

THE PHYSICAL PROTECTION OF NUCLEAR MATERIAL

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PREFACE

Physical protection against the theft or unauthorized diversion of nuclear materials and against the sabotage of nuclear facilities by individuals or groups has long been a matter of national and international concern. Although responsibility for establishing and operating a comprehensive physical protection system for nuclear materials and facilities within a State rests entirely with the Government of that State, it is not a matter of indifference to other States whether and to what extent that responsibility is fulfilled. Physical protection has therefore become a matter of international concern and co-operation. The need for international co-operation becomes evident in situations where the effectiveness of physical protection in one State depends on the taking by other States also of adequate measures to deter or defeat hostile actions against nuclear facilities and materials, particularly when such materials are transported across national frontiers.

The IAEA recognized early on that it might be called upon to play a role in the area of the physical protection of nuclear materials and facilities. Its first effort resulted in the publication, in 1972, of "Recommendations for the Physical Protection of Nuclear Material", which was prepared by a panel of experts convened by the Director General. These recommendations were revised by a group of experts in co-operation with the IAEA Secretariat, and the revised version was published in 1975 in the INFCIRC series.¹ This was modified by an Advisory Group in 1977. The modified document² was favorably received by Member States and has since become a standard reference document. The document was later updated in 1989 and published as Revision 2.

The Convention on the Physical Protection of Nuclear Material³, which came into force on 8 February 1987, constitutes an important framework for international co-operation in the physical protection of "nuclear material used for peaceful purposes while in international nuclear transport". A Review Conference of the Physical Protection Convention was held in September 1992. The final statement of the Review Conference called on the IAEA to organize a meeting to examine INFCIRC/225/Rev.2, primarily to consider the need for consistency of the Categorization Table contained in that document with the Convention, and to consider the incorporation of further guidance on such issues as irradiated fuel, nuclear material contained in waste and other matters.

As a result of that recommendation, a Technical Committee met 21 - 25 June 1993⁴ to consider changes to INFCIRC/225/Rev.2. The revised document, INFCIRC/225/Rev.3, reflects the Technical Committee recommendations for changes to the text as well as other modifications determined necessary to advance the consistency of the Categorization Table in INFCIRC/225/Rev.2 with the categorization table contained in The Convention on the Physical Protection of Nuclear Material and to reflect additional improvements presented by the experts. The recommendations presented in this IAEA document reflect a broad consensus among Member States on the requirements which should be met by systems for the physical protection of nuclear materials and facilities. It is hoped that they will provide helpful guidance for Member States.

Hans Blix
Director General

¹ INFCIRC/225/(Corrected).

² INFCIRC/225/Rev.1.

³ INFCIRC/274/Rev.1.

⁴ Participants and observers from the following countries attended the meeting of the Technical Committee on Physical Protection of Nuclear Material in Vienna from 21 to 25 June 1993: Australia, Austria, Belgium, Canada, China, the Republic of Croatia, the Czech Republic, Denmark, the Federal Republic of Germany, France, Hungary, Italy, Japan, Luxembourg, Morocco, Netherlands, the Russian Federation, Spain, Sweden, Switzerland, the United Kingdom of Great Britain and Northern Ireland and the United States of America. An observer from the International Maritime Organization also attended.

CONTENTS

1. INTRODUCTION	1
2. OBJECTIVES	2
3. ELEMENTS OF A STATE'S SYSTEM OF PHYSICAL PROTECTION OF NUCLEAR MATERIAL AND NUCLEAR FACILITIES	2
3.1 General	
3.2 Regulations	
3.3 Implementation of the physical protection measures prescribed by the regulations	
3.4 Control of compliance with the prescribed physical protection measures	
3.5 Quality assurance in implementing physical protection	
3.6 State's contact points for physical protection matters	
4. ASSIGNMENT OF NUCLEAR ACTIVITIES TO PHYSICAL PROTECTION CATEGORIES	6
4.1 Basis for concern	
4.2 Categorization of nuclear material	
4.3 Potential for sabotage	
5. REQUIREMENTS FOR PHYSICAL PROTECTION OF NUCLEAR MATERIAL IN USE AND STORAGE AND OF NUCLEAR FACILITIES	10
5.1 General	
5.2 Requirements for Category I material in use and storage	
5.3 Requirements for Category II material in use and storage	
5.4 Requirements for Category III material in use and storage	
6. REQUIREMENTS FOR PHYSICAL PROTECTION OF NUCLEAR MATERIAL IN TRANSIT	17
6.1 General	
6.2 Requirements for Category I material in transit	
6.3 Requirements for Category I material related to the mode of transport	
6.4 Requirements for Category II material in transit	
6.5 Requirements for Category III material in transit	
7. DEFINITIONS	25

1. INTRODUCTION

1.1. Principles of physical protection are realized through administrative and technical measures. The measures for the physical protection of nuclear material in use, transit and storage 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 materials and nuclear facilities.

1.2 The State's physical protection system should be based on the State's assessment 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 facilities and shipments.

1.3 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, transit and storage and for nuclear facilities.

1.4 It is essential that the recommended measures be reviewed and updated from time to time 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 is expected to vary from these recommendations when prevailing circumstances indicate a need for a different level of physical protection.

1.5 In implementing these recommendations, States are encouraged to co-operate and consult, and to exchange information on physical protection techniques and practices, either directly or through international organizations.

1.6 The Convention on the Physical Protection of Nuclear Material (INFCIRC/274) 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
- extradite or prosecute those accused of committing such acts.

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

2. OBJECTIVES

2.1 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 or for *sabotage*¹, and
- (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 minimize the effects of *sabotage*².

2.2 The objective of the Agency are:

- (a) To provide a set of recommendations on requirements for the physical protection of nuclear material in use, transit and storage 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; and
- (b) To be in a position to give advice to State's 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 Agency.

It should be noted that the Agency 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 Agency will be provided only when so requested by the State.

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

3.1. GENERAL

3.1.1. A State's system of physical protection of nuclear material and nuclear facilities should include the elements described in Sections 3.2. - 3.6. below.

¹Terms in italics are defined in Section 7 below.

² See also 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).

3.1.2. An assessment by the State of the threat of unauthorized removal of nuclear material and of *sabotage* 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.

3.2 REGULATIONS

3.2.1. Responsibility, authority and sanctions

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

3.2.1.2. 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.

3.2.1.3 If the elements of the State's system of physical protection are divided between two or more authorities, arrangements should be made for overall co-ordination. A State can delegate the administration of physical protection measures either to a national body, or to duly authorized persons. It will be implicit in case of delegation that the State has satisfied itself that the physical protection arrangements conform to the requirements laid down by the State. The duly authorized persons should be fully responsible for the continuing confirmation of complete compliance with the physical protection measures.

3.2.1.4 In the case of international transfer of nuclear material the responsibility for physical protection measures should be the subject of agreement between the States concerned. The sending State should consider, before allowing the international transfer, if the States involved in the transfer, including the transit States:

- are Parties to the Convention on the Physical Protection of Nuclear Material (INFCIRC/274); 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 licenses which contain appropriate physical protection provisions for the transport of the nuclear material.

3.2.1.5 Sanctions to enforce standards of physical protection are not in themselves a necessary part of a State's physical protection system; they can, however, provide support to it. Sanctions against the unauthorized removal of nuclear material and against *sabotage* are important to an effective State system of physical protection.

3.2.2. Licensing

3.2.2.1. The State should license activities only when they comply with its physical protection regulations. It should be noted that other regulations such as those relating to radiological safety may also apply.

3.2.3. Categorization of nuclear material

3.2.3.1. The State should regulate the categorization of nuclear material in order to ensure an appropriate relationship between the material concerned and the protective measures. This categorization should be based on the potential hazard of the material, which itself depends on: the type of material, i.e. plutonium, uranium, thorium; isotopic composition, i.e. content of fissile isotopes; physical and chemical form; degree of dilution; radiation level; and quantity. For example, nuclear material with a radiation level that exceeds 1 Gy/hr (100 rads/hr) at one meter unshielded may be protected in accordance with the requirements of a lower category than that determined by the fissile content of the material. Additionally, 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.

3.2.4. Physical protection requirements for nuclear material in use, transit and storage

3.2.4.1. The State should define requirements for the physical protection of nuclear material in use, transit and storage. They should take into account the category of nuclear material, its location (use, transit, storage) and the particular circumstances prevailing either in the State or along the transportation route. When considering the measures required for the physical protection of irradiated fuel against unauthorized removal or sabotage, the State should take into account the attractiveness and self-protecting nature of the material and the containment measures used for safety reasons.

3.2.5. Physical protection requirements for nuclear facilities

3.2.5.1. 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.

3.2.5.2. 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.

3.2.5.3. Several types of nuclear facilities pose a hazard to the environment in case of *sabotage* because of the potential for release of radioactivity. The categorization of nuclear material may not reflect this hazard in an adequate way. Therefore, it is important that the protection of the facility take also this hazard into consideration.

3.2.6. System of information

3.2.6.1. The State's system of physical protection should include an information system which enables the State to be informed of any change at nuclear sites or transportation of nuclear material which may affect implementation of physical protection measures.

3.2.6.2. In addition, the State's physical protection system should have access to information from the State's system of accounting for and control of nuclear material.

3.2.7. Protection of detailed physical protection information

3.2.7.1. The State should take steps to ensure appropriate protection of specific or detailed information concerning the physical protection of nuclear materials in use, storage, or transport, and or nuclear facilities at which there is a potential for *sabotage*.

3.3. IMPLEMENTATION OF THE PHYSICAL PROTECTION MEASURES PRESCRIBED BY THE REGULATIONS

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

3.4. CONTROL OF COMPLIANCE WITH THE PRESCRIBED PHYSICAL PROTECTION MEASURES

3.4.1. The State's system of physical protection should make provisions for periodic review of the licensed activities, and whenever a significant change takes place, to ensure continuous compliance with physical protection regulations.

3.5. QUALITY ASSURANCE IN IMPLEMENTING PHYSICAL PROTECTION

3.5.1. To ensure that physical protection measures are maintained in a condition capable of effectively responding to potential threats, the State physical protection authority should ensure that quality assurance programmes are implemented at facilities and for transportation. Such programmes should include periodic testing of detection, *alarm* and communications systems and periodic audits of security procedure implementation. Such programmes should also include exercises to test the training and readiness of *escorts*, *guards* and *off-site response forces*.

3.6. STATE'S CONTACT POINTS FOR PHYSICAL PROTECTION MATTERS

3.6.1. States should inform each other, either directly or through the Agency, of appropriate points of contact for matters related to the physical protection of nuclear materials and facilities.

4. ASSIGNMENT OF NUCLEAR ACTIVITIES TO PHYSICAL PROTECTION CATEGORIES

4.1. BASIS FOR CONCERN

4.1.1. The possibility exists that the theft of plutonium, highly enriched uranium or uranium-233 could lead to the construction of a nuclear explosive device by a technically competent group. The theft of these materials could lead to their use as radiological contaminants. An act of *sabotage* against a nuclear facility or against a shipment of nuclear material could create a radiological hazard to the public.

4.2. CATEGORIZATION OF NUCLEAR MATERIAL

4.2.1. 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 considerations given in Section 3.2.3.1 above.

4.2.2. In determining the levels of physical protection in a facility, which may consist of several buildings, it is possible that the State's physical protection 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.

4.2.3. The following table gives a categorization of the different types of nuclear material taking into account the above considerations. This categorization has been used throughout this document.

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 rads/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 rads/hr) at one meter unshielded.

4.3. POTENTIAL FOR SABOTAGE

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

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

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

4.3.1.3. At reprocessing plants, a potential for *sabotage* exists because of the inventory of irradiated fuel, separated plutonium, and other radioactive material and the potential for release.

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

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

4.3.1.6. For nuclear material in transit, a potential for *sabotage* exists if the load contains plutonium and/or other radioactive material.

4.3.2. Radiological hazards are strongly dependent on the threat to be considered, on the design of the facility or package and on its safety features. Consequently, a plant-specific or package design assessment of the potential for *sabotage* and associated radiological consequences should be made in close consultation between safety and physical protection specialists.

4.3.3. The State's competent authority should determine if there is a credible threat to disperse plutonium malevolently. The State should then apply physical protection requirements for Category I, II or III nuclear material, as it deems appropriate and without regard to the plutonium quantity specified under each category, to the plutonium isotopes in those quantities and forms determined by the State to fall within the scope of the credible dispersal threat.

5. REQUIREMENTS FOR PHYSICAL PROTECTION OF NUCLEAR MATERIAL IN USE AND STORAGE AND OF NUCLEAR FACILITIES

5.1. GENERAL

5.1.1 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 physical protection system is designed specifically for each facility after taking into account the geographical location and the State's assessment of the threat. Emergency procedures should be prepared to handle effectively any possible threat.

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

- (a) Limiting access to nuclear material or facilities to a minimum number of individuals. To accomplish this aim the State's physical protection authority can designate *protected areas*, *inner areas* and *vital areas*. In designating such areas, consideration should be given to the plant safety design, the location of the plant and the threat circumstances. Access to these areas should be limited and controlled; and
- (b) Requiring predetermination of the trustworthiness of all individuals regularly permitted access to nuclear material or facilities.

5.1.3. Some types of nuclear facilities may pose a hazard to the public and to the environment because of the potential for *sabotage*. Safety specialists should evaluate the consequences of malevolent acts, considered in the context of the State's threat assessment, to identify equipment, systems or devices the failure of which could directly or indirectly endanger the public health and safety by exposure to radiation. Equipment, systems or devices identified as vital should be protected by designation of *vital areas*. It is important that physical protection issues are considered early in the design of the nuclear facility. Close co-operation between physical protection and nuclear safety specialists is important to ensure that the physical protection system takes into account measures that have been designed into the facility for safety purposes. Physical protection measures should not jeopardize nuclear safety during emergency conditions.

5.2. REQUIREMENTS FOR CATEGORY I MATERIAL IN USE AND STORAGE

5.2.1. Category I material should be used or stored only within an *inner area* or *inner areas*.

5.2.2. All persons entering the *protected area* should be issued either with special passes or with badges, appropriately registered, and access to the *protected area* should be kept to the minimum necessary.

5.2.3. Access to *inner areas* should be limited to persons whose trustworthiness has been predetermined and to persons in their *escort*. Access to *inner areas* should be kept to the minimum necessary.

5.2.4. Badging of persons entering *protected* or *inner areas* should follow the general outline below:

Type I: Employees whose duties permit or require continual access to *inner areas*.

Type II: Other employees who are permitted access to the *protected area*.

Type III: Temporary repair, service or construction workmen should be escorted by a Type I badged employee at all times when they may have access to *inner areas*, and by a Type II badged employee when they have access to *protected areas*.

Type IV: Visitors should be escorted by a Type II badged employee at all times in the *protected area*, and by a Type I badged employee when they have access to the *inner areas*.

Visitor-escort ratios should be limited. Passes and badges should be designed so as to make counterfeiting extremely difficult.

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

5.2.6. Entry of private motor vehicles into *protected areas* should be minimized and limited to authorized parking areas. Private motor vehicles should be prohibited access to *inner areas*.

5.2.7. 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).

5.2.8. All employees should be frequently (about annually) informed of the importance of effective physical protection measures and be trained in their implementation. Notices on the subject should be conspicuously posted throughout the facility.

5.2.9. 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 endeavor 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 the a discrepancy exists.

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

Locks should be changed if compromised.

5.2.11. 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 in transit, after taking account of prevailing conditions.

5.2.12. The perimeter of the *protected area* should normally consist of a *physical barrier* in addition to and outside of the building walls. However, where the walls of a building are of such solid construction as to be designated, as a result of a *security survey*, as being the perimeter of a *protected area*, a supplementary *surveillance* system should be provided outside the building walls. Clear areas should be provided at the perimeter of the *protected area* with illumination sufficient for observation. Intrusion detection and assessment should be performed at the *protected area* perimeter.

5.2.13. *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 *alarms*. All external windows should be permanently locked, alarmed and covered with firmly embedded bars. *Inner areas* should not be sited close to public thoroughfares.

5.2.14. Storage areas should be of the "strong room" type in design and should be located within an *inner area*. They should be provided with *alarms* and adequate locks and the issue of keys or key-cards should be closely controlled. Access to storage should be strictly limited to assigned persons and to others only when under their *escort*. Where nuclear material is stored overnight in work areas, or in sub-storage structure within a

work area, specially authorized procedures should be used to protect the area. *Alarms, patrols* or TV monitors can satisfy this requirement.

5.2.15. A 24-hour guarding service should be provided. The *guard* should report at scheduled intervals to local police or other public security forces during non-working hours. States are encouraged to use armed *guards* to the extent that laws and regulations permit. If *guards* are not armed, compensating measures should be applied. The objective should be the arrival of adequately armed response forces rapidly enough to counter armed attacks and prevent the unauthorized removal of nuclear material or *sabotage*.

5.2.16. An external and an internal *patrol* should be provided.

5.2.17. Independent, duplicated transmission systems for two-way voice communication should be provided for activities involving detection, assessment and response. This should include links between *guards*, their headquarters and response forces.

5.2.18. Independent, duplicated transmission systems, including independent power supplies, should be provided between the sensors and display areas (audible and/or visual) of *alarms*.

5.2.19. Emergency plans of action should be prepared to counter effectively any possible threats, including attempted unauthorized removal of nuclear material or *sabotage*. Such plans should provide for the training of facility personnel in their actions in case of *alarm* or emergency. In addition, personnel trained in the facility should be prepared to meet all necessary demands of physical protection and recovery of nuclear material and should act in full co-ordination with response forces and safety response teams, who should also be appropriately trained.

5.2.20. Arrangements should be made to ensure that during emergency evacuation conditions (including drills) nuclear material is not removed in an unauthorized manner. Such unauthorized removal can be prevented by, for example, keeping persons under continuous *surveillance* and searching them. Instruments for the detection of nuclear material and metals can be used for such searches.

5.2.21. A *security survey* should be made at least annually (or whenever a significant change in the facility, or its function, takes place) by the State's designated physical protection authority to evaluate the effectiveness of the physical protection measures, and to identify necessary changes in measures so as to optimize their effectiveness in particular situations at the facility. Furthermore, plant operators should maintain checks on the efficient functioning of physical protection measures.

5.3. REQUIREMENTS FOR CATEGORY II MATERIAL IN USE AND STORAGE

5.3.1. Category II material should be used, or stored, within a *protected area* or *protected areas*.

5.3.2. All persons entering the *protected area* should be issued either with special passes or with badges, appropriately registered, and access to the *protected area* should be kept to the minimum necessary.

5.3.3. Access to the *protected area* should be limited to persons whose trustworthiness has been predetermined and to persons in their *escort*.

5.3.4. Badging should follow the general outline below:

Type I: Employees whose duties permit continual access to the *protected area*.

Type II: Temporary repair, service or construction workmen and visitors: these should be escorted by a Type I badged employee at all times when they may have access to the *protected area* (except where their trustworthiness has been predetermined).

Visitor-escort ratios should be limited. Passes and badges should be designed so as to make counterfeiting extremely difficult.

5.3.5. From time to time persons and packages entering or leaving the *protected area* should be searched.

5.3.6. Vehicles and all large objects entering the *protected area* should be checked to ensure that no unauthorized persons and articles of *sabotage* are introduced.

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

5.3.8. All employees should be frequently (about annually) informed of the importance of effective physical protection measures and be trained in their implementation. Notices on the subject should be conspicuously posted throughout the facility.

5.3.9. 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 endeavor 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.

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

Locks should be changed if compromised.

5.3.11. 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 in transit, after taking account of prevailing conditions.

5.3.12. The perimeter of the *protected area* should normally consist of a *physical barrier* in addition to and outside of the building walls. However, where the walls of a building are of such solid construction as to be designated, as a result of a *security survey*, as being the perimeter of a *protected area*, a supplementary *surveillance* system should be provided outside the building walls. Clear areas should be provided at the perimeter of the *protected area* with illumination sufficient for observation. Intrusion detection and assessment should be performed at the *protected area* perimeter.

5.3.13. Emergency plans of action should be prepared to counter effectively any possible threats, including attempted unauthorized removal of nuclear material or *sabotage*. Such plans should provide for the training of facility personnel in their actions in case of *alarm* or emergency. They should also provide for appropriate response by *guards* or off-site response forces to attempted intrusion into the *protected area*. In addition, personnel trained in the facility should be prepared to meet all necessary demands of physical protection and recovery of nuclear material and should act in full co-ordination with external response forces and safety response teams, who should also be appropriately trained.

5.3.14. Arrangements should be made to ensure that during emergency evacuation conditions (including drills) nuclear material is not removed in an unauthorized manner. Such unauthorized removal may be prevented by, for example, keeping persons under continuous *surveillance* and searching them. Instruments for the detection of nuclear material and metals can be used for such searches.

5.3.15. A *security survey* should be made at least annually (or whenever a significant change in the facility or its function takes place) by the State's designated physical protection authority to evaluate the effectiveness of the physical protection measures, and to identify necessary changes in measures so as to optimize their effectiveness in particular situations at the facility. Furthermore, plant operators should maintain checks on the efficient functioning of the physical protection measures.

5.4 REQUIREMENTS FOR CATEGORY III MATERIAL IN USE AND STORAGE

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

5.4.2. All employees should be frequently (about annually) informed of the importance of effective physical protection measures and be trained in their implementation. Notices on the subject should be conspicuously posted throughout the facility.

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

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

5.4.5. Emergency plans of action should be prepared to counter effectively any possible threats, including attempted unauthorized removal of nuclear material or *sabotage*. Such plans should provide for the training of facility personnel in their actions in case of *alarm* or emergency. They should also provide for appropriate response by *guards* or off-site response forces to attempted intrusion.

5.4.6. A *security survey* should be made initially and whenever a significant change in the facility or its function takes place by the State's designated physical protection authority to evaluate the effectiveness of the physical protection measures, and to identify necessary changes in measures so as to optimize their effectiveness in particular situations at the facility. Furthermore, plant operators should maintain checks on the efficient functioning of the physical protection measures.

6. REQUIREMENTS FOR PHYSICAL PROTECTION OF NUCLEAR MATERIAL IN TRANSIT

6.1. GENERAL

6.1.1. The transport of nuclear material is probably the operation most vulnerable to an attempted act of unauthorized removal of nuclear material or *sabotage*. Therefore it is important that the protection provided should be "in depth" and that particular attention should be given to the recovery system. Emergency procedures should be prepared to handle effectively any possible threat.

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

- (a) Minimizing the total time during which the nuclear material remains in transit;
- (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 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 in transport of nuclear material; and
- (f) Limiting advance knowledge of transport information to the minimum number of persons necessary.

6.1.3. 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 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 shipments of nuclear material. When a message is required by safeguards or radiological safety regulations, consideration should be given to measures such as coding and appropriate routing to the extent practicable; care should be exercised in the handling of such information. These considerations should apply also to any subsequent communications.

6.2. REQUIREMENTS FOR CATEGORY I MATERIAL IN TRANSIT

6.2.1. Advance notification to receiver

6.2.1.1. 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.

6.2.1.2. 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.

6.2.2. Advance authorization

6.2.2.1. In cases where physical protection is adequately covered by regulations, advance authorization for routine shipments is not required.

6.2.2.2 In all cases not covered by existing regulations, or going beyond limits specified in such regulations, the consent of a state control authority to a transport operation should be sought in advance. 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.

6.2.3. Selection of transportation and routing

6.2.3.1. 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. 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 transit. The co-operation of the carrier concerning the implementation of physical protection measures should be ensured in advance.

6.2.3.2. Before shipment 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.

6.2.4. Provision of locks and seals

6.2.4.1. 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.

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

6.2.5. Search of load vehicle

6.2.5.1. 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.

6.2.6. Written instructions

6.2.6.1. Transport authorities with physical protection responsibilities in transit should be given written instructions detailing their responsibilities and should be provided with a standard form of written authority.

6.2.6.2. Transport authorities should be consulted on the route, approved stopping places, destination hand-over arrangements, identification of persons authorized to take delivery, accident procedures, and reporting procedures, both routine and emergency.

6.2.7. Measures after shipment

6.2.7.1. The receiver should check the integrity of the packages, locks and seals and accept the shipment immediately upon arrival. He 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 *escort* or *guard* should be instructed to report by radio or telephone to the shipper or shipper/receiver designee his arrival at his destination and each overnight stopping place and place of hand-over of the shipment.

6.2.8. Communication

6.2.8.1. Domestic physical protection measures should include provision of continuous two-way radio communication or frequent telephone communication between the vehicle and the shipper, receiver and/or shipper/receiver/State designee.

6.2.9. *Escorts or guards*

6.2.9.1. *Escorts or guards* should accompany each shipment to protect the material against hostile acts. The *escorts* or *guards* should ensure continuous *surveillance* in the case of road transport. If the packages, vehicle, cargo hold or compartment are locked and sealed, frequent and periodic examination of seals together with continuous *surveillance* of the cargo hold when the vehicle is not in motion should be allowed in place of package *surveillance*. States are encouraged to use armed *escorts* or *guards* to the extent that laws and regulations permit. When armed *escorts* or *guards* are not used, compensating measures should be applied.

6.2.10. Emergency action

6.2.10.1. Arrangements should be made to provide an adequately sized and trained team to deal with domestic emergencies. The response forces should reach the scene of an incident in transit while the act of unauthorized removal of nuclear material or *sabotage* is in process so that they can prevent its successful completion. The objective should be the arrival of the armed response force rapidly enough to prevent the unauthorized removal of nuclear material or *sabotage* and to counter an armed attack.

6.2.11. Advance agreement on responsibilities for international shipments

6.2.11.1 In the case of transit between two States sharing a common frontier, 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 the 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 frontier and will then be transferred to the receiving State.

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

6.2.11.3. States should aid each other in physical protection, and particularly in the recovery of nuclear material, in cases where such aid is needed.

6.2.11.4. In the case of an 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.

6.2.12. Arrangements for international transit

6.2.12.1. In addition to the international agreements mentioned above, in contracts or agreements between shippers and receivers involving international transit of material, the point at which responsibility for physical protection is transferred from the shipper to the receiver should be clearly stated.

6.2.12.2. When the contract or agreement involving international transit 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.

6.2.12.3 The use of coded information on the exact dates and places of shipments should be considered between the involved States and international organizations.

6.3. REQUIREMENTS FOR CATEGORY I MATERIAL RELATED TO THE MODE OF TRANSPORT

6.3.1. General

6.3.1.1. 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.

6.3.2. Shipment by road

6.3.2.1. The load vehicle should preferably be specially designed to resist attack, prevent unauthorized removal of the nuclear material, and also preferably be equipped with a vehicle disabling system.

6.3.2.2. A single designated vehicle should be used exclusively for each consignment (i.e. full load concept). The load vehicle should carry a second man to act as *escort* or *guard* for that vehicle.

6.3.2.3. The load vehicle should be accompanied by a vehicle manned by one or more *guards*.

6.3.2.4. The *guards* should maintain continuous *surveillance* and check the seals and locks at each stop.

6.3.2.5. If the journey cannot be completed in one day, prior arrangements should be made for overnight stay at an approved stopping place. During such overnight stays the load vehicle should be immobilized or parked in a locked and guarded building or compound.

6.3.2.6. There should be two-way radio communication between the load vehicle and the *escort* vehicle in addition to communication between these vehicles and the shipper, receiver and/or shipper/receiver/State designee.

6.3.2.7. Alternative routing should be planned in advance, so that any decision to change routes can be implemented at short notice.

6.3.3. Shipment by rail

6.3.3.1. Shipment should be in a goods train or in a separate wagon attached to a passenger train.

6.3.3.2. Shipment should be accompanied by one or more *escorts* or *guards*, who should travel in the carriage nearest to the shipment wagon and keep it under *surveillance* and check locks and seals at stopping places. The *escort* or *guard* should maintain communication by two-way radio or by telephone at scheduled stopping places.

6.3.4. Shipment by sea

6.3.4.1. Each shipment should be accompanied by one or more *escorts* or *guards*.

6.3.4.2. The shipment should be placed in a secure compartment or container which is locked and sealed. Locks and seals should be periodically inspected in transit.

6.3.5. Shipment by air

6.3.5.1. Shipment should be by designated charter cargo aircraft or designated scheduled cargo aircraft and should be accompanied by one or more *escorts* or *guards*.

6.4. REQUIREMENTS FOR CATEGORY II MATERIAL IN TRANSIT

6.4.1. Advance notification to receiver

6.4.1.1. 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.

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

6.4.2. Selection of transportation and routing

6.4.2.1. 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. 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 transit. The co-operation of the carrier concerning the implementation of physical protection measures should be ensured in advance.

6.4.3. Provision of locks and seals

6.4.3.1. Unless there are overriding safety considerations, the packages containing 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 shall be allowed in open vehicles. Subject to safety considerations, the package should be tied down or attached to the vehicle or freight container.

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

6.4.4. Search of load vehicle

6.4.4.1. 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.

6.4.5. Written instructions

6.4.5.1. Transport authorities with physical protection responsibilities in transit should be given written instructions detailing their responsibilities and should be provided with a standard form of written authority.

6.4.5.2. Transport authorities should be consulted on the route, approved stopping places, destination hand-over arrangements, identification of persons authorized to take delivery, accident procedures, and reporting procedures, both routine and emergency.

6.4.6. Measures after shipment

6.4.6.1. The receiver should check the integrity of the packages, locks and seals and accept the shipment immediately upon arrival. He 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.

6.4.7. Communication

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

6.4.8. Advance agreement on responsibilities for international shipments

6.4.8.1. In the case of transit between two States sharing a common frontier, 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 the 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 frontier and will then be transferred to the receiving State.

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

6.4.8.3. States should aid each other in physical protection, and particularly in the recovery of nuclear material, in cases where such aid is needed.

6.4.9. Arrangements for international transit

6.4.9.1. In addition to the international agreement mentioned above, in contracts or agreements between shippers and receivers involving international transit of material, the point at which responsibility for physical protection is transferred from the shipper to the receiver should be clearly stated.

6.4.9.2. When the contract or agreement involving international transit 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.

6.5. REQUIREMENTS FOR CATEGORY III MATERIAL IN TRANSIT

6.5.1. Advance notification to receiver

6.5.1.1. 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.

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

6.5.2. Provision of locks and seals

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

6.5.3. Search of load vehicle

6.5.3.1. 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.

6.5.4. Measures after shipment

6.5.4.1. 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.

6.5.5. Advance agreement on responsibilities for international shipments

6.5.5.1. In the case of transit between two States sharing a common frontier, 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 the 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 frontier and will then be transferred to the receiving State.

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

6.5.5.3. States should aid each other in physical protection and in particular in the recovery of nuclear material in cases where such aid were needed.

7. DEFINITIONS

7.1. ALARM: A technical device for the purpose of sensing intrusion or interference. Such a device should be independent of any power supply failure. It should signal any interference with its function.

7.2. ESCORT OR GUARD: A person for whom a prior trustworthiness determination has been made entrusted with *surveillance* or access control. His duties should be specified by the *security survey*.

7.3. INNER AREA: An area inside a *protected area* in which Category I nuclear material is used or stored.

7.4. PATROL: A person or persons (who may be *guards*) scheduled to inspect barriers, seals or other features at regular or irregular intervals.

7.5. PHYSICAL BARRIER: A fence or wall or a similar impediment approved by a *security survey*.

- 7.6. PROTECTED AREA:** An area under constant *surveillance* (by a *guard* or by electronic means) surrounded by a *physical barrier* and having a limited number of controlled admittance points and approved by a *security survey*. Where the wall(s) of a building serves as part (or all) of the perimeter of a *protected area*, all emergency exits on the perimeter wall should be alarmed. All perimeter wall windows should be permanently locked, alarmed and covered with firmly embedded bars.
- 7.7. SABOTAGE:** Any deliberate act directed against a plant, facility, nuclear material transport vehicle or nuclear material which could directly or indirectly endanger the public health and safety by exposure to radiation.
- 7.8. SECURITY SURVEY:** A critical examination made by competent officers, in order to evaluate, approve and specify physical protection measures.
- 7.9. SURVEILLANCE:** Close *surveillance* to be achieved by observers, and/or photo electric, closed-circuit television, sonic detectors, electronic, photographic or other means.
- 7.10. VITAL AREA:** An area containing equipment, systems or devices which are, alone or in combination, determined vulnerable to *sabotage*.