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Guidance and considerations for the implementation of INFCIRC/225/Rev.4, The Physical Protection of Nuclear Material and Nuclear Facilities

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FOREWORD

The Physical Protection of Nuclear Material and Nuclear Facilities, INFCIRC/225/Rev.4, provides recommendations for the physical protection of nuclear material against unauthorized removal in its use, storage and transport, whether domestic or international and whether for peaceful or military use, and provides recommendations for protection against sabotage of nuclear material or facilities. The recommendations contained in INFCIRC/225/Rev.4 detail the elements that should be included in a State's system of physical protection. They also recognize the potential proliferation concerns arising from the unauthorized removal of nuclear material and the potential adverse health and safety consequences resulting from the sabotage of nuclear material or facilities. Most industrial and developing countries follow these recommendations in the establishment and operation of their physical protection systems.

Physical protection against the unauthorized removal of nuclear material and against sabotage of nuclear material and facilities by adversaries is a matter of domestic and international concern. Although responsibility for establishing and operating a comprehensive domestic physical protection system for nuclear material and facilities rests entirely with that State, the IAEA has long contributed recommendations in this area. Discussions with representatives from various States indicate that for a better understanding of the meaning and intent of INFCIRC/225/Rev.4, additional guidance for implementing those portions of the recommendations which are open to varied interpretations would be very useful.

States continue to desire guidance regarding the responsibilities of the States's competent authority, guidance for the State's competent authority to establish domestic requirements and guidance to give to the nuclear operators (licensees) and applicants on how to implement domestic requirements in a manner consistent with the recommendations in INFCIRC/225/Rev.4. Although INFCIRC/225 was recently revised to provide up-to-date recommendations for protecting nuclear materials and facilities from unauthorized removal of nuclear material and sabotage, additional guidance continues to be useful for implementing these recommendations. The manner in which these recommendations are implemented can have significant implications on the effectiveness and cost of physical protection systems.

This publication is intended to provide guidance and considerations for a State's competent authority to better understand and prescribe appropriate requirements, consistent with INFCIRC/225/Rev.4 for the protection of nuclear material and nuclear facilities which are compatible with accepted international practice, while a more detailed companion document, *Handbook on the Physical Protection of Nuclear Material and Facilities*, is being considered for the licensee or designer of physical protection systems who has specific implementation and compliance responsibilities. These two reports will supplement INFCIRC/225/Rev.4 and should be used in conjunction with each other to provide better and comprehensive guidance on physical protection. The IAEA staff member responsible for this publication was B. Weiss of the Office of Physical Protection and Material Security, Department of Safeguards.

ORGANIZATION OF REPORT

To assist in promoting consistent high standards for the protection of nuclear material and nuclear facilities, the IAEA provides recommendations in INFCIRC/225/Rev.4, *The Physical Protection of Nuclear Material and Nuclear Facilities*, on requirements for physical protection of these nuclear materials in use, storage and transport and of nuclear facilities. The following guidance and considerations are provided in an effort to assist in ensuring that the recommendations of INFCIRC/225/Rev.4 are applied consistently and rigorously throughout the international nuclear community. The designation of sections in this report is identical to that in INFCIRC/225/Rev.4. Further, this report provides the specific text of INFCIRC/225/Rev.4 (in a smaller font size) followed by guidance, where it was determined that additional explanation would be useful. The guidance provided may apply to one or more of the preceding paragraphs and utilizes a numerical designation preceded by "G" to clearly indicate that it is a paragraph providing guidance.

Section 1, Introduction provides a description of the principles of physical protection used in the field which are applicable to both protection of unauthorized removal of nuclear material and of sabotage. Section 2, Definitions, is identical to that contained in INFCIRC/225/Rev.4. When terms are used in the body of this report which are defined in Section 2, they will be shown in italics. Section 3, Objectives, provides additional guidance and elaboration of the objectives stated in INFCIRC/225/Rev.4. Section 4, Elements of the State's System of Physical Protection of Nuclear Material and Nuclear Facilities, describes in more detail the recommendations for the establishment of a State system of physical protection to protect against the unauthorized removal of nuclear material in use, storage or transport, or the sabotage of nuclear material or nuclear facilities. Section 5, Categorization of Nuclear Material, provides some additional guidance on how this system of categorization can best be applied and utilized in the protection of nuclear material. Section 6, Requirements for Physical Protection Against Unauthorized Removal of Nuclear Material in Use and Storage, focuses specifically on the physical protection against unauthorized removal of Categories I, II, and III nuclear material. Section 7, Requirements for Physical Protection Against Sabotage of Nuclear Facilities and Nuclear Material During Use and Storage, focuses specifically on the sabotage of nuclear material or nuclear facilities. Section 8, Requirements for Physical Protection of Nuclear Material During Transport, focuses on transport of nuclear material.

CONTENTS

1. INTRODUCTION

1.1. Principles of physical protection are realized through administrative and technical measures, including physical barriers. The measures for the physical protection of nuclear material in use and storage and during transport, and of nuclear facilities presented herein are recommended for use by States as required in their physical protection systems. These measures are based on the state of the art in physical protection hardware and systems and on the types of nuclear material and nuclear facilities.

1.2. It is essential that this document be reviewed and updated periodically to reflect advances made both in physical protection systems and nuclear technology.

1.3. In implementing these recommendations, States are encouraged to cooperate and consult, and to exchange information on physical protection techniques and practices, either directly or through international organizations. States should aid each other in physical protection, and particularly in the recovery of nuclear material, in cases where such aid is requested.

1.4. The Convention on the Physical Protection of Nuclear Material (INFCIRC/274 Rev.1) obligates parties to:

- make specific arrangements and meet defined standards of physical protection for international shipments of nuclear material;
- co-operate in the recovery and protection of stolen nuclear material;
- make as criminal offences specified acts to misuse or threats to misuse nuclear materials to harm the public; and
- prosecute or extradite those accused of committing such acts.

The Convention also promotes international co-operation in the exchange of physical protection information.

1.5. States should inform each other, either directly or through the International Atomic Energy Agency, of appropriate points of contact for matters related to the physical protection of nuclear material and nuclear facilities.

G101. The ultimate objective of a physical protection system is to prevent the *unauthorized removal* of nuclear materials or *sabotage* of nuclear materials or nuclear facilities. The general approach is to protect against the State's *design basis threat* through the establishment of a system based on a combination of personnel, hardware, procedures and facility design with due consideration to compatibility with the safety of the facility.

G102. In order for a physical protection system to counter a threat against the unauthorized removal of nuclear material or the *sabotage* of nuclear material or nuclear facilities, it should perform the following primary functions:

- Deter
- Detect
- Assess
- Delay
- Respond

G103. *Unauthorized removal* or *sabotage* can be prevented in two ways: by deterring adversaries or by defeating them should they attempt to steal nuclear materials or *sabotage* nuclear material or nuclear facilities. Deterrence is achieved by implementing a physical protection system that adversaries perceive as too difficult to defeat; the physical protection measures make the protected nuclear material or facility an unattractive target.

G104. While protection against both *unauthorized removal* or *sabotage* requires consideration of a number of factors (including the *design basis threat*, the potential consequences of malevolent activities involving nuclear materials, the facility layout, hardware, on-site *guard* force size, training and procedures and the *response force* size, timeliness and capabilities), the protection philosophy differs. For unauthorized removal, the primary physical protection objective is to protect against unauthorised individuals obtaining access to nuclear material and removing it from the facility. For *sabotage* the primary objective is to prevent adversaries from even gaining access to the nuclear material or vital equipment. While similar concepts are employed for detection and *assessment* of a potential intrusion, the use of delay features and emergency procedures, including the *response force* strategy, can be quite different. For protection against *unauthorized removal*, the use of penetration delay in barriers securing the material provides time for the *guards* to call for assistance, and contain or delay the adversaries until the arrival of the *response force*. For protection against *sabotage*, the use of delay features or sufficient distance to the target provides sufficient time for the *guards* or the *response force* to interpose themselves between the adversaries and the nuclear material or vital equipment to preclude access to the potential *sabotage* targets.

G105. Detection is the discovery of an attempted or actual intrusion which could have the objective of unauthorized removal or sabotaging nuclear material or equipment, systems or devices in a *protected area*. Detection can be accomplished by sensors or personal observation, for example by an employee or *guard*. In a narrow sense, detection is a physical phenomenon, i.e., a sensor or person determines that something needs to be investigated or assessed at a given location. To be useful, detection needs to be coupled with an *assessment* of what has been detected. Did a sensor detect an animal or a person? Was the sensor triggered by weather conditions resulting in a nuisance alarm? Is the person seen (detected) by an entrance *guard* assessed as someone authorized to enter the facility, or does the individual pose a threat to the facility?

G106. Sensors are an important part of a detection system. By activating alarms they provide an indication of an activity that requires *assessment*. The ultimate goal of any detection system is to maximize the probability of detection while minimizing the rate of nuisance alarms. This can be accomplished by providing a continuous line of detection using a single sensor technology appropriate for the environmental conditions and terrain at the facility, or by using multiple and complementary sensors that function on different technical principles.

G107. A *central alarm station* (CAS), is required to continuously evaluate detection and *assessment* information and communicate with *guards* and the *response force*. A reliable communications system between the CAS and the *guards* and the *response force* is an essential part of a physical protection system. The CAS should be hardened, i.e., constructed and located in such a manner so as to allow it to continue operating at all times, even when under attack. If the CAS is not so protected, adversaries may neutralize *guards* in the CAS preventing them from alerting response forces.

G108. *Assessment* is typically aided by closed circuit television (CCTV) coverage of each sensor sector, complemented by visual checks from *guards*, either static or mobile. In addition to determining the cause of a detection alarm, *assessment* should provide specific details such

as what, who, where, when, and how many in a timely manner. These details help determine the number of *guards* who should respond and how they should be equipped. This information is vital to allow *response forces* is to react timely and effectively to take appropriate action.

G109. Delay is another important element of a physical protection system. Since it is usually not possible to maintain a sufficient number of *guards* at all points to provide immediate protection against all types of adversaries, some means of delaying adversaries is required to provide the *guards* time to react after the intrusion has been detected and to call for assistance. This delay can be achieved by barriers such as, fences, walls, and locks. Delay should slow the adversaries sufficiently to provide time for the *guards* or the *response force* to interpose themselves between the adversaries and their target and using force, including weapons where *guards* are armed, to stop or delay the attack before the adversaries can accomplish their objective. Where *guards* are armed, they can delay adversaries by firepower. Delay should be sufficient to prevent adversaries from accomplishing their mission before *guards/response forces* can intercede and neutralise the adversaries.

G110. *Unauthorized removal* of nuclear material can be prevented by delaying access to the material or by containing the adversaries before they remove the nuclear material from the facility. *Sabotage*, however, must be prevented by denying the adversaries access to the *sabotage* target. *Guards* and/or the *response force* need to respond more rapidly to prevent *sabotage* than to prevent *unauthorized removal*. They may be able to prevent adversaries from removing nuclear material from a site even though they were able to gain access to the material; but to prevent *sabotage*, the *guards* and/or the *response force* need to stop the adversaries before they can access the nuclear material or vital equipment that could be *sabotaged* and potentially result in a radiological release. The speed with which knowledgeable adversaries could attack a facility and damage vital equipment could negate the effectiveness of a *response force* for protection against *sabotage*. Barriers may not provide sufficient delay time for an effective off-site response. Therefore, exercises should be performed to ensure the timely response of the *guards* and/or *response force* during the critical early stages of an attack. If a facility requires assistance from an off-site *response force* for protection, a "time-line" analysis should be conducted to determine if the *response force* could arrive in time to prevent a *sabotage*. Moreover, periodic exercises which include the off-site *response force* should be conducted to establish the effectiveness of such a response and be utilized as a tool to develop, correct or modify facility defensive strategies, including barriers.

G111. *Guards* and *response forces* need to survive in order to prevent adversaries from accomplishing their objectives. Many factors contribute to *guard* and *response force* capability and survival including tactical planning, equipment, including weapons, plus training and exercises. Drills should be conducted to demonstrate their effectiveness and improve response capabilities. Consideration may be given to the strategic placement of defensive barriers to provide cover for the *guards* and *response force* attempting to interdict an attack.

G112. An effective physical protection system has several specific characteristics. Besides being compatible with a facility's safety system, the physical protection system should provide:

- *Defence in depth*;
- Minimum consequence of component failure;
- Balanced protection; and
- Graded protection in accordance with the significance or potential radiological consequences.

G113. *Defence in depth* means that for adversaries to accomplish their objectives, they should have to circumvent or defeat a number of different protective devices or barriers in sequence. For example, adversaries may have to penetrate two or more separate barriers before gaining access to a reactor control room. From a facility standpoint, *defence in depth* eliminates dependency on one barrier or system (which might fail at the critical period) to counter an attack. The effect produced on adversaries by a physical protection system that provides *defence in depth* will be to:

- Increase uncertainty about the physical protection system (and thus possibly deter an attack);
- Require more extensive preparation prior to attacking the facility (with the associated greater risk of these preparations being discovered before the attack);
- Require different techniques and different tools to penetrate barriers; and
- Create additional steps that could cause the adversaries to fail or abort their attack.

G114. Minimum consequence of component failure is an important physical protection system characteristic because it is unlikely that a complex system will ever be developed and operated that does not experience some component failure during its lifetime. Causes of component failure in a physical protection system can range from environmental factors to tampering by adversaries. It is important that contingency plans are provided so that the system can continue to operate effectively in the event of component failure. Redundant equipment that takes over automatically is highly desirable in some cases. An example is an emergency power supply that activates automatically should the primary power source fail.

G115. Balanced protection implies that no matter how adversaries attempt to accomplish their objectives, they will encounter effective elements of the physical protection system. For example the building fabric that surrounds a reactor control room may consist of:

- Walls, floors, and ceilings constructed of several types of materials;
- Doors of several types; equipment hatches in floors and ceilings; and
- Heating, ventilating, and air conditioning openings protected with various types of grilles.

G116. Complete balance is probably not possible or may not be necessary. Though penetration delay provided by doors, hatches, and grills may be considerably less than that provided by the walls, it would be adequate if designed as a barrier to provide sufficient time for the arrival of response forces and successful interdiction.

G117. There is no advantage in over designing by, for example, installing a costly vault door that would take several minutes to penetrate with explosives, if the wall is corrugated asbestos which could be penetrated in a few seconds with hand tools. Both the walls and the doors should provide the appropriate level of protection determined by the *design basis threat*, the capabilities of the response forces and the time they need to respond efficiently.

G118. The objective should be to provide adequate protection against all reasonable scenarios identified in the *design basis threat* and to maintain a balance with other considerations, such as cost, safety, and structural integrity.

2. DEFINITIONS

2.1. **ASSESSMENT**: The determination by a *guard* or an electronic system of the cause of an alarm and the extent of the threat.

2.2. **CENTRAL ALARM STATION**: An installation which provides for the complete and continuous alarm monitoring, *assessment* and communications with *guards*, facility management and the *response force*.

2.3. **DEFENCE IN DEPTH:** A concept used to design physical protection systems that requires an adversary to overcome or circumvent multiple obstacles, either similar or diverse, in order to achieve his objective.

2.4. **DESIGN BASIS THREAT:** The attributes and characteristics of potential insider and/or external adversaries, who might attempt *unauthorized removal* of nuclear material or *sabotage*, against which a physical protection system is designed and evaluated.

2.5. **GUARD:** A person who is entrusted with responsibility for patrolling, monitoring, assessing, escorting individuals or *transport*, controlling access and/or providing initial response.

2.6. **INNER AREA:** An area inside a *protected area* where Category I nuclear material is used and/or stored.

2.7. **INTRUSION DETECTION:** Detection of an intruder by a *guard* or by a system comprising of a sensor(s), transmission medium and control panel to annunciate an alarm.

2.8. **PATROL:** A function carried out by *guards* to inspect elements of physical protection at regular or irregular intervals.

2.9. **PHYSICAL BARRIER:** A fence or wall or a similar impediment which provides penetration delay and complements access control.

2.10. **PROTECTED AREA:** An area under surveillance, containing Category I or II nuclear material, and/or *vital areas* surrounded by a *physical barrier*.

2.11. **RESPONSE FORCES:** Persons, on-site or off-site who are armed and appropriately equipped and trained to counter an attempted *unauthorized removal* of nuclear material or an act of *sabotage*.

2.12. **SABOTAGE:** Any deliberate act directed against a nuclear facility or nuclear material in use, storage or *transport* which could directly or indirectly endanger the health and safety of personnel, the public and the environment by exposure to radiation or release of radioactive substances.

2.13. **SECURITY SURVEY**: A detailed examination, made by the State's competent authority, of proposed physical protection measures in order to evaluate them for approval.

2.14. **TRANSPORT**: International or domestic carriage of nuclear material by any means of transportation beginning with the departure from a facility of the shipper and ending with the arrival at a facility of the receiver.

2.15. **TRANSPORT CONTROL CENTRE**: An installation which provides for the continuous monitoring of vehicle location and security status and for communication with the *transport* vehicle, its *guards*, the *response forces* and the shipper/receiver.

2.16. **UNAUTHORIZED REMOVAL**: The theft or other unlawful taking of nuclear material.

2.17. **VITAL AREA:** An area inside a *protected area* containing equipment, systems or devices, or nuclear material, the *sabotage* of which could directly or indirectly lead to unacceptable radiological consequences.

3. OBJECTIVES

3.1. The objectives of the State's physical protection system should be:

(a) To establish conditions which would minimize the possibilities for *unauthorized removal* of nuclear material and/or for *sabotage*;

G301. Each State is responsible for the physical protection of nuclear materials and facilities on its own territory and during *transport* under its jurisdiction. However, in order to prevent proliferation consequences that could result from the *unauthorized removal* of nuclear material and the domestic and possibly transboundary health and safety consequences that could result from the *sabotage* of nuclear materials and nuclear facilities, States should establish conditions to ensure that these nuclear activities are properly protected. These conditions are the elements of a State's system of physical protection described in Section 4.

(b) To provide information and technical assistance in support of rapid and comprehensive measures by the State to locate and recover missing nuclear material and to cooperate with safety authorities in minimizing the radiological consequences of *sabotage*.

G302. The State's role in physical protection should not only address how to protect against the *unauthorized removal* of nuclear material or the *sabotage* of nuclear material or nuclear facilities, but should actively support the implementation of contingency plans for responding to and mitigating the consequences if such attempts were successful. In the case of *unauthorized removal* of nuclear material, such assistance could include coordinating law enforcement assistance from various organizations within the State, notifying bordering States of the event so that they may alert their law enforcement organizations, and drawing upon State assets with the capability to monitor for the presence of nuclear material. In the case of *sabotage*, the State could coordinate action with the safety authorities to ensure that appropriate efforts, consistent with the *Convention on Early Notification of a Nuclear Accident* (INFCIRC/335) and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (INFCIRC/336), were underway.

3.2. The objectives of the International Atomic Energy Agency (IAEA) are:

(a) To provide a set of recommendations on requirements for the physical protection of nuclear material in use and storage and during *transport* and of nuclear facilities. The recommendations are provided for consideration by the competent authorities in the States. Such recommendations provide guidance but are not mandatory upon a State and do not infringe the sovereign rights of States;

G303. The IAEA supports and furthers the goal of consistent international physical protection standards by coordinating support for and providing guidance for implementing systems to protect nuclear material in use and storage and during *transport*, and nuclear facilities. The IAEA has promulgated *The Physical Protection of Nuclear Material and Nuclear Facilities* (INFCIRC/225/Rev.4) which provides recommendations for developing such a system. This TECDOC provides additional information that may be useful to understand the elements of an effective physical protection system, how it can be accomplished and the roles and responsibilities of the State, the competent authority and the operator or licensee.

G304. The IAEA has also developed a *Handbook on the Physical Protection of Nuclear Material and Facilities* to provide specific design and implementation guidance for an effective physical protection system.

G305. Because of differences in States' perceived *design basis threats*, culture, legal systems and history, there may be reasonable and necessary variations in physical protection practices between different States. For example, State's *response forces* timely arrival on the scene, their capabilities, and their degree of responsibility for dealing with an attack against a nuclear facility or nuclear material during *transport* will have great impact on physical protection practices in different States. Therefore, there may be differences in the implementation of international recommendations contained in INFCIRC/225/Rev.4. For example, some States prohibit arming of *guards*. This can be compensated for by adding barriers which provide delay equivalent to the time required for the timely arrival of armed *response forces*.

(b) To be in a position to give advice to States' authorities in respect of their physical protection systems at the request of the State. The intensity and the form of assistance required are, however, matters to be agreed upon between the State and the IAEA .

It should be noted that the IAEA has no responsibility either for the provision of a State's physical protection system or for the supervision, control or implementation of such a system. Assistance by the IAEA will be provided only when so requested by the State.

G306. Assistance in the form of the International Physical Protection Advisory Service (IPPAS) is available to States on request to the IAEA . The role of IPPAS missions is to provide advice and assistance to States to help strengthen and enhance the effectiveness of the State's physical protection system by interpreting and applying INFCIRC/225/Rev.4 recommendations and other applicable obligations and practices to the needs of the requesting State. Further details of this service are contained in a separate document entitled *IPPAS guidelines -- Reference document for the IAEA International Physical Protection Advisory Service*, IAEA Services Series No.3.

4. ELEMENTS OF A STATE'S SYSTEM OF PHYSICAL PROTECTION OF NUCLEAR MATERIAL AND NUCLEAR FACILITIES

GENERAL

4.1.1. A State's system of physical protection of nuclear material and nuclear facilities should include the elements described in Sections 4.2 - 4.4 below.

4.1.2. The responsibility for the establishment, implementation and maintenance of a physical protection system within a State rests entirely with that State.

G401. Each State needs to discharge its responsibility to regulate the physical protection of nuclear activities in order to protect nuclear material from *unauthorized removal* and public health and safety from undue radiological risk as a result of *sabotage*. A State therefore needs to have an adequate and supportive governmental organization and legislative base.

4.1.3. The State's physical protection system should be based on the State's evaluation of the threat. Other factors should also be considered, including the State's emergency response capabilities and the existing and relevant measures of the State's system of accounting for and control of nuclear material. The recommended physical protection measures are intended for all nuclear material in use and storage and during *transport* and for all nuclear facilities.

G402. The State's evaluation of the threat is accomplished by evaluating intentions and capabilities of individuals or groups of individuals believed to pose a threat to national security or a serious threat to law and order in the State.

4.1.4. A *design basis threat* developed from an evaluation by the State of the threat of *unauthorized removal* of nuclear material and of *sabotage* of nuclear material and nuclear facilities is an essential element of a State's system of physical protection. The State should continuously review the threat, and evaluate the implications of any changes in that threat for the levels and the methods of physical protection.

G403. The *design basis threat* should be developed by the designated competent authority in collaboration with other relevant authorities and organizations such as the national intelligence organizations. The *design basis threat* determines the level of physical protection measures required to protect against *unauthorized removal* of nuclear material and *sabotage* at nuclear facilities and during nuclear material *transport*. Measures to counter the *design basis threat* should then be incorporated into physical protection standards and regulatory requirements.

G404. The *design basis threat* should take into account the possibility of these groups being assisted by or formed of individual(s) who have authorised access to the facilities, the tactics employed by these groups, their technical competence, size and the equipment available to them for use in any attack. The *design basis threat* should be reviewed on a regular basis and the implications of any change taken into account in reviewing the adequacy of existing physical protection standards and regulatory requirements.

G405. Special threat circumstances at an individual facility could require additional measures above the level normally employed to counter the *design basis threat*.

4.1.5. It is essential that the State's system of physical protection for nuclear material and nuclear facilities be reviewed and updated periodically to reflect advances made in the state of the art in physical protection hardware and systems or introduction of new types of facilities. Further, the design of a physical protection system for a specific facility may vary from these recommendations when prevailing circumstances indicate a need for a different level of physical protection.

G406. The review period should be determined by the State's competent authority.

G407. An example where prevailing circumstances may indicate a need for a higher level of physical protection would be where the nuclear facility is critical to the national economic infrastructure and therefore an attractive target for terrorist acts.

4.1.6. The State should develop and implement emergency plans for any needed response to *unauthorized removal* and subsequent unauthorized use of nuclear material or *sabotage* of nuclear material or nuclear facilities to support and supplement, when needed, those emergency plans prepared by operators.

4.1.7. The recommended measures are in all cases additional to, and not a substitute for, other measures established for safety purposes for nuclear material in use and storage and during *transport* and for nuclear facilities.

G408. There are different levels of emergency plans designed to deal effectively with physical protection contingencies. Emergency plans at the first level are the responsibility of the operator (licensee) and represents the first response to a contingency (see paragraph 4.2.5.3 below). The next level is the responsibility of the local authorities, e.g., the *response force* in some States is designed to bring off-site resources to deal with the incident which is beyond the capability of the operator. A third level is developed by the State to bring national resources to bear to an incident at a nuclear facility. In all cases the emergency plans should identify the resources to be provided, the individual responsibilities of the bodies involved and coordination arrangements. The emergency plans should be coordinated with plans established at all levels to deal with safety related incidents.

LEGISLATION AND REGULATIONS

4.2.1. The State's legislation should provide for the regulation of physical protection and include a licensing requirement. The State should promulgate and review regularly its comprehensive regulations for the physical protection of nuclear material and nuclear facilities whether in State or private possession.

G409. As the State is responsible for the physical protection of nuclear material and nuclear facilities it should establish a nuclear legislative structure. The general approach should either:

- Lay out the basic principles and requirements in a framework law while detailed requirements and provisions are addressed in ordinances and regulations, or

- Include both basic and detailed requirements and provisions in the law.

G410. The main advantage of the first approach is that law provides a foundation for the basic requirements and principles that are of fundamental importance to the legislative system. Detailed rules and requirements, many of which are of a technical nature, do not appear in the law, but are included in ordinances, regulations and guidelines that are issued by the

government or the regulatory body. They can, therefore, be changed more easily, without changing the law. Such changes may be necessary as a result of technical development. The advantage of the second approach is that the law will give a complete description of detailed rules and requirements that are implemented. This may be of help to the legislative body during the law making process, but would make it more difficult and time consuming to, later on, introduce changes when it becomes necessary.

G411. Comprehensive regulations and guides are not obligatory for all situations. The State may consider it appropriate to develop them progressively with the development of the national nuclear programme.

G412. The requirement for licensing by the State is the most important and effective measure to ensure that nuclear activities are being implemented in accordance with the law. The licensing process gives the regulatory body the means to establish conditions with respect to physical protection. In practice, the system of licensing means that an applicant or licensee must prove that it has sufficient technical competence, as well as financial and other resources, to manage a nuclear facility or handle nuclear material in a way that ensures a satisfactory level of physical protection.

G413. The law should stipulate that licensing by a regulatory body is required for all nuclear activities, and should state the consequences of non-adherence to licensing requirements in the form of sanctions (e.g., suspension of license, and/or penalties).

4.2.2. The State should define requirements for the physical protection of nuclear material in use and storage and during *transport* and for nuclear facilities depending on the associated consequences of either *unauthorized removal* of nuclear material or *sabotage*. For protection against *unauthorized removal* of nuclear material, the State should regulate the categorization of nuclear material (see Chapter 5) in order to ensure an appropriate relationship between the nuclear material of concern and the protection measures. For protection against *sabotage* (Chapter 7), the State should establish the design objectives pertaining to off-site radiological consequences in order to determine an appropriate level of physical protection measures (e.g., making use of existing nuclear safety or radiological protection standards). Based on these analyses, the State should apply the more stringent requirements for physical protection, either those against *unauthorized removal* of nuclear material or those against *sabotage*.

G414. Those involved in planning the *transport* of nuclear material need to know, at least in broad terms, the physical protection requirements which should be incorporated into any transport plan. In defining these requirements, the competent authority should not only take into account the recommendations in Chapter 8, but also:

(a) the State's obligations to comply with the requirements of the *Convention on the Physical Protection of Nuclear Material* (INFCIRC/274/Rev.1) for nuclear material in international *transport,* and/or

(b) any commitments made by the State (either as a supplier, or as a recipient under the terms of a Supply Agreement) to protect nuclear material in accordance with Annex C of the *Nuclear Suppliers Group Guidelines* (INFCIRC/254/Rev.2).

G415. In addition, the competent authority should consider in defining these requirements what steps need to be taken from the outset to ensure appropriate protection of detailed information concerning proposed *transport* operations.

Responsibility, authority and sanctions

4.2.3.1. A State should take appropriate measures within the framework of its national law to establish and ensure the proper implementation of the State's system of physical protection. The State should be responsible for verifying continued compliance with the physical protection regulations and licence conditions through periodic inspections and ensuring that corrective actions are taken, when needed.

4.2.3.2. A State should designate a competent authority under its legislation which is empowered to establish and ensure the proper implementation of the State's system of physical protection. If the elements of the State's system of physical protection are divided between two or more authorities, arrangements should be made for overall coordination. Clear lines of responsibility should be established and recorded between the relevant entities.

4.2.3.3. The State's competent authority should have a clearly defined legal status and independence from the applicant(s)/operator(s) and have the legal authority to enable it to perform its responsibilities and functions effectively.

4.2.3.4. The State's competent authority should have access to information from other State authorities on present and foreseeable threats to nuclear activities.

4.2.3.5. The State's competent authority should have access to information from the State's system of accounting for and control of nuclear material.

4.2.3.6. Enforcement of physical protection regulations is a necessary part of a State's physical protection system. Sanctions against the unauthorized removal of nuclear material and against sabotage are important to an effective State system of physical protection.

G416. The State should establish a system for the physical protection of nuclear material and facilities within which the competent authority has adequate legal powers, sufficient funds for its activities and can pursue its regulatory task without undue interference. In particular, the competent authority should be separated in the governmental organization and be independent from the bodies responsible for developing, promoting or operating nuclear facilities. The competent authority should also be identified in the law as having the power to initiate legal proceedings or impose sanctions in accordance with the law.

G417. The primary objectives of the competent authority are to ensure that nuclear material is protected from the *unauthorized removal* of nuclear material and the domestic and possibly transboundary health and safety consequences that could result from the *sabotage* of nuclear materials and nuclear facilities, including nuclear material in *transport*. To fulfil these objectives the competent authority needs to:

(a) Establish a system to define and maintain acceptable levels of physical protection to counter the *design basis threat*; to monitor the licensees to ensure that they fulfil their physical protection responsibilities; to evaluate the implemented physical protection systems and to ensure that the licensees provide appropriate levels of physical protection; and

(b) Establish clear regulatory objectives, taking into consideration international standards and good practices. The competent authority will also need to establish effective liaison and cooperation with other appropriate regulatory bodies and with international bodies and organizations.

G418. The involvement and participation of other government organizations and agencies such as the law enforcement agencies and the State's security service should ensure the exchange of timely information on possible and real threats to the nuclear material and facilities. The establishment of a written agreement between the competent authority and other appropriate organizations can assist to ensure cooperation, commitment and the timely exchange of information in this area.

G419. The State's system of physical protection will encompass not only physical protection regulations and the associated competent authorities but also the participation of other State organizations, agencies and official bodies whose participation in the system is essential to ensure that:

(a) The threat is assessed, the *assessment* is kept up to date and communicated to the competent authority responsible for the arrangements for the physical protection of nuclear materials and facilities;

(b) *Response forces* with the necessary legal and constitutional authority are made available to respond to incidents which could threaten nuclear material at facilities or in *transport* and that these *response forces* have prepared the necessary emergency plans and are exercised in their role; and

(c) The responsibility for investigation of malevolent activity involving nuclear material and nuclear facilities, and recovery of nuclear materials is clear.

G420. The competent authority should establish a structured inspection and enforcement system to evaluate and systematically following up all inspection findings. An enforcement system should ensure that all aspects of legislation, including the licence, are fully complied with by each licensee, are verifiable and that experience gained is fed back to the licensee.

G421. In exercising their authority in matters of physical protection, staff of the competent authority should understand their organization's legal authority, regulatory role and objectives, and how they compare with international standards and practices.

G422. The competent authority should ensure that the responsible persons in a licensee's organization are qualified to discharge their physical protection functions and that the required quality and performance are achieved at all times.

Licensing and other procedures to grant authorization

4.2.4.1. The State should define a *design basis threat* as a common basis for physical protection planning by the operator and its approval by the competent authority. In the event of any change to the *design basis threat*, the State's competent authority should ensure that the change is sufficiently reflected in the regulations and by the operator's protective measures.

4.2.4.2. Physical protection measures can be implemented by the State itself, the operator or any other entity duly authorized by the State.

4.2.4.3. The State should license activities only when they comply with its physical protection regulations. The State's system of physical protection should make provisions for a *security survey* of these activities prior to licensing, and whenever a significant change takes place, to ensure continued compliance with physical protection regulations. It should be noted that other regulations such as those relating to radiological protection and nuclear safety may also apply.

G423. While responsibility for physical protection rests with each applicant/licensee, control over physical protection by the competent authority, at all stages of the life of nuclear facilities and during *transport*, is exercised primarily through governmental licence(s). Hence, a primary task of the competent authority is to consider whether to approve (or not) applications for new licences and renewals or amendments to existing licences. The licence itself should be an official document authorizing an activity or activities and approving the licensee's physical protection plan describing how it will implement its physical protection system. Specifically how the applicant proposes to satisfy the regulatory requirements can be a matter of choice as long as the intent of the requirements is met. For example, where a State's guidance may propose a CCTV system to aid remote *assessment*, an applicant could propose to employ full time *guard* presence in view of the intrusion detection system to assess alarms.

G424. The competent authority should ensure that it has received and reviewed documentary evidence from each applicant/licensee regarding the physical protection plan for activity or activities to be licensed before the license is issued. The review should be supported by a *security survey* of the physical protection measures implemented at the facility.

G425. The competent authority should ensure that any license issued is:

(a) In compliance with the relevant national legislation;

(b) Accurately specifies the activity or activities to be licensed; and

(c) Clearly identifies any constraints regarding the activities, i.e. requirements, conditions or time limits.

G426. The license needs to be kept current throughout all stages of the life of a nuclear facility. The licence may be changed or modified as circumstances dictate but always by and under the control of the competent authority. The competent authority should establish criteria to determine what significant changes after a license is granted would require a *security survey*. Such proposed changes should be reported to the competent authority in advance.

Physical protection requirements for nuclear material in use and storage and during transport and for nuclear facilities

4.2.5.1. State requirements for the physical protection of nuclear material should take into account the category of nuclear material, its location (use, storage, during *transport*) and the particular circumstances prevailing either in the State or along the transportation route. When considering the measures required for the physical protection of nuclear material against *unauthorized removal* or *sabotage*, the State should take into account the attractiveness and self-protecting nature of the material, the radiological consequences, and the containment measures used for safety reasons.

4.2.5.2. State requirements for physical protection should be based on the concept of *defence in depth* for preventive and protective measures. The concept of physical protection is one which requires a designed mixture of hardware (security devices), procedures (including the organization of *guards* and the performance of their duties) and facility design (including layout). The physical protection system is designed specifically for each facility taking into account the State's *design basis threat.*

G427. It is the responsibility of an applicant/licensee to design a physical protection system for a facility and submit that design to the competent authority for approval. Detailed guidance on designing a system is contained in the *Handbook On The Physical Protection of Nuclear Material and Facilities.*

4.2.5.3. The State's competent authority should ensure that the operator prepares emergency plans of action to counter effectively the *design basis threat*, including attempted *unauthorized removal* of nuclear material or *sabotage,* taking into consideration actions of the *response force.*

G428. The competent authority should require each licensee/operator of a facility where physical protection measures are required to develop and implement an emergency plan which should, as a minimum, contain:

(a) The criteria for initiation and termination of responses to physical protection emergencies together with the specific decisions, actions and supporting information needed to bring about such responses;

(b) An identification of the data, criteria, procedures and mechanisms affecting emergency planning that are specific to the facility or means of *transport* involved and are necessary to efficiently implement the emergency plan; and

(c) A designation of the individual, group or organization responsible for each decision and action associated with specific responses to physical protection emergencies.

G429. The competent authority should require that response exercises for the nuclear activity be conducted with the off-site emergency responders frequently enough to ensure facility familiarisation and appropriate integration with licensee/operator response.

4.2.5.4. Several types of nuclear facilities pose a hazard to the environment in case of *sabotage* because of the potential for release of radioactivity. Therefore, it is important that the level of protection of the facility should take the radiological consequences into consideration.

G430. The physical protection measures to be implemented at a nuclear facility and for nuclear materials in *transport* should take into account not only the attractiveness of nuclear material for *unauthorized removal*, but also whether there exists a potential for *sabotage*.

(a) At nuclear reactors, a potential for *sabotage* exists because of the inventory of radioactive material and the potential for release.

(b) At separate irradiated fuel storage facilities, a potential for *sabotage* exists because of the inventory of radioactive material and the potential for release.

(c) At reprocessing plants, a potential for *sabotage* exits because of the inventory of irradiated fuel, separated plutonium and other radioactive material, and the potential for release.

(d) At fuel fabrication plants utilizing plutonium, a potential for *sabotage* exists in the areas where plutonium is used or stored.

(e) At other nuclear facilities, a potential for *sabotage* exists if there is an inventory of radioactive material.

4.2.5.5. The State should define requirements for the physical protection of nuclear facilities against *sabotage*. They should take into account possible releases of radioactivity, the location of the nuclear facility, and the particular circumstances prevailing in the State. Adequate physical protection measures should be implemented for nuclear facilities which may be subject to *sabotage* regardless of the categorization of nuclear materials therein contained.

G431. States should identify acts of sabotage, based on a defined specific level of radiological consequences, against which the physical protection system should protect. Existing domestic nuclear safety standards and accident scenarios are good references for a State's competent authority to use in defining this level. The extent of physical protection measures required should correspond to a level of possible off-site impact and the relative risk of radiological consequences.

4.2.5.6. The State's evaluation of the threat should determine if there is a credible threat to disperse nuclear material malevolently. The State should then apply the level of physical protection measures needed to ensure protection against the acts leading to radiological consequences without regard to the categorisation of the material.

G432. The dispersal threat relates to the *unauthorized removal* of plutonium or other radioactive material in an appropriate form from one location and its subsequent malevolent use as a radiological contaminant at another location.

Additional physical protection requirements for nuclear material during transport

4.2.6.1. During international *transport* of nuclear material the responsibility for physical protection measures should be the subject of agreement between the States concerned. The shipping State should consider, before allowing the international *transport*, if the States involved in the *transport*, including the transit States:

- are parties to the Convention on the Physical Protection of Nuclear Material (INFCIRC/274/ Rev.1); or

- have concluded with it a formal agreement which ensures that physical protection arrangements are implemented; or

- formally declare that their physical protection arrangements are implemented according to internationally accepted guidelines; or

- have issued licences which contain appropriate physical protection provisions for the *transport* of the nuclear material.

4.2.6.2. During international *transport* between two States sharing a common border, the State's responsibility for physical protection and the point at which physical protection responsibilities are transferred from one State to another should be the subject of an agreement between the States. However, with respect to the maintenance of communication regarding the continuing integrity of the shipment and with respect to the responsibility for carrying out physical protection measures and recovery actions in the event that a shipment becomes lost, the agreement between the States should provide that this responsibility will rest with the shipping State up to the border and will then be transferred to the receiving State.

4.2.6.3. When international shipments transit the territory of States other than the shipping State and the receiving State, the arrangements between the shipping and receiving States should identify the other States involved in such transit with a view to informing them and securing in advance their cooperation and assistance for adequate physical protection measures and for recovery actions on the territory of such States in case of loss of an international shipment thereon.

4.2.6.4. In the case of a Category I nuclear material international shipment transiting international waters or air space, the shipping and receiving States should establish specific measures to ensure the maintenance of communication regarding the continued integrity of the shipment and to ensure that responsibility for response planning and capabilities is defined and fulfilled.

G433. The recommendations in this chapter and Chapter 8 are not made in sequence with the steps necessary to plan, approve and execute a *transport* of nuclear material. To aid a competent authority in coordinating and approving a *transport*, the relevant recommendations for a Category I international *transport* are summarised below in a more chronological order. [Relevant recommendations for Category I domestic transports and Category II/III domestic and international transports follow in the same chronological order.]

G434. Responsibility for planning the *transport* rests with the owner of the nuclear material (or his designated agent), acting in conjunction with the shipping facility, any transport company to be used, and the receiving facility. In doing so, the owner should take into account the principles listed at paragraph 8.1.2 according to which the objectives of sound physical protection may be assisted through careful planning of the movement schedule. The plan will need to comply with regulations of the sending State and the requirements of its competent authority, and with the regulations and requirements of the receiving State and of other States which are transited.

G435. In drawing up contracts or agreements for the *transport*, it is important to state clearly the point at which responsibility for physical protection is transferred from one transport authority to another. This will not necessarily coincide with the point at which legal ownership of the material is transferred, but it will determine whether the shipper or the receiver (or even a third party) and its State has the responsibility for the physical protection of the material, the

maintenance of communications, the arrangements for dealing with an emergency and the arrangements for recovery if needed. Under the terms of the Convention on the Physical Protection of Nuclear Material, each State Party is required to ensure as far as practicable that nuclear material within its territory, or on board a ship or aircraft under its jurisdiction is protected to prescribed levels. This indicates that the point of handover of responsibility for air and sea transports will be dictated by the flag of the carrier, as a State will assume or have continuing responsibilities in international waters or airspace for nuclear material carried on its ships or aircraft. Contracts or agreements should contain provisions for the appropriate degree of advance notice to be provided so that physical protection arrangements may be made by the parties involved.

G436. In order to grant advance authorization, the competent authority should require physical protection plans for the *transport* (or series of identical transports) to be submitted by operators in advance. Experience suggests that it is rarely possible for existing regulations to cover every contingency and liaison will be necessary with other State bodies and relevant overseas competent authorities. The competent authority may wish to undertake a *security survey* on part of the route or the mode of *transport* to be used. Additionally, the competent authority or relevant State body should consider whether (or, if a State Party to the Convention on the Physical Protection of Nuclear Material will require assurances that) the material will be adequately protected during international *transport*, perhaps before granting an import or export licence. Examples of what could constitute a satisfactory assurance are contained in paragraph 4.2.6.1.

G437. In reviewing plans for proposed transports, the competent authority should consider whether the package to be used needs to be assessed for its resistance to acts of *sabotage*. The competent authority should also consider the implications of the proposed point of handover of physical protection responsibility from it's State to that of the recipient (or third party) State. For road and rail movements, this may involve reaching agreement with the State whose border is to be crossed concerning the exact point at which handover will take place, e.g. at which State's border control post. For air movements, advance arrangements may need to be made with States en route in whose territory emergency diversion airports have been identified for cooperation in protecting the nuclear material if the diversion airport is required. For sea transports through international waters, the competent authority will have to be satisfied that adequate arrangements have been made regarding maintenance of communications throughout the voyage and that *response forces* have been designated for both international and foreign territorial waters. Therefore, close liaison with relevant overseas competent authorities will be necessary before the *transport*, and specific communication links will have to be established for use immediately prior to and during the *transport*.

G438. In granting consent to the proposed *transport*, the competent authority may lay down specific limitations and conditions related to the particular circumstances. It is the responsibility of the licensee/operator to whom approval or a licence for the *transport* has been given by the competent authority to issue in advance written instructions to those persons responsible for physical protection during the *transport*. The competent authority should coordinate the issue of satisfactory written instructions by other external bodies involved in protecting the nuclear material during *transport* (such as police escorts).

G439. Shortly prior to commencement of the *transport*, the shipper should confirm details and timings of the proposed *transport* with the receiving facility and obtain prior confirmation of its readiness to accept delivery at the designated point of handover. The competent authorities of the States involved and designated *response forces* should also be informed of the timetable of the transport by the shipper directly or through the competent authority. (The Convention on the Physical Protection of Nuclear Material requires the responsible State Party to inform States in advance if nuclear material is expected to transit through their territory other than through their territorial waters or airspace).

G440. Physical protection of the *transport* should be undertaken in accordance with the approved transport plan and the associated written instructions, which take into account relevant regulations and any specific conditions stipulated by the competent authorities of the States through whose territory the transport passes. Competent authorities are encouraged to carry out periodic inspections of *transports* in order to confirm that physical protection arrangements conform to applicable requirements.

G441. If road movements cannot be completed without overnight stops, or if there is a requirement to place nuclear material in temporary storage en route (for instance at a transfer point), then the nuclear material should be protected in a manner consistent with that employed to protect it in use and storage at a facility. For Category I and Category II transports, this involves the establishment of a temporary *protected area* (or the use of an existing *protected area* at a nuclear facility) to which access is restricted and which is under surveillance by *guards* who are in close communication with *response forces*. If the material is to remain on the load vehicle, then the vehicle should be immobilised in order to deter or delay any unauthorised movement. Temporary storage arrangements should be approved in advance by the competent authority as part of the transport plan approval.

G442. The receiver should check the integrity of the packages at the point of handover and notify the shipper/owner immediately of their safe arrival. At the same time the escorts should notify the *transport control centre* of the handover of the packages to the receiver. If there have been any incidents or unscheduled delays during *transport*, a review of physical protection arrangements should be carried out in order to evaluate their effectiveness and identify any necessary improvements which may be made to optimize their effectiveness during future transports.

Reporting of information

4.2.7.1. The State's system of physical protection should include reporting of events and information which enables the State's competent authority to be informed of any change at nuclear facilities or related to *transport* of nuclear material which may affect implementation of physical protection measures.

G443. The competent authority should determine the types of events the operator is required to report. It should receive timely information about any significant events concerning unauthorized actions affecting the physical protection of nuclear material or nuclear facilities, e.g.,

- actual or attempted intrusion on a site
- any incident arising from use of explosive devices
- any malevolent action
- any attempted or actual *unauthorized removal*, loss or unauthorized movement of nuclear material
- any loss or unauthorized disclosure of confidential physical protection information
- any failure to maintain the approved physical protection system, e.g., as a result of strikes, loss of power.

CONFIDENTIALITY

4.3.1. The State should take steps to ensure appropriate protection of specific or detailed information the unauthorized disclosure of which could compromise the physical protection of nuclear materials and nuclear facilities. It should define requirements for the confidentiality of physical protection systems and associated documentation.

G444. Confidential information could include information on the *design basis threat*; the specific targets (e.g., nuclear material inventory and location, or site specific drawings or maps of equipment, systems or devices that represent the design features of specific targets) to be protected; the physical protection plan for a nuclear facility; site specific drawings, diagrams, sketches, or maps that represent the design features of a physical protection system; details of alarm system layouts showing location of *intrusion detection* systems, alarm system wiring, emergency power sources, and duress alarms; details of on-site and off-site security communications systems; *guard* procedures; schedules and itineraries for specific *transport* shipments; and response emergency plans.

4.3.2. Management of physical protection systems should limit access to sensitive information to those who need to know for the performance of their duties. Information addressing possible vulnerabilities in physical protection systems should be highly protected as it could indicate means of successfully removing nuclear material or of carrying out *sabotage*.

G445. Management, both by individuals and the regulatory framework, should facilitate the control of confidential information. Individuals who receive confidential information required for the performance of their duties, such as lock combinations, passwords and mechanical key designs should protect the information and limit access to those with a need to know. Individuals receiving confidential information should, as a matter of prudence, be reminded of the need for proper protection of it.

4.3.3. Sanctions against persons violating confidentiality should be part of the State's legislative or regulatory system.

G446. Sanctions against persons violating confidentiality should be severe enough to act as a deterrent against such actions. States should make such offences punishable by appropriate penalties which take into account their potentially grave nature.

EVALUATION OF THE IMPLEMENTATION OF PHYSICAL PROTECTION MEASURES

4.4.1. To ensure that physical protection measures are maintained in a condition capable of meeting the State's regulations and of effectively responding to the *design basis threat*, the State's competent authority should ensure that evaluations are conducted by operators at nuclear facilities and for *transport*. Such evaluations, which should be reviewed by the State's competent authority, should include administrative and technical measures, such as testing of detection, *assessment* and communications systems and reviews of the implementation of physical protection procedures. Such evaluations should also include exercises to test the training and readiness of *guards* and/or *response forces*. When deficiencies are identified, the State should ensure that corrective actions are taken by the operator.

G447. The competent authority should determine the form and frequency of the evaluations and the required documentation to describe the specific evaluations conducted and the results achieved. Criteria should be established by the competent authority for use in evaluating the acceptability of the results and a programme developed to ensure that appropriate corrective actions are promptly taken, if needed.

5. CATEGORIZATION OF NUCLEAR MATERIAL

BASIS FOR CONCERN

5.1.1. In determining the level of physical protection to be implemented for nuclear materials in use and storage or during *transport* account should be taken of the possibility that the *unauthorized removal* of plutonium, highly enriched uranium or uranium-233 could lead to the construction of a nuclear explosive device by a technically competent group.

CATEGORIZATION

5.2.1. The primary factor for determining the physical protection measures against *unauthorized removal* of nuclear material is the nuclear material itself, categorized in accordance with the following table which gives a categorization of the different types of nuclear material and with the considerations given below.

5.2.2. This categorization should be based on the potential risk of the material being used for a nuclear explosive device, which itself depends on: the type of material, e.g. plutonium, uranium; isotopic composition, i.e. content of fissile isotopes; physical and chemical form; degree of dilution; radiation level; and quantity. For example:

(a) The protection of nuclear material with a radiation level that exceeds 1 Gy/hr (100 rad/h) at one metre unshielded, which is classified as Category I or II, may be reduced one category level below that determined by the fissile content of the material; and

(b) Nuclear material that is in a form that is no longer usable for any nuclear activity, minimizes environmental dispersal and is practicably irrecoverable, may be protected in accordance with prudent management practices.

5.2.3. In determining the levels of physical protection in a facility, which may consist of several buildings, it is possible that the State's competent authority may identify part of the facility which contains material of a different category and which is therefore protected at a different level than the rest of the facility. Conversely, consideration may need to be given to adding together the total amount of material contained in a number of buildings to determine the appropriate protection arrangements for this group of buildings.

G501. Paragraph 4.2.2 concisely states that the rationale for the categorization of nuclear material is to provide a basis to establish "an appropriate relationship between the material of concern and the protective measures." The State should define the categorization of nuclear material to ensure that appropriate protection measures are implemented. A sound basis for such categorization is contained in this chapter. Since implementation of physical protection measures requires extensive resources, the State's competent authority needs a coherent basis for the measures being required of facility operators. This section provides additional guidance for understanding the intended process of material categorization.

G502. As noted in paragraph 5.2.2, categorization of nuclear material is based on the potential risk of the material being used for a nuclear explosive device. Thus, the *Categorization Table* pertains only to the *unauthorized removal* of nuclear material, not to *sabotage*.

G503. In using the *Categorization Table,* the initial fissile content of the material should be used. For example, 15 kg of uranium enriched to 20% = 3 kg ^{235}U fissile weight for categorization purposes. Similarly, 10 kg of uranium fuel enriched to 90% = 9 kg ^{235}U fissile weight for purposes of categorization.

NOTE: This table is not to be used or interpreted independently of the text of the entire document.

TABLE: CATEGORIZATION OF NUCLEAR MATERIAL

Material	Form	Category I	Category II	Category III[c]
1.Plutonium [a]	Unirradiated [b]	2 kg or more	Less than 2 kg but more than 500 g	500 g or less but more than 15 g
2.Uranium-235	Unirradiated[b] - uranium enriched to 20% ^{235}U or more - uranium enriched to 10% ^{235}U but less than 20 % ^{235}U - uranium enriched above natural, but less than 10 % ^{235}U	5 kg or more	Less than 5 kg but more than 1 kg 10 kg or more	1 kg or less but more than 15g Less than 10kg but more than 1 kg 10 kg or more
3. Uranium-233	Unirradiated[b]	2 kg or more	Less than 2 kg but more than 500 g	500 g or less but more than 15 g
4. Irradiated Fuel (The categorization of irradiated fuel in the table is based on international *transport* considerations. The State may assign a different category for domestic use, storage, and *transport* taking all relevant factors into account.)			Depleted or natural uranium, thorium or low-enriched fuel(less than 10% fissile content)[d/e]	

[a] All plutonium except that with isotopic concentration exceeding 80 % in plutonium-238.

[b] Material not irradiated in a reactor or material irradiated in a reactor but with a radiation level equal to or less than 1 Gy/hr (100 rad/hr) at one meter unshielded.

[c] Quantities not falling in Category III and natural uranium, depleted uranium and thorium should be protected at least in accordance with prudent management practice.

[d] Although this level of protection is recommended, it would be open to States, upon evaluation of the specific circumstances, to assign a different category of physical protection.

[e] Other fuel which by virtue of its original fissile material content is classified as Category I or II before irradiation may be reduced one category level while the radiation level from the fuel exceeds 1 Gy/hr (100 rad/hr) at one meter unshielded.

G504. The fourth type of material listed in the *Categorization Table* is irradiated, depleted or natural uranium, thorium or low-enriched uranium fuel (less than 10% fissile content). The categorization of these irradiated uranium fuels is based on their plutonium content, not on their uranium content.

G505. The *Categorization Table* does not indicate a de minimus quantity for irradiated fuels, i.e., a given quantity less than which may be considered Category III. There may be occasions when only small quantities of irradiated fuel are stored or transported, for instance in or to a post irradiation examination facility. In this event, it would be appropriate in accordance with footnote (d) of the Table to consider the irradiated fuel as Category III if it is estimated to contain less than 2 kg of plutonium (or 5 kg of HEU) and is self protecting as defined by footnote (e).

G506. As noted, the *Categorization Table* indicates that fuel which by virtue of its original fissile material content is classified as Category I or II before irradiation may be reduced one category level while the radiation level from the fuel exceeds 1 Gy/hr (100 rad/hr) at one metre unshielded. However, it does not address the method of determining the radiation level.

G507. A determination of radiation level can be made by measurement in air or water or by calculation. It is preferable to estimate the absorbed dose rate on the basis of direct measurement in water (spent fuel pool) and then calculate the radiation level at one metre unshielded. Where possible, measurements should be made on individual fuel elements. A constraint on this type of measurement is the necessity of moving or lifting elements in order to isolate individual elements from neighbouring spent fuel. However, if that is possible, measurements of a number of fuel elements is satisfactory. In all cases, measurements should be made by means of an underwater probe (e.g. shielded G-M counter) at a certain distance from the vertical axis of the item and at the mid point at several positions around a fuel element or a fuel assembly. Then recalculation of one metre distance in air should be performed.

G508. Where calculations are performed instead of actual measurements (e.g., by means of Monte Carlo Code), the fuel structure, isotopic composition, initial fissile content, burn-up and cooling time should be taken into account to calculate the absorbed dose rate.

G509. Paragraph 5.2.2 states that the potential risk of material being used for an explosive device depends on the type of material, isotopic composition, physical and chemical form, degree of dilution, radiation level, and quantity, but the *Categorization Table* does not consider the physical or chemical form of the material. However, paragraph 5.2.2 (b) states that nuclear material that is in a form no longer usable for any nuclear activity, minimizes environmental nuclear dispersal and is practically irrecoverable, may be protected in accordance with prudent management practice. Some immobilised or vitrified wastes may meet this definition.

G510. Paragraph 5.2.3 addresses the physical protection category when combining quantities of different materials. Such combination is frequently referred to as "roll-up." In some facilities, nuclear material of the same type, i.e., uranium enriched to more than 20%, may be located in several buildings. For example, there may be 4 kg of such material in one building and another 4 kg of similar material in another building within the same *protected area*. Considered

individually, each quantity of material is Category II. However, if considered jointly, i.e."rolled up", the material is Category I and the physical protection system should be correspondingly robust.

G511. However, "roll-up" is not required when the competent authority determines that multiple losses of the separate quantities of material are not possible because:

1. The separate buildings are protected by separate access and detection systems and *guards* and/or *response forces* are able to effectively counter simultaneous attacks by adversaries to both buildings; and

2. The separate buildings are managed by and under control of different groups of employees, thereby limiting the threat of an insider to one building.

6. REQUIREMENTS FOR PHYSICAL PROTECTION AGAINST UNAUTHORIZED REMOVAL OF NUCLEAR MATERIAL IN USE AND STORAGE

GENERAL

6.1.1. The concept of physical protection is one which requires a designed mixture of hardware (security devices), procedures (including the organization of *guards* and the performance of their duties) and facility design (including layout). The level of the physical protection measures should be specifically designed to take into account the nuclear material or nuclear facility and the State's *design basis threat*. Emergency procedures should be prepared to counter effectively the State's *design basis threat*.

6.1.2. Achievement of the objectives of the physical protection system should be assisted by:

(a) Taking into account physical protection of nuclear material in the design of the facility as early as possible;

(b) Limiting access to nuclear material or facilities to a minimum number of individuals. To accomplish this aim the State's competent authority should validate the operator's designation of *protected areas*, and *inner areas*. In designating such areas, the operator should give consideration to the plant safety design, the location of the plant and the *design basis threat*. Access to these areas should be limited and controlled; and

(c) Requiring predetermination of the trustworthiness of all individuals permitted unescorted access to nuclear material or facilities.

6.1.3. Potential conflicting requirements, resulting from safety and physical protection considerations, should be carefully analysed to ensure that they do not jeopardize nuclear safety, including during emergency conditions.

REQUIREMENTS FOR CATEGORY I NUCLEAR MATERIAL

6.2.1. Category I nuclear material should be used or stored only within an *inner area* or *inner areas*, located in a *protected area*. The ceiling, walls and floor of *inner areas* should provide penetration delay against *unauthorized removal* of nuclear material.

6.2.2. Access to and the number of access points into the *protected area* and *inner areas* should be kept to the minimum necessary. Persons authorized unescorted access to the *protected area* or *inner areas* should be limited to persons whose trustworthiness has been determined. Persons whose trustworthiness has not been determined such as temporary repair, service or construction workers and visitors should be escorted by a person authorized unescorted access. The identity of all persons entering such areas should be verified and they should be issued with appropriately registered passes or badges.

G601. Access to the *inner area* should be limited to only those individuals who have a legitimate need for access and whose trustworthiness has been predetermined. Individuals granted access to the *protected area* or *inner area* should be positively identified and should meet entry criteria before being badged or permitted entry. Control measures should be in place to initiate response measures to deny unauthorized entry. The object of using badges should be to provide an easy and quick means to distinguish whether an individual is an employee or a visitor, whether an individual is authorized unescorted access, and to what areas access has been approved. Badges should be visibly displayed on all individuals at all times. Picture badges for employees aid in positive identification and different types of badges aid in distinguishing different levels of access. Visitor badges should clearly distinguish visitors from employees and indicate that an escort is required. Badges should be difficult to counterfeit and should preferably remain on-site at all times. Access control can be enhanced by using picture

badges in combination with other unique individual identifiers such as personal identification numbers (PIN) or biometrics.

G602. Visitor-escort ratios should be limited to that which enables the escort to exercise positive control over the location and actions of the visitors.

6.2.3. All persons and packages entering or leaving *inner areas* should be subject to search to prevent the *unauthorized removal* of nuclear material. Instruments for the detection of nuclear material and metals can be used for such searches.

6.2.4. Entry of private motor vehicles into *protected areas* should be strictly minimized and limited to designated parking areas. All vehicles entering and leaving the *protected area* should be subject to search. Private motor vehicles should be prohibited access to *inner areas*.

G603. The primary objective in protecting against unauthorized removal is to prevent adversaries from gaining access to the nuclear material and removing it from an authorised area. The designation of a *protected area* around buildings containing Category I and II quantities of nuclear material helps accomplish this objective. The *protected area* should be surrounded by a *physical barrier* which defines the area of protective concern, limits access to the buildings, and provides some delay to any attempted intrusion. The *protected area* barrier could be a fence, a separate solid wall, a building wall or a combination of barriers, with openings secured with material of sufficient strength that the integrity of the barrier is not lessened by any opening. Access into the *protected area* should be controlled and limited to only those with a valid need whose trustworthiness has been predetermined.

G604. Searching individuals and vehicles prior to their entering the *protected area* is to ensure that they are not introducing any items that could be used to commit or assist *unauthorized removal or sabotage*. The search should detect items that could be concealed on the body or in the vehicle, as well as hand carried items. Individuals, vehicles, or any items exiting the *protected area* should be searched to ensure that nuclear material is not being removed from the area. It is preferable that means used to detect the unauthorised removal of nuclear material are located as close as possible to where the nuclear material is held, for example at the *inner area* boundary, as this is usually more effective than at a more outer boundary. Since vehicles are very difficult to search and could aid adversaries in quickly escaping with material from the facility, the objective should be to prohibit, escort or tightly control their access into the *protected area*.

6.2.5. Whenever persons are present in *inner areas*, those areas should be under constant surveillance. The surveillance can be effected by mutual observation between two or more co-workers (e.g. two-man rule).

G605. To protect against the insider threat, whenever the *inner area* is occupied the area should be under constant surveillance. The objective should be to ensure that activities of any authorised employee are always monitored by at least one other knowledgeable, authorised employee in order that unauthorized activities on the part of one can be immediately detected and reported i.e. two- man rule.

6.2.6. All employees should be informed at least annually of the importance of effective physical protection measures and be trained in their implementation as appropriate.

G606. Security awareness training should be conducted to include activities such as access control procedures, authorization levels, responsibility for reporting suspicious activities, etc. Verification of individual training should be recorded.

6.2.7. Every nuclear material handler should be required to conform to procedures for transferring custody of the nuclear material to the succeeding handler. Additionally, nuclear material handlers should endeavour to ascertain on reporting for duty that no interference with or *unauthorized removal* of nuclear material has taken place, and report to a senior authority whenever they have reason to suspect that a discrepancy exists.

6.2.8. A record should be kept of all persons having access to or possession of keys or key-cards concerned with the containment or storage of nuclear material. Arrangements should be made for:

(a) The checking and custody of keys or key-cards, particularly to minimize the possibility of duplication;

(b) The changing of combination settings at suitable intervals; and

(c) The changing of locks, keys, or combinations whenever there is evidence or suspicion that they have been compromised.

G607. All keys, key-cards, combinations and related equipment used to control access to a *protected area*, *inner area* or "strong room" should be protected and controlled on-site to prevent unauthorized use and to reduce the possibility of system compromise. It is recommended that any key-card or combination be changed if employment of any individual with access to these items is terminated.

6.2.9. Movements of nuclear material within the *inner area* and the *protected area* should be the responsibility of the operator who should apply all prudent and necessary physical protection measures. Movements out of or between two *protected areas* should be treated in full compliance with the requirements for nuclear material during *transport*, after taking account of prevailing conditions.

G608. Nuclear material should be protected while it is being transferred between *inner areas* at a level that provides comparable protection to that provided within an *inner area*. When nuclear material is moved between *inner areas* compensatory measures such as *guards* and/or the *response force*, and special transport vehicles or containers should be used. Movement of material between *protected areas* should be protected in compliance with requirements for nuclear material in transit taking into consideration such factors as distance, protective arrangements in place at the facility and the existing threat environment.

6.2.10. *Intrusion detection* should be performed at the *physical barrier* surrounding the *protected area* and timely *assessment* should be carried out. Clear areas should be provided on both sides of the *physical barrier* with illumination sufficient for *assessment*. To protect against unauthorized access or malevolent acts, special attention should be paid to all points of potential access. The perimeter of the *protected area* should normally consist of a *physical barrier* in addition to and outside the building walls. In cases where the walls of a building are of a specially solid construction, these walls may be designated as being the perimeter of the *protected area* under conditions specified by a *security survey*.

G609. *Intrusion detection* and *assessment* should be conducted at the *protected area* barrier with the objective of detecting, with a high degree of confidence, the *design basis threat* so that the *guards* and/or *response force* can be notified and response procedures implemented as soon as possible. The objective of the intrusion detection system should be to detect the adversaries

going over, through or under the *protected area* barrier. Actions should be taken to identify and correct any conditions that contribute to false/nuisance alarms of the intrusion detection system. *Assessment* of an intrusion detection alarm needs to be done promptly so as to determine if an actual intrusion has occurred. The *assessment* process is aided by having clear areas around the intrusion detection equipment and on either side of the *protected area* barrier so as to provide an unobstructed view of the area. Adequate illumination is important to allow observation and *assessment* by patrolling *guards* and/or those operating CCTV monitors. Care should be taken when designating building walls as *protected area* barriers so that there is a clear area outside the building wall for *intrusion detection* and *assessment*.

6.2.11. *Inner areas* should be so arranged that the number of entries and exits is minimized (ideally only one). All emergency exits should be fitted with *intrusion detection* sensors. Other points of potential access should be appropriately secured and alarmed. *Inner areas* should not be sited close to public thoroughfares.

G610. The objective of *inner areas* is to provide a further layer of access control, detection and delay around Category I quantities of nuclear material. *Inner areas*, in combination with the "strong room", should provide additional penetration delay to aid in preventing the *unauthorized removal* of nuclear material before the arrival of an effective response. Any openings should be secured with material of sufficient strength such that the integrity of the *inner area* boundary is not lessened by the opening below what is needed to provide appropriate delay. Whenever the *inner area* is unoccupied, the access door(s) should be locked and alarmed. CCTV cameras should preferably cover the exterior of these doors in order to assist *assessment* of any alarm condition and enable monitoring of the area when the *inner area* is occupied.

6.2.12. Storage areas should be of the "strong room" type in design and should be located within an *inner area*. They should be continuously locked and alarms activated when not occupied. The issuing of keys or key-cards should be closely controlled and keys or key-cards should remain within the *protected area*. Access to storage should be strictly limited to assigned persons and to others only when under their escort. Where nuclear material is held in an unmanned work area, e.g., overnight, specially authorized procedures should be used to protect the nuclear material. *Intrusion detection* and *assessment or patrols* can satisfy this requirement.

G611. Category I quantities of nuclear material should be stored within a "strong room" when not undergoing processing. A "strong room" should provide sufficient penetration delay to prevent forced entry, except if such an act would both destroy the barrier and render the nuclear material incapable of being removed, or to permit the arrival of a *response force* capable of preventing *unauthorized removal* of nuclear material. When nuclear material is undergoing processing, consideration should be given to keeping the material in locked compartments or locked/sealed process equipment except when personally attended. When the "strong rooms" are not occupied, they should be locked and protected with an intrusion detection system (preferably supplemented by CCTV) which will alarm upon entry, and upon movement of an individual within the area.

6.2.13. All *intrusion detection* sensors should annunciate and be recorded in a continuously staffed *central alarm station* to provide for monitoring and *assessment* of alarms, initiation of response and communication with the *guards*, facility management and, *response force*. The *central alarm station* should normally be located in the *protected area* unless its function will be more effectively performed in another area nearby. The *central alarm station* should be hardened so that its functions can continue in the presence of the *design basis threat*.

6.2.14. A 24-hour guarding service should be provided. The *guard* force or the *central alarm station* personnel should report at scheduled intervals to the off-site *response forces* during non-working hours. *Guards* should be trained and adequately equipped for their function in accordance with national laws and regulations. When *guards* are not armed, compensating measures should be applied. The objective should be the arrival of adequately armed *response forces* in time to counter armed attacks and prevent the *unauthorized removal* of nuclear material.

G612. The objective of the compensating measures when *guards* are not armed should be to provide additional delay to allow the arrival of the *response force* in time to prevent the *unauthorized removal* of nuclear material. Compensating measures may consist of additional barriers, increasing barrier delay time and/or decreasing arrival time of the *response force.*

G613. The objectives of the scheduled reporting between the *guard* force or the *central alarm station* and the off-site *response force* is to verify the operation of the communication system and enhance liaison.

6.2.15. *Patrols* of the *protected area* should be provided.

G614. *Patrols* serve to enhance the physical protection system through acting as a deterrent, providing supplementary detection and *assessment,* and they usually act as the first line of response. They can provide a timely compensatory measure for temporary failures of *intrusion detection* systems or *physical barriers*. *Patrols* may be conducted randomly so they are not predictable and thereby introduce uncertainty to complicate adversary planning. *Patrols* may be deployed on foot or in vehicles. Dogs may be used to supplement *patrols* outside *protected areas*. *Patrols* should be in regular communication with the *central alarm station*, which directs their activities. The effectiveness of *patrols* may be enhanced by the use of duress alarms.

6.2.16. Dedicated, tamper-indicating transmission systems and independent power supplies, should be provided between the *intrusion detection* sensors and the *central alarm station*. Alarms generated by *intrusion detection* sensors should be promptly assessed and appropriate action taken.

G615. Alarm *assessment* is normally accomplished by CCTV, complemented by *patrols*. All camera pictures associated with the zone(s) that have indicated an alarm should be automatically displayed on dedicated monitors in the *central alarm station* to allow timely *assessment.*

6.2.17. Dedicated, redundant and diverse transmission systems for two-way voice communication between the *central alarm station* and the *response force* should be provided for activities involving detection, *assessment* and response. Also, dedicated two-way voice communication should be provided between *guards* and the *central alarm station*.

6.2.18. Emergency plans of action should be prepared to counter effectively any attempted *unauthorized removal* of nuclear material. Such plans should provide for the training of *guards* and *response forces* in their actions in case of an emergency. They should also provide for appropriate response by *guards* or *response forces* to attempted intrusion into the *protected area* and *inner areas*. The close co-ordination between *guards* and *response forces* should be regularly exercised. In addition, other facility personnel should be trained and prepared to act in full co-ordination with the *guards*, *response forces* and safety response teams for implementation of emergency plans.

G616. An emergency plan should be established at all facilities and activities where physical protection measures are required by the competent authority. This plan should provide guidance to licensee personnel for accomplishing specific defined objectives in the event of threats, *unauthorized removal* or *sabotage* relating to nuclear material or nuclear facilities.

G617. The goals of the emergency plan for responding to threats or attempts of *unauthorized removal* and *sabotage* are:

(a) To identify a range of credible emergency situations that may occur;

(b) To organize the response effort at the licensee/operator level;

(c) To identify predetermined, structured responses by the licensee/operator to an emergency situation;

(d) To ensure the integration of the licensee/operator response with other entities; and

(e) To achieve a measurable performance in response capability.

G618. Licensee/operator emergency planning should organize the licensee/operator's resources in such a way that possible emergency events will be identified with preplanned responses, the various emergency responders will be identified, their responsibilities specified and the responses coordinated in a timely manner. Planning should take account of the need for prompt and controlled access to facilities by off-site emergency responders. It is also important to note that the licensee/operator emergency plan is intended to be complimentary to other emergency plans in place for responding to other safety-related radiological incidents or accidents. Periodic response exercises should be conducted with emergency responders to demonstrate effectiveness and to provide familiarisation and training.

6.2.19. Arrangements should be made to ensure that during emergency evacuation conditions (including exercises) *unauthorized removal* of nuclear material does not occur.

6.2.20. Evaluations of the overall implemented physical protection system, procedures and the timely response of the *guards* and *response forces* should be conducted at least annually by the operator to determine their reliability and effectiveness.

6.2.21. Operators should regularly test *intrusion detection*, *assessment* and communications systems as well as other physical protection functions to determine their continued operability. When deficiencies are identified, corrective actions should be taken as soon as possible.

REQUIREMENTS FOR CATEGORY II NUCLEAR MATERIAL

6.3.1. Category II nuclear material should be used or stored only within a *protected area*.

6.3.2 Access to and the number of access points into the *protected area* should be kept to the minimum necessary. Persons authorized unescorted access to the *protected area* should be limited to persons whose trustworthiness has been determined. Persons whose trustworthiness has not been determined such as temporary repair, service or construction workers and visitors should be escorted by a person authorized unescorted access.

The identity of all persons entering such areas should be verified and they should be issued with appropriately registered passes or badges.

G619. Refer to paragraph G601 for guidance regarding *protected areas*.

6.3.3. Vehicles, persons and packages entering or leaving the *protected area* should be subject to search.

6.3.4. Entry of private motor vehicles into the *protected area* should be minimized and limited to designated parking areas.

G620. Refer to paragraph G604 for guidance.

6.3.5. All employees should be informed at least annually of the importance of effective physical protection measures and be trained in their implementation, as appropriate.

G621. Refer to paragraph G606 for guidance.

6.3.6. Every nuclear material handler should be required to conform to procedures for transferring custody of the nuclear material to the succeeding handler. Additionally, nuclear material handlers should endeavour to ascertain on reporting for duty that no interference with or *unauthorized removal* of nuclear material has taken place, and report to a senior authority whenever they have reason to suspect that a discrepancy exists.

6.3.7. A record should be kept of all persons having access to or possession of keys or key-cards concerned with the containment or storage of nuclear material. Arrangements should be made for:

a) The checking and custody of keys or key-cards, particularly to minimize the possibility of duplication;

(b) The changing of combination settings at suitable intervals; and

(c) The changing of locks, keys, or combinations whenever there is evidence or suspicion that they have been compromised.

G622. Refer to paragraph G607 for guidance

6.3.8. Movements of nuclear material within a *protected area* should be the responsibility of the operator who should apply all prudent and necessary physical protection measures. Movements out of or between two *protected areas* should be treated in full compliance with the requirements for nuclear material during *transport*, due account should be taken of prevailing conditions.

G623. Refer to paragraph G608 for guidance.

6.3.9. *Intrusion detection* should be performed at the *physical barrier* surrounding the *protected area* and timely *assessment* should be carried out. Clear areas should be provided on both sides of the perimeter of the *protected area* with illumination sufficient for *assessment*. To protect against unauthorized access or malevolent acts, special attention should be paid to all points of potential access. The perimeter of the *protected area* should normally consist of a *physical barrier* in addition to and outside the building walls. In cases where the walls of a building are of a specially solid construction, these walls may be designated as being the perimeter of the *protected area* under conditions specified by a *security survey*.

G624. Refer to paragraph G609 for guidance.

6.3.10. All *intrusion detection* sensors should annunciate and be recorded in a continuously staffed *central alarm station* to provide for monitoring and *assessment* of alarms, initiation of response and communication with the *guards*, facility management and, *response force*. The *central alarm station* should normally be located in the *protected area* unless its function will be more effectively performed in another area nearby. The *central alarm station* should be hardened so that its functions can continue in the presence of the *design basis threat*.

6.3.11. Dedicated, tamper indicating transmission systems, and independent power supplies, should be provided between the *intrusion detection* sensors and the *central alarm station*. Alarms generated by *intrusion detection* sensors should be promptly assessed and appropriate action taken.

G625. Refer to paragraph G615 guidance.

6.3.12. Dedicated, redundant and diverse transmission systems for two-way voice communication between the *central alarm station* and the *response force* should be provided for activities involving detection, *assessment* and response. Also, dedicated two-way voice communication should be provided between *guards* and the *central alarm station*.

6.3.13. Emergency plans of action should be prepared to counter effectively any attempted *unauthorized removal* of nuclear material. Such plans should provide for the training of *guards* and *response forces* in their actions in case of an emergency. They should also provide for appropriate response by *guards* or *response forces* to attempted intrusion into the *protected area*. The close co-ordination between *guards* and *response force* should be periodically exercised. In addition, other facility personnel should be trained and prepared to act in full co-ordination with the *guards*, *response forces* and safety response teams for implementation of emergency plans.

G626. Refer to paragraph G616-618 for guidance.

6.3.14. Arrangements should be made to ensure that during emergency evacuation conditions (including exercises) *unauthorized removal* of nuclear material does not occur.

6.3.15. Evaluations of the overall implemented physical protection system, procedures and the timely response of the *guards* and *response forces* should be conducted periodically by the operator to determine their reliability and effectiveness.

6.3.16. Operators should regularly test *intrusion detection*, *assessment* and communications systems as well as other physical protection functions to determine their continued operability. When deficiencies are identified, corrective actions should be taken as soon as possible.

REQUIREMENTS FOR CATEGORY III NUCLEAR MATERIAL

6.4.1. Category III nuclear material should be used or stored only within an area to which access is controlled.

G627. An area should be contained by a physical barrier such as a fence, building, room, or container to which access is restricted to a limited number of authorized individuals.

6.4.2. All employees should be frequently (about annually) informed of the importance of effective physical protection measures and be trained in their implementation.

G628. Refer to paragraph G606 for guidance.

6.4.3. Movements of nuclear material should be the responsibility of the operator, who should apply all prudent and necessary physical protection measures.

6.4.4. Provision should be made for detecting *unauthorized intrusion* and for appropriate action by *guards* or *response forces* to attempted intrusions.

6.4.5. Emergency plans of action should be prepared to counter effectively any attempted *unauthorized removal* of nuclear material. Such plans should provide for the training of facility personnel in their actions in case of an emergency. They should also provide for appropriate response by *guards* or *response forces* to attempted intrusion.

G629. Refer to paragraph G616-618 for guidance.

6.4.6. Evaluations of the implemented physical protection system and the timely response of the *guards* and *response forces* should be conducted periodically by the operator to determine their reliability and effectiveness. When deficiencies are identified, corrective action should be taken, as soon as possible.

7. REQUIREMENTS FOR PHYSICAL PROTECTION AGAINST SABOTAGE OF NUCLEAR FACILITIES AND NUCLEAR MATERIAL DURING USE AND STORAGE

GENERAL

7.1.1. An act of *sabotage* involving nuclear material or against a nuclear facility could create a radiological hazard to the personnel, and a potential radioactive release to the public and the environment. Radiological hazards are strongly dependent on the threat to be considered, on the type of nuclear material, on the inventory of nuclear material and associated fission products, on the design of the facility or package and on its safety features. Consequently, a plant-specific or package design evaluation of the potential for *sabotage* and associated radiological consequences should be made in close consultation between safety and physical protection specialists.

7.1.2. The concept of physical protection to protect against *sabotage* requires a designed mixture of hardware (security devices), procedures (including the organization of *guards* and the performance of their duties) and facility design (including layout). The level of the physical protection measures should be specifically designed to take into account the nuclear facility or nuclear material, the State's *design basis threat* and the radiological consequences. Emergency procedures should be prepared to counter effectively the State's *design basis threat*.

7.1.3. The objective of the physical protection system should be to prevent or delay access to or control over the nuclear facility or nuclear material through the use of a set of protective measures including *physical barriers* or other technical means or the use of *guards* and *response forces* so that the *guards* or *response forces* can respond in time to prevent the successful completion of *sabotage*.

7.1.4. Achievement of the objectives of the physical protection system should be assisted by:

(a) Taking into account physical protection in the design of the nuclear facility as early as possible;

(b) Limiting access to nuclear material or facilities to a minimum number of individuals. To accomplish this aim the State's competent authority should validate the operator's designation of *protected areas*, *vital areas* or other areas. In designating such areas, consideration should be given to the plant safety design, the location of the plant and the *design basis threat*. Access to these areas should be limited and controlled; and

(c) Requiring predetermination of the trustworthiness of all individuals permitted unescorted access to nuclear material or facilities.

7.1.5. Safety specialists, in close cooperation with physical protection specialists, should evaluate the consequences of malevolent acts, considered in the context of the State's *design basis threat*, to identify nuclear material, or the minimum complement of equipment, systems or devices to be protected against *sabotage*. Also measures that have been designed into the facility for safety purposes should be taken into account. When protecting against *sabotage*, nuclear material or equipment, systems or devices the *sabotage* of which, alone or in combination based on analysis, could lead to unacceptable radiological consequences, should be located in a *vital area(s)*. Potential conflicting requirements, resulting from safety and physical protection considerations, should be carefully analysed to ensure that they do not jeopardize nuclear safety, including during emergency conditions.

7.1.6. Evaluations of the overall implemented physical protection system, procedures and the timely response of the *guards* and *response forces* should be conducted at least annually by the operator to determine their reliability and effectiveness.

7.1.7. Operators should regularly test *intrusion detection*, *assessment* and communications systems as well as other physical protection functions to determine their continued operability. When deficiencies are identified, corrective actions should be taken as soon as possible.

REQUIREMENTS FOR NUCLEAR POWER REACTORS

7.2.1. The following set of measures represents the requirements applicable for the physical protection of nuclear power plants against *sabotage* because of their inventory of fission products and their inherent driving force for dispersion.

G701. Although there are strong similarities between the approach to physical protection against *unauthorized removal* and *sabotage*, there are also some significant differences. Therefore, the protection measures against *sabotage* may differ from those against *unauthorized removal*. In particular, the attractiveness of nuclear material as a target for each of these scenarios can be very different. The protection of nuclear material from *unauthorized removal* is enhanced by high radiation levels. However, these identical high levels of radioactivity increase the attractiveness of the same material for *sabotage*.

7.2.2. Nuclear material or equipment, systems or devices that are important to safety or the *sabotage* of which could lead to unacceptable radiological consequences, should only be located within a *vital area(s)*. Equipment, systems or devices located outside the *protected area* should be evaluated with respect to their potential impact on plant safety when subjected to the *design basis threat*.

7.2.3. Access to and the number of access points into the *protected area* and *vital area(s)* should be kept to the minimum necessary. Persons authorized unescorted access to the *protected area* or *vital areas* should be limited to persons whose trustworthiness has been determined. Persons whose trustworthiness has not been determined such as temporary repair, service or construction workmen and visitors should be escorted by a person authorized unescorted access. The identity of all persons entering such areas should be verified and they should be issued with appropriately registered passes or badges.

G702. Refer to paragraph G601 for guidance.

7.2.4. All persons and packages entering *protected areas* should be subject to search to prevent the introduction of articles for use for *sabotage*. All vehicles entering the *protected area* should be subject to search. Instruments for the detection of explosives and metals can be used for such searches. Consideration should be given to preventing the forceful intrusion of motor vehicles.

G703. Refer to paragraph G604 for guidance.

7.2.5. Entry of private motor vehicles into *protected areas* should be strictly minimized and limited to designated parking areas. Private motor vehicles should be prohibited access to *vital areas*.

7.2.6. All employees should be informed at least annually of the importance of effective physical protection measures and be trained in their implementation as appropriate.

G704. Refer to paragraph G606 for guidance.

7.2.7. Operators should monitor to detect that no tampering or interference with equipment, systems or devices in *vital areas* has taken place, or to provide for timely detection of such tampering or interference. A report should be made to the competent authority whenever there is reason to suspect that any malevolent activity has occurred.

7.2.8. Following a shutdown/maintenance period, special precautions should be taken prior to reactor startup to detect any malevolent actions.

7.2.9. A record should be kept of all persons having access to or possession of keys or key-cards concerned with the containment or storage of nuclear material or to *vital areas*. Arrangements should be made for:

(a) The checking and custody of keys or key-cards, particularly to minimize the possibility of duplication;

(b) The changing of combination settings at suitable intervals; and

(c) The changing of locks, keys, or combinations whenever there is evidence or suspicion that they have been compromised.

G705. Refer to paragraph G607 for guidance.

7.2.10. *Intrusion detection* should be performed at the *physical barrier* surrounding the *protected area* and timely *assessment* should be carried out. Clear areas should be provided on both sides of the perimeter of the *protected area* with illumination sufficient for *assessment*. To protect against unauthorized access or malevolent acts, special attention should be paid to all points of potential access. The perimeter of the *protected area* should normally consist of a *physical barrier* in addition to and outside the building walls. In cases where the walls of a building are of a specially solid construction, these walls may be designated as being the perimeter of the *protected area* under conditions specified by a *security survey*.

G706. Refer to paragraph G609 for guidance.

7.2.11. *Vital areas* should be so arranged that the number of entries and exits is minimized (ideally only one). All emergency exits should be fitted with *intrusion detection* sensors. Other points of potential access should be appropriately secured and alarmed. *Vital areas* should not be sited close to public thoroughfares.

7.2.12. *Vital areas* should provide penetration delay. They should be appropriately secured and alarmed when unattended. The issuing of keys or key-cards should be closely controlled. They should be appropriately protected to ensure that they are not malevolently used.

7.2.13. All *intrusion detection* sensors should annunciate and be recorded in a continuously staffed *central alarm station* to provide for monitoring and *assessment* of alarms, initiation of response and communication with the *guards*, facility management and *response force*. The *central alarm station* should normally be located in the *protected area* unless its function will be more effectively performed in another area nearby. The *central alarm station* should be hardened so that its functions can continue in the presence of the *design basis threat*.

7.2.14. A 24-hour guarding service should be provided. The *guard* force or the *central alarm station* personnel should report at scheduled intervals to the off-site *response forces* during non-working hours. *Guards* should be trained and adequately equipped for their function in accordance with national laws and regulations. When *guards* are not armed, compensating measures should be considered. The objective should be the arrival of adequately armed *guards* and/or *response forces* before an act of *sabotage* begins or while the act is in progress so that they may prevent its successful completion.

G707. Refer to paragraph G612-613 for guidance.

7.2.15. *Patrols* of the *protected area* should be provided.

G708. Refer to paragraph G614 for guidance.

7.2.16. Dedicated, tamper indicating transmission systems and independent power supplies, should be provided between the *intrusion detection* sensors and the *central alarm station*. Alarms generated by *intrusion detection* sensors should be promptly assessed and appropriate action taken.

G709. Refer to paragraph G615 for guidance.

7.2.17. Dedicated, redundant and diverse transmission systems for two-way voice communication between the *central alarm station* and the *response forces* should be provided for activities involving detection, *assessment* and response. Also, dedicated two-way voice communication should be provided between *guards* and the *central alarm station*.

7.2.18. Emergency plans of action should be prepared to counter effectively any attempted *sabotage*. Such plans should provide for the training of *guards* and *response forces* in their actions in case of an emergency. They should also provide for appropriate response by *guards* or *response forces* to attempted intrusion into the *protected area* and *vital areas*. The close co-ordination between *guards* and *response forces* should be regularly exercised. In addition, other facility personnel should be prepared to act in full coordination with *guards*, *response forces* and safety response teams for implementation of emergency plans.

G710. Refer to paragraph G616-618 for guidance.

7.2.19. Arrangements should be made to ensure that during emergency evacuation exercises access to *vital areas* remains controlled.

REQUIREMENTS FOR OTHER NUCLEAR FACILITIES AND NUCLEAR MATERIALS

7.3.1. *Sabotage* of nuclear facilities other than nuclear power plants and of various forms and quantities of nuclear material could also result in radiological hazards to the public. States should determine the level of protection needed against such *sabotage* depending upon the degree of radiological consequences. Measures specified in Section **7.2.** may be applied as appropriate.

8. REQUIREMENTS FOR PHYSICAL PROTECTION OF NUCLEAR MATERIAL DURING TRANSPORT

GENERAL

8.1.1. The *transport* of nuclear material is probably the operation most vulnerable to an attempted act of *unauthorized removal* of nuclear material or *sabotage*. Therefore, taking into account the State's *design basis threat*, the physical protection provided should be "in depth" and particular attention should be given to the recovery of missing nuclear material. Emergency procedures should be prepared to counter effectively the State's *design basis threat*.

G801. When nuclear material is being transported between facilities, the usual protective measures cannot be applied. It is therefore important that compensatory measures be provided "in depth", so that adversaries would have to defeat a number of these measures in sequence to accomplish their objectives. The protection measures which may be applied to provide this *defence in depth* are:

(a) Limiting advance knowledge of *transport* operations and protecting the confidentiality of this information (in part, through predetermining the trustworthiness of all individuals involved in the *transport*);

(b) Providing as appropriate escorts (or *guards*) for the *transport* who are able to communicate with *response forces*, either directly or through a *transport control centre* monitoring the movement;

(c) Transporting packages inside closed and locked vehicles, railway wagons or holds of ships (with vehicles involved in movements of Category I quantities preferably being designed to resist forcible attack and equipped with immobilisation devices);

(d) Locking or sealing packages and ensuring, where necessary, that the package design takes account of the potential for *sabotage*; and

(e) Having plans in place for response and recovery operations in the event of any threatened or actual *unauthorized removal* or *sabotage* of nuclear material in *transport*.

G802. In three important areas, i.e., load carriers, escorts and communications, the competent authority may wish to define more clearly than INFCIRC/225/Rev.4 the State's physical protection requirements to take account of local circumstances, including the *design basis threat*. Particularly where Category I material is involved or additional *sabotage* protection has to be performed, there is a close inter-relationship between these three areas to ensure that the escorts can summon immediate assistance from a *response force* who will arrive before adverseries have time to remove the nuclear material, hijack the vehicle carrying it, or carry out an act of *sabotage* leading to a radiological release. The larger and better armed the escorts, the less likelihood there is of it being overwhelmed. However, where there are constraints on the size or arming of the escorts, then increased dependency must be placed on providing a load carrier that is capable of resisting forcible attack or hijacking until the expected arrival of the *response force*.

G803. The competent authority should establish a minimum size of an escort for each of the various modes of Category I transport and its distribution between load vehicles and escort vehicles. States are encouraged to use armed escorts to the extent that laws and regulations permit. This may involve coordinating the provision of armed *guards* through another State body such as the police. It may be decided that escorts are required also for the transport of other categories of nuclear material, depending upon local circumstances.

G804. When armed escorts are not used for Category I *transports*, compensatory measures should be applied. These compensatory measures should be designed to delay adversaries long enough for the *response force* to arrive and thus prevent successful *unauthorized removal* or *sabotage*. Essentially they consist of barriers which provide delay to adversaries attempting to gain access to the nuclear material and immobilisation (or disabling) systems which further delay any attempt to hijack the load vehicle. Even where armed escorts are used, vehicles preferably should be specially designed to provide penetration delay and be equipped with an immobilisation (or vehicle disabling) system in order to provide *defence in depth*.

G805. It is the role of the competent authority to ensure that emergency procedures are prepared to handle effectively any possible threat to nuclear material in *transport*. This involves ensuring that *response forces* are identified who are prepared to arrive rapidly enough to prevent the *unauthorised removal* of a Category I *transport* or *sabotage* and who may rapidly recover a lost Category II or III *transport*.

8.1.2. Achievement of the objectives of physical protection should be assisted by:

(a) Minimizing the total time during which the nuclear material remains in *transport*;

(b) Minimizing the number and duration of nuclear material transfers, i.e. transfer from one conveyance to another, transfer to and from temporary storage and temporary storage while awaiting the arrival of a vehicle, etc.;

(c) Protecting nuclear material during *transport* and in temporary storage in a manner consistent with the category of that material;

(d) Avoiding the use of regular movement schedules;

(e) Requiring predetermination of the trustworthiness of all individuals involved during *transport* of nuclear material; and

(f) Limiting advance knowledge of *transport* information to the minimum number of persons necessary.

8.1.3. Appropriate measures, consistent with national requirements, should be taken to protect the confidentiality of information relating to *transport* operations, including detailed information on the schedule and route, and particular consideration should be given to those operations involving Category I and II nuclear material. This requires great restraint in the use of any special markings on vehicles, and also in the use of open channels for transmission of messages concerning *transports* of nuclear material. When a message is required by safeguards or radiological safety regulations, measures such as coding and appropriate routing to the extent practicable should be taken; care should be exercised in the handling of such information. These considerations should apply also to any subsequent communications.

G806. Knowledge of the schedule and route, in particular of Category I and II *transports*, should be strictly limited to the minimum number of persons necessary. Any wider dissemination of this information to other official bodies should be made as close to the time of departure as possible so as to reduce the risk of compromise and these bodies requested to keep the information confidential. If secure communications are not available, the introduction of codes for information on dates and places of *transports* should be considered.

8.1.4. An evaluation of the potential for *sabotage* and associated radiological consequences of a package design with respect to its mode of *transport* may be required by the State's competent authority. This should be done in close consultation with safety specialists.

8.1.5. Before an international *transport* is made the shipper should ensure that the arrangements are in accordance with the physical protection regulations of the receiving State and of other States which are transited.

REQUIREMENTS FOR CATEGORY I NUCLEAR MATERIAL

Advance notification to receiver

8.2.1.1. The shipper should give the receiver advance notification of the planned shipment specifying the mode of *transport* (road/rail/sea/air), the estimated time of arrival of the shipment and the exact point of hand-over if this is to be done at some intermediate point before the ultimate destination.

8.2.1.2. The receiver should confirm his readiness to accept delivery immediately (and hand-over, if applicable) at the expected time, prior to commencement of the shipment.

Advance authorization

8.2.2.1. Advance authorization by the competent authority is required. This implies the performance of a *security survey* in advance. The consent to a *transport* operation can include specific limitations and conditions related to the particular circumstances and to whatever emergency plans have been prepared.

Selection of mode of transport and routing

8.2.3.1. In choosing the route, consideration should be given to the security of passage, in particular, arranging the route in such a way as to avoid areas of natural disasters or civil disorders and taking into consideration the capabilities of the *response forces*. The mode of *transport* for any given consignment should be such as to keep to a minimum the number of cargo transfers and the length of time the cargo remains in *transport*. The co-operation of the carrier concerning the implementation of physical protection measures should be ensured in advance.

8.2.3.2. Competent authorities should approve the route, including alternate routing as appropriate, stopping places, destination hand-over arrangements, identification of persons authorized to take delivery, accident procedures and reporting procedures, both routine and emergency.

Provision of locks and seals

8.2.4.1. Unless there are overriding safety considerations, the packages containing nuclear material should be carried in closed, locked vehicles, compartments or freight containers. However, carriage of packages weighing more than 2000 kg that are locked or sealed should be allowed in open vehicles. Subject to safety considerations, the package should be tied down or attached to the vehicle or freight container.

G807. Delay may be provided by constructing the load compartment of the vehicle, train or ship similar to a "strong room" through the use of armour plating and other barrier materials to delay or mitigate a forcible or explosive attack. The door to the compartment should be of similar standard fitted with multiple locking pins and special locks. Nuclear material packages may be further secured within the compartment by cargo tie-down systems, and packages designed to provide thermal protection against the consequences of an explosive or ballistic attack.

8.2.4.2. Checks should be made before dispatch to confirm the integrity of the locks and seals on the package, vehicle, compartment or freight container.

Search of load vehicle

8.2.5.1. There should be a detailed search of the load vehicle prior to loading and shipment, to ensure that *sabotage* devices have not been implanted or that *sabotage* has not been initiated.

Written instructions

8.2.6.1. Personnel with physical protection responsibilities should be given written instructions detailing their responsibilities during the *transport* which have been approved by the competent authority.

Measures after shipment

8.2.7.1. The receiver should check the integrity of the packages, locks and seals and accept the shipment immediately upon arrival. The receiver should notify the shipper of the arrival of the shipment immediately or of non-arrival within a reasonable interval after the estimated time of arrival at its destination. In addition, the *guard* should be instructed to report by two-way voice communications to the *transport control centre* his arrival at his destination and each overnight stopping place and place of hand-over of the shipment.

Communication

8.2.8.1. Physical protection measures should include provision of a continuous two-way voice communication system between the vehicle, its escort and the *transport control centre*. Redundant and diverse communication systems should be utilized, where available.

8.2.8.2 For shipments by road, rail or sea, there should be a *transport control centre* for the purpose of keeping track of the current position and security status of the shipment of nuclear material, alerting *response forces* in case of an attack and maintaining continuous two-way communication with the shipment and the *response forces*. The *transport control centre* should be hardened so that its function can continue in the presence of the *design basis threat*. While the shipment is in progress, the *transport control centre* should be staffed by qualified shipper or State designees, whose trustworthiness has been predetermined.

G808. The purpose of communications between the vehicle/train/ship/aircraft carrying the nuclear material and a *transport control centre* is to enable the latter to monitor the continued integrity of the *transport* and relay emergency reports to designated *response forces*. It is the responsibility of competent authorities to ensure that a suitably manned and equipped *transport control centre* to monitor *transports* is established by the shipper, receiver, transport company involved or an independent State authority. Current technology now makes it possible to install an automatic data transmission tracking system on load carriers which enables a *transport*

control centre to note and investigate immediately any unplanned stops or deviation from the planned route. These tracking systems may incorporate short pre-assigned data messages which can be transmitted in an emergency by the driver or on-board escorts. However, it is important that the escort is able also to communicate verbally by radio, mobile telephone or satellite system to the *transport control centre* in order to provide detailed information in the case of emergencies. It is also advantageous if the escort is able to communicate directly by radio with designated *response forces* in an emergency. Where justified by the threat, the load vehicle should have:

(a) redundant communications with the transport control centre and escort/response forces to prevent communications failures;

(b) encrypted communications to guard against interception by adversaries; and

(c) pre-arranged duress alarm signals in case of attack/hijacking.

G809. In addition to keeping shippers and receivers updated concerning the progress of a *transport*, the *transport control centre* has a key role in alerting *response forces* to any emergency.

Guards

8.2.9.1. *Guards*, who are appropriately equipped and trained, should accompany each shipment to protect the nuclear material against *unauthorized removal* or *sabotage*. Continuous, effective surveillance of the packages or locked cargo hold, or compartment holding the packages is to be maintained by the *guard* at all times, especially when the *shipment* is not in motion. States are encouraged to use armed *guards* to the extent that laws and regulations permit. When *guards* are not armed, compensating measures should be applied.

Emergency action

8.2.10.1. Arrangements should be made to provide an adequately sized, equipped and trained *response force* to deal with emergencies. The objective should be the arrival of the *response force* in time to prevent the *unauthorized removal* of nuclear material or *sabotage*.

Arrangements for international transport

8.2.11.1. In contracts or agreements between shippers and receivers involving international *transport* of nuclear material, the point at which responsibility for physical protection is transferred from the shipper to the receiver should be clearly stated.

8.2.11.2. When the contract or agreement involving international *transport* provides for delivery to a destination in the receiving State in the vehicle of the shipping State, this contract or agreement should provide that information be supplied in time to enable the receiver to make adequate physical protection arrangements.

REQUIREMENTS FOR CATEGORY I NUCLEAR MATERIAL RELATED TO THE MODE OF TRANSPORT

General

8.3.1.1. In addition to the requirements mentioned above, there should be further detailed requirements for Category I material related to the mode of *transport* as set out below.

Shipment by road

8.3.2.1. Designated load vehicle(s) should be used exclusively for each consignment and should preferably be specially designed to resist attack and equipped with a vehicle disabling device. Each load vehicle should carry a *guard* for that vehicle.

G810. In order to prevent adversaries from simply driving a captured vehicle away, the driver's cab should also be made secure through armouring and the fitting of special locks and the vehicle should be fitted with at least one immobilisation system operated from the driver's cab for use in an emergency. Systems available include ones that cut off the fuel supply, lock the gears or the wheels, disable the accelerator or shut-off the air brakes. Any immobilisation device used should be of a design that is not capable of being disengaged easily and quickly.

8.3.2.2. Each load vehicle should be accompanied by at least one vehicle manned by one or more *guards*.

G811. The competent authority may wish to stipulate that the number of load vehicles be limited for any one transport and that the number of escorts be decided accordingly with due consideration to the number of load vehicles and on timely and adequate response in case of an emergency.

8.3.2.5. If the *transport* cannot be completed in one day, prior arrangements should be made for overnight stay at a stopping place approved by the competent authority. During such overnight stays the load vehicle should be immobilized or parked in a locked and guarded building or compound.

8.3.2.6. There should be two-way communication between the load vehicle and the escort vehicle in addition to communication between these vehicles and the *transport control centre*.

G812. Radio communications should be established between the Category I load vehicle and the escort vehicle. Prudent practice would indicate that there should be at least two escort vehicles, one to provide close protection to the load vehicle and a second adopting a stand-off position, equipped to raise the alarm direct with the *transport control centre* in the event of an attack.

Shipment by rail

8.3.3.1. Shipment should be in a freight train in an exclusive use wagon.

8.3.3.2. Accompanying *guards* should travel in the carriage nearest to the shipment.

G813. In the case of rail movements, prudent practice would suggest that the escorts on the train are able to communicate with the train engineer in order to establish the reason for, and

anticipated duration of, unscheduled stops. If the use of trains for Category I *transports* is necessary, a dedicated freight train should be used; the use of passenger trains is not being encouraged because of the opportunities this would present to potential adversaries.

Shipment by sea

8.3.4.1. Shipment should be carried out by a dedicated *transport* ship.

8.3.4.2. The shipment should be placed in a secure compartment or container which is locked and sealed.

Shipment by air

8.3.5.1. Shipment should be by aircraft designated for cargo only and for which the nuclear material is its sole cargo.

REQUIREMENTS FOR CATEGORY II NUCLEAR MATERIAL

Advance notification to receiver

8.4.1.1. The shipper should give the receiver advance notification of the planned shipment specifying the mode of *transport* (road/rail/sea/air), estimated time of arrival of the shipment and the exact point of hand-over if this is to be done at some intermediate point before the ultimate destination.

Selection of mode of transport and routing

8.4.2.1. In choosing the route, consideration should be given to the security of passage, in particular, arranging the route in such a way as to avoid areas of natural disasters or civil disorders, and taking into consideration the capabilities of the *response force*. The *transport* method for any given consignment should be such as to keep to a minimum the number of cargo transfers and the length of time the cargo remains in *transport*. The co-operation of the carrier concerning the implementation of physical protection measures should be ensured in advance.

8.4.2.2. Competent authorities should approve the route, including alternate routing as appropriate, stopping places, destination hand-over arrangements, identification of persons authorized to take delivery, accident procedures, and reporting procedures, both routine and emergency.

Provision of locks and seals

8.4.3.1. Unless there are overriding safety considerations, the packages containing nuclear material should be carried inclosed, locked vehicles, compartments or freight containers. However, carriage of packages weighing more than 2000 kg that are locked or sealed shall be allowed in open vehicles. Subject to safety considerations, the package should be tied down or attached to the vehicle or freight container.

8.4.3.2. Checks should be made before dispatch to confirm the integrity of the locks and seals on the package, vehicle, compartment or freight container.

Search of load vehicle

8.4.4.1. There should be a detailed search of the load vehicle prior to loading and *transport* to ensure that *sabotage* devices have not been implanted or that *sabotage* has not been initiated.

Written instructions

8.4.5.1. Personnel with physical protection responsibilities should be given written instructions detailing their responsibilities during *transport* which have been approved by the competent authority.

Measures after shipment

8.4.6.1. The receiver should check the integrity of the packages, locks and seals and accept the shipment immediately upon arrival. The receiver should notify the shipper of the arrival of the shipment immediately or of non-arrival within a reasonable interval after the estimated time of arrival at its destination.

Communication

8.4.7.1. Physical protection measures should include provision of frequent communication between the vehicle and the shipper, receiver and/or shipper/receiver/State designee.

Arrangements for international transport

8.4.8.1. In contracts or agreements between shippers and receivers involving international *transport* of nuclear material, the point at which responsibility for physical protection is transferred from the shipper to the receiver should be clearly stated.

8.4.8.2. When the contract or agreement involving international *transport* provides for delivery to a destination in the receiving State in a vehicle of the shipping State, this contract or agreement should provide that information be supplied in time to enable the receiver to make adequate physical protection arrangements.

REQUIREMENTS FOR CATEGORY III NUCLEAR MATERIAL

Advance notification to receiver

8.5.1.1. The shipper should give the receiver advance notification of the planned shipment specifying the mode of *transport* (road/rail/sea/air), the estimated time of arrival of the shipment and the exact point of hand-over if this is to be done at some intermediate point before the ultimate destination.

Provision of locks and seals

8.5.2.1. Where practicable, locks and seals should be applied to vehicles or freight containers.

Search of load vehicle

8.5.3.1. There should be a detailed search of the load vehicle prior to loading and shipment, to ensure that *sabotage* devices have not been implanted or that *sabotage* has not been initiated.

Measures after shipment

8.5.4.1. The receiver should notify the shipper of the arrival of the shipment immediately or of non-arrival within a reasonable interval after the estimated time of arrival at the destination.

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