

THE PHYSICAL PROTECTION OF NUCLEAR MATERIAL

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In June 1972 a booklet entitled "Recommendations for the Physical Protection of Nuclear Material" was prepared; it was based on work done by a panel of experts convened by the Director General earlier that year. Early in 1975 these recommendations were reviewed by a group of experts¹, for the purpose of bringing them up to date by reflecting in them the progress in physical protection which has been made in the meantime and by taking into account additional problems created by the increasing use of nuclear energy for peaceful purposes.

The revised recommendations now brought to the attention of all Member States in the present booklet reflect an attempt to consolidate and reconcile the contributions made by the group of experts, comments made by some governmental organizations and the views of the Secretariat.

¹ The composition of the group is given in the Annex.

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1. INTRODUCTION

1.1. The measures for the physical protection of nuclear material in use, transit and storage presented herein are recommended for use by States as required in their physical protection systems.

1.2. The State's physical protection system should take into account the existing and relevant measures of the State's system of accounting for and control of nuclear material². The recommended physical protection measures are intended for all nuclear facilities and shipments. It is recognized, however, that research type facilities outside the nuclear fuel cycle and corresponding shipments may not be able to meet the recommendations. In such cases the State's physical protection system may make specific exceptions on a case-by-case basis.

1.3. It is intended to formulate further recommendations in respect of radioactive material not covered by these recommendations (i.e. material used in educational, medical and other industrial operations).

1.4. 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.

1.5. The recommended measures are based on the current state of the art in physical protection hardware and systems and on current types of nuclear facilities. It is essential that they be reviewed and updated from time to time to reflect advances made in the state of the art or introduction of new types of facilities. Further, the design of a physical protection system for a specific facility is expected to go beyond these recommendations when the particular threat to the environment dictates a need to ensure a greater degree of protection than they provide for.

² See The Structure and Content of Agreements between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons, para.7 (INFCIRC/153 (Corrected)).

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*³, 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.

2.2 The objectives 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. 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 a 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. The Agency may informally advise the State on results of observations made during its normal safeguards activities⁴. Further assistance by the Agency will be provided only when so requested by the State.

³ Terms in italics are defined in Section 7 below.

⁴ Document INFCIRC/153, para.68 provides that a State shall make special reports to the Agency without delay in the case of possible loss of nuclear material within the State. Similarly para.97 provides for reporting to the Agency in case of possible loss of nuclear material during international transfers. Corresponding provisions are included in safeguards agreements between the Agency and States which are not based upon this document (see document INFCIRC/66/Rev.2, para.42).

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

3.1. GENERAL

3.1.1. A State's system of physical protection of nuclear material should include the elements described in Sections 3.2.—3.4. below.

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 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.

3.2.1.5. Sanctions are not in themselves a necessary part of a State's physical protection system; they can, however, provide support to it.

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; radiation level; and quantity.

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

3.2.4.1. The regulations 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.

3.2.5. System of information

3.2.5.1. 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.

3.2.5.2. 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.

**3.3. 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.

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 plutonium or other radioactive materials could also lead to the use of these materials as radiological contaminants. Finally, one or more individuals could carry out an act of *sabotage* against a facility involved in the nuclear fuel cycle or against a shipment of nuclear material in such a manner as to create a radiological hazard to the public. None of these possibilities can, however, be quantitatively assessed.

4.2. ATTRACTIVENESS OF NUCLEAR MATERIAL FOR UNAUTHORIZED REMOVAL AND OF FACILITIES FOR *SABOTAGE*

4.2.1. There are several kinds of facilities to be examined. Fuel fabrication facilities, reactors, and fuel reprocessing facilities, as examples, are discussed below.

4.2.2. Fuel fabrication facilities, to the extent that they process low-enriched fuel elements, do not contain nuclear material of great attractiveness to a potential thief. Such material cannot be used to fabricate a nuclear explosive device nor can it be used effectively as a medium of dispersing radioactivity. Additionally, *sabotage* to such facilities does not have the potential of creating a serious radiological hazard to the public. However, when such facilities use highly enriched uranium for fabricating fuel elements, the material becomes highly attractive to a potential thief as the basis for fabrication of a nuclear explosive device. When the facility processes plutonium fuel, the material is very attractive to a potential thief both for fabricating a nuclear explosive device and also for making a radiological dispersal device. Additionally, *sabotage* of a facility having plutonium material in process does have a potential for serious radiological hazard to the public.

4.2.3. At power reactors using natural or low-enriched uranium fuel only, the principal attractiveness relates only to possible *sabotage*, which could prove a radiological hazard to the public.

4.2.4. At power reactors using plutonium or highly enriched uranium fuel, the fuel material is attractive to a potential thief only before it is sealed in the reactors.

4.2.5. In reprocessing facilities the product end of the operation contains those materials which are particularly attractive to a potential thief. The entire facility is an attractive target to a saboteur.

4.3. CATEGORIZATION OF NUCLEAR MATERIAL FOR PROTECTIVE PURPOSES

4.3.1. The mechanism for determining the physical protection measures necessary for different types of facilities in the nuclear fuel cycle uses the nuclear material itself as the basis of the control. The nuclear material should be categorized in accordance with the indications given in Section 3.2.3.1. above in order to determine the physical protection category in a facility, which may consist of several buildings. It is possible that the State's physical protection authority may identify a single building which is part of the facility and which serves, e.g., as a laboratory, in a lower category than the remaining buildings in the facility.

4.3.2. The State's physical protection authority should assess the threat situation in the State and take account of the location and safety design of the facility for which categorization would be made and for which a physical protection system would be developed.

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

CATEGORIZATION OF NUCLEAR MATERIAL

Material	Form	Category		
		I	II	III
1. Plutonium	Unirradiated			
	– not easily dispersible	2 kg or more	Less than 2 kg but more than 500 g	500 g or less ^c
	– easily dispersible	2 kg or more	Less than 2 kg but more than 10 g	10 g or less ^c
2. Uranium-235	Unirradiated, any chemical form			
	– uranium enriched to 20% ²³⁵ U or more	5 kg or more	Less than 5 kg but more than 1 kg	1 kg or less ^c
	– uranium enriched to 10% ²³⁵ U but less than 20%	--	10 kg or more	Less than 10 kg ^c
	– uranium enriched above natural, but less than 10% ²³⁵ U ^a	–	–	10 kg or more
3. Uranium -233	Unirradiated, any chemical form	2 kg or more	Less than 2 kg but more than 500 g	500 g or less ^c
4. Irradiated fuel		Reprocessing plant	Reactor site ^b	
		Storage facilities separated from reactor sites	In transit	

^a Natural uranium, depleted uranium and thorium and quantities of uranium enriched to less than 10% not falling in Category III should be protected in accordance with prudent management practice.

^b Although the recommendations of the group of experts are for this level of protection, it would be open to States, upon evaluation of reactor characteristics, to assign a different degree of physical protection.

^c Less than a radiologically significant quantity should be exempted.

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

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.

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 special areas as vital areas. A vital area is an area of a plant or a facility which is potentially vulnerable to *sabotage* with consequences of radiation exposure to the public. In designating such areas, consideration should be given to the plant safety design, the location of the plant and the *sabotage* threat circumstances. Access to vital areas should be limited and controlled; and
- (b) Requiring predetermination of the trustworthiness of all individuals regularly permitted access to nuclear material or facilities.

5.2. REQUIREMENTS FOR CATEGORY I MATERIAL IN USE AND STORAGE

5.2.1. Category I material should be used or stored within an inner area which is within a *protected area*.

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 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 from 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 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.

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 when 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.

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 a 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. If *guards* are not armed appropriate arrangements should be made by the State for adequately armed external emergency teams to arrive rapidly enough to counter armed attack.

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 reserve 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 external emergency teams 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 the 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*.

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 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.

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 when 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.

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 emergency teams 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 emergency teams 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 emergency teams 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 emergency teams 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.

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) Avoiding the use of regular movement schedules; and
- (d) Requiring predetermination of the trustworthiness of all individuals involved in transport of nuclear material.

6.1.3. Transit operations should not be advertised if this could lead to a decrease in the degree of physical protection. This requires great restraint in the use of any special marking 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 handover 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, of going beyond limits specified in such regulations, the consent of a national 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 despatch 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 designee.

6.2.9. Emergency action

6.2.9.1. Arrangements should be made to provide an adequately sized and trained team to deal with domestic emergencies. The emergency teams should reach the scene of an incident in transit either while the act of unauthorized removal of nuclear material or *sabotage* is in process so that they can prevent its successful completion, or immediately after its completion, when the possibility of recovery is most favourable. The emergency teams should be sited at strategic locations within the State.

6.2.10. Escorts or guards

6.2.10.1. *Escorts* or *guards* should accompany each shipment to give the alarm, to expedite handling at transfer points and to help avoid misrouting. 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*.

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 consider the possibility of establishing a convention whereby they would aid each other in physical protection and in particular in the recovery of nuclear material in cases where such aid were needed.

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.

6.3. 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 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 check the seals and locks at each stop and maintain continuous *surveillance* during refreshment stops and the like.

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 or shipper/receiver 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. 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 telephone communication between the vehicle and the shipper, receiver and/or shipper/receiver 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 consider the possibility of establishing a convention whereby they would aid each other in physical protection and in particular in the recovery of nuclear material in cases where such aid were needed.

6.4.9. Arrangements for international transit

6.4.9.1. 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.

6.4.9.2. 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 consider the possibility of establishing a convention whereby they would 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 be arranged to 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. **PATROL:** A person or persons (who may be *guards*) scheduled to inspect barriers, seals or other features at regular or irregular intervals.

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

7.5. **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.

7.6. **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.

7.7. **SECURITY SURVEY:** A critical examination made by competent officers, in order to evaluate, approve and specify physical protection measures.

7.8. **SURVEILLANCE:** Close *surveillance* to be achieved by observers, and/or photo electric, closed-circuit television, sonic detectors, electronic, photographic or other means.

ANNEX

COMPOSITION OF A GROUP OF EXPERTS TO REVIEW RECOMMENDATIONS FOR THE PHYSICAL PROTECTION OF NUCLEAR MATERIAL (APRIL 1975)

Mr. M. Arai	Japan
Mr. L. Brenner	United States of America
Mr. A. Burtscher	Austria
Mr. C.R. Cullington	European Atomic Energy Community
Mr. M. Desneiges	France
Mr. P. Ek	Sweden
Mr. L. Flyghed	Sweden
Mr. I. Fukuoka	Japan
Mr. D. Gledhill	United Kingdom of Great Britain and Northern Ireland
Mr. A. Hagen	Federal Republic of Germany
Mr. R.J.S. Harry	Netherlands
Mr. J. Heil	Federal Republic of Germany
Mr. P.I.M. Irwin	United Kingdom of Great Britain and Northern Ireland
Mr. A. Ishizuka	Japan
Mr. D. Jenkins	United States of America
Mr. F. Martin	United States of America
Mr. A. Op den Kamp	Netherlands
Mr. R. Page	United States of America
Mr. A. Ross (Chairman)	United Kingdom of Great Britain and Northern Ireland
Mr. A. Rumyantsev	Union of Soviet Socialist Republics
Mr. R.L. Rutter	United Kingdom of Great Britain and Northern Ireland
Mr. F. Schmidt	Austria
Mr. D. Sellinschegg	Federal Republic of Germany
Mr. D. Sinden	Canada
Mr. H. Stute	Federal Republic of Germany
Mr. D. Tolchenkov	Union of Soviet Socialist Republics
Mr. R. Venchiarutti	Italy