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Response to events involving the inadvertent movement or illicit trafficking of radioactive materials

Jointly sponsored by IAEA, WCO, EUROPOL and INTERPOL

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Radiation Safety Section
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P.O. Box 100
A-1400 Vienna, Austria

RESPONSE TO EVENTS INVOLVING THE INADVERTENT MOVEMENT OR ILLICIT TRAFFICKING OF RADIOACTIVE MATERIALS
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FOREWORD

By international agreements, the movement of all radioactive materials within and between States should be subject to high standards of regulatory, administrative, safety and engineering controls to ensure that such movements are conducted in a safe and secure manner. In the case of nuclear materials, there are additional requirements for physical protection and accountability to ensure against threats of nuclear proliferation and to safeguard against any attempts at diversion.

The results of the terrorist attacks of September 2001 emphasized the requirement for enhanced control and security of nuclear and radioactive materials. In this regard, measures are being taken to increase the global levels of physical protection and security for nuclear materials. In like manner, efforts are underway to enhance the safety and security of radioactive sources so prevalent in many industries and health care facilities. It follows that detection of radioactive materials (nuclear material and radioactive sources) at borders is an essential component of an overall strategy to insure that such materials do not fall into the hands of terrorist groups and those criminal organizations that would supply them. Shipments of radioactive materials warrant the attention of law enforcement and regulatory agencies to ascertain legality, and to prevent diversion and illicit trafficking.

Experience in many parts of the world continues to prove that movements of radioactive materials outside of the regulatory and legal frameworks continue to occur. Such movements may be either deliberate or inadvertent. Deliberate, illegal movements of radioactive materials, including nuclear material, for terrorist, political or illegal profit is generally understood to be illicit trafficking. The more common movements outside of regulatory control are inadvertent in nature. An example of an inadvertent movement might be the transport of steel contaminated by a melted radioactive source that was lost from proper controls. Such a shipment may present health and safety threats to the personnel involved as well as to the general public.

States have the responsibility for combating illicit trafficking and inadvertent movements of radioactive materials. The IAEA co-operates with Member States and other international organizations in joint efforts to prevent incidents of illicit trafficking and inadvertent movements and to harmonize policies and measures by the provision of relevant advice through technical assistance and documents. As an example, the IAEA and the World Customs Organization (WCO) maintain a Memorandum of Understanding (MOU) (1998) to promote co-operation at the international level in order to improve the control of radioactive materials. At the time of the drafting of this report, a similar MOU between the IAEA and the International Criminal Police Organization (INTERPOL) is pending.

There are a number of measures that must be undertaken by States to combat the illicit trafficking and inadvertent movements of radioactive materials. These measures are, generally, shared between the regulatory and law enforcement agencies as part of a State's national arrangements. One of these measures is monitoring for radioactive materials at borders. This Technical Document (TECDOC) provides information to front-line officers on response to events involving the detection of inadvertent movement or illicit trafficking of radioactive materials. The emphasis in this publication is on operational and tactical response measures. These may entail a multi-agency response, particularly at the tactical level. Detailed scientific information has been kept to a minimum as it is recognized that the majority of law

enforcement personnel will not have the background necessary to use such information effectively.

This is the third of a group of three TECDOCs on inadvertent movement and illicit trafficking of radioactive materials, which are co-sponsored by WCO, EUROPOL and INTERPOL. The first is entitled “Prevention of the Inadvertent Movement and Illicit Trafficking of Radioactive Materials” (IAEA-TECDOC-1311) and the second “Detection of Radioactive Materials at Borders” (IAEA-TECDOC-1312). The IAEA officer responsible for these publications was B. Dodd of the Division of Radiation and Waste Safety.

EDITORIAL NOTE

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1. INTRODUCTION

1.1. Illicit trafficking definition

The IAEA glossary definition at the time of writing is: "Illicit trafficking is the receipt, possession, use, transfer or disposal of radioactive material without authorization". This definition is much broader than the term as it is generally understood by police, customs and other law enforcement bodies. In view of this, and the diverse professional interest of the three co-sponsors of this TECDOC, it is important to provide some amplification of the term illicit trafficking to ensure its correct application.

In the context of this TECDOC, the term 'illicit trafficking' should not be interpreted as covering all unauthorized events involving radioactive materials, irrespective of type and cause, since most of these may only be administrative offences and matters for the national nuclear or radiological regulatory authority, rather than for law enforcement.

The interests of the co-sponsoring organizations all include criminal activities (such as breaches of national and international law) and it is this dimension that underlies the purpose of this definition, this TECDOC and its two companions [1, 2].

Criminal activities under consideration include:

— subversive activities, such as breaches of proliferation controls (as they are subversive to international will);
— other actual or potential malevolent acts intended to cause harm to people or the environment;
— illegal gain, such as profits from the sale of the radioactive material;
— avoiding prescribed costs of disposal, or relevant taxes;
— violation of transport regulations.

Experience of some Member States has shown that many cases where radioactive materials have been shown to have been moved illegally across international borders have been due to inadvertent movements, rather than those with true criminal intent. An example of this is when radioactive materials have been moved across international borders mixed with scrap metal [3]. For this reason, instances where loss of control has occurred unintentionally, and the material is then found in another country can be usefully included in the discussion. In reality, it is only after such cases have been discovered and investigated can they be distinguished from cases with clear criminal intent. The problems of radiation safety, and harm to people, property and the environment are identical in both categories of incident.

To summarize, this TECDOC uses the term "illicit trafficking" to mean any intentional unauthorized movement or trade (particularly international) of radioactive materials (including nuclear materials) with criminal intent. This use of the term is consistent with that used by police, customs and other law enforcement bodies involved in combating trafficking in firearms, people, motor vehicles and drugs.

1.2. Background

It should be noted that since nuclear materials are also radioactive, in this report the term "radioactive materials" includes nuclear materials. "Radioactive materials" is used simply to

avoid repetitious use of the phrase “nuclear, and other radioactive materials”. It is recognized that nuclear materials will be of prime interest from an illicit trafficking viewpoint.

Inadvertent movement and illicit trafficking of radioactive materials is of concern to Member States. The IAEA has responded to those concerns and recognises the need for response mechanisms to manage such activities. Incidents vary considerably, and while the majority of these relate to inadvertent movement of small quantities of radioactivity, there have been some instances of larger-scale shipments or attempted shipments of radioactive materials across international boundaries.

In order to address such a wide magnitude of incidents, this publication advises three tiers of response arrangements. The majority of incidents will be dealt with at the lowest of these, termed the operational level. In some cases, it may become necessary to escalate this to a tactical level, where the seriousness is such that it is necessary for several organizations to work together in a co-ordinated way. Further escalation to a strategic response may be required for the most serious and rare cases. It is envisaged that these cases would involve the activation of a national or district emergency response plan for radiological accidents. Requirements for the preparedness and response for radiological emergencies are available [4] as is guidance on the development of such plans [5] and generic procedures for assessment and response during a radiological emergency [6].

This TECDOC is concerned primarily with the design and maintenance of arrangements to respond to incidents of inadvertent movement or illicit trafficking of radioactive materials, in a manner that protects health and safety, as well as addressing regulatory and other law enforcement interests. The specific security and proliferation issues relevant to nuclear materials are dealt with in elsewhere [7].

Despite the varied nature of these incidents, two clear types of response can be identified. The first occurs when radioactive materials are discovered and the second occurs when information is received that necessitates a search for radioactive materials. An example of the first would include the response to an event where inadvertent movement or illicit trafficking of radioactive materials is detected, usually at a border or other checkpoint. Because of the possibility of transfer across borders, regaining control of radioactive materials at the point of entry to the country, or other checkpoints prevents escalation of problems later, when the consequences may be much greater. For such reasons, some States have chosen to place radiation detectors at some of their border crossings. The intent of border monitoring is clearly to try to detect radioactive materials that are being illicitly brought into a country as well as to find any orphan[1] sources that may be inadvertently transported. Since an incident at a border is likely to involve customs authorities or border guards, and any incident may involve police, this report is aimed at informing such people about response procedures.

The second type of response is a proactive one based upon information received, such as that from intelligence reports. This information then requires an investigation and search to determine if radioactive materials are indeed present. While the initiators of the two types of response may be different, once radioactive materials have been discovered the subsequent procedures are basically the same.

[1] Orphan source: A source which poses sufficient radiological hazard to warrant regulatory control, but which is not under regulatory control because it has never been so, or because it has been abandoned, lost, misplaced, stolen or otherwise transferred without proper authorization.

1.3. Scope

This TECDOC considers the response procedures required for the majority of incidents of inadvertent movement or illicit trafficking of radioactive materials.

The planning for, and management of incidents involving loss of control of radioactive materials where international movement is not involved, is outside the scope of this report, but Member States may find the report is useful in this regard.

It is recognized that there are circumstances in which radioactive materials may be discovered that are out of control, and it is only after the incident has been handled with that it becomes apparent that the material was illicitly trafficked into the country. While this publication may be useful in these circumstances it is not possible to address such cases directly, so they are outside the scope. However, for such incidents, an essential part of a response plan is the reporting of the incident to the relevant international bodies. Specifically, these are the IAEA, the World Customs Organization (WCO), EUROPOL and the International Criminal Police Organization (INTERPOL), who would all welcome such information for the purposes of building their collective knowledge base. Member States are therefore encouraged to report to these organizations any cases where it is established that radioactive material has inadvertently or illicitly crossed national boundaries [8].

The TECDOC also contains some basic information relating to strategic considerations, which may be necessary if a radiologically hazardous situation occurs, if there is a proliferation threat, or an event with security implications. Such cases are extremely rare and it is assumed that most States will have emergency response plans in place to deal with such incidents. This TECDOC does not seek to replace, or in any way supersede, existing emergency response plans, but provides an overview of the main elements required in the formulation of such plans.

This TECDOC has neither the aim nor the intention of interfering with the regulation or practice of customs or other law enforcement agencies. This report aims to support their countermeasures against the illicit trafficking or inadvertent movement of radioactive materials.

The report also does not intend to interfere with legitimate shipments of radioactive materials. Such shipments are regulated under the provisions of the IAEA Regulations for the Safe Transport of Radioactive Material [9], or equivalent national regulations.

As discussed in Ref. [2], there may be innocent alarms from radiation detectors due, for example, to naturally-occurring radioactive materials (NORM) or due to the presence of residual radioactive materials from patients who have recently undergone certain medical procedures. Administrative methods (such as interview, or checking of manifests) will normally make it clear that such alarms are innocent, and that no further response is required. Accordingly, these are also outside the scope of this publication.

1.4. Objectives

The prime objective of this TECDOC is to provide Member States with practical information for use by emergency response and law enforcement personnel involved in dealing with incidents of inadvertent movement or illicit trafficking of radioactive materials. The purpose of the response is to regain control of the relevant radioactive materials so that the risk of harm to people and the environment is mitigated.

This information is aimed primarily at police, customs and other law enforcement officers who may become involved in incidents concerning inadvertent movement or illicit trafficking of radioactive materials. Effective inter-agency co-operation can only be achieved if personnel who are not normally involved with radiological emergencies are aware of the issues associated with radiation protection that have to be considered in such cases.

It is also likely to be of use to radiation protection specialists who are part of the planned technical response to such incidents and who need to understand the statutory and forensic interests of their law enforcement colleagues.

2. RESPONSE REQUIREMENTS

2.1. Control of radioactive materials

Radioactive materials may be considered to be under control when cognizant supervision is maintained by the national regulatory authority over the production, use, storage, transport and disposal of these materials. Implementation of the Code of Conduct on the Safety and Security of Radioactive Sources [10] would provide good assurance of effective control. However, there will be occasional losses from control, such as when an authorized user of radioactive material unintentionally misplaces a source or when radioactive material is stolen.

2.2. Situations requiring response

It is anticipated that response measures will either be reactive or proactive depending upon the circumstances of each incident. Reactive responses are those where radioactive materials are likely to be present, while proactive responses are those where information is provided that requires an investigation and search for radioactive materials. In general terms, discovery of inadvertent movement or illicit trafficking of radioactive materials will require an immediate reactive response at the scene of the discovery, to regain control and to prevent further escalation of problems.

A reactive response will be required in the following circumstances:

— a real[2] alarm of a border monitor due to the unauthorized or uncontrolled presence or movement of radioactive materials [2];
— notification[3] of radioactive materials having been found in an unauthorized location;
— notification about an object suspected of containing radioactive materials;
— notification about an incident involving, or suspected of involving, radioactive materials, and where illicit activity is indicated; and
— a discovery of a discrepancy between a customs declaration form and the corresponding shipment of radioactive materials.

When Member States receive intelligence suggesting that illicitly trafficked (or inadvertently moved) materials may be found at a specified location, (such as on board a specific vessel), then a proactive response will be required.

A proactive response will be required in the following circumstances:

[2] Not a false alarm or an innocent alarm.
[3] Notification is meant to include both formal and casual elements, whether through written reports, oral statements, telephone conversations, or similar communications.

— receipt of information suggesting the inadvertent movement or illicit trafficking of radioactive materials;
— notification about the discovery at a border of instances of non-compliance with transport regulations; and
— discrepancies found in an inventory of radioactive materials.

Once radioactive materials have been discovered, then the subsequent procedures for both types of response are essentially the same.

2.3. Response objectives

The over-riding objectives and priorities of any response to inadvertent movement or illicit trafficking of radioactive materials are:

(1) to minimize any potential health hazards;
(2) to bring the radioactive materials under appropriate control; and
(3) to investigate, gather evidence and prosecute any offenders.

2.4. Scale of response

An assessment of previous incidents has shown diverse situations ranging from inadvertent or illicit possession of small quantities of radioactive materials, which were relatively harmless, to the possession and trafficking of nuclear materials, which may pose a serious security threat. Few situations are found where there are hazardous radiation or contamination levels.

The scale of the response needs to be geared to the severity of the individual situation. Three scales of response are discussed:

(1) operational,
(2) tactical, and
(3) strategic.

The procedures for first two are detailed in this TECDOC while considerations regarding the third are outlined in Annex I.

In cases where there is no significant health hazard, no security implication or no proliferation threat, front-line officers and the routine response mechanisms of their respective agencies can deal with an incident simply yet effectively. This is termed an *operational response*.

In a more serious incident, there will be a need for a more elaborate response mechanism and the scale of the response will increase. In particular, the assistance of radiation safety professionals will probably be needed. It is therefore appropriate to consider a flexible approach, which can move from the immediate operational requirements into a *tactical response* mechanism involving other agencies.

Only on very rare occasions, will the need arise to move to a *strategic level response*. Such a response might be characterized by the activation of a district or national emergency response plan because of a significant potential hazard to the environment or the public.

An overall outline of response to proactive and reactive initiators leading to the three categories of response described is illustrated in Fig. 1. This outline is consistent with the companion TECDOCs [1, 2].

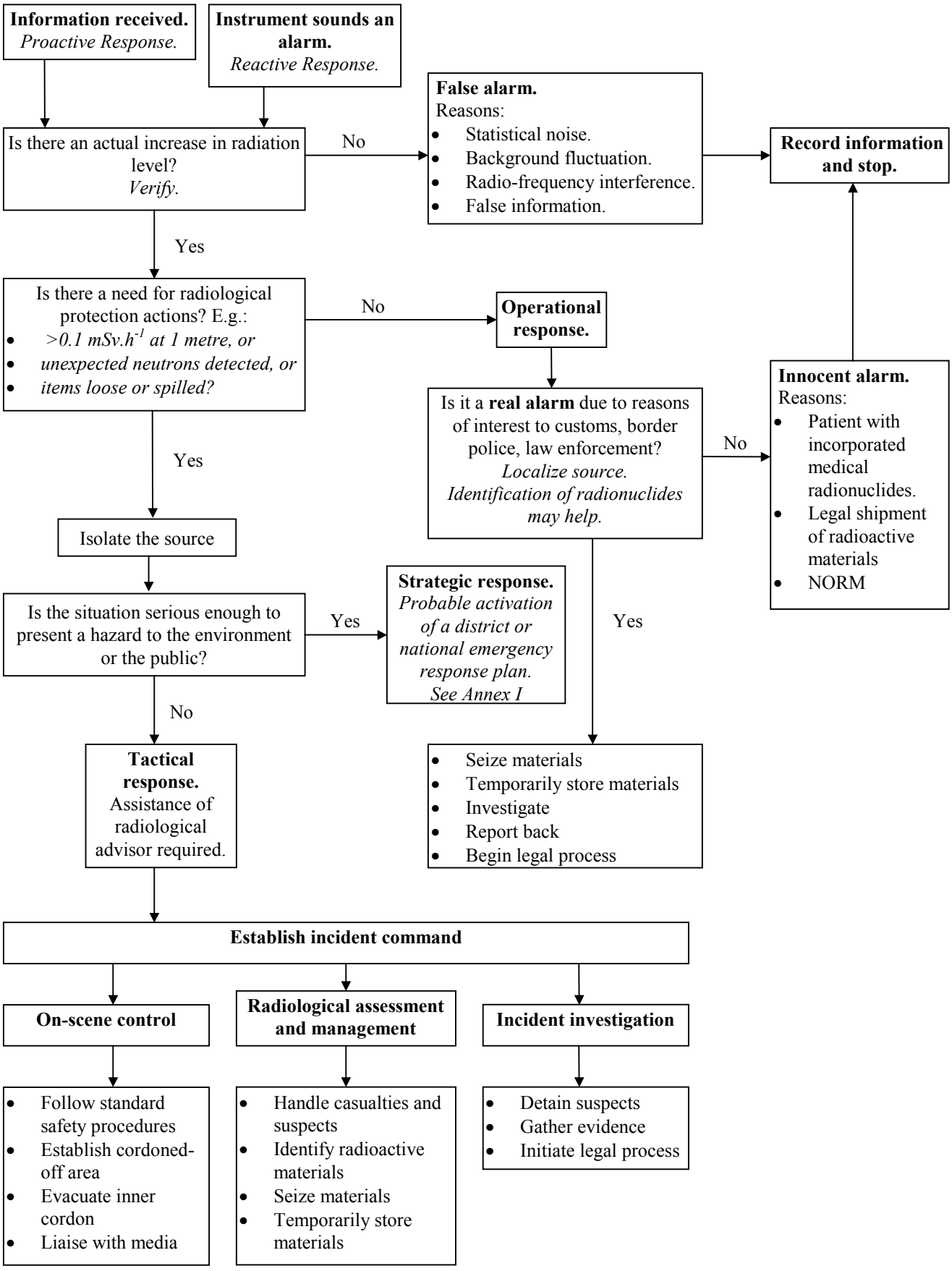

FIG. 1. Flowchart showing the initial response to inadvertent movement or illicit trafficking of radioactive materials.

3. RESPONSE INITIATION

3.1. Reactive response

As part of national arrangements to combat inadvertent movement and illicit trafficking of radioactive materials, some Member States have deployed radiation detection equipment at locations such as border crossing points, ports and airports [11]. This equipment may provide an alarm when increased levels of radiation are encountered. The companion TECDOC, "Detection of Radioactive Materials at Borders" [2] provides more information concerning monitoring equipment, its operational characteristics, and the range of causes of alarms.

Reference [2] describes a five-step process for the detection of inadvertent movement or illicit trafficking of radioactive materials:

(1) strategic evaluation of the need for border monitoring,
(2) selection of instruments,
(3) determination of investigation levels and instrument alarm settings,
(4) evaluation of alarms and appropriate response, by verification and localization of the radioactive material, and
(5) evaluation of any radioactive materials found.

Steps 1 through 3 will have been completed prior to, and as part of, the installation of any monitoring system. At some level, steps 4 and 5 may be undertaken by front-line staff from customs, police or other law enforcement bodies, for whom the detection of illicit trafficking of radioactive materials is an activity that is secondary to their main task. However, others will probably repeat these actions as part of the operational response.

It is envisaged that front-line staff would react to an initial alarm sounded by, for example, a portal monitor at a border crossing. They may be able to undertake a straightforward verification procedure, by directing the vehicle through the portal monitor for a repeat measurement, or by using a different, hand-held instrument. In this way, they would be able to screen out some false alarms and innocent alarms, without invoking any further response arrangements.

Having performed an initial evaluation under steps 4 or 5, the staff may decide that more support is required and activate an appropriate higher level response.

It is not possible to generalize on exactly when a fully developed response is required as this depends very much on the circumstances of each incident. It is assumed that to fully implement steps 4 and 5 will require the support of specialists not routinely available to front-line police, customs and other law enforcement bodies. In some cases, this may simply mean calling on additional staff of their own organization to undertake a more detailed survey with a hand-held instrument. In other cases, it will mean invoking arrangements to involve other agencies who will provide specialist staff and resources.

3.2. Proactive response

A proactive response differs from a reactive one only in that it begins with information that requires being evaluated further. Depending on the likely authenticity of the intelligence or the source of the information, the front-line staff may or may not be involved with the response. Many events will be directly evaluated by an operational response team.

4. OPERATIONAL RESPONSE

4.1. First information

The information recorded and transmitted to relevant authorities following the verification of detection is designated as a first information report. Ideally, this would only be sent after the exclusion of the possibility of an innocent alarm. The person who compiles the first information report is designated the response initiator [6]. Alternatively, in a proactive response, a first information report may result from the conclusions drawn from intelligence reports.

Whatever form it takes, a first information report is intended to result in activation of a systematic response, including the mobilization of the first responder. This is the first person or team to arrive at the scene for the specific purpose of managing the incident. This may be the duty supervisor of the personnel who created the first information report, who might normally assume the initial command and control functions. Alternatively, it could be a front-line officer who has received special training beyond that of other front-line colleagues.

4.2. Safety considerations

4.2.1. Radiological safety

Irrespective of the scale of the incident, response personnel must always be aware that there may be both radiological and conventional hazards associated with an incident involving radioactive materials. The safety of response personnel and the general public is of paramount importance. Response personnel must be familiar with radiological safety procedures and measures that can be adopted to mitigate health hazards. These are discussed in detail later in this report. However, it should be stated at the beginning that if the first responder encounters any of the following conditions, the scene is likely to require prompt radiological evaluation to assess the magnitude of the radiation hazards:

— radiation level greater than 0.1 $mSv \cdot h^{-1}$ at a distance of 1 m from a surface or object[4];
— the confirmed detection of neutron radiation that is not from a legal shipment of radioactive materials[5]; or
— radioactive contamination indicated by loose, spilled or leaking radioactive materials.

Further information on the assessment of radiological hazards is given in Section 4.5.

It is advisable to have the capability of alerting all personnel at the scene so that they can be made aware of a potential incident involving radioactive materials.

An assessment of previous incidents has shown that the majority are of a minor nature with little or no radiological hazard. These can be dealt with at an operational level without the necessity to activate a tactical response or strategic response.

[4] This reading is equivalent to the upper radiation level at 1 m distance from a package used for the legal transport of radioactive materials, as detailed in IAEA Safety Standards Series No. ST-1 [9].
[5] Neutron radiation sources, such as nuclear density gauges, may be legally shipped, although the presence of neutrons may also be due to the presence of illictly trafficked fissionable nuclear materials.

4.2.2. Conventional safety

While radiological safety is one aspect to be considered, it is also important to remember that there may be other physical hazards present, and that appropriate methods may be required to protect against these. For example, if the suspect item is high off the ground a means of safe access to it will be required. If the assessment indicates that other potentially hazardous materials are present, then the response may be escalated as specialist skilled personnel and equipment are likely to be required.

4.3. Actions by the first responder

While several of the necessary actions may have already been performed by the front-line staff, the first responder will normally repeat them to provide confirmation of the event parameters. Therefore, it is important that response personnel at the scene are equipped with appropriate radiation detection equipment [2]. Operational response actions include:

— verification of an actual increase in radiation levels, and confirmation that a response is necessary;
— assessment of the radiological situation to ensure the appropriate level response;
— notification to senior staff;
— location of the source;
— identification of the material;
— seizure and temporary storage of radioactive materials;
— initial investigation of the event;
— report back to senior staff.

4.4. Verification of event

The first responders should perform their own procedures to verify that the alarm is genuine and to confirm the presence of radiation. It is recommended that a second set of radiation detection equipment be used for this purpose. For instance, if a static portal alarm is activated, the first responder could utilize a radiation pager, hand-held survey meter or some other radiation detection equipment to verify the presence of radiation. If the initial alarm cannot be verified by a second instrument, it may be assumed that the first indication was a false alarm, or that the information received was false. If the presence of radiation is confirmed by the verification process, action should then be taken to assess the radiological hazards.

Advice with respect to the selection of detectors and how to use them is given in the companion TECDOC “Detection of Radioactive Materials at Borders” [2].

4.5. Assessment of radiological hazards

The use of hand-held dose rate meters (survey meters) is recommended to assess the radiological hazard at the scene of an incident. Such instruments offer flexibility of movement as well as enabling a range of measurements. They also help minimize the radiation exposure of the assessor, because the survey can be undertaken in a short time. A hand-held instrument may be used to locate the radioactive source and delineate areas of increased radiation hazard in one step.

If the first responder is competent, the presence or absence of loose radioactive contamination at the scene should be assessed. Until such time as a full radiological assessment is made,

response personnel must take precautions to avoid contact with materials that are suspected as being contaminated as skin contamination, inhalation and ingestion of radioactive substances can also pose health hazards. Response personnel must therefore avoid eating, drinking and smoking in the immediate area until it is ascertained that there is no loose contamination present. Further information on measures to mitigate health hazards may be found in Section 6. If the first responder feels it necessary, additional specialist support may be requested in order to exclude the possibility of the presence of loose radioactive contamination.

Having identified the general location of the radioactive source, the first responder may approach the radioactive source using a dose rate meter to determine the extent of the radiological hazard and to observe the situation close to the radioactive source.

As discussed, if the first responder encounters any of the following conditions, the scene is likely to require prompt radiological evaluation to assess the magnitude of the radiation hazards:

— radiation level greater than 0.1 $mSv \cdot h^{-1}$ at a distance of 1 m from a surface or object;
— the confirmed detection of neutron radiation that is not from a legal shipment of radioactive materials; or
— contamination indicated by loose, spilled or leaking radioactive materials.

In such a situation the first responder should primarily ensure:

— personal safety and the safety of individuals in the vicinity;
— isolation of the radioactive source; and
— notification of the situation to the duty supervisor.

The first responder should then withdraw to a safe distance from the radioactive source and activate a higher-level response. Guidance on safe distances is given in paragraphs Section 5.

4.6. Notification to senior staff

When an alarm is activated as a result of a radiation monitoring programme, the first responder should report the circumstances of the alarm activation to the duty supervisor at the scene, giving as much information as is immediately available.

From initial observations at the scene, the first responder is likely to be able to provide the following information relating to the radiological assessment:

— measurements taken during the initial survey;
— the presence of packages bearing radiation warning symbols;
— the type of packaging of the radioactive materials;
— the condition of the packaging and whether the packaging appears damaged or breached; and
— any placarding, labelling, shipping documentation or other information to indicate the nature of the suspect radioactive materials.

The duty supervisor should consider the scale of the incident and initiate a higher-level response if it is deemed necessary. If the situation is one that comes within the scope of a

dangerous radiological incident, the duty supervisor should activate a tactical response or seek authorization to do so from a pre-designated senior officer.

The use of radiation detection equipment requires specialized training and technical knowledge. In the event that front-line officers are unable to conduct an initial radiological hazard assessment, or if they need assistance, it is recommended that they inform their duty supervisor, with the aim of securing the support of their radiological advisor. Suggested duties of the radiological advisor are listed in Annex III and can be usefully incorporated into an emergency response plan. Ideally, this individual would be automatically deployed to the scene if a dangerous radiological incident is encountered. However, it is also appropriate to seek advice from the radiological advisor on the management of routine incidents when there is any doubt or ambiguity in making the initial hazard assessment.

4.7. Location of the radioactive source

If it is safe to do so (and if it has not already been done by front-line staff), the first responder should establish the location of the radioactive material. At this stage, it is sufficient to determine the general location of the source of radiation without knowing its exact location. For example, it would be acceptable to determine that the radioactive source was confined to a piece of luggage, to a vehicle or to a large commercial container, where the materials could be isolated if the first responder felt this was necessary from a safety point of view. The general location of the radioactive material can be determined without the necessity of opening the item that contains the material.

4.8. Identification

If it has been established that there are no significant radiological health hazards associated with an incident, the next action of front-line officers is to identify the radioactive source. At this stage it is possible that the suspect radioactive source may be identified as an innocent source. If it is ascertained that the radiation does arise from an innocent radioactive source, then front-line officers are advised to record the details of the incident and terminate the response procedures.

To help determine if the event involves inadvertent or illicit activity, it is useful to note that, in nearly all cases of legal transportation of radioactive materials, the persons responsible for the shipments will be in possession of authentic documentation to support the transportation. The radioactive materials will be labelled and packaged in accordance with the regulations governing the transportation of radioactive materials [9] and most importantly the radiation levels will be within the acceptable levels for the transportation of such materials. Note that specific regulations exist for the physical protection of nuclear materials [7].

It therefore follows that lack of documentation, incorrect labelling, inadequate packaging, levels of radiation above the acceptable levels, or radiation levels significantly different from those specified in the documentation can be treated as suspicious and an indicator of inadvertent movement or illicit trafficking of radioactive materials.

4.9. Seizure and temporary storage of materials

If it is determined that it is a case of illicit trafficking, the first responder needs to consider gathering evidence at the scene to support a future criminal prosecution. This will require

protection of the crime scene and the evidence that may be within it. Similar actions may also be necessary with materials involved in inadvertent movement.

Further notification to the relevant competent authorities will usually be advisable. Evidence gathering will then be undertaken following close liaison between the prosecuting and nuclear security authorities.

In addition, if the materials are confirmed to be of an illicit nature, but not hazardous, they should be seized and temporarily stored in a secure location. Radiation levels at the surface of a radioactive source can be high, even when measurements made at just a few centimetres from the surface indicate the levels are low. It is, therefore, good practice to always use a tool (such as tongs or forceps) to handle a radioactive source, and never to handle the source directly. Guards may be appropriate to watch over the seized materials if nuclear weapons-related materials are involved. Further information on the seizure and storage of radioactive materials is contained in Section 5, which outlines tactical response measures.

4.10. Incident investigation

In all incidents of inadvertent movement or illicit trafficking of radioactive materials it will be necessary to conduct an investigation into the circumstances of the case. This topic is discussed in more detail in Section 7. However minor incidents may not require a prolonged or detailed investigation, particularly if the radioactive materials can be readily identified and there are no further matters of concern arising from the incident.

Depending upon national legislation, and the circumstances of the event, it may be necessary to prosecute certain individuals. As a consequence, the investigation procedures should reflect the legal requirements of the judicial process of the State involved. Note that in certain countries there are different regulations and legal requirements governing nuclear materials, as opposed to other radioactive materials and investigators must take due cognizance of the local situation.

In order to corroborate the legal process, an expert opinion may be required to verify the presence, quantity and nature of the radioactive material, as well as other details, such as the degree of danger caused by the incident.

4.11. Report back to senior staff

In addition to the initial report following the radiological assessment, the first responder should report back to senior staff as and when significant additional data become available. In particular, if the event can be categorized as an innocent alarm, an inadvertent movement or illicit trafficking this needs to be reported.

5. TACTICAL RESPONSE

When a more hazardous radiological situation develops it will be necessary to adopt a tactical response mechanism (see Fig. 1). This entails the management of an incident by a response team which has a pre-designated command structure and which will operate to a tactical response plan in accordance with the relevant procedures. However, should the situation be serious enough to present a hazard to the environment or the public, then a full strategic response should be expected and a district or national emergency response plan activated.

5.1. Incident command

5.1.1. Command structure

All military forces, law enforcement agencies and emergency services will have their own command structure and internal reporting procedures. Consequently it is not appropriate to specify a different command structure just for tactical response to inadvertent movement or illicit trafficking of radioactive materials. Therefore, the structure outlined in the following paragraphs and illustrated in Fig. 2 is offered as a generic model of the command functions, that may be required during a tactical response at the scene of an incident. States may use this model to devise their own command mechanisms but it is stressed that other models may be entirely appropriate. Each command structure should be derived in order to cater for national and local conditions.

The generic model is a framework that requires modification for every incident, as each will present a different scenario and require differing levels of flexibility in the response procedures.

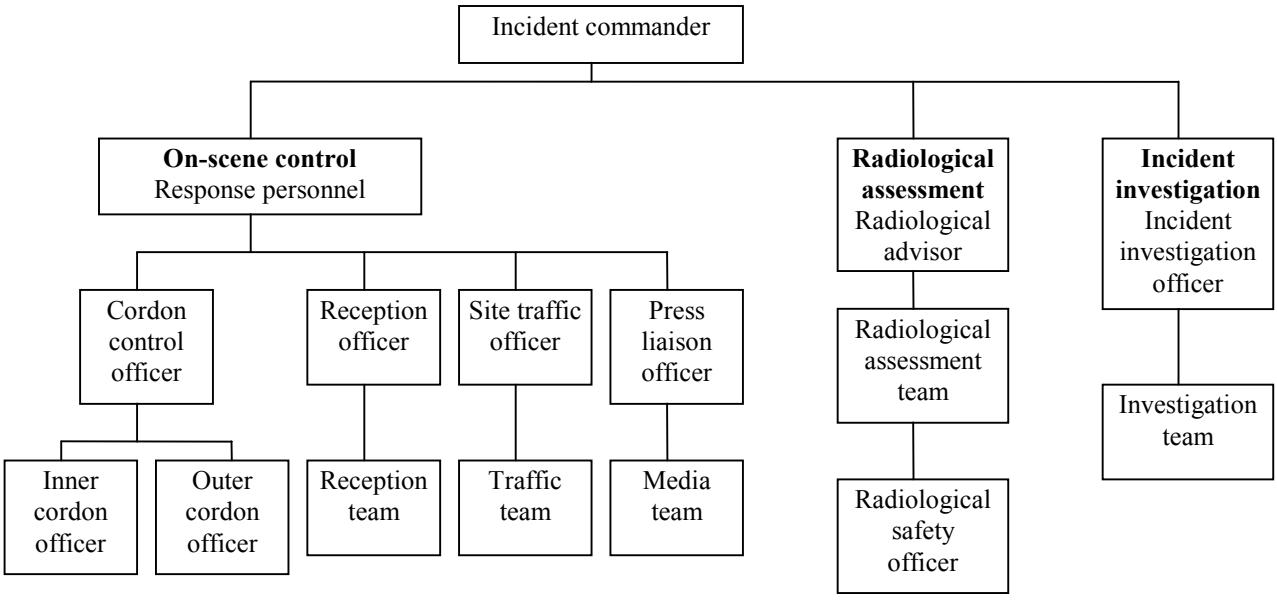

FIG.2. Example of a tactical response command structure.

Activation of a tactical response is likely to result in the mobilization of three key command personnel who can form the response team. These are:

— the incident commander, would be in charge of deployment and direction of resources at the scene of the incident;
— the radiological advisor, would be responsible for radiation surveys, contamination control and radiation protection support to response personnel and the public; and to provide expert advice to the incident commander as appropriate; and
— the incident investigation officer, would be responsible for all investigative processes associated with the incident, including arresting and interviewing suspects, gathering evidence and preparation for any future criminal prosecution, judicial inquiry, inquest or other statutory investigation.

From the time of the notification of the incident occurrence until the pre-designated officers are in position to exercise their command functions, the responsibilities of the incident commander can be assumed by the most senior officer of the responding agency at the scene of the incident. Initially, this may be the duty supervisor of the organization of which the response initiator is a member. It may be appropriate to hand-over these responsibilities to a more specialist or senior incident commander when such a person arrives at the scene.

5.1.2. Incident command centre

Tactical command of all field personnel is best co-ordinated from an incident command centre, which has been provided for the incident commander in order to manage resources deployed at the scene. The incident command centre also acts as the central point of contact for all agencies involved.

The siting of the incident command centre will be dependent upon the prevailing circumstances at the scene. If there are no suitable buildings nearby, it may be necessary to operate the incident command centre from a vehicle. There are several considerations regarding the siting of the incident command centre.

— **Safety** – The command centre must be located away from any external radiation hazard. Ideally, the incident command centre should be sited up-wind of any radioactive sources, to avoid the spread of potential contamination. If contamination is known to be present, or has not been excluded, the location may be chosen to be sufficiently remote to minimize exposure to radioactivity;
— **Accessibility** – It is desirable for the incident command centre to be sited adjacent to an approach route to the scene. The site will need to provide sufficient space for parking of emergency vehicles.
— **Conspicuous** – The incident command centre needs to be clearly marked and posted; and
— **Security** – The incident command centre needs to be secure from any criminal activity and accessible to authorized personnel only. The media should be kept away and eavesdropping prevented, although media briefings should be arranged (see Section 8).

Communications are essential and all available systems must be considered. It should be noted that the use of radios and mobile phones, although extremely useful in field operations, are not secure unless encrypted.

Ideally, the size and configuration of the incident command centre will accommodate representatives of all responding agencies deployed at the scene. This helps to ensure co-operation and encourages liaison.

The primary function of the incident command centre is to provide facilities to enable the incident commander to control and co-ordinate the response at the scene. In addition, amongst other things, it makes provision for:

— liaison between responding agencies deployed at the scene;
— assessment of the radiological and any other safety hazards;
— implementation of measures to protect health;
— handling and management of any casualties;
— handling and reception of any arrested individual(s);

— recording details of personnel operating at the scene as well as logging major activities and decisions;
— supervision of cordoned-off areas; and
— traffic control and vehicle movement.

5.1.3. Termination of tactical response

It is the responsibility of the incident commander to terminate the tactical response when the scene is declared safe by the radiological advisor and all evidence has been gathered by the investigating officers. Action may then be taken to return the scene to normal in accordance with the procedures set out in the tactical response plan**.**

5.2. On-scene control

5.2.1. Consideration of conventional safety

The presence of radiation or radioactive material contamination should not detract from the need to consider conventional safety issues with respect to the incident site.

5.2.2. Establishment of cordoned-off areas

When a radiation hazard is suspected or known, it is essential that an inner cordon be established around the radioactive source and all personnel evacuated from within the inner cordon control area. The inner cordon should be set up at a distance where the external dose rate level does not exceed 0.1 mSv per hour [6]. Additional safe distance will be required if there is any indication of airborne radioactive contamination.

In certain incidents it may not be practicable to establish cordon procedures. For example, a passenger disembarking from an aircraft, train, bus or vessel and carrying illicit radioactive materials, may be detected when the individual passes through an inspection point. In such eventuality it would not be practicable to establish a cordon around the inspection point and the most appropriate response would be to immediately escort the individual to a secure room where he/she can be isolated so as to prevent exposure of other people.

For security reasons an outer cordon can also be established as a working area for field personnel. Access control staff can then ensure that the cordon control area remains free of any individual who does not have authority from the incident commander to be there. The distance of the outer cordon can be determined by the prevailing circumstances, but must allow sufficient area for field personnel to operate effectively. It should also be noted, if airborne contamination is confirmed or suspected, the area of the outer cordon that is down-wind of the radioactive source needs to be kept free of personnel. A diagram of cordon control areas is shown in Fig. 3.

The incident commander is advised to appoint staff to control access to the two cordon controlled areas, with specific instructions as to who is permitted into these areas. All personnel on cordon control duty must be fully briefed on their role, particularly those deployed on the outer cordon where sightseers and media personnel are likely to attempt entry. It is the duty of the radiological safety officer to provide personal dosimeters and all other necessary protective equipment. Any individual entering the inner cordon can only do so on the personal directive of the incident commander and should be accompanied and supervised

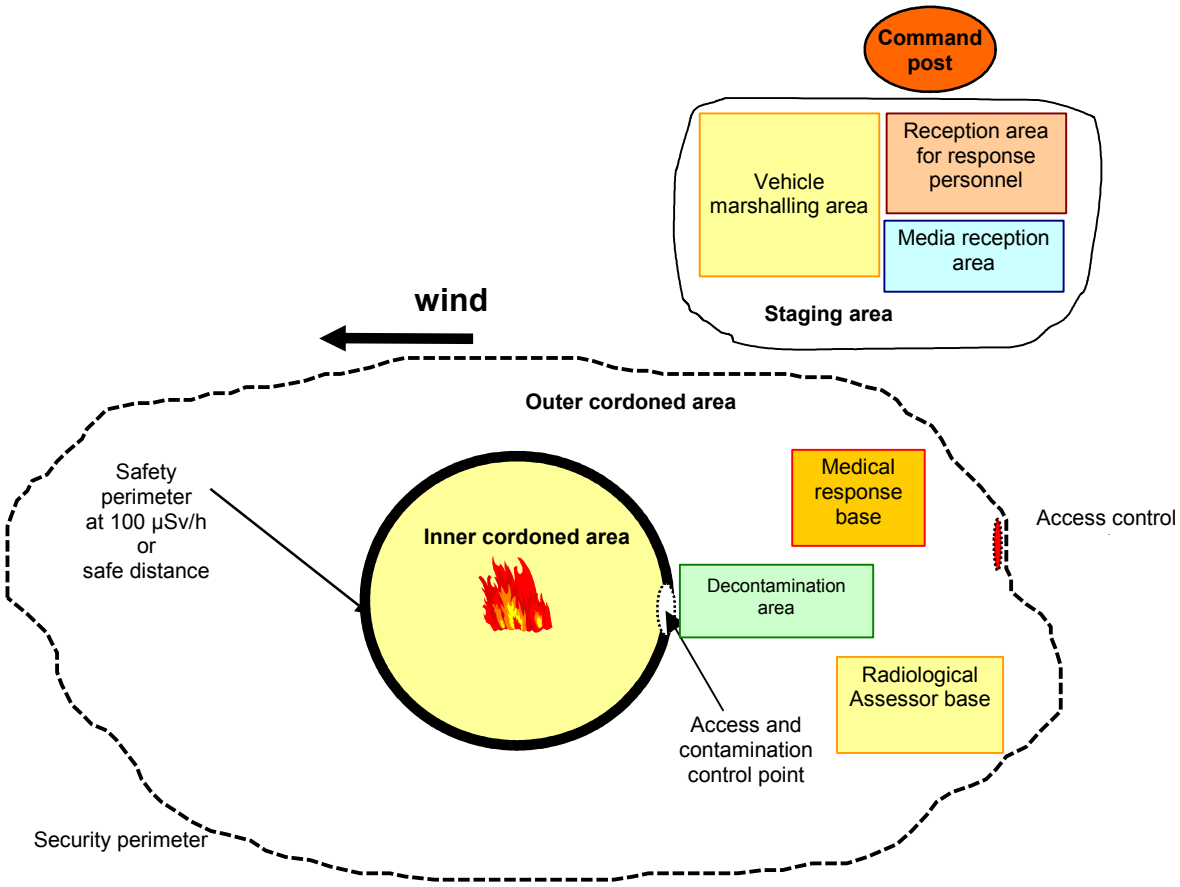

FIG.3. Diagram of cordon control areas.

by a radiological safety officer from the radiological advisor's team (see Fig. 2). The radiation exposure of persons entering the inner cordon should be controlled by restricting their time spent in this area The maximum time persons are allowed to remain in the inner cordon should be determined by the radiological advisor. A log should be maintained of the movement of individual personnel into and out of the inner cordon, with specific timings of entry and exit being recorded to enable the cumulative time spent in the area to be monitored.

5.2.3. Evacuation of inner cordon

The inner cordon should be kept clear of non-essential personnel as individuals will accrue unnecessary radiation exposure if they stay inside the area any longer than necessary. In the event that individuals might have become contaminated with radioactive materials, they should undergo a contamination check and decontamination procedures at the scene.

5.2.4. Liaison with media

An incident of illicit trafficking in radioactive materials will almost certainly attract the attention of the news media. This will be particularly true if there are radiological hazards associated with the incident. Representatives of the press and television are likely to be at the scene and may even be broadcasting live coverage before the full mobilization of the response personnel occurs.

It is important that personnel at the scene are aware of the potential for rapid media response and that they make arrangements for the reception, assembly and control of media personnel as soon as practicable. The incident commander will find it advisable to establish a media reception point and appoint a press liaison officer.

The press must not be allowed unrestricted access to the scene, but, where practicable, could be permitted to photograph and film the scene. In some cases, the assistance of the media may be invaluable and if good relations are established early, this will facilitate future co-operation. The provision of regular bulletins to media personnel keeps them updated on the facts as the incident progresses. This allows them to do their work without having to make repeated inquiries. It will also ensure that media personnel do not hinder the work of the incident commander. Further guidance on dealing with the media is provided in Section 8.

5.3. Radiological assessment and management

5.3.1. Casualty handling

In the unlikely event that a situation arises where there are injured individuals at the scene, who have also been contaminated and/or exposed to radiation, qualified response personnel are advised to deal with the injured individuals immediately before other considerations. Normal first aid measures to deal with life threatening conditions should be performed:

— check vital signs such as consciousness, breathing and pulse;
— apply resuscitation techniques if required;
— stop further exposure of the casualty. e.g: by moving the casualty away from the source of radiation, or moving the source away from the casualty;
— monitor and remove any grossly contaminated clothing if this will not affect the casualty's condition;
— if it is not possible to remove contaminated clothing from the casualty, try to contain the contamination (e.g: by wrapping the casualty in a blanket), to prevent or reduce the spread of contamination in the ambulance;
— transport the casualty to hospital, and warn the receiving medical facility if the casuality is, or may be, contaminated.

As soon as practical, both the injured individual and the emergency personnel who have handled the injured person should be monitored for radioactive contamination, and appropriate decontamination processes implemented if necessary. However, treatment of severe trauma to the injured individual takes precedence. Further information on casualty management is contained in Annex IV.

5.3.2. Handling of suspects

The arrest and detention of suspects may pose additional difficulties to those normally encountered when an arrest is made. If there is no loose radioactive contamination present, then there is no additional risk from suspects who have been in close proximity to the radioactive source. However, if loose radioactive contamination is present or suspected then it is important to treat the suspects as if they are contaminated and arresting officers should be aware that they may themselves become contaminated through contact with the suspects. In such situations, arrested individuals, and any personnel who have been in contact with them, will therefore need to be monitored for radioactive contamination at the earliest opportunity. If

it is found that an arrested individual or arresting officer has been contaminated, the radiological advisor should arrange for decontamination procedures to be initiated.

It is emphasized that decontamination procedures, if undertaken by untrained personnel can result in more widely spread contamination, and health effects due to skin abrasion. For this reason, it is best if such procedures are only undertaken under the supervision of the radiological advisor.

5.3.3. Identification of radioactive materials

After any casualties and the radiological safety at the scene have been dealt with, the next step is to identify the radioactive material. The radiological advisor can be expected to manage all procedures and equipment necessary to identify the radioactive materials. This process will provide the incident commander with the necessary information to manage the response prior to the seizure of the radioactive materials.

The process of identifying the radioactive materials could take only a few minutes, but in some circumstances it may take several hours. It is possible that additional equipment will be required at the scene before the identification process can be started, and this may also cause some delay. The output from this process is a gamma-ray spectrum that is characteristic of the radionuclide(s) present. By comparison with reference data it will normally be possible to identify the radioactive material. In a few cases however, this will only be possible by removing samples to a laboratory for highly specialized measurements.

If nuclear materials are identified, the incident commander will wish to arrange for the relevant competent authority to be informed, prior to taking any further action.

5.3.4. Seizure of radioactive materials

It is recommended that the seizure of radioactive materials in a tactical response be conducted at the request of the investigation officer, but under the direction of the radiological advisor. There are a number of considerations in the seizure of radioactive materials.

The seizure and eventual disposal of loose or unshielded materials, or materials which have not been sealed and packaged in the prescribed manner, may require the deployment of substantial resources over an extended period to minimize health hazards and to ensure that there is no unnecessary exposure or contamination beyond the scene.

Radioactive materials, which are in powder or liquid form and are loose or have been spilled, pose the most difficult problems in terms of their seizure as they may cause contamination at the scene of an incident. They may not be easily recovered and it may prove difficult to contain the spread of contamination.

The topography of the scene is a critical factor in the determination of the most effective means of seizing the radioactive materials and bringing them under control. If the scene is at a location where it is possible to maintain cordon procedures for a prolonged period, then the seizure and removal of the items can be deferred until a full analysis of materials and the site has been conducted and a plan for the seizure made. If the scene is in a location such as an airport or a border crossing point where the maintenance of a cordon for long periods may be difficult, it will be important that plans are established to attempt seizure and remove the items as soon as possible.

Prior to the seizure of the materials, the incident commander must confer with the radiological advisor to ensure that all means to protect the public, response personnel and the environment have been deployed. The incident commander is likely to want to ascertain the following information:

— the identity, quantity and physical properties of the radioactive materials;
— the physical condition of the radioactive materials;
— the resources available to ensure that the materials are packaged, transported and stored in accordance with IAEA Safety Standards;
— the resources necessary to deal with loose or spilled radioactive materials; and
— whether immediate removal of the items is necessary and possible.

If seizure of the items is to be attempted, it is recommended that the radiological advisor first gives advice on the most appropriate method to move the materials, having regard to the availability of proper containers, shielding and equipment. Efforts to remove loose or spilled items might result in exposure to field personnel and an increased risk of contamination. The seizure process may disturb the items and, in addition to spreading surface contamination, may also cause airborne release of the material. The radiological advisor should ensure that the seizure of items is operated in a safe manner (see Section 6).

5.3.5. Temporary storage of radioactive materials

If it is necessary to effect immediate seizure, then the radiological advisor may give consideration to effecting a temporary storage area at the scene. It may be possible to prepare a secure storage area in close proximity and to store the items with little or no risk to personnel until such time as it is possible to move the materials to a more permanent store prior to disposal.

The establishment of a temporary storage facility at the scene will depend upon the availability of equipment to ensure that the radioactive materials are secure, shielded and in suitable containers. Temporary removal and storage will allow decontamination procedures to be implemented much sooner and although there are risks associated with such an arrangement, temporary storage may well prove to be the best option. Further information on the transportation and disposal is contained in Annex VI.

5.4. Incident investigation

As is the case with operational response, in all incidents of inadvertent movement or illicit trafficking of radioactive materials, it will be necessary to investigate the circumstances of the incident. This topic is covered in more detail in Section 7.

5.4.1. Arrest of suspects

While the radiological advisor manages the health-related aspects of handling any suspects, it is the responsibility of the investigation officer to designate who should be detained and to ensure that they are interviewed in accordance with the appropriate regulations. Information gained may lead to further proactive responses.

5.4.2. Gathering of evidence

The incident investigation officer will wish to ensure that evidence is gathered in an appropriate manner, and that the chain of evidence is not broken. The responsibility for the

eventual storage of the radioactive materials also needs to be delegated to the appropriate authority.

5.4.3. Initiation of legal process

Depending upon national legislation, and the circumstances of the incident, it may be necessary to prosecute certain individuals. As a consequence, the investigation procedures will reflect the legal requirements of the judicial process of the State involved. Note that in certain countries there are different regulations and legal requirements governing nuclear materials, as opposed to other radioactive materials and investigators must take due cognizance of the local situation.

6. MITIGATION OF HEALTH HAZARDS

While the issues discussed under this section are in the context of the tactical response, the principles are applicable to all levels of response.

6.1. General considerations

The radiological advisor is responsible to the incident commander on all matters relating to mitigation of health hazards. Field personnel working at the scene must do so under the supervision of the radiological advisor to ensure that their radiation doses are kept as low as reasonably achievable and within national dose limits. In exceptional circumstances emergency workers may be permitted to receive higher exposures (see Annex V), but this will depend on national requirements.

In some circumstances, field personnel may not be able to avoid exposure to external radiation, but the following precautions can be used to reduce the level of exposure:

— maintaining a safe distance from the radioactive source;
— limiting the time in close proximity to the radioactive source; and
— using shielding materials to reduce the level of radiation.

If there is loose radioactive material present, there is a risk that field personnel may become contaminated, either externally (e.g. clothes, skin etc) or internally (by inhaling or ingesting the radioactive material). If external contamination occurs, the contamination needs to be removed as early as feasible. If there are no standard facilities available, then arrangements will be needed for field personnel to change their clothes and wash themselves as soon as practicable (see Section 6.5).

To avoid internal contamination via inhalation or ingestion of radioactive material, field personnel are advised not to:

— disturb any materials, which have leaked or spilled from a suspicious container.
— disturb the contents of any suspicious package; or
— eat, drink or smoke within the cordon controlled areas or prior to being checked for contamination.

6.2. Protective measures

Protective clothing and gloves can help to avoid body surface contamination. As a general rule field personnel are advised not to touch suspicious substances. Arrangements need to be made for the disposal of contaminated protective clothing.

If the radiological advisor indicates that there is any danger of airborne radioactive particles, then field personnel may need to use respiratory protection as a precautionary measure. However, the use of specialized breathing apparatus requires specific training and the equipment should only be used by trained personnel.

6.3. Personal dosimeters

Personal dosimeters are small instruments that are worn by an individual to record the exposure to external radiation. Some personal dosimeters may also provide an alarm when the radiation dose or dose rate exceeds a predetermined level. Ideally, all field personnel working within the inner cordon should be issued with, and should use, personal dosimeters. It should be noted that standard dosimeters cannot generally be used to measure exposure to neutron radiation. In such cases, where neutron emitting materials are present, the radiological advisor should determine whether specialized personal neutron dosimeters are needed.

6.4. Hand-held monitoring equipment

Radiation survey meters can be used to measure radiation levels. Most survey meters are sensitive to gamma radiation, some can detect beta radiation, some can detect neutron radiation, and some can be used to monitor for contamination. Field personnel should know the limitations of any survey meter they use. Unless there are fixed installations in place to monitor levels of radiation, a portable survey meter will normally provide the first information on radiation levels at a scene.

The survey meter should be switched on when approaching any suspicious object, so the instrument can give an early indication of increased levels of radiation. The results of the radiation survey will be important when trying to establish a safe working distance and to determine the size of the inner cordon. Records are needed of all measurements, together with the timing and exact location of the reading.

6.5. Monitoring and decontamination

The establishment of cordon controlled areas would normally provide single access points to both the inner and outer cordon (see Fig. 3). The radiological advisor is likely to implement contamination control at an appropriate place outside the inner cordon area. If necessary, and as space allows, the radiological advisor may establish a decontamination corridor leading from the inner cordon area.

Personnel and equipment can then be monitored when they exit the inner cordon area. As a general rule, if there are detectable contamination levels in excess of twice the normal background radiation levels, personnel need to be advised to first proceed to the decontamination facilities and decontamination can be attempted. In life threatening situations, treat trauma first. Once this has been attended, decontamination may then be performed.

Decontamination serves several purposes. First, it reduces the potential for continued exposure. Second, it minimizes dose to the individual and dose rates within the operational area. Third, it also limits the spread of contamination and hastens the return to normality.

It is recommended that final monitoring of personnel and equipment is performed at the exit of the outer cordon to ensure that no contaminated individuals or equipment leave the cordon controlled areas. Contaminated items should be placed in sealed plastic bags that should be labelled.

If persons have contamination on their body this should be promptly removed by washing or irrigating the affected area repeatedly, taking care not to damage the skin surface. The radiological advisor, or trained medical expert should, preferably supervise the decontamination procedure. In the event that decontamination processes at the scene do not result in complete decontamination of an individual, that individual may, under the direction of the radiological advisor, be referred to an appropriate medical facility.

7. INCIDENT INVESTIGATION AND GATHERING OF EVIDENCE

7.1. General considerations

Member States may wish to consider the requirement to establish written directives to provide specific procedures for investigating all incidents involving inadvertent movement or illicit trafficking of radioactive materials.

7.1.1. Illicit trafficking

If an incident is classified as one of illicit trafficking in radioactive materials, such activity may be regarded as a criminal act and any investigation will proceed on that basis. This may result in a series of peripheral criminal offences such as:

— conspiracy to commit criminal acts;
— bribery and corruption offences;
— theft of nuclear or other radioactive materials;
— criminal negligence on the part of the those persons responsible for the safe storage and security of the radioactive materials;
— assault occasioning actual bodily harm or reckless endangerment of life as a result of innocent individuals becoming irradiated;
— criminal damage to property which has been contaminated; and
— violation of customs laws and other relevant import and export control regimes.

In addition to criminal proceedings, there may also be:

— a death inquest by a coroner if any individual is killed as a result of the incident;
— a judicial or other public inquiry;
— a statutory inquiry by the national regulatory authority for the control of radioactive materials;
— a statutory inquiry by other national agencies such as Civil Aviation, Marine, Railway or Transportation authorities, or
— a statutory inquiry by the legislative body of a Member State.

The incident investigation officer must be fully aware of the potential needs associated with all of the above inquiry processes. If there is a need for parallel inquiries to support different processes, then it is encouraged that the incident investigating officer forms a multi-disciplined team, with staff drawn from the key agencies.

Consideration needs to be given to the importance of conducting only one investigation, through the appointment of a lead agency, which covers all the likely contingencies. Separate investigations by different agencies not only duplicates work, but may also cause confusion if there are different conclusions or investigative techniques. In many countries pre-trial disclosure of evidence is a legal requirement. If there is more than one investigation, then all aspects of parallel investigations are subject to disclosure. If there are discrepancies between the parallel investigations, these discrepancies may undermine any criminal prosecution or other judicial processes.

7.1.2. Inadvertent movement

Because an incident involving inadvertent movement is probably the result of ignorance, carelessness, or negligence involving a violation of licence or registration conditions, it is likely that an investigation will still be warranted. However, in this case it will probably be the regulatory body performing the investigation and enforcing any penalties, rather than the law enforcement agencies.

7.2. Legal provisions under national legislation

The incident investigation officer needs to be fully conversant with all legal provisions relating to incidents of illicit trafficking in radioactive materials and other regulations which may be applicable to the management of such incidents. The incident investigation officer will also need access to references on national legislation governing:

— criminal offences relating to inadvertent movement or illicit trafficking of radioactive materials;
— powers of arrest, search and seizure;
— regulations for the control and safe storage of radioactive materials;
— regulations for the safe transport of radioactive materials;
— other regulations or legal requirements under civil law; and
— regulations for physical protection of nuclear materials.

If national legislation does not provide for a specific criminal offence of illicit trafficking in radioactive materials, then legal advice can be sought as to the most appropriate legal provisions applicable to the situation.

7.3. Scene-of-crime procedures

Given that an incident of illicit trafficking in radioactive materials, especially in nuclear materials, may constitute a crime, then there will undoubtedly be a need to gather any available evidence to support a future criminal prosecution. However, normal scene-of-crime procedures may be difficult to implement while there is a risk of exposure to the investigating officers. Although it may be desirable to seize items as evidence, care must be taken to ensure that any item seized at the scene is handled safely.

In addition to normal equipment, it is advised that a scene-of-crime officer be accompanied by a radiological safety officer who is equipped with:

— personal dosimetry;
— surface contamination monitors and low range survey instruments;
— other protection equipment such as, overalls, overshoes, face-masks and gloves; and
— plastic containers and bags.

Consultation between the incident investigation officer and the radiological advisor will be needed on the advisability of conducting a scene-of-crime examination of the scene before decontamination processes are implemented. This is because the decontamination processes will result in the loss of normal contact evidence such as fingerprints. Also, in order to conduct an examination of the scene for contact evidence, it may be necessary for a scene-of-crime officer to be in close proximity to a radioactive source, with the associated risk of exposure.

The scene-of-crime investigation will ultimately be dictated by the safety requirements as set down by the radiological advisor. If circumstances dictate, it may be necessary to delay such investigations.

7.4. Search procedures

A full forensic search of the scene will be needed if possible. The radiological advisor and the advisor's team will wish to conduct a survey of the site to monitor for contamination and it may be possible for investigating officers to search the scene at the same time.

A grid system could aid the radiological survey of the site and individual readings can be referenced to specific grid squares. A systematic search of each square may reveal evidence to support the investigation. Any item seized should be monitored to ensure that there is no health hazard to the officers involved with the documentation and custody of seized items.

7.5. Recording procedures

Only in extreme cases, will radiation levels have an effect upon the quality of undeveloped photographic materials. However, when very high levels are present it may be necessary to ensure that undeveloped photographic materials are removed to a safe distance to ensure the quality of photographic evidence. It is suggested that video or digital equipment are most suitable for recording the scene under such circumstances.

It is advisable to draw an accurate plan of the scene showing the location of any radioactive and other evidential materials, the extent of the contamination and the establishment of cordon control areas. The use of a grid system can assist with the production of such a drawing. The plan could become an essential item of information in any judicial process.

7.6. Witnesses

Witnesses will generally fall into four categories, which are:

— individuals who have come into contact with the radioactive materials or into contact with the person(s) engaged in illicit trafficking;
— response personnel;

— background witnesses; and
— technical experts.

The incident investigation officer will wish to plan for the management of these four witness groups. Similar to normal investigations, it is important to locate and interview witnesses at the earliest opportunity while events are still fresh in their minds. Late statement taking runs the risk of distortion from the inevitable media coverage and from discussions with others.

Witnesses who have come into contact with the radioactive materials will need to be monitored for contamination prior to being interviewed. These witnesses may be surprised and distressed to learn that they may have been exposed to radiation. A brief statement can be taken to record essential information at the initial stage. This can be followed by a full statement at a later stage once the witness is no longer distressed.

Response personnel will be important witnesses and the incident commander will wish to ensure that all personnel deployed at the scene of an incident keep accurate and contemporary notes of all actions taken.

Background witnesses are those individuals who can provide background information surrounding the incident, such as airline staff or shipping clerks. Such witnesses may prove to be of considerable value in tracking the movement of the radioactive materials and also in the identification of individuals who have unknowingly been exposed to radiation.

Technical experts will clearly be necessary to provide information on:

— the identification of the radioactive materials;
— the expected health effects of any radiation exposure;
— the extent of contamination, if any;
— the measures required to control radioactive materials; and
— any other relevant specialized evidence.

Investigating officers, such as customs officers or police, are unlikely to have the depth of scientific knowledge necessary and therefore may experience difficulty in interviewing technical experts. Therefore, it may prove helpful to have an investigating officer accompanied by an independent technical expert who can assist the officer in asking appropriate questions and recording technical information accurately.

7.7. Prosecution of offenders

Member States will each have their own judicial process to bring a prosecution against those persons who engage in illicit trafficking in radioactive materials. Incidents of illicit trafficking may extend across several jurisdictions. Theft of radioactive materials may occur in one State and the materials transported across several national boundaries. In such cases there will be a need for international co-operation in both the investigative processes and in the prosecution of offenders. In the case of nuclear materials, there may be specific commitments for Member States under the Convention on Physical Protection [7].

Further information on cross-border co-operation, and the assistance available to deal with international incidents of inadvertent movement or illicit trafficking of radioactive materials, may be obtained from the World Customs Organization (WCO), EUROPOL or the International Criminal Police Organization (INTERPOL).

8. MEDIA AWARENESS

8.1. General considerations

An incident that involves the inadvertent movement or illicit trafficking of radioactive materials may generate intense media interest, particularly so if the incident involves a serious potential security threat or health hazard. Television crews, reporters and photographers may well arrive at the scene of an incident very quickly and often in advance of the deployment of the response personnel.

Staff from the responding agencies will attempt to quickly isolate the scene of the incident, to mitigate any actual or potential health hazards. However, the media representatives will consider that they have a duty to the public to report the incident and will seek access to the site to take photographs and to videotape events. Response personnel need to be briefed on how to deal with approaches from the media, and how to ensure that they do not enter the area that is cordoned off. Response personnel should be advised to direct media enquiries to the designated press liaison officer.

The incident commander can alleviate tensions and media pressures by understanding the media's needs and by making provision for them. For example, a brief statement of the facts might be made as early as possible covering:

— the circumstances of what has occurred and the fact that radioactive materials could be involved; and
— what actions are being taken to contain the situation.

A brief statement will allow media personnel to prepare basic reports for their various agencies and may help to alleviate public concerns about the incident. Speculation regarding the possible health or other impacts of the event is best avoided. The incident commander can then arrange for further factual statements at specified times or provide regular bulletins at specified intervals. This arrangement helps to ensure that the media co-operate with emergency response personnel, as they will have some assurance that the facts relating to the incident will be provided regularly.

8.2. Working with the media

The incident commander would normally be aware of the problems posed by an aggressive media and can alleviate the problems by appointing a press liaison officer. The function of the press liaison officer is to facilitate the work of the media so that they do not impede the operational response.

At the initial stages of an incident it may not be possible to arrange accreditation of media representatives, but it is important that the press liaison officer takes steps to establish some agreed form of identification and accreditation as early as possible.

As stated, the media representatives will seek access to the cordon control area, but safety and forensic requirements will prevent free access, especially to the inner cordon. The press liaison officer has the responsibility of making provision for media requirements.

It is usually helpful if an explanation is provided to media representatives as to the reasons why the cordons have been established and access restricted. Quite apart from preventing any

interference with field personnel, the response team has a responsibility to ensure everybody's safety at the scene, including that of media personnel.

8.3. Media reception point

A key element in good media relations is to establish a media reception point close to the scene. There are several factors to be considered when selecting a site for the media reception point. These are:

— the media reception point is best located close to, but outside the cordon controlled areas;
— the site should have adequate parking and easy vehicle access;
— the provision for press briefings requires a large hall or similar facility to accommodate all members of the media; and
— the media reception point is best when it provides a dedicated zone for the use of media personnel and another zone for the press liaison officer and support staff.

The creation of a media reception point with the provision of communication facilities will provide a framework to deal with the media, but it must be recognized that it is also established to serve the media and to facilitate their work.

8.4. Using the media to alert the public

Improved technology and communications now result in an immediate and enormous distribution of information in response to any major incident. Within hours of an incident, television pictures can be beamed to households around the world. This provides the incident commander with a valuable resource because the media can be utilized to circulate important information relating to the incident. For example if there is a loss of control of radioactive material and the location is not known, the media could be used to alert the public to the potential dangers and provide information regarding the actions to be taken if the material is found.

The media can also assist with an investigation in that individuals may have become unwittingly exposed to radiation or have unknowingly been contaminated. The media can be used to contact these people and to urge such individuals to seek medical treatment or to come forward as witnesses.

Finally, the media can inform the public that response personnel are taking all possible steps to minimize security risks and to mitigate health hazards and this can go a long way towards reassuring the public and allaying their fears. If the incident commander seeks to use the media resource, then it is vital that a good working relationship is established with them from the beginning.

9. NEED FOR PLANNING, EQUIPMENT AND TRAINING

The production of response plans is no simple task, but such planning is necessary if incidents of inadvertent movement or illicit trafficking of radioactive materials are to be handled effectively and in a safe manner. IAEA-TECDOC-953 "Method for the Development of Emergency Response Preparedness for Nuclear or Radiological Accidents" [5] will be helpful in this process. During the planning stage, provision also needs to be made for a programme

of training to be implemented to ensure that response personnel are familiar with the procedures and equipment.

However, the work does not end when the plan is finally written and published. For any plan to be effective, it has to be practised. This does two things: first, it ensures that everyone who is required to undertake a role within the plan structure is familiar with their role and the respective elements of the plan. Second, the process tests the validity of the plan and allows a revision of the planning concepts and strategies in light of the lessons to be learned. These principles are embodied in the familiar concept that exercises should "Test The Plan and Train The People (TTP)[2]".

In certain cases, contingency plans are implemented and tested regularly in real life situations, but the frequency of incidents involving inadvertent movement or illicit trafficking of radioactive materials is very low. Therefore there will be little opportunity for response personnel to gain actual experience in dealing with such incidents and the key to effective response plans is to conduct routine drills and simulation exercises.

10. CONCLUSION

10.1. Summary

The information in this TECDOC is intended as an overview of the response mechanisms required to deal with incidents of inadvertent movement or illicit trafficking of radioactive materials. It is written for an audience of customs or police officers, or other front-line response individuals who may be confronted with such incidents. Detailed scientific information has been kept to a minimum as the majority of such personnel will not have sufficient scientific knowledge to use the information effectively.

The framework outlined in this TECDOC provides a basis for operational and tactical response measures. These need to have elements of flexibility built into the response programme since the nature of incidents will vary greatly both in scale and the types of response required.

10.2. Standard operating procedures

Various elements of this TECDOC can be separated into modules and a standard operating procedure (SOP) developed for each module. The preparation of SOPs needs to take account of the prevailing circumstances in the Member State, which will vary due to national legislation or other statutory requirements. However, SOPs form an integral part of response planning and provide personnel with specific information relating to their part in the overall response mechanism. They also form the basis upon which to devise training drills or simulation exercises. IAEA-TECDOC-1162 "Generic Procedures for Assessment and Response During a Radiological Emergency" [6] will be a useful starting point in this regard.

Annex I
STRATEGIC RESPONSE CONSIDERATIONS

A.I.1. Introduction

It is recognized that the vast majority of incidents of inadvertent movement or illicit trafficking of radioactive materials will be dealt with at an operational level, with the occasional incident requiring a tactical response. In the unlikely event that a very serious situation develops, which necessitates the activation of an emergency response plan, there will be strategic considerations in the response mechanism. These issues will be detailed in the emergency response plan, but some main points are summarized in this Annex as a general overview.

A.I.2. Multi-agency response

The activation of an emergency response plan will result in a number of different agencies responding to the incident. If the incident is to be managed effectively, then it is an essential management strategy to have an effective co-ordination of all responding agencies. To achieve that it is first necessary to recognize that the command structure will need to change.

A.I.3. Command structure

The overall command of the incident will move from the incident commander at the scene to a higher level of command, called the response manager. A pre-designated individual will be appointed as the response manager and assume overall command of the response. Typical duties and responsibilities of the response manager are detailed later in this annex.

The incident commander, radiological advisor and the incident investigation officer, together with their respective support teams will all report directly to the response manager. In a complex situation there may be more than one scene and this will necessitate the deployment of an incident commander and response personnel to each location, all of whom will come under the command of the response manager.

A.I.4. Creation of a response command centre

The emergency response plan will detail the mechanism for the creation of a response command centre. This can be implemented as soon as practicable and can be done in parallel with the mobilization of personnel detailed in the emergency response plan. The duty supervisor may assume the role of the response manager until such time as the response personnel are fully deployed. In this role the duty supervisor will oversee the creation of the response command centre. The aim would be to have the response command centre fully operational by the time that the response manager arrives and assumes responsibility for the incident.

A.I.5. Response management

The response manager will be based in the response command centre and will co-ordinate the actions of all agencies responding to the incident. To facilitate inter-agency co-operation, the response manager will want to convene an inter-agency support group, which will provide a forum for policy formulation and strategic decision-making.

The composition of the inter-agency support group will vary according to the responding agencies. It is essential that there is adequate representation from all responding agencies by personnel, who have sufficient seniority to make decisions on behalf of their parent agency. The main objectives of the inter-agency support group are to:

— identify overall objectives and set policy;
— identify areas of expertise and the responsibilities of agencies involved;
— identify and set individual agency objectives;
— identify and resolve areas of conflict between responding agencies;
— identify resource requirements; and
— establish a common approach to the media.

A.I.6. Actions by the response manager

The response manager will assume control of the incident and will ensure that all response mechanisms are channelled through the response command centre. In addition to the co-ordination role, the response manager will be the authority for the deployment of all resources during the incident.

The response manager will wish to obtain briefings from all personnel already engaged in the management of the incident. His/her primary functions will be to:

— assess the nature of the incident;
— decide on response measures;
— consider public announcements; and,
— enable strategic thinking on potential outcomes as the response develops.

If not already in place, the response manager needs to ensure that a log of the incident is maintained to record all critical actions and decisions taken during the incident. Matters recorded in the log will include, among other things:

— timings of the incident, response initiation, notification, arrival and deployment of resources;
— list of individuals participating in the response team;
— details of all personnel at the scene;
— records of individual doses and, if not in possession of personal dosimeters, the length of time that personnel have been in the inner cordon area;
— details of any casualties;
— details of any arrested individuals ;
— decisions on protective actions;
— decisions on response actions;
— details of the site plan; and
— major changes to the situation.

The response manager will stipulate reporting criteria, whereby all response personnel provide regular situation reports on their respective activities. The timing and frequency of these reports will be determined by the prevailing circumstances, but it is likely that the frequency will be higher during the early stages of an incident.

A.I.7. Duties and responsibilities of the response manager

A.I.7.1. Role

The role of the response manager is to co-ordinate the strategic response of all agencies deployed to deal with an incident in accordance with the emergency response plan. The response manager must anticipate requirements and make senior command decisions necessary for the effective management of all aspects of the response procedures. This individual will ensure that key and support functional command responsibilities have been suitably allocated and will also have particular responsibility for directing the flow of information to the media.

A.I.7.2. Objectives

The principal objectives of the response manager are to:

— minimize any potential health hazards;
— neutralize any security threat.

A.I.7.3. Duties

The specific duties[6] of the response manager are to:

— assume overall command of the response;
— ensure that the appropriate command structure has been activated;
— co-ordinate the response of all emergency and support services;
— chair meetings of the inter-agency support group;
— identify resource requirements and to ensure acquisition if necessary;
— ensure that all critical actions and decisions are recorded;
— ensure compilation of all relevant documentation;
— facilitate the incident investigation;
— devise and implement a media strategy;
— control the release of information to the media;
— compile the response management report.

[6] The duties listed are suggested as the principal functions which will be undertaken by the response manager. In some incidents it may not be necessary to undertake all functions, while in other incidents there may be additional functions which need to be undertaken.

Annex II
GENERIC STRUCTURE OF AN EMERGENCY RESPONSE PLAN

The following outline offers a model structure for the formulation of an emergency response plan to cater for inadvertent movement or illicit trafficking of radioactive materials. It is similar to other outline plans which deal with radiological accidents. However, it is stressed that no single model will be appropriate in all circumstances. Other formats and structures are entirely adequate, provided they are comprehensive, and cognizance must also be taken of national, regional and local conditions. Further guidance in IAEA-TECDOCs on the subject will also be found useful [5, 6].

TITLE PAGE

Title of the plan, approval date, concurrence/signatures, and signatures of the heads of all agencies with a role in the response mechanisms.

TABLE OF CONTENTS

4.1. Overview of tactics and strategy
4.2. Command structure
4.3. Command facilities
4.4. Overall management
4.5. On-scene management
4.6. General outline of procedures to mitigate health hazards
4.7. Casualty management
4.8. Seizure and disposal of radioactive materials
4.9. Incident investigation
4.10. Media awareness

5. EMERGENCY PREPAREDNESS

5.1. Responsibility: *Describe who is responsible for producing the emergency response plan and for the maintenance of the plan.*
5.2. Revisions: *Explain the requirements and mechanisms for revision of the plan.*
5.3. Training: *Define the general training policy and requirements, including who is responsible for training.*
5.4. Exercises: *Describe how often exercises take place, who is responsible for planning, preparation and implementation and how lessons learned can be incorporated into the plan. This can also include drills and tabletop exercises.*
5.5. Public Education: *Define responsibilities for educating the public on emergency plans.*

Annex III
DUTIES AND RESPONSIBILITIES OF KEY PERSONNEL

A.III.1. Incident commander

A.III.1.1. Role

The role of the incident commander is to:

— direct all operations at the scene of an incident;
— be in command of all field response personnel;
— ensure control the scene;
— facilitate response procedures;
— liaise closely with the radiological advisor and the incident investigation officer.

A.III.1.2. Objectives

The principal objectives of the incident commander at the scene are to:

— neutralize any security risks;
— minimize any potential health or environmental hazards;
— secure and preserve evidence for potential judicial process;
— restore the scene in accordance with standard safety practice.

A.III.1.3. Duties

The specific duties[7] of the incident commander at the scene are to:

— establish and maintain control of the scene;
— establish an incident command centre at a suitable location;
— ensure that a hazard assessment is conducted;
— co-ordinate response actions of agencies at the scene;
— liaise with and report to the response manager;
— seek provision of manpower, communications and specialist resources through the response command centre;
— appoint a cordon control officer and to instigate cordon procedures;
— appoint a reception officer and establish a reception area for response personnel;
— facilitate traffic management and to ensure the establishment of a vehicle marshalling area;
— appoint a press liaison officer and to establish a media reception point.

A.III.2. Radiological advisor

A.III.2.1. Role

The role of the radiological advisor is to:

— assess the radiological hazard at the scene of any incident;
— provide radiation protection for response personnel and the public; and
— provide expert advice on measures necessary to minimize any radiological hazard.

[7] The duties listed are suggested as the principal functions which will be undertaken. In some incidents it may not be necessary to undertake all functions, while in other incidents there may be additional functions which need to be undertaken.

A.III.2.2. Objectives

The principal objectives of the radiological advisor are to:

— assess the radiological hazard;
— minimize potential health and environmental hazards;
— locate and render the radioactive materials safe;
— prevent the spread of radioactive contamination;
— assess the nuclide composition, the amount and physical condition of the radioactive materials.

A.III.2.3. Specific duties

The specific duties[7] of the radiological advisor are to:

— conduct a radiological survey of the scene of an incident;
— establish decontamination procedures at the scene;
— provide expert advice on decontamination of the scene;
— provide radiation protection support to response personnel including provision of personal dosimetery;
— estimate the dose received by response personnel or the public;
— provide expert advice on the seizure of radioactive materials;
— maintain an inventory of monitoring and personal protective equipment.

A.III.3. Incident investigation officer

A.III.3.1. Role

The role of the incident investigation officer is to assume responsibility for all investigative processes associated with an incident. This will include investigation of confirmed incidents where inadvertent movement or illicit trafficking of radioactive materials has been disclosed and also incidents where they are suspected, but the location of the radioactive materials is not known.

A.III.3.2. Objectives

The principal objectives of the incident investigation officer are to:

— identify the location of the radioactive materials;
— bring the radioactive materials under control;
— identify the persons or individuals engaged in the inadvertent movement or illicit trafficking;
— apprehend the individual(s) responsible.

A.III.3.3. Specific duties

The specific duties[7] of the incident investigation officer are to:

— establish an incident investigation room;
— interview witnesses and to collect evidence;
— record details of the scene by such means as photographs, video film and plan drawings;
— conduct scene-of-crime procedures at the scene having due regard to radiological hazards;
— assume responsibility for arrested individuals;
— prepare investigation reports for criminal prosecutions, judicial inquiries, death inquests or other statutory investigations.

Annex IV
CASUALTY MANAGEMENT

A.IV.1. Introduction

Basic information on casualty handling at the scene has been included in Section 5 of the main text of the TECDOC. However, in the unlikely event that a very dangerous situation develops, where there are also a number of casualties, some further considerations on casualty management are necessary.

A.IV.2. Liaison with medical authorities

Due to the low frequency of radiological accidents, the majority of medical personnel will have little or no experience in dealing with patients who have been irradiated or who may be contaminated. Emergency response plans therefore need to make provision for initial treatment facilities and for a programme of assistance to medical staff who may be required to respond during an incident of inadvertent movement or illicit trafficking of radioactive materials. Initial treatment facilities need to have the capability to treat non-radiation injuries of contaminated patients and to implement decontamination processes. They also need to identify personnel with radiation exposures who require specialized treatment and to prepare patients for transport.

A good emergency response plan will also recognize that specialized medical centres may be required, depending upon the degree and nature of the radiation injuries.

Under the emergency response plan, provision can be made for the maintenance of a register that contains the following information:

— a list of medical facilities at local, regional and national level, which have the capability to deal with radiation induced injuries;
— a list of medical personnel and support staff who have the necessary expertise to deal with casualties from a hazardous radiological incident;
— a list of contact personnel in emergency ambulance services with the necessary expertise to handle the transportation of casualties from the scene of a radiological hazardous incident; and
— an inventory of specialized equipment and supplies as designated under the plan.

It is best if the response manager/incident commander liaises with medical authorities at the early stage of an incident, providing them with such information as is available, with regard to:

— the number of injured individuals and their injuries;
— the number of individuals who have been exposed to radiation;
— the number of individuals who have been contaminated;
— the type of radioactive materials encountered;
— decontamination processes at the scene of the incident; and
— transportation arrangements to transport casualties to the most appropriate receiving hospital.

In consultation with the radiological advisor, medical authorities will need to decide upon the medical facility to be used to receive casualties and implement procedures for the medical management of the casualties. Further guidance for medical arrangements can be found in IAEA Safety Series No. 88 [12].

A.IV.3. Mobile medical teams at the scene

In the event that there are a large number of casualties at the scene, it is normal emergency practice that mobile medical teams would be sent to the scene from the local hospital. It is important that the mobile medical teams have adequate training in the management of radiological injuries and are fully familiar with procedures to mitigate health hazards, both in terms of their own personal protection and in preventing the spread of contamination. In addition to normal first aid equipment, a mobile medical team will need to be equipped with:

— personal dosimeters and protective equipment such as overalls, overshoes, face-masks and gloves;
— surface contamination monitors and radiation survey instruments;
— plastic covers and bags to prevent the spread of contamination;
— radiation warning labels and signs; and
— equipment for collecting biological samples.

In the event of a large number of casualties, medical teams will need to carry out a medical triage. Casualties should be stabilised before being monitored for radioactive contamination and a similar triage process should be adopted based on the results of the contamination survey. To ensure the well-being of the casualty, the contamination monitoring should be done by radiological experts working under the supervision of medical specialists. Casualties with serious injuries and in a critical condition will need to be transported to the medical receiving facility first, with contamination monitoring being carried out later if necessary.

A.IV.4. Transportation of casualties

The response manager should liase with the emergency ambulance authorities to arrange transportation of casualties to the receiving facility. Ambulance crews may, in addition to their normal medical first aid equipment, be in possession of equipment similar to that carried by the mobile medical team. Contamination control of ambulance personnel and the vehicle should be done as soon as possible following the transportation of a casualty and certainly before using the ambulance for any other purpose. If any contamination is found, then both the ambulance personnel and the vehicle must undergo decontamination procedures, before the crews can be further deployed or the vehicle re-used. The exception to this is if they are returning for more contaminated casualties.

A.IV.5. Reception of casualties at hospital

Arrangements need to be in place at the initial receiving facility to ensure that the facilities and hospital personnel do not become adversely affected upon the arrival of a contaminated patient. These arrangements will provide for:

— a clearly defined entrance that allows a contaminated casualty to be received and segregated from other patients;
— a prepared treatment area, where the casualty can be examined and treated;

— personal protective equipment for medical personnel and support staff who may come into contact with the patient;
— radiation monitoring equipment, including wound monitoring equipment to determine the extent of any radioactive contamination and to minimize the spread of contamination;
— decontamination facilities to cater for patients, ambulance crews and other personnel who may become contaminated by contact with the casualties;
— the capability to obtain and process biological samples; and
— containers for, and management of, contaminated clothing, equipment and other wastes.

It is important that all personnel who come into contact with a contaminated patient are monitored prior to leaving the segregation area and also that the area itself is monitored to ensure that there is no residual contamination after the patient has been treated. This will prevent the spread of contamination and allow decontamination processes to be implemented where necessary.

A.IV.6. Conclusion

This Annex provides a short overview for persons who are not familiar with casualty management at the scene of a radiological hazardous incident and attempts to summarize the main points for consideration. Much has already been written on the subject of casualty management during radiological accidents and it is not intended to duplicate that work. The procedures to deal with casualties from an incident of inadvertent movement or illicit trafficking of radioactive materials will be identical to those procedures, which have been developed for radiological accident situations.

Annex V
PROTECTION OF WORKERS UNDERTAKING INTERVENTION

Protection of workers undertaking intervention is addressed in the Basic Safety Standards [13]. The following extract from the IAEA Safety Guide on Occupational Radiation Protection [14] explains in more detail.

"6.10. The fundamental difference between members of the public and workers in situations requiring intervention is that members of the public will receive doses unless some action is taken to prevent them, whereas workers will not receive doses (except during the initial course of an accident) unless a decision is made to expose them to the source. Thus, in most cases, it is reasonable to continue to treat workers' exposures within the system of protection for practices, particularly so in the latter stages of intervention. Because the exposure is deliberate and controlled, the dose limits for workers should be assumed to apply unless there are overriding reasons not to apply them, such as the need to save life immediately after an accident or to prevent the development of catastrophic conditions.

6.11. It therefore follows that the doses to workers undertaking intervention should, if at all feasible, be kept below the maximum single year dose limit for occupational exposure, which in the case of effective dose is 50 mSv. Paragraph V.28 of the BSS (Ref. [2]) specifically requires workers undertaking tasks which might cause them to receive a dose above the maximum single year dose limit to be volunteers. However, it is stated in a footnote that if military personnel are involved, this requirement may not apply in some circumstances. The footnote also implies that the levels of dose discussed above for workers involved in undertaking actions may not necessarily apply to military personnel. Nevertheless, it states that the exposure of such personnel should be limited to levels specified by the regulatory authority.

6.12. The BSS (Ref. [2], para. V.27) envisage three situations where it would be justified for the dose limits to be exceeded, as follows:

(a) for the purpose of saving life or preventing serious injury;
(b) if undertaking actions intended to avert a large collective dose; or
(c) if undertaking actions to prevent the development of catastrophic conditions."

6.13. For these situations the objective, in general, should be to keep doses below twice the maximum single year dose limit (i.e. below an effective dose of 100 mSv or equivalent doses of 1 Sv to the skin and 300 mSv to the lens of the eye). However, where life saving actions are concerned, significantly higher levels of dose could be justified, although every effort should be made to keep doses below ten times the maximum single year dose limit in order to avoid deterministic effects on health (i.e. below an absorbed dose to the whole body of 500 mGy or an absorbed dose to the skin of 5 Gy). Workers undertaking actions in which their doses may approach or exceed ten times the maximum single year dose limit shall do so only when the benefits to others clearly outweigh their own risk.

6.14. In a footnote to para. V.27 of the BSS it is noted that "Workers undertaking an intervention may include, in addition to those employed by registrants and licensees, such assisting personnel as police, firemen, medical personnel and drivers and crews of evacuation vehicles". Such workers should be treated as discussed in paras 6.16–6.20 below.

6.15. Paragraph V.28 of the BSS (Ref. [2]) specifically requires workers who may receive a dose greater than the maximum single year dose limit to "be clearly and comprehensively informed in advance of the associated health risk, and shall to the extent feasible, be trained in the actions that may be required." These actions relate to the protection of the public and themselves. In particular, information and, where necessary, training should be provided on protective measures, such as respiratory protection, use of protective clothing, means of shielding and iodine prophylaxis. Where workers may be exposed to radiation fields with relatively high dose rates, pre-established guidance should be given on dose, dose rates and air concentrations for the appropriate time period."

Annex VI
TRANSPORT ARRANGEMENTS FOR RADIOACTIVE MATERIALS

Some basic information has been provided in Section 5 of the TECDOC on the seizure and the temporary storage of radioactive materials at the scene of an incident. If a very dangerous situation develops, where it is necessary to transport the radioactive materials from the scene of an incident, some further considerations are necessary.

There are specific regulations governing the transportation of radioactive materials. These regulations are contained in the IAEA Safety Standards on Regulations for the Safe Transport of Radioactive Material [9]. For transport of nuclear materials, provision must also be made for physical protection [7]. The main considerations are to:

— keep individual doses as low as possible;
— limit the number of individuals who are exposed; and
— maintain the likelihood of incurring exposure at the lowest achievable level.

The aim is to comply with the IAEA Safety Standards in regard to the containment system for radioactive materials, packaging and the radiation levels, which are prescribed for a package or container. However, in an emergency situation where transportation of the radioactive materials cannot be done in accordance with the IAEA Safety Standards, special arrangements have to be implemented. These arrangements may cover a single movement of the materials or a series of consignments.

The response manager will need to consider all possible options available for the transportation of the radioactive materials. The ultimate aim is to transport the items to a secure and safe storage facility and then to arrange disposal in accordance with IAEA Safety Standards. If the response manager instigates special arrangements for the transportation of the radioactive materials, the option should be selected that provides the best alternative to compliance with the IAEA Safety Standards having regard to:

— the potential exposure of response personnel, transportation workers and the general public;
— the potential for the spread of contamination; and
— the security risks.

In emergency situations where transportation of radioactive materials is necessary, but cannot be done in accordance with IAEA Safety Standards, then consideration can be given to using either temporary storage facilities at the scene, or an interim storage facility as close to the scene as possible. Keeping the transportation distance and time as short as possible will minimize the potential for exposure of personnel and the spread of contamination.

When all radioactive materials have been removed from the scene, the area can be re-surveyed to identify any areas where there is contamination. The site can the be decontaminated. If it is not possible to bring radiation levels back to normal background readings, then cordon procedures must be maintained. Arrangements will be needed to isolate and shield areas, which cannot easily be decontaminated.

A.VI.1. Disposal of radioactive materials

Once the radioactive materials have been brought under control and transported to a safe storage facility, the responsibility for eventual disposal of the materials can be passed to the appropriate national authority. Although it may be desirable to dispose of the materials immediately, there is an added dimension to the seizure of radioactive materials during an incident of inadvertent movement or illicit trafficking. The radioactive materials may be regarded as an exhibit for any future court process and in such circumstances may be regarded as case property relative to the criminal activity associated with the incident. Final disposal of the radioactive materials may have to await the conclusion of any judicial process or criminal prosecution and may require a court order before destruction or eventual disposal can be implemented.

If there are continuing hazards or security risks associated with the storage of the items, then dispensation from the court or appropriate legal authority can be sought to dispose of the items, prior to the conclusion of any criminal prosecution or judicial process. Care must be taken to ensure that the evidential value of the materials is not overlooked or lost due to disposal or destruction without legal authorization.

Annex VII
SAMPLE ACTION CARD

A.VII.1. Hazardous incident of inadvertent movement or illicit trafficking

When an incident of inadvertent movement or illicit trafficking of radioactive materials is reported, and where there is a hazardous situation that cannot be handled at either the operational or tactical response levels, the duty supervisor of the responding agency will:

(1) Direct officers at the scene **NOT TO**:

— handle any suspect packages;
— walk into or touch spilled materials; or
— inhale fumes or other gases emanating from the radioactive radioactive source.

(2) Direct the implementation of an inner cordon around the radioactive source if practicable, with evacuation procedures, or if not practicable to otherwise to isolate the radioactive source.

(3) Activate, or if necessary, seek authority to activate the **emergency response plan**.

(4) If authorized, instigate call-out procedures for the designated **response team**.

Response Manager:

Name: …… Contact: ……

Incident Commander:

Name: …… Contact: ……

Radiological Advisor:

Name: …… Contact: ……

Incident Investigation Officer:

Name: …… Contact: ……

(5) Activate the response command centre and ensure that an incident command centre has been established.

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GLOSSARY

The following definitions apply for the purposes of the present publication:

Control of radioactive materials

The act of maintaining cognizant supervision by proper authorities over the production, use, storage, transport and disposal of radioactive materials.

Criticality

A property of nuclear material which can lead, under special conditions, to a self-sustained chain reaction.

Emergency response plan

A document describing the organizational structures, roles and responsibilities, concept of operation, means and principles for intervention during an emergency. In the context of this publication the plan will specifically cover the response to a radiological hazardous incident of inadvertent movement or illicit trafficking of radioactive materials.

Fixed, installed monitors

Equipment usually installed at border crossing points, in airports or port areas, but can also be found at the exit/entrance points to other facilities such as nuclear power plants or scrap metal yards. The equipment operates as a static portal to monitor vehicles or individuals passing through the portal.

Hand-held survey meters

Portable instruments that can be used to determine radiation and contamination levels.

Illicit trafficking

Any intentional unauthorized movement or trade (particularly international) of radioactive materials (including nuclear materials) with criminal intent.

Inadvertent movement

Any unintentional unauthorized receipt, possession, use or transfer of radioactive, including nuclear, materials.

Incident commander

The individual in charge of deployment and direction of resources during a tactical response to inadvertent movement or inadvertent movement or illicit trafficking of radioactive materials.

Incident investigation officer

The individual responsible for all investigative processes associated with an incident, including evidence gathering, and preparation for any future criminal prosecution, judicial inquiry, death inquest or other statutory investigation.

Inner cordon

The immediate cordon control area to isolate the radioactive source, and which delineates the area of potential hazard.

Innocent radioactive source

Radioactive materials that are not deemed to be illicit, such as naturally occurring radioactive material and those used in medical circumstances or legal shipments.

Mobile Survey equipment

Equipment normally carried in a vehicle, which is used to determine radiation and contamination levels. In addition some mobile survey equipment can identify and quantify radioactive materials.

Monitoring

The measurement of dose or contamination for reasons related to the assessment or control of exposure to radiation or radioactive substances, and the interpretation of the results. A check for radiation or contamination.

Non-proliferation

A broad term used in international agreements in relation to limiting the availability of nuclear material and thus reducing the capability for production of nuclear weapons.

Nuclear material

Plutonium except that with isotopic concentration exceeding 80% in plutonium-238; uranium-233; uranium enriched in the isotope 235 or 233; uranium containing the mixture of isotopes as occurring in nature other than in the form of ore or ore-residue; any material containing one or more of the foregoing.

Orphan source

A source which poses sufficient radiological hazard to warrant regulatory control, but which is not under regulatory control because it has never been so, or because it has been abandoned, lost, misplaced, stolen or otherwise transferred without proper authorization.

Outer cordon

A cordon controlled area surrounding the inner cordon, which provides a safe and secure working area for responsefield personnel.

Personal dosimeters

Small devices usually clipped onto an individual's clothing, which measure the personal dose of an individual. In addition some electronic dosimeters can measure the dose rate with an audible alarm function.

Physical protection

Measures for the protection of nuclearradioactive material or authorized facilities designed to prevent unauthorized access or removal of fissile material or sabotage with regards to safeguards, as, for example, in the Convention on the Physical Protection of Nuclear Material.

Radioactive material

Material designated in national law or by a regulatory body as being subject to regulatory control because of its radioactivity.

Radiological advisor

The individual responsible for radiation surveys, contamination control and radiation protection support to the public and response personnel and the public during an incident.

Radiological safety officer

An individual who works under the direction of the radiological advisor to provide safety support to response personnel.

Regulatory authority

An authority or authorities designated or otherwise recognized by a government for regulatory purposes in connection with protection and safety.

Response manager

The individual responsible for overall management of a radiological hazardousmajor incident and co-ordination of all responding agencies.

Standard operating procedure

A detailed and specific directive on the procedures to be adopted in the event of predetermined circumstances.

Triage

Process adopted by medical personnel to determine the priority for dealing with casualties at the scene of an incident.

CONTRIBUTORS TO DRAFTING AND REVIEW

Andrasi, A.	KFKI Atomic Energy Research Institute, Hungary
Aygün, A.	Customs Administration, Turkey
Beck, P.	Research Centre Seibersdorf, Austria
Becker, D.	Bundesamt für Strahlenschutz, Germany
Betko, I.	Customs Administration, Slovak Republic
Ciani, V.	European Commission, Belgium
Cunningham, J.	Pennant Security Consultants Ltd, United Kingdom
Dodd, B.	International Atomic Energy Agency
Duftschmid, K.E.	International Atomic Energy Agency
Englefield, C.	Environment Agency, United Kingdom
Gayral, J.P.	Commissariat à l'Energie Atomique, France
Geysels, F.	Programme Environnement, Service Général d'Appui Policier, Belgium
Golder, F.	KFKI Atomic Energy Research Institute, Hungary
Hagberg, N.	Swedish Radiation Protection Institute, Sweden
Hohenberg, J.K.	Federal Ministry for Agriculture, Austria
Hort, M	RC Plzen, Czech Republic
Jurina, V.	Ministry of Health Protection, Slovak Republic
Karakaya, M.	General Directorate of Security, Turkey
Klastersky, K.	NCB Interpol Prague, Czech Republic
Kolobov, I	Ministry of Fuel and Energy, Ukraine
Kravchenko, N.	State of Customs Committee of the Russian Federation
Kümbül, A.	Customs Administration, Turkey
Maher, L.	Exploranium, Ltd, Canada
Maiorano, N.	National Europol Unit, Italy
Maroto, R.	ICPO (INTERPOL), France
Meehan, W.	International Atomic Energy Agency
Mellwig, R.	World Customs Organization, Belgium
Menga, A.	Service Opérationnel pour l'Ecologie de L'Arme des Carabiniers, Italy
Miklush, D.I.	International Atomic Energy Agency
Molnár, k.	Atomic Energy Authority, Hungary
Montmayeul, J.P.	Commissariat à l'Energie Atomique, France

Nilsson, A.	International Atomic Energy Agency
Okyar, B.	Atomic Energy Authority, Turkey
Ortiz López, P.	International Atomic Energy Agency
Osborne, R.V.	Private consultant, Canada
Paaladino, N.	Triestes's Anti Fraud Team, Italy
Raggetti, N.	Colonel Des Carabiniers, Italy
Rakshit, S.	Customs Administration, Finland
Rostek, H.J.	Zollkriminalamt, Germany
Saka, E.	World Customs Organization, Belgium
Samiei, M.	International Atomic Energy Agency
Schmitzer, C.	Research Centre Seibersdorf, Austria
Sedlácek, J.	State Office for Nuclear Safety, Czech Republic
Sloover, J. de	Customs Administration, Belgium
Smagala, G.	Central Laboratory for Radiological Protection, Poland
Smith, D.	US Customs Service, United States of America
Solomin, A.	National Central Bureau (INTERPOL), Russian Federation
Stavrov. A.	Polimaster, Belarus
Stefulova, A.	Nuclear Regulatory Authority, Slovak Republic
Strand, J.	Customs Administration, Norway
Sudakou, I.	Nuclear and Radiation Safety Regulation Comm., Belarus
Thomson, J.	Pennant Security Consultants Ltd, United Kingdom
Tikkinen, J.	Radiation & Nuclear Safety Authority, Finland
Todorova, B.Z.	Bulgarian Customs Service, Bulgaria
Vadala, G.	Corps Forestier de l'Etat, Italy
Valle, A.D.	Departamento de Aduanas e Impuestos, Spain
Weil, L.	International Atomic Energy Agency
Weiss, B.	International Atomic Energy Agency
Willuhn, K.	Bundesamt für Strahlenschutz, Germany
Wrixon, A.D.	International Atomic Energy Agency
Wynne, B.	Permanent Mission of the United Kingdom to the IAEA
York, R.L.	Los Alamos National Laboratory, United States of America
Yusko, J.	International Atomic Energy Agency