATIONAL ATOMIC ENERGY AGENCY (2015) Nuclear Security Series No. 23-G – Implementing Guide – Security of Nuclear Information

INTERNATIONAL ATOMIC ENERGY AGENCY (2011) Nuclear Security Series No. 17 – Technical Guidance – Computer Security at Nuclear Facilities

INTERNATIONAL ATOMIC ENERGY AGENCY (2010) Nuclear Security Series No. 12 – Technical Guidance – Educational Programme

INTERNATIONAL ATOMIC ENERGY AGENCY Safety Standards Series no. GS-R-1 – Legal and Governmental Infrastructure for Nuclear Radiation Waste and Transport Safety Requirements

INTERNATIONAL ATOMIC ENERGY AGENCY (2005) Safety Standards Series No. RS-G-1.9 Safety Guide – Categorisation of Radioactive Sources

INTERNATIOANL ATOMIC ENERGY AGENCY. (1998). *Developing Safety Culture in Nuclear Activities: Practical Suggestions to Assist Progress.* Vienna, Austria (Safety Report Series No. 11)

INTERNATIONAL ATOMIC ENERGY AGENCY. (2014). *Incident and Tracking Database: 2014 Fact Sheet.* Vienna, Austria. Available from http://www.-ns.iaea.org/downloads/security/itdb-fact-sheet.pdf. [Accessed: 28 June 2015]

INTERNATIONAL ATOMIC ENERGY AGENCY. (2002) *Safety Culture in Nuclear Installation: Guidance for Use in the Enhancement of Safety Culture.* Vienna, Austria. (TECDOC-1329).

INTERNATIONAL ATOMIC ENERGY AGENCY. (2010) *The Interface Between Safety and Security at Nuclear Power Plants.* Vienna, Austria (InSAG-24)

BUNN, M. and SAGAN, S. (2014) *A Worst Practice Guide to Insider Threat: Lessons from Past Mistakes,* Cambridge, Mass: American Academy of Arts and Sciences.

CAMERON, K. and QUINN, R. (2006) *Diagnosing and Changing Organizational Culture,* Rev. Ed. San Francisco, CA: Jossey-Bass.

HOFSTEDE, G., HOFSTEDE, G.J., MINKOV, M. (2010), *Cultures and Organizations: Software of the Mind.* 3d ed. rev. New York: McGraw-Hill USA.

KARTCHNER, K.M. (2009) *Strategic Culture and WMD Decision Making.* In Johnson, J.L., Kartchner, K.M. and Larsen, L.A. (eds.). *Strategic Culture and Weapons of Mass Destruction.* New York: Palgrave Macmillan.

KOTTER, J. (1996). *Leading Change.* Boston, Mass: Harvard Business School Press.

ROPER, C and FISCHER, L. (2005) *Security Education, Awareness, and Training.* Oxford, UK: Elsevier.

SCHEIN, E. (1999) *The Corporate Culture: Survival Guide.* San Francisco, CA: Jossey-Bass.

SCHEIN, E. (2004) *The Corporate Culture and Leadership.* 3rd ed. San Francisco, CA: Jossey-Bass.

U.S. DEPARTMENT OF ENERGY. OFFICE OF INSPECTOR GENERAL. (AUGUST 2012). *Inquiry into the Security Breach at the National Security Administration's Y-12 National Security Complex.* Washington DC: DOE/IG-0868. Available from: http://energy.gov/sites/prod/files/UG0868 [Accessed: 28th June 2015].

VINCENTE, K. (2004) *The Human Factor.* New York: Routledge.

WEICK, K.E. and Sutcliffe, K.M. (2007) *Managing the Unexpected.* 2nd ed. San Francisco, CA: Jossey-Bass.

NSE7. Designing physical protection systems for nuclear and radiological facilities

A. Learning objectives

Upon completion of this module students will be able to apply specifics of physical protection measures and national regulations for security of nuclear and other radioactive material and facilities. They will be able to design and evaluate a physical protection system for such facilities.

B. Short description

This course will describe the essential components of the process of physical protection system design specific for nuclear and radioactive material, sources and facilities. A significant part of the course (up to 50% of the course time) is devoted to a comprehensive project.

C. Main modules

1. Introduction to physical protection of nuclear and other radioactive material and facilities
   - 1.1. The Convention of Physical Protection of Nuclear Material (CPPNM) and its Amendment;
   - 1.2. Code of Conduct on Safety and Security of Radioactive Sources;
   - 1.3. Categorization of nuclear material and radioactive sources;
   - 1.4. Consequences from theft or sabotage related to nuclear material, sources and facilities;
   - 1.5. Misuse of nuclear facilities or equipment;
   - 1.6. Certification of the sources;
   - 1.7. IAEA Catalogue of sealed sources.
2. Application of fundamental principles of physical protection to nuclear material and other radioactive material and facilities
   - 2.1. Roles and responsibility of international, national, local authorities and operators;
   - 2.2. Legislative and regulatory framework to govern physical protection;
   - 2.3. Competent authorities;
   - 2.4. State threat evaluation;
   - 2.5. Physical protection requirements;
   - 2.6. Graded approach;

2.7. Consequence analysis;

2.8. Quality assurance;

2.9. Contingency plan.

3. Characteristics of nuclear facilities

3.1. Design of typical nuclear facilities;

3.2. Vital areas;

3.2.1. Fuel cycle facilities (uranium production, enrichment, fuel fabrication, reactors, reprocessing, spent fuel and waste storage);

3.2.2. Research reactor facilities;

3.2.3. Other facilities.

4. Radioactive material and sources use and storage

4.1. Containers for radioactive material and sources;

4.2. Construction of typical storages for radioactive material and sources;

4.3. Construction of typical radiation facilities (medical, industrial and agricultural).

5. Application of physical protection approaches and methods for nuclear and other radioactive material and facilities

5.1. Specifics of PPS for nuclear facilities and facilities with radioactive material;

5.2. Target identification;

5.3. Threats and vulnerability assessment in relation to nuclear and other radioactive material and facilities;

5.4. Implementation of security measures;

5.4.1. Security grouping;

5.4.2. Security objectives and measures;

5.4.3. Administrative measures;

5.4.3.1. Periodic accounting and inventory taking;

5.4.3.2. Access control;

5.4.3.3. Emergency response plan;

5.4.3.4. Security plan;

5.4.3.5. Information security;

5.4.3.6. Timely response;

5.4.3.7. Specific technical measures;

5.4.3.8. Practical application of security measures for nuclear and other radioactive material and facilities.

6. Establishing national infrastructure for security of nuclear and other radioactive material and facilities
   6.1. Creation of security awareness;
   6.2. Reviewing legislative authorities;
   6.3. Building regulatory capacity;
   6.4. Developing regulatory framework;
   6.5. Establishing graded security levels;
   6.6. Specification of security level application to nuclear material and facilities;
   6.7. Selection of regulatory approach.

D. Practical exercises

Comprehensive project: Design and evaluate a physical protection system of a nuclear or radiological facility.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested reading

INTERNATIONAL ATOMIC ENERGY AGENCY, Code of Conduct on the Safety and Security of Radioactive Sources, IAEA/CODEOC/2001, IAEA, Vienna (2001).

INTERNATIONAL ATOMIC ENERGY AGENCY, Dangerous Quantities of Radioactive Material (D-Values), EPR-D-VALUES 2006, IAEA, Vienna (2006).

INTERNATIONAL ATOMIC ENERGY AGENCY, Design of Spent Fuel Storage Facilities, Safety Series No. 116, IAEA, Vienna (1994).

INTERNATIONAL ATOMIC ENERGY AGENCY, Engineering Safety Aspects of the Protection of Nuclear Power Plants against Sabotage, IAEA Nuclear Security Series No. 4, IAEA, Vienna (2007).

INTERNATIONAL ATOMIC ENERGY AGENCY, Guidance on the Import and Export of Radioactive Sources, IAEA, Vienna (2005).

INTERNATIONAL ATOMIC ENERGY AGENCY, Handbook on Physical Protection of Nuclear Material and Facilities, IAEA-TECDOC-1276, Vienna (2002).

Nuclear Security — Measures to Protect against Nuclear Terrorism, Amendment to the Convention on the Physical Protection of Nuclear Material, Report by the Director General, GOV/INF/2005/10-GC(49)/INF/6, IAEA, Vienna (2005).

IAEA Nuclear Security Series No. 20 Objective and Essential Elements of a State's Nuclear Security Regime, 2013

IAEA Nuclear Security Series No. 13 Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5), 2011

IAEA Nuclear Security Series No. 14 Nuclear Security Recommendations on Radioactive Material and Associated Facilities, 2011

IAEA Nuclear Security Series No. 7 Nuclear Security Culture, 2008

IAEA Nuclear Security Series No. 8 Preventive and Protective Measures Against Insider Threats, 2008

IAEA Nuclear Security Series No. 9 Security in the Transport of Radioactive Material, 2008

IAEA Nuclear Security Series No. 10 Development, Use and Maintenance of the Design Basis Threat, 2009

IAEA Nuclear Security Series No. 11 Security of Radioactive Sources, 2009

IAEA Nuclear Security Series No. 19 Establishing the Nuclear Security Infrastructure for a Nuclear Power Programme, 2013

IAEA Nuclear Security Series No. 23-G Security of Nuclear Information, 2015

IAEA Nuclear Security Series No. 26-G Security of Nuclear Material in Transport, 2015

IAEA Nuclear Security Series No. 16 Identification of Vital Areas at Nuclear Facilities, 2012

IAEA Nuclear Security Series No. 17 Computer Security at Nuclear Facilities, 2011

IAEA Nuclear Security Series No. 4 Engineering Safety Aspects of the Protection of Nuclear Power Against Sabotage, 2007

NSE8. Nuclear material accounting and control for nuclear power plants and research reactors

A. Learning objectives

After successfully completing this module students will be able to identify, design, develop, and implement technical and administrative measures for nuclear material accounting and control for nuclear security at Nuclear Power Plants (NPPs) and Research Reactors (RRs).

B. Short description

This module provides an overview of the nuclear material accounting and control measures for nuclear power plants (NPP) and research reactors (RR).

C. Main modules

1. Introduction to the guidance document "Use of NMAC for Nuclear Security Purposes at Facilities," NSS 25-G
2. Use of NMAC for nuclear security
   - 2.1. Differences of NMAC for nuclear security as opposed to safeguards
   - 2.2. Nuclear security objectives of an NMAC system
   - 2.3. Security threats to nuclear material addressed by NMAC
3. Role of the State's competent authority in use of NMAC for nuclear security
   - 3.1. Developing comprehensive regulations for facility NMAC systems
   - 3.2. Reviewing facilities' NMAC programs prior to issuing a license to possess nuclear material
   - 3.3. Inspecting implementation of the facilities' NMAC programs
   - 3.4. Enforcing regulations.
4. Managing the NMAC System
   - 4.1. Assignment of a person with overall responsibility for the facility's nuclear material
   - 4.2. Importance of NMAC training and awareness for facility staff at all levels
   - 4.3. Use of "sub-MBAs" for improving nuclear material control (e.g. fresh fuel storage area, spent fuel pond, reactor, dry spent fuel storage)
   - 4.4. Importance of maintaining current knowledge of the location of all nuclear material items
5. NMAC records and reports

5.1. Keeping records of all activities and items

5.2. Preparing an item history form that begins with receipt of each item at the facility and following its individual history throughout its existence at the facility.

5.3. Records of moving assemblies from the fresh fuel storage area to the spent fuel pond, then into the reactor, and removing them from the reactor.

5.4. Documenting damage to assemblies or rods that may result in separation of the nuclear material from its original item.

5.5. Preparing and maintaining records of reconstitution of assemblies, if it occurs.

5.6. Maintaining an up-to-date list of inventory that includes identification numbers and locations.

6. Physical Inventory of Nuclear Material
7. Nuclear Material Control

7.1. Nuclear power plants (NPP)

7.1.1. Control measures (locks and keys, lists of authorized personnel, maintaining control over keys to essential equipment such as the spent fuel pond bridge and the area where fresh fuel is stored, etc.) used to deter and detect unauthorized facility personnel accessing nuclear material and areas of the facility where nuclear material is used or stored

7.2. Research reactors

7.2.1. Control measures (locks and keys, lists of authorized personnel, maintaining control over keys to essential equipment such as the spent fuel pond bridge and the area where fresh fuel is stored, etc.) used to deter and detect unauthorized facility personnel accessing nuclear material and areas of the facility where nuclear material is used or stored

7.2.2. Activities used to deter and detect misuse of the reactor or other equipment associated with nuclear material including unauthorized research activities (i.e. the use of high precision instrumentation and equipment) or unauthorized production and/or modification of nuclear or other radioactive materials

8. Tamper-Indicating Devices (TIDs)

8.1. Used to ship nuclear material from the fuel manufacturing facility

8.2. Assuring the integrity of containers of small nuclear material items (such as pins and pieces of pins separated from their assemblies)

9. Monitoring Nuclear Material Between PITs – Item Monitoring

9.1. Increasing assurance that nuclear material items are stored in their assigned and recorded locations.

9.2. Assuring that bulk material has not been stolen or misused

9.3. Applicability to NPPs and RRs.

10. Measurements and Measurement Control

10.1. The importance of measurements of discards and waste streams at a reactor site to ensuring that no nuclear material has been stolen or misused

10.2. Calculations of nuclear production (gain) and loss to ensure that nuclear material stolen, if that should occur, can be identified

11. Coordination of NMAC, Physical Protection, and Other Facility Functions

11.1. Communication and coordination among the organizations responsible for the facility's nuclear material

12. Nuclear Material Movements

12.1. Controlling movements of nuclear material

12.2. Keeping complete records of movements

13. Detection, Investigation, and Resolution of Irregularities

13.1. Detecting irregularities involving nuclear material

13.2. Investigating an irregularity and identifying the root cause

13.3. Importance of irregularities as an indication of possible attempted theft or misuse of nuclear material.

14. Assessment and Performance Testing of the NMAC System

14.1. Importance of assessments and performance tests

14.2. Conducting assessments and performance tests

D. Exercises

1. Tamper-indicating device selection
    a. Show various types of tamper-indicating devices
    b. Demonstrate use of tamper-indicating devices.
2. Receipt of nuclear material (e.g. fuel assemblies, rods) from the fuel manufacturer
    a. Demonstrate record-keeping associated with receipt of fresh fuel.
    b. Discuss activities for verifying receipts.
3. Periodic item monitoring test and administrative check
    a. Demonstrate selecting a sample of items from a list of inventory.

b. Discuss characteristics that should be observed (e.g. identification number, location).

4. Investigation and reporting of an irregularity
5. Discuss steps to be taken when investigating an irregularity.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

INTERNATIONAL ATOMIC ENERGY AGENCY, Use of nuclear material accounting and control for nuclear security at facilities, IAEA Nuclear Security Series No. 25-G, IAEA, Vienna (2015).

INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Material Accounting Handbook, IAEA Services Series No. 15, IAEA, Vienna (2008).

INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities, (INFCIRC/225/Revision 5), IAEA Nuclear Security Series No. 13, IAEA, Vienna (2011).

INTERNATIONAL ATOMIC ENERGY AGENCY, Preventive and Protective Measures against Insider Threats, Implementing Guide, IAEA Nuclear Security Series No. 8, IAEA, Vienna (2008).

United Nations Security Council Resolution 1540, Resolution S/RES/1540, United Nations, New York (2004).

The Convention on the Physical Protection of Nuclear Material, INFCIRC/274/Rev.1, IAEA, Vienna (1980); Amendment to the Convention on the Physical Protection of Nuclear Material, Resolution GOV/INF/2005/10-GC (49)INF/6, IAEA, Vienna (2005).

STOIBER, C., BAER, A., PELZER, N., TONHAUSER, W., Handbook on Nuclear Law, IAEA, Vienna (2003).

STOIBER, C., CHERF, A., TONHAUSER, W., DE LOURDES VEZ CARMONA, M. Handbook on Nuclear Law: Implementing Legislation, IAEA, Vienna (2010).

INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Security Culture, Implementing Guide, IAEA Nuclear Security Series No. 7, IAEA, Vienna (2008).

INTERNATIONAL ATOMIC ENERGY AGENCY, International Target Values 2010 for Measurement Uncertainties in Safeguarding Nuclear Materials, Safeguards Technical Report STR-368, IAEA, Vienna (2010).

Center for International & Security Studies at Maryland, Martha Williams, On the Importance of MC&A to Nuclear Security. https://www.files.ethz.ch/isn/177623/on_the_importance_of_mca_to_nuclear_security.pdf

Center for International & Security Studies at Maryland, Jonas Siegel, John Steinbruner, and Nancy Gallagher, Comprehensive Nuclear Material Accounting. http://drum.lib.umd.edu/bitstream/handle/1903/15589/compnucmatacct_cissm_final.pdf;sequence=1

NSE9. Nuclear material accounting and control for facilities that process nuclear material

A. Learning objectives

Upon completion of this module, students should be able to identify, design, develop, and implement measures to account and control for nuclear material at a facility that processes bulk nuclear material.

B. Short description

This module provides an overview of the nuclear material accounting and control measures for the facilities processing bulk nuclear material.

C. Main modules

1. Introduction to the IAEA guidance document "Use of NMAC for Nuclear Security Purposes at Facilities", NSS 25-G
2. Use of NMAC for nuclear security
   - 2.1. Differences of NMAC for nuclear security as opposed to safeguards
   - 2.2. Nuclear security objectives of an NMAC system
   - 2.3. Security threats to nuclear material addressed by NMAC
3. Role of the State's competent authority in use of NMAC for nuclear security
   - 3.1. Developing comprehensive regulations for facility NMAC systems
   - 3.2. Reviewing facilities' NMAC programs prior to issuing a license to possess nuclear material
   - 3.3. Inspecting implementation of the facilities' NMAC programs
   - 3.4. Enforcing regulations
4. Managing the NMAC System
   - 4.1. Assignment of a person with overall responsibility for the facility's nuclear material
   - 4.2. Importance of NMAC training and awareness for facility staff at all levels
   - 4.3. Use of "sub-MBAs" for improving nuclear material control (e.g. fresh fuel storage area, spent fuel pond, reactor, dry spent fuel storage)
   - 4.4. Importance of maintaining current knowledge of the location of all nuclear material items
5. NMAC records and reports

5.1. Keeping records of all activities and items

5.2. Preparing an item history form that begins with receipt of each item at the facility and following its individual history throughout its existence at the facility.

5.3. Records of moving assemblies from the fresh fuel storage area to the spent fuel pond, then into the reactor, and removing them from the reactor.

5.4. Documenting damage to assemblies or rods that may result in separation of the nuclear material from its original item.

5.5. Preparing and maintaining records of reconstitution of assemblies, if it occurs.

5.6. Maintaining an up-to-date list of inventory that includes identification numbers and locations.

6. Physical Inventory of Nuclear Material
7. Nuclear Material Control
   7.1. Control of access
      7.1.1. Control of locks and keys to essential equipment such as the tie downs, glove boxes, or storage cabinets
      7.1.2. Lists of authorized personnel coordinated with operations and physical protection
   7.2. Authorization of activities to detect and deter:
      7.2.1. unauthorized removal (abrupt or protracted)
      7.2.2. unauthorized production and/or modification of nuclear or other radioactive materials
8. Tamper-Indicating Devices (TIDs)
   8.1. Used on containment such as storage areas or containers of nuclear material to maintain the continuity of knowledge to reduce the time required for physical inventory taking (scheduled or non-scheduled).
9. Monitoring Nuclear Material Between PITs
   9.1. Item Monitoring
   9.2. Process Monitoring
10. Measurements and Measurement Control
   10.1. Assigning element and isotope values to all nuclear material
   10.2. Measurements of nuclear material during processing
   10.3. Measurements of nuclear material during shipping/receiving and transfers
11. Coordination of NMAC, Physical Protection, and Other Facility Functions

11.1. Communication and coordination between the organizations responsible for the facility's nuclear material.

12. Nuclear Material Movements
    12.1. Controlling movements of nuclear material
    12.2. Keeping complete records of movements
13. Detection, Investigation, and Resolution of Irregularities
    13.1. Using NMAC for detecting irregularities involving nuclear material
    13.2. Investigating an irregularity and identifying the root cause
        13.2.1. Any irregularity should be investigated
14. Assessment and Performance Testing of the NMAC System
    14.1. Importance of assessments and performance tests
    14.2. Conducting assessments and performance tests

D. Exercises

1. Tamper-indicating device selection
    1.1. Show various types of tamper-indicating devices
    1.2. Demonstrate use of tamper-indicating devices.
2. Receipt of nuclear material from an outside facility
    2.1. Demonstrate record-keeping associated with receipt of nuclear material.
    2.2. Discuss activities including measurements for verifying receipts.
3. Periodic item monitoring test and administrative check
    3.1. Demonstrate selecting a sample of items from a list of inventory.
    3.2. Discuss characteristics that should be observed (e.g. identification number, location).
4. Movement of nuclear material from one MBA to another within a facility
    4.1. Discuss activities including records and measurements for transfers.
5. Split and down blending exercise
    5.1. Discuss activities including measurements for splits and down blending.
6. Investigation and reporting of an irregularity
    6.1. Discuss steps to be taken when investigating an irregularity.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

INTERNATIONAL ATOMIC ENERGY AGENCY, Use of nuclear material accounting and control for nuclear security at facilities, IAEA Nuclear Security Series No. 25-G, IAEA, Vienna (2015).

INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Material Accounting Handbook, IAEA Services Series No. 15, IAEA, Vienna (2008).

INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities, (INFCIRC/225/Revision 5), IAEA Nuclear Security Series No. 13, IAEA, Vienna (2011).

INTERNATIONAL ATOMIC ENERGY AGENCY, Preventive and Protective Measures against Insider Threats, Implementing Guide, IAEA Nuclear Security Series No. 8, IAEA, Vienna (2008).

United Nations Security Council Resolution 1540, Resolution S/RES/1540, United Nations, New York (2004).

The Convention on the Physical Protection of Nuclear Material, INFCIRC/274/Rev.1, IAEA, Vienna (1980); Amendment to the Convention on the Physical Protection of Nuclear Material, Resolution GOV/INF/2005/10-GC (49)INF/6, IAEA, Vienna (2005).

STOIBER, C., BAER, A., PELZER, N., TONHAUSER, W., Handbook on Nuclear Law, IAEA, Vienna (2003).

STOIBER, C., CHERF, A., TONHAUSER, W., DE LOURDES VEZ CARMONA, M. Handbook on Nuclear Law: Implementing Legislation, IAEA, Vienna (2010).

INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Security Culture, Implementing Guide, IAEA Nuclear Security Series No. 7, IAEA, Vienna (2008).

INTERNATIONAL ATOMIC ENERGY AGENCY, International Target Values 2010 for Measurement Uncertainties in Safeguarding Nuclear Materials, Safeguards Technical Report STR-368, IAEA, Vienna (2010).

Center for International & Security Studies at Maryland, Martha Williams, On the Importance of MC&A to Nuclear Security. https://www.files.ethz.ch/isn/177623/on_the_importance_of_mca_to_nuclear_security.pdf

Center for International & Security Studies at Maryland, Jonas Siegel, John Steinbruner, and Nancy Gallagher, Comprehensive Nuclear Material Accounting. http://drum.lib.umd.edu/bitstream/handle/1903/15589/compnucmatacct_cissm_final.pdf;sequence=1

NSE10. Establishing and implementing a transport security plan

A. Learning objectives

Upon successful completion of this module, students should be able to:

- Understand the purpose of the transport security plan
- Describe the elements of a transport security plan
- Develop an effective transport security plan

B. Short description

This module will introduce to the students the concept of a transport security plan for the nuclear and other radioactive materials

C. Main modules

1. Goals and objectives of the Transport Security Plan
    1.1. Protect personnel, equipment, material and environment
    1.2. Identify responsibilities for all aspects of material protection
        1.2.1. Material control and accountability
        1.2.2. Material protection
        1.2.3. Information control
        1.2.4. Emergency and contingency response
2. Elements of a Transport Security Plan
    2.1. Scope
    2.2. Objectives
    2.3. Applicability
        2.3.1. Description of the material to be transported
    2.4. Administrative Requirements
        2.4.1. Policies, procedures and operations
            2.4.1.1. Testing and evaluation of the security plan
            2.4.1.2. Review and update of the security plan
            2.4.1.3. Readiness review and vulnerability assessment
            2.4.1.4. Threat assessment
            2.4.1.5. Reporting of threats and incidents
    2.5. Responsibilities

2.5.1. Allocation of responsibilities

2.5.2. Organizational structure

2.5.3. Trustworthiness

2.5.4. Training

2.6. Information Management

2.6.1. Information security

2.6.2. Records management

2.6.3. Confidentiality and protection of information

2.7. Transport Security Measures

2.7.1. Primary and alternative routes

2.7.2. Description of the security system

2.7.2.1. Equipment and modes of transport

2.7.2.2. Operations command and control

2.7.2.3. Additional security measures

2.7.2.4. Maintenance and testing of security systems and equipment

2.8. Emergency Response

2.8.1. Non-tactical and tactical emergency response

2.8.2. Incident communication

2.8.3. Notification of relevant agencies

3. Developing a transport security plan

3.1. Responsible entity

3.2. Planning timeline

3.3. Involvement of stakeholders

3.4. Approvals

D. Exercises

Table top: Develop a transport security plan for a hypothetical transport involving Category I nuclear material

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

IAEA Nuclear Security Series No. 9 Security in the Transport of Radioactive Material, IAEA, 2008

IAEA Nuclear Security Series No. 26-G Security of Nuclear Material in Transport, IAEA, 2015

IAEA Nuclear Security Series No. 20 Objectives and Essential elements of a State's Nuclear Security Regime, IAEA, 2013

IAEA Nuclear Security Series No. 13 Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5, IAEA, 2011

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL LABOUR ORGANIZATION, INTERNATIONAL MARITIME ORGANIZATION, INTERPOL, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, PREPARATORY COMMISSION FOR THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, UNITED NATIONS OFFICE FOR THE CO−ORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, WORLD METEOROLOGICAL ORGANIZATION, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, IAEA, Vienna (2015).

INTERNATIONAL ATOMIC ENERGY AGENCY, Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material, IAEA Safety Standards Series No. TS-G-1.2, IAEA, Vienna (2002).

INTERNATIONAL ATOMIC ENERGY AGENCY, Method for Developing Arrangements for Response to a Nuclear or Radiological Emergency, EPR-Method, IAEA, Vienna (2003).

NSE11. Designing and implementing a national detection architecture (NDA)

A. Learning objectives

Upon the successful completion of this module students will be able to identify the attributes and components of national nuclear security detection architecture, and to draft such a plan using various inputs.

B. Short description

This module provides an overview of the national detection architecture, its attributes, structural and organizational elements, and the role of informational and human factors in its effectiveness.

C. Main modules

1. Attributes of an effective nuclear security detection architecture
    1.1. National strategy
    1.2. National capabilities
    1.3. Needs assessment and evaluation
    1.4. International and regional cooperation
2. Structural and organizational elements of an NDA
    2.1. Legal framework
    2.2. Competent authorities
    2.3. Coordinating body
3. Nuclear security detection architecture design attributes
    3.1. Risk-informed approach
    3.2. Adaptability to specific conditions/circumstances
    3.3. Defence-in-depth
    3.4. Graded and balanced
    3.5. Adaptive and evolving over time
    3.6. Element of unpredictability
    3.7. Operational flexibility
    3.8. Reliance on a range of detection technologies (not only radiation)
    3.9. Integration of capabilities
    3.10. Iterative design process

4. Role of information in effective nuclear security detection architecture
    4.1. Types of information
    4.2. Information sources
    4.3. Handling the information
    4.4. Expert support
5. Human factor
    5.1. Trustworthiness of personnel
    5.2. Role of nuclear security culture

D. Exercises

Developing a notional national nuclear security detection architecture based on a hypothetical scenario and involving various stakeholders.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

International Atomic Energy Agency, *Nuclear Security Recommendations Nuclear and Other Radioactive Material out of Regulatory Control,* IAEA Nuclear Security Series No. 15 (Vienna, Austria: IAEA), 2011.

International Atomic Energy Agency, *Risk Informed Approach for Nuclear Security Measures for Nuclear and Other Radioactive Material out of Regulatory Control, Implementing Guide,* IAEA Nuclear Security Series No. 24-G (Vienna, Austria: IAEA), 2015.

International Atomic Energy Agency, *Nuclear Security Systems and Measures for the Detection of Nuclear and Other Radioactive Material out of Regulatory Control, Implementing Guide,* IAEA Nuclear Security Series No. 21 (Vienna, Austria: IAEA), 2013.

NSE12. Import/export and transit control mechanism and regime

A. Learning objectives

Upon the successful completion of this module, the students will be able to differentiate and apply the legal, procedural and administrative measures used for practical implementation of import and export control.

B. Short description

The module will provide a comprehensive knowledge of import/export control measures, legal aspects and documentation required for nuclear security specialists. Special attention will be paid to import/export of nuclear and other radioactive material and nuclear related equipment. Examples outside the nuclear and radioactive material field may be considered.

C. Main modules

1. Proliferation of nuclear weapons and export controls
   1.1. Early indications of proliferation activities;
   1.2. Interdicting and delay of proliferation;
   1.3. Terrorist organizations and export control.
2. Import/export national regulatory infrastructure and regulations
   2.1. Implementation of national law and regulations;
   2.2. Additional protocol and national export control requirements;
   2.3. Reporting system;
   2.4. Training.
3. Import/export legal instruments
   3.1. NPT and export/import control;
   3.2. Zangger Committee;
   3.3. Trigger list;
   3.4. Nuclear Suppliers Group (NSG);
   3.5. Multilateral export control;
   3.6. Additional protocol reporting requirements;
   3.7. Code of conduct.
4. Methodology for practical implementation
   4.1. Important nuclear weapon proliferation technologies, equipment and material;

4.2. Dual use equipment;

4.3. Nuclear proliferation practice, illicit nuclear trade;

4.4. Export/import control practice.

5. Nuclear and radioactive material international trade

5.1. Nuclear and radioactive material as objects of international trade;

5.2. Transportation in international trade;

5.3. Export/import packing and labelling;

5.4. Nuclear and radioactive material tariff classification codes;

5.5. Nuclear and radioactive material characteristics subject to customs verification.

6. Exporting/importing and transit of nuclear and radioactive material: Procedures and documentation

6.1. Legal framework and regulations;

6.2. Non-tariff restrictions and licenses;

6.3. Export/import documentation;

6.4. Transit documentation;

6.5. Customs clearance and customs inspection;

6.6. Risks associated with transit countries;

6.7. Differences in national export control systems;

6.8. Relationship between the international and the national export control system;

6.9. Gaps at the interface of the two systems.

D. Exercises

Case study: Import of dual use equipment for clandestine enrichment purposes.

Demonstration of typical import/export and transit documentation.

Case study: Check for correctness a set of documentation and labelling for import of nuclear related equipment.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

Communication Received from Certain Member States Regarding Guidelines for the Export of Nuclear Material, Equipment and Technology, INFCIRC254/Rev. 6/Part 2 and Rev. 7/Part 1, IAEA, Vienna (2005).

Communication Received from Members Regarding the Export of Nuclear Material and of Certain Categories of Equipment and other Material, INFCIRC/209/Rev. 1, IAEA, Vienna (1990).

Customs Convention on Containers, United Nations/International Maritime Organization, Brussels (1972).

INTERNATIONAL ATOMIC ENERGY AGENCY, Combating Illicit Trafficking in Nuclear and other Radioactive Material, IAEA Nuclear Security Series No. 6, Vienna (2007).

INTERNATIONAL ATOMIC ENERGY AGENCY, Guidance on the Import and Export of Radioactive Sources, IAEA, Vienna (2005).

INTERNATIONAL ATOMIC ENERGY AGENCY, Security in the Transport of Radioactive Material, IAEA Nuclear Security Series No. 9, IAEA, Vienna (2008).

INTERNATIONAL ATOMIC ENERGY AGENCY, Security of Radioactive Sources, IAEA Nuclear Security Series No. 11, IAEA, Vienna (2009).

INTERNATIONAL ATOMIC ENERGY AGENCY, UNIVERSAL POSTAL UNION WORLD CUSTOMS ORGANIZATION, Monitoring of Radioactive Material in International Mail Transported by Public Postal Operators, IAEA Nuclear Security Series No. 3, Vienna (2006).

International Convention on Mutual Assistance in Customs Matters (Johannesburg Convention), World Customs Organization, Brussels (2003).

International Convention on the Simplification and Harmonization of Customs Procedures, World Customs Organization, Kyoto (1973, as amended 1993).

NSE13. Nuclear security framework for major public events

A. Learning objectives

Upon the successful completion of this module students will be able to design a comprehensive nuclear security system for major public events.

B. Short description

This module will emphasize the practical issues of a comprehensive nuclear security system for major public events, including threat analysis, prevention, detection and response activities, and the general principles for the development of an action plan.

C. Main modules

1. Design of comprehensive nuclear security system for major public events
   1.1. Threat analysis;
   1.2. Prevention activities;
   1.3. Detection activities;
   1.4. Response activities;
   1.5. General principles for the development of an action plan;
   1.6. Management of resources and information security.
2. Threat analysis
   2.1. Evaluation of threat;
   2.2. Vulnerability assessment;
   2.3. Security measures for radioactive sources;
   2.4. IAEA Illicit Trafficking Database.
3. Prevention measures
   3.1. Physical protection of critical radiation sources;
   3.2. Role of the State in creating an effective physical protection system;
   3.3. Border monitoring;
   3.4. Nuclear security preparation for a State hosting a major public event;
   3.5. Awareness and training.
4. Detection measures
   4.1. Selection of venues and other strategic locations for detection systems;
   4.2. Detection approach and equipment deployment strategies;

4.3. Detection instruments;

4.3.1. Types of detection instrumentation;

4.3.2. Detection instruments at strategic locations;

4.3.3. Pre-event radiological surveys and background mapping;

4.3.4. Early detection systems outside strategic locations;

4.4. Acceptance testing;

4.5. Equipment calibration and maintenance;

4.6. Training.

5. Response measures

5.1. Elements of response;

5.2. Organizational structure for response;

5.2.1. Role of the response organization;

5.2.2. Required infrastructure for the response organization;

5.3. Response to an alarm;

5.3.1. Alarm response procedures for strategic locations and other important points;

5.3.2. Search procedures;

5.3.3. Mobile expert support team (MEST) and reach-back to experts;

5.4. Emergency preparedness and response;

5.4.1. National emergency management system;

5.4.2. Event-specific arrangements for major public event under the emergency response plan;

5.4.3.

5.4.4. Medical emergency preparedness and response

5.4.5. Protection of emergency workers

5.4.6. Public communications

5.5. Consequence management for nuclear security;

5.5.1. Assessment, rescue, recovery and restoration;

5.5.2. Recovery and return nuclear and other radioactive material under regulatory control;

5.6. Collection and preservation of evidence and prosecution;

5.7. Training and awareness.

D. Exercises

Case study: Example command and control structure for a major sports event.

Action plan: Study of an example.

Case study: Design basis threat for a major sports event.

Presentation of a generic alarm response scheme for a major public event.

E. Laboratory work

Radiation alarm verification in a crowd.

F. Suggested readings

IAEA Nuclear Security Series No. 15 Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control, 2011

IAEA Nuclear Security Series No. 11 Security of Radioactive Sources, 2009

IAEA Nuclear Security Series No. 18 Nuclear Security Systems and Measures for Major Public Events, 2012

IAEA Nuclear Security Series No. 21 Nuclear Security Systems and Measures for the Detection of Nuclear and Other Radioactive Material out of Regulatory Control, 2013

IAEA Nuclear Security Series No. 22-G Radiological Crime Scene Management, 2014

IAEA Nuclear Security Series No. 24-G Risk Informed Approach for Nuclear Security Measures for Nuclear and other Radioactive Material out of Regulatory Control, 2015

INTERNATIONAL ATOMIC ENERGY AGENCY, Categorization of Radioactive Sources, IAEA Safety Standards Series No. RS-G-1.9, IAEA, Vienna (2005).

INTERNATIONAL ATOMIC ENERGY AGENCY, Code of Conduct on the Safety and Security of Radioactive Sources, IAEA/CODEOC/2001, IAEA, Vienna (2001).

INTERNATIONAL ATOMIC ENERGY AGENCY, Combating Illicit Trafficking in Nuclear and Other Radioactive Material, IAEA Nuclear Security Series No. 6, Vienna (2007).

INTERNATIONAL ATOMIC ENERGY AGENCY, Development, Use and Maintenance of the Design Basis Threat, IAEA Nuclear Security Series No. 10, IAEA, Vienna (2009).

INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Security Measures at the XV Pan American Games: Rio de Janeiro 2007, IAEA, Vienna (2009).

INTERNATIONAL ATOMIC ENERGY AGENCY, Regulations for the Safe Transport of Radioactive Material, IAEA Safety Standards Series No. TS-R-1, 9th ed., IAEA, Vienna (2009).

INTERNATIONAL ATOMIC ENERGY AGENCY, Security of Radioactive Sources, IAEA Nuclear Security Series No. 11, IAEA, Vienna (2009).

INTERNATIONAL ATOMIC ENERGY AGENCY, Technical and Functional Specifications for Border Monitoring Equipment, IAEA Nuclear Security Series No. 1, Vienna (2006).

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL LABOUR ORGANIZATION, INTERNATIONAL MARITIME ORGANIZATION, INTERPOL, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, PREPARATORY COMMISSION FOR THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, UNITED NATIONS OFFICE FOR THE CO¬ORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, WORLD METEOROLOGICAL ORGANIZATION, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, IAEA, Vienna (2015).

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR OFFICE, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS OFFICE FOR THE CO-ORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH

ORGANIZATION, Arrangements for Preparedness for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GS-G-2.1, IAEA, Vienna (2006).

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR OFFICE, PAN AMERICAN HEALTH ORGANIZATION, WORLD HEALTH ORGANIZATION, Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSG-2, IAEA, Vienna (2011).

INTERNATIONAL ATOMIC ENERGY AGENCY, Generic Procedures for Monitoring in a Nuclear or Radiological Emergency, IAEA-TECDOC-1092, Vienna (1999).

INTERNATIONAL ATOMIC ENERGY AGENCY, Manual for First Responders to a Radiological Emergency, EPR-First Responders, IAEA, Vienna (2006).

INTERNATIONAL ATOMIC ENERGY AGENCY, Method for developing Arrangements for Response to a Nuclear or Radiological Emergency, EPR-METHOD 2003, IAEA, Vienna (2003).

INTERNATIONAL ATOMIC ENERGY AGENCY, WORLD HEALTH ORGANIZATION, Generic Procedures for Medical Response During Nuclear and Radiological Emergency, EPR-MEDICAL, IAEA, Vienna (2005).

INTERNATIONAL ATOMIC ENERGY AGENCY, Generic procedures for assessment and response during a radiological emergency, IAEA TECDOC 1162, IAEA, Vienna (2000).

INTERNATIONAL ATOMIC ENERGY AGENCY, Communication with the Public in a Nuclear or Radiological Emergency, EPR-Public Communications, IAEA, Vienna (2012).

INTERNATIONAL ATOMIC ENERGY AGENCY, Method for Developing a Communication Strategy and Plan for a Nuclear or Radiological Emergency, EPR-Communication Plan, IAEA, Vienna (2015).

NSE14. Radiological crime scene management

A. Learning objectives

Upon the successful completion of this module students should be familiar with radiological crime scene investigation and its relation to the conduct of a nuclear forensics examination. Students will be able to identify the basics of crime scene management, collection of evidence and forensic techniques, which provide insights into methods of production and sources of illicit radioactive material. The students' understanding of nuclear forensics will be most powerful when combined with traditional methods of investigation, including intelligence sources and traditional law enforcement investigations.

B. Short description

This module has two main goals: to offer introductions to crime scene management and to traditional and nuclear forensic techniques. The available tools, techniques and methods of traditional forensics will be introduced. In particular, the course will focus on the forensics examination process, which can play a decisive role in attributing and prosecuting crimes involving radioactive material. Basic principles of nuclear forensics and nuclear forensic interpretation will be presented and discussed. The course will include lectures on international cooperation, the principles of incident response and nuclear forensics model action plan.

C. Main modules

1. Introduction to traditional forensics
    1.1. Crime scene techniques and methods;
    1.2. Traditional forensic evidence.
2. Radiological crime scene — organization and fundamental stages
    2.1. Conduct of operations;
        2.1.1. Securing the incident site;
        2.1.2. Involvement of national regulatory authority;
        2.1.3. On-site measurements.
            2.1.3.1. Categorization.
        2.1.4. Collection of traditional and radioactive evidence;
        2.1.5. Arrangements for safe handling of the radioactive material;

2.1.6. Chain of Custody.

2.2. Traditional forensics related to a radiological crime scene;

2.2.1. Inked and latent finger prints;

2.2.2. Toxicology and forensic entomology;

2.2.3. Serology, nuclear and mitochondrial DNA analysis;

2.2.4. Impression forensics: Firearms, tool marks, shoe and tire prints;

2.2.5. Document analysis and digital evidence.

2.3. Collection of evidence in radiological incidents;

2.3.1. Interdicted radiological material in transit;

2.3.2. Range of potential RDD material and their legitimate uses;

2.3.3. Radiologically contaminated traditional trace and bulk evidence in a radiological dispersal event;

2.3.4. Sample handling.

2.4. Final survey and release of scene;

2.5. Evidence holding site;

2.6. Transportation of evidence;

2.7. Case treatment by the national courts.

3. Forensics examination plan and nuclear forensics analytical plan

3.1. Forensics examination plan;

3.1.1. Investigations to be foreseen at the specialized national nuclear forensics laboratory;

3.1.2. Material Sampling and Distribution.

3.2. Nuclear forensics analytical plan;

3.2.1. Consideration of traditional forensics analyses.

3.3. Introduction Nuclear forensics analysis;

3.3.1. Forensics analysis of interdicted nuclear and other radioactive material;

3.3.2. Categorization;

3.3.3. Characterization.

3.4. Nuclear forensics interpretation;

3.5. National nuclear forensics libraries and databases;

3.6. Nuclear forensics findings.

3.6.1. Confidence in conclusions;

3.6.2. Communication of nuclear forensics findings to law enforcement and competent authorities.

D. Exercises

Examples of traditional forensic evidence.

Examples of a forensics examination plan.

Tabletop exercise: Transportation and storage of evidence.

E. Laboratory work

Determination of the source of radioactive material and its method of production.

F. Suggested reading

INTERNATIONAL ATOMIC ENERGY AGENCY, Radiological Crime Scene Management, IAEA Nuclear Security Series No. 22-G, Vienna (2014).

INTERNATIONAL ATOMIC ENERGY AGENCY, Combating Illicit Trafficking in Nuclear and other Radioactive Material, IAEA Nuclear Security Series No. 6, Vienna (2007).

INTERNATIONAL ATOMIC ENERGY AGENCY, Identification of Radioactive Sources and Devices, IAEA Nuclear Security Series No. 5, IAEA, Vienna (2007).

INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Forensics Support of Investigations, IAEA Nuclear Security Series No. 2-G Rev.1, IAEA, Vienna (2015).

INTERNATIONAL ATOMIC ENERGY AGENCY, Application of Nuclear Forensics in Combating Illicit Trafficking of Nuclear and Other Radioactive Material, IAEA TECDOC 1730, Vienna (2015).

Advances in Destructive and Non-Destructive Analysis for Environmental Monitoring and Nuclear Forensics (Proc. Int. Conf. Karlsruhe, 2002), IAEA, Vienna (2003).

NSE15. Nuclear forensic analysis

A. Learning objectives

Upon the successful completion of this module students will have a solid understanding of the conduct of a nuclear forensic analysis supporting the investigation of a nuclear security event to include relevant methodologies, tools and procedures.

B. Short description

The focus of this module on nuclear forensics laboratory analysis will incorporate descriptions of analytical tools and their application as part of a nuclear forensic examination. In addition, the course will emphasize the sampling and distribution methods in a nuclear forensics laboratory as well as development of analytical plans. Considerable time will be spent on interpretation of findings in nuclear forensics and data quality methods aiming to enhance confidence in driven conclusions.

C. Main modules

1. Introductory elements of nuclear forensic science
    1.1. Nuclear and other radioactive material;
    1.2. Effects of production and treatment of nuclear and other radioactive material on specific signatures (physical, chemical and isotopic signatures);
        1.2.1. Separation and enrichment of uranium;
        1.2.2. Nuclear reactors and the production of plutonium;
        1.2.3. Nuclear fuel cycle operations;
        1.2.4. Threat from nuclear and radiological explosive devices;
        1.2.5. Nuclear applications in medicine, industry and research.
2. Radioanalytical chemistry principles and practices
    2.1. Dissolution of solids;
    2.2. Carriers and tracers in inorganic analysis;
    2.3. Relevant chemical and physical properties;
    2.4. Analytical techniques for forensic signatures.
        2.4.1. Radionuclide separation and purification;
        2.4.2. Standard methods in radioanalytical chemistry.
3. Iterative nuclear forensics process;

3.1. Development of forensic examination plan and nuclear forensic analytical plan meeting requirements of the lead investigator;

3.2. Hypothesis building (case knowledge bases, archived material, other experts);

3.3. Analysis (radioactive material and traditional forensics);

3.4. Interpretation/exclusion;

3.5. Communication of nuclear forensics findings;

3.6. Confidence in nuclear forensics findings.

4. Forensic examination plan and nuclear forensic analytical plan

4.1. Development of a forensics examination plan;

4.1.1. Traditional evidence contaminated with radionuclides;

4.1.2. Nuclear forensics analysis;

4.1.3. Sampling and distribution;

4.2. Development of a nuclear forensics analytical plan;

4.3. Nuclear forensic laboratory;

4.4. Time scale for completion of analysis (24 hours, one week, two months).

4.4.1. Expected outputs at each period.

5. Nuclear forensic analysis

5.1. Categorization goals

5.2. Characterization goals;

5.3. Presentation of available analytical tools for nuclear forensics;

5.3.1. Type of information provided;

5.3.2. Typical detection limit;

5.3.3. Spatial resolution.

5.4. Non-destructive followed by destructive analysis techniques and methods;

5.4.1. Radiological (estimated total activity, dose rate (a, b, g, n), surface contamination);

5.4.2. Physical (visual inspection, radiography, photography, weight, dimensions, optical microscopy, density);

5.4.2.1.1. Isotope analysis (g spectroscopy, a spectroscopy);

5.4.2.1.2. Mass spectrometry;

5.4.2.1.3. Elemental/chemical analysis;

5.4.2.2. Particle analysis;

5.4.2.3. Traditional forensics (fingerprints, fibres);

5.4.2.4. Other techniques.

6. Nuclear forensic interpretation
   6.1. Methods and forensic signatures;
      6.1.1. Empirical approach through the systematic analysis of nuclear and radioactive material;
      6.1.2. Modelling based on the chemistry and physics of nuclear processes;
      6.1.3. Radiochronometry and interpretation of signatures;
      6.1.4. Interpretation of other signatures, i.e. morphological, trace element, minor isotopes (e.g., U-236).
   6.2. Knowledge basis of nuclear fuel cycle processes;
      6.2.1. Archived material;
      6.2.2. Open literature;
      6.2.3. Closed literature;
      6.2.4. National nuclear forensics libraries and databases;
      6.2.5. Information exchange in nuclear forensics;
      6.2.6. Cooperation with other nuclear forensics laboratories.
7. Confidence of nuclear forensics findings
   7.1. Analytical data quality objectives;
   7.2. Quality Systems;
      7.2.1. Quality control regime;
      7.2.2. Laboratory accreditation.
   7.3. Certified reference materials;
      7.3.1. Analysis of known standards;
   7.4. Precision and accuracy;
   7.5. Uncertainty determination;
   7.6. State of practice;
   7.7. Validated and accepted methods;
      7.7.1. Written procedures and protocols;
   7.8. Demonstrated competency and peer review.
8. Communication of nuclear forensics findings
   8.1. Provenance assessment;
   8.2. Communication of findings to law enforcement and competent authorities;
   8.3. Legal Considerations;

8.3.1. Rules of evidence;

8.3.2. Documentation;

8.3.2.1. Chain of custody;

8.3.2.2. Case notes and communication logs;

8.3.3. Confidentiality;

8.3.4. Expert qualification.

9. International cooperation

9.1. Nuclear Forensics International Technical Working Group;

9.2. National Nuclear Forensics Library;

9.3. Inter-laboratory forensic exercises;

9.4. Procedure for requesting assistance in nuclear forensic investigations through the IAEA or through already existing bi- and multi-lateral mechanisms.

D. Exercises

Proposal for a series of exercises related to the interdiction of material in a container:
Sampling of interdicted material, taken from the surface of an interdicted container.
Development of an analytical plan.
Instrument selection for analysis of sample.
Analysis of sample.
Data interpretation of the results of analysis.
Evaluation of material origin and history (including use of databases).
Communication of findings.

E. Laboratory work

Use of various analytical tools to determine the source of nuclear and radioactive material and its method of production.

F. Suggested readings

INTERNATIONAL ATOMIC ENERGY AGENCY, Categorization of Radioactive Sources, IAEA Safety Standards Series No. RS-G-1.9, IAEA, Vienna (2005).

INTERNATIONAL ATOMIC ENERGY AGENCY, Combating Illicit Trafficking in Nuclear and Other Radioactive Material, IAEA Nuclear Security Series No. 6, Vienna (2007).

INTERNATIONAL ATOMIC ENERGY AGENCY, Identification of Radioactive Sources and Devices, IAEA Nuclear Security Series No. 5, IAEA, Vienna (2007).

INTERNATIONAL ATOMIC ENERGY AGENCY, Dangerous Quantities of Radioactive Material (D-Values), EPR-D-VALUES 2006, IAEA, Vienna (2006).

INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Forensics in Support of Investigations, IAEA Nuclear Security Series No. 2-G Rev. 1, Vienna (2015).

INTERNATIONAL ATOMIC ENERGY AGENCY, Security of Radioactive Sources, IAEA Nuclear Security Series No. 11, IAEA, Vienna (2009).

INTERNATIONAL ATOMIC ENERGY AGENCY, Radiological Crime Scene Management, IAEA Nuclear Security Series No. 22-G, Vienna (2014).

INTERNATIONAL ATOMIC ENERGY AGENCY, Application of Nuclear Forensics in Combating Illicit Trafficking of Nuclear and Other Radioactive Material, IAEA TECDOC 1730, Vienna (2015).

Advances in Destructive and Non-Destructive Analysis for Environmental Monitoring and Nuclear Forensics (Proc. Int. Conf. Karlsruhe, 2002), IAEA, Vienna (2003).

INTERNATIONAL ATOMIC ENERGY AGENCY, IAEA Response and Assistance Framework, EPR-RANET, IAEA, Vienna (2013).

NSE16. Information/computer security incident response

A. Learning objectives

Upon the successful completion of this module, students should be able to develop comprehensive contingency plans for computer security incidents which have potential impact on nuclear security and/or nuclear safety

B. Short description

This module will introduce students to the concept of the information and computer security incident response, including all phases of the response, analysis, relevant policies, and roles and responsibilities of various stakeholders in the response process.

C. Main modules

1. Concepts And Context
    1.1. Definition of a computer security incident
    1.2. Incident Response Overview
    1.3. Tiers Of Incident Response
2. Incident Response Phases
    2.1. Preparation
    2.2. Detection And Analysis
    2.3. Mitigation (Containment, Eradication, Recovery)
    2.4. Post Incident Activity
    2.5. Reporting
3. Incident Analysis
    3.1. Determining the Severity of an Incident
    3.2. Computer Security Incidents Impact On Safety
    3.3. Loss Or Compromise Of Sensitive Information
    3.4. Threat Analysis
    3.5. Technical Characterization
4. Policy, Roles And Responsibilities
    4.1. Computer Security Incident Response Policies
    4.2. Computer security incident response roles and responsibilities
    4.3. Computer Security Incident Response Plan

4.4. Computer Security Incident Response Plan (CRISP) Elements

4.5. Incident Response Organisation

4.6. Computer Security Incident Response Processes And Procedures

5. Special considerations for industrial control systems

D. Exercises

Table top: develop a response plan for computer security incident

Table top: develop a response plan for information security incident

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

Nuclear Security Series No. 17 Computer Security at Nuclear Facilities, IAEA, http://www-pub.iaea.org/books/IAEABooks/8691/Computer-Security-at-Nuclear-Facilities.

IAEA Computer Security Incident Response Planning at Nuclear Facilities, IAEA, http://www-pub.iaea.org/MTCD/Publications/PDF/TDL005web.pdf.

NSE17. Conducting computer security assessments

A. Learning objectives

Upon the successful completion of this module students should be able to demonstrate the knowledge of the methodology for conducting assessments of computer security at nuclear facilities.

B. Short description

This module outlines the methodology and implementation of the assessment for information and computer security activities at nuclear facilities.

C. Main modules

1. Overview of Assessment Methodology and Process
    1.1. Setting Objectives
    1.2. Guiding Principles
    1.3. Assessment Domains
    1.4. Evaluation Techniques
    1.5. Information Security Considerations
2. Preparatory Activities
    2.1. Establishing the Scope of the Review
    2.2. Preparatory Activities
    2.3. Developing an Assessment Team
    2.4. Schedule of Mission Activities
3. Evaluation Methodology
    3.1. Assessing computer security
        3.1.1. Prescriptive/compliance analysis
        3.1.2. Performance analysis
    3.2. Assessment Matrix
4. Assessing Security Domains
    4.1. Security Policy
    4.2. Computer Security Management
    4.3. Asset Management
    4.4. Human Resources Security

4.5. Physical Protection

4.6. Communications and Operations Management

4.7. Computer Access Controls

4.8. Computer Systems Acquisition, Development and Maintenance

4.9. Computer Security Incident Management

4.10. Continuity Management

5. Evaluation and Post-Assessment Activities

5.1. Developing the Final Report

5.2. Assessment Trends

5.3. Analysis of Results

D. Exercises

Planning an assessment

Conducting assessment activities

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested readings

Nuclear Security Series No. 17 Computer Security at Nuclear Facilities, IAEA, http://www-pub.iaea.org/books/IAEABooks/8691/Computer-Security-at-Nuclear-Facilities.

Conducting Computer Security Assessments at Nuclear Facilities, IAEA, http://www-pub.iaea.org/MTCD/Publications/PDF/TDL006web.pdf.

ANNEX II:
RECOMMENDED COURSES FOR A CERTIFICATE PROGRAMME CURRICULUM IN NUCLEAR SECURITY

The Certificate Programme in Nuclear Security differs from the Master's programme curriculum mainly in terms of the volume of information delivered throughout the programme, the learning objectives, and the number of courses or modules offered. In general, whereas the Master students are expected to be able to show in-depth understanding of a broad range of topics in the area of nuclear security, holders of a certificate may only have to become aware of the importance, depth, and breadth of this field, to familiarize themselves with these topics to.

It is important, however, to ensure that certificate programme participants are introduced to each aspect of nuclear security, at least briefly, to facilitate this broad awareness. For that purpose, the outlines of the teaching modules introduced in Annex I can be used by the instructor, who can scale the scope of each presented module to the timeframe allocated to it, combine modules where necessary, and design modules with the ultimate learning objective of the certificate programme in mind. Depending on the priority, programmatic needs, and regulations of education institutions, certificate programmes may range in length from 1-2 to 14-16 weeks. Therefore, each institution deciding to establish such a certificate programme in the field of nuclear security may use this model curriculum to design the programme that fits their exact need.

Given the factors outlined above, a notional certificate programme in nuclear security may be based on the following outline:

1. Introduction to Nuclear Security

1.1. Interface of nuclear security with safety and safeguards

1.2. Legal and regulatory framework for nuclear security

1.3. Risk-informed approach to nuclear security: prevention, detection, and response

1.4. Management of nuclear security

1.4.1. International and national stakeholder cooperation in nuclear security

1.4.2. Human factor in nuclear security

1.4.2.1. Nuclear security culture

1.4.2.2. Preventing and protecting against insider threat

1.4.2.3. Human resource development

1.4.3. Information security

2. Protecting Materials, Facilities, and Activities

2.1. Threat and vulnerability assessment for nuclear and other radioactive materials, facilities, and activities

2.1.1. Design Basis Threat (DBT)

2.2. Principles and systems of physical protection (design, evaluation, technologies, and equipment)

2.3. Nuclear material accounting and control for nuclear security (NMAC)

2.4. Security of nuclear and other radioactive material in transport

2.5. Computer security for a nuclear world

3. Detecting and Responding to Nuclear Security Events Involving Materials Out of Regulatory Control

3.1. Detection of criminal and other unauthorized acts involving nuclear and other radioactive material out of regulatory control (MORC)

3.1.1. Threat assessment for MORC

3.1.2. National detection architecture

3.1.3. Nuclear security for major public events

3.2. Response to criminal and other unauthorized acts involving nuclear and other radioactive material out of regulatory control (MORC)

3.2.1. National Response Plan

3.2.2. Response measures

3.2.3. Radiological crime scene management

3.2.4. Nuclear forensic analysis