MINISTRY OF HEALTH Government of the Republic of Trinidad and Tobago

TRINIDAD AND TOBAGO
NATIONAL RADIATION EMERGENCY PLAN
(NREP)

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PART 1: GENERAL

1. Introduction

1.1 Background

In Trinidad and Tobago, public health emergency management activities have historically focused on the detection, identification and response to emergencies associated with biological agents and, to a lesser extent, chemical agents. Experience with and knowledge of radiological agents is more limited. Nevertheless, national response agencies and first responders are expected to be fully prepared for and capable of detecting, identifying and responding to a diverse spectrum of threats as part of an all-hazard approach to public health emergencies.

Given the increasing domestic utilization of medical and industrial applications of radiation, the demand for radioactive sources will increase. Despite the low probability of a radiation emergency in Trinidad and Tobago, a national emergency response plan for this hazard is an important component of the national disaster management plan.

As a new Member State of the International Atomic Energy Agency (IAEA), Trinidad and Tobago is committed to compliance with the IAEA Safety Standards, including the Basic Safety Standard [1] and the emergency preparedness requirements [2]. Furthermore, this is one of the core capacities identified in the International Health Regulations (IHR) 2005, which must be achieved by June 15, 2014.

Not only can radiation emergencies result from known, domestic, medical or industrial sources of radiation but they may also include lost or stolen sources, sources onboard vessels in or near Trinidad and Tobago waters, as well as the ever-present threat of criminal or terrorist acts. Consequently, national radiation emergency preparedness must take into account a broad spectrum of scenarios.

The National Radiation Emergency Plan (NREP) is based on an all-hazard approach. Indeed, response to a radiation emergency would involve many organizations whose functions would be the same for a radiation emergency as for a conventional emergency. However, the plan must take into account specificities of radiation emergencies; they require the involvement of specialized agencies and technical experts, and the many misconceptions prevalent concerning radiation could lead to inappropriate decisions.

In order to be effective, the response to a radiation emergency must therefore be well coordinated and arrangements must be appropriately integrated with those for a conventional emergency. This will involve partnership between the public and private sectors, health and industrial sectors, and among stakeholders at points of entry. Additionally the need for coordinated efforts among first responders, law-enforcement services and technical experts from different agencies cannot be overstated.

Finally, given the magnitude of the risk and the limited but growing technical capacities within Trinidad and Tobago, there is a need to optimize preparedness efforts on a regional and international basis. Hence, this Plan makes use of cooperative arrangements (current and future) with the Pan American Health Organization (PAHO), other organizations in the CARICOM region and of the Convention on Assistance in Case of a Nuclear or Radiological Emergency of the International Atomic Energy Agency [3].

1.2 Aim

This plan seeks to establish an organized and integrated capability for a timely, coordinated and effective response by national agencies and first response organizations to radiation emergencies.

It provides operational guidance for identified stakeholders to:

a. Regain control of the situation;
b. Prevent or mitigate consequences at the scene;
c. Render first aid;
d. Manage the treatment of radiation injuries; and
e. Prevent, to the extent practicable, the occurrence of radiation health effects in workers and the public.

1.3 Authority

The Ministry of Health is the authority responsible for coordinating the technical expertise in the detection and assessment of the risk of radiation injury. The Office of Disaster Preparedness and Management (ODPM) will coordinate the efforts of all stakeholder agencies towards preserving life and restoring normalcy.

The legislative framework under which this plan operates includes:

a. Public Health Ordinance;
b. Regional Health Authorities Act, Chapter 29:05;
c. Occupational Safety and Health Act, 2004 (Act No. 1 of 2004 which was amended by Act No. 3 of 2006);
d. Disaster Measures Act, Chapter 16:50; and
e. International Health Regulations (2005).

1.4 Plan Administration

Responsibility for updating of and amendments to this plan rests with the Emergency Services and Disaster Preparedness Coordinating Unit (ESDPCU) of the Ministry of Health.

This plan is to be kept current and shall be reviewed annually or whenever changes to key agencies and/or personnel occur. It shall also be revised based on experiences from actual incidents or exercises and shall take into account any changes in the hazard/risk or technology.

No revisions to the Plan can be made unless these are made through the ESDPCU, who will ensure that the revised Plan is distributed to all Plan holders.

2. Planning basis

This plan is based on a set of planning basis scenarios. As new scenarios are developed and assessed, and if their risk is considered significant, they shall be incorporated in this planning basis and the response concept of operations and subsequent roles and responsibilities of the organizations involved shall be amended.

The scenarios currently considered in the planning basis are the following:

a. Transportation accident involving radioactive material;
b. Accident at a facility containing radioactive material;
c. Lost or stolen dangerous radioactive source;
d. Discovery of an orphan radioactive source;
e. Radioactive source handling incident involving the use of industrial radioactive sources;
f. Inadvertent or intentional smuggling of radioactive material through an international transfer point (air or sea port); and
g. Accidental or intentional exposure of the public using radioactive sources or contamination.

Other possible scenarios have been considered but are not, at the present time, considered to represent a significant risk for Trinidad and Tobago. They include:

a. Accidents involving nuclear reactors or other nuclear facilities;
b. Accidents involving nuclear powered vessels;
c. Incidents involving nuclear weapons;
d. Dirty bombs;
e. Satellite re-entry; and
f. Intentional contamination of food and drinking water.

Although LINAC overexposure of patients does present a health risk, in the context of this manual, it is not considered an emergency.

A more detailed description of each planning scenario is provided in Part 2 of this document, along with the response requirements.

3. General roles and responsibilities

General roles and responsibilities of ministries and agencies are described in the National Response Framework for disaster management in Trinidad and Tobago [4]. The following is a description of the responsibilities of key stakeholders in the NREP as they relate to radiation emergencies.

3.1 Ministry of Health

The Ministry of Health is the agency responsible for setting a policy for Health Disaster Management in Trinidad and Tobago [5]. This policy directs all planning, coordination, response and recovery operations within the Health Sector. In the context of radiation emergencies, the Ministry is responsible for:

a. Leading the emergency preparedness effort, in coordination with all agencies and organizations involved, in particular with the Office of Disaster Preparedness and Management (ODPM);
b. Managing the process described in part 3 of this plan for maintaining the nation's capability to respond to radiation emergencies;
c. Ensuring the Radiation Emergency Plan remains current and effective;
d. Ensuring, in coordination with other agencies, that organizational radiation emergency plans and procedures are current and effective;
e. Ensuring that owners or radioactive material and operators take appropriate precautions to assure the safety and security of the radioactive material; and
f. Providing a 24/7-point of contact for the initiation of the national response.

When a radiation emergency occurs, the Ministry is responsible for:

a. Working under the Incident Command System managed by ODPM to coordinate the national response and provide technical support to local responders;
b. Making arrangements with designated hospitals for the emergency care of potentially contaminated patients;
c. Liaison with PAHO, CARICOM and the IAEA for the provision of international assistance for the assessment and management of medical impacts of the radiation emergency; and
d. Coordinating, with ODPM, the effective influx and operation of international radiation support teams and resources in the country.

The Chemistry, Food and Drugs Division (CFDD) of the Ministry of Health is responsible for providing radiation specialists to support first responders.

3.2 Officer of Disaster Preparedness and Management (ODPM)

ODPM is responsible for coordinating the national response in support of local responders. ODPM works in close cooperation with the Ministry of Health in preparedness and in response. During an emergency, ODPM coordinates logistics and operational actions at the national level, while the Ministry of Health coordinates technical and medical support. When radiation specialist support is needed at the location of an accident or event, ODPM coordinates with TEMA/CERTs, TTPS and TTDF, as appropriate,

to arrange rapid transport to the location.

3.3 Regional Health Authorities

The Eric Williams Medical Sciences Complex (EWMSC) of the North Central Regional Health Authority (NCRHA) is the designated hospital for providing emergency medical care to potentially contaminated victims.

The National Radiotherapy Centre (NRC) of the North West Regional Health Authority (NWRHA) is responsible for providing radiation specialists to assist first responders in assessing the radiation risk.

3.4 Other Medical Facilities

All public hospitals should be ready to receive critically injured and potentially contaminated casualties for trauma care and stabilization prior to being dispatched to the most appropriate medical facility.

The Southern Medical Clinic (SMC) and the Brian Lara Cancer Treatment Centre (BLCTC) can provide radiation safety officers to support first responders.

3.5 Tobago Emergency Management Agency (TEMA)

TEMA is responsible for coordinating any radiation emergency response occurring in Tobago, in close cooperation with ODPM and the Ministry of Health. When radiation specialist support is required at the site of an accident, TEMA shall coordinate the rapid transport to the location.

3.6 Airports Authority of Trinidad and Tobago (AATT)

The AATT is responsible for developing plans and procedures to deal with cargo, packages and luggage suspected of containing radioactive material, and for aircraft incidents involving the possible presence or radioactive material. In an emergency, airport management is responsible for the initial response to events and accidents involving radioactive material, including establishing a controlled safety perimeter around the source and notifying ODPM and the Ministry of Health.

3.7 Sea Port Authorities

There are several sea port authorities in Trinidad and Tobago: Port Authority of Trinidad and Tobago (PATT), Point Lisas Industrial Port Development Corporation Limited (PLIPDECO), Chaguaramas Development Autority (CDA), National Energy Company (NEC), Petroleum Company of Trinidad and Tobago Limited (Petrotrin) and Trinidad Cement Limited (TCL). These authorities are responsible for developing plans and procedures to deal with containers, cargo and packages suspected of containing radioactive material. In an emergency, those authorities are responsible for the initial response to

events and accidents involving radioactive material, including establishing a controlled safety perimeter around the source and notifying ODPM and the Ministry of Health.

3.8 Customs and Excise Division

The Customs and Excise Division of the Ministry of Finance is responsible for ensuring that radioactive material exported from, or imported into Trinidad and Tobago, is authorized by the CFDD. Customs and Excise is also responsible for securing any imported or exported good that is expected to contain radioactive material without the appropriate authorization and for immediately notifying the Ministry of Health. Customs and Excise is also responsible for immediately notifying the Ministry of Health in any suspicious situation potentially involving radioactive material.

3.9 National Radiation Emergency Roster

Specialized resources identified in the National Radiation Emergency Roster include personnel with expertise in radiation measurements, radiation assessment, contamination control and decontamination. The National Radiation Emergency Roster is included in Appendix 2. Specialists on that roster are responsible for responding to an accident scene when requested by the Chief Medical Officer (CMO) of the Ministry of Health, if available. There is no duty system for personnel on the National Radiation Emergency Roster. Resources are called on a cascading order and respond on an as-available basis.

Until specialized emergency kits can be provided to the radiation specialists on the National Radiation Emergency Roster, those specialists should make efforts to ensure that radiation detectors and PPE are always available on short notice for dispatch to an accident scene.

Arrangements have been made with ODPM, TTPS and TTDF for the rapid transport by road or air to the accident location. In an emergency, the mobilized specialists shall coordinate with the Ministry of Health contact point to establish a pickup location.

3.10 Trinidad and Tobago Fire Services

TTFS normally acts as the Incident Commander at the accident scene. In special cases where the event takes place in a sea or airport, the TTFS acts in support of the port authorities.

TTFS is responsible for determining, based on the information available (e.g. placards, manifest or radiation measurements) if radioactive material may be present. When this is the case, TTFS is responsible for ensuring the safety of the first responders and members of the public present at the scene until specialist support is available.

TTFS can also provide transport of casualties to an appropriate medical facility taking due precautions to prevent the spread of contamination in cases involving the possible presence of radioactive material.

3.11 Trinidad and Tobago Police Services

TTPS personnel may be the first ones at the scene. They should be aware of the signs indicating the possible presence of radioactive material, including Transport of Dangerous Goods placards (class 7) and trefoils (the symbol for radioactivity). TTPS is responsible for maintain security and order at the scene of an accident and, if the presence of radioactive material is suspected, keeping members of the public present at the scene on location until they can be monitored by radiation specialists.

3.12 Global Medical Response of Trinidad and Tobago

GMRTT is responsible for providing transport of casualties to an appropriate medical facility taking due precautions to prevent the spread of contamination in cases involving the possible presence of radioactive material.

3.13 Trinidad and Tobago Defense Force

TTDF is responsible for providing logistics and operational support in cooperation with ODPM. When requested by ODPM, TTDF is responsible for assisting in the rapid dispatch of radiation specialists to the accident site or to medical facilities where their presence may be required.

PART 2: EMERGENCY RESPONSE

4. Introduction

The National Response Framework [4] classifies emergency according to a three-level scale. For radiation emergencies, this scale corresponds to the following definitions.

A Level 1 emergency is a localized incident is one that can be managed by the owner of the source, including recovery and clean up. First responder agencies within a Municipality, or the Tobago Emergency Management Agency (in the case of Tobago) may be involved. These agencies may include for example the Trinidad and Tobago Police Service (TTPS), the Trinidad and Tobago Fire Service (TTFS) and the Health Services. They may provide assistance, provide security, help cordon off the area, etc. However, even in this case, the local organizations should request the assistance of radiation specialists to confirm that all sources have been recovered and that all contamination, if any, has been cleaned up.

At Level 2, first response agencies require the assistance of national assets such as radiation specialists. Specialized radiation emergency assets shall be identified, mobilized and coordinated by ODPM in consultation with the Ministry of Health from a radiation emergency roster. The national radiation emergency roster is maintained by the Ministry of Health.

At Level 3, the national resources become overwhelmed and international assistance is required. In accordance with the national disaster framework, the acquisition and coordination of non-specialized aid assistance will be effected by ODPM, through the Ministries of National Security, Foreign Affairs and Finance. The acquisition and coordination of radiation specialists will be done by the Ministry of Health in close cooperation with ODPM. There are three ways to acquire such resources: through CARICOM, PAHO and the IAEA, in accordance with the International Convention on the Provision of Assistance in Case of a Nuclear Accident or Radiological Emergency [3].

5. Scenario-based concepts of operations

5.1 Transportation accident involving radioactive material and accidents involving the mobile use of a radioactive source

5.1.1 Description

Many radioactive sources are transported, mainly by road, but sometimes by maritime or air transporters. Such radioactive sources may be solid, powder or liquid. They are normally inside containers that are designed to keep the dose rate at the surface sufficiently low that they present no risk to the transport personnel. For strong sources, the containers are usually designed to sustain the shock of a collision or the sustained heat of a fire.

Possible impacts of a transport accident involving radioactive material include:

a. Breach of the shielding and higher risk of exposure for responders and people in the vicinity;
b. Spill of the content and contamination on the ground presenting a risk to the response personnel, the public and the environment;
c. Loss of a solid source and later discovery by unknowing members of the public;
d. Dispersion of the content by a fire, resulting in airborne contamination presenting a risk to the response personnel and the public through inhalation and contamination downwind.

5.1.2 Response concept of operations

If the presence of radioactive material is suspected[1], first responders shall:

a. Follow basic safety precautions (see section 6.9 on personal protection).
b. Immediate provide life-saving first aid if required.
c. Establish a safety perimeter according to the guidelines provided in section 6.4 (30 to 300 m, depending on the situation).
d. Segregate any members of the public who were within the safety perimeter. Ensure they are sheltered from the elements. Assign a responder to stay with them and keep them informed. Register their names. Wait until they can be controlled for contamination before releasing them.
e. Notify ODPM (through TEMA in Tobago).
f. Manage the scene and wait for the Health Physicist.

[1] At the moment, only some first response teams are equipped with radiation detection instruments. For those who are, detection of elevated radiation levels indicates the presence of radioactive material. For those who don't the transport manifest is the best source of information and should be obtained as soon as possible. It is important to note that the absence of elevated levels on a radiation detector is not proof that there is no radioactive material; alpha and beta emitting radioactive sources may not register on the most common radiation detectors.

ODPM (in cooperation with TEMA in Tobago) shall, upon confirmation of the possible presence of radioactive material:

a. Notify the Ministry of Health (24/7 point of contact).
b. In cooperation with the Ministry of Health, activate a health physicist and arrange for dispatch to the accident location. Depending on the distance, ODPM shall coordinate with TTPS, TEMA (in Tobago) or the TTDF for road transport and/or airlift to the location.
c. Maintain liaison with the on-scene Incident Commander and coordinate any additional resources required.

The Health Physicist shall:

a. Collect his/her emergency kit.
b. Go to location using transport arrangements coordinated by ODPM.
c. Upon arrival, report to the on-scene Incident Commander.
d. Survey the scene and determine the presence of radiation or contamination.
e. Recommend adjusting the safety perimeter to a point where the dose rate is less than 0.1 mSv/h or there is no contamination on the ground.
f. Set up an improvised contamination control and decontamination point (for guidance see section 6.7).
g. Proceed with the contamination control and decontamination of the public held at the site.
h. When the critical response is over, proceed with the contamination control and decontamination of the responders.
i. Survey the site. If surface contamination is present, determine its extent and cordon off the affected area. Communicate with ODPM and the Ministry of Health to define the recovery strategy (see section 6.14 for guidance).
j. Ensure contaminated waste is properly disposed of (see section 6.13 for guidance).

If there are casualties at the site, follow the response concept for pre-hospital care of potentially contaminated casualties (see section 6.5)

5.2 Fire or explosion at a facility containing radioactive material

5.2.1 Description

A fire or explosion where radioactive material is stored could result in contamination of the air and surfaces inside the facility and the possible dispersion of airborne contamination outside the facility. The main hazard is for the first responders in and around the facility. There is no facility in Trinidad and Tobago storing sufficient radioactive material for the hazard outside the facility to be significant. This does not, however, eliminate the need to confirm that the contamination outside the facility resulting from a fire or explosion does not pose a public health threat.

5.2.2 Response concept of operations

All facilities where radioactive material is stored shall inform the local TTFS division and provide 24/7 contact information for a radiation technician able to assess the presence of radioactivity. Upon being notified of a fire or explosion involving a facility with radioactive material, first responders shall:

a. Notify the 24/7 contact provided by the facility.
b. Mobilize the appropriate HAZMAT team.
c. Go to the scene and initiate boundary cooling.
d. Rescue people in the facility using conventional protective gear.
e. Notify ODPM (through TEMA in Tobago).
f. Continue firefighting efforts outside the facility until arrival of the radiation technician or HAZMAT team.
g. Once the radiation technician is at the location, he/she can advise on safety measures to penetrate the building, if required.
h. If contamination is suspected, first responders should not leave the scene until they are checked and, if required, decontaminated.
i. If the facility does not in due time provide a radiation technician, request the assistance of a Health Physicist from ODPM (through TEMA in Tobago).

ODPM (in cooperation with TEMA in Tobago) shall:

a. Notify CMO, who will activate the Ministry of Health ESDPCU.
b. Maintain liaison with the first responders (through TEMA in Tobago) and monitor the situation.
c. Coordinate the provision of assistance if required.

The Ministry of Health shall monitor the situation and, if required, arrange for the dispatch of a radiation specialist to the scene.

If there are casualties at the site, follow the response concept for pre-hospital care of potentially contaminated casualties (see section 6.5).

5.3 Lost or stolen dangerous radioactive source

5.3.1 Description

Every year, several small to large radioactive sources are lost or stolen. The main hazard from this scenario does not come from the source itself being lost or stolen, but rather from the possible improper or inadvertent handling of the source by people who are not aware of the risks involved or by the use of the source in a malevolent act. In recent years, a number of incidents illustrating these points have occurred all over the world.

In February 2000 Thailand, a cobalt-60 source was improperly discarded in a junkyard. It was found by junk hunters, who handled it for a few minutes before throwing it back in the junk pile. Three individuals died of infectious complications within two months of exposure, despite all efforts made by hospital staff that provided many treatment modalities. A number of other people suffered acute effects as a result of exposure to the radioactive source however there was no contamination of the junkyard or any other sites [6].

Another scenario involving a lost radioactive source occurred in 1987, in Goiania, Brazil. A radiotherapy unit from an abandoned clinic was removed and dismantled. The extracted radiological source (1,375 curies of cesium-137) was dismantled, then spread and handled by many people resulting in 5 fatalities and 20 short-term injuries due to exposure to radiation, and many contaminated areas that had to be cleaned up. A massive medical response had to be mounted including a survey of approximately 112,000 people [7].

Dealing with a lost or stolen source, or the subsequent discovery of the source, is primarily a national issue, unless it is suspected that the source may have been taken outside the country; in which case, it becomes an international issue.

5.3.2 Response concept of operations

Response to this type of accident shall be closely coordinated with the TTPS.

Any radioactive source owner who becomes aware of the loss or theft of radioactive material shall, after rapid verification with their own personnel and an initial search to confirm the loss or theft, notify CMO.

If the source is deemed NOT DANGEROUS in accordance with IAEA [8] (see Appendix 4 for common sources), the Ministry of Health, in consultation with the Government Information Services, shall issue an advisory to TTPS advising of the loss/theft, the appearance and actions to take upon discovery, which include:

a. Avoid direct handling.
b. Put in a secure place using remote handling tools.
c. Contact ODPM (through TEMA in Tobago), who will contact the Ministry of Health.

The Ministry of Health shall coordinate the activation of appropriate personnel for the recovery and disposal of the source.

If the source is DANGEROUS according to the IAEA source classification, the CMO shall request an immediate police investigation. The TTPS shall coordinate with the Ministry of Health, with the support of Health Physicists, for the conduct of the investigation. Possible locations where the source may be should not be approached without the support of a Health Physicist. If available, police investigating units that are without the support of a Health Physicist should be provided alarming electronic dosimeters.

Police shall record the name and address of anyone who may have been in contact with the source. The Ministry of Health, with the support of the Health Physicists, shall assess those persons for contamination. Medical follow up may be required. If overexposure is suspected, the concepts described in sections 6.8 shall be applied.

Once discovered, the source is to be recovered, secured and disposed of appropriately. The Health Physicist, in cooperation with the Ministry of Health, shall supervise the operation.

5.4 Discovery of an orphan radioactive source

5.4.1 Description

Orphan radioactive sources are legitimate sources that have been lost, abandoned, misplaced or stolen. On many occasions, persons who did not know they were radioactive have found such orphan sources. On one such recent event, in 2010, in Mayapuri, India, an orphan source caused the death of one worker and irradiated seven others in a scrap yard. In 1987, in one of the most famous such incidents, in Goiania, an abandoned cesium source from a teletherapy unit was found, dismantled, causing the early death of four people, 128 cases of severe exposures, the need to survey about 112,000 people and the destruction of contaminated houses and decontamination of large areas of the city of Goiania.

5.4.2 Response concept of operations

Whichever agency becomes first aware that an orphan radioactive source has been discovered must immediately notify the Ministry of Health and TTFS.

TTFS, in cooperation with TTPS and the owner of the facility where the source was found:.

a. Cordon off the area at a safe distance (at least 30 m from the source).
b. Identify all possible persons who may have handled the source and refer them to the Ministry of Health.
c. Maintain security around the source until its removal by qualified personnel.

The Ministry of Health, in cooperation with ODPM:

a. Mobilize a radiation specialist to the scene to assessment the radiation risk and locate the source.
b. Make arrangements for the removal, transport and disposal of the source.
c. Make arrangement for the assessment of the exposure of the individuals involved.
d. Make arrangements with medical facilities for the monitoring and care of the individuals involved.

5.5 Radioactive source handling incident involving the use of industrial radioactive sources

5.5.1 Description

This scenario involves an incident while a dangerous radioactive source is being used or is under the active care of a professional trained in its use. A good example is the incomplete retrieval of a source contained in a gamma ray projector. This would result in high dose rates that would present a risk to the device operator and to persons in the vicinity of the device. This is not a serious emergency provided that the operator implements its own emergency response plan. However, the facility where the activity was taking place may need to establish a safety perimeter and this may affect operations until the source can be secured. In addition, if the accident is combined with a medical emergency for the device operator(s), this event may require the intervention of TTFS's ambulances or GMRTT.

5.5.2 Response concept of operations

The facility where the activity was taking place shall coordinate its emergency actions with the operator of the device (as many as operated by contractors). If medical assistance is required, the facility shall notify 811 and inform them that a radioactive source is involved.

GMRTT personnel responding to the scene shall:

a. Approach the scene with caution.
b. Follow the advice of the radiation technician who should be present at the scene. If no technician is present or conscious, promptly remove the casualty to the safety perimeter with due care for possible spinal injury. Note that contamination is not present in such cases and the only precaution is to minimize the time spent near the source.
c. Provide emergency first aid and transport to the appropriate medical facility, if required, as per normal. Note that the patient is not contaminated and no special precaution are required during transport and at the receiving hospital.
d. Notify the Ministry of Health.

The Ministry of Health shall:

a. Dispatch a radiation specialist to the scene to assess the level of radiation hazard and assist in the source recovery.
b. Liaise with the owner of the gamma projector to arrange for source recovery.
c. Coordinate a dose assessment of the victim.
d. Arrange for advanced medical care in cases of overexposure.

5.6 Inadvertent or intentional smuggling of radioactive material through an international transfer point

5.6.1 Description

Radioactive sources should not normally enter the country without legitimate authorization by CFDD. However, should a radioactive source be detected at any point of entry without the proper clearance, it constitutes an unusual event and requires a response to ensure that the source or radioactive material is properly handled.

5.6.2 Response concept of operations

The port (sea or air) authorities and/or the customs officials who discover the event shall:

a. Notify port security.
b. Notify the OPDM and the Ministry of Health.
c. Establish a safety perimeter around the object.
d. If leakage is visible and contamination is suspected, the object should not be moved.
e. Wait for a radiation specialist.

The Ministry of Health, in consultation with ODPM, shall dispatch a radiation specialist to the scene. Consideration shall be given to dispatching a nearby TTFS HAZMAT team.

The radiation specialist verifies the presence of radiation and contamination and advises the port authorities on how to secure the source and return the scene to normal.

Any persons who may have been in contact with the object should be kept on location until they can be checked for contamination. If there is indeed external radiation and the dose rate is high, those persons should be referred to the Ministry of Health for further dose assessment. In this case, the Ministry of Health shall coordinate the dose assessment and, if overexposure is suspected, the advanced medical treatment of affected persons.

5.7 Accidental or intentional exposure of the public

5.7.1 Description

In this scenario, the public becomes exposed to radiation or contaminated without knowing it. This can happen accidentally, as in the case of Goiania, Brazil, in 2007 [7], or Georgia, 1996-97 [9], or intentionally. In the later case, it is either a criminal or terrorist act.

A malevolent act that can be targeted at specific individuals or at the general population. The possibilities include, for example:

- Concealing a strong unshielded radioactive source in the clothing, luggage, home, work-place or vehicle of target individuals;
- Concealing a strong unshielded source in a place frequented by the public or on public transport; or
- Deliberately contaminating a person with a strong unshielded source (difficult to do, but has happened in the past).

The worst-case scenario is the indiscriminate exposure of a large population with the intent of causing crippling disruption of the economic, transport, medical and political infrastructure. An example of this scenario would be if terrorists placed several strong, unshielded radioactive sources in public areas, shopping areas or resorts without informing the authorities for several days. The sources would likely go undetected until authorities were notified of their presence. Thousands to hundreds of thousands of people could come in close vicinity to (or even in direct contact with) the sources and within minutes, could receive doses above the acute thresholds.

Another example involves the malevolent contamination of persons. On 1 November 2006, Alexander Litvinenko, a former officer of the Russian State security service, presented to hospital with flu-like symptoms. Eventually it was discovered that he had high amounts of Polonium-210 (Po-210) inside his body. Po-210 is a radioisotope that emits high-energy alpha particles. Outside of the body it poses no health hazard, but if ingested or inhaled its effects can prove fatal. A fairly small quantity of Po-210 (~10 micrograms) was placed into Litvenenko's cup and ingested. He died 23 days later as a result of the radioactive poisoning [10].

5.7.2 Response concept of operations

The Ministry of Health shall take immediate lead of the national response, in coordination with ODPM. Both organizations shall fully activate. Together, the Ministry of Health and ODPM shall:

a. Dispatch radiation specialists to confirm the presence of radioactive sources.
b. Initiate a city-wide survey to locate other, undisclosed sources. Consider requesting IAEA assistance to conduct aerial surveys.
c. Carry out a dose assessment to estimate the dose that could have been received by the public.
d. Inform the IAEA so that the risk assessment can be communicated to foreign nationals.

e. Issue a media advisory explaining the situation and the risk based on the dose assessment.
f. Request international assistance for the estimation of acute dose to the public.
g. Set up dose screening centres in controlled facilities away from the normal A&E departments.
h. Establish a strategy to deal with people deemed to have been exposed to more than 500 mSv, including medical follow up and psychological care.

Places where sources were discovered should be treated as crime scenes until evidence as been collected by the TTPS. Sources should be removed prior to the scene survey and preserved as evidence. IAEA assistance should be requested to deal with forensics in the presence of high radiation.

6. Generic response functions

6.1 Notification of the Ministry of Health

The 24/7 point of contacts at the Ministry of Health are the Chief Medical Officer (CMO), Permanent Secretary or the Manager of the ESDPCU. The contact information is as follows:

Contact Point	Mobile	E-mail
CMO	687-5119	cmo@health.gov.tt
Permanent Secretary	684-8794	antonia.popplewell@health.gov.tt
Manager, ESDPCU	761-8077	dcc.moh@hotmail.com

6.2 Command, Control and Coordination

The command, control and coordination of emergency response shall be consistent with the Incident Command System and the National disaster framework. The TTFS is normally the On-Scene Incident Commander. ODPM provides national coordination of resources and organizations at the national level. The Ministry of Health provides the overall coordination of technical specialists and medical resources, including ambulances, at the national level.

6.3 Detection

At the moment, detection capabilities and resources are limited. The following organizations have some detection capabilities and expertise:

a. TTFS: two operational gamma detectors;
b. NRC: two health physicists with one gamma detector and TLDs;
c. CFDD: five radiation technicians with two Victoreen 451 ionization chamber beta-gamma detectors;
d. SMC: one radiation safety officer with one Victoreen 451 detector, one pancake probe contamination meter and TLDs;
e. BLCTC: two radiation safety officers with gamma detectors and TLDs.

When verification, characterization and assessment of radiation and contamination levels are required, the responders shall request same from the Ministry of Health through ODPM. This could be at the incident site or at the hospital treating potentially contaminated victims. The Ministry of Health shall activate the appropriate resource. ODPM shall arrange for rapid transport to the accident location.

Ports (sea and air) do not at the moment have routine detection capabilities. When the presence of radioactive material is suspected in unauthorized, unidentified or unknown cargo, luggage or passengers, the port authorities shall immediately detain the said carrier and request assistance from a specialist from the RER from the Ministry of Health through ODPM.

6.4 Safe distances

Whenever emergency responders suspect the presence of radioactivity at an incident or accident site, they shall establish a safety perimeter around the site corresponding to the distance provided in Table 1. Once a qualified radiation specialist is on location, the safety perimeters may be adjusted on the basis of actual radiation measurements. If contamination is present, anyone entering the safety perimeter is to be deemed contaminated until verified by a qualified radiation specialist.

Table 1: Safety distance (default)

Situation	Initial safety perimeter
Outdoors	
Unshielded or damaged source	30 m radius
Spill involving radioactive material	100 m radius
Fire involving radioactive material	300 m radius
Indoors	
Loss of shielding or spill involving radioactive material	Affected room and immediately adjacent rooms, including above and below
Fire	Entire building

6.5 Pre-hospital care of potentially contaminated casualties

If there are casualties at the site, given the fact that most of the radioactive sources transported in Trinidad and Tobago are sealed sources, the casualty shall be assumed to be uncontaminated and dealt with using normal procedures.

If contamination meters are available, the presence of contamination should be verified. If contamination is present, EWMSC is able to receive and treat the contaminated casualty. However, GMRTT's policy is to transport only uncontaminated casualties. Therefore, the casualty shall be decontaminated prior to transport to the appropriate facility. The Fire Services Ambulance will also be mobilized as appropriate.

If there is contamination, Emergency Medical Technicians should stay outside the safety perimeter so they minimize the risk of cross contamination. If it is essential to transport a contaminated casualty, the potentially contaminated casualty should be wrapped into clean sheets. Emergency Medical Technicians should wear universal precautions. The ambulance and the attendants should be checked for contamination and, if required, decontaminated prior to return to service.

6.6 In-hospital emergency care of contaminated casualties

If a casualty is suspected of being contaminated, he/she shall be treated as contaminated until proven otherwise.

The receiving hospital for potentially contaminated casualties shall normally be the EWMSC. However, in extreme cases where the trauma care is critical and there is not time to transport the casualty to the EWMSC, any medical trauma care facility can adopt the following basic safety precautions to stabilize the victim. ***In all cases of medical trauma care to contaminated victims, there has never been a case of overexposure of medical personnel.***

An area is to be identified at the emergency radiation area, where trauma care will be provided. All medical personnel responsible for the emergency care shall be instructed that there will be a potentially contaminated patient, that normal protective postures are entirely adequate and that a health physicist is being dispatched to provide assistance.

Other patients are to be moved to other suitable areas where critical care can continue to be provided. The area and access to the area should, in possible, be covered with non-slip paper (plastic may become slippery if wet). Equipment should be covered with plastic in a way that allows it to continue to be operated. Although the contamination does not present a great risk, covering the equipment will facilitate later decontamination.

If the access to the resuscitation room as through a busy area and cordoning the area off would be disruptive, a clean stretcher and clean attendants can be used to transfer the patient from the ambulance to the resuscitation room.

When the casualty arrives, open wounds should be covered. Life-saving trauma care should be provided without delay. If possible the patient should be kept in the prepared area. If possible, nasal swabs, facial swipes and irrigation samples should be collected for further analysis of possible internal contamination. A blood sample should also be collected for further cytogenetic analysis, if required.

Once the patient is stabilized, he/she should be moved to the contamination control area and, if required, completely decontaminated prior to being moved to the normal care area or to an appropriate medical facility for advanced care.

All areas used to treat the contaminated patient should be clearly marked and decontaminated prior to return to service. The medical personnel who tended to the contaminated patient should be controlled and decontaminated, if required, before returning to normal duty. Contaminated waste should be placed in clearly labeled plastic bags, checked for surface contamination and turned over to the health physicist and the Ministry of Health for disposal. Although the water used to decontaminate the patient may have become contaminated, the levels would be very low and there should be no need to segregate the run off.

The emergency radiation area is conceptually illustrated in Figure 1.

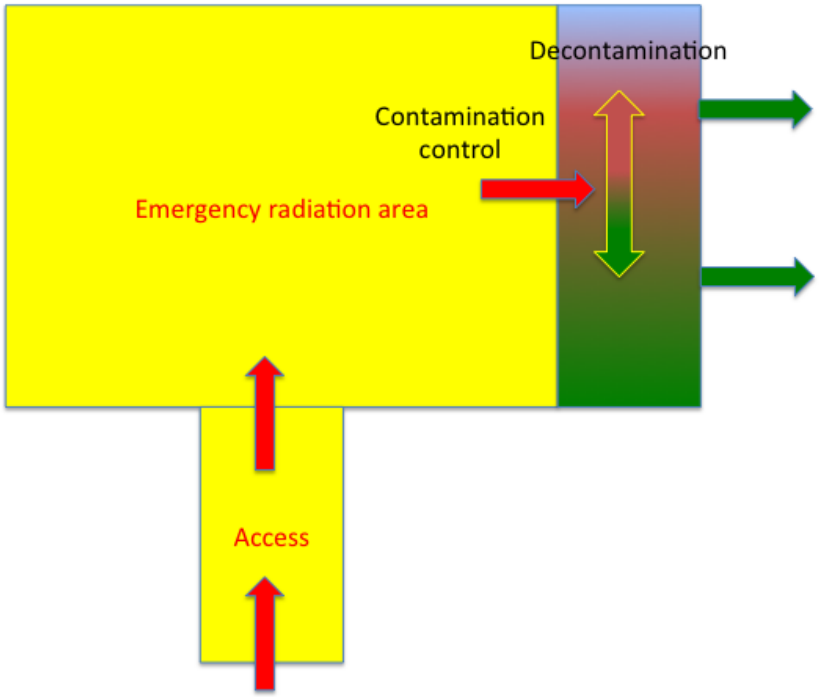

Figure 1: Conceptual emergency radiation area

6.7 Decontamination of the public

If the public at the accident site needs to be decontaminated, a HAZMAT unit of TTFS shall be called to the site and normal HAZMAT decontamination protocol shall be followed. If the HAZMAT unit cannot get there in a reasonable time, the following procedure shall be followed:

a. Clearly mark an area for decontamination.
b. Rig a low-pressure shower system using available means, for example fire hoses with low pressure spray nozzle.
c. Shower contaminated people after removing and disposing of their clothes. A privacy area for men and women may be required.
d. Measure contamination levels after the shower.
e. If the person is still contaminated, return to shower and use a soft brush and soap if available.
f. Have replacement clothes ready; blankets, towels, Tivek suits, bathrobes, etc. are also appropriate.
g. Register the names, contact information and contamination levels before and after decontamination for all people processed through the decontamination area.

If it is suspected that members of the public may have been present, contaminated and left the scene, an advisory shall be issued to ask them to avoid physical contact with other people until they have showered and washed their clothes, including their shoes or boots.

6.8 Advanced medical care of contaminated or overexposed victims

Any patient who is suspected of having been internally contaminated or externally overexposed shall be referred to the NRC. The NRC shall arrange for the necessary bioanalyses required to estimate the total exposure. At the moment, the NRC does not have the required equipment (whole-body counting, etc.) to perform an accurate assessment of internal contamination, not does it have the capability to estimate with precision the dose received in cases of overexposure. Therefore, in such cases, the Ministry of Health shall arrange for international assistance, either through CARICOM, PAHO or the IAEA.

6.9 Protection of emergency response personnel

In all scenarios contained in the planning basis for this Plan, the radiation risk to first responder is low. However, basic precautions will ensure that this always remains the case.

For first responders at the scene of an incident of accident, the risk will remain low provided that:

a. Normal protective equipment is used to protect again the conventional hazards present, e.g. fire and smoke;
b. The objects that are suspected of being radioactive or contaminated are not handled;
c. A safety distance is maintained;
d. Time near the suspected radioactive material is minimized; and
e. If it is essential to move the suspected radioactive material, gloves are used and, if possible, remote handling tools are used to manipulate the source.

Emergency responders should be aware of the expected hazard from standard radioactive transport containers. On a properly labeled container, the label can be WHITE or YELLOW, as shown in Figure 2.

Figure 2: Radioactive transport label

For labeled containers, the radiation levels at the surface should, provided that the container is intact, be within the value provided in Table 2. Provided that the container is intact, these levels are very low and present no risk to the first responders.

Table 2: Expected radiation levels at the surface of undamaged radioactive source containers

Type	Transport Index (box in Figure)	Maximum radiation readings on surface of container
WHITE	0	< 0.005 mSv/h
YELLOW II	0-1	< 0.5 mSv/h
YELLOW III	1-10	< 2 mSv/h
YELLOW III	>10	< 10 mSv/h

6.10 Counseling for emergency responders

Regardless of the magnitude of the emergency, first responder may be affected by the perceived radiation risk to which they were exposed. The Ministry of Health, in coordination with the first responders agencies and ODPM, shall assess the needs for counseling of the emergency responders, including hospital personnel, and shall take appropriate actions to dispatch people trained in psychological first aid to assist affected first responders. The impact on their family shall also be assessed and, if required, psychological first aid shall be offered to direct family members.

6.11 Media relations

Radiation emergencies have a disproportionate impact on the public based on perception. This indeed can be the most important impact, politically, economically and even health-wise. Therefore, this aspect shall not be undermined in any radiation emergency, regardless of the scale.

The Ministry of Health shall implement its risk communication strategy, including a strategy to reach out to the directly and indirectly affected public. The Ministry of Health shall designate credible spokespersons to convey the messages. The Ministry of Health shall be the lead spokesperson on health issues and health impacts of the emergency. ODPM's Public Information Department shall liaise with the Government Information Services to adapt the communications strategy. The Incident Commander at the scene shall respond to media inquiries, time permitting, restricting comments to facts about the situation. The radiation specialist shall provide advice to the on-scene Incident Commander on the magnitude of the risk in terms that can be easily understood by lay persons.

The Ministry of Health shall set up a telephone hotline for public inquiries about the radiation risk. The Ministry's Corporate Communications Department shall prepare questions and answers for the hotline operators, in close cooperation with the ESDPCU and with the assistance of radiation specialists.

6.12 Mass casualties

In cases involving a large number of contaminated people and/or casualties, the national disaster management plan shall be activated. In this case, temporary shelters shall be activated. Ambulatory people shall be directed to a facility where they can be comfortably held until they can be controlled and, if required, decontaminated. A sport facility, for example, would constitute a suitable holding shelter.

6.13 Waste management

Any confirmed or suspected contaminated items from the site should be double-bagged and clearly labeled as “RADIOACTIVE WASTE”. The Ministry of Health shall coordinate the removal of the contaminated waste from the accident site. The waste shall then be transported to the National Radiotherapy Centre or to a suitable secure facility for holding until it can be semi-permanently disposed. Dose rates at the room boundary shall be measured to ensure that they do not exceed 0.5 µSv/h.

6.14 Recovery

Once critical emergency actions have been completed and the scene is ready to be returned to normal, a survey is to be completed. If there is no contamination, the scene can be returned to service in accordance with normal procedures, provided that the TTFS investigation is complete and all evidence, in a suspect criminal case, has been collected.

If the survey indicates that contamination is present, incident command shall be handed to a Ministry of Health designated official, who shall supervise clean up operations. The Ministry of Health shall coordinate with ODPM to expeditiously acquire the appropriate resources and proceed with source recovery and decontamination.

PART 3: EMERGENCY PREPAREDNESS

7. Emergency planning organization

National radiation emergency response capabilities shall be maintained via an emergency preparedness sustainability process, described in Part 3 of this plan, and managed by the ESDPCU. The ESDPCU shall work in close cooperation with ODPM's Preparedness and Response Unit and shall maintain regular liaison with the stakeholders of this Plan. A meeting of stakeholder representatives should take place annually to review the results of preparedness process activities, determine the required changes to the plan and propose a strategic direction for the plan's evolution, for approval by the CMO.

8. Sustainability process

8.1 General

The general emergency preparedness management process is based on the Deming management cycle (plan, do, check, act); it is illustrated in Figure 3 and described in the following subsections.

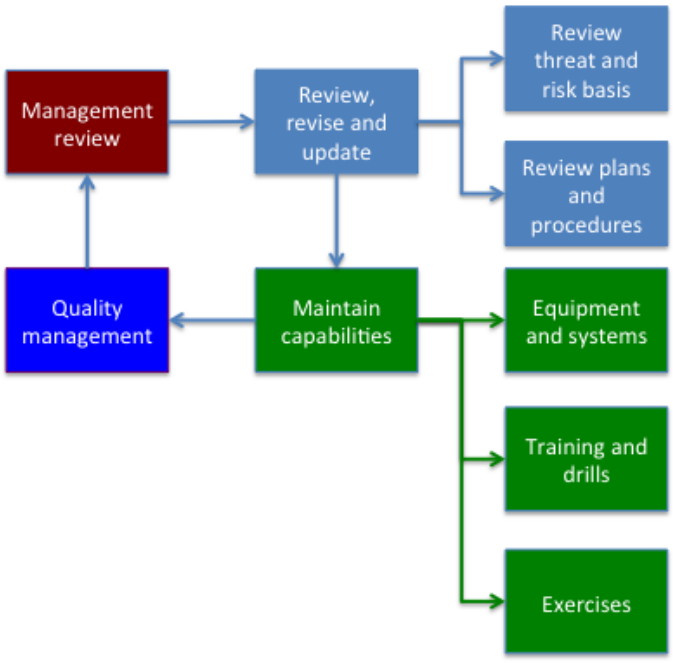

Figure 3: Emergency preparedness (sustainability) process

8.2 Emergency preparedness tasks

8.2.1 PLAN: Review, revise and update

This task is performed by the ESDPCU annually or when major changes occur. It consists of two subtasks:

a. Review of the threat and planning basis; and
b. Review of the plans and procedures based on the above.

The threat and planning basis shall be reviewed taking into consideration recent events, information from open and confidential sources such as the IAEA, and intelligence information from national intelligence agencies.

Plans and procedures shall be reviewed and revised to reflect the results of the threat and planning basis review. All procedures should be incorporated in the existing ICT emergency management systems, including in Trinidad the WEB EOC system and, in Tobago, the WEB EOC and the EM/2000 systems.

8.2.2 DO: Maintain capabilities

Maintaining capabilities means training, drills and exercises.

Training on this plan shall be provided to all key emergency personnel as follows:

a. National emergency management personnel and TEMA: within six months of taking their function and yearly refresher thereafter;
b. First responders: the training shall be incorporated in the HAZMAT training with a minimum 30 minute module on radiation emergencies and refreshed at the same frequency as the HAZMAT training;
c. Front-line workers at ports (air and sea): as part of the orientation, and yearly refresher training; and
d. Health Physicists and Radiation technicians: initial training and yearly refresher training.

In addition, sensitization campaigns should be considered from time to time to maintain awareness amongst the stakeholders' personnel.

Drills test specific functions of the emergency plan. The following drills shall be conducted at the stated frequency:

a. Notification and activation: quarterly;
b. Radiation survey drills for personnel with radiation detection equipment: quarterly;
c. Pre-hospital care of contaminated casualties: quarterly;
d. In-hospital emergency care of contaminated patients: yearly;
e. Decontamination drills for TTFS: yearly.

An annual exercise of the plan shall be conducted. The aim of this annual exercise shall be to test the national system in terms of communication, coordination, assessment and decision-making process.

8.2.3 CHECK: Quality assurance

The Ministry of Health, in cooperation with ODPM, shall perform a check of all perishable information quarterly. A full audit of the plans and procedures shall be performed by an independent organization every five years. The Ministry of Health is responsible for coordinating this review.

8.2.4 ACT: Management review

An annual review of the emergency preparedness arrangements shall be conducted by the ESDPCU, in cooperation with ODPM and TEMA, and presented to the CMO before 31 December of each year. The management review shall cover, at a minimum:

a. Results of drills and exercises;
b. Training performed;
c. New information of threat and planning basis;
d. Major revisions to the plans and procedures;
e. Results of any audit, if available; and
f. Proposed strategy for evolution of the plan.

The CMO shall determine, on the basis of this management review, the focus for the coming 12 months.

9. Roster of experts

The Ministry of Health is responsible for maintaining a directory of specialized radiation emergency resources in the country and within CARICOM, known as the radiation emergency roster (RER). The RER shall cover the following capabilities with resources from the private and public sector:

a. Health physicists;
b. Radiation technicians capable of basic radiation measurements;
c. Decontamination equipment and resources;
d. Laboratories for cytogenetic analysis;
e. Whole body counting; and
f. Radioactive waste transport.

Radiation specialists (health physicists and radiation technicians) should be provided with emergency kits that include:

a. Gamma/beta dose rate meters;
b. Alpha/beta/gamma field contamination meters;
c. NaI portable isotope identifier;
d. PPE and respiratory protection;
e. Extra batteries;
f. Labels and bags for disposal of contaminated waste;
g. Shielded container;
h. Hand-held radio; and
i. Source retrieval equipment.

The resources included in the RER shall be signatories to memoranda of understanding or similar instruments detailing:

a. How they can be contacted;
b. The precise capabilities they provide;
c. Liability and compensation; and
d. The time to deployment target.

This list should be maintained at least annually and updated as required. It is included as Appendix 2.

10. Detection capability

At the moment, radiation detection capabilities within the private and public sectors are limited in Trinidad and Tobago. They include:

a. Eight gamma detectors distributed amongst the TTFS HAZMAT teams of which two are currently operational (POS and Couva South);
b. Gamma detector at the NRC;
c. Beta/gamma detector and pancake probe contamination meter at the SMC;
d. Beta/gamma detectors (2) at the CFDD;
e. Beta/gamma detector at the BLCTC;
f. Gamma detectors in private companies operating radiation-based non-destructive testing devices.

In the future, arrangements shall be made to provide the following basic radiation detection capabilities:

a. Electronic alarming dosimeters to:
   - A representative number of airside operations personnel at international airports;
   - A representative number of cargo handling personnel at international airports;
   - A representative number of cargo and passenger personnel at sea ports and ferry terminals;
   - First responder teams throughout the country.
b. At least one alpha-beta-gamma contamination meter to each TTFS unit throughout the country.
c. Electronic dosimeters, gamma detectors, alpha-beta-gamma contamination meters and portable spectrometers to designated health physicists who are part of the radiation emergency response organization.

11. Waste management arrangements

All waste collected from a radiation emergency shall be transported to the NRC and stored in the radioactive storage room. Dose rate measurements at the outside wall and door shall not exceed 0.5 μSv/h. If this cannot be met, shielding is to be added or consideration is to be given to relocated part of the waste to an alternate, secure facility. If the volume of waste is too large, an alternate facility is to be identified by the Ministry of Health.

If shielding is required, consider the use of lead weights around the source or the walls. This improvised shielding can also be used at the accident scene to shield the source while the response is carried out.

12. Organizational focal points for preparedness and alert points for response

Every agency and organization mentioned in this plan as a part of the response organization shall designate a 24/7 contact point able to receive notification and initiate the activation of their internal emergency response system. ODPM shall be the custodian of the list of 24/7 contact points and shall verify, at least on a quarterly basis, that the contact information is valid.

13. Human health surveillance system

The Ministry of Health shall prepare and distribute awareness material to the national medical and public health community at large to sensitize medical sector workers of the symptoms of acute radiation exposure. Medical doctors who recognize those symptoms shall immediately notify the Ministry of Health. A large number of reports of possible overexposure could be an indication of an exposure event (accidental or intentional) in progress.

14. Regional and international cooperation

In September 2012, CARICOM representatives agreed that, in an effort to optimize resources, existing regional capabilities should be utilized. On that basis, the Ministry of Health shall proactively endeavour to establish a list of regional resources available in the CARICOM region and bilateral agreements with the owners of these resources for use during an emergency. Specialized resources should include the following:

a. Whole body counting;
b. Bioassay analysis for determining body burden of radionuclides;
c. Cytogenetic analysis;
d. Treatment of severely internally contaminated patients;
e. Treatment of severely overexposed patients.

Other capabilities not available in the country may be obtained in cooperation with PAHO and the IAEA. They may include, for example:

a. Aerial surveys;
b. Dose assessment and reconstruction expertise; and
c. Decontamination assets.

References

1. IAEA, International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radioactive Sources, Safety Series 115, Vienna, 1996, revised in 2012.
2. IAEA, Safety Standards Series GS-R-2, Preparedness and Response to a Nuclear or Radiological Emergency, Vienna, 2002.
3. IAEA, International Convention on the Provision of Assistance in Case of a Nuclear Accident or Radiological Emergency, Vienna 1986.
4. National Response Framework, 2010.
5. Emergency Services and Disaster Preparedness Coordinating Unit, National Health Disaster Operational Plan, Trinidad and Tobago, July 2012.
6. IAEA, The Radiological Accident in Samut Prakarn, Vienna, 2002
7. IAEA, The Radiological Accident in Goiania, Vienna, 1988
8. IAEA, EPR D-Values, Dangerous Quantities of Radioactive Material, Vienna, 2006.
9. IAEA, The Radiological Accident in Lilo, Vienna, 2000.
10. Ham, G.J. "The determination of Polonium-201 in urine following the Litvinenko incident." Radioprotection, 2009: 41-46.

Appendix 1: Glossary

AATT	Airports Authority of Trinidad and Tobago.
Alpha	Type of radiation. Easily shielded. High hazard if inhaled or ingested.
Beta	Type of radiation. Shielded by a sheet of plastic. High skin contamination hazard.
BLCTC	Brian Lara Cancer Treatment Centre.
CARICOM	The Caribbean Community.
CERT	Community Emergency Response Team.
CFDD	Chemistry, Food and Drugs Division of the Ministry of Health.
CMO	Chief Medical Officer.
Contamination	Presence on an object, clothes or skin of a radioactive material.
Dangerous source	Source that could lead to severe early health effects if improperly handled.
ESDPCU	Emergency Services and Disaster Preparedness Coordinating Unit of the Ministry of Health.
EWMSC	Eric Williams Medical Sciences Complex.
Gamma	Type of radiation. Electromagnetic emission similar to cosmic rays and X-rays but with a higher energy.
GMRTT	Global Medical Response of Trinidad and Tobago.
HAZMAT	Hazardous material.
International Atomic Energy Agency (IAEA)	Agency responsible for the promotion of nuclear energy and radiation applications for peaceful purposes. The IAEA establishes international safety and emergency preparedness standards and requirements.
International Health Regulations (IHR 2005)	An international legal instrument binding on Member States of the World Health Organization. Their aim is to help the international community prevent and respond to acute public health risks that have the potential to cross borders and threaten people worldwide.
LINAC	Linear accelerator for the treatment of solid cancer tumours.

NaI	Sodium iodide detector, sensitive to gamma radiation, and able to identify the energy signature or radioactive emissions, thereby allowing the identification of the isotope.
NCRHA	North Central Regional Health Authority.
NRC	National Radiotherapy Centre.
NREP	National Radiation Emergency Plan.
NWRHA	North West Regional Health Authority.
ODPM	Office of Disaster Preparedness and Management.
PAHO	Pan American Health Organization.
PATT	Port Authority of Trinidad and Tobago.
PPE	Personal Protective Equipment.
Radiation	Emission of high-energy particles or waves (alpha, beta or gamma) following the disintegration of an atom.
Radiological	Relating to or involving radioactive material.
RER	Radiation Emergency Roster.
Safe distance	Distance from a source beyond which the dose to a member of the public is expected to be negligible.
Sievert (Sv, mSv, micro)	Unit of radiation exposure related to the magnitude of the potential health impact. 1 Sv (1000 mSv) is often quoted as the threshold for acute radiation effects.
SMC	Southern Medical Clinic.
TEMA	Tobago Emergency Management Agency.
TLD	Thermoluminescent Dosimeter.
TTDF	Trinidad and Tobago Defense Force.
TTFS	Trinidad and Tobago Fire Services.
TTPS	Trinidad and Tobago Police Services.

Appendix 2: Radiation Emergency Roster

RADIATION SPECIALISTS

Name	Institution	Contact	Detection equipment
Patricia Singh	NRC	389-2106 622-7381	Gamma dose rate meter
Vladimir Henderson-Suite	NRC	754-1513 622-7381	
Naveen Ratan	NRC	782-1585 622-7381	
Hasmath Ali	MOH	468-4841 623-7544	Beta/gamma Victoreen gamma meter (2)
Richard Glasgow	MOH	793-1622 623-7544	
Nipaul Gangaram	MOH	769-7916 623-7544	
Terrence Courrand	MOH	749-3669 623-7544	
Rhonda Sieunarine	MOH	384-5973 623-7544	
Parthiban Vinai Ourappan	SMC	337-1784 652-2954 Ext 192/186	Beta/gamma Victoreen gamma meter Pancake probe contamination meter
Huriyyah Mohammed	SMC	350-0913 652-2954 Ext 192/186	
Barry Jordan	BLCTC	790-3933 625-4276	Beta/gamma dose rate meter
Amanda Moses	BLCTC	735-3519 625-4276	
TBP	TTFS HAZMAT	TBP	Gamma detector
TBP	TTFS HAZMAT	TBP	
TBP	TTFS HAZMAT	TBP	

LABORATORIES

Name	Country	Contact	Capabilities

DECONTAMINATION

Name	Location	Contact	Capabilities

Appendix 3: Contamination screening levels

According to IAEA GSG-2 Pub 1467, a person should be considered contaminated and in need of decontamination if the following conditions are met:

- Gamma measurement at 10 cm from the skin > 1 mSv/h
- Skin contamination measurement using beta contamination meter > 1000 CPS
- Skin contamination measurement using alpha contamination meter > 50 CPS

Appendix 4: Dangerous quantity value for common radioactive sources

Isotope	D-value (value of activity above which a source is considered "dangerous"[1]
Cobalt-60	0.03 TBq
Iodine-131	0.2 TBq
Cesium-137	0.1 TBq
Iridium-192	0.08 TBq
Polonium-210	0.06 TBq
Radium-226	0.04 TBq
Americium-241	0.06 TBq

[1] Note that a source can still cause harm if it is less that the D-value, but only if it is grossly mishandled (for example swallowed).