ROPME SEA AREA
REGIONAL RADIOLOGICAL/NUCLEAR EMERGENCY RESPONSE PLAN

Volume 2a

OPERATIONAL RESPONSE PLAN

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Annual Review Certification

I hereby certify that I reviewed the *ROPME Radiological/Nuclear Emergency Response Plan, Volume 2a, Operational Response Plan*. This plan incorporates all necessary changes. I distributed changed pages to all recorded holders of the plan.

Date	Name/Signature

Record of Changes

Change Number	Date of Change	Date Entered	Change Made By (Signature)

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1. INTRODUCTION

1.1 Preamble

Radiation emergencies (radiological, nuclear and terrorism; hereinafter referred to as RN) represent one type of emergency that could significantly affect the Regional Organization for the Protection of the Marine Environment (ROPME) sea area (RSA) – see Figure 1. Planning for, and responding to a RN emergency requires a coordinated effort at all levels: local, regional, national and international. This coordination needs to be harmonized with other existing mechanisms and processes that have been developed to manage crises in general and to ensure a clear, coordinated and effective response.

1.2 Regional emergency response plan

The documents comprising the regional plan were developed to provide the required response structure and guidance to support a regional, coordinated response to an RN emergency in international waters within the RSA.

This regional plan, championed by the ROPME and the Marine Emergency Mutual Aid Center (MEMAC), is entitled the RSA (Regional) RN Emergency Response Plan (RNERP).

1.3 Participating Member States

The RSA RNERP includes the following participating Member States (MS):

- Kingdom of Bahrain;
- Islamic Republic of Iran;
- State of Kuwait;
- Sultanate of Oman;
- State of Qatar;
- Kingdom of Saudi Arabia; and
- United Arab Emirates.

All of these MS have a vested interest in the ongoing safety within the ROPME Sea Area, the safety and health of their population and the protection of the environment.

1.4 Structure

The RNERP is comprised of three volumes, as follows:

- Volume 1 – Planning Basis;
- Volume 2 – Regional Radiological/Nuclear Emergency Response Plan (RNERP);
    - Volume 2a – Operational response plan; and
    - Volume 2b – Preparedness plan; and
- Volume 3 – RNERP Procedures.

This document is Volume 2a – Operational Response Plan.

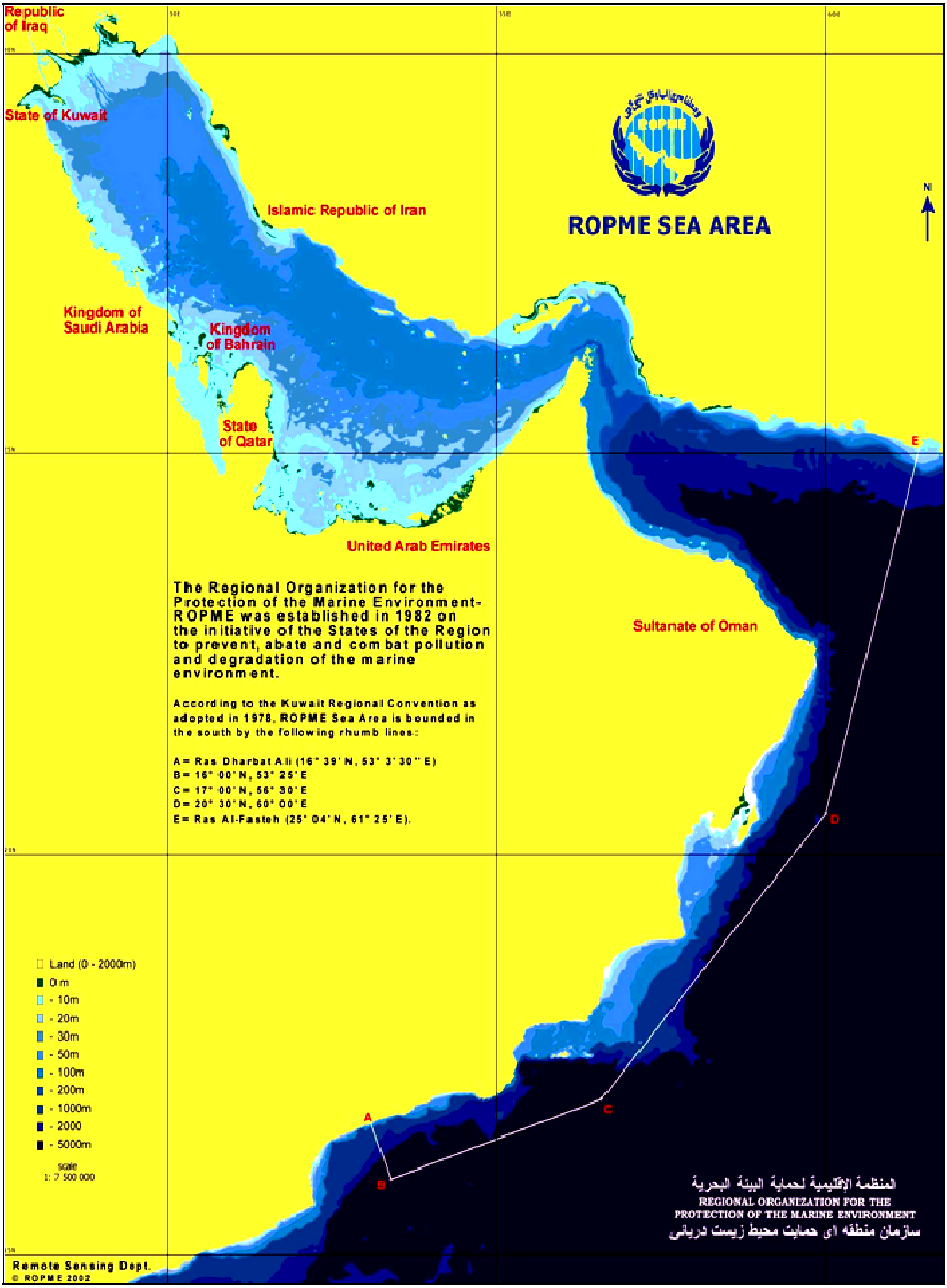

Figure 1: Regional area covered by the emergency plan

1.5 Relevant international, regional and bilateral agreements and conventions

The Regional RN emergency plan is intended to support and reinforce existing Agreements and Conventions. Table 1 summarizes the main relevant documents and how they are related to the RN emergency planning and response processes.

Table 1: Relevant Agreements and Conventions

Document	Relationship to this RN plan
The United Nations Convention of the Law of the Sea, 1982 (UNCLOS)	The principles of the nation's sovereignty over their respective territorial sea and the jurisdictions with regards to the protection and preservation of the marine environment are inalienable principles of the current plan.
International Convention for the Prevention of Pollution from Ships (MARPOL)	Contains requirements for the packaging of hazardous substances and a ship borne, marine emergency plan.
Convention on early notification of a nuclear accident	Commits signatory MS to the prompt notification of nuclear and radiation emergencies having transboundary impacts. In this context, "impacts" is given the broadest meaning, and includes public interest and concern.
International Convention on assistance in the case of nuclear or radiological emergency	Provides a mechanism for the International Atomic Energy Agency (IAEA) to coordinate assistance from signatory MS to requesting States. Assistance can also be provided to non-signatory States.
Bilateral agreements	TBD Regional MS are encouraged to establish bilateral agreements with other Regional MS.
Kuwait Convention	The governing agreement for the ROPME Sea Area is The Kuwait Regional Convention for Co-operation on the Protection of the Marine Environment from Pollution 1978. This, together with its Protocol, provides the legal framework for actions concerning regional co-operation in combating accidental marine pollution. These legal instruments oblige the Contracting States to initiate, both individually and jointly, the actions required in order to effectively prepare for and respond to marine pollution incidents.
Protocol Concerning Regional Cooperation in Combating Pollution by Oil and Other Harmful Substances in Cases of Emergency	The Protocol Concerning Regional Cooperation in Combating Pollution by Oil and Other Harmful Substances in Cases of Emergency also established the Marine Emergency Mutual Aid Centre (MEMAC) to implement the requirements of the protocol and also to fulfill additional functions necessary for initiating operations to combat pollution by oil and other harmful substances on a regional level, when authorized by the Council.

1.6 Authority and responsibility for the response processes

The Regional RN emergency Committee is responsible for the implementation and management of the RN emergency response and preparedness processes (see also Volume 3 – Preparedness Plan), including the Operational Plan. All ROPME MS are responsible for providing the support and resources to execute the processes contained in this Op Plan and the preparedness plan.

1.7 Aim

The aim of this Operational Response Plan is to provide the Concept of Operations (ConOps) for the regional response detailed in the RNERP.

1.8 Scope

This Op Plan provides a description of the proposed regional response to the emergencies postulated in the RN planning basis document [1]. The scope of this document is limited to the regional coordination of response actions; it does not address the response by individual MS, except for the interface with the regional coordination organization. The scope is also limited to emergencies that could take place in the RSA.

1.9 Structure of this document

The structure of this Op Plan is based on the IAEA GS-R-2 functional requirements [2].

1.10 Planning Basis

The Planning Basis (PB) forms Volume 1 of the RNERP and is described, in general, here to provide background information to the Section 2 ConOps.

The PB describes postulated emergency scenarios that are deemed credible and could affect the RSA. These scenarios were developed to constitute a justifiable and reasonable basis for the development and implementation of the RNERP. The planning emergencies included are limited to those that could occur within the limits of the RSA or that could have an impact on the RSA. Other emergency types (e.g., medical overexposure, loss of shielding, etc.) are deemed to be within the jurisdiction of the individual MS and are not specifically addressed in the PB.

The PB focuses on a broad scope of postulated RN emergency scenarios, their estimated likelihoods, and their possible impacts on health, the environment and critical infrastructure. Though real emergencies often look very different from theoretical postulations, planning on the basis of the scenarios described in the PB will serve as a solid foundation for a comprehensive and flexible response capability; this response capability can then be easily adapted to emergencies that are different from those detailed in this document.

The postulated scenarios considered in this planning basis include current and possible future threats; they take into account expected nuclear technology developments in the region. The postulated emergency scenario categories are:

1) Nuclear Power Plant (NPP) reactor accidental release;
2) Nuclear Vessel emergency:
    a. Nuclear Powered Vessel (NPV); and
    b. Nuclear Capable Vessel (NCV);
3) Transportation emergency (marine or land-based, fire or spill);
4) Lost or stolen source; and
5) Terrorist emergencies:
    a. Radiological dispersal device (RDD) or "dirty bomb" that is (or can be) detonated in the RSA;
    b. Attack on a NPP; and
    c. Credible or confirmed terrorist threat affecting the RSA.

The response requirements and capabilities for these PB scenarios form the basis of the Concept of Operations and supporting organizational structure for the RNERP.

1.11 Terminology

A glossary and a list of abbreviations are provided at the end of this document in Annexes G and H, respectively.

2. CONCEPT OF OPERATIONS

2.1 General

This ConOps provides for the designation of a regional response organization for the establishment of a coordinated, multinational on-scene or support response role to the postulated RN emergencies in Volume 1 – Planning Basis. The regional response team organization is comprised mainly of resources and expertise from supporting MS.

2.2 Organization

This regional response organization is entitled the Regional Nuclear/Radiological Coordination Team (RNCT).

The RNCT is responsible to the designated representative within the RSA who is tasked with this oversight.

The RNCT is managed by a committee of MS senior representatives and is normally chaired by the member state representative initiating the regional response, or with the largest potential impact from the emergency.

The regional team structure is based on the Incident Command System (ICS) and consists of the functions depicted in Figure 2. The organization can be modified, based on this regional structure, to meet the specific requirements of an emergency.

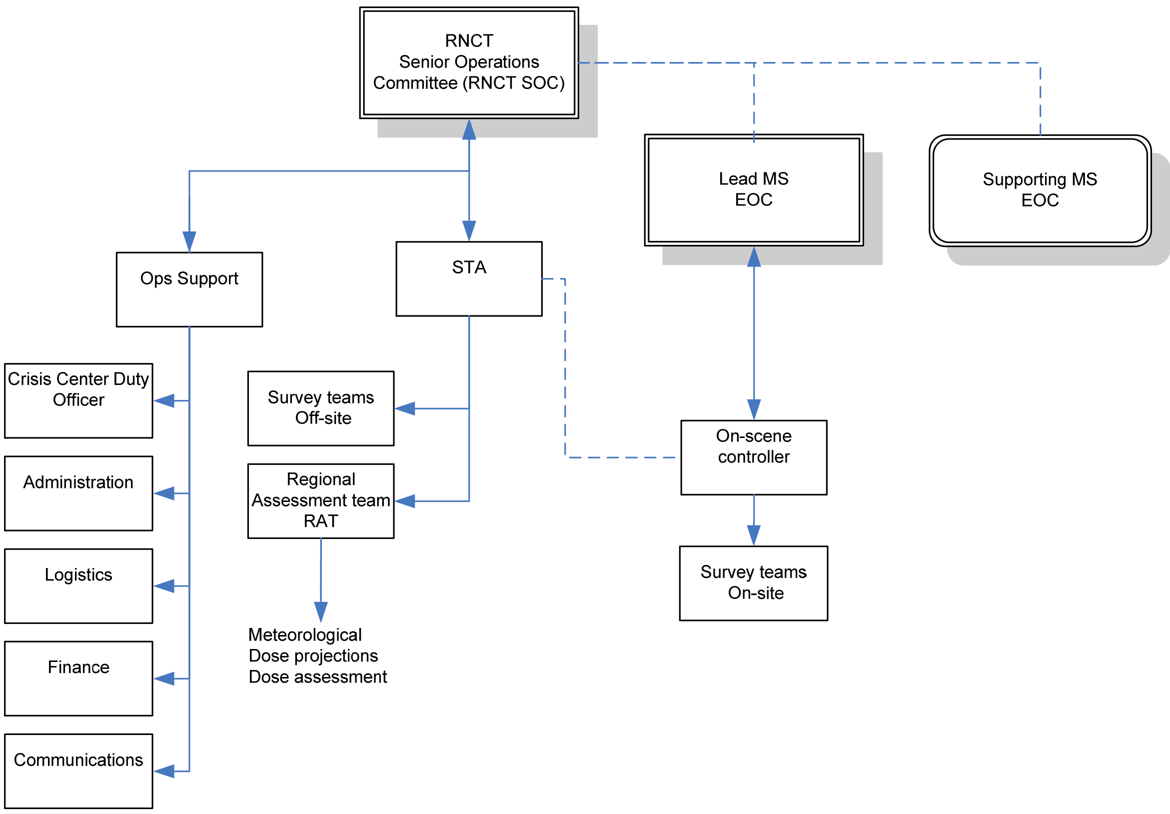

Figure 2: RNCT organization

RNCT Senior Operations Committee – This RNCT Senior Operations Committee (hereafter called the SOC) is comprised of senior MS representatives that are part of the overall regional response organization. A Chair (hereafter called the RNCT Chair or Chair) will be appointed based on MS relevance and proximity to the emergency; the remaining MS will provide delegates to the committee. The SOC will formulate decisions to guide the overall regional response process. As well, the delegates provide two-way communication with their respective MS Emergency Operation Centers (EOC).

Lead MS EOC – The Lead MS will normally be the first MS on scene. The lead MS EOC will also be responsible for the management of the on-scene operations. The Lead MS will liaise with the RNCT senior technical advisor (STA) to provide informational awareness and resource requests, etc.

Support MS EOC - Based on the emergency, many MS will also have activated EOCs. These MS EOCs will provide information to and require information from the RNCT. This information transfer will take place through the respective MS delegates that are part of the RNCT SOC. Resource requests from the Lead MS to Support MS EOC will be managed by the RNCT.

Senior Technical Advisor (STA) – The STA will provide technical and emergency response advice and guidance to the RNCT SOC. The STA will also have communications with the On-Scene Controller (OSC) to provide regional guidance and to allow for the provision of situational awareness information for the committee. The STA also directs the Regional survey and sampling teams and coordinates the work of the Regional Assessment teams.

Survey teams – These are regional survey teams_comprised of resources from MS response teams, requested by the RNCT SOC. When on site, they are responsive to either the OSC or the STA at the RNCT (for downwind surveys, etc.).

Regional Assessment Teams (RAT) – The regional assessment teams are established offices within the RSA that provide the RNCT with the following services:

- Meteorological data;
- Dose assessment; and
- Dose and plume projection.

These offices, including the extent of their capabilities, are identified and included in Volume 2b - Preparedness.

Operations support – The RNCT SOC has operational support in the form of:

- The MEMAC duty officer – providing access to the resources and functionality of the crisis center;
- Logistics – providing a resource from the MS to manage and coordinate the regional logistical response issues;
- Finance – A MS representative to manage and coordinate the regional financial response issues; and
- Communications – A MS representative to manage and coordinate the regional financial response issues.

On-Scene Controller (OSC) – The OSC is normally a MS responder who is in overall charge of the scene. The OSC reports directly to the Lead MS and provides information to the RNCT.

2.3 Command and control

The RNCT is a flexible organization, managed by a committee of senior emergency response decision makers; i.e., the SOC. The SOC must have effective communication with all MS EOC and affected OSC(s), either directly or via the MS

Information and data sharing between the RNCT and MS is conducted through the MS representatives that form the SOC. The Chair of the SOC has the authority of ROPME and the participating MS to respond as required, mitigating the emergency or providing protection to the general public (not the general public within a MS) and regional emergency workers.

The effectiveness of the RNCT will be predicated on the effective collection of emergency data and information; this will allow for the highest level of situational awareness at all times.

2.3.1 SOC Chair

The SOC will normally be chaired by the lead MS representative, the MS that may have the largest territorial impact from the emergency or a pre-designated MS by ROPME. As an example for a marine response, the first marine response team on-scene will set up on-scene control, and the owner MS will normally be the lead MS.

These roles remain in effect until modified by the RNCT SOC, in consultation with the lead MS. If there is no marine response present in the area where the emergency occurred, the SOC, in consultation with appropriate MS, designates a lead MS.

2.3.2 Regional Nuclear/Radiological Coordination Centre (RNCC)

Regional coordination of RN emergency actions will be conducted by the MEMAC operations staff until the RNCT is activated and functional. The MEMAC staff is trained on the triggers for activation of RNCT members (Volume 3 – Procedures).

Each MS EOC will have direct communication and data sharing with the RNCC.

The RNCC would normally be the MEMAC EOC. The RNCC may also be transferred to a MS EOC for proximity requirements, dependant on the emergency location and type.

ROPME provides administrative and coordination support to the RNCT. This will include operational staff from MEMAC, as well as available communication equipment and processes established for all hazard response.

2.3.3 On-scene control

For emergencies that occur in international waters, the first authorized marine response team at the scene assumes the role of OSC.

In all cases, the lead MS and/or the OSC keeps the RNCT informed of the situation at the scene.

The OSC communicates with the STA when sending information to the RNCT or when receiving information from the SOC.

All recommendations for public protective actions are directed from the RNCT to the MS EOC for MS action. MS should keep the RNCT informed on all protective actions taken within their borders.

Resources to assist the OSC or a RNCT response are requested from MS through the SOC.

2.3.4 Regional interoperability

All response organizations that may need to carry out emergency operations in the RSA operate in accordance with standardized regional operating procedures and guidelines (Volume 2b – Preparedness Plan). The RNCT facilitates the integration of joint teams and the cooperation amongst those teams on the basis of common procedures and equipment.

In the event that a response team is required that may not have received the requisite training on the RNCT procedures and guidelines, the STA must be pro-active to ensure a harmonization of procedures and a safe and effective joint response.

A list of trained and interoperable teams is included in Volume 2b –Preparedness.

2.4 Identification, classification, notification and activation

RN emergencies are detected through a proactive surveillance and detection program. Following a verified detection, the emergency is classified and appropriate authorities are notified. Depending on the classification level, emergency response teams and organizations are activated. These concepts for the RNCT are described in detail in the following subsections.

2.4.1 Identification

2.4.1.1 General

An emergency is normally identified by the MS through the proactive detection and surveillance processes in the RSA. This integrated system of radiation detectors and monitors (Early Warning and Monitoring System – (EWMS)) includes:

- Fixed detection networks installed in all MS (refer to Annex A, Appendix 1 of Volume 1 – Planning Basis for more details on detection system requirements);
- Mobile marine and land based detectors. Both the fixed and mobile detection networks are MS assets. These detection systems are connected to real time data collection, display and decision making software. This system is monitored continually by MS and provides automatic early warning and response recommendations. This data is available to RNCT during an emergency, with a real-time link to a central database which includes a decision making and display system;
- Detectors located at strategic chokepoints in commercial transit areas (ports, airports and major roads);
- First responder personal dosimeters and detectors used during normal all hazard scene response; and
- Air-borne-capable NaI detection system.

This system is based on MS assets and monitored by MS resources. The system is also integrated to allow data sharing (i.e., RNCT and applicable MS access) during an emergency.

Access to data is subject to separate protocol between MEMAC, ROPME and the applicable MS. The protocol will delineate the triggers and procedures for emergency data sharing via this centralized network. In general, data is made available to all potentially affected MS during an emergency.

The RNCT surveillance hardware and software is to be maintained by MEMAC with ROPME support. Details of this requirement are outlined in the preparedness section of the RNERP.

Any increase in readings from any one detector is interpreted and responded to by the MEMAC duty officer as detailed in Table 2.

Table 2: Early warning system response triggers and response actions

Readings	Code	Meaning
Background levels		Standard symbology display for data coming in from all sensors for readings < 2 x normal level
Sustained increase in background level above 2 x normal level		Probably a natural occurrence. Monitor the whole network closely for other increases. If the detection occurs at a choke point, the reading is to be investigated more closely.
Sustained increase or spike above 5 x normal level		Possible emergency. The increase must be promptly investigated.
Sustained increase or spike above 10 x normal level		Emergency. The emergency plan must be initiated after reading verification.

Note – Sustained is based on a reading that sustained above the indicated level over a one minute period, disregarding normal fluctuations in radiation measurements.

Identification of an emergency or threat can also be initiated by information from MS, IAEA or intelligence organizations (i.e., credible or confirmed threat). The information received through these channels will be validated and then acted upon as required (i.e., notification, activation and classification procedures).

2.4.1.2 Environmental monitoring program

The surveillance and detection network monitors real time radiation fields and contamination levels. Field measurements require a comparison to baseline levels to ensure there is a man-made variation to original 'background' levels. This baseline data is stored in the monitoring network database for manual or automatic comparison to real-time measured values. The baseline data is based on initial and ongoing sampling and analysis of the natural background at the following locations:

- land based (aerial or mobile survey of varying data fidelity based on country wide priority determinations);
- sea water – selected sampling locations;
- sea weed – selected sampling locations;
- crustaceans – selected sampling locations;
- well water; and
- soil samples – selected sampling locations.

The exact sampling locations are noted in the Environmental Radionuclide Baseline Study (ERBS) document, included in the Regional Environmental Radiological Monitoring Program (ERMP). This data is also available and viewable as dedicated icons on the Early Warning and Monitoring System.

2.4.1.3 Other identification means

Depending on the type of emergency, identification could also come from other means, as shown in Table 3.

Table 3: Additional detection methods

Planning Basis emergency type	Other possible detection means
NPP emergency	Notification from the NPP/MS.
NPV emergencies	Notification to MS EOC from the NPV and then to MEMAC. Visual indication of problem on board (e.g., fire, smoke or steam escaping from the ship). EWMS.
NCV emergency	Idem. However, in this case, most radiation detection instruments will not detect the presence of the nuclear material from the vessel. See the section on assessment for more information.
Accidental dispersion from fire or explosion in facility/ship	First responder's detection instruments or personal alarming dosimeters and requisite training to alert them of the presence of radiation. EWMS.
Transportation emergency	As above.
Lost or stolen source	Notification from the organization that lost the source or police/intelligence information. Detection from mobile detectors. Procedures must be in place to ensure that respective MS are promptly informed of missing or stolen sources.
Radioactive dispersal device	As for accidental dispersion from fire.

2.4.2 Classification

After the initial identification or detection and confirmation of an emergency, the emergency must be classified. The provisional classification will normally be implemented by the MS that identified the emergency.

Each MS is responsible for defining an emergency classification system for a RN emergency and for determining the classification when an emergency occurs. The regional classification levels are defined in Table 4.

When the emergency takes place in international waters, the lead MS recommends the classification to the RNCC.

The RNCC will review the provisional classification level provided by the Lead MS and whenever new information or data becomes available.

Table 4: Regional classification levels

Classification level	Definition
Alert	Abnormal or uncertain situation that could lead to a radiological hazard to the personnel within the facility or vessel, or a serious threat.
Site emergency	Events resulting in a major decrease in the level of protection for those on or near the site. Radiological or nuclear emergency with localized consequences limited to the facility site or on-scene, and that can be managed by facility personnel or on-scene responders.
General Emergency	Actual or substantial risk of a release of radioactive material or radiation exposure that warrants taking urgent protective actions outside the facility, vessel or on-scene area.

Specific RNCT procedures (Volume 3 – Emergency Procedures) delineate measurable criteria for the determination of the classification level, based on field measurements and other relevant information.

The classification level will be used to determine the organizations to notify and the RNCT activation levels.

2.4.3 Notification

2.4.3.1 General

The MEMAC maintains a 24/7 contact number with a Duty Officer trained in the procedures for notification of applicable RNCT resources and of MS operation centers.

Following the detection or discovery of any RN emergency that has or could require regional assistance or response (classified as ALERT or above by the reporting MS), the affected MS notifies the MEMAC Duty Officer.

The MEMAC Duty Officer will collect as much information as possible on the emergency or emergency including, but not limited to:

- MS classification level;
- Type of emergency or threat;
- Possibly affected MS;
- MS contact information;
- OSC contact information;
- Assets deployed; and
- Resources required.

The MEMAC Duty Officer will contact the Duty SOC Chair and STA. The Duty Chair and STA will review the information collected and conduct a classification of the emergency.

Based on the recommended classification by the Duty Chair, the MEMAC Duty officer will notify:

- MS;
- IAEA (as applicable); and
- RNCT members, through activation processes applicable to the emergency classification (Table 5).

Once activated, the RNCT notifies all MS regardless of the fact that they may not be affected, either directly or indirectly, by the emergency. In case of a General Emergency, the RNCT (or MEMAC if RNCT is not operational) notifies all MS.

Activation of the RNCT can also take place as part of an assistance request from a MS. This request should be made from the MS to the MEMAC Duty Officer. Once the RNCT has been activated, the MS should dispatch a committee chairperson to lead the SOC during the emergency assistance request.

The RNCC notifies the IAEA of any General Emergency that has, or could have, transboundary impacts.

2.4.3.2 Special case of terrorist emergencies or threats

In the case of terrorist emergencies or threats, confidentiality of the information and the need to carefully control its distribution must be seriously considered. Any party (ROPME, RNCC or MS) that becomes aware of a terrorist threat carries out a threat assessment. For serious threats, designated intelligence contact points in each party are notified through secure communications channels.

2.4.4 Activation

The MEMAC Duty Officer, in consultation with the Duty Chair and STA, activates the RNCT and ensures that the RNCC is functional and operational, including all communications links with the OSC and MS EOC.

Should no OSC be present at the scene, RNCC notifies the most appropriate MS (based on emergency type and location) and requests the MS to take over the function of OSC and Lead MS.

In general, activation levels are in accordance with Table 5.

Table 5: Activation levels

MS Classification level	MS Classification Description	RNCC Activation
Alert	Abnormal or uncertain situation that could lead to a radiological hazard to the personnel within the facility or vessel, or a serious threat.	Duty RNCT operations staff MEMAC EOC only. Remaining RNCT members are notified and on standby. All RNCT members are kept informed of the situation.
Site emergency	Events resulting in a major decrease in the level of protection for those on or near the site. Radiological or nuclear emergency with localized consequences limited to the facility site or on-scene, and that can be managed by facility personnel or on-scene responders.	Elevated RNCT operations staff levels, including SOC Chair and STA at the RNCC. Communication amongst SOC members is arranged by the RNCC.
General Emergency	Actual or substantial risk of a release of radioactive material or radiation exposure that warrants taking urgent protective actions outside the facility, vessel or on-scene area.	Full RNCT operations recalled to MEMAC EOC, including applicable SOC.

2.5 Mitigation

The OSC, with possible support from RNCT, determines what mitigation actions are required. If assistance is required, the OSC may request assistance from its respective MS. For emergencies that occur in international waters and that are coordinated by the RNCT, assistance may be requested directly through the RNCC.

Mitigation actions may include the following, for example, as described in Table 6.

Table 6: Examples of mitigating actions

Emergency type	Examples of mitigating actions
NPP emergency	Cooling the reactor, ensuring containment and putting out any fire that may be the cause of the emergency. This is normally fully under the control of the facility.
NPV emergencies	Aside from the mitigating measures that are solely within the control of the NPV crew, emergency responders may be asked to assist with plume suppression (knock down), and the provision of emergency de-mineralized water as coolant.
NCV emergency	Firefighting and plume suppression.
Accidental dispersion from fire or explosion in facility/ship	Firefighting and plume suppression.
Transportation emergency	Firefighting, plume suppression and spill control.
Lost or stolen source	Locate and recover.
Radioactive dispersal device	Source recovery or containment, plume suppression, fire fighting (for explosive material).

2.6 Taking urgent protective actions

The OSC is responsible for implementing protective actions at the scene. Each MS is responsible for the determination and implementation of urgent protective actions within their MS. If the emergency occurs in international waters, or involves a multi-national response, the RNCT SOC is responsible for recommending consistent urgent protective actions based on recommendations provided by the RNCT STA.

Once activated, the RNCT must be kept informed of all planned and executed protective actions. The RNCT STA provides advice to the OSC and to requesting MS on what protective actions should be considered. The RNCT, when requested, coordinates the provision of assistance. Even when not requested to provide assistance, the RNCT remains proactive, constantly assessing the possible needs of the affected MS. If required, the RNCT also makes preliminary arrangements to be able to provide this assistance promptly, if requested.

The RNCT monitors planned and actual protective actions implemented by MS and identifies any conflict or discrepancy that could reduce the effectiveness of the measures. Additionally, the RNCT questions the appropriateness of the measures that were taken. When such discrepancies or inconsistencies are noted, the RNCT SOC liaises with the concerned MS and fosters a harmonization of national and regional countermeasures.

2.7 Instructions to the public

Instructions to the public within each MS are the sole responsibility of the MS. For ships and facilities in international water within the RSA, the RNCT is responsible for communicating relevant information and instructions.

All MS inform the RNCT of planned and actual communiqués issued for the purpose of providing instructions to the public. The RNCT monitors these communiqués and identifies any discrepancy or inconsistency that could affect their effectiveness or credibility. In the case of discrepancy or inconsistency, the RNCT coordinates with the relevant MS to resolve the issue.

The RNCT SOC keeps the relevant organizations within their respective MS informed of public instructions disseminated by other MS.

2.8 Protection of emergency workers

The protection of emergency workers is the responsibility of each MS. However, when working in multinational joint teams within the RSA, the RNCT coordinates the adoption of standard protective posture for all emergency workers involved in the on-scene response, in consultation with the lead MS.

RNCT employs emergency worker procedures that are consistent with MS.

If assistance is required for the provision of protective equipment, dosimetry or prophylaxis, the RNCT coordinates this assistance and organizes the delivery of the required resources to the OSC.

Any worker expected to work in a radiation area, where exposure could exceed the annual limit of exposure for a member of the general public (1 mSv above normal background), should already be designated by their MS as nuclear emergency workers. RNCT will utilize MS emergency worker designations (i.e., no requirement for a regional emergency worker designation).

Each MS (normally through OSC) is responsible for maintaining a dose registry of its respective emergency workers and for carrying out follow-on internal dosimetry assessments, if required.

RNCT will maintain dose tracking of all emergency workers employed directly by the RNCT (i.e., they will not be tracked by their own MS during an emergency where a team is deployed to support the regional operation).

Emergency worker intervention levels and turn back limits are detailed in Volume 3 – Procedures.

2.9 Assess and evaluate

Two types of assessments are considered:

1. On-scene assessment of the situation and radiation levels to determine the need for mitigation actions, the need to evacuate the scene, the size of the immediately affected area and the measures required to stabilize the on-scene situation. This will normally be carried out by the Lead MS EOC and OSC; and
2. Consequence assessment, to determine the need for protective actions to protect the public, the extent of the affected areas, and the need for longer-term protective measures. In international waters, this will be carried out by the RNCC, as required.

2.9.1 On-scene assessment

On-scene assessment is the responsibility of the OSC and the Lead MS. In general, from a radiological perspective, this will be done on the basis of direct measurements of ambient dose rates, surface contamination levels and air contamination levels. Once activated, decisions are based on RNCT operational intervention levels (which should be consistent with MS intervention levels) in combination with information regarding the status of the source of radiation (e.g., plant, package, source, etc.) and the situational trends. On-scene responders will have instruments to determine those radiation levels or will be supported by coordinated survey teams. RNCT STA, when activated, will provide assistance to the OSC or the Lead MS EOC as required.

2.9.2 Consequence assessment

Consequence assessment is based on a combination of the following:

- Assessment of the condition of the source, reactor, facility, etc.;
- Source term or release information from the emergency;
- Population density and other environmental and infrastructure site specific criteria;
- Direct measurements compared to operational intervention levels;
- Meteorological data;
- Dose predictions; and
- Plume trajectory predictions.

The regional consequence assessment is coordinated by the RNCT STA. The following teams/organizations cooperate to produce regular updates and projections:

- The regional survey teams (i.e., survey teams for downwind measurements) are coordinated by the STA and provide real-time field measurements of radiation levels and contamination in the environment, in accordance with a well-established survey strategy;
- The STA collects all data from MS radiation monitoring networks and consolidates it into a single product;
- The regional meteorological center(s), supported by the IAEA or WHO as applicable, provides meteorological data for current conditions as well as projections at six, twelve, and 24 hour intervals, including weather conditions and wind trajectory;
- The regional dose projection center(s) provides dose projections based on current data. Two dose projections are to be provided:
  - Dose projections based on known conditions; and
  - Dose projections based on the likely worst case scenario, along with a qualitative judgment on the likelihood of this scenario; and
- The SOC, with the assistance of the STA and MS experts, integrates all the above information and formulates a recommendation for the protection of the public in the region.

The STA reviews and validates the recommendations and other assessment information, and promptly distributes this information to all appropriate MS.

2.9.3 Survey teams

Survey teams are jointly trained teams using standardized survey procedures and instruments. The following survey teams are available in case of an RN emergency:

Table 7: Regional survey teams

MS	Survey team description
Kingdom of Bahrain	TBD
Islamic Republic of Iran	TBD
Republic of Iraq	TBD
State of Kuwait	TBD
Sultanate of Oman	TBD
State of Qatar	TBD
Kingdom of Saudi Arabia	TBD
United Arab Emirates	TBD

2.9.4 Survey strategy

The regional survey strategy is based on the characterization of areas where operational intervention levels may be exceeded. Survey teams are positioned taking into account the location of fixed monitoring stations and atmospheric conditions with a goal to provide air and ground ambient dose rate and contamination data, as applicable, in populated areas where protective actions have not been initiated (i.e., un-surveyed areas). As much as possible, areas where contamination or ambient dose rates are sufficient to warrant evacuation should be avoided.

The data collected from the survey teams will be displayed for situational awareness and recorded and stored for comparison to baseline analyses and for post emergency analysis.

On-scene surveys will normally be conducted by Lead MS state survey teams, as directed by the OSC.

OILs are detailed in Annex A.

Medical Response

The OSC is responsible for coordinating medical response at the scene. If the OSC does not have the required medical resources for first aid and transportation to a suitable medical facility, the OSC first requests such assistance from their MS. Should the MS not have access to such resources, the OSC may, directly or through the MS, request prompt assistance from the RNCT. The RNCT constantly monitors the situation to proactively anticipate such needs and make the necessary arrangements for the rapid dispatch of trained medical response teams, if required.

An inventory of qualified medical response teams, along with their capabilities and contact information, shall be maintained in the regional procedures. Medical response teams include:

- Medical First responders; and
- Casualty transport teams (air, marine and ground).

In cases involving mass casualties (which is defined as any number of casualties that may overwhelm the existing and available medical capability), the RNCT is to be immediately notified and will coordinate the provision of additional medical resources, in consultation with the lead MS.

Victims are to be transported to appropriate medical facilities. In cases involving potential or actual contamination, only approved medical facilities are to be used to receive patients and provide care. A list of approved medical facilities will be compiled and maintained in the Emergency procedures – Volume 3. Once the patient has been decontaminated and stabilized, the casualty is to be transferred, as required, to a medical facility suitable to deal with the nature of the injuries. Cases of severe internal contamination are to be provided follow up care in a facility capable of managing such cases.

Decontaminated victims of severe overexposures are NOT a threat to the medical personnel and will be transported to a medical facility that is suitable to deal with the primary trauma. Once the patient has been stabilized, they are to be transferred to a medical team with appropriate expertise for dealing with the follow up aspect of severe overexposure.

2.10 Public information

MS are solely responsible for communications with the media. The RNCT designates a regional spokesperson who may address the media, but only at the request of, and in coordination with, the lead MS. The RNCT does not include a media team; it therefore relies on coordination with the MS media teams.

Each MS keeps the RNCT informed of:

- The planned media strategy;
- The key messages;
- The most critical media rumours; and
- Media activities (press conference, media releases, news, etc.).

The RNCT communications section monitors the various MS media activities and products to ensure that the messaging at the regional level is consistent and coherent. If required, the RNCT coordinates with the involved MS to harmonize media messages and activities. Messaging internal to a MS is the responsibility of the MS. In cases involving significant media activities that have a regional dimension, the RNCT may establish a regional media coordination centre. The media coordination centre then becomes the regional ‘nerve centre’ designed to monitor all media activities, issue joint media statements and organize joint media activities. National spokespersons should meet at the regional media centre, along with their media support teams.

2.11 Longer-term protective actions

If required, longer term protective actions, such as agricultural countermeasures, relocation, resettlement and tourism bans are the responsibility of each MS, with support of the RNCT. Longer term protection actions in international areas are the responsibility of the RNCT.

The RNCT is kept informed by all MS of planned longer-term protective actions. The RNCT ensures that these actions are consistent with this regional plan and with participating MS plans. The RNCT also coordinates regional and international assistance that may be required to assist individual MS, at their request.

Since the management of longer-term protective actions may be a protracted activity, the RNCT may establish a separate group and a different meeting schedule for the coordination of these longer-term activities. This new coordination group may be the same as the regional recovery coordination committee mentioned below.

2.12 Mitigation of the non-radiological impacts

During an emergency, there are many indirect effects or non-radiological impacts that can result either from the emergency or through the response effort. Some of those consequences can include psychosocial effects in the affected population resulting from lack of information, misinformation and ineffectiveness in reassuring the public of the risks involved.

Mitigation efforts to control non-radiological impacts will include the following:

- Providing counseling to emergency response workers and their families;
- Providing counseling to victims and their families;
- Holding public consultation sessions with affected public groups to explain the impacts of the emergency and the health risks;
- Providing reassurance, contamination and health monitoring to concerned members of the public;
- Maintaining a 24/7 hotline, website, etc. for the provision of information to concerned members of the public; and
- Any other measure that could contribute to the reassurance of the public.

These measures are solely the responsibility of the MS. The RNCT may assist in providing expert resources to requesting MS. The RNCT also ensures that emergency teams that worked under the auspices of this regional plan receive appropriate follow up care.

2.13 Recovery

Each MS is responsible for the recovery operations within its own territory.; the RNCT is responsible for leading and managing recovery actions in international waters. To coordinate the recovery effort within the region, a regional recovery coordination committee will be established by the RNCT in coordination with the affected MS. The recovery committee will meet at regular intervals to review planned recovery measures and to ensure consistency of recovery strategies on a regional level.

2.14 Other operational considerations

2.14.1 Communications

Communications between response organizations are illustrated in Figure 3. Operational control of on-scene resources is under the OSC and the lead MS. The provision and administrative control of each response team is the responsibility of the providing MS. The RNCT maintains liaison with the lead MS, all involved MS and the OSC.

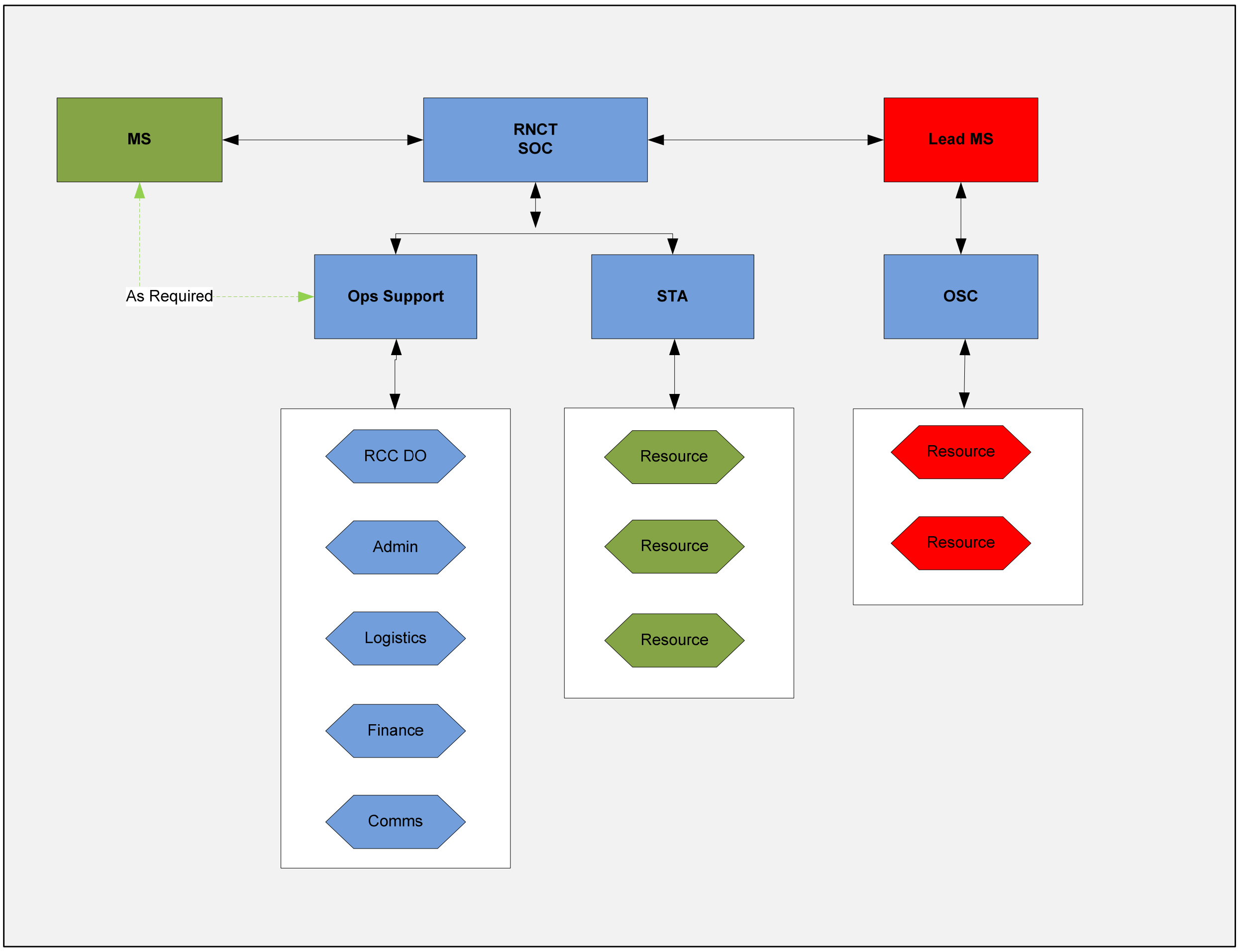

Figure 3: Regional communication during an emergency

2.14.2 Customs and entry into MS

The RNCT will proactively facilitate the entry of individual MS experts, material, equipment, resources and patients, including permission into national air and marine spaces (e.g., medical transport of casualties). This can be expedited using pre-existing arrangements from ROPME or MEMAC for equipment and/or resources.

2.14.3 Language

The language of communications during an emergency will be English. In the case of an emergency NOT involving Iran in operations, coordination or information, the language of communications may be Arabic.

2.14.4 Return to normal operations

Return to normal operations for a regionally led emergency will be carried out when all data, samples, etc. have been collected. Additionally, a scene under police forensics control is available for normal operations when all hazards have been removed or identified and made safe for later remediation

Return to normal operations for a MS led emergency will be the responsibility of the MS.

3. EMERGENCY RESPONSE FACILITIES AND EQUIPMENT

3.1 Crisis center

The Regional RN Coordination Center (RNCC) will normally be the MEMAC EOC in Bahrain or a MS EOC.

The decision on location will be made by the SOC Chair on activation.

3.2 Detection and Personal Protective Equipment (PPE)

Equipment utilized by the response and survey teams is MS equipment, as these teams are MS teams seconded for use in the Regional response. This includes all PPE, detection equipment and disposables required for the response.

Compensation for equipment replacement to MS will be reviewed by ROPME on completion of the response phase.

3.3 Communications equipment

Communications equipment will be supplied by the MEMAC for the RNCC, and by the MS teams as part of the on-scene response.

3.4 Vehicles and aircraft

All required vehicles and aircraft will be supplied by MS or as an asset of a MS response team.

ANNEX A – INTERVENTION LEVELS

Protective actions introduce a benefit, which is measured in terms of the reduction in the health impact. But they also have an inherent detriment associated with them (e.g., economic loss, disturbance, anxiety). Ideally, the benefit introduced by a protective action must outweigh its detriment.

The objectives of emergency response are to:

- prevent acute health effects; and
- minimize long-term health impacts.

The first objective is achieved by avoiding the hazard, i.e., evacuating or substantially sheltering people from the immediate area, where radiological and conventional hazards may lead to acute health effects. In this case, the benefit (preventing acute health effects) almost always outweighs the detriment.

The second objective is also achieved by minimizing the dose received through the implementation of sheltering or evacuation. However, in this case, the health benefit is the statistical reduction of incremental long-term health effects in a large population. Unlike the reduction of acute health effects, it is not immediate and it is more difficult to measure. The benefit, which is the dose reduction achieved, does not always outweigh the detriment associated with the protective action unless the dose reduction is significant. The value of the dose reduction achieved at which the benefit becomes greater than the detriment can be calculated [3]. This value is called the intervention level for that particular protective action.

Table A-8 lists the intervention levels for urgent protective actions for use in this document. These are based on International Atomic Energy Agency (IAEA) guidance [4] and are consistent with other international guidance [5]. The value of the intervention level corresponds to the dose averted for the time during which the protective measure is in effect. For an evacuation, this should not be greater than seven days. For sheltering, the IAEA [4] suggests two days as a maximum. However, in practice, this measure should not be in effect for more than one day, since many people would need to go out to get food and other essential supplies. It should also be noted that sheltering is less than 100% effective at reducing the dose and that an appropriate dose reduction factor must be applied to calculate the dose averted.

Note 1 - If the dose accumulated in a month is not expected to fall below this level in a year or two, permanent resettlement should be considered.
Note 2 - Provided the total life time dose to any member of the population will be less than 1 Sv.

Table A-9 contains the generic recommended action levels for restricting contaminated food.

Table A-8: Protective action intervention levels

Protective action	Generic intervention level
Sheltering	10 mSv
Evacuation	50 mSv
Iodine prophylaxis	100 mGy
Temporary relocation	Initiate at 30 mSv in 30 days Terminate at 10 mSv in 30 days
Permanent resettlement	1 Sv in lifetime

Note 1 - If the dose accumulated in a month is not expected to fall below this level in a year or two, permanent resettlement should be considered.
Note 2 - Provided the total life time dose to any member of the population will be less than 1 Sv.

Table A-9: Action levels for restricting contaminated food

Radionuclides In Foods Destined For General Consumption	kBq/kg
Cs-134, Cs-137, I-131, Ru-103, Ru-106, Sr-89	1
Sr-90	0.1
Am-241, Pu-238, Pu-239, Pu-240, Pu-242	0.01
Radionuclides In Milk, Infant Foods And Drinking Water	**kBq/kg**
Cs-134, Cs-137, Ru-103, Ru-106, Sr-89	1
I-131, Sr-90	0.1
Am-241, Pu-238, Pu-239, Pu-240, Pu-242	0.001

Intervention levels are planning values. During an actual emergency, decisions must also take into consideration practical factors such as road conditions, weather, time of day, etc.

The implementation of generic intervention levels in emergency response requires further planning for some complex scenarios involving the release of alpha or beta emitters. The use of avoided dose intervention levels on-scene, based on measurements, is therefore emergency or emergency specific (i.e., isotope, etc.). The following sections provide scenario specific intervention levels based on the generic intervention levels provided above.

Table A-10 [6] provides a detailed list of default radionuclide specific OIL for food, water and milk consumption, based on analysis providing an activity per unit mass determination.

Table A-10: Default radionuclide-specific oils for food, milk and water concentrations by laboratory analysis

Radionuclide		Bq/kg	Radionuclide		Bq/kg
H-3		2×10^5	Pm-147		1×10^4
Be-7		7×10^5	Pm-148m	+	1×10^4
Be-10		3×10^3	Pm-149		3×10^5
C-11		2×10^9	Pm-151		8×10^5
C-14		1×10^4	Sm-145		2×10^4
F-18		2×10^8	Sm-147		1×10^2
Na-22		2×10^3	Sm-151		3×10^4
Na-24		4×10^6	Sm-153		5×10^5
Mg-28	+[a]	4×10^5	Eu-147		8×10^4
Al-26		1×10^3	Eu-148		2×10^4
Si-31		5×10^7	Eu-149		9×10^4
Si-32	+	9×10^2	Eu-150b		3×10^6
P-32		2×10^4	Eu-150a		4×10^3
P-33		1×10^5	Eu-152		3×10^3
S-35		1×10^4	Eu-152m		4×10^6
Cl-36		3×10^3	Eu-154		2×10^3

Radionuclide		Bq/kg	Radionuclide		Bq/kg
Cl-38		3×10^8	Eu-155		1×10^4
K-40		NA[b,c]	Eu-156		2×10^4
K-42		3×10^6	Gd-146	+	8×10^3
K-43		4×10^6	Gd-148		1×10^2
Ca-41		4×10^4	Gd-153		2×10^4
Ca-45		8×10^3	Gd-159		2×10^6
Ca-47	+	5×10^4	Tb-157		9×10^4
Sc-44		1×10^7	Tb-158		3×10^3
Sc-46		8×10^3	Tb-160		7×10^3
Sc-47		4×10^5	Dy-159		7×10^4
Sc-48		3×10^5	Dy-165		7×10^7
Ti-44	+	6×10^2	Dy-166	+	6×10^4
V-48		3×10^4	Ho-166		5×10^5
V-49		2×10^5	Ho-166m		2×10^3
Cr-51		8×10^5	Er-169		2×10^5
Mn-52		1×10^5	Er-171		6×10^6
Mn-53		9×10^4	Tm-167		1×10^5
Mn-54		9×10^3	Tm-170		5×10^3
Mn-56		3×10^7	Tm-171		3×10^4
Fe-52	+	2×10^6	Yb-169		3×10^4
Fe-55		1×10^4	Yb-175		4×10^5
Fe-59		9×10^3	Lu-172		1×10^5
Fe-60		7×10^1	Lu-173		2×10^4
Co-55		1×10^6	Lu-174		1×10^4
Co-56		4×10^3	Lu-174m		1×10^4
Co-57		2×10^4	Lu-177		2×10^5
Co-58		2×10^4	Hf-172	+	2×10^3
Co-58m		9×10^7	Hf-175		3×10^4
Co-60		8×10^2	Hf-181		2×10^4
Ni-59		6×10^4	Hf-182	+	1×10^3
Ni-63		2×10^4	Ta-178a		1×10^8
Ni-65		4×10^7	Ta-179		6×10^4
Cu-64		1×10^7	Ta-182		5×10^3
Cu-67		8×10^5	W-178	+	2×10^5
Zn-65		2×10^3	W-181		1×10^5
Zn-69		6×10^8	W-185		2×10^4
Zn-69m	+	3×10^6	W-187		1×10^6
Ga-67		1×10^6	W-188	+	3×10^3
Ga-68		2×10^8	Re-184		2×10^4
Ga-72		1×10^6	Re-184m	+	3×10^3
Ge-68	+	3×10^3	Re-186		1×10^5
Ge-71		5×10^6	Re-187		5×10^5
Ge-77		6×10^6	Re-188		7×10^5
As-72		4×10^5	Re-189		8×10^5
As-73		3×10^4	Os-185		2×10^4
As-74		3×10^4	Os-191		8×10^4
As-76		4×10^5	Os-191m		1×10^7
As-77		1×10^6	Os-193		7×10^5
Se-75		4×10^3	Os-194	+	8×10^2

Radionuclide		Bq/kg	Radionuclide		Bq/kg
Se-79		7×10^2	Ir-189		2×10^5
Br-76		3×10^6	Ir-190		6×10^4
Br-77		5×10^6	Ir-192		8×10^3
Br-82		1×10^6	Ir-194		6×10^5
Rb-81		8×10^7	Pt-188	+	6×10^4
Rb-83		7×10^3	Pt-191		9×10^5
Rb-84		1×10^4	Pt-193		8×10^4
Rb-86		1×10^4	Pt-193m		3×10^5
Rb-87		2×10^3	Pt-195m		3×10^5
Sr-82	+	5×10^3	Pt-197		2×10^6
Sr-85		3×10^4	Pt-197m		1×10^8
Sr-85m		3×10^9	Au-193		8×10^6
Sr-87m		3×10^8	Au-194		1×10^6
Sr-89		6×10^3	Au-195		2×10^4
Sr-90	+	2×10^2	Au-198		3×10^5
Sr-91		3×10^6	Au-199		5×10^5
Sr-92		2×10^7	Hg-194	+	2×10^2
Y-87	+	4×10^5	Hg-195		2×10^7
Y-88		9×10^3	Hg-195m		8×10^5
Y-90		9×10^4	Hg-197		1×10^6
Y-91		5×10^3	Hg-197m		2×10^6
Y-91m		2×10^9	Hg-203		1×10^4
Y-92		1×10^7	Tl-200		5×10^6
Y-93		1×10^6	Tl-201		3×10^6
Zr-88		3×10^4	Tl-202		2×10^5
Zr-93		2×10^4	Tl-204		3×10^3
Zr-95	+	6×10^3	Pb-201		2×10^7
Zr-97	+	5×10^5	Pb-202	+	1×10^3
Nb-93m		2×10^4	Pb-203		2×10^6
Nb-94		2×10^3	Pb-205		2×10^4
Nb-95		5×10^4	Pb-210	+	2.0
Nb-97		2×10^8	Pb-212	+	2×10^5
Mo-93		3×10^3	Bi-205		7×10^4
Mo-99	+	5×10^5	Bi-206		8×10^4
Tc-95m	+	3×10^4	Bi-207		3×10^3
Tc-96		2×10^5	Bi-210		1×10^5
Tc-96m		2×10^9	Bi-210m		2×10^2
Tc-97		4×10^4	Bi-212	+	7×10^7
Tc-97m		2×10^4	Po-210		5.0
Tc-98		2×10^3	At-211	+	2×10^5
Tc-99		4×10^3	Ra-223	+	4×10^2
Tc-99m		2×10^8	Ra-224	+	2×10^3
Ru-97		2×10^6	Ra-225	+	2×10^2
Ru-103	+	3×10^4	Ra-226	+	2×10^1
Ru-105		2×10^7	Ra-228		3.0
Ru-106	+	6×10^2	Ac-225		3×10^3
Rh-99		1×10^5	Ac-227	+	5.0
Rh-101		8×10^3	Ac-228		7×10^6
Rh-102		2×10^3	Th-227	+	9×10^1

Radionuclide		Bq/kg	Radionuclide		Bq/kg
Rh-102m		5×10^{3}	Th-228	+	2×10^{1}
Rh-103m		5×10^{9}	Th-229	+	8.0
Rh-105		1×10^{6}	Th-230		5×10^{1}
Pd-103	+	2×10^{5}	Th-231		2×10^{6}
Pd-107		7×10^{4}	Th-232		4.0
Pd-109	+	2×10^{6}	Th-234	+	8×10^{3}
Ag-105		5×10^{4}	Pa-230		5×10^{4}
Ag-108m	+	2×10^{3}	Pa-231		2×10^{1}
Ag-110m	+	2×10^{3}	Pa-233		3×10^{4}
Ag-111		7×10^{4}	U-230	+	8×10^{2}
Cd-109	+	3×10^{3}	U-232		2×10^{1}
Cd-113m		4×10^{2}	U-233		1×10^{2}
Cd-115	+	2×10^{5}	U-234		2×10^{2}
Cd-115m		6×10^{3}	U-235	+	2×10^{2}
In-111		1×10^{6}	U-236		2×10^{2}
In-113m		4×10^{8}	U-238	+	1×10^{2}
In-114m	+	3×10^{3}	Np-235		7×10^{4}
In-115m		5×10^{7}	Np-236l	+	8×10^{2}
Sn-113	+	1×10^{4}	Np-236s		4×10^{6}
Sn-117m		7×10^{4}	Np-237	+	9×10^{1}
Sn-119m		1×10^{4}	Np-239		4×10^{5}
Sn-121m	+	5×10^{3}	Pu-236		1×10^{2}
Sn-123		3×10^{3}	Pu-237		2×10^{5}
Sn-125		2×10^{4}	Pu-238		5×10^{1}
Sn-126	+	5×10^{2}	Pu-239		5×10^{1}
Sb-122		2×10^{5}	Pu-240		5×10^{1}
Sb-124		5×10^{3}	Pu-241		4×10^{3}
Sb-125	+	3×10^{3}	Pu-242		5×10^{1}
Sb-126		3×10^{4}	Pu-244	+	5×10^{1}
Te-121		1×10^{5}	Am-241		5×10^{1}
Te-121m	+	3×10^{3}	Am-242m	+	5×10^{1}
Te-123m		5×10^{3}	Am-243	+	5×10^{1}
Te-125m		1×10^{4}	Am-244		4×10^{6}
Te-127		1×10^{7}	Cm-240		4×10^{3}
Te-127m	+	3×10^{3}	Cm-241		3×10^{4}
Te-129		2×10^{8}	Cm-242		5×10^{2}
Te-129m	+	6×10^{3}	Cm-243		6×10^{1}
Te-131		4×10^{8}	Cm-244		7×10^{1}
Te-131m		3×10^{5}	Cm-245		5×10^{1}
Te-132	+	5×10^{4}	Cm-246		5×10^{1}
I-123		5×10^{6}	Cm-247		6×10^{1}
I-124		1×10^{4}	Cm-248		1×10^{1}
I-125		1×10^{3}	Bk-247		2×10^{1}
I-126		2×10^{3}	Bk-249		1×10^{4}
I-129		NA[d]	Cf-248		2×10^{2}
I-131		3×10^{3}	Cf-249		2×10^{1}
I-132		2×10^{7}	Cf-250		4×10^{1}
I-133		1×10^{5}	Cf-251		2×10^{1}
I-134		2×10^{8}	Cf-252		4×10^{1}

Radionuclide		Bq/kg	Radionuclide		Bq/kg
I-135		2×10^6	Cf-253		3×10^4
Cs-129		1×10^7	Cf-254		3×10^1
Cs-131		2×10^6	Es-253		5×10^3
Cs-132		4×10^5	Pu-239/Be-9		5×10^1
Cs-134		1×10^3	Am-241/Be-9		5×10^1
Cs-134m		3×10^8	Ce-141		3×10^4
Cs-135		9×10^3	Ce-143		5×10^5
Cs-136		4×10^4	Ce-144	+	8×10^2
Cs-137	+	2×10^3	Pr-142		6×10^5
Ba-131	+	1×10^5	Pr-143		4×10^4
Ba-133		3×10^3	Nd-147		6×10^4
Ba-133m		9×10^5	Nd-149		8×10^7
Ba-140	+	1×10^4	Pm-143		3×10^4
La-137		4×10^4	Pm-144		6×10^3
La-140		2×10^5	Pm-145		3×10^4
Ce-139		3×10^4			

a ‘+’ indicates radionuclide with progeny listed in Table A-10 that are assumed to be in equilibrium with the parent radionuclide and therefore do not need to be considered independently, when assessing compliance with OILs.

b NA: not applicable.

c The dose from the ingestion of K-40 is considered to be zero because it does not accumulate in the body and is maintained at a constant level independent of intake

d Not a significant source of radiation because of the low specific activity.

Air and ground contamination intervention levels

The measurement of ground or airborne contamination levels is dependent on the instrumentation and detection method selected. As an example, an explosion involving a nuclear weapon will produce an airborne plume containing radioactive material, resulting in ground contamination downwind.

The plume concentrations that correspond to intervention levels for sheltering (10 mSv) and evacuation (50 mSv) are summarized in Table A-11 [7]. These represent the minimum levels that must be detected for urgent protective action recommendations.

Table A-11: Measurable air concentrations corresponding to intervention levels

Protective action	Alpha+beta emitter concentration (Bq/m^3)	Alpha emitter concentration (Bq/m^3)	Gamma emitter concentration (Bq/m^3)
Evacuation based on effective dose of 50 mSv	2,000	700	5
Sheltering based on effective dose of 10 mSv	400	140	1

It may be impractical to detect these concentrations by simply holding a probe in the air. It would be entirely practical to use an air sampler to concentrate the particles on an air filter and subsequently detect these levels in a shielded enclosure.

The ground concentrations that correspond to intervention levels for evacuation (50 mSv in seven days) and relocation (30 mSv for the first month) are summarized in Table A-12 [7]. These levels consider exposure to re-suspended contamination. These represent the minimum levels that must be detected for making urgent protective action recommendations.

Table A-12: Measurable ground concentrations corresponding to intervention levels

Protective action	Alpha+beta emitter deposition (kBq/m^2)	Alpha emitter deposition (kBq/m^2)	Gamma emitter Deposition (kBq/m^2)
Relocation based on 30 day effective dose of 30 mSv	1,000	300	8
Evacuation based on 7 day effective dose of 50 mSv	7,000	2,100	55

Weapons emergency detection options

Further information is provided to facilitate a complete understanding of what is required for an effective weapons emergency detection. This information allows for the protective action to be implemented based on the OILS provided in Table A-11 and Table A-12.

This detector selection methodology also applies to other specific isotopes.

Ambient gamma survey meters

This type of instrument includes general-purpose survey meters that are commonly available to nuclear emergency response teams and radiation protection personnel. They measure dose rates in Gy/h or Sv/h.

In a weapon emergency, the main contribution to dose is via inhalation. The measurable external gamma dose rate is extremely low compared with the effective dose rate. The current analysis shows that, on average, the effective dose rate in the radioactive plume would be 6.5×10^{8} times greater than the measured ambient dose rate. This means that, based on a 30-minute exposure duration, the evacuation intervention level of 50 mSv effective dose would be reached for an ambient dose rate reading on field instruments of 1.5×10^{-7} mSv/h. This is well below background (approximately 1×10^{-4} mSv/h) and would not be detectable. Therefore, ambient gamma survey meters are not recommended for detection and measurements in a weapon-related emergency. For the same reasons, thermoluminescent dosimeters and electronic personal dosimeters are not useful for this type of emergency.

Scintillation detectors

Scintillation detectors measure the light emission produced by ionizing radiation in a *scintillation* material. The main advantage of scintillation detectors is their ability to discriminate between different radiation types and energies. By selecting a scintillation detector calibrated for a specific energy window, it is possible to achieve great sensitivities to specific isotopes. A scintillator with an energy window at 60 keV can detect the americium that accompanies the nuclear material released from a nuclear weapon.

Preliminary calculations have shown that air concentrations of plutonium and americium that are of concern for emergency response can be detected using a scintillation detector with a 60 keV window. Only detectors with very low normal background counts will be sensitive enough to detect these levels. Instrument readings depend on the characteristics of the instrument (i.e., its normal background, its detection surface and the sensitivity of the scintillation material used). Readings can be related to the airborne concentration[1].

[1] The relationship between instrument readings and contamination levels can be determined by performing

Scintillators can also be used to detect ground contamination. Because they detect gamma radiation instead of alpha, they can be used to detect the presence of americium (and therefore plutonium) even from great distances. Provided that they are calibrated to detect the 60-keV energy of americium, they will easily detect the levels of surface contamination that are meaningful for emergency response.

Using scintillation detectors, it is also possible to perform aerial surveys of the contaminated area. Such surveys can quickly determine the extent of the contamination and the presence of hot spots. Hot spots can result from isolated showers or enhanced deposition due to the presence of vegetation.

In practice, one must be careful in interpreting measurements above background radiation, as normal radon[2] fluctuations can influence the readings.

Alpha-beta contamination detectors

Alpha-beta contamination detectors are commonly available to nuclear emergency response teams and radiation protection technicians. They include personnel and equipment contamination probes (friskers with a detection area of approximately 20 cm^2) and laboratory surface contamination probes (with a detection area of 100 cm^2). Some can discriminate between alpha and beta radiation.

In the plume, the minimum concentration levels required for emergency response would generate a very low count rate using a hand-held alpha-beta probe. At those levels, most detectors would not measure a statistically significant increase in count rate. In ideal conditions, any significant increase in count rate could be interpreted as an indication of the presence of plutonium and the need to shelter.

On the other hand, this type of detector is used to detect very low surface contamination levels for regulatory and emergency purposes. They are normally capable of detecting less than 10 kBq/m^2. They are therefore entirely appropriate for detecting ground contamination of plutonium at levels that are meaningful for emergency response purposes. The exact relationship between the detector response and the ground contamination level can be estimated based on the detector characteristics and the measurement geometry.

Air samplers

Air sampling through a suitable filter medium allows a large quantity of air contamination to be concentrated on a small surface. The amount of contamination depends on the quantity of air sampled (i.e., on the sampling rate and the sampling time). Using an alpha-beta contamination meter, a scintillation detector or performing a more sophisticated laboratory analysis, it is possible to accurately measure the level of airborne contamination. These measurements would not be affected by the presence of radon and its progenies. The relationship between the detector response and the level of airborne contamination can be estimated based on the detector characteristics and the measurement geometry. Sensitivity is enhanced when the measurement is taken in a shielded enclosure.

The matter of taking and interpreting air sampling data is complex. The complexity results from having to determine the flow rate of air samples, sampling time, filter media type and efficiency, field versus laboratory analysis of collected nuclides, and then converting these to a meaningful airborne

radiation transport calculations that calculate the theoretical flux, taking into account air attenuation and detector configuration. Alternatively, the instrument can be calibrated using a known source of americium.

[2] Radon is a naturally occurring radioactive isotope that emanates from the ground. Radon concentrations can fluctuate widely from place to place within a relatively small area. Natural phenomena such as rain can also affect the radon concentration.

concentration value in terms of intervention levels. However, it is possible to determine operational intervention levels that are based on airborne measurements. This would only be useful for prolonged releases.

Surface swipes and ground samples

Surface swipes and ground samples are only useful to determine ground contamination levels. Swipes collect the loose contamination. Ground samples allow the measurement of combined loose and fixed contamination. These measurements would not be affected by the presence of radon and its progenies.

Swipes and samples can be measured using an alpha-beta or a scintillation detector, at the site or in a laboratory. There is a relationship between the instrument reading and the level of contamination, which depends on the swiping or survey protocol used.

Summary of detection options

The various detection options are summarized in Table A-13.

Table A-13: Summary of detection options

Method	Used for	Advantages	Disadvantages
Common ambient dose rate meter	• Dose rate measurement	Common.	Not sensitive enough for weapon emergencies.
Scintillation detector calibrated for Am-241 detection (60 keV)	• Detect airborne contamination • Detect ground contamination • Aerial surveys	Robust, fast. Can be used to quickly prioritize contaminated areas.	Sensitivity depends on type of instrument used.
Air sampling	• Detect airborne contamination	No radon interference.	
Alpha-beta contamination detector	• Detect ground contamination	Very sensitive.	Fragile window may break upon contact with ground material such as grass or plants. May be affected by the presence of radon.
Soil sample and on-site or laboratory measurement	• Detect ground contamination	Accurate and robust. No radon interference.	Takes time. Screening can be done using a hand-held probe with a shielded enclosure. Hard surfaces cannot easily be sampled.
Swipes and on-site or laboratory analysis	• Detect loose contamination on the ground	Easy and fairly accurate. Appropriate for loose contamination on hard surfaces. No radon interference.	Takes time. Difficult to swipe loose surfaces. Screening can be done using a hand-held probe with a shielded enclosure.

Operational intervention levels

Operational intervention levels (OILs) are instrument readings that correspond to intervention levels. Above the OIL, the corresponding protective action would be justified. Below the OIL, the protective action may not be justified.

OILs should be calculated and incorporated in the emergency plans and procedures. They should be based on the values for air concentration and ground contamination given in Annex A, Section A1. The exact instrument readings that correspond to these values will depend on the instrument characteristics and measurement protocol.

OILs that correspond to the sheltering and evacuation intervention levels for NPP or NPV emergencies with a release are:

- Sheltering – 0.2 mSv/hr; and
- Evacuation – 1 mSv/hr

Scenarios involving low energy gamma emitters or beta and/or alpha emitters require OIL for air or ground contamination levels. The development of these OILs is specific to the detection methodology and the detector(s) selected for the measurements. Therefore, these OILs can only be included in the plan when equipment selection is complete. This includes OILS for weapons emergency and dispersion due to fire for many non-high energy, gamma emitting isotopes.

ANNEX B – EMERGENCY PLANNING ZONES

General

The planning zones required for each postulated scenario vary based on the actual emergency and on the severity of that emergency. In the case of fixed facilities (e.g. NPP), these zones are pre-defined. However, in the case of mobile risk objects (e.g., ships), the zone cannot be pre-defined, as the location of the source of risk changes constantly. In this case, safety distances, guidance on which is given in this Plan, are applied and define de facto an on-site (or on scene) area and an equivalent to the off-site area designated for fixed facilities.

This Annex provides recommended planning zones for each postulated scenario and/or guidance for modifications based on severity.

In many instances for the postulated scenarios, the actual regional impact is mainly due to the possible ground contamination, leading to the requirement for agricultural and soft countermeasures. These countermeasures are normal based primarily on measured data and therefore the planning zones are a guide that cannot replace a detailed and effective survey strategy.

The following zones are included in this annex for planning (detailed description is available in Volume 1 – Planning Basis):

- Precautionary Action Zone (PAZ) – mainly for NPP emergency with release. Zone where automatic protective actions are taken based on classification
- Urgent Protective Action Zone (UPZ) – Zone where urgent protective actions are taken based on measurements, as compared to generic intervention levels and operational intervention levels.
- Food restriction planning radius (FRPR) – Zone where restriction may be required for food and drinking water based on measured contamination levels, as compared to generic intervention levels and operational intervention levels.

Postulated emergencies

Table B-14 details the PAZ, UPZ and Food Restriction Planning Radius (FRPR). The FRPR includes a nominal distance for design basis emergencies with a release and a severe emergency zone size.

Table B-14: Emergency scenario planning zones

Emergency scenario	PAZ (km)	UPZ (km)	FRPR Nominal (km)	FRPR Severe (km)
Nuclear Power Plant (NPP) reactor accidental release	5	25	300	1000
Nuclear Powered Vessel (NPV) – SSN Submarine	1	10	30	100
Nuclear Powered Vessel (NPV) – CVN Aircraft carrier	2	15	50	300
Nuclear Capable Vessel (NCV) – Nuclear weapon	1	15	50	NA
Fire involving RN material	2	10	50	NA
Radiological dispersion device (explosive)	2	10	50	NA

The remaining of the scenarios presented in the Volume 1 – Planning Basis will have safety distances based specifically on the hazard at the scene, or measured ambient dose rates or contamination levels.

ANNEX C – MONITORING NETWORK

This Annex contains the operating plans for the regional fixed detection network.

TBP

ANNEX D – EMERGENCY SURVEY TEAMS

This Annex contains a list of all trained and available RN survey teams in the region.

TBP

ANNEX E – MEDICAL RESOURCES

This Annex contains a list of all regional hospitals and medical facilities, as well as their associated RN medical emergency support capabilities.

TBP

ANNEX F – REGIONAL NUCLEAR COORDINATION CENTRE EQUIPMENT AND CAPABILITIES

This Annex contains a list of all regional sites available for use as an RN emergency operation centers, as well as their equipment and capabilities.

TBP

ANNEX G – GLOSSARY

Action Level	The level of dose rate or activity concentration above which remedial actions or protective actions should be carried out in chronic exposure or emergency exposure situations. An action level can also be expressed in terms of any other measurable quantity as a level above which intervention should be undertaken.
Acute Exposure	An exposure to radiation received in a short period of time, i.e., seconds, minutes, or hours.
Acute Radiation Syndrome	A collection of symptoms caused by receiving a relatively high dose of radiation to the body in a short time (usually minutes). The earliest symptoms are blood cell changes, nausea, fatigue, vomiting and diarrhea. Hair loss, bleeding, swelling of the mouth and throat and general loss of energy may follow. Deterministic effects may be detectable above 0.5 Sv and severe deterministic health effects are possible above 1 to 5 Sv.
ALARA	All reasonable measures are taken to minimize radiation exposure to levels As Low As Reasonably Achievable (ALARA), social and economic factors taken into consideration. For military operations, operational considerations are also taken into consideration.
Background Radiation	Radiation associated with natural sources or any other sources in the environment that are not amenable to control.
Bioassay	Any procedure used to determine the nature, activity, location or retention of radionuclides in the body by direct (in vivo) measurement or by in vitro analysis of material excreted or otherwise removed from the body.
Chronic Exposure	Exposure persisting in time. Normally refers to exposures persisting for many years as a result of long-loved radionuclides in the environment.
Cloud Shine	External exposure from airborne radionuclides.
Controlled Access Area	An area where the dose rate may exceed the level permitted in public access areas and to which access by any person other than a worker is controlled.
Decontamination	The complete or partial removal of contamination by a deliberate physical, chemical or biological process.
Deterministic Effects	A radiation effect for which generally a threshold level of dose exists above which the severity of the effect is greater for a higher dose. Such an effect is described as a 'severe deterministic effect' if it is fatal or life-threatening or results in a permanent injury that decreases the quality of life.

Dirty Bomb	A device designed to spread radioactive material by conventional explosives when the bomb explodes. A dirty bomb kills or injures people through the initial blast of the conventional explosive and spreads radioactive contamination over possibly a large area—hence the term "dirty." Such bombs could be miniature devices or large truck bombs. See also Radiological Dispersal Device (RDD).
Dose Averted	The dose prevented by the application of a countermeasure or set of countermeasures, i.e. the difference between the projected dose if the countermeasure(s) had not been applied and the actual projected dose.
Dosimetry	Assessment (by measurement or calculation) of radiation dose.
Downwind Sector	The sector 30^{o} on either side of the prevailing wind direction, downwind of the emergency site.
Emergency Classification Level	A simple system that describes the severity scale of an emergency. The emergency class is directly related to risk for the workers and the public. It is used for communicating to the response organizations and the public the level of response needed.
Emergency Worker	A worker who may be exposed in excess of occupational dose limits while performing actions to mitigate the consequences of an emergency for human health and safety, quality of life, property and the environment.
Fission Products	The radioactive elements created by the fission process.
Hull Shine	The external gamma radiation hazard on the exterior of a nuclear powered vessel due to fission products released to and dispersed within the reactor compartment of the vessel.
Noble Gases	A group of gaseous elements (e.g., xenon, krypton, etc.) that do not interact with other elements (i.e., NER team). Radioactive noble gases dissipate quickly and are not retained inside the body even when inhaled, thus pose little threat to an individual (except in a closed-in area).
Nuclear Capable Vessel (NCV)	A ship or submarine that is designed for the transport, storage or deployment of nuclear weapons.
Nuclear Powered Vessel (NPV)	A ship or submarine that is powered wholly or partly by nuclear energy.
Nuclear Weapon Emergency	An unexpected event involving a fire or explosion involving a nuclear weapon.
Off-Site Emergency	A nuclear emergency involving a reactor or nuclear weapon, which has led, or may lead, to a significant release of radioactive material from the facility.

On-Scene Response This is the portion of the response that takes place within the immediate area of the emergency. There is no fixed or firm definition of what is meant by "immediate". In general, this includes the area that is controlled by the emergency first responders and from which non-essential personnel and persons are evacuated.

On-Scene Controller (OSC) An Officer who, through their training and experience, is capable of overseeing the on-scene non-radiological response to a nuclear emergency.

On-Scene Authority In general, this is the Lead MS. The direct on-scene authority is the senior designated officer at or near the emergency site. A designated component of the on-scene authority is responsible for liaison with the off-site authority.

Operational Intervention Levels (OIL) A calculated level, measured by instruments or determined by laboratory analysis, that corresponds to an intervention level or action level.

Recovery This involves two concepts. The first one is "back to business", and the second is return to normal. In the first case, measures are taken to render the affected areas safe enough for business activities to resume, though special precautions may need to be taken to reduce the potential exposure of the public or workers. In the second case, longer term measures are taken to return the affected area to its pre-emergency state.

Regional Nuclear/Radiological Coordination Center (RNCC) This is the centre from which the regional response is coordinated. Normally, this is the CRISIS CENTER operations centre, unless otherwise agreed to by the lead MS and CRISIS CENTER. In this concept of operations, within the context of an RN event, the CRISIS CENTER operations centre is referred to as the RNCC.

Senior Technical Advisor A person who, through their training and experience, is qualified to advise on all radiological and technical aspects of a RN emergency. This person is normally a post-graduate qualified nuclear engineer or physicist.

Site Area immediately surrounding the location where an emergency has taken place or can take place. For a fixed facility, this is a geographical area that contains the authorized facility, activity or source, and within which the management of the authorized facility or activity may directly initiate emergency actions. For an event that takes place in the RSA, the site refers to the area controlled by the on-scene emergency response services.

Site Emergency Events resulting in a major decrease in the level of protection for those on or near the site. Emergency response level adopted when there is a confined nuclear emergency with no radiological threat to the public.

Surveillance This is part of the prevention phase preceding the discovery of a RN emergency. It involves active and passive measures to detect the present of illicit RN material, or the unexpected presence of radiation in the environment.

Survey Specialist A person who through their training and practical experience is qualified to conduct surveys of radioactive contamination.

Threat An act of coercion wherein a negative consequence is proposed to elicit response.

ANNEX H – LIST OF ABBREVIATIONS

ACMZ .... Automatic Countermeasure Zone

ACP .... Access Control Point

AEZ .... Automatic Evacuation Zone

ALARA .... As Low As Reasonably Achievable

Bq .... Becquerel

CAZ .... Controlled Access Zone

CC .... Crisis Center

CCP .... Contamination Control Point

Ci .... Curie

cpm .... Counts Per Minute

cps .... Counts Per Second

CPZ .... Contingency Planning Zone

CVN .... Nuclear Powered Aircraft Carrier

DCP .... Decontamination Control Point

DM .... Deputy Minister

dps .... Disintegrations per Second

DPZ .... Detailed Planning Zone

DRD .... Direct Reading Dosimeter

ED .... Electronic Dosimeter (see DRD)

EOC .... Emergency Operations Center

EPZ .... Emergency Planning Zone

ERBS .... Environmental Radionuclide Baseline Study

ERL .... Emergency Response Level

ERMP .... Environmental Radiological Monitoring Program

Gy .... Gray

HE .... High Explosives

HF .... High Frequency

IAEA .... International Atomic Energy Agency

ICRP .... International Commission on Radiation Protection

IEC .... Incident and Emergency Center of the IAEA

IHE .... Insensitive High Explosive

KI .... Potassium Iodide

LPZ..Longer Term Protective Action Zone
MARPOL ....International Convention for the Prevention of Pollution from Ships
MEMAC .... Marine Emergency Mutual Aid Center
MS ....Member State
mSv .... millisievert
MS EOC ....Member State Emergency Operations Center
NCV .... Nuclear Capable Vessel
NER .... Nuclear Emergency Response
NPP ....Nuclear Power Plant
NPV .... Nuclear Powered Vessel
OIL..Operational Intervention Level
OSC.. On-Scene Controller
PA...Public Affairs
PAZ ....Precautionary Action Zone
PB ....Planning Basis
PIT .... Potassium Iodide Tablet
PPE .... Personal Protective Equipment
PWR...Pressurized Water Reactor
RAM ....Radioactive Material
RCC.. Regional Coordination Center
RN ....Radiological/Nuclear
RNCC ....Regional RN Coordination Center
RNEPC ....Regional RN Emergency Preparedness Committee
RNCT .... Regional RN Coordination Team
RNERP .... RN Emergency Response Plan
RO ....Regional Organization
ROPME .... Regional Organization for the Protection of the Marine Environment
RSA ....ROPME Sea Area
SCBA... Self Contained Breathing Apparatus
SOP...Standard Operating Procedure
SSBN... Nuclear Powered Ballistic Missile Submarine
SSGN .... Nuclear Powered Guided Missile Submarine
SSN..Nuclear Powered Attack Submarine
STA ....Senior Technical Advisor
Sv.. sievert

TBD...To Be Developed

TBP .... To Be Promulgated

TLD ....Thermoluminescent Dosimeter

TTX ……Table Top Exercise

UNCLOS…………………………………………………………………..United Nations Convention of the Law of the Sea

UPZ……………………………………………………………………………………………….………..Urgent Protective Action Zone

WMO ……………………………………………………………………………………….World Meteorological Organization

WSC ……Working Sub Committee

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