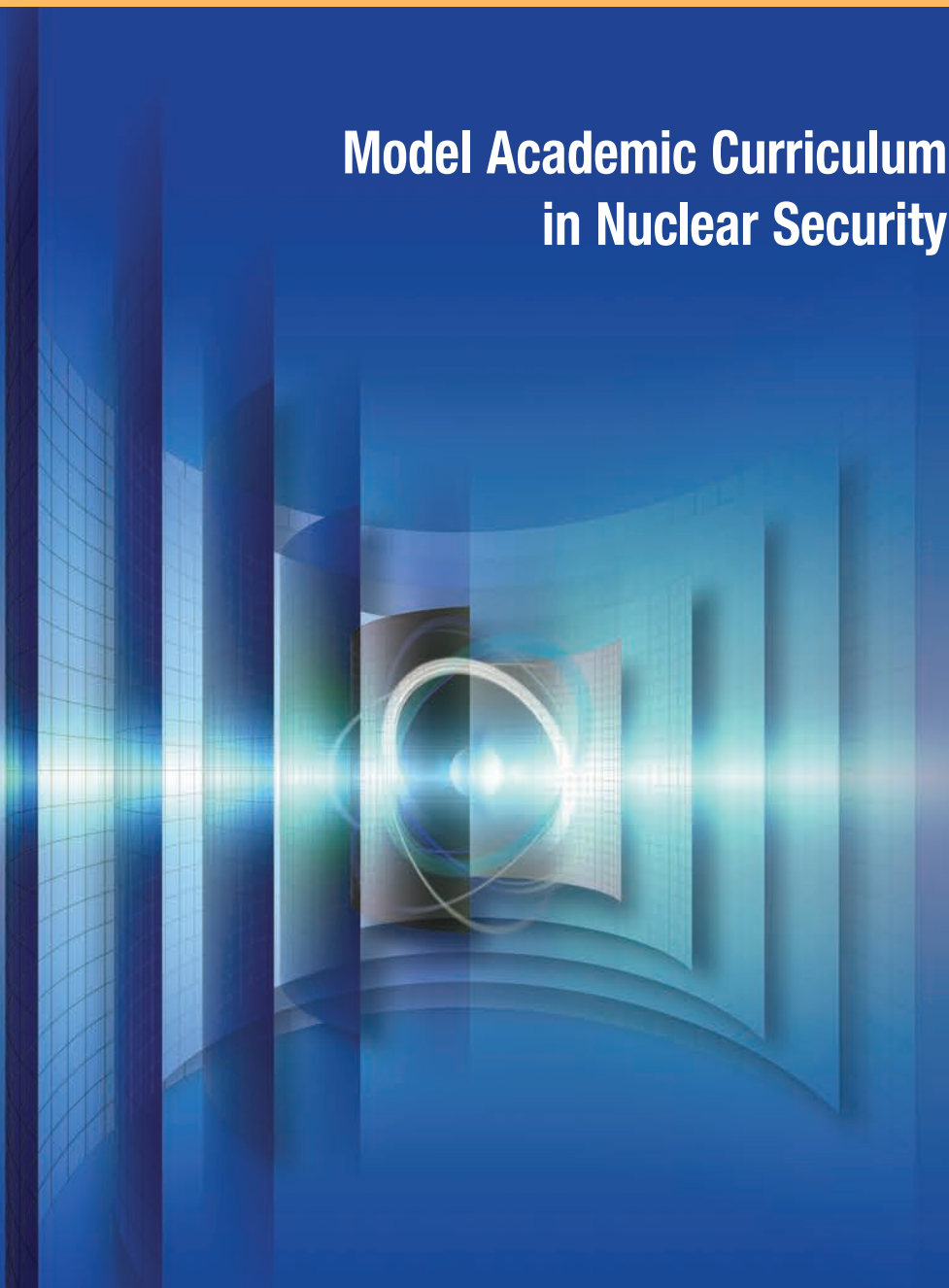
IAEA Nuclear Security Series No. 12-T (Rev. 1)

Technical Guidance

Model Academic Curriculum in Nuclear Security



IAEA
International Atomic Energy Agency

IAEA NUCLEAR SECURITY SERIES

Nuclear security issues relating to the prevention and detection of, and response to, criminal or intentional unauthorized acts involving, or directed at, nuclear material, other radioactive material, associated facilities or associated activities are addressed in the **IAEA Nuclear Security Series**. These publications are consistent with, and complement, international nuclear security instruments, such as the Convention on the Physical Protection of Nuclear Material and its Amendment, the International Convention for the Suppression of Acts of Nuclear Terrorism, United Nations Security Council resolutions 1373 and 1540, and the Code of Conduct on the Safety and Security of Radioactive Sources.

CATEGORIES IN THE IAEA NUCLEAR SECURITY SERIES

Publications in the IAEA Nuclear Security Series are issued in the following categories:

- **Nuclear Security Fundamentals** specify the objective of a State's nuclear security regime and the essential elements of such a regime. They provide the basis for the Nuclear Security Recommendations.
- **Nuclear Security Recommendations** set out measures that States should take to achieve and maintain an effective national nuclear security regime consistent with the Nuclear Security Fundamentals.
- **Implementing Guides** provide guidance on the means by which States could implement the measures set out in the Nuclear Security Recommendations. As such, they focus on how to meet the recommendations relating to broad areas of nuclear security.
- **Technical Guidance** provides guidance on specific technical subjects to supplement the guidance set out in the Implementing Guides. They focus on details of how to implement the necessary measures.

DRAFTING AND REVIEW

The preparation and review of Nuclear Security Series publications involves the IAEA Secretariat, experts from Member States (who assist the Secretariat in drafting the publications) and the Nuclear Security Guidance Committee (NSGC), which reviews and approves draft publications. Where appropriate, open-ended technical meetings are also held during drafting to provide an opportunity for specialists from Member States and relevant international organizations to review and discuss the draft text. In addition, to ensure a high level of international review and consensus, the Secretariat submits the draft texts to all Member States for a period of 120 days for formal review.

For each publication, the Secretariat prepares the following, which the NSGC approves at successive stages in the preparation and review process:

- An outline and work plan describing the intended new or revised publication, its intended purpose, scope and content;
- A draft publication for submission to Member States for comment during the 120 day consultation period;
- A final draft publication taking account of Member States' comments.

The process for drafting and reviewing publications in the IAEA Nuclear Security Series takes account of confidentiality considerations and recognizes that nuclear security is inseparably linked with general and specific national security concerns.

An underlying consideration is that related IAEA safety standards and safeguards activities should be taken into account in the technical content of the publications. In particular, Nuclear Security Series publications addressing areas in which there are interfaces with safety — known as interface documents — are reviewed at each of the stages set out above by relevant Safety Standards Committees as well as by the NSGC.

MODEL ACADEMIC CURRICULUM IN NUCLEAR SECURITY

The following States are Members of the International Atomic Energy Agency:

AFGHANISTAN
ALBANIA
ALGERIA
ANGOLA
ANTIGUA AND BARBUDA
ARGENTINA
ARMENIA
AUSTRALIA
AUSTRIA
AZERBAIJAN
BAHAMAS
BAHRAIN
BANGLADESH
BARBADOS
BELARUS
BELGIUM
BELIZE
BENIN
BOLIVIA, PLURINATIONAL STATE OF
BOSNIA AND HERZEGOVINA
BOTSWANA
BRAZIL
BRUNEI DARUSSALAM
BULGARIA
BURKINA FASO
BURUNDI
CAMBODIA
CAMEROON
CANADA
CENTRAL AFRICAN REPUBLIC
CHAD
CHILE
CHINA
COLOMBIA
COMOROS
CONGO
COSTA RICA
CÔTE D'IVOIRE
CROATIA
CUBA
CYPRUS
CZECH REPUBLIC
DEMOCRATIC REPUBLIC OF THE CONGO
DENMARK
DJIBOUTI
DOMINICA
DOMINICAN REPUBLIC
ECUADOR
EGYPT
EL SALVADOR
ERITREA
ESTONIA
ESWATINI
ETHIOPIA
FIJI
FINLAND
FRANCE
GABON
GEORGIA
GERMANY
GHANA
GREECE
GRENADA
GUATEMALA
GUYANA
HAITI
HOLY SEE
HONDURAS
HUNGARY
ICELAND
INDIA
INDONESIA
IRAN, ISLAMIC REPUBLIC OF
IRAQ
IRELAND
ISRAEL
ITALY
JAMAICA
JAPAN
JORDAN
KAZAKHSTAN
KENYA
KOREA, REPUBLIC OF
KUWAIT
KYRGYZSTAN
LAO PEOPLE'S DEMOCRATIC REPUBLIC
LATVIA
LEBANON
LESOTHO
LIBERIA
LIBYA
LIECHTENSTEIN
LITHUANIA
LUXEMBOURG
MADAGASCAR
MALAWI
MALAYSIA
MALI
MALTA
MARSHALL ISLANDS
MAURITANIA
MAURITIUS
MEXICO
MONACO
MONGOLIA
MONTENEGRO
MOROCCO
MOZAMBIQUE
MYANMAR
NAMIBIA
NEPAL
NETHERLANDS
NEW ZEALAND
NICARAGUA
NIGER
NIGERIA
NORTH MACEDONIA
NORWAY
OMAN
PAKISTAN
PALAU
PANAMA
PAPUA NEW GUINEA
PARAGUAY
PERU
PHILIPPINES
POLAND
PORTUGAL
QATAR
REPUBLIC OF MOLDOVA
ROMANIA
RUSSIAN FEDERATION
RWANDA
SAINT LUCIA
SAINT VINCENT AND THE GRENADINES
SAMOA
SAN MARINO
SAUDI ARABIA
SENEGAL
SERBIA
SEYCHELLES
SIERRA LEONE
SINGAPORE
SLOVAKIA
SLOVENIA
SOUTH AFRICA
SPAIN
SRI LANKA
SUDAN
SWEDEN
SWITZERLAND
SYRIAN ARAB REPUBLIC
TAJIKISTAN
THAILAND
TOGO
TRINIDAD AND TOBAGO
TUNISIA
TURKEY
TURKMENISTAN
UGANDA
UKRAINE
UNITED ARAB EMIRATES
UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND
UNITED REPUBLIC OF TANZANIA
UNITED STATES OF AMERICA
URUGUAY
UZBEKISTAN
VANUATU
VENEZUELA, BOLIVARIAN REPUBLIC OF
VIET NAM
YEMEN
ZAMBIA
ZIMBABWE

The Agency's Statute was approved on 23 October 1956 by the Conference on the Statute of the IAEA held at United Nations Headquarters, New York; it entered into force on 29 July 1957. The Headquarters of the Agency are situated in Vienna. Its principal objective is "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world".

IAEA NUCLEAR SECURITY SERIES No. 12-T (Rev. 1)

MODEL ACADEMIC CURRICULUM IN NUCLEAR SECURITY

TECHNICAL GUIDANCE

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2021

COPYRIGHT NOTICE

Marketing and Sales Unit, Publishing Section
International Atomic Energy Agency
Vienna International Centre
PO Box 100
1400 Vienna, Austria
fax: +43 1 26007 22529
tel.: +43 1 2600 22417
email: sales.publications@iaea.org
www.iaea.org/publications

Printed by the IAEA in Austria
August 2021
STI/PUB/1930

IAEA Library Cataloguing in Publication Data

Names: International Atomic Energy Agency.
Title: Model academic curriculum in nuclear security / International Atomic Energy Agency.
Description: Vienna : International Atomic Energy Agency, 2021. | Series: IAEA nuclear security series, ISSN 1816–9317 ; no. 12-T (Rev. 1) | Includes bibliographical references.
Identifiers: IAEAL 21-01423 | ISBN 978–92–0–132620–1 (paperback : alk. paper) | ISBN 978–92–0–132720–8 (pdf) | ISBN 978–92–0–132820–5 (epub)
Subjects: LCSH: Nuclear facilities — Security measures — Study and teaching (Higher). | Nuclear industry — Security measures — Study and teaching (Higher). | Curriculum planning.
Classification: UDC 374:341.67 | STI/PUB/1930

FOREWORD

by Rafael Mariano Grossi
Director General

The IAEA Nuclear Security Series provides international consensus guidance on all aspects of nuclear security to support States as they work to fulfil their responsibility for nuclear security. The IAEA establishes and maintains this guidance as part of its central role in providing nuclear security related international support and coordination.

The IAEA Nuclear Security Series was launched in 2006 and is continuously updated by the IAEA in cooperation with experts from Member States. As Director General, I am committed to ensuring that the IAEA maintains and improves upon this integrated, comprehensive and consistent set of up to date, user friendly and fit for purpose security guidance publications of high quality. The proper application of this guidance in the use of nuclear science and technology should offer a high level of nuclear security and provide the confidence necessary to allow for the ongoing use of nuclear technology for the benefit of all.

Nuclear security is a national responsibility. The IAEA Nuclear Security Series complements international legal instruments on nuclear security and serves as a global reference to help parties meet their obligations. While the security guidance is not legally binding on Member States, it is widely applied. It has become an indispensable reference point and a common denominator for the vast majority of Member States that have adopted this guidance for use in national regulations to enhance nuclear security in nuclear power generation, research reactors and fuel cycle facilities as well as in nuclear applications in medicine, industry, agriculture and research.

The guidance provided in the IAEA Nuclear Security Series is based on the practical experience of its Member States and produced through international consensus. The involvement of the members of the Nuclear Security Guidance Committee and others is particularly important, and I am grateful to all those who contribute their knowledge and expertise to this endeavour.

The IAEA also uses the guidance in the IAEA Nuclear Security Series when it assists Member States through its review missions and advisory services. This helps Member States in the application of this guidance and enables valuable experience and insight to be shared. Feedback from these missions and services, and lessons identified from events and experience in the use and application of security guidance, are taken into account during their periodic revision.

I believe the guidance provided in the IAEA Nuclear Security Series and its application make an invaluable contribution to ensuring a high level of nuclear security in the use of nuclear technology. I encourage all Member States to promote and apply this guidance, and to work with the IAEA to uphold its quality now and in the future.

EDITORIAL NOTE

CONTENTS

1. INTRODUCTION

BACKGROUND

1.1. According to IAEA Nuclear Security Series No. 20, Objective and Essential Elements of a State's Nuclear Security Regime [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.

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

1.3. This publication is intended to assist States in developing a model academic curriculum for nuclear security. It is complementary to, and consistent with, the following Nuclear Security Recommendations publications:

(a) IAEA Nuclear Security Series No. 13, Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5) [2];
(b) IAEA Nuclear Security Series No. 14, Nuclear Security Recommendations on Radioactive Material and Associated Facilities [3];
(c) IAEA Nuclear Security Series No. 15, Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control [4].

1.4. This publication updates and supersedes IAEA Nuclear Security Series No. 12, Educational Programme in Nuclear Security, which was issued in 2010.[1] Since that time, the body of knowledge in the field of nuclear security has grown substantially, and the IAEA Nuclear Security Series has expanded to cover more topics. The first revision of this publication takes into account the IAEA Nuclear Security Series guidance published between 2010 and 2018, as well as the

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, Educational Programme in Nuclear Security, IAEA Nuclear Security Series No. 12, IAEA, Vienna (2010).

feedback from the International Nuclear Security Education Network (INSEN) community and other international experts.

OBJECTIVE

1.5. 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 for an academic certificate programme in nuclear security. The publication can be used by university[2] curriculum developers as well as 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 nuclear security, such as decision makers, operators, regulators, law enforcement agencies and other entities responsible for nuclear security. It may also be useful to prospective students as an informational resource.

1.6. This model academic curriculum in nuclear security can also be used as a resource to facilitate the development by national authorities of a comprehensive national nuclear security human resource development programme, which has the purpose of developing and maintaining relevant knowledge and skills and sustaining personnel qualified to deal with current and future nuclear security challenges.

SCOPE

1.7. This publication offers 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.

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

---

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

1.9. 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 material and associated facilities, security of other radioactive material and associated facilities and activities, detection of material out of regulatory control and response to nuclear security events, among other more specific topics.

STRUCTURE

1.10. Section 2 describes the structure and possible implementation of the proposed curriculum and provides an overview of the recommended master's degree programme. Section 3 offers an overview to the academic certificate programme. Annex I provides a brief description of each module, relevant learning objectives, and an outline of individual modules. Annex II provides an overview of a notional curriculum for a certificate programme in nuclear security.

2. MASTER'S DEGREE PROGRAMME IN NUCLEAR SECURITY

2.1. Given the multidisciplinary nature of the field of nuclear security, the number of universities implementing the degree programme in full as outlined in this publication may be small. The academic curriculum presented in this publication is therefore a model that seeks to describe accurately and exhaustively the existing body of knowledge in the field of nuclear security at the time of its publication.[3] Institutions and faculties wishing to establish such academic programmes may choose to use this publication 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;

[3] See Ref. [5] for more general information on establishing academic curricula in the nuclear field and Ref. [6] for a summary of good practices in nuclear education.

(d) To offer a course or module on nuclear security to enhance an existing curriculum.

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

CURRICULUM STRUCTURE

2.3. The model curriculum is divided into four parts: prerequisite knowledge; a standalone module NS0. Introduction to Nuclear Security; core modules; and elective modules. Each of these parts is discussed in the following sections.

Prerequisite knowledge

2.4. Students participating in a full Master of Science in Nuclear Security can be expected to have prior demonstrable knowledge in the following areas:

(a) NSPR1. Ionizing Radiation, Safety and Radiation Protection;
(b) NSPR2. Methods and Instruments for Nuclear and Other Radioactive Material Measurements;
(c) NSPR3. Nuclear Energy, Nuclear Fuel Cycle and Nuclear Applications;
(d) NSPR4. Methods of Scientific Research.

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

Standalone module: NS0. Introduction to Nuclear Security

2.6. 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. One example of the use of this module is to provide students who are in the process of completing a Master of Science in Nuclear Engineering or a Master in International Relations with a comprehensive overview of nuclear security in a single module. Depending on the nature of the existing academic

programme, instructors may wish to emphasize some parts of this module while covering others briefly.

2.7. This module is not intended to be part of a comprehensive master's degree programme as described in the rest of this publication because it provides the same information in a condensed format and would therefore be redundant.

Core modules

2.8. Students participating in a full programme for a Master of Science in Nuclear Security according to the model curriculum described in this publication would be expected to take the following core modules:

(a) NSC1. International and National Legal, Regulatory and Institutional Framework for Nuclear Security;
(b) NSC2. Risk Informed Approach to Nuclear Security;
(c) NSC3. Coordination and Cooperation of Stakeholders at the National and International Level;
(d) NSC4. Nuclear Security Management at the Facility Level;
(e) NSC5. Security of Sensitive Nuclear Information;
(f) NSC6. Nuclear Security Culture;
(g) NSC7. Threat Assessment;
(h) NSC8. Physical Protection Systems Design and Evaluation;
(i) NSC9. Physical Protection Technologies and Equipment;
(j) NSC10. Use of Nuclear Material Accounting and Control (NMAC) for Nuclear Security;
(k) NSC11. Preventing and Protecting Against Insider Threat;
(l) NSC12. Security of Nuclear and Other Radioactive Material in Transport;
(m) NSC13. Computer Security for a Nuclear World;
(n) NSC14. Detection of Criminal or Other Unauthorized Acts involving Nuclear and Other Radioactive Material out of Regulatory Control;
(o) NSC15. Response to Criminal or Other Unauthorized Acts Involving Nuclear and Other Radioactive Material out of Regulatory Control.

Elective modules

2.9. Elective modules are designed to supplement the core modules described above with specialized knowledge in various areas of nuclear security. The selection of elective modules 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

modules could be supplemented by the university or instructor to include other modules relevant to the degree programme. These elective modules include:

(a) NSE1. Interfaces of Nuclear Security with Safety and Safeguards;
(b) NSE2. Legal Drafting for Nuclear Security;
(c) NSE3. International Cooperation on Nuclear Security;
(d) NSE4. Developing and Implementing Design Basis Threat (DBT);
(e) NSE5. Vulnerability Assessment of Physical Protection Systems;
(f) NSE6. Nuclear Security Culture Self-Assessment and Enhancement;
(g) NSE7. Designing Physical Protection Systems for Nuclear and Radiological Facilities;
(h) NSE8. Nuclear Material Accounting and Control for Nuclear Power Plants and Research Reactors;
(i) NSE9. Nuclear Material Accounting and Control for Facilities that Process Nuclear Material;
(j) NSE10. Establishing and Implementing a Transport Security Plan;
(k) NSE11. Designing and Implementing a National Detection Architecture (NDA);
(l) NSE12. Import/Export and Transit Control Mechanism and Regime;
(m) NSE13. Nuclear Security Framework for Major Public Events;
(n) NSE14. Radiological Crime Scene Management;
(o) NSE15. Nuclear Forensics Analysis;
(p) NSE16. Information and Computer Security Incident Response;
(q) NSE17. Conducting Computer Security Assessments.

2.10. Table 1 outlines the approximate percentage distribution of various types of learning module cluster within a degree programme. These percentages have also been aligned with two common types of academic credit calculation system found in different 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; instead it 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.

2.11. Figure 1 represents an outline of the structure of the proposed master's degree programme curriculum.

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

Modules	% value of total degree workload	ECTS	North American credit hour system	Estimated contact hours	Estimated total student workload hours
Core					
Protection	20	24	7	160	500
Detection and response	15	18	5	120	300
Cross-cutting topics	20	24	7	160	500
Electives	25	30	8	200	600
Thesis/final project	20	24	6	160	500
Total	100	120	33	800	2400

NOTIONAL PATHS TOWARDS A MASTER OF SCIENCE IN NUCLEAR SECURITY IN A SPECIALIZED FIELD

2.12. This section introduces a set of notional paths towards a master's degree, which could incorporate a specialization in nuclear security into one of several commonly found academic programmes offered by universities worldwide.

2.13. Given the diversity of educational systems around the world and of the mechanisms used to evaluate and analyse such demand[4], it would be impossible for this publication to offer an exact formula that universities might follow to design and implement a successful and, more importantly, sustainable degree programme in nuclear security. One of the biggest challenges that universities

[4] Approaches to evaluating and analysing national needs for graduates with a Master of Science 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 institutions make an 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.

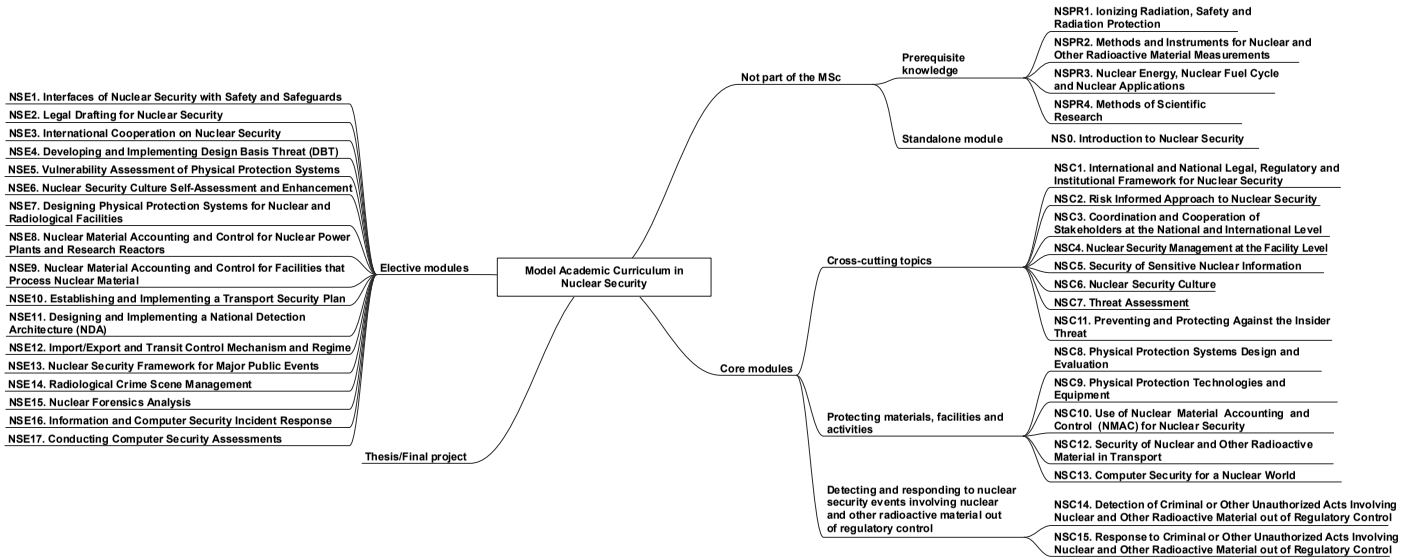


FIG. 1. Structure of the model academic curriculum in nuclear security.

need to overcome on their path towards establishing a new degree programme is to verify that job market analysis demonstrates that there is long term demand for graduates with the degree in the proposed discipline. 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 a university were to succeed in this first step, the proposed curriculum should be approved and then periodically accredited by a government authority or a professional accreditation body, which frequently results in the timeline of establishing such new degree programmes spanning 5–10 years.

2.14. In addition, nuclear security is a multidisciplinary field of study. Development of a comprehensive master's degree programme in this field would therefore necessitate the input and participation of the faculty and experts from a multitude of disciplines, faculties, departments and sometimes even outside institutions. For these reasons, many institutions choose instead the much more flexible path of incorporating the topic of nuclear security, in some format, into existing degree programmes at the institution that are relevant to nuclear security. Moreover, a programme drawing on the existing degree framework available in the university and tailored to a specific target group of potential students is likely to be more sustainable.

2.15. 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;
(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 where nuclear security is frequently assumed to be an exclusively technical field of study.

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

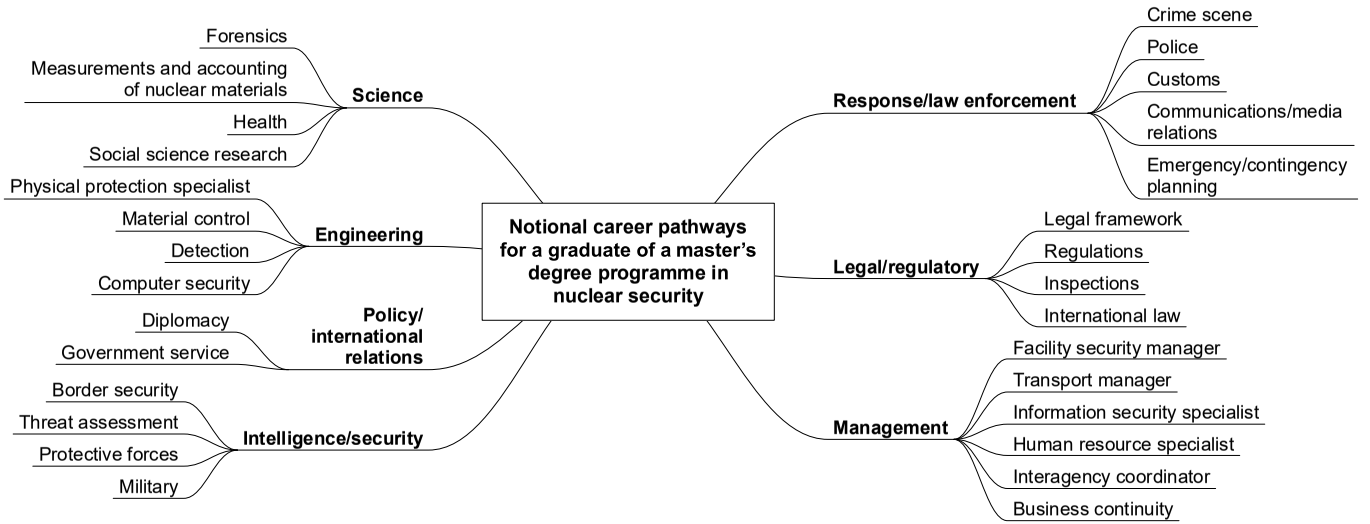


FIG. 2. Notional career pathways for a graduate of a Master of Science in Nuclear Security.

2.17. Table 2 provides a cross-reference of these areas of expertise with relevant core and elective modules 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 both the core and elective modules of the proposed model curriculum.

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

Areas of expertise	Core modules (55%)	Elective modules (25%)	Thesis/final project (20%)
Engineering	Institutions offering an MSc 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 against the intended focus of the programme.	NSE4. Developing and Implementing Design Basis Threat (DBT) NSE5. Vulnerability Assessment of Physical Protection Systems NSE7. Designing Physical Protection Systems for Nuclear and Radiological Facilities NSE11. Designing and Implementing a National Detection Architecture (NDA) NSE16. Information and 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 on Nuclear Security NSE12. Import/Export and Transit Control Mechanism and Regime	Thesis/essay
Science		NSE15. Nuclear Forensics Analysis	Thesis

TABLE 2. NOTIONAL PATHS TOWARDS A MASTER OF SCIENCE IN NUCLEAR SECURITY AS PART OF A SPECIALIZED FIELD, WITH RECOMMENDED ELECTIVE MODULES (cont.)

Areas of expertise	Core modules (55%)	Elective modules (25%)	Thesis/final project (20%)
Policy/ international relations		NSE1. Interfaces of Nuclear Security with Safety and Safeguards NSE2. Legal Drafting for Nuclear Security NSE3. International Cooperation on Nuclear Security	Thesis for MA Qualifying exams/final project for terminal degrees
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 on Nuclear Security NSE6. Nuclear Security Culture Self-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

TABLE 2. NOTIONAL PATHS TOWARDS A MASTER OF SCIENCE IN NUCLEAR SECURITY AS PART OF A SPECIALIZED FIELD, WITH RECOMMENDED ELECTIVE MODULES (cont.)

Areas of expertise	Core modules (55%)	Elective modules (25%)	Thesis/final project (20%)
Intelligence/ security		NSE1. Interfaces of Nuclear Security with Safety and Safeguards NSE3. International Cooperation on Nuclear Security NSE4. Developing and Implementing Design Basis Threat (DBT) NSE5. Vulnerability Assessment of Physical Protection Systems 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

METHODOLOGY

2.18. In the majority of universities, students have to be physically present 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 might 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 necessitate coordination with other departments or instructors;
(b) The availability of technical experts, who might be invited from outside, and who might 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 degree programme in nuclear security might come from the nuclear profession, and are likely already engaged in a full time career in their field;

(d) The availability of degree programmes in nuclear security locally or even regionally might be fairly low, creating a need for students and employers to look for educational opportunities globally.

2.19. These challenges are not unique to nuclear security education. To address them in similar situations, many universities offer graduate degree programmes to early and mid-career professionals that accommodate their limitations with respect to time available and the ability to be physically present at the university. Such programmes fully utilize innovations in computer and information technologies, virtual reality, videoconferencing, social media and other methods of delivering and exchanging information. Some universities also offer blended learning options, which include various types of long distance learning, short term visits to the main campus for examinations and 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 might wish to consider all of these proven and sustainable possibilities for establishing their programmes.

PROGRAMME LEARNING OBJECTIVES

2.20. 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 various interactions, as well as the measures necessary to establish and sustain a nuclear security regime;
(b) Knowledge and understanding of the principles, assumptions, tools and equipment for protecting nuclear material as well as other radioactive material, associated facilities, computers and networks, activities and related information;
(c) Awareness and appreciation of the threats posed by nuclear and other radioactive material out of regulatory control as well as knowledge of the tools necessary to address these threats at the national level;
(d) Recognition of the importance of human factors in nuclear security, including nuclear security culture and the insider threat;
(e) Awareness and comprehension of the international legal framework related to nuclear security, as well as relevant national laws, regulations and procedures;
(f) Ability to creatively apply the above concepts, attributes and scientific methods to find and implement solutions to nuclear security challenges.

CHALLENGES TO CONSIDER

2.21. Universities planning to establish educational programmes in nuclear security might need to address two important challenges in addition to that of curriculum development. The first challenge is the availability of qualified instructors to provide instruction on most, if not all, areas of nuclear security. This issue can be addressed through the various options outlined above for different teaching methodology approaches. In addition, the sharing of experience, resources and good practices in nuclear security education among States is valuable, as are faculty development courses offered by more experienced institutions and academics.

2.22. The second challenge is the availability of well equipped laboratories to be used in educational settings. Most suitable for this task would be laboratories already available in the departments of nuclear physics or engineering. However, few of them have the specialized equipment and tools that a comprehensive educational programme in nuclear security might demand. One of the options that could help universities to address this challenge could be to partner with a national or regional nuclear security support centre, if available. In some cases, these centres possess a comprehensive inventory of equipment for training needs.

3. ACADEMIC CERTIFICATE PROGRAMME IN NUCLEAR SECURITY

3.1. 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 at conveying knowledge and skills needed to perform a specific job function. 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.

3.2. It is also important, in this context, to differentiate between an academic certificate (proposed here) 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 of and qualifications in a specialized subject. The latter, on the other hand, offers a professional certification that is recognized by a government or a professional

accreditation or certification organization, and may be necessary for the recipient to perform professional services in that field. An example of such certification would be a licence to handle radioactive, explosive, toxic or other hazardous materials. Such certification is tied to the knowledge, skills and experience expected of a professional in the field in question, as well as to job tasks assigned to such a professional.

3.3. This publication offers a model outline of an academic certificate in nuclear security, which a university may use 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, a standard name for this programme, the duration or number of academic hours necessary for its completion and other requirements that universities may wish to impose on the students are not specified. Rather, an outline of a notional academic certificate programme in nuclear security, including the body of knowledge that would be most appropriate for inclusion in a certificate programme curriculum, is summarized in Annex II.

REFERENCES

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, 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 (INFCIRC/225/Revision 5), IAEA Nuclear Security Series No. 13, IAEA, Vienna (2011).

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

[4] EUROPEAN POLICE OFFICE, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, UNITED NATIONS INTERREGIONAL CRIME AND JUSTICE RESEARCH INSTITUTE, UNITED NATIONS OFFICE ON DRUGS AND CRIME, WORLD CUSTOMS ORGANIZATION, Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 15, IAEA, Vienna (2011).

[5] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Engineering Education: A Competence Based Approach to Curricula Development, IAEA Nuclear Energy Series No. NG-T-6.4, IAEA, Vienna (2014).
[6] INTERNATIONAL ATOMIC ENERGY AGENCY, Status and Trends in Nuclear Education, IAEA Nuclear Energy Series No. NG-T-6.1, IAEA, Vienna (2011).

Annex I

PROPOSED MODULES FOR A MASTER OF SCIENCE ACADEMIC CURRICULUM IN NUCLEAR SECURITY

I–1. This annex provides a brief description and outline of each module, as well as the relevant learning objectives of individual modules for a master of science academic curriculum in nuclear security. Where appropriate, practical and/or laboratory exercises are listed and reference publications are proposed. The references are not exhaustive, since they are for the most part limited to relevant international legal instruments (conventions, treaties, resolutions of the United Nations Security Council), IAEA Nuclear Security Series publications, 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.

PREREQUISITE KNOWLEDGE

I–2. 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 degree programme, and ultimately to succeed in this programme, prospective students need to have a prior basic understanding of radiation, the nuclear fuel cycle, radiation detection and measurement, 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 in this annex. These modules provide an introduction to the concepts and principles of ionizing radiation, nuclear safety and radiation protection, methods and instruments for nuclear material measurement, basics of nuclear energy, fuel cycle, and applications, as well as methods of scientific research.

I–3. While these modules are very important to the overall context of the master's degree programme in nuclear security, their content covers issues broader than the field of nuclear security, and they are therefore specifically excluded from the proposed model curriculum. Another reason for this exclusion is the fact that many universities have only limited time and number of academic modules that they are able to include into a comprehensive master's degree programme. They rely instead on the prospective 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.

I–4. It is assumed that a university would ultimately make a decision about the format, scope and level at which this prior knowledge has to be demonstrated by the applicant, as well as whether to offer these modules as part of the planned master's degree curriculum or request their completion beforehand. Consequently, no outline for these modules is provided as it is assumed that their content (either offered or requested) will be determined by the university.

I–5. Proposed prerequisite modules include:

(a) NSPR1. Ionizing Radiation, Safety and Radiation Protection;
(b) NSPR2. Methods and Instruments for Nuclear and Other Radioactive Material Measurements;
(c) NSPR3. Nuclear Energy, Nuclear Fuel Cycle and Nuclear Applications;
(d) NSPR4. Methods of Scientific Research.

STANDALONE MODULE

NS0. INTRODUCTION TO NUCLEAR SECURITY

A. Short description

This is an introductory standalone module 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.

B. Learning objectives

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

(a) To describe nuclear security main concepts and approaches, using appropriate terminology;
(b) To discuss interrelationships of nuclear security with safety and safeguards;
(c) To list the essential elements of a State's nuclear security regime;

(d) To demonstrate the importance of nuclear security.

C. Module outline

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 the 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 versus external 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 security event scenarios
            - 2.2.1.1. Theft of a nuclear weapon
            - 2.2.1.2. Acquisition of nuclear material and development of a nuclear explosive device (NED)
            - 2.2.1.3. Sabotage of a nuclear facility or transport of nuclear or other radioactive material
            - 2.2.1.4. Development of a radiological dispersal device (RDD) or a radiation exposure 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. Activities involving nuclear material (e.g. transport)
2.2.3. Nuclear security as part of broader chemical, biological, radiological and nuclear (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 material, facilities and activities
4.1. Principles and systems for physical protection of a nuclear or 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 case of alarms
4.1.4. Contingency plans and drills
4.2. Nuclear material accounting and control (NMAC) for nuclear security
4.2.1. Differences between international and domestic NMAC programmes
4.2.2. NMAC role in the use, storage and processing of nuclear material, and protecting against insider threats and external threats
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. Radiation portal monitors and other detection devices
4.2.5.5. Administrative checks
4.2.6. Movement of nuclear material
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 material
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 nuclear and other radioactive material out of regulatory control
   5.1. Prevention and detection of criminal or other 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 other 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 computer security controls in depth
   6.4. The cyber insider threat
   6.5. Network security basics
   6.6. Introduction to malware and exploits
   6.7. Industrial control systems
   6.8. Security culture and the impact of the human factor
   6.9. Conducting computer security assessments
   6.10. Risk assessment and management
   6.11. Computer security management
   6.12. Computer security incident response

D. Exercises

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

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested reading

EUROPEAN POLICE OFFICE, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, UNITED NATIONS INTERREGIONAL CRIME AND JUSTICE RESEARCH INSTITUTE, UNITED NATIONS OFFICE ON DRUGS AND CRIME, WORLD CUSTOMS ORGANIZATION, Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 15, IAEA, Vienna (2011).

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

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

Code of Conduct on the Safety and Security of Radioactive Sources (2004).

Amendment to the Convention on the Physical Protection of Nuclear Material, IAEA International Law Series No. 2 (2006).

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

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

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

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

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

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

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

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

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

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

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

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

Security of Radioactive Material in Use and Storage and of Associated Facilities, IAEA Nuclear Security Series No. 11-G (Rev. 1) (2019).

Preventive and Protective Measures against Insider Threats, IAEA Nuclear Security Series No. 8-G (Rev. 1) (2020).

Security of Radioactive Material in Transport, IAEA Nuclear Security Series No. 9-G (Rev. 1) (2020).

National Nuclear Security Threat Assessment, Design Basis Threats and Representative Threat Statements, IAEA Nuclear Security Series No. 10-G (Rev. 1) (2021).

Computer Security Techniques for Nuclear Facilities, IAEA Nuclear Security Series No. 17-T (Rev. 1) (in preparation).

INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, Risk Informed Approach for Nuclear Security Measures for Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 24-G, IAEA, Vienna (2015).

INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, UNITED NATIONS INTERREGIONAL CRIME AND JUSTICE RESEARCH INSTITUTE, Radiological Crime Scene Management, IAEA Nuclear Security Series No. 22-G, IAEA, Vienna (2014).

INTERNATIONAL NUCLEAR SECURITY EDUCATION NETWORK, Introduction to Nuclear Security, INSEN, Vienna (2019).

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

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

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

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

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

International Convention for the Suppression of Acts of Nuclear Terrorism, A/RES/59/290, United Nations, New York (2005).

NSC1. INTERNATIONAL AND NATIONAL LEGAL, REGULATORY AND INSTITUTIONAL FRAMEWORK FOR NUCLEAR SECURITY

A. Short description

This module is designed to introduce students to the international and national legal, regulatory and institutional framework for nuclear security. It addresses the issues of State responsibility for nuclear security, and focuses on the existing multilateral treaties and conventions, resolutions of the United Nations Security Council, IAEA guidance and recommendations relating to nuclear security, as well as national legal and regulatory principles and practices. It also provides an overview of the existing international organizations, institutions and initiatives relating to nuclear security.

B. Learning objectives

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

(a) To demonstrate understanding of the State responsibility for nuclear security as the basic principle;
(b) To demonstrate the knowledge of the international legal binding and non-binding instruments relating to nuclear security;
(c) To know the principal international and national organizations and other entities engaged in nuclear security, and the role they play;
(d) To know the scope of international guidance and recommendations relating to nuclear security;
(e) To demonstrate the understanding of the national regulatory infrastructure relating to nuclear security.

C. Module outline

1. The role of law in implementing nuclear security
    1.1. International law
        1.1.1. Introduction to the international legal framework for nuclear security
        1.1.2. Development of the international legal framework for nuclear security

1.1.3. Overview of the international institutional framework relating 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
2.1.2. 2005 Amendment to the Convention on the Physical Protection of Nuclear Material
2.1.3. International Convention for the Suppression of Acts of Nuclear Terrorism
2.1.4. Other multilateral treaties relevant to nuclear security
2.2. Other legally binding obligations
2.2.1. Security Council resolution 1540
2.2.2. Security Council resolution 1373
2.2.3. Security Council resolution 1970
3. Other relevant treaty based obligations
3.1. The Convention on 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. 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 (IAEA Nuclear Security Series No. 20)
5.2. Recommendations (IAEA Nuclear Security Series Nos 13–15)
5.3. Implementing guides
5.4. Technical guidance
6. 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 body 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 reading

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

Statute of the International Atomic Energy Agency (as amended up to 28 December 1989).

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

Code of Conduct on the Safety and Security of Radioactive Sources (2004).

Guidance on the Import and Export of Radioactive Sources (2012).

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

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

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

Communications 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).

Model Protocol Additional to the Agreement(s) between State(s) and the International Atomic Energy Agency for the Application of Safeguards, INFCIRC/540/Corr.1, IAEA, Vienna (1998).

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

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

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

International Convention for the Suppression of Acts of Nuclear Terrorism, A/RES/59/290, United Nations, New York (2005).

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

Communications Received from Certain Member States Regarding Guidelines for Transfers of Nuclear-related Dual-use Equipment, Materials, Software and Related Technology, INFCIRC/254/Rev. 6/Part 2, IAEA, Vienna (2005).

Communications Received from Certain Member States Regarding Guidelines for the Export of Nuclear Material, Equipment and Technology, INFCIRC/254/Rev. 7/Part 1, IAEA, Vienna (2005).

Amendment to the Convention on the Physical Protection of Nuclear Material, IAEA International Law Series No. 2 (2006).

Convention on International Civil Aviation (The Chicago Convention), 9th edn, ICAO, Montreal (2006).

International Maritime Dangerous Goods Code (incorporating Amendment 39-18), IMO, London (2018).

NSC2. RISK INFORMED APPROACH TO NUCLEAR SECURITY

A. Short description

This module 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 material, facilities and activities; and to provide them with analytical tools to perform threat and risk analysis for nuclear security.

B. Learning objectives

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

(a) To describe the evolution of the understanding of threat and risk;
(b) To differentiate between threat and risk;
(c) To identify possible threat scenarios and targets at the facility and State level;
(d) To identify the attributes of possible adversaries;
(e) To describe the process and methodologies, to analyse and to perform threat and risk assessment (depending on the scope of the module chosen by instructor).

C. Module outline

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 the 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 and protests
        - 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 and planning for events
1.4.9.2. Flagging events that are chemical, biological, radiological and nuclear (CBRN) or similar
1.4.9.3. Need for continuous reassessment
1.4.10. Review of known threats
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 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 versus external threat
2. Identification and assessment of potential targets and consequences
2.1. Four main nuclear security event scenarios
2.1.1. Theft of a nuclear weapon
2.1.2. Acquisition of nuclear material and development of a nuclear explosive device (NED)
2.1.3. Sabotage of a nuclear facility or transport of nuclear or other radioactive material
2.1.4. Development of a radiological dispersal device (RDD) or radiation exposure device (RED)
2.2. Consequences of security breaches that do not result in a nuclear or radiological event
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. Activities involving nuclear material (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

(i) Probabilistic risk calculation exercise.
(ii) Development of a hypothetical design basis threat based on scenario information:
— State level;
— Facility level;
— Continuous assessment (PDCA methodology — plan–do–check–act).
(iii) Developing a list of potential consequences of nuclear security event scenarios.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested reading

EUROPEAN POLICE OFFICE, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, UNITED NATIONS INTERREGIONAL CRIME AND JUSTICE RESEARCH INSTITUTE, UNITED NATIONS OFFICE ON DRUGS AND CRIME, WORLD CUSTOMS ORGANIZATION, Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 15, IAEA, Vienna (2011).

GARCIA, M.L., Vulnerability Assessment of Physical Protection Systems, Butterworth-Heinemann, Oxford (2006).

— The Design and Evaluation of Physical Protection Systems, 2nd edn, Butterworth-Heinemann, Oxford (2008).

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

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

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

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

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

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

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

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

Preventive and Protective Measures against Insider Threats, IAEA Nuclear Security Series No. 8-G (Rev. 1) (2020).

National Nuclear Security Threat Assessment, Design Basis Threats and Representative Threat Statements, IAEA Nuclear Security Series No. 10-G (Rev. 1) (2021).

Computer Security Techniques for Nuclear Facilities, IAEA Nuclear Security Series No. 17-T (Rev. 1) (in preparation).

INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, Risk Informed Approach for Nuclear Security Measures for Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 24-G, IAEA, Vienna (2015).

ROPER, C., FISCHER, L., GRAU, J.A., Security Education, Awareness and Training: From Theory to Practice, Elsevier, Oxford (2006).

TALBOT, J., JAKEMAN, M., Security Risk Management: Body of Knowledge, John Wiley and Sons, Hoboken, NJ (2009).

NSC3. COORDINATION AND COOPERATION OF STAKEHOLDERS AT THE NATIONAL AND INTERNATIONAL LEVEL

A. Short description

This module provides an overview of cooperation efforts among various national agencies and international coordination in case of nuclear and 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 chemical, biological, radiological and nuclear (CBRN) incidents or when a dirty bomb is involved. Furthermore, it will be emphasized that nuclear security is and will remain a national responsibility and that some countries still lack the programmes and the resources to respond properly to the threat of nuclear and radiological terrorism. This module covers international cooperation essential to help States to strengthen their national capacities and to build regional and global networks for combating transnational threats.

B. Learning objectives

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

(a) To identify various national and international stakeholders in nuclear security and describe their role in nuclear security;
(b) To demonstrate skills in establishing and maintaining cooperative relationships among the stakeholders at the national and international level;
(c) To describe the importance of international cooperation and national commitment in promoting effective nuclear security.

C. Module outline

1. Interagency coordination and cooperation at the national level
    1.1. Roles and responsibilities of nuclear and radiological regulatory bodies, 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 nuclear and other radioactive material out of 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. Hazardous materials
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
1.6.1. Communication with the media for nuclear security events
1.6.2. Communication with local communities for nuclear security events

2. Cooperation with other competent organizations in case of incidents involving radiological dispersal devices (RDDs)
2.1. Explosives and conventional ordnance
2.2. Role of the 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, cleanup workers and others
2.6. Organizations and authorities involved in radiological dispersal device (RDD) response
2.7. Command and management

3. International coordination
    3.1. Legal framework for international coordination
    3.2. International Atomic Energy Agency
    3.3. Other institutions and organizations
4. Cooperation with other competent organizations in case of combined chemical, biological, radiological and nuclear (CBRN) events
    4.1. Joint operations in chemical, biological, radiological and nuclear (CBRN) environments
    4.2. Difference between chemical, biological, radiological and nuclear (CBRN) events

D. Exercises

(i) Case study 1: International cooperation for a large scale international exercise in response to a nuclear security event.
(ii) 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 reading

COMPREHENSIVE NUCLEAR-TEST-BAN TREATY ORGANIZATION, EURO-ATLANTIC DISASTER RESPONSE COORDINATION CENTRE, EUROPEAN COMMISSION, EUROPEAN POLICE OFFICE, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL LABOUR ORGANIZATION, INTERNATIONAL MARITIME ORGANIZATION, INTERPOL, NUCLEAR ENERGY AGENCY OF THE ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS DEVELOPMENT PROGRAMME, UNITED NATIONS ENVIRONMENT PROGRAMME, UNITED NATIONS OFFICE FOR THE COORDINATION OF HUMANITARIAN AFFAIRS, UNITED NATIONS OFFICE FOR OUTER SPACE AFFAIRS, WORLD HEALTH ORGANIZATION, WORLD METEOROLOGICAL ORGANIZATION, Joint Radiation Emergency Management Plan of the International Organizations, EPR–JPLAN 2017, IAEA, Vienna (2017).

EUROPEAN POLICE OFFICE, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, UNITED NATIONS INTERREGIONAL CRIME AND JUSTICE RESEARCH INSTITUTE, UNITED NATIONS OFFICE ON DRUGS AND CRIME, WORLD CUSTOMS ORGANIZATION, Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 15, IAEA, Vienna (2011).

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

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 COORDINATION 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 (Vienna)

Method for Developing Arrangements for Response to a Nuclear or Radiological Emergency, EPR–Method 2003 (2003).

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

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

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

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

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

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

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

IAEA Response and Assistance Network, EPR–RANET 2018 (2018).

Operations Manual for Incident and Emergency Communication, EPR–IEComm 2019 (2020).

Security of Radioactive Material in Transport, IAEA Nuclear Security Series No. 9-G (Rev. 1) (2020).

INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, UNITED NATIONS INTERREGIONAL CRIME AND JUSTICE RESEARCH INSTITUTE, Radiological Crime Scene Management, IAEA Nuclear Security Series No. 22-G, IAEA, Vienna (2014).

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

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, Vienna (2005).

NSC4. NUCLEAR SECURITY MANAGEMENT AT THE FACILITY LEVEL

A. Short description

This module provides 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 module covers the following aspects:

(a) Essential elements of nuclear security;
(b) Basic principles of security management, budgeting and human resource planning, security culture, security awareness and integration with other disciplines;
(c) Set-up of a functional security organization, including governance instruments for establishing roles and responsibilities within the nuclear security management activities.

B. Learning objectives

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

(a) To describe the basic principles and processes of successfully managing security at nuclear and radiological facilities;
(b) To demonstrate a holistic approach towards nuclear security;
(c) To demonstrate knowledge of main international and national guidance and regulations;
(d) To demonstrate knowledge of the responsibilities of a security manager;
(e) To 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;
(f) To develop and implement contingency plans.

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

C. Module outline

1. Essential elements of nuclear security management at the facility level
   1.1. Holistic approach (legal, organizational, 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 versus operator responsibilities
1.5. Design and implementation principles
1.6. Human resource management
1.7. Coordination with other stakeholders
    1.7.1. Law enforcement and military
    1.7.2. Safety
    1.7.3. Local government
    1.7.4. Other internal and external parties
1.8. Operation, 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. 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, and cost–benefit analysis
    2.9. Security performance assurance programmes
    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
   5.3. Plant security programme, including the computer security programme
   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 module is practical exercises, where students 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 reading

EUROPEAN POLICE OFFICE, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, UNITED NATIONS INTERREGIONAL CRIME AND JUSTICE RESEARCH INSTITUTE, UNITED NATIONS OFFICE ON DRUGS AND CRIME, WORLD CUSTOMS ORGANIZATION, Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 15, IAEA, Vienna (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 COORDINATION 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 COORDINATION 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).

GARCIA, M.L., Vulnerability Assessment of Physical Protection Systems, Butterworth-Heinemann, Oxford (2006).

— The Design and Evaluation of Physical Protection Systems, 2nd edn, Butterworth-Heinemann, Oxford (2008).

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

Method for Developing Arrangements for Response to a Nuclear or Radiological Emergency, EPR–Method 2003 (2003).

Code of Conduct on the Safety and Security of Radioactive Sources (2004).

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

National Nuclear Security Threat Assessment, Design Basis Threats and Representative Threat Statements, IAEA Nuclear Security Series No. 10-G (Rev. 1) (2021).

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

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

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

Computer Security Techniques for Nuclear Facilities, IAEA Nuclear Security Series No. 17-T (Rev. 1) (in preparation).

ROPER, C., FISCHER, L., GRAU, J.A., Security Education, Awareness and Training: From Theory to Practice, Elsevier, Oxford (2006).

TALBOT, J., JAKEMAN, M., Security Risk Management: Body of Knowledge, John Wiley and Sons, Hoboken, NJ (2009).

NSC5. SECURITY OF SENSITIVE NUCLEAR INFORMATION

A. Short description

This module provides theoretical and practical knowledge of security methods for the security of sensitive nuclear information. Learning is supported by theoretical lectures, real world examples and practical exercises.

B. Learning objectives

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

(a) To clearly describe the role of information security in nuclear security;
(b) To explain and give examples of information security controls relevant to nuclear and other radioactive material facilities and activities.

C. Module outline

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. Insider threat
3. Framework for securing sensitive information
    - 3.1. Responsibilities
    - 3.2. Legal and regulatory framework for securing sensitive information

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

(i) Plan information security measures at a research reactor facility using high enriched uranium.

(ii) Role play: Develop and implement a role play of addressing information security violations by an employee at a nuclear facility.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested reading

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

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

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

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

INTERNATIONAL NUCLEAR SECURITY EDUCATION NETWORK, NS 22 Cyber Security for Nuclear Security Professionals, INSEN, Vienna (2013).

NSC6. NUCLEAR SECURITY CULTURE

A. 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.

B. Learning objectives

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

(a) To describe the concept of nuclear security culture as a subset of organizational culture;
(b) To describe the model of nuclear security culture as promoted by the IAEA, its components and attributes;
(c) To identify the individual and organizational indicators that affect culture.

C. Module outline

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 towards 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 nuclear security culture
   4.6. Relevant nuclear security series publications
5. IAEA as a nuclear security culture promoter and coordinator
   5.1. Introduce tools for nuclear security and culture capacity building (human resource development, knowledge management, knowledge networks)
   5.2. Role of the International Network for Nuclear Security Training and Support Centres (NSSC Network) and the International Nuclear Security Education Network (INSEN)
6. Nuclear security culture: concept, model and characteristics
   6.1. IAEA Nuclear Security Series No. 7, Nuclear Security Culture (2008)
   6.2. The role of the State, organizations, managers, personnel, the public and the international community in promoting and sustaining nuclear security culture
   6.3. Characteristics of the model and associated culture indicators
   6.4. Beliefs, attitudes and guiding principles
   6.5. Characteristics of nuclear security culture in the observable sections of the IAEA model
      6.5.1. Management systems
      6.5.2. Personnel behaviour
7. Safety–security interfaces
   7.1. Definitions of nuclear safety culture compared with nuclear security culture
   7.2. Types of interaction between safety and security in specific work settings
   7.3. Safety–security interfaces: international legal, organizational and programmatic as well as national and facility based operational
   7.4. Synergies and contradictions among elements of safety culture and security culture
8. Security culture for radioactive sources
   8.1. Outline of the international legal and management frameworks for radioactive sources

8.2. Special considerations for security culture with regard to radioactive sources
8.3. Evaluation methods: basic, intermediate and comprehensive

9. Nuclear security culture as a tool to address the insider threat
9.1. Definitions and profiles of insider adversaries
9.2. IAEA guidance on preventing and protecting against the insider threat
9.2.1. References to culture
9.3. Culture related measures and relevant indicators to address the insider threat

D. Exercises

(i) Risk perception survey;
(ii) 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 reading

BUNN, M., SAGAN, S.D., A Worst Practices Guide to Insider Threats: Lessons from Past Mistakes, American Academy of Arts and Sciences, Cambridge, MA (2014).

CAMERON, K.S., QUINN, R.E., Diagnosing and Changing Organizational Culture, 3rd edn, Jossey-Bass, San Francisco, CA (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 COORDINATION 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).

HOFSTEDE, G., HOFSTEDE, G.J., MINKOV, M., Cultures and Organizations: Software of the Mind, 3rd edn, McGraw-Hill, New York (2010).

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

Developing Safety Culture in Nuclear Activities: Practical Suggestions to Assist Progress, Safety Report Series No. 11 (1998).

Safety Culture in Nuclear Installations: Guidance for Use in the Enhancement of Safety Culture, IAEA-TECDOC-1329 (2002).

Method for Developing Arrangements for Response to a Nuclear or Radiological Emergency, EPR–Method 2003 (2003).

Code of Conduct on the Safety and Security of Radioactive Sources (2004).

Categorization of Radioactive Sources, IAEA Safety Standards Series No. RS-G-1.9 (2005).

Amendment to the Convention on the Physical Protection of Nuclear Material, IAEA International Law Series No. 2 (2006).

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

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

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

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

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

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

Governmental, Legal and Regulatory Framework for Safety, IAEA Safety Standards Series No. GSR Part 1 (Rev. 1) (2016).

Security of Radioactive Material in Use and Storage and of Associated Facilities, IAEA Nuclear Security Series No. 11-G (Rev. 1) (2019).

IAEA Incident and Trafficking Database (ITDB): 2020 Fact Sheet (2020), www.iaea.org/sites/default/files/20/02/itdb-factsheet-2020.pdf

Preventive and Protective Measures against Insider Threats, IAEA Nuclear Security Series No. 8-G (Rev. 1) (2020).

Computer Security Techniques for Nuclear Facilities, IAEA Nuclear Security Series No. 17-T (Rev. 1) (in preparation).

INTERNATIONAL NUCLEAR SAFETY GROUP, The Interface Between Safety and Security at Nuclear Power Plants, INSAG-24, IAEA, Vienna (2010).

INTERNATIONAL NUCLEAR SECURITY EDUCATION NETWORK, Nuclear Security Culture: The State of Play, INSEN, Vienna (2018).

KARTCHNER, K.M., "Strategic culture and WMD decision making", in Strategic Culture and Weapons of Mass Destruction: Culturally Based Insights into Comparative National Security Policymaking (JOHNSON, J.L., KARTCHNER, K.M., LARSEN, J.A., Eds), Palgrave Macmillan, New York (2009) 55–68.

KOTTER, J.P., Leading Change, Harvard Business School Press, Boston, MA (1996).

ROPER, C., FISCHER, L., GRAU, J.A., Security Education, Awareness, and Training: From Theory to Practice, Elsevier, Oxford (2006).

SCHEIN, E.H., The Corporate Culture Survival Guide, Jossey-Bass, San Francisco, CA (2009).

— Organizational Culture and Leadership, 5th edn, Jossey-Bass, San Francisco, CA (2017).

UNITED STATES DEPARTMENT OF ENERGY, Inquiry into the Security Breach at the National Security Administration's Y-12 National Security Complex, DOE/IG-0868, USDOE, Washington, DC (2012).

VICENTE, K., The Human Factor, Routledge, New York (2006).

WEICK, K.E., SUTCLIFFE, K.M., Managing the Unexpected: Resilient Performance in an Age of Uncertainty, 2nd edn, Jossey-Bass, San Francisco, CA (2007).

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

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

International Convention for the Suppression of Acts of Nuclear Terrorism, A/RES/59/290, United Nations, New York (2005).

NSC7. THREAT ASSESSMENT

A. Short description

This module provides a general description of adversaries (their tactics and methods, psychological aspects, adversary organizations), the role of threat information in developing appropriate security measures and counterterrorism methods. It also focuses on detailed study of threat assessments and design basis threat development and implementation.

B. Learning objectives

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

(a) To analyse motivations and capabilities of adversaries and to have basic information about protection against terrorism;
(b) To describe the methodology and the steps in performing State nuclear threat assessments, and in developing, implementing and maintaining design basis threats;
(c) To describe the relationship between the design basis threat, risk analysis and protecting against terrorism.

C. Module outline

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 unrest and protests
1.5. List of threat characteristics
1.6. Sources and analysis of threat related information
1.7. External threats
1.8. Insider threats
1.9. Review of actual, planned and possible threat actions
    1.9.1. Events, training events and planning for events
    1.9.2. Flagging events that are chemical, biological, radiological and nuclear (CBRN) or similar
1.10. Review of known threats
1.11. Analysis of threat related data
    1.11.1. List of threat attributes and characteristics
    1.11.2. Confidence assigned to data and analysis
1.12. Practical application of threat assessment for malicious acts

2. Design basis threat (DBT)
    2.1. International recommendations for DBT
    2.2. Audience for DBT
    2.3. Roles and responsibilities
    2.4. Screening of output of threat assessment
        2.4.1. Capabilities
        2.4.2. Intentions
    2.5. Translating specific threats in threat assessment to generic adversary attributes and characteristics
    2.6. Modifying generic adversary attributes and characteristics based on policy concerns
    2.7. Assigning which attributes and characteristics are part of the DBT, and which are excluded
3. Addressing other remaining credible threat attributes and characteristics that are not included in the final DBT
    3.1. DBT and another alternative threat based approach
    3.2. Implementing the DBT
    3.3. Maintaining the DBT
4. Role of threat analysis in developing adequate security measures
    4.1. Relationship between protection features and the threat
    4.2. Graded protection
    4.3. DBT approach versus alternatives

D. Exercises

(i) Case study: Threat assessment for a nuclear or radiological facility.
(ii) Case study: Design basis threat development for a State.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested reading

GARCIA, M.L., Vulnerability Assessment of Physical Protection Systems, Butterworth-Heinemann, Oxford (2006).

— The Design and Evaluation of Physical Protection Systems, 2nd edn, Butterworth-Heinemann, Oxford (2008).

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

Code of Conduct on the Safety and Security of Radioactive Sources (2004).

Amendment to the Convention on the Physical Protection of Nuclear Material, IAEA International Law Series No. 2 (2006).

National Nuclear Security Threat Assessment, Design Basis Threats and Representative Threat Statements, IAEA Nuclear Security Series No. 10-G (Rev. 1) (2021).

Handbook on the Design of Physical Protection Systems for Nuclear Material and Nuclear Facilities, IAEA Nuclear Security Series No. 40-T (2021).

TALBOT, J., JAKEMAN, M., Security Risk Management: Body of Knowledge, John Wiley and Sons, Hoboken, NJ (2009).

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

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

NSC8. PHYSICAL PROTECTION SYSTEMS DESIGN AND EVALUATION

A. Short description

This module provides all important elements of the process of a physical protection system design, such as target identification, evaluation approaches, response and communication, vulnerability assessment, performance testing, operating principles and the contingency plan. Definition of system requirements and physical protection system design and evaluation are described in detail. Some theoretical parts of the module are supported by practical exercises.

B. Learning objectives

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

(a) To present and discuss the fundamental principles of a physical protection system;
(b) To plan and implement the process of physical protection system design;
(c) To design and evaluate physical protection systems for different types of nuclear installation and facility.

C. Module outline

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 and graded approach
    - 1.4. Concept of several layers and methods, definition of in-depth, balanced protection, no single point failures and redundant equipment
    - 1.5. Quality assurance
    - 1.6. Contingency plan
    - 1.7. Confidentiality
2. Overview of process of physical protection system (PPS) 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 PPS
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. Consequence analysis, radiological consequences of sabotage
   5.3. Risk equation
   5.4. Threat assessment and design basis threat
   5.5. Trade-off and policy factors in use of design basis threat 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 a PPS
   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. Developing requirements for the design of a 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 time of response force
      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 resources
   10.5. Response exercises
   10.6. Communication to the public
11. Operating principles of a PPS
   11.1. Implementation of PPS at any stage of its life
   11.2. Inspection and enforcement regime, compliance with licence
   11.3. Insurance of necessary 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

(i) Case study: Identification of physical protection requirements and objectives for a hypothetical nuclear facility.
(ii) Case study: Design of a physical protection system according to the previously identified requirements.
(iii) 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 reading

GARCIA, M.L., Vulnerability Assessment of Physical Protection Systems, Butterworth-Heinemann, Oxford (2006).

— The Design and Evaluation of Physical Protection Systems, 2nd edn, Butterworth-Heinemann, Oxford (2008).

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

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

Code of Conduct on the Safety and Security of Radioactive Sources (2004).

Amendment to the Convention on the Physical Protection of Nuclear Material, IAEA International Law Series No. 2 (2006).

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

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

Handbook on the Design of Physical Protection Systems for Nuclear Material and Nuclear Facilities, IAEA Nuclear Security Series No. 40-T (2021).

TALBOT, J., JAKEMAN, M., Security Risk Management: Body of Knowledge, John Wiley and Sons, Hoboken, NJ (2009).

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

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

NSC9. PHYSICAL PROTECTION TECHNOLOGIES AND EQUIPMENT

A. Short description

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

B. Learning objectives

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

(a) To acquire an in-depth understanding of current technical methods, sensors and instruments in physical protection;
(b) To learn how to select the appropriate equipment to satisfy the requirements for different physical protections systems.

C. Module outline

1. Function of a PPS
    - 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. Sensor classification
        - 2.2.1. Active and passive sensors
        - 2.2.2. Covert and visible sensors
        - 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. Fibre 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 PPSs
   - 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. Alarm assessment systems
   - 6.3. Video alarm assessment systems

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 forces
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 and 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 and protection equipment
10.3. Other equipment

D. Exercises

(i) Case study: Selection of sensors for the research reactor perimeter (according to provided drawings and descriptions).
(ii) Case study: Selection of sensors for the research reactor control room, fresh and spent fuel storages (according to provided drawings and descriptions).
(iii) Practical exercise: Selection of required equipment, design and evaluation of a PPS satisfying the described requirements.

E. Laboratory work

(i) Familiarization with sensors.
(ii) Sensitivity level of selected sensors.
(iii) Review of video images.
(iv) Alarm assessment.

F. Suggested reading

GARCIA, M.L., Vulnerability Assessment of Physical Protection Systems, Butterworth-Heinemann, Oxford (2006).

— The Design and Evaluation of Physical Protection Systems, 2nd edn, Butterworth-Heinemann, Oxford (2008).

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

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

Code of Conduct on the Safety and Security of Radioactive Sources (2004).

Amendment to the Convention on the Physical Protection of Nuclear Material, IAEA International Law Series No. 2 (2006).

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

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

Handbook on the Design of Physical Protection Systems for Nuclear Material and Nuclear Facilities, IAEA Nuclear Security Series No. 40-T (2021).

TALBOT, J., JAKEMAN, M., Security Risk Management: Body of Knowledge, John Wiley and Sons, Hoboken, NJ (2009).

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

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

NSC10. USE OF NUCLEAR MATERIAL ACCOUNTING AND CONTROL (NMAC) FOR NUCLEAR SECURITY

A. Short description

This module describes a national accounting and control system and its function at nuclear and radiological facilities. Special attention will be paid to performance of national inspections and physical inventory taking activities. This module also focuses on international safeguards, which will help students to understand the IAEA's function, and international safeguards measures and activities.

B. Learning objectives

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

(a) To define and describe a State system of accounting for and control of nuclear and other radioactive material;
(b) To become familiar with international safeguards;
(c) To arrange national nuclear accounting and control systems at bulk and item facilities, perform national inspections, and analyse and report results of physical inventory taking as a part of broader State nuclear security measures.

C. Module outline

1. Differences between international and domestic NMAC programmes

2. NMAC role in the use, storage and processing of nuclear material, and protecting against insider threats and external threats
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. Radiation portal monitors and other detection devices
   - 5.5. Administrative checks
6. Movement of nuclear material
   - 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

(i) Practical exercise: Design the nuclear material accounting and control system at a nuclear reactor with associated isotope production hot cell laboratory (material balance areas, control of nuclear material production and loss, receipt of target nuclear material, shipment of nuclear material and radioactive sources, frequency of national inspections, physical inventory taking).

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested reading

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

Amendment to the Convention on the Physical Protection of Nuclear Material, IAEA International Law Series No. 2 (2006).

Nuclear Material Accounting Handbook, IAEA Services Series No. 15 (2008).

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

International Target Values 2010 for Measurement Uncertainties in Safeguarding Nuclear Materials, Safeguards Technical Report No. 368 (2010).

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

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

Preventive and Protective Measures against Insider Threats, IAEA Nuclear Security Series No. 8-G (Rev. 1) (2020).

SIEGEL, J., STEINBRUNER, J., GALLAGHER, N., Comprehensive Nuclear Material Accounting: A Proposal to Reduce Global Nuclear Risk, Center for International and Security Studies at Maryland, College Park, MD (2014).

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).

WILLIAMS, M., On the Importance of MC&A to Nuclear Security, CISSM Working Paper, Center for International and Security Studies at Maryland, College Park, MD (2014).

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

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

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

NSC11. PREVENTING AND PROTECTING AGAINST INSIDER THREAT

A. Short description

This module provides a general description of the insider threat (their capabilities, motivation and categories). It also describes the situations to be considered in the analysis of insider threats. It also focuses on the preventive and protective measures to be developed and implemented against possible insider threats.

B. Learning objectives

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

(a) To differentiate the capabilities and motivations of potential insider adversaries;
(b) To design and develop measures to prevent and protect the facility against this type of threat.

C. Module outline

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 threat 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 and 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 transport 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 insider threats
    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

(i) 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 reading

INTERNATIONAL ATOMIC ENERGY AGENCY, Preventive and Protective Measures against Insider Threats, IAEA Nuclear Security Series No. 8-G (Rev. 1), IAEA, Vienna (2020).

PARKER, C., Insider threats biggest challenge to nuclear security, CISAC News, Center for International Security and Cooperation (9 Apr. 2014).

SNOW, C., PEDERSON, A., TOWNSEND, J., SHANNON, M., Review of July 2013 Nuclear Security Insider Threat Exercise, ORNL/TM-2013/530, Oak Ridge National Laboratory, Oak Ridge, TN (2013).

THE WHITE HOUSE, Joint Statement on Insider Threat Mitigation (1 Apr. 2016).

NSC12. SECURITY OF NUCLEAR AND OTHER RADIOACTIVE MATERIAL IN TRANSPORT

A. Short description

This module provides 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.

B. Learning objectives

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

(a) To outline international transport security requirements;
(b) To use practical guidelines for developing security measures for transport of nuclear and other radioactive material;
(c) To select and implement transport security measures and technologies.

C. Module outline

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 requirements and transport security requirements

1.3. Types of threat
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. Convention on the Physical Protection of Nuclear Material
      2.1.2. 2005 Amendment to the Convention on the Physical Protection of Nuclear Material
      2.1.3. United Nations Security Council resolutions
      2.1.4. Physical protection of nuclear material (see IAEA Nuclear Security Series Nos 13, Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5), and 26-G, Security of Nuclear Material in Transport)
      2.1.5. Transport of dangerous goods
      2.1.6. Security of radioactive sources
      2.1.7. Radioactive material transport security
   2.2. State responsibilities
   2.3. International institutions relevant to transport security (IATA, ICAO, IMO, UNECE, WNTI)
   2.4. Cooperation with other States and the IAEA
   2.5. Regional cooperation and regulations on the transport of dangerous goods
      2.5.1. European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) (UNECE)
      2.5.2. European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN) (UNECE)
      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 material 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 (e.g. security level, security locks, training, personnel identity, tracking, communication, security plans, notification)
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 (e.g. planned and alternate routes, communication, positional tracking)
   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

(i) Tabletop: Identification of security measures and preparation of transport security plan for the transport of irradiated high enriched uranium fuel assemblies from the storage facility.
(ii) Developing the transport security plan.
(iii) Vulnerability assessment of transport.
(iv) 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 reading

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

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 COORDINATION 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 (Vienna)

Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material, IAEA Safety Standards Series No. TS-G-1.2 (ST-3) (2002).

Method for Developing Arrangements for Response to a Nuclear or Radiological Emergency, EPR–Method 2003 (2003).

Code of Conduct on the Safety and Security of Radioactive Sources (2004).

Amendment to the Convention on the Physical Protection of Nuclear Material, IAEA International Law Series No. 2 (2006).

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

Guidance on the Import and Export of Radioactive Sources (2012).

Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2012 Edition), IAEA Safety Standards Series No. SSG-26 (2014).

Regulations for the Safe Transport of Radioactive Material, 2018 Edition, IAEA Safety Standards Series No. SSR-6 (Rev. 1) (2018).

Security of Radioactive Material in Transport, IAEA Nuclear Security Series No. 9-G (Rev. 1) (2020).

Handbook on the Design of Physical Protection Systems for Nuclear Material and Nuclear Facilities, IAEA Nuclear Security Series No. 40-T (2021).

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

UNITED NATIONS, Recommendations on the Transport of Dangerous Goods, 21st edn, 2 vols, United Nations, New York (2019).

UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE, Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), ECE/TRANS/300, 2 vols, UNITED NATIONS, New York and Geneva (2020).

— European Agreement Concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN), ECE/TRANS/301, 2 vols, UNITED NATIONS, New York and Geneva (2020).

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

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

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

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

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

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

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

Convention on International Civil Aviation (The Chicago Convention), 9th edn, ICAO, Montreal (2006).

Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID), Appendix C to the Convention Concerning International Carriage by Rail (2017).

International Maritime Dangerous Goods Code (incorporating Amendment 39-18), 2018 edn, IMO, London (2018).

NSC13. COMPUTER SECURITY FOR A NUCLEAR WORLD

A. Short description

This module provides theoretical and practical knowledge of security methods for computers and computing systems. Learning is supported by theoretical lectures, real world examples and practical exercises.

B. Learning objectives

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

C. Module outline

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 and availability
    - 1.5. Computer security control measures
        - 1.5.1. Technical controls
        - 1.5.2. Administrative controls
        - 1.5.3. Physical controls
2. Cyber threat
    - 2.1. Threat actors
    - 2.2. Types of attack and common attack vectors
    - 2.3. Potential impacts of attack

2.4. Anatomy of an attack
2.5. Case studies of actual attacks

3. 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. Regulations
   4.2. Policy development
   4.3. Programme elements
   4.4. Models for computer security regulations
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 and demilitarized zone (DMZ) networks
   6.4. Wireless security
   6.5. Intrusion detection systems (IDSs) and intrusion prevention systems (IPSs)
   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 (ICSs)
   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–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. 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 life cycle
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

(i) Conducting a risk assessment of a computer security incident;
(ii) Designing a computer security control system for a nuclear facility.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested reading

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

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

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

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

NSC14. DETECTION OF CRIMINAL OR OTHER UNAUTHORIZED ACTS INVOLVING NUCLEAR AND OTHER RADIOACTIVE MATERIAL OUT OF REGULATORY CONTROL

A. Short description

This module emphasizes the need for a robust second line of defence in a State; that is, effective capabilities to detect and interdict unauthorized movement of nuclear and other radioactive material both at borders and within the State. The module provides the fundamental components necessary for developing and implementing effective detection strategies and for maintaining detection systems.

B. Learning objectives

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

(a) To explain and apply the principles of detection of criminal or other unauthorized acts involving nuclear and other radioactive material, which is an important element of a comprehensive nuclear security system;
(b) To outline the main detection systems and make recommendations for prevention and detection strategies at borders, strategic points and other locations of importance;
(c) To comprehend the design features, the procedures for performance monitoring and the sustainability of detection systems.

C. Module outline

1. Introduction of nuclear and other radioactive material out of regulatory control
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 specifications
   - 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 and 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

(i) Demonstration of deployment and operation of radiation detection equipment at land borders, seaports, airports and other locations of importance.
(ii) Tabletop and field: Response procedures to be implemented after detection of nuclear or other radioactive material out of regulatory control in different cases.
(iii) Operation of handheld devices to locate and identify hidden source in a vehicle.

E. Laboratory work

(i) Familiarization with radiation portal monitors.
(ii) Familiarization with handheld radiation detection equipment.
(iii) Field use of spectroscopic techniques.

F. Suggested reading

EUROPEAN POLICE OFFICE, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, UNITED NATIONS INTERREGIONAL CRIME AND JUSTICE RESEARCH INSTITUTE, UNITED NATIONS OFFICE ON DRUGS AND CRIME, WORLD CUSTOMS ORGANIZATION, Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 15, IAEA, Vienna (2011).

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

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

Identification of Radioactive Sources and Devices, IAEA Nuclear Security Series No. 5 (2007).

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

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

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

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

Security of Radioactive Material in Use and Storage and of Associated Facilities, IAEA Nuclear Security Series No. 11-G (Rev. 1) (2019).

Security of Radioactive Material in Transport, IAEA Nuclear Security Series No. 9-G (Rev. 1) (2020).

INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, Risk Informed Approach for Nuclear Security Measures for Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 24-G, IAEA, Vienna (2015).

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

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

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

NSC15. RESPONSE TO CRIMINAL OR OTHER UNAUTHORIZED ACTS INVOLVING NUCLEAR AND OTHER RADIOACTIVE MATERIAL OUT OF REGULATORY CONTROL

A. Short description

In this module, emphasis is placed on response to criminal or other unauthorized acts involving nuclear and other radioactive material. The module contains 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.

B. 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 other unauthorized acts involving nuclear and other radioactive material.

C. Module outline

1. Introduction
    - 1.1. Regulations overview
    - 1.2. Role of the regulatory body
    - 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 alerts by intelligence gathering and assessment
   2.3. Response to alarm or alert as a result of nuclear and radioactive material being out of regulatory control
   2.4. Response to alarm or alert 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. Necessary 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

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 radiological dispersal devices (RDDs)
   8.2. Dispersion of radioactive material, basics of an 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. Management of mass casualties

D. Exercises

(i) Personal protective equipment exercise.
(ii) Tabletop: Incident response management and emergency procedures.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested reading

EUROPEAN POLICE OFFICE, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, UNITED NATIONS INTERREGIONAL CRIME AND JUSTICE RESEARCH INSTITUTE, UNITED NATIONS OFFICE ON DRUGS AND CRIME, WORLD CUSTOMS ORGANIZATION, Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 15, IAEA, Vienna (2011).

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

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 COORDINATION 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 COORDINATION 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).

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 ASSOCIATION OF FIRE AND RESCUE SERVICES, PAN AMERICAN HEALTH ORGANIZATION, INTERNATIONAL ATOMIC ENERGY AGENCY, WORLD HEALTH ORGANIZATION, Manual for First Responders to a Radiological Emergency, EPR–First Responders 2006, IAEA, Vienna (2006).

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

Generic Procedures for Monitoring in a Nuclear or Radiological Emergency, IAEA-TECDOC-1092 (1999).

Generic Procedures for Assessment and Response during a Radiological Emergency, IAEA-TECDOC-1162 (2000).

Method for Developing Arrangements for Response to a Nuclear or Radiological Emergency, EPR–Method 2003 (2003).

Preparation, Conduct and Evaluation of Exercises to Test Preparedness for a Nuclear or Radiological Emergency, EPR–Exercise 2005 (2005).

Identification of Radioactive Sources and Devices, IAEA Nuclear Security Series No. 5 (2007).

Communication with the Public in a Nuclear or Radiological Emergency, EPR–Public Communications 2012 (2012).

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

Method for Developing a Communication Strategy and Plan for a Nuclear or Radiological Emergency, EPR–Public Communication Plan 2015 (2015).

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

Security of Radioactive Material in Use and Storage and of Associated Facilities, IAEA Nuclear Security Series No. 11-G (Rev. 1) (2019).

INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, Risk Informed Approach for Nuclear Security Measures for Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 24-G, IAEA, Vienna (2015).

INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, UNITED NATIONS INTERREGIONAL CRIME AND JUSTICE RESEARCH INSTITUTE,

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

INTERNATIONAL ATOMIC ENERGY AGENCY, UNIVERSAL POSTAL UNION, WORLD CUSTOMS ORGANIZATION, 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, WORLD HEALTH ORGANIZATION, Generic Procedures for Medical Response during a Nuclear or Radiological Emergency, EPR–MEDICAL 2005, IAEA, Vienna (2005).

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

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

ELECTIVE MODULES

NSE1. INTERFACES OF NUCLEAR SECURITY WITH SAFETY AND SAFEGUARDS

A. Short description

This module 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.

B. Learning objectives

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

(a) To identify and describe the concepts, objectives and principles of nuclear security as they interact with nuclear safety and safeguards;
(b) To describe the interfaces between nuclear security with nuclear safety and safeguards, and the challenges and opportunities that they present.

C. Module outline

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 the 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 Treaty on the Non-Proliferation of Nuclear Weapons
   - 6.2. Prevention, detection and response to malicious acts involving nuclear and other radioactive material by non-State actors
7. Interface between security and safeguards
   - 7.1. Technologies
   - 7.2. Information
   - 7.3. Procedures

D. Exercises

(i) 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 reading

EUROPEAN ATOMIC ENERGY COMMUNITY, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR ORGANIZATION, INTERNATIONAL MARITIME ORGANIZATION, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, WORLD HEALTH ORGANIZATION, Fundamental Safety Principles, IAEA Safety Standards Series No. SF-1, IAEA, 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 COORDINATION 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 COORDINATION 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 2003, IAEA, Vienna (2003).

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

INTERNATIONAL NUCLEAR SAFETY GROUP, The Interface Between Safety and Security at Nuclear Power Plants, INSAG-24, IAEA, Vienna (2010).

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

Treaty on the Non-Proliferation of Nuclear Weapons, United Nations, New York (1968).

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), IAEA, Vienna (1972).

Communications 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).

Model Protocol Additional to the Agreement(s) between State(s) and the International Atomic Energy Agency for the Application of Safeguards, INFCIRC/540/Corr.1, IAEA, Vienna (1998).

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

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

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

Communications Received from Certain Member States Regarding Guidelines for Transfers of Nuclear-related Dual-use Equipment, Materials, Software and Related Technology, INFCIRC/254/Rev. 6/Part 2, IAEA, Vienna (2005).

Communications Received from Certain Member States Regarding Guidelines for the Export of Nuclear Material, Equipment and Technology, INFCIRC/254/Rev. 7/Part 1, IAEA, Vienna (2005).

NSE2. LEGAL DRAFTING FOR NUCLEAR SECURITY

A. Short description

This module provides an overview of the basic components and substantive elements of a comprehensive national nuclear law, with emphasis on nuclear security. It provides students who have a general legal or policy background with the knowledge needed:

(a) To be able to develop and draft legal acts and other documentation relating to nuclear security;
(b) To integrate them into the existing national legal structure and process;
(c) To ensure that they reflect the State's obligations under the existing international legal instruments relating to nuclear security.

B. Learning objectives

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

(a) To identify basic concepts and substantive elements of a State's comprehensive nuclear law, and in particular its components related to nuclear security;
(b) To draft laws and regulations that fit within the overall national legal structure and process, and integrate State's obligations under the relevant international legal instruments.

C. Module outline

1. Definition, scope and application of nuclear law
2. Overview of main international legal instruments related to nuclear security
   - 2.1. Convention on the Physical Protection of Nuclear Material
   - 2.2. 2005 Amendment to the Convention on the Physical Protection of Nuclear Material
   - 2.3. United Nations conventions
   - 2.4. United Nations Security Council resolutions
   - 2.5. Codes of conduct and other non-binding instruments

2.6. Linking international legal instruments with national obligations

3. National legislation
   - 3.1. Areas of coverage
     - 3.1.1. Nuclear safety
     - 3.1.2. Nuclear security
     - 3.1.3. Safeguards
     - 3.1.4. Liability
   - 3.2. Comprehensive versus 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 physical protection requirements
   - 5.6. Enforcement

5.7. Nuclear or other radioactive material out of 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

(i) 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 reading

In addition to the reference material proposed for module NSC1, the following are also useful:

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 COORDINATION 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, 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).

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).

NSE3. INTERNATIONAL COOPERATION ON NUCLEAR SECURITY

A. Short description

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

B. Learning objectives

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

(a) To demonstrate knowledge of the principal stakeholders involved in the international cooperation on nuclear security;
(b) To describe their goals, objectives, challenges and accomplishments.

C. Module outline

1. Need for international cooperation on nuclear security
   - 1.1. Nuclear security as State prerogative and responsibility
   - 1.2. Nuclear security as a global issue
   - 1.3. Need for a cooperative approach to address nuclear security
2. Principal international and multilateral stakeholders in nuclear security
   - 2.1. 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 United Nations organizations and their involvement in nuclear security
    2.2.1. United Nations Security Council
    2.2.2. Security Council Committee established pursuant to resolution 1540 (2004) (1540 Committee)
    2.2.3. United Nations Office on Drugs and Crime (UNODC)
    2.2.4. United Nations Office for Disarmament Affairs (UNODA)
    2.2.5. United Nations Office of Counter-Terrorism (UNOCT)
2.3. Other international and multilateral organizations
    2.3.1. Organization for Security and Co-operation in Europe (OSCE)
    2.3.2. International Criminal Police Organization–INTERPOL and regional police organizations
    2.3.3. World Customs Organization (WCO)
    2.3.4. World Health Organization (WHO)
    2.3.5. International Maritime Organization (IMO)
    2.3.6. International Civil Aviation Organization (ICAO)
    2.3.7. United Nations Interregional Crime and Justice Research Institute (UNICRI)
    2.3.8. Joint Research Centre (JRC)
2.4. International and multilateral initiatives
    2.4.1. 2010–2016 Nuclear Security Summit process
    2.4.2. Global Initiative to Combat Nuclear Terrorism (GICNT)
    2.4.3. Global Partnership Against the Spread of Weapons and Materials of Mass Destruction (Global Partnership)
    2.4.4. Border Monitoring Working Group (BMWG)
    2.4.5. Other initiatives
2.5. Non-governmental organizations
    2.5.1. World Institute for Nuclear Security (WINS)
    2.5.2. World Nuclear Transport Institute (WNTI)
    2.5.3. Nuclear Threat Initiative (NTI)
    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

(i) Role play: Identify a set of objectives and priorities towards the development of an IAEA nuclear security plan for a period of four years.
(ii) 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 to avoid duplication of effort.
(iii) 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 reading

EUROPEAN POLICE OFFICE, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, UNITED NATIONS INTERREGIONAL CRIME AND JUSTICE RESEARCH INSTITUTE, UNITED NATIONS OFFICE ON DRUGS AND CRIME, WORLD CUSTOMS ORGANIZATION, Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 15, IAEA, Vienna (2011).

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

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

Code of Conduct on the Safety and Security of Radioactive Sources (2004).

Amendment to the Convention on the Physical Protection of Nuclear Material, IAEA International Law Series No. 2 (2006).

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

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

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

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

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

Security of Radioactive Material in Transport, IAEA Nuclear Security Series No. 9-G (Rev. 1) (2020).

INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, Risk Informed Approach for Nuclear Security Measures for Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 24-G, IAEA, Vienna (2015).

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

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

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

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

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

International Convention for the Suppression of Acts of Nuclear Terrorism, A/RES/59/290, United Nations, New York (2005).

NSE4. DEVELOPING AND IMPLEMENTING DESIGN BASIS THREAT (DBT)

A. Short description

This module provides an in-depth study of the goals, objectives and main elements of a design basis threat (DBT), including the principal stakeholders, procedure for conducting a threat assessment, roles and responsibilities of principal stakeholders, and main inputs and outputs of the DBT process.

B. Learning objectives

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

(a) To identify the goals, objectives and principal elements of the DBT;
(b) To develop the DBT using the necessary information.

C. Module outline

1. Description of a DBT
   - 1.1. Definition
   - 1.2. Main topics
     - 1.2.1. Insider/external adversaries
     - 1.2.2. Relationship between malicious acts and unacceptable consequences
     - 1.2.3. Attributes and characteristics
     - 1.2.4. Design and evaluation
2. Purpose of a DBT
   - 2.1. Need for a DBT
   - 2.2. Value of a DBT
3. Roles and responsibilities
   - 3.1. State
   - 3.2. Competent authority(ies) for the development, use and maintenance of a DBT
   - 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 DBT or another threat based approach
5. Developing a DBT
    5.1. Input to the DBT
    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 DBT
7. Maintaining the DBT

D. Exercises

(i) 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 reading

GARCIA, M.L., Vulnerability Assessment of Physical Protection Systems, Butterworth-Heinemann, Oxford (2006).

— The Design and Evaluation of Physical Protection Systems, 2nd edn, Butterworth-Heinemann, Oxford (2008).

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

Amendment to the Convention on the Physical Protection of Nuclear Material, IAEA International Law Series No. 2 (2006).

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

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

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

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

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

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

Security of Radioactive Material in Use and Storage and of Associated Facilities, IAEA Nuclear Security Series No. 11-G (Rev. 1) (2019).

Security of Radioactive Material in Transport, IAEA Nuclear Security Series No. 9-G (Rev. 1) (2020).

National Nuclear Security Threat Assessment, Design Basis Threats and Representative Threat Statements, IAEA Nuclear Security Series No. 10-G (Rev. 1) (2021).

Computer Security Techniques for Nuclear Facilities, IAEA Nuclear Security Series No. 17-T (Rev. 1) (in preparation).

INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, Risk Informed Approach for Nuclear Security Measures for Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 24-G, IAEA, Vienna (2015).

ROPER, C., FISCHER, L., GRAU, J.A., Security Education, Awareness and Training: From Theory to Practice, Elsevier, Oxford (2006).

TALBOT, J., JAKEMAN, M., Security Risk Management: Body of Knowledge, John Wiley and Sons, Hoboken, NJ (2009).

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

NSE5. VULNERABILITY ASSESSMENT OF PHYSICAL PROTECTION SYSTEMS

A. Short description

This module aims to provide students with knowledge of system analysis, risk management, evaluation and optimization methods and their application for physical protection systems (PPSs) evaluation.

B. Learning objectives

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

(a) To perform a comprehensive evaluation and propose an optimization of different PPSs;
(b) To perform a qualitative and quantitative risk assessment.

C. Module outline

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 PPS
4.1. Adversary path: scenario and path analysis
4.2. Probabilistic and graph analytical methods in evaluation of PPSs
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

D. Exercises

(i) Case study: Risk assessment, evaluation of effectiveness and optimization of the PPS of a large nuclear reactor.
(ii) Case study: Evaluation of the PPS of a facility or radiological installation.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested reading

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

Code of Conduct on the Safety and Security of Radioactive Sources (2004).

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

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

GARCIA, M.L., Vulnerability Assessment of Physical Protection Systems, Butterworth-Heinemann, Oxford (2006).

— The Design and Evaluation of Physical Protection Systems, 2nd edn, Butterworth-Heinemann, Oxford (2008).

NSE6. NUCLEAR SECURITY CULTURE SELF-ASSESSMENT AND ENHANCEMENT

A. Short description

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

B. Learning objectives

Upon successful completion of this module, students will be familiar with and will be able to 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.

C. Module outline

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. Review of documentation
    - 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 identified programme
8.9. Continuous improvement of nuclear security
8.10. Enhancing nuclear security culture

D. Exercises

(i) Developing a model security culture assessment survey based on a set of proposed indicators;
(ii) Conducting a mock assessment interview with a facility manager or staff member;
(iii) 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 reading

BUNN, M., SAGAN, S.D., A Worst Practices Guide to Insider Threats: Lessons from Past Mistakes, American Academy of Arts and Sciences, Cambridge, MA (2014).

CAMERON, K., QUINN, R.E., Diagnosing and Changing Organizational Culture, 3rd edn, Jossey-Bass, San Francisco, CA (2011).

HOFSTEDE, G., HOFSTEDE, G.J., MINKOV, M., Cultures and Organizations: Software of the Mind, 3rd edn, McGraw-Hill, New York (2010).

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

Developing Safety Culture in Nuclear Activities: Practical Suggestions to Assist Progress, Safety Report Series No. 11 (1998).

Safety Culture in Nuclear Installations: Guidance for Use in the Enhancement of Safety Culture, IAEA-TECDOC-1329 (2002).

Code of Conduct on the Safety and Security of Radioactive Sources (2004).

Categorization of Radioactive Sources, IAEA Safety Standards Series No. RS-G-1.9 (2005).

Amendment to the Convention on the Physical Protection of Nuclear Material, IAEA International Law Series No. 2 (2006).

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

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

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

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

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

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

Governmental, Legal and Regulatory Framework for Safety, IAEA Safety Standards Series No. GSR Part 1 (Rev. 1) (2016).

Self-assessment of Nuclear Security Culture in Facilities and Activities, IAEA Nuclear Security Series No. 28-T (2017).

Security of Radioactive Material in Use and Storage and of Associated Facilities, IAEA Nuclear Security Series No. 11-G (Rev. 1) (2019).

IAEA Incident and Trafficking Database (ITDB): 2020 Fact Sheet (2020), www.iaea.org/sites/default/files/20/02/itdb-factsheet-2020.pdf

Preventive and Protective Measures against Insider Threats, IAEA Nuclear Security Series No. 8-G (Rev. 1) (2020).

Enhancing Nuclear Security Culture in Organizations Associated with Nuclear and Other Radioactive Material, IAEA Nuclear Security Series No. 38-T (2021).

Computer Security Techniques for Nuclear Facilities, IAEA Nuclear Security Series No. 17-T (Rev. 1) (in preparation).

INTERNATIONAL NUCLEAR SAFETY GROUP, The Interface Between Safety and Security at Nuclear Power Plants, INSAG-24, IAEA, Vienna (2010).

KARTCHNER, K.M., "Strategic culture and WMD decision making", in Strategic Culture and Weapons of Mass Destruction: Culturally Based Insights into Comparative National Security Policymaking (JOHNSON, J.L., KARTCHNER, K.M., LARSEN, J.A., Eds), Palgrave Macmillan, New York (2009) 55–68.

KOTTER, J.P., Leading Change, Harvard Business School Press, Boston, MA (1996).

ROPER, C., FISCHER, L., GRAU, J.A., Security Education, Awareness, and Training: From Theory to Practice, Elsevier, Oxford (2006).

SCHEIN, E.H., The Corporate Culture Survival Guide, Jossey-Bass, San Francisco, CA (2009).

— Organizational Culture and Leadership, 5th edn, Jossey-Bass, San Francisco, CA (2017).

UNITED STATES DEPARTMENT OF ENERGY, Inquiry into the Security Breach at the National Security Administration's Y-12 National Security Complex, DOE/IG-0868, USDOE, Washington, DC (2012).

VICENTE, K., The Human Factor, Routledge, New York (2006).

WEICK, K.E., SUTCLIFFE, K.M., Managing the Unexpected: Resilient Performance in an Age of Uncertainty, 2nd edn, Jossey-Bass, San Francisco, CA (2007).

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

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

International Convention for the Suppression of Acts of Nuclear Terrorism, A/RES/59/290, United Nations, New York (2005).

NSE7. DESIGNING PHYSICAL PROTECTION SYSTEMS FOR NUCLEAR AND RADIOLOGICAL FACILITIES

A. Short description

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

B. Learning objectives

Upon completion of this module, students will be able:

(a) To apply specifics of physical protection measures and national regulations for security of nuclear and other radioactive material and associated facilities;
(b) To design and evaluate a PPS for such facilities.

C. Module outline

1. Introduction to physical protection of nuclear and other radioactive material and associated facilities
    1.1. Convention on the Physical Protection of Nuclear Material
    1.2. 2005 Amendment to the Convention on the Physical Protection of Nuclear Material
    1.3. Code of Conduct on the Safety and Security of Radioactive Sources
    1.4. Categorization of nuclear material and radioactive sources
    1.5. Consequences from theft or sabotage relating to nuclear material, sources and associated facilities
    1.6. Misuse of nuclear facilities or equipment
    1.7. Certification of the sources
    1.8. IAEA catalogue of sealed sources
2. Application of fundamental principles of physical protection to nuclear material and other radioactive material and associated 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 radiological facilities (medical, industrial, agricultural)
5. Application of physical protection approaches and methods for nuclear and other radioactive material and associated facilities
   5.1. Specifics of PPSs 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 associated 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 associated facilities

6. Establishing national infrastructure for security of nuclear and other radioactive material and associated 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 nuclear facilities
   - 6.7. Selection of regulatory approach

D. Exercises

(i) Comprehensive project: Design and evaluate a PPS of a nuclear or radiological facility.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested reading

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

Code of Conduct on the Safety and Security of Radioactive Sources (2004).

Dangerous Quantities of Radioactive Material (D-Values), EPR–D-VALUES 2006 (2006).

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

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

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

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

Guidance on the Import and Export of Radioactive Sources (2012).

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

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

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

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

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

Security of Radioactive Material in Use and Storage and of Associated Facilities, IAEA Nuclear Security Series No. 11-G (Rev. 1) (2019).

Preventive and Protective Measures against Insider Threats, IAEA Nuclear Security Series No. 8-G (Rev. 1) (2020).

Security of Radioactive Material in Transport, IAEA Nuclear Security Series No. 9-G (Rev. 1) (2020).

Storage of Spent Nuclear Fuel, IAEA Safety Standards Series No. SSG-15 (Rev. 1) (2020).

Handbook on the Design of Physical Protection Systems for Nuclear Material and Nuclear Facilities, IAEA Nuclear Security Series No. 40-T (2021).

National Nuclear Security Threat Assessment, Design Basis Threats and Representative Threat Statements, IAEA Nuclear Security Series No. 10-G (Rev. 1) (2021).

Computer Security Techniques for Nuclear Facilities, IAEA Nuclear Security Series No. 17-T (Rev. 1) (in preparation).

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

NSE8. NUCLEAR MATERIAL ACCOUNTING AND CONTROL FOR NUCLEAR POWER PLANTS AND RESEARCH REACTORS

A. Short description

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

B. Learning objectives

Upon successful completion of this module, students will be able to identify, design, develop and implement technical and administrative measures for NMAC for nuclear security at nuclear power plants and research reactors.

C. Module outline

1. Introduction to the guidance publication IAEA Nuclear Security Series No. 25-G, Use of Nuclear Material Accounting and Control for Nuclear Security Purposes at Facilities
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 facility NMAC programmes prior to issuing a licence to possess nuclear material
    - 3.3. Inspecting implementation of facility NMAC programmes
    - 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-material balance areas' 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 might 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 inventory list that includes identification numbers and locations

6. Physical inventory of nuclear material
7. Nuclear material control
   7.1. Nuclear power plants
      7.1.1. Control measures (locks and keys, lists of authorized personnel, maintaining control over keys to essential equipment, i.e. the spent fuel pond bridge and the area where fresh fuel is stored) 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, i.e. the spent fuel pond bridge and the area where fresh fuel is stored) 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 material
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 (i.e. pins and pieces of pins separated from their assemblies)
9. Monitoring nuclear material between physical inventory taking (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 nuclear power plants and research reactors

10. Measurements and measurement control
10.1. The importance of measurements of discards and waste streams at a reactor site to ensure 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 occurs, 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

(i) Tamper indicating device (TID) selection:
— Show various types of TID;
— Demonstrate use of TIDs.

(ii) Receipt of nuclear material (e.g. fuel assemblies, rods) from the fuel manufacturer:
— Demonstrate record keeping associated with receipt of fresh fuel;
— Discuss activities for verifying receipts.

(iii) Periodic item monitoring test and administrative check:
— Demonstrate selecting a sample of items from a list of inventory;
— Discuss characteristics that have to be observed (e.g. identification number, location).

(iv) Investigation and reporting of an irregularity:
— Discuss steps to be taken when investigating an irregularity.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested reading

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

Amendment to the Convention on the Physical Protection of Nuclear Material, IAEA International Law Series No. 2 (2006).

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

Nuclear Material Accounting Handbook, IAEA Services Series No. 15 (2008).

International Target Values 2010 for Measurement Uncertainties in Safeguarding Nuclear Materials, Safeguards Technical Report No. 368 (2010).

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

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

Preventive and Protective Measures against Insider Threats, IAEA Nuclear Security Series No. 8-G (Rev. 1) (2020).

SIEGEL, J., STEINBRUNER, J., GALLAGHER, N., Comprehensive Nuclear Material Accounting: A Proposal to Reduce Global Nuclear Risk, Center for International and Security Studies at Maryland, College Park, MD (2014).

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).

WILLIAMS, M., On the Importance of MC&A to Nuclear Security, CISSM Working Paper, Center for International and Security Studies at Maryland, College Park, MD (2014).

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

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

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

NSE9. NUCLEAR MATERIAL ACCOUNTING AND CONTROL FOR FACILITIES THAT PROCESS NUCLEAR MATERIAL

A. Short description

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

B. Learning objectives

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

C. Module outline

1. Introduction to the guidance publication IAEA Nuclear Security Series No. 25-G, Use of Nuclear Material Accounting and Control for Nuclear Security Purposes at Facilities
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 facility NMAC programmes prior to issuing a licence to possess nuclear material

3.3. Inspecting implementation of facility NMAC programmes
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-material balance areas' 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 might 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 material
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 needed for physical inventory taking (scheduled or non-scheduled).

9. Monitoring nuclear material between physical inventory taking
   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 among the organizations responsible for the facility's nuclear material
12. Nuclear material movement
   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
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

(i) Tamper indicating device (TID) selection:
   — Show various types of TID;
   — Demonstrate use of TIDs.

(ii) Receipt of nuclear material from an outside facility:
   — Demonstrate record keeping associated with receipt of nuclear material;
   — Discuss activities including measurements for verifying receipts.

(iii) Periodic item monitoring test and administrative check:
   — Demonstrate selecting a sample of items from an inventory list;
   — Discuss characteristics that have to be observed (e.g. identification number, location).

(iv) Movement of nuclear material from one material balance area to another within a facility:
   — Discuss activities including records and measurements for transfers.

(v) Split and down blending exercise:
   — Discuss activities including measurements for splits and down blending.

(vi) Investigation and reporting of an irregularity:
— Discuss steps to be taken when investigating an irregularity.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested reading

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

Amendment to the Convention on the Physical Protection of Nuclear Material, IAEA International Law Series No. 2 (2006).

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

Nuclear Material Accounting Handbook, IAEA Services Series No. 15 (2008).

International Target Values 2010 for Measurement Uncertainties in Safeguarding Nuclear Materials, Safeguards Technical Report No. 368 (2010).

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

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

Preventive and Protective Measures against Insider Threats, IAEA Nuclear Security Series No. 8-G (Rev. 1) (2020).

SIEGEL, J., STEINBRUNER, J., GALLAGHER, N., Comprehensive Nuclear Material Accounting: A Proposal to Reduce Global Nuclear Risk, Center for International and Security Studies at Maryland, College Park, MD (2014).

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).

WILLIAMS, M., On the Importance of MC&A to Nuclear Security, CISSM Working Paper, Center for International and Security Studies at Maryland, College Park, MD (2014).

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

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

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

NSE10. ESTABLISHING AND IMPLEMENTING A TRANSPORT SECURITY PLAN

A. Short description

This module introduces to the students the concept of a transport security plan for nuclear and other radioactive material.

B. Learning objectives

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

(a) To understand the purpose of a transport security plan;
(b) To describe the elements of a transport security plan;
(c) To develop an effective transport security plan.

C. Module outline

1. Goals and objectives of a 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

(i) Tabletop: 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 reading

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 COORDINATION 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 (Vienna)

Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material, IAEA Safety Standards Series No. TS-G-1.2 (ST-3) (2002).

Method for Developing Arrangements for Response to a Nuclear or Radiological Emergency, EPR–Method 2003 (2003).

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

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

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

Security of Radioactive Material in Transport, IAEA Nuclear Security Series No. 9-G (Rev. 1) (2020).

NSE11. DESIGNING AND IMPLEMENTING A NATIONAL DETECTION ARCHITECTURE (NDA)

A. Short description

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

B. Learning objectives

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

(a) To identify the attributes and components of an NDA for nuclear security;
(b) To draft such a plan using various inputs.

C. Module outline

1. Attributes of an effective NDA for nuclear security
   - 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. Design attributes for an NDA for nuclear security
   - 3.1. Risk informed approach
   - 3.2. Adaptability to specific conditions and 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 an effective NDA for nuclear security
   - 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

(i) Developing a notional NDA for nuclear security based on a hypothetical scenario and involving various stakeholders.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested reading

EUROPEAN POLICE OFFICE, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, UNITED NATIONS INTERREGIONAL CRIME AND JUSTICE RESEARCH INSTITUTE, UNITED NATIONS OFFICE ON DRUGS AND CRIME, WORLD CUSTOMS ORGANIZATION, 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, Nuclear Security Systems and Measures for the Detection of Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 21, IAEA, Vienna (2013).

INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, Risk Informed Approach for Nuclear Security Measures for Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 24-G, IAEA, Vienna (2015).

NSE12. IMPORT/EXPORT AND TRANSIT CONTROL MECHANISM AND REGIME

A. Short description

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

B. Learning objectives

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

C. Module outline

1. Proliferation of nuclear weapons and export controls
    - 1.1. Early indications of proliferation activities
    - 1.2. Detection and delay of proliferation
    - 1.3. Malicious non-State actors 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. Treaty on the Non-Proliferation of Nuclear Weapons and import/export 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 and illicit nuclear trade
4.4. Import/export control practice

5. International trade in nuclear and radioactive material
   5.1. Nuclear and radioactive material as objects of international trade
   5.2. Transport in international trade
   5.3. Import/export packing and labelling
   5.4. Nuclear and radioactive material tariff classification codes
   5.5. Nuclear and radioactive material characteristics subject to customs verification

6. Import/export and transit of nuclear and radioactive material: Procedures and documentation
   6.1. Legal framework and regulations
   6.2. Non-tariff restrictions and licences
   6.3. Import/export documentation
   6.4. Transit documentation
   6.5. Customs clearance and customs inspection
   6.6. Risks associated with transit and transshipment
   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

(i) Case study: Import of dual use equipment for clandestine enrichment purposes.
(ii) Demonstration of typical import/export and transit documentation.
(iii) 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 reading

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

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

Guidance on the Import and Export of Radioactive Sources (2012).

Security of Radioactive Material in Use and Storage and of Associated Facilities, IAEA Nuclear Security Series No. 11-G (Rev. 1) (2019).

Security of Radioactive Material in Transport, IAEA Nuclear Security Series No. 9-G (Rev. 1) (2020).

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

Customs Convention on Containers, United Nations/IMO, Geneva (1972).

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

Communications 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 Convention on Mutual Administrative Assistance in Customs Matters (Johannesburg Convention), WCO, Brussels (2003).

Communications Received from Certain Member States Regarding Guidelines for Transfers of Nuclear-related Dual-use Equipment, Materials, Software and Related Technology, INFCIRC/254/Rev. 6/Part 2, IAEA, Vienna (2005).

Communications Received from Certain Member States Regarding Guidelines for the Export of Nuclear Material, Equipment and Technology, INFCIRC/254/Rev. 7/Part 1, IAEA, Vienna (2005).

NSE13. NUCLEAR SECURITY FRAMEWORK FOR MAJOR PUBLIC EVENTS

A. Short description

This module emphasizes 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 and implementation of an action plan.

B. Learning objectives

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

C. Module outline

1. Goals and objectives of a comprehensive nuclear security system for major public events
2. Design of a comprehensive nuclear security system for major public events
   - 2.1. Threat analysis
   - 2.2. Prevention activities
   - 2.3. Detection activities
   - 2.4. Response activities
   - 2.5. General principles for the development of an action plan
   - 2.6. Management of resources and information security
3. Threat analysis
   - 3.1. Evaluation of threat
   - 3.2. Vulnerability assessment
   - 3.3. Security measures for radioactive sources
   - 3.4. IAEA Incident and Trafficking Database
4. Prevention measures
   - 4.1. Physical protection of radiation sources
   - 4.2. Role of the State in creating an effective physical protection system
   - 4.3. Border monitoring
   - 4.4. Nuclear security preparation for a State hosting a major public event
   - 4.5. Awareness and training
5. Detection measures
   - 5.1. Selection of venues and other strategic locations for detection systems
   - 5.2. Detection approach and equipment deployment strategies
   - 5.3. Detection instruments

5.3.1. Types of detection instrument
5.3.2. Detection instruments at strategic locations
5.3.3. Pre-event radiological surveys and background mapping
5.3.4. Early detection systems outside strategic locations
5.4. Acceptance testing
5.5. Equipment calibration and maintenance
5.6. Training

6. Response measures
6.1. Elements of response
6.2. Organizational structure for response
6.2.1. Role of the response organization
6.2.2. Needed infrastructure for the response organization
6.3. Response to an alarm
6.3.1. Alarm response procedures for strategic locations and other important points
6.3.2. Search procedures
6.3.3. Mobile expert support team (MEST) and reach-back to experts
6.4. Emergency preparedness and response
6.4.1. National emergency management system
6.4.2. Event specific arrangements for a major public event under the emergency response plan
6.4.3. Medical emergency preparedness and response
6.4.4. Protection of emergency workers
6.4.5. Public communications
6.5. Consequence management for nuclear security
6.5.1. Assessment, rescue, recovery and restoration
6.5.2. Recovery and return of nuclear and other radioactive material under regulatory control
6.6. Collection and preservation of evidence and prosecution
6.7. Training and awareness

D. Exercises

(i) Case study: Example command and control structure for a major sports event.
(ii) Action plan: Study of an example.
(iii) Case study: Design basis threat for a major sports event.
(iv) Presentation of a generic alarm response scheme for a major public event.

E. Laboratory work

Radiation alarm verification in a crowd.

F. Suggested reading

EUROPEAN POLICE OFFICE, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, UNITED NATIONS INTERREGIONAL CRIME AND JUSTICE RESEARCH INSTITUTE, UNITED NATIONS OFFICE ON DRUGS AND CRIME, WORLD CUSTOMS ORGANIZATION, Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 15, IAEA, Vienna (2011).

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

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 COORDINATION 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 COORDINATION 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).

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 ASSOCIATION OF FIRE AND RESCUE SERVICES, PAN AMERICAN HEALTH ORGANIZATION, INTERNATIONAL ATOMIC ENERGY AGENCY, WORLD HEALTH ORGANIZATION, Manual for First Responders to a Radiological Emergency, EPR–First Responders 2006, IAEA, Vienna (2006).

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

Generic Procedures for Monitoring in a Nuclear or Radiological Emergency, IAEA-TECDOC-1092 (1999).

Generic Procedures for Assessment and Response during a Radiological Emergency, IAEA-TECDOC-1162 (2000).

Method for Developing Arrangements for Response to a Nuclear or Radiological Emergency, EPR–Method 2003 (2003).

Code of Conduct on the Safety and Security of Radioactive Sources (2004).

Categorization of Radioactive Sources, IAEA Safety Standards Series No. RS-G-1.9 (2005).

Technical and Functional Specifications for Border Monitoring Equipment, IAEA Nuclear Security Series No. 1 (2006).

Nuclear Security Measures at the XV Pan American Games: Rio de Janeiro 2007 (2009).

Communication with the Public in a Nuclear or Radiological Emergency, EPR–Public Communications 2012 (2012).

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

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

Method for Developing a Communication Strategy and Plan for a Nuclear or Radiological Emergency, EPR–Public Communication Plan 2015 (2015).

Regulations for the Safe Transport of Radioactive Material, 2018 Edition, IAEA Safety Standards Series No. SSR-6 (Rev. 1) (2018).

Security of Radioactive Material in Use and Storage and of Associated Facilities, IAEA Nuclear Security Series No. 11-G (Rev. 1) (2019).

National Nuclear Security Threat Assessment, Design Basis Threats and Representative Threat Statements, IAEA Nuclear Security Series No. 10-G (Rev. 1) (2021).

INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, Risk Informed Approach for Nuclear Security Measures for Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 24-G, IAEA, Vienna (2015).

INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, UNITED NATIONS INTERREGIONAL CRIME AND JUSTICE RESEARCH INSTITUTE, Radiological Crime Scene Management, IAEA Nuclear Security Series No. 22-G, IAEA, Vienna (2014).

INTERNATIONAL ATOMIC ENERGY AGENCY, WORLD HEALTH ORGANIZATION, Generic Procedures for Medical Response during a Nuclear or Radiological Emergency, EPR–MEDICAL 2005, IAEA, Vienna (2005).

NSE14. RADIOLOGICAL CRIME SCENE MANAGEMENT

A. Short description

The two main goals of this module are to offer an introduction to radiological crime scene management and to support the conduct of an ensuing nuclear forensics examination. The available tools, techniques and methods of

traditional forensics will be introduced. In particular, the module focuses on the forensics examination process, which can play a decisive role in investigating and prosecuting crimes involving nuclear and radioactive material. Basic principles of nuclear forensics and nuclear forensic interpretation will be presented and discussed. The module will include lectures on international cooperation, the principles of incident response and a nuclear forensics model action plan.

B. Learning objectives

Upon successful completion of this module, students will 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 origins of illicit radioactive material. The students' understanding of radiological crime scene management principles, including traditional methods of investigation and use of intelligence, will benefit from an awareness of nuclear forensics considerations.

C. Module outline

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 body
        - 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 relating to a radiological crime scene
        - 2.2.1. Inked and latent fingerprints
        - 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 radioactive material in transit

2.3.2. Range of potential radiological dispersal device (RDD) material and its 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. Transport 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 to 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 systems for the identification of nuclear and other radioactive material out of regulatory control including a national nuclear forensics library
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

(i) Examples of traditional forensic evidence.
(ii) Examples of a forensics examination plan.
(iii) Tabletop exercise: Transport and storage of evidence.

E. Laboratory work

(i) Determination of the origin of radioactive material and its method of production.

F. Suggested reading

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

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

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

Identification of Radioactive Sources and Devices, IAEA Nuclear Security Series No. 5 (2007).

Application of Nuclear Forensics in Combating Illicit Trafficking of Nuclear and Other Radioactive Material, IAEA-TECDOC-1730 (2014).

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

Identification of High Confidence Nuclear Forensics Signatures, IAEA-TECDOC-1820 (2017).

Development of a National Nuclear Forensics Library: A System for the Identification of Nuclear or Other Radioactive Material out of Regulatory Control (2018).

INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, UNITED NATIONS INTERREGIONAL CRIME AND JUSTICE RESEARCH INSTITUTE, Radiological Crime Scene Management, IAEA Nuclear Security Series No. 22-G, IAEA, Vienna (2014).

NSE15. NUCLEAR FORENSICS ANALYSIS

A. Short description

The focus of this module on nuclear forensics laboratory analysis incorporates descriptions of analytical tools and their application as part of a nuclear forensic examination. In addition, the module emphasizes 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 the findings of the analysis.

B. Learning objectives

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

C. Module outline

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 a forensic examination plan and nuclear forensic analytical plan in accordance with the requirements

3.2. Hypothesis building (case knowledge bases, archived material, other experts)
3.3. Analysis (radioactive material and traditional forensics)
3.4. Interpretation and exclusion
3.5. Communication of nuclear forensics findings
3.6. Confidence in nuclear forensics findings

4. Forensics examination plan and nuclear forensics 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 forensics laboratory
4.4. Timescale for completion of analysis (e.g. 24 hours, one week, two months)
4.4.1. Expected outputs at each period

5. Nuclear forensics 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 analysis followed by destructive analysis techniques and methods
5.4.1. Radiological analysis (estimated total activity, dose rate (dose due to alpha, beta, gamma, neutron radiation), surface contamination)
5.4.2. Physical analysis (visual inspection, radiography, photography, weight, dimensions, optical microscopy, density)
5.4.2.1. Isotope analysis (gamma spectroscopy, alpha spectroscopy)
5.4.2.2. Mass spectrometry
5.4.2.3. Elemental and chemical analysis
5.4.3. Particle analysis
5.4.4. Traditional forensics (fingerprints, fibres)
5.4.5. 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, such as morphological, trace element and minor isotopes (e.g. ^{236}U)
6.2. Knowledge basis of nuclear fuel cycle processes
6.2.1. Archived material
6.2.2. Open literature
6.2.3. Literature under restricted distribution
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 (ITWG)
9.2. Global Initiative to Combat Nuclear Terrorism (GICNT)
9.3. Interlaboratory forensic exercises

9.4. Establishing bilateral and multilateral mechanisms for requesting, receiving and providing nuclear forensics assistance in advance of an investigation

D. Exercises

(i) 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

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

F. Suggested reading

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

INTERNATIONAL ATOMIC ENERGY AGENCY (Vienna)

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

Categorization of Radioactive Sources, IAEA Safety Standards Series No. RS-G-1.9 (2005).

Dangerous Quantities of Radioactive Material (D-Values), EPR–D-VALUES 2006 (2006).

Identification of Radioactive Sources and Devices, IAEA Nuclear Security Series No. 5 (2007).

Application of Nuclear Forensics in Combating Illicit Trafficking of Nuclear and Other Radioactive Material, IAEA-TECDOC-1730 (2014).

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

Identification of High Confidence Nuclear Forensics Signatures, IAEA-TECDOC-1820 (2017).

IAEA Response and Assistance Network, EPR–RANET 2018 (2018).

Security of Radioactive Material in Use and Storage and of Associated Facilities, IAEA Nuclear Security Series No. 11-G (Rev. 1) (2019).

INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CRIMINAL POLICE ORGANIZATION–INTERPOL, UNITED NATIONS INTERREGIONAL CRIME AND JUSTICE RESEARCH INSTITUTE, Radiological Crime Scene Management, IAEA Nuclear Security Series No. 22-G, IAEA, Vienna (2014).

NSE16. INFORMATION AND COMPUTER SECURITY INCIDENT RESPONSE

A. Short description

This module introduces 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.

B. Learning objectives

Upon successful completion of this module, students will be able to develop comprehensive contingency plans for computer security incidents that can potentially impact nuclear security and nuclear safety.

C. Module outline

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 incident 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 elements
   - 4.4. Computer security incident response team
   - 4.5. Computer security incident response processes and procedures
5. Special considerations for industrial control systems

D. Exercises

(i) Tabletop: Develop a response plan for a computer security incident.
(ii) Tabletop: Develop a response plan for an information security incident.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested reading

INTERNATIONAL ATOMIC ENERGY AGENCY, Computer Security Techniques for Nuclear Facilities, IAEA Nuclear Security Series No. 17-T (Rev. 1), IAEA, Vienna (in preparation).

— Computer Security Incident Response Planning at Nuclear Facilities (2016).

NSE17. CONDUCTING COMPUTER SECURITY ASSESSMENTS

A. Short description

This module outlines the methodology and implementation of the assessment for information and computer security activities at nuclear facilities.

B. Learning objectives

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

C. Module outline

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 and 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

(i) Planning a computer security assessment;
(ii) Conducting computer security assessment activities.

E. Laboratory work

No laboratory work is proposed for this module.

F. Suggested reading

INTERNATIONAL ATOMIC ENERGY AGENCY, Computer Security Techniques for Nuclear Facilities, IAEA Nuclear Security Series No. 17-T (Rev. 1), IAEA, Vienna (in preparation).

— Conducting Computer Security Assessments at Nuclear Facilities (2016).

Annex II

PROPOSED MODULES FOR A CERTIFICATE PROGRAMME CURRICULUM IN NUCLEAR SECURITY

II–1. The proposed certificate programme in nuclear security differs from the master's degree 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 and command 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 in order to afford it due priority while performing their main functions, and to bring to their organizations good nuclear security culture.

II–2. 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 educational 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.

II–3. 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 material, facilities and activities
   2.1. Threat and vulnerability assessment for nuclear and other radioactive material, associated facilities and activities
      2.1.1. Design basis threat
   2.2. Principles and systems of physical protection (design, evaluation, technologies, equipment)
   2.3. Nuclear material accounting and control for nuclear security
   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 nuclear and other radioactive material out of regulatory control
   3.1. Detection of criminal and other unauthorized acts involving nuclear and other radioactive material out of regulatory control
      3.1.1. Threat assessment for nuclear and other radioactive material out of regulatory control
      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
      3.2.1. National response plan
      3.2.2. Response measures
      3.2.3. Radiological crime scene management
      3.2.4. Nuclear forensics analysis

IAEA
International Atomic Energy Agency

No. 26

ORDERING LOCALLY

IAEA priced publications may be purchased from the sources listed below or from major local booksellers.

Orders for unpriced publications should be made directly to the IAEA. The contact details are given at the end of this list.

NORTH AMERICA

Bernan / Rowman & Littlefield
15250 NBN Way, Blue Ridge Summit, PA 17214, USA
Telephone: +1 800 462 6420 • Fax: +1 800 338 4550
Email: orders@rowman.com • Web site: www.rowman.com/bernan

REST OF WORLD

Please contact your preferred local supplier, or our lead distributor:

Eurospan Group
Gray's Inn House
127 Clerkenwell Road
London EC1R 5DB
United Kingdom

Trade orders and enquiries:
Telephone: +44 (0)176 760 4972 • Fax: +44 (0)176 760 1640
Email: eurospan@turpin-distribution.com

Individual orders:
www.eurospanbookstore.com/iaea

For further information:
Telephone: +44 (0)207 240 0856 • Fax: +44 (0)207 379 0609
Email: info@eurospangroup.com • Web site: www.eurospangroup.com

Orders for both priced and unpriced publications may be addressed directly to:

Marketing and Sales Unit
International Atomic Energy Agency
Vienna International Centre, PO Box 100, 1400 Vienna, Austria
Telephone: +43 1 2600 22529 or 22530 • Fax: +43 1 26007 22529
Email: sales.publications@iaea.org • Web site: www.iaea.org/publications

NUCLEAR SECURITY RECOMMENDATIONS ON PHYSICAL PROTECTION OF NUCLEAR MATERIAL AND NUCLEAR FACILITIES (INFCIRC/225/REVISION 5)
IAEA Nuclear Security Series No. 13
STI/PUB/1481 (57 pp.; 2011)
ISBN 978–92–0–111110–4 Price: € 28.00

NUCLEAR SECURITY RECOMMENDATIONS ON RADIOACTIVE MATERIAL AND ASSOCIATED FACILITIES
IAEA Nuclear Security Series No. 14
STI/PUB/1487 (27 pp.; 2011)
ISBN 978–92–0–112110–3 Price: € 22.00

NUCLEAR SECURITY RECOMMENDATIONS ON NUCLEAR AND OTHER RADIOACTIVE MATERIAL OUT OF REGULATORY CONTROL
IAEA Nuclear Security Series No. 15
STI/PUB/1488 (33 pp.; 2011)
ISBN 978–92–0–112210–0 Price: € 23.00

OBJECTIVE AND ESSENTIAL ELEMENTS OF A STATE'S NUCLEAR SECURITY REGIME
IAEA Nuclear Security Series No. 20
STI/PUB/1590 (15 pp.; 2013)
ISBN 978–92–0–137810–1 Price: € 20.00

BUILDING CAPACITY FOR NUCLEAR SECURITY
IAEA Nuclear Security Series No. 31-G
STI/PUB/1764 (62 pp.; 2018)
ISBN 978–92–0–111916–2 Price: € 40.00

A State's nuclear security regime can be strengthened through appropriate training and education at all levels, and in all organizations and facilities involved in nuclear security, by preparing the next generation of professionals with knowledge, expertise and understanding of the importance of nuclear security. This Technical Guidance publication is intended to assist States in developing a model academic curriculum for nuclear security.

This publication can be used by university curriculum developers, faculties and instructors from academic and other educational institutions that are implementing or considering educational programmes in nuclear security. It might be of value to decision makers, operators, law enforcement agencies, regulatory bodies and other competent authorities responsible for nuclear security.

This publication can also be used as a resource to facilitate the development by national authorities of a comprehensive national security human resource development programme, which has the purpose of developing and maintaining relevant knowledge and skills for dealing with current and future nuclear security challenges.

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA