DEMA

DELAWARE EMERGENCY MANAGEMENT AGENCY

Partners for Protection and Response

MEMORANDUM

TO: Radiological Incident Response Plan Distribution List

FROM: Technological Hazards Section

RE: Radiological Incident Response Plan

DATE: January 19, 2007

A copy of the Radiological Incident Response Plan (Radiological Plan) is enclosed. The plan provides guidance for State of Delaware personnel responding to radioactive material incidents or accidents, other than those originating on the site of nuclear power facilities. The plan does not supplant policy and guidance in the Delaware Emergency Operations Plan (DEOP) or the Oil and Hazardous Substance Incident Contingency Plan, short title: SERT Plan (State Emergency Response Team Plan).

The State Emergency Response Commission (SERC) approved the Radiological Plan and it will be included as an Annex in the upcoming revision of the SERT Plan.

The Radiological Plan was developed and closely coordinated between:

- Department of Safety Homeland Security (DSHS), Delaware Emergency Management Agency, Technological Hazards Section
- Department of Natural Resources and Environmental Control, Division of Air & Waste Management, Emergency Prevention & Response Branch
- Department Health and Social Services (DHSS), Division of Public Health, Office of Radiation Control

An outline of the Radiological Plan is attached. Electronic copies of the plan can be obtained by contacting Art Paul, 302-659-2253 or Arthur.paul@state.de.us

STP-00L Template

RIDS: SP05

SUNSI Review Complete

State of Delaware, Department of Safety and Homeland Security

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Radiological Incident Response Plan Outline

Purpose of the Plan

- Provides guidance for State of Delaware personnel responding to radioactive material incidents or accidents that do not originate from a fixed nuclear power facility.
- DNREC approved by the SERC as the lead response agency in February, 2003, change reflected in the December 2003 SERT Plan revision.
- The plan will become an annex to the SERT Plan.

Situation & Assumptions

- The plan addresses accidents or incidents involving radioactive materials in locations, facilities and vehicles not associated with a nuclear power facility.
    - These incidents may include, but are not limited to the following:
        - Motor Vehicles, Railroad Transport, Aircraft, Watercraft, & Spacecraft (Satellite Re-entry)
        - Accidental dumping, dropping, or loss of radioactive materials
        - Unauthorized or illegal disposal of radioactive materials & dumpsites
        - Laboratories (radiopharmaceuticals), Industrial Complexes, & Warehouses
        - Criminal or Terrorist Activities (Radiological Dispersal Device (RDD) or Improvised Nuclear Device (IND))
- Response activities include technical assessments, response actions, advising & assisting other response agencies, material owner notification, and determining protective action recommendations.
- DNREC is in an advisory role if the event involves a criminal activity or a nuclear weapon until the scene is secure, then response actions will commence.

Agency Responsibilities

- Department of Health & Social Services - Division of Public Health (DPH)
    - Responds to SERT Level II or higher incident.
    - Provides technical support in developing Protective Action Recommendations (PARs).
    - Provides a Radiological Health Advisor to co-chair the Technical Assessment Center (TAC).
    - Activates the State Health Operations Center (SHOC) if warranted.
    - Lead agency for communications with the media & public.
- Department of Natural Resources & Environmental Control (DNREC)
    - DNREC Emergency Response Team (ERT) provides a response capability & responds to all incidents involving radioisotopes.
    - DNREC provides a Science Advisor to co-chair the TAC.
    - Assumes role of Site Manager & Hazardous Materials Officer
    - Provides technical support & monitoring capability to the Incident Commander.
    - Assesses extent and type of radiological contamination & makes response recommendations.
    - Develops response related Standard Operating Procedures for radiological incidents.
- Department of Safety & Homeland Security
    - Delaware Emergency Management Agency (DEMA) is the lead coordinating agency.

- DEMA notifies and coordinates with the appropriate Federal, State, & Local agencies in the event of a radiological incident.
- Assumes the role of On-Scene Coordinator in the event of a Level III incident.
- Provides & obtains assistance for DPH & DNREC.

Reporting and Notification

- Reporting and Notification of a Radiological Incident is the same as a hazardous materials incident.
- The Emergency Reporting Center (911) notifies the DNREC via KENTCOM.
- DNREC notifies DEMA & DPH, who in turn notify appropriate agencies as designated in the Radiological Response Plan notification protocol (Appendix 1).

Response Phases

- The response to a radiological incident is divided into three (3) phases; Emergency, Intermediate, and Recovery.
  - Emergency Phase - Consists of typical emergency response and protective actions. Mitigating factors include radiation exposure, contamination, evacuation, sheltering, and administering radioprotective drugs.
  - Intermediate Phase - Begins after the source of the release is brought under control. Protective action decisions are developed based on field measurements. Mitigating factors in this phase include preventing ingestion of contaminated food & water, relocation, water controls, refinement of access controls, release of real property, & re-entry.
  - Recovery Phase - Begins with clean-up and recovery actions to reduce radiation to acceptable levels & ends when recovery actions have been completed.

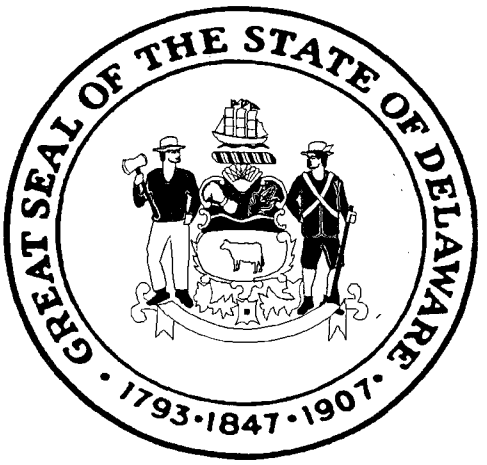
Planning & Response Considerations

- Directs response organizations (namely DNREC) to develop plans & protocols that address radiation protection during an RDD or IND incident and to ensure appropriate training for responders & decision makers.
- Requires the plans & protocols to be developed from the Federal Protective Action Guides (PAGs).
- Directs response organizations (namely DNREC) to prepare emergency response plans & protocols that incorporate the As Low As Reasonably Achievable (ALARA) principle.

Appendices

- Appendix 1 - Notification Protocol
- Appendix 2 - Protective Action Guides for RDD/IND Incidents
- Appendix 3 - Radiation Emergency FAQ
- Appendix 4 - Characteristics of Certain Isotopes of Greatest Concern
- Appendix 5 - Dispersion Methodologies
- Appendix 6 - Major Routes of Exposure
- Appendix 7 - Significance/Credibility as an Agent of Terrorism
- Appendix 8 - DPH Pre-Event Planning Message: Dirty Bomb
- Appendix 9 - Plan Distribution List

STATE OF DELAWARE



RADIOLOGICAL INCIDENT RESPONSE PLAN

Annex D to the Oil and Hazardous Substance Incident Contingency Plan or the State Emergency Response Team Plan (SERT Plan)

September 2006

Prepared by the
Delaware Emergency Management Agency Technological Hazards Section

STATE OF DELAWARE
RADIOLOGICAL INCIDENT RESPONSE PLAN

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BASIC PLAN

APPENDICES

1.0 PURPOSE

This plan provides guidance for State of Delaware personnel responding to radioactive material incidents or accidents, other than those originating on the site of nuclear power facilities. This plan is not designed to supplant policy and guidance in the Delaware Emergency Operations Plan (DEOP) or the Oil and Hazardous Substance Incident Contingency Plan, also known as the State Emergency Response Team (SERT) Plan. This plan augments established policy and provides additional guidance relative to radiological incidents.

2.0 SITUATION AND ASSUMPTIONS

2.1 The following plan is established for response to accidents or incidents involving radioactive materials in locations, facilities, and vehicles not associated with, nor taking place on, the site of nuclear power facilities. These incidents may involve, or occur in, but are not necessarily limited to:

Motor vehicle transport
Railroad transport
Aircraft
Watercraft
Spacecraft (satellite re-entry)
Accidental dumping, dropping, or loss of radioactive materials
Unauthorized or illegal disposal of radioactive materials
Laboratories, and radiopharmaceutical wastes
Industrial complexes
Warehouses
Dumpsites
Criminal or terrorist actions that may include:
- Radiological Dispersal Devices (RDD) - purposeful contamination
- Improvised Nuclear Devices (IND) - covertly developed or stolen

2.2 Response activities would include conducting a technical assessment of the situation from a radiological hazard standpoint, conducting appropriate response actions, providing advice and assistance to other responders (fire, police, etc.), notification of the owner of the materials, and partnering with other agencies to determine protective action recommendations.

2.3 The FBI, law enforcement, and/or military organizations will also be first responders when these incidents involve criminal intent, and/or nuclear weapons. DNREC responders will assume an advisory role until the situation is rendered safe from a security standpoint. If DNREC is made aware of such an incident prior to Federal Authorities, contact State Police and the organizations listed in Section 4.0 and Appendix 1.

2.4. Effective dispersal of a radiological agent is likely to produce a significant number of impacted parties, and presents potential for contaminated patients, vehicles, facilities, and the nearby environment, such as soil, surface water, and groundwater.

2.5. By design, nuclear weapons in transit cannot be accidentally detonated. Even if subjected to severe impact and/or extreme heat, the possibility of a fission or fusion reaction and subsequent nuclear detonation is EXTREMELY IMPROBABLE. Nuclear weapons contain a small amount of conventional explosives (e.g. C-4, Semtex or Pentex). These may be detonated by extreme heat and/or impact, but the concern is that the conventional explosions would scatter radioactive components of the weapon onto the immediate surrounding area.

2.6. A terrorist attack involving a RDD or IND may have immediate effects on the community's emergency response system, and presents significant potential for operational disruption and radiation dose to emergency workers and the public in the form of contaminated patients, vehicles and facilities, and impacts on the environment.

2.7. A terrorist attack could also be carried out by dispersing radioisotopes surreptitiously, so that recognition of the contamination event might occur later, after significant spread of the radioactive material. Methodology could include introducing radioactive aerosols into the ventilation intake of a building or dispersing an aerosol from an airplane.

2.8. It is impossible to measure or anticipate the psychological harm caused by a terrorist attack. The psychological impact of a RDD or IND will be greater than the physical impact. The broad nature of the psychological consequences will require a significant risk communication effort on the part of public health and public information officials, see Appendix 8.

2.9. The situations and assumptions listed are not exhaustive, but represent selected methodologies that are widely recognized as most plausible. For guidance on radiological incidents see Appendices 2-8; provided by the Division of Public Health (DPH).

3.0 RESPONSIBILITIES

3.1 Department of Health and Social Services (DHSS, Division of Public Health). DHSS/DPH is the lead agency for health and medical services for incidents involving dispersal of radiological agents presenting a radiation dose hazard to emergency workers or the general public. The Division of Public Health will:

- Respond to SERT Level II, or higher, as established in the SERT Plan.
- Provide technical support and assistance in developing protective action recommendations (PARs) to support the Technical Assessment Center (TAC), per Delaware Radiological Emergency Preparedness (REP) Plan.
- Provide a Radiological Health Advisor to serve as co-chair to the TAC.

- Activate the State Health Operations Center (SHOC) in the event of a significant radiological release.
- Serve as the lead agency and handle all communication with the media and public, through the Division Public Information Officer (PIO) or Joint Information Center (JIC) if established.
- Serve as the primary agency for ESF 8: Public Health and Medical Services, under the DEOP.

3.2. Department of Natural Resources and Environmental Control (DNREC). The DNREC Emergency Prevention and Response Branch is the lead agency for initial response to radiological incidents. The Division of Air and Waste Management serves as the primary agency for ESF 10: Hazardous Material Response, under the DEOP. The Division of Water Resources provides a Senior Science Advisor to serve as co-chair to the TAC. The ERT will:

- Provide a response capability and respond to all incidents involving radioisotopes, and implement this plan, as required.
- Notify DEMA and DPH as prescribed in the SERT Plan and Section 4.0 of this plan.
- Assume the role of Site Manager and Hazardous Material Officer, per the SERT Plan.
- Provide technical support and monitoring capability to the Fire Officer-in-Charge, or the Incident Commander.
- Assess the extent and type of radiological contamination and make response recommendations on actions to be taken.
- Develop response related standard operating procedures (SOPs) to respond to incidents described in Section 2.0 Situation and Assumptions.

3.3. Department of Safety and Homeland Security (DSHS). DSHS is responsible for the overall safety of the citizens of Delaware. The Delaware Emergency Management Agency (DEMA) is the lead agency for coordinating the emergency response system and will:

- Notify the State's Homeland Security Advisor, Secretary of the Department of Safety and Homeland Security, the Governor's Office and Federal agencies, as necessary.
- Assume the role of On-Scene Coordinator for SERT Level III/Federal Response Level, per SERT Plan.
- Turn over the role of On-Scene Coordinator during Federal Response Level, as the situation requires and become the State point of contact when using the National Incident Management System (NIMS) and unified command.
- Coordinate State and Federal resources.
- Establish initial coordination with the Department of Defense (DOD), U.S. Department of Energy (U.S. DOE), the U.S. Nuclear Regulatory Commission (NRC), and the U.S. Environmental Protection Agency (EPA).
- Activate the State Emergency Operations Center (EOC) and the TAC for suspected radiological releases resulting from criminal or terrorist activity.
- Provide or obtain assistance for DPH and ERT, as requested.

4.0 REPORTING AND NOTIFICATION DIAGRAM

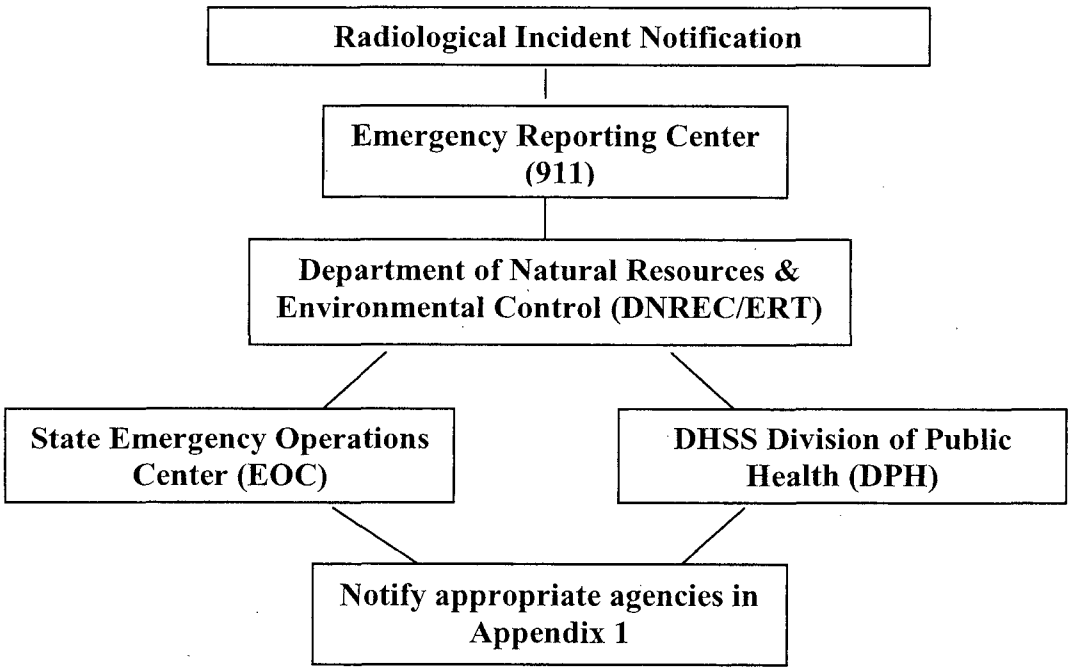
4.1 Reporting and notification of radiological incidents is presented below, prescribed in the SERT Plan, and is the same for any hazardous substance. The majority of hazardous substance notifications are made to the Emergency Reporting Centers (911), which in turn notify the DNREC/ERT. DNREC/ERT may implement SERT Levels I-III based on the severity of the situation. In the event of any radiological release, DNREC is responsible for the immediate notification of DEMA and DPH. DEMA will initiate State and Federal notifications.

4.2 **DNREC -** 24-hours reporting number is 1- (800)-662-8802.

4.3 **DEMA** - During working hours contact the receptionist at the State EOC at (877) 729-3362 or (302) 659-3362. The receptionist will notify the Technological Hazards Section. During off-hours and weekends, notify the DEMA Duty Officer, *through Delaware State Police Communications using the working hours telephone numbers above (DEMA phones forwarded).*

4.4 **DPH -** During working hours contact the Office of Radiation Control at (302)-744-4546, or the DPH Duty Officer at (302)-744-4700. During off-hours and weekends, notify the DPH Duty Officer at (302)-744-4700. See Appendix 1.

4.5 Below is a flow diagram for radiological incident notification.



5.0 RESPONSE PHASES

The response to an RDD or IND incident can be divided into three time phases, the early phase, the intermediate phase, and the late phase. These phases are not exact and may overlap; however, they are generally accepted as being common to all radiological incidents and provide a framework for emergency response considerations.

5.1 Early (Emergency) Phase - Includes typical emergency response actions and protective actions that need to be made quickly, and modified as more information becomes available. Protective action decisions should be made based on the Protective Action Guide (Appendix 2) and known particulars of the incident. Early phase considerations are radiation exposure, contamination, evacuation, sheltering, administration of radioprotective drugs, etc.

In the State of Delaware, the State Emergency Response Team (SERT) responds to incidents involving radioactive material, through the Incident Management System under the direction of the State On-Scene Coordinator or Fire-Officer-in-Charge (see basic plan for SERT member responsibilities and levels of response). During all phases of response, SERT members will use their internal SOPs to accomplish their responsibilities.

5.2 Intermediate Phase - Begins after the source and releases have been brought under control and protective action decisions can be made based on field measurements. Actions in this phase typically overlap with the early and late phases and may continue until protective actions are terminated. Decisions must be made on initial actions for recovery. Intermediate phase considerations include preventing ingestion of contaminated food and water, relocation, water controls, refinement of access controls, release of real property, re-entry, etc.

In the event of an intentional release of radioisotopes, the State EOC and the Technical Assessment Center (TAC) will be activated to develop protective action recommendations (PARs). The Radiological Emergency Preparedness (REP) Plan, SOP 301 defines the role of the TAC. The TAC will assess the radiological hazard and develop PARs, based on the DHS Protective Action Guidelines (PAG's) for RDD and IND incidents (see Appendices).

Risk communication will be managed and disseminated by the Joint Information Center (JIC). The goal of the JIC will be to keep the public informed.

5.3 Late (Recovery) Phase - Begins with clean-up and recovery actions to reduce radiation to acceptable levels and ends when recovery actions have been completed. Depending on the magnitude of the incident, actions may be necessary to restore the incident scene to an acceptable condition. Such actions may range from washing down surfaces to remove radioactive contamination in the form of dusty particulates, to removing radioactive debris or objects with fixed contamination (non-removable contamination). The State Radiological Emergency Preparedness (REP) Plan and Department of Homeland Security Protective Actions Guides (PAG's) for RDD/IND Events may be used to address recovery actions.

6.0 PLANNING AND RESPONSE CONSIDERATIONS

6.1 Response organizations must develop plans and protocols that address radiation protection during a RDD or IND incident and ensure appropriate training for responders and decision makers. Federally developed protective action guides and operational guidelines must be used to develop local SOPs for radiological emergencies, in particular, those related to terrorist incidents using RDDs and INDs. Appendix 2 contains four tables with information that should be considered during the response phases and should be included in the locally developed SOPs .

- Table 1 - Protective Action Guides for RDD or IND Incidents
- Table 1A - Risk Management Considerations for Emergency and Normal Operations
- Table 1B - Response Worker Guidelines
- Table 1C - Acute Radiation Syndrome

6.2 Maintaining the "As Low As Reasonably Achievable" (ALARA)) Principle[1] - Employers of first responders should prepare emergency response plans and protocols to minimize the risks from exposure to ionizing radiation. Standard operating procedures should require recording radiation dose to emergency workers and emphasizing protocols to:

- Minimize the time spent in the contaminated area (e.g., rotation of workers);
- Maintain the maximum distance from sources of radiation;
- Tailor hazard controls to the work performed;
- Properly select and use respirators and other personal protective equipment (PPE) to prevent exposure to internally deposited radioactive materials (e.g. alpha and beta emitters);
- Use radioprotective medications that block the uptake of radioiodine when directed to do so by a Public Health Official;
- Establish a turn-back value based on U.S. EPA Guidelines, field measurements and the assessment of on-scene hazards.

The Incident Commander should be prepared to identify, to the extent possible, all hazardous conditions or substances and to perform an appropriate site hazard analysis. Emergency plans should include protocols to control worker exposures, establish exposure guidelines in advance, and outline procedures for worker protection. All activities should be performed in conjunction with emergency procedures that include provisions for exposure monitoring, worker training on the hazards involved in response operations, ways to control them, and medical monitoring.

[1] Federal Register Department of Homeland Security, Protective Action Guides for Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents, Appendix 1 (d)

APPENDIX 1

RADIOLOGICAL NOTIFICATIONS PROTOCOL

1.0 Primary Notifications for Radiological Incidents. Once the initial information has been taken about the incident, notify the following organizations and pass on the information.

1.1 Department of Safety and Homeland Security, Office of the Secretary.
(302) 744-2680 / 2665

1.2 Delaware Emergency Management Agency
(302) 659-3362

1.3 Department of Health and Social Services, Division of Public Health, Health Systems Protection, Radiation Control Program Director (Office of Radiation Control & Duty Officer).
(302) 744-4546 / (302) 659-3362 & (302) 744-4700

1.4 Department of Natural Resources and Environmental Control, Division of Air and Waste Management, Enforcement Section & Emergency Prevention & Response Branch.
1-800-662-8802 (24 hour), (302) 739-9401 & (302) 739-9404

1.5 Department of Natural Resources and Environmental Control
Water Resources, Environmental Services Section.
(302) 739-9942

1.6 Nuclear Regulatory Commission (NRC) Region I, Regional State Liaison Officer
(610) 337-5213

1.7 Headquarters NRC Operations Center, (24 hours):
(301) 816-5100

1.8 Federal Emergency Management Agency Region III
(215) 931-5500/5757

1.9 Environmental Protection Agency, Philadelphia Office
(if source is unknown and contamination is known or suspected).
24-hr number (215) 814-9016 Spill Line

2.0 Department of Energy, Regional Coordinating Office.
(631) 344-2200

2.0 Other important offices, which may need to be notified:

New Castle County EOC.....(302) 395-3600
Kent County EOC.....(302) 735-3461
Sussex County EOC .....(302) 855-7801
Delaware State Police.....911
Local Fire Department.....911
Division of Highway Operations (DelDOT-TMC).....(302) 659-2400

Delaware State Fire School.....(302) 739-4773
Dover Air Force Base Disaster Preparedness Office....(302) 677-6213 / (302) 363-9104(24-hr)
Delaware National Guard.....(302) 323-3440 24-hr
Emergency Departments, Christiana Care Hospitals
Wilmington .....(302) 428-4886
Christiana.....(302) 733-1840/1601

3.0 Notifications for Nuclear Fuel Incidents - In addition to the normal state and local agencies, DEMA must notify the following in the event of a nuclear fuel accident:

3.1 DOE Regional Coordinating Office
Brookhaven Area Office
Upton, Long Island, NY
(631) 344-2200
24-hour number for DOE Emergency Operations Center (EOC):
(631) 344-2200

3.2 FEMA Region III
Philadelphia, PA
(215) 931-5757
24-hr number for FEMA National Emergency Coordination Center:
(202) 931-5652

3.3 NRC Operations Center
One White Flint North
Rockville, MD
Ph: (301) 816-5100
Fax (301) 816-5151
24-hr number: (301) 816-5100 / (800) 449-3694

3.4 Environmental Protection Agency Regional Office
Philadelphia, PA.
(800) 438-2474
24-hour number: (215) 814-9016

4.0 Notifications for Nuclear Weapons Accidents.

4.1 In addition to the normal state and local agencies, notify the following in the event of an accident/incident involving a nuclear weapon: Department of Defense and/or Department of Energy organizations will be the first responders to incidents and accidents involving nuclear weapons. DNREC/ERT responders will assume an advisory/liaison role unless assigned a primary role by Federal organizations.

4.2 If DNREC/ERT should be informed of a nuclear weapon accident/incident they shall notify DEMA prior to Federal organizations, DEMA shall ensure the following steps are taken:

4.2.1 Notify the nearest military installation:

Dover Air Force Base
Command Post: (302) 677-4201
Civil Engineer Readiness (Disaster Preparedness): (302) 677-6213
Security Police: (302) 677-6664
Switchboard: (302) 677-3000

4.2.1 Notify the DOE Regional Coordinating Office:

Brookhaven Area Office
Upton, Long Island, NY
(631) 344-2200
24-hour number for EOC: (631) 344-2200

4.2.2 Notify FEMA Region III:
Philadelphia, PA
(215) 931-5757
24-hour number for FEMA National Emergency Coordination Center:
(202)-931-5652

APPENDIX 2

TABLE 1.—PROTECTIVE ACTION GUIDES FOR RDD OR IND INCIDENTS

Phase	Protective action	Protective action guide	Reference
Early	Limit Emergency Worker Exposure.	5 rem (or greater under exceptional circumstances[1]).	EPA PAG Manual.
	Sheltering of Public	1 to 5 rems projected dose [2]	EPA PAG Manual.
	Evacuation of Public	1 to 5 rems projected dose [3]	EPA PAG Manual.
	Administration of Prophylactic Drugs.	For potassium iodide, FDA Guidance dose values[4, 5].	FDA Guidance [6].
Intermediate	Limit Worker Exposure	5 rem/yr	See Appendix 1.
	Relocation of General Public	2 rems, projected dose first year Subsequent years: 500 mrem/yr projected dose.	EPA PAG Manual.
	Food Interdiction	500 mrem/yr projected dose	FDA Guidance [7].
	Drinking Water Interdiction	500 mrem/yr dose	EPA guidance in development.
Late	Final Cleanup Actions	Late phase PAG based on optimization.	

1 In cases when radiation control options are not available or, due to the magnitude of the incident, are not sufficient, doses above 5 rems may be unavoidable. 2 Should normally begin at 1 rem; however, sheltering may begin at lower levels if advantageous.
3 Should normally begin at 1 rem.
4 Provides protection from radioactive iodine only.
5 For other information on medical prophylactics and treatment please refer to http://www.fda.gov/cder/drugprepare/default.htm or http://www.bt.cdc.gov/radiation/index/asp or http://www.orau.gov/reacts.
6 "Potassium Iodide as a Thyroid Blocking Agent in Radiation Emergencies," December 2001, Center Drug Evaluation and Research, FDA, HHS (http://www.fda.gov/cder/guidance/5386fnl.htm).
7 "Accidental Radioactive Contamination of Human Food and Animal Feeds: Recommendations for State and Local Agencies," August 13, 1998, Office of Health and Industry Programs, Center for Devices and Radiological Health, FDA, HHS (http://www.fda.gov/cdhr/dmqrp/84.html).

Note: Extracted from Department of Homeland Security, Preparedness Directorate; Protective Action Guides for Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents.

APPENDIX 2 (continued)

TABLE 1A. RISK MANAGEMENT CONSIDERATIONS FOR EMERGENCY AND NORMAL OPERATIONS	
Emergency	Normal operations
An adversary may attempt to create conditions that will cause high radiation exposures, widespread contamination, and mass disruption. Actions must be taken as soon as possible to minimize exposures even when information on the risks is incomplete. Lack of action—due to unclear, overly complicated, or reactive guidelines—have a high possibility of causing unintended consequences. During emergencies, the undesired consequences can be significant, uncontrollable, and unpredictable.	Key elements to radiation protection are to contain radioactivity and confine access to it. There is adequate time to fully characterize situations and determine risks and mitigating measures. Inaction or delays may increase costs but rarely results in consequences that cannot be mitigated. Consequences associated with implementation of the standard are well characterized, considered, and controlled so as not to be of concern from either a health or public welfare perspective.

TABLE 1B.—RESPONSE WORKER GUIDELINES		
Total effective date equivalent (TEDE) guideline	Activity	Condition
5 rems	All occupational exposures	All reasonably achievable actions have been taken to minimize dose.
10 rems *	Protecting valuable property necessary for public welfare (e.g., a power plant).	Exceeding 5 rems unavoidable and all appropriate actions taken to reduce dose. Monitoring available to project or measure dose.
25 rems **	Lifesaving or protection of large populations	Exceeding 5 rems unavoidable and all appropriate actions taken to reduce dose. Monitoring available to project or measure dose. Only on a voluntary basis to persons fully aware of the risks involved.
* For potential doses >10 rems, special medical monitoring programs should be employed, and exposure should be tracked in terms of the unit of absorbed dose (rad) rather than TEDE (rem). TEDE denotes the use of internal and external dose. ** In the case of a very large incident such as an IND, incident commanders may need to consider raising the property and lifesaving response worker guidelines in order to prevent further loss of life and massive spread of destruction.		

Table 1C. Acute Radiation Syndrome*

Feature or Illness	Effects of Whole-Body Absorbed Dose, from external radiation or internal absorption, by dose range in rad				
	0-100	100-200	200-600	600-800	>800
Nausea, vomiting	None	5-50%	50-100%	75-100%	90-100%
Time of onset		3-6 h	2-4 h	1-2 h	<1 h to minutes
Duration		<24 h	<24 h	<48 h	<48 h
Lymphocyte count	Unaffected	Minimally decreased	<1000 at 24 h	<500 at 24 h	Decreases within hours
Central Nervous System function	No Impairment	No Impairment	Cognitive impairment for 6-20 h	Cognitive impairment for >20 h	Rapid incapacitation
Mortality	None	Minimal	Low with aggressive therapy	High	Very High; Significant neurological symptoms indicate lethal dose

*Prompt health effects with whole-body absorbed doses received within a few hours.
Source: Medical Management of Radiological Casualties, Second Edition, Armed Forces Radiobiology Research Institute,
Bethesda, MD, April 2003.

Note: Extracted from Department of Homeland Security, Preparedness Directorate; Protective Action Guides for Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents.

APPENDIX 3

RADIATION EMERGENCIES

FREQUENTLY ASKED QUESTIONS (FAQS)
Dirty Bombs

People have expressed concern about dirty bombs and what they should do to protect themselves if a dirty bomb incident occurs. Because your health and safety are our highest priorities, the health experts at the Centers for Disease Control and Prevention (CDC) have prepared the following list of frequently asked questions and answers about dirty bombs.

What is a dirty bomb?
A dirty bomb is a mix of explosives, such as dynamite, with radioactive powder or pellets. When the dynamite or other explosives are set off, the blast carries radioactive material into the surrounding area.

A dirty bomb is *not* the same as an atomic bomb
An atomic bomb, like those bombs dropped on Hiroshima and Nagasaki, involves the splitting of atoms and a huge release of energy that produces the atomic mushroom cloud.

A dirty bomb works completely differently and *cannot create an atomic blast.* Instead, a dirty bomb uses dynamite or other explosives to scatter radioactive dust, smoke, or other material in order to cause radioactive contamination.

What are the main dangers of a dirty bomb?

The main danger from a dirty bomb is from the explosion, which can cause serious injuries and property damage. The radioactive materials used in a dirty bomb would probably not create enough radiation exposure to cause immediate serious illness, except to those people who are very close to the blast site. However, the radioactive dust and smoke spread farther away could be dangerous to health if it is inhaled. Because people cannot see, smell, feel, or taste radiation, you should take immediate steps to protect yourself and your loved ones.

What immediate actions should I take to protect myself?
These simple steps—recommended by doctors and radiation experts—will help protect you and your loved ones. The steps you should take depend on where you are located when the incident occurs: outside, inside, or in a vehicle.

If you are outside and close to the incident
- Cover your nose and mouth with a cloth to reduce the risk of breathing in radioactive dust or smoke.
- Don't touch objects thrown off by an explosion—they might be radioactive.
- Quickly go into a building where the walls and windows have not been broken. This area will shield you from radiation that might be outside.
- Once you are inside, take off your outer layer of clothing and seal it in a plastic bag if available. Put the cloth you used to cover your mouth in the bag, too. Removing outer clothes may get rid of up to 90% of radioactive dust.
- Put the plastic bag where others will not touch it and keep it until authorities tell you what to do with it.
- Shower or wash with soap and water. Be sure to wash your hair. Washing will remove any remaining dust.
- Tune to the local radio or television news for more instructions.

APPENDIX 3 (continued)

If you are inside and close to the incident

• If the walls and windows of the building are not broken, stay in the building and do not leave.
• To keep radioactive dust or powder from getting inside, shut all windows, outside doors, and fireplace dampers. Turn off fans and heating and air-conditioning systems that bring in air from the outside. It is not necessary to put duct tape or plastic around doors or windows.
• If the walls and windows of the building are broken, go to an interior room and do not leave. If the building has been heavily damaged, quickly go into a building where the walls and windows have not been broken. If you must go outside, be sure to cover your nose and mouth with a cloth. Once you are inside, take off your outer layer of clothing and seal it in a plastic bag if available. Store the bag where others will not touch it.
• Shower or wash with soap and water, removing any remaining dust. Be sure to wash your hair.
• Tune to local radio or television news for more instructions.

If you are in a car when the incident happens

• Close the windows and turn off the air conditioner, heater, and vents.
• Cover your nose and mouth with a cloth to avoid breathing radioactive dust or smoke.
• If you are close to your home, office, or a public building, go there immediately and go inside quickly.
• If you cannot get to your home or another building safely, pull over to the side of the road and stop in the safest place possible. If it is a hot or sunny day, try to stop under a bridge or in a shady spot.
• Turn off the engine and listen to the radio for instructions.
• Stay in the car until you are told it is safe to get back on the road.

What should I do about my children and family?

• If your children or family are with you, stay together. Take the same actions to protect your whole family.
• If your children or family are in another home or building, they should stay there until you are told it is safe to travel.
• Schools have emergency plans and shelters. If your children are at school, they should stay there until it is safe to travel. Do not go to the school until public officials say it is safe to travel.

How do I protect my pets?

• If you have pets outside, bring them inside if it can be done safely.
• Wash your pets with soap and water to remove any radioactive dust.

Should I take potassium iodide?

• Potassium iodide, also called KI, only protects a person's thyroid gland from exposure to radioactive iodine. KI will not protect a person from other radioactive materials or protect other parts of the body from exposure to radiation.
• Since there is no way to know at the time of the explosion whether radioactive iodine was used in the explosive device, taking KI would probably not be beneficial. Also, KI can be dangerous to some people.

Will food and water supplies be safe?

• Food and water supplies most likely will remain safe. However, any unpackaged food or water that was out in the open and close to the incident may have radioactive dust on it. Therefore, do not consume water or food that was out in the open.

APPENDIX 3 (continued)

• The food inside of cans and other sealed containers will be safe to eat. Wash the outside of the container before opening it.
• Authorities will monitor food and water quality for safety and keep the public informed.

How do I know if I've been exposed to radiation or contaminated by radioactive materials?

• People cannot see, smell, feel, or taste radiation; so you may not know whether you have been exposed. Police or firefighters will quickly check for radiation by using special equipment to determine how much radiation is present and whether it poses any danger in your area.
• Low levels of radiation exposure (like those expected from a dirty bomb situation) do not cause any symptoms. Higher levels of radiation exposure may produce symptoms, such as nausea, vomiting, diarrhea, and swelling and redness of the skin.
• If you develop any of these symptoms, you should contact your doctor, hospital, or other sites recommended by authorities.

Where do I go for more information?

• For more information about dirty bombs, radiation, and health, contact:
  • The Conference of Radiation Control Program Directors (CRCPD) http://www.crcpd.org (502) 227-4543
  • The U.S. Environmental Protection Agency (EPA) http://www.epa.gov/radiation/rert/
  • The Nuclear Regulatory Commission (NRC) http://www.nrc.gov/ (301) 415-8200
  • The Federal Emergency Management Agency (FEMA) http://www.fema.gov/ (202) 646-4600
  • The Radiation Emergency Assistance Center/Training Site (REAC/TS) http://www.orau.gov/reacts/ (865) 576-3131
  • The U.S. National Response Team (NRT) http://www.nrt.org/
  • The U.S. Department of Energy (DOE) http://www.energy.gov/engine/content.do 1-800-dial-DOE

For more information, visit www.bt.cdc.gov/radiation, or call CDC at 800-CDC-INFO (English and Spanish) or 888-232-6348 (TTY).

March 21, 2005 Page 3 of 3

APPENDIX 4

CHARACTERISTICS OF CERTAIN ISOTOPES OF GREATEST CONCERN

Isotope	Common Use	Description
Am-241 (Americium)	Measurement instruments, e.g. well logging instruments and gauges, smoke detectors	Sources are typically small to moderate in physical size and radiological emission (up to 1 inch in diameter, 6-inches long, and tens of millicuries to tens of curies in strength); smoke detectors use microcurie quantities. In neutron sources the Am-241 is typically mixed with beryllium oxide, which is a toxic substance; double-encapsulated in stainless steel holders; and used for a variety of industrial assay applications. Thousands of these sources are in use.
Cs-137 (Cesium)	Medical imaging, food/other irradiation, gauges	Found in sealed portable sources and in large irradiation facilities. The sealed sources are often found as cesium chloride, a form of particular concern for RDD use.
Pu-238 (Plutonium)	Medical devices and measurement instruments	In the past used as a heat source for pacemakers, an application that was phased out in the early 1970's. Also used as thermal-electric generator heat source where it is contained as an oxide in stainless steel or other containers. As with Am-241 and Pu-239, and unlike the gamma emitters, a great deal of shielding is not required in application.
Sr-90 (Strontium)	Heat source for thermal-electric generators and sealed sources	Used in large quantities in heavily shielded configurations.
Po-210 (Polonium)	Static eliminators	Typically found as metal foils.
Co-60 (Cobalt)	Food/other irradiation and radiography	Typically cast as metal rods, or pins, several to dozens of which are combined in a holder to provide desired radiation intensity. Storage requires heavy shielding, typically in large facility.
Ir-192 (Iridium)	Gamma source used for mobile and fixed radiography applications.	Used in many fixed and mobile irradiation applications, these sources are found in instruments used for weld inspections and other industrial applications. The mobile application of these sources and availability make them a particular concern.
Pu-239 (Plutonium)	Alpha or neutron source, typically used in research	Used in research facilities, these sources are generally small because significant quantities of Pu-239 are tightly regulated because of weapons potential.
Cm-244 (Curium) Or Cf-252 (Californium)	Neutron source used in research and measuring instruments	Sources are small, and those in instruments are shielded.

Radiological Dispersal Devices:
Report to the Nuclear Regulatory Commission and the Secretary of Energy,
By the DOE/NRC Interagency Working Group on RDD's
May 2003

APPENDIX 5

DISPERSION METHODOLOGIES

Prior to September 11, 2001, approaches to controlling radioactive materials were generally oriented to beneficial uses, and protecting workers and the public from unnecessary radiation dose. However, the nation's concerns regarding the use of radioactive materials for a malevolent act have been heightened, and many actions have been taken to strengthen safeguards to ensure the security and authorized use of materials.

Of particular concern is the nation's ability to control inventories of radioactive materials that could be used in a radiological dispersal device (RDD). An RDD is a device combining conventional explosive material for detonation, to effect dispersal of radioactive material over an area. Lethality and serious injury would affect those in the immediate vicinity of the blast, but probability of delivering sufficient radiation dose to create serious injury is low. RDD's have been described as "weapons of mass disruption", because they are unlikely to result in many deaths, but are likely to cause panic, spread radioactive contamination requiring significant clean up, and potentially disrupt operations for an extended period of time. The economic impact of such disruption would be considerable if an RDD were exploded in a major transportation hub, entertainment venue or other mass gathering.

A second methodology for dispersing radiation from radioisotopes is an improvised nuclear device (IND). Such a device would utilize fissile radioactive material to initiate a nuclear chain reaction (explosion associated with a nuclear bomb). Such a device could be used as a weapon of mass destruction, that would result in many deaths, many cases of acute radiation syndrome, and ultimately, for many years following the explosion, elevated incidence rates and mortality from radiation-related cancers among survivors, as well as increased incidence of birth defects, cancer and/or mental retardation for offspring exposed *in utero*.

A third methodology is dispersing radiation from radioisotopes surreptitiously so that recognition of the contamination event might occur sometime later, after significant spread of the radioactive material. An example is introducing radioactive particulates or aerosols in the ventilation intake of a building or other facility (e.g. transportation hub). Factors that make this scenario less likely include: very low probability of lethality or serious injury, technology needed to aerosolize radioisotopes (make them available for inhalation) is technology/cost-intensive, and quantity of aerosolized radioisotope used would limit the magnitude of exposure (area affected is dependent on quantity of radioisotope available).

Radiological Dispersal Devices: Report to the NRC and Secretary of Energy, By the DOE/NRC Interagency Working Group on RDD's, May 2003

APPENDIX 6

MAJOR ROUTES OF EXPOSURE

External Irradiation

Radiation dose delivered to the skin from external irradiation. External irradiation can occur to an individual located in close proximity to a radioactive source emitting high energy, highly penetrating radiation (eg. gamma or x-rays or neutrons). External irradiation can also occur to an individual coming into contact with a radioactive plume (airborne release of particulate or gaseous radioactive material).

Inhalation

Radiation dose can be delivered and internalized by breathing in air containing radioactive gases or particulates, such as a radioactive plume. Inhalation exposure can also occur by inspiring radioactive residue deposited on surfaces, and then re-suspended in air.

Ingestion

Radiation dose delivered to the gastrointestional tract by ingesting radioactive material, as residue or contamination of crops/foodstuff or as contamination from radioactive particulate matter deposited on surfaces (e.g. food eaten with contaminated hands).

Internalization

Radioactive material may be inhaled, either as gases or particulates. Some may be ingested, from mouth contamination, ciliary movement in the bronchial system that moves particulates to the mouth, or the eating and drinking of contaminated food. In addition, radioactive shrapnel from the destruction of a sealed source of radioactive material of RDD can become embedded in a wound. Radioisotopes that deliver radiation dose while internalized are said to be "incorporated." Medical treatment to reduce residence time, bind or compete with radioisotopes and/or encourage excretion is called "decorporation".

Radiological Dispersal Devices: Report to the NRC and Secretary of Energy, By the DOE/NRC Interagency Working Group on RDD's, May 2003

APPENDIX 7

SIGNIFICANCE/CREDIBILITY AS AN AGENT OF TERRORISM

Radioisotopes are unstable chemicals, whose radioactivity is measured by the number of atoms disintegrating per unit time. A disintegrating atom can emit a beta particle, an alpha particle, a gamma or x- ray, or some combination, which disrupts molecules in living cells, and deposits energy in tissues, causing damage.

Radioisotopes have a number of beneficial uses, such as medical imaging, diagnosing disease and treating cancer, generating electricity via nuclear power, conducting biomedical research and development, industrial uses such as measuring material thickness and density, and increasingly, for homeland security purposes such as imaging of shipping containers at Ports of Entry to the U.S.

Radiation has been described as having a "higher perceived risk" than some other potential terror agents due to a number of factors: radiation is a source of public dread (nuclear weapons, nuclear power), is not observable, is unknown to the exposed, chronic effects are insidious, effects are not equitable, exposure is involuntary, consequences are potentially fatal, and exposure to parents presents potential genetic risk to future generations. High-risk groups for psychosocial harm in a radiological terror scenario are: children, mothers with young children, pregnant women, emergency/clean-up workers, and their families.

Certain radioisotopes are considered more likely to be of interest as agents of terror, due to their high-energy emissions, long half-life (duration of radioactive emissions), and/or the relatively large number of sources distributed throughout medical, academic, industrial and research facilities. "Isotopes of greatest concern" were identified in 2003 by the federal government based on relative dose impacts & potential for dispersion (material index) and relative attractiveness for access i.e. number of facilities with greater than threshold values & level of facility security (attractiveness index).

Radiological Dispersal Devices: Report to the Nuclear Regulatory Commission and the Secretary of Energy, By the DOE/NRC Interagency Working Group on RDD's
May 2003

APPENDIX 8

DIVISION OF PUBLIC HEALTH
PRE-EVENT PLANNING MESSAGE: DIRTY BOMB

The goal of risk communication during a crisis is to assist the public to become aware of the nature of events that have taken place, what steps they can take to protect themselves, and what steps are being taken by others to mitigate the incident and alleviate concerns.

According to risk communication experts, perception of risk is often very different from actual risk. Risks that are perceived as less acceptable, or "worse" can be characterized as:

- Involuntary
- Insidious (odorless, colorless, tasteless)
- Long-term effects
- Manmade
- Catastrophic
- Affects children more than adults
- Risk to future generations
- Poorly understood by the public.

Radiation risk is characterized by all of the criteria above, and is considered to present a considerably higher "perceived risk" than many other hazards. In addition, radiation evokes a widespread sense of dread, due to the collective memory of the nuclear bombs dropped on Hiroshima and Nagasaki and the Chernobyl nuclear reactor accident in the Ukraine.

Communicating messages about radiation risk to the public requires effective pre-planning, to increase the probability that members of the public are productively informed, and know what steps to take to minimize risks to themselves, and others.

The Association of State and Territorial Health Officials (ASTHO) is the source for the concept of the "message map" for risk communication. The concept calls for focusing on a few simple questions that the public would be most likely to need answers to, and identifying supporting facts for each of the key message elements. Such a message map provides a framework for effective risk communication.

The following is an example of a recommended message map for communicating messages about a radiological incident to the public.

APPENDIX 8 (continued)

What is the health risk to the community from a Dirty Bomb?

Key Message Fact 1	**Key Message Fact 2**	**Key Message Fact 3**
Health risks from a dirty bomb are death or physical injury in the vicinity of the blast, and exposure to radiation from contaminated dusts released during the blast.	A dirty bomb is an improvised weapon that combines a conventional explosive such as dynamite, with radioactive material.	We can protect ourselves from a dirty bomb by moving away from the incident scene, tuning to public announcements, and staying indoors with ventilation systems turned off.
Supporting Fact 1-1	**Supporting Fact 2-1**	**Supporting Fact 3-1**
Death and serious injury from a dirty bomb are the same risks as for a conventional bomb using explosives such as dynamite .	A dirty bomb is **not** a nuclear bomb – these two types of explosive weapons are very different.	A dirty bomb will release contaminated dusts into the air and onto surfaces, in the vicinity of the blast.
Supporting Fact 1-2	**Supporting Fact 2-2**	**Supporting Fact 3-2**
The amount of radiation contamination would depend on the size and nature of the bomb, and the location where it was detonated.	A dirty bomb would release radioactive dusts into the air, and onto surfaces. Once such dusts are washed away (such as laundering clothes and showering), radiation exposure from the blast would be alleviated.	Those caught in the vicinity of the incident scene should move to a clean area, remove clothing and seal it in a trash bag, and shower to remove contaminated dusts.
Supporting Fact 1-3	**Supporting Fact 2-3**	**Supporting Fact 3-3**
The amount of radiation exposure to individuals in the vicinity of the blast would be measurable, but very low when compared with a nuclear bomb	The greatest impact from a dirty bomb would be disruption of operations in the vicinity of the blast, and performing clean-up to return the area to it's previous condition.	Providing first aid and lifesaving is the highest response priority. Preventing or cleaning up radioactive contamination from a dirty bomb is an important recovery priority.

Daniel J. Barnett, MD, MPH of the Johns Hopkins Center for Public Health Preparedness is acknowledged for content in this attachment derived from his presentation on "Risk Communication and Radiation Terror", at the Dirty Bomb Seminar presented in Dover, DE on December 13, 2004.

APPENDIX 9

PLAN DISTRIBUTION LIST

AGENCY

U.S. Nuclear Regulatory Commission, Regional State Liaison Officer

U.S. Department of Energy Brookhaven Office

U.S. Environmental Protection Agency Philadelphia Office

Delaware State Fire School, Director

Delaware State Police, Superintendent

Department of Health and Social Services (DHSS), Secretary

- Division of Public Health, Director
- Division of Public Health, Health Systems Protection, Section Chief
- Division of Public Health, Office of Radiation Control, Administrator
- Division of Public Health, Environmental Health Evaluation Administrator

Department of Natural Resources and Environmental Control (DNREC), Secretary

- Division of Air & Waste Management, Director
- Division of Air & Waste Management, Emergency Prevention & Response Branch, Program Mgr
- Division of Air & Waste Management, Enforcement Chief
- Division of Water Resources, Senior Science Advisor

Department of Safety and Homeland Security (DSHS), Secretary

- DEMA Director
- DEMA Deputy Director
- DEMA Principal Planner
- DEMA Technological Planner Supervisor
- DEMA Duty Officer
- DEMA Operations

New Castle County Administrator

New Castle County Department of Public Safety, Director

New Castle County Office of Emergency Management, Director

Kent County Administrator

Kent County Emergency Operations Center, Director

Sussex County Administrator

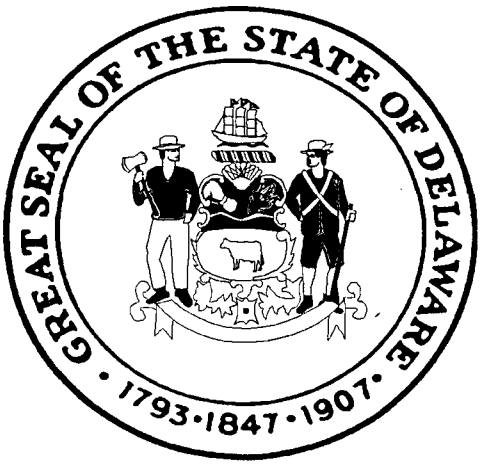
Sussex County Emergency Operations Center, Director

City of Wilmington, Mayor

City of Wilmington Office of Emergency Mgt., Director

911 Centers

STATE OF DELAWARE



RADIOLOGICAL INCIDENT RESPONSE PLAN

Annex D to the Oil and Hazardous Substance Incident Contingency Plan or the State Emergency Response Team Plan (SERT Plan)

September 2006

Prepared by the
Delaware Emergency Management Agency Technological Hazards Section

STATE OF DELAWARE
RADIOLOGICAL INCIDENT RESPONSE PLAN

TABLE OF CONTENTS

BASIC PLAN

APPENDICES

1.0 PURPOSE

This plan provides guidance for State of Delaware personnel responding to radioactive material incidents or accidents, other than those originating on the site of nuclear power facilities. This plan is not designed to supplant policy and guidance in the Delaware Emergency Operations Plan (DEOP) or the Oil and Hazardous Substance Incident Contingency Plan, also known as the State Emergency Response Team (SERT) Plan. This plan augments established policy and provides additional guidance relative to radiological incidents.

2.0 SITUATION AND ASSUMPTIONS

2.1 The following plan is established for response to accidents or incidents involving radioactive materials in locations, facilities, and vehicles not associated with, nor taking place on, the site of nuclear power facilities. These incidents may involve, or occur in, but are not necessarily limited to:

Motor vehicle transport
Railroad transport
Aircraft
Watercraft
Spacecraft (satellite re-entry)
Accidental dumping, dropping, or loss of radioactive materials
Unauthorized or illegal disposal of radioactive materials
Laboratories, and radiopharmaceutical wastes
Industrial complexes
Warehouses
Dumpsites
Criminal or terrorist actions that may include:
- Radiological Dispersal Devices (RDD) - purposeful contamination
- Improvised Nuclear Devices (IND) - covertly developed or stolen

2.2 Response activities would include conducting a technical assessment of the situation from a radiological hazard standpoint, conducting appropriate response actions, providing advice and assistance to other responders (fire, police, etc.), notification of the owner of the materials, and partnering with other agencies to determine protective action recommendations.

2.3 The FBI, law enforcement, and/or military organizations will also be first responders when these incidents involve criminal intent, and/or nuclear weapons. DNREC responders will assume an advisory role until the situation is rendered safe from a security standpoint. If DNREC is made aware of such an incident prior to Federal Authorities, contact State Police and the organizations listed in Section 4.0 and Appendix 1.

2.4. Effective dispersal of a radiological agent is likely to produce a significant number of impacted parties, and presents potential for contaminated patients, vehicles, facilities, and the nearby environment, such as soil, surface water, and groundwater.

2.5. By design, nuclear weapons in transit cannot be accidentally detonated. Even if subjected to severe impact and/or extreme heat, the possibility of a fission or fusion reaction and subsequent nuclear detonation is EXTREMELY IMPROBABLE. Nuclear weapons contain a small amount of conventional explosives (e.g. C-4, Semtex or Pentex). These may be detonated by extreme heat and/or impact, but the concern is that the conventional explosions would scatter radioactive components of the weapon onto the immediate surrounding area.

2.6. A terrorist attack involving a RDD or IND may have immediate effects on the community's emergency response system, and presents significant potential for operational disruption and radiation dose to emergency workers and the public in the form of contaminated patients, vehicles and facilities, and impacts on the environment.

2.7. A terrorist attack could also be carried out by dispersing radioisotopes surreptitiously, so that recognition of the contamination event might occur later, after significant spread of the radioactive material. Methodology could include introducing radioactive aerosols into the ventilation intake of a building or dispersing an aerosol from an airplane.

2.8. It is impossible to measure or anticipate the psychological harm caused by a terrorist attack. The psychological impact of a RDD or IND will be greater than the physical impact. The broad nature of the psychological consequences will require a significant risk communication effort on the part of public health and public information officials, see Appendix 8.

2.9. The situations and assumptions listed are not exhaustive, but represent selected methodologies that are widely recognized as most plausible. For guidance on radiological incidents see Appendices 2-8; provided by the Division of Public Health (DPH).

3.0 RESPONSIBILITIES

3.1 Department of Health and Social Services (DHSS, Division of Public Health). DHSS/DPH is the lead agency for health and medical services for incidents involving dispersal of radiological agents presenting a radiation dose hazard to emergency workers or the general public. The Division of Public Health will:

- Respond to SERT Level II, or higher, as established in the SERT Plan.
- Provide technical support and assistance in developing protective action recommendations (PARs) to support the Technical Assessment Center (TAC), per Delaware Radiological Emergency Preparedness (REP) Plan.
- Provide a Radiological Health Advisor to serve as co-chair to the TAC.

- Activate the State Health Operations Center (SHOC) in the event of a significant radiological release.
- Serve as the lead agency and handle all communication with the media and public, through the Division Public Information Officer (PIO) or Joint Information Center (JIC) if established.
- Serve as the primary agency for ESF 8: Public Health and Medical Services, under the DEOP.

3.2. Department of Natural Resources and Environmental Control (DNREC). The DNREC Emergency Prevention and Response Branch is the lead agency for initial response to radiological incidents. The Division of Air and Waste Management serves as the primary agency for ESF 10: Hazardous Material Response, under the DEOP. The Division of Water Resources provides a Senior Science Advisor to serve as co-chair to the TAC. The ERT will:

- Provide a response capability and respond to all incidents involving radioisotopes, and implement this plan, as required.
- Notify DEMA and DPH as prescribed in the SERT Plan and Section 4.0 of this plan.
- Assume the role of Site Manager and Hazardous Material Officer, per the SERT Plan.
- Provide technical support and monitoring capability to the Fire Officer-in-Charge, or the Incident Commander.
- Assess the extent and type of radiological contamination and make response recommendations on actions to be taken.
- Develop response related standard operating procedures (SOPs) to respond to incidents described in Section 2.0 Situation and Assumptions.

3.3. Department of Safety and Homeland Security (DSHS). DSHS is responsible for the overall safety of the citizens of Delaware. The Delaware Emergency Management Agency (DEMA) is the lead agency for coordinating the emergency response system and will:

- Notify the State's Homeland Security Advisor, Secretary of the Department of Safety and Homeland Security, the Governor's Office and Federal agencies, as necessary.
- Assume the role of On-Scene Coordinator for SERT Level III/Federal Response Level, per SERT Plan.
- Turn over the role of On-Scene Coordinator during Federal Response Level, as the situation requires and become the State point of contact when using the National Incident Management System (NIMS) and unified command.
- Coordinate State and Federal resources.
- Establish initial coordination with the Department of Defense (DOD), U.S. Department of Energy (U.S. DOE), the U.S. Nuclear Regulatory Commission (NRC), and the U.S. Environmental Protection Agency (EPA).
- Activate the State Emergency Operations Center (EOC) and the TAC for suspected radiological releases resulting from criminal or terrorist activity.
- Provide or obtain assistance for DPH and ERT, as requested.

4.0 REPORTING AND NOTIFICATION DIAGRAM

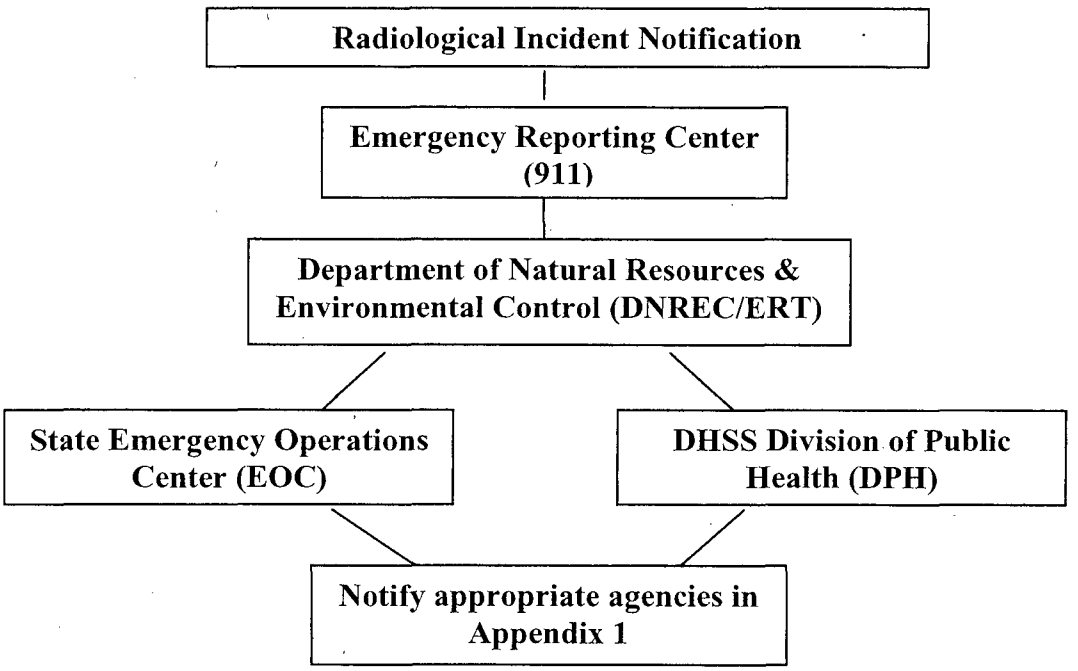
4.1 Reporting and notification of radiological incidents is presented below, prescribed in the SERT Plan, and is the same for any hazardous substance. The majority of hazardous substance notifications are made to the Emergency Reporting Centers (911), which in turn notify the DNREC/ERT. DNREC/ERT may implement SERT Levels I-III based on the severity of the situation. In the event of any radiological release, DNREC is responsible for the immediate notification of DEMA and DPH. DEMA will initiate State and Federal notifications.

4.2 **DNREC** - 24-hours reporting number is 1- (800)-662-8802.

4.3 **DEMA** - During working hours contact the receptionist at the State EOC at (877) 729-3362 or (302) 659-3362. The receptionist will notify the Technological Hazards Section. During off-hours and weekends, notify the DEMA Duty Officer, *through Delaware State Police Communications using the working hours telephone numbers above (DEMA phones forwarded).*

4.4 **DPH** - During working hours contact the Office of Radiation Control at (302)-744-4546, or the DPH Duty Officer at (302)-744-4700. During off-hours and weekends, notify the DPH Duty Officer at (302)-744-4700. See Appendix 1.

4.5 Below is a flow diagram for radiological incident notification.



5.0 RESPONSE PHASES

The response to an RDD or IND incident can be divided into three time phases, the early phase, the intermediate phase, and the late phase. These phases are not exact and may overlap; however, they are generally accepted as being common to all radiological incidents and provide a framework for emergency response considerations.

5.1 Early (Emergency) Phase - Includes typical emergency response actions and protective actions that need to be made quickly, and modified as more information becomes available. Protective action decisions should be made based on the Protective Action Guide (Appendix 2) and known particulars of the incident. Early phase considerations are radiation exposure, contamination, evacuation, sheltering, administration of radioprotective drugs, etc.

In the State of Delaware, the State Emergency Response Team (SERT) responds to incidents involving radioactive material, through the Incident Management System under the direction of the State On-Scene Coordinator or Fire-Officer-in-Charge (see basic plan for SERT member responsibilities and levels of response). During all phases of response, SERT members will use their internal SOPs to accomplish their responsibilities.

5.2 Intermediate Phase - Begins after the source and releases have been brought under control and protective action decisions can be made based on field measurements. Actions in this phase typically overlap with the early and late phases and may continue until protective actions are terminated. Decisions must be made on initial actions for recovery. Intermediate phase considerations include preventing ingestion of contaminated food and water, relocation, water controls, refinement of access controls, release of real property, re-entry, etc.

In the event of an intentional release of radioisotopes, the State EOC and the Technical Assessment Center (TAC) will be activated to develop protective action recommendations (PARs). The Radiological Emergency Preparedness (REP) Plan, SOP 301 defines the role of the TAC. The TAC will assess the radiological hazard and develop PARs, based on the DHS Protective Action Guidelines (PAG's) for RDD and IND incidents (see Appendices).

Risk communication will be managed and disseminated by the Joint Information Center (JIC). The goal of the JIC will be to keep the public informed.

5.3 Late (Recovery) Phase - Begins with clean-up and recovery actions to reduce radiation to acceptable levels and ends when recovery actions have been completed. Depending on the magnitude of the incident, actions may be necessary to restore the incident scene to an acceptable condition. Such actions may range from washing down surfaces to remove radioactive contamination in the form of dusty particulates, to removing radioactive debris or objects with fixed contamination (non-removable contamination). The State Radiological Emergency Preparedness (REP) Plan and Department of Homeland Security Protective Actions Guides (PAG's) for RDD/IND Events may be used to address recovery actions.

6.0 PLANNING AND RESPONSE CONSIDERATIONS

6.1 Response organizations must develop plans and protocols that address radiation protection during a RDD or IND incident and ensure appropriate training for responders and decision makers. Federally developed protective action guides and operational guidelines must be used to develop local SOPs for radiological emergencies, in particular, those related to terrorist incidents using RDDs and INDs. Appendix 2 contains four tables with information that should be considered during the response phases and should be included in the locally developed SOPs .

- Table 1 - Protective Action Guides for RDD or IND Incidents
- Table 1A - Risk Management Considerations for Emergency and Normal Operations
- Table 1B - Response Worker Guidelines
- Table 1C - Acute Radiation Syndrome

6.2 Maintaining the "As Low As Reasonably Achievable" (ALARA)) Principle[I] - Employers of first responders should prepare emergency response plans and protocols to minimize the risks from exposure to ionizing radiation. Standard operating procedures should require recording radiation dose to emergency workers and emphasizing protocols to:

- Minimize the time spent in the contaminated area (e.g., rotation of workers);
- Maintain the maximum distance from sources of radiation;
- Tailor hazard controls to the work performed;
- Properly select and use respirators and other personal protective equipment (PPE) to prevent exposure to internally deposited radioactive materials (e.g. alpha and beta emitters);
- Use radioprotective medications that block the uptake of radioiodine when directed to do so by a Public Health Official;
- Establish a turn-back value based on U.S. EPA Guidelines, field measurements and the assessment of on-scene hazards.

The Incident Commander should be prepared to identify, to the extent possible, all hazardous conditions or substances and to perform an appropriate site hazard analysis. Emergency plans should include protocols to control worker exposures, establish exposure guidelines in advance, and outline procedures for worker protection. All activities should be performed in conjunction with emergency procedures that include provisions for exposure monitoring, worker training on the hazards involved in response operations, ways to control them, and medical monitoring.

[I] Federal Register Department of Homeland Security, Protective Action Guides for Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents, Appendix 1 (d)

APPENDIX 1

RADIOLOGICAL NOTIFICATIONS PROTOCOL

1.0 Primary Notifications for Radiological Incidents. Once the initial information has been taken about the incident, notify the following organizations and pass on the information.

1.1 Department of Safety and Homeland Security, Office of the Secretary.
(302) 744-2680 / 2665

1.2 Delaware Emergency Management Agency
(302) 659-3362

1.3 Department of Health and Social Services, Division of Public Health, Health Systems Protection, Radiation Control Program Director (Office of Radiation Control & Duty Officer).
(302) 744-4546 / (302) 659-3362 & (302) 744-4700

1.4 Department of Natural Resources and Environmental Control, Division of Air and Waste Management, Enforcement Section & Emergency Prevention & Response Branch.
1-800-662-8802 (24 hour), (302) 739-9401 & (302) 739-9404

1.5 Department of Natural Resources and Environmental Control
Water Resources, Environmental Services Section.
(302) 739-9942

1.6 Nuclear Regulatory Commission (NRC) Region I, Regional State Liaison Officer
(610) 337-5213

1.7 Headquarters NRC Operations Center, (24 hours):
(301) 816-5100

1.8 Federal Emergency Management Agency Region III
(215) 931-5500/5757

1.9 Environmental Protection Agency, Philadelphia Office
(if source is unknown and contamination is known or suspected).
24-hr number (215) 814-9016 Spill Line

2.0 Department of Energy, Regional Coordinating Office.
(631) 344-2200

2.0 Other important offices, which may need to be notified:

New Castle County EOC.....(302) 395-3600
Kent County EOC.....(302) 735-3461
Sussex County EOC .....(302) 855-7801
Delaware State Police.....911
Local Fire Department.....911
Division of Highway Operations (DelDOT-TMC).....(302) 659-2400

Delaware State Fire School.....(302) 739-4773
Dover Air Force Base Disaster Preparedness Office....(302) 677-6213 / (302) 363-9104(24-hr)
Delaware National Guard.....(302) 323-3440 24-hr
Emergency Departments, Christiana Care Hospitals
Wilmington .....(302) 428-4886
Christiana.....(302) 733-1840/1601

3.0 Notifications for Nuclear Fuel Incidents - In addition to the normal state and local agencies, DEMA must notify the following in the event of a nuclear fuel accident:

3.1 DOE Regional Coordinating Office
Brookhaven Area Office
Upton, Long Island, NY
(631) 344-2200
24-hour number for DOE Emergency Operations Center (EOC):
(631) 344-2200

3.2 FEMA Region III
Philadelphia, PA
(215) 931-5757
24-hr number for FEMA National Emergency Coordination Center:
(202) 931-5652

3.3 NRC Operations Center
One White Flint North
Rockville, MD
Ph: (301) 816-5100
Fax (301) 816-5151
24-hr number: (301) 816-5100 / (800) 449-3694

3.4 Environmental Protection Agency Regional Office
Philadelphia, PA.
(800) 438-2474
24-hour number: (215) 814-9016

4.0 Notifications for Nuclear Weapons Accidents.

4.1 In addition to the normal state and local agencies, notify the following in the event of an accident/incident involving a nuclear weapon: Department of Defense and/or Department of Energy organizations will be the first responders to incidents and accidents involving nuclear weapons. DNREC/ERT responders will assume an advisory/liaison role unless assigned a primary role by Federal organizations.

4.2 If DNREC/ERT should be informed of a nuclear weapon accident/incident they shall notify DEMA prior to Federal organizations, DEMA shall ensure the following steps are taken:

4.2.1 Notify the nearest military installation:

Dover Air Force Base
Command Post: (302) 677-4201
Civil Engineer Readiness (Disaster Preparedness): (302) 677-6213
Security Police: (302) 677-6664
Switchboard: (302) 677-3000

4.2.1 Notify the DOE Regional Coordinating Office:

Brookhaven Area Office
Upton, Long Island, NY
(631) 344-2200
24-hour number for EOC: (631) 344-2200

4.2.2 Notify FEMA Region III:
Philadelphia, PA
(215) 931-5757
24-hour number for FEMA National Emergency Coordination Center:
(202)-931-5652

APPENDIX 2

TABLE 1.—PROTECTIVE ACTION GUIDES FOR RDD OR IND INCIDENTS

Phase	Protective action	Protective action guide	Reference
Early	Limit Emergency Worker Exposure.	5 rem (or greater under exceptional circumstances[1]).	EPA PAG Manual.
	Sheltering of Public	1 to 5 rems projected dose [2]	EPA PAG Manual.
	Evacuation of Public	1 to 5 rems projected dose [3]	EPA PAG Manual.
	Administration of Prophylactic Drugs.	For potassium iodide, FDA Guidance dose values[4, 5].	FDA Guidance [6].
Intermediate	Limit Worker Exposure	5 rem/yr	See Appendix 1.
	Relocation of General Public	2 rems, projected dose first year Subsequent years: 500 mrem/yr projected dose.	EPA PAG Manual.
	Food Interdiction	500 mrem/yr projected dose	FDA Guidance [7].
	Drinking Water Interdiction	500 mrem/yr dose	EPA guidance in development.
Late	Final Cleanup Actions	Late phase PAG based on optimization.	

1 In cases when radiation control options are not available or, due to the magnitude of the incident, are not sufficient, doses above 5 rems may be unavoidable. 2 Should normally begin at 1 rem; however, sheltering may begin at lower levels if advantageous.
3 Should normally begin at 1 rem.
4 Provides protection from radioactive iodine only.
5 For other information on medical prophylactics and treatment please refer to http://www.fda.gov/cder/drugprepare/default.htm or http://www.bt.cdc.gov/radiation/index/asp or http://www.orau.gov/reacts.
6 "Potassium Iodide as a Thyroid Blocking Agent in Radiation Emergencies," December 2001, Center Drug Evaluation and Research, FDA, HHS (http://www.fda.gov/cder/guidance/5386fnl.htm).
7 "Accidental Radioactive Contamination of Human Food and Animal Feeds: Recommendations for State and Local Agencies," August 13, 1998, Office of Health and Industry Programs, Center for Devices and Radiological Health, FDA, HHS (http://www.fda.gov/cdhr/dmqrp/84.html).

Note: Extracted from Department of Homeland Security, Preparedness Directorate; Protective Action Guides for Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents.

APPENDIX 2 (continued)

TABLE 1A. RISK MANAGEMENT CONSIDERATIONS FOR EMERGENCY AND NORMAL OPERATIONS	
Emergency	Normal operations
An adversary may attempt to create conditions that will cause high radiation exposures, widespread contamination, and mass disruption. Actions must be taken as soon as possible to minimize exposures even when information on the risks is incomplete. Lack of action—due to unclear, overly complicated, or reactive guidelines—have a high possibility of causing unintended consequences. During emergencies, the undesired consequences can be significant, uncontrollable, and unpredictable.	Key elements to radiation protection are to contain radioactivity and confine access to it. There is adequate time to fully characterize situations and determine risks and mitigating measures. Inaction or delays may increase costs but rarely results in consequences that cannot be mitigated. Consequences associated with implementation of the standard are well characterized, considered, and controlled so as not to be of concern from either a health or public welfare perspective.

TABLE 1B.—RESPONSE WORKER GUIDELINES		
Total effective date equivalent (TEDE) guideline	Activity	Condition
5 rems	All occupational exposures	All reasonably achievable actions have been taken to minimize dose.
10 rems *	Protecting valuable property necessary for public welfare (e.g., a power plant).	Exceeding 5 rems unavoidable and all appropriate actions taken to reduce dose. Monitoring available to project or measure dose.
25 rems **	Lifesaving or protection of large populations	Exceeding 5 rems unavoidable and all appropriate actions taken to reduce dose. Monitoring available to project or measure dose. Only on a voluntary basis to persons fully aware of the risks involved.
* For potential doses >10 rems, special medical monitoring programs should be employed, and exposure should be tracked in terms of the unit of absorbed dose (rad) rather than TEDE (rem). TEDE denotes the use of internal and external dose. ** In the case of a very large incident such as an IND, incident commanders may need to consider raising the property and lifesaving response worker guidelines in order to prevent further loss of life and massive spread of destruction.		

Table 1C. Acute Radiation Syndrome*

Feature or Illness	Effects of Whole-Body Absorbed Dose, from external radiation or internal absorption, by dose range in rad				
	0-100	100-200	200-600	600-800	>800
Nausea, vomiting	None	5-50%	50-100%	75-100%	90-100%
Time of onset		3-6 h	2-4 h	1-2 h	<1 h to minutes
Duration		<24 h	<24 h	<48 h	<48 h
Lymphocyte count	Unaffected	Minimally decreased	<1000 at 24 h	<500 at 24 h	Decreases within hours
Central Nervous System function	No Impairment	No Impairment	Cognitive impairment for 6-20 h	Cognitive impairment for >20 h	Rapid incapacitation
Mortality	None	Minimal	Low with aggressive therapy	High	Very High; Significant neurological symptoms indicate lethal dose

*Prompt health effects with whole-body absorbed doses received within a few hours.
Source: Medical Management of Radiological Casualties, Second Edition, Armed Forces Radiobiology Research Institute,
Bethesda, MD, April 2003.

Note: Extracted from Department of Homeland Security, Preparedness Directorate; Protective Action Guides for Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents.

APPENDIX 3

RADIATION EMERGENCIES

FREQUENTLY ASKED QUESTIONS (FAQS)
Dirty Bombs

People have expressed concern about dirty bombs and what they should do to protect themselves if a dirty bomb incident occurs. Because your health and safety are our highest priorities, the health experts at the Centers for Disease Control and Prevention (CDC) have prepared the following list of frequently asked questions and answers about dirty bombs.

What is a dirty bomb?
A dirty bomb is a mix of explosives, such as dynamite, with radioactive powder or pellets. When the dynamite or other explosives are set off, the blast carries radioactive material into the surrounding area.

A dirty bomb is *not* the same as an atomic bomb
An atomic bomb, like those bombs dropped on Hiroshima and Nagasaki, involves the splitting of atoms and a huge release of energy that produces the atomic mushroom cloud.

A dirty bomb works completely differently and *cannot create an atomic blast.* Instead, a dirty bomb uses dynamite or other explosives to scatter radioactive dust, smoke, or other material in order to cause radioactive contamination.

What are the main dangers of a dirty bomb?

The main danger from a dirty bomb is from the explosion, which can cause serious injuries and property damage. The radioactive materials used in a dirty bomb would probably not create enough radiation exposure to cause immediate serious illness, except to those people who are very close to the blast site. However, the radioactive dust and smoke spread farther away could be dangerous to health if it is inhaled. Because people cannot see, smell, feel, or taste radiation, you should take immediate steps to protect yourself and your loved ones.

What immediate actions should I take to protect myself?
These simple steps—recommended by doctors and radiation experts—will help protect you and your loved ones. The steps you should take depend on where you are located when the incident occurs: outside, inside, or in a vehicle.

If you are outside and close to the incident
- Cover your nose and mouth with a cloth to reduce the risk of breathing in radioactive dust or smoke.
- Don't touch objects thrown off by an explosion—they might be radioactive.
- Quickly go into a building where the walls and windows have not been broken. This area will shield you from radiation that might be outside.
- Once you are inside, take off your outer layer of clothing and seal it in a plastic bag if available. Put the cloth you used to cover your mouth in the bag, too. Removing outer clothes may get rid of up to 90% of radioactive dust.
- Put the plastic bag where others will not touch it and keep it until authorities tell you what to do with it.
- Shower or wash with soap and water. Be sure to wash your hair. Washing will remove any remaining dust.
- Tune to the local radio or television news for more instructions.

APPENDIX 3 (continued)

If you are inside and close to the incident

• If the walls and windows of the building are not broken, stay in the building and do not leave.
• To keep radioactive dust or powder from getting inside, shut all windows, outside doors, and fireplace dampers. Turn off fans and heating and air-conditioning systems that bring in air from the outside. It is not necessary to put duct tape or plastic around doors or windows.
• If the walls and windows of the building are broken, go to an interior room and do not leave. If the building has been heavily damaged, quickly go into a building where the walls and windows have not been broken. If you must go outside, be sure to cover your nose and mouth with a cloth. Once you are inside, take off your outer layer of clothing and seal it in a plastic bag if available. Store the bag where others will not touch it.
• Shower or wash with soap and water, removing any remaining dust. Be sure to wash your hair.
• Tune to local radio or television news for more instructions.

If you are in a car when the incident happens

• Close the windows and turn off the air conditioner, heater, and vents.
• Cover your nose and mouth with a cloth to avoid breathing radioactive dust or smoke.
• If you are close to your home, office, or a public building, go there immediately and go inside quickly.
• If you cannot get to your home or another building safely, pull over to the side of the road and stop in the safest place possible. If it is a hot or sunny day, try to stop under a bridge or in a shady spot.
• Turn off the engine and listen to the radio for instructions.
• Stay in the car until you are told it is safe to get back on the road.

What should I do about my children and family?

• If your children or family are with you, stay together. Take the same actions to protect your whole family.
• If your children or family are in another home or building, they should stay there until you are told it is safe to travel.
• Schools have emergency plans and shelters. If your children are at school, they should stay there until it is safe to travel. Do not go to the school until public officials say it is safe to travel.

How do I protect my pets?

• If you have pets outside, bring them inside if it can be done safely.
• Wash your pets with soap and water to remove any radioactive dust.

Should I take potassium iodide?

• Potassium iodide, also called KI, only protects a person's thyroid gland from exposure to radioactive iodine. KI will not protect a person from other radioactive materials or protect other parts of the body from exposure to radiation.
• Since there is no way to know at the time of the explosion whether radioactive iodine was used in the explosive device, taking KI would probably not be beneficial. Also, KI can be dangerous to some people.

Will food and water supplies be safe?

• Food and water supplies most likely will remain safe. However, any unpackaged food or water that was out in the open and close to the incident may have radioactive dust on it. Therefore, do not consume water or food that was out in the open.

APPENDIX 3 (continued)

- The food inside of cans and other sealed containers will be safe to eat. Wash the outside of the container before opening it.
- Authorities will monitor food and water quality for safety and keep the public informed.

How do I know if I've been exposed to radiation or contaminated by radioactive materials?

- People cannot see, smell, feel, or taste radiation; so you may not know whether you have been exposed. Police or firefighters will quickly check for radiation by using special equipment to determine how much radiation is present and whether it poses any danger in your area.
- Low levels of radiation exposure (like those expected from a dirty bomb situation) do not cause any symptoms. Higher levels of radiation exposure may produce symptoms, such as nausea, vomiting, diarrhea, and swelling and redness of the skin.
- If you develop any of these symptoms, you should contact your doctor, hospital, or other sites recommended by authorities.

Where do I go for more information?

- For more information about dirty bombs, radiation, and health, contact:
  - The Conference of Radiation Control Program Directors (CRCPD) http://www.crcpd.org (502) 227-4543
  - The U.S. Environmental Protection Agency (EPA) http://www.epa.gov/radiation/rert/
  - The Nuclear Regulatory Commission (NRC) http://www.nrc.gov/ (301) 415-8200
  - The Federal Emergency Management Agency (FEMA) http://www.fema.gov/ (202) 646-4600
  - The Radiation Emergency Assistance Center/Training Site (REAC/TS) http://www.orau.gov/reacts/ (865) 576-3131
  - The U.S. National Response Team (NRT) http://www.nrt.org/
  - The U.S. Department of Energy (DOE) http://www.energy.gov/engine/content.do 1-800-dial-DOE

For more information, visit www.bt.cdc.gov/radiation, or call CDC at 800-CDC-INFO (English and Spanish) or 888-232-6348 (TTY).

March 21, 2005 Page 3 of 3

APPENDIX 4

CHARACTERISTICS OF CERTAIN ISOTOPES OF GREATEST CONCERN

Isotope	Common Use	Description
Am-241 (Americium)	Measurement instruments, e.g. well logging instruments and gauges, smoke detectors	Sources are typically small to moderate in physical size and radiological emission (up to 1 inch in diameter, 6-inches long, and tens of millicuries to tens of curies in strength); smoke detectors use microcurie quantities. In neutron sources the Am-241 is typically mixed with beryllium oxide, which is a toxic substance; double-encapsulated in stainless steel holders; and used for a variety of industrial assay applications. Thousands of these sources are in use.
Cs-137 (Cesium)	Medical imaging, food/other irradiation, gauges	Found in sealed portable sources and in large irradiation facilities. The sealed sources are often found as cesium chloride, a form of particular concern for RDD use.
Pu-238 (Plutonium)	Medical devices and measurement instruments	In the past used as a heat source for pacemakers, an application that was phased out in the early 1970's. Also used as thermal-electric generator heat source where it is contained as an oxide in stainless steel or other containers. As with Am-241 and Pu-239, and unlike the gamma emitters, a great deal of shielding is not required in application.
Sr-90 (Strontium)	Heat source for thermal-electric generators and sealed sources	Used in large quantities in heavily shielded configurations.
Po-210 (Polonium)	Static eliminators	Typically found as metal foils.
Co-60 (Cobalt)	Food/other irradiation and radiography	Typically cast as metal rods, or pins, several to dozens of which are combined in a holder to provide desired radiation intensity. Storage requires heavy shielding, typically in large facility.
Ir-192 (Iridium)	Gamma source used for mobile and fixed radiography applications.	Used in many fixed and mobile irradiation applications, these sources are found in instruments used for weld inspections and other industrial applications. The mobile application of these sources and availability make them a particular concern.
Pu-239 (Plutonium)	Alpha or neutron source, typically used in research	Used in research facilities, these sources are generally small because significant quantities of Pu-239 are tightly regulated because of weapons potential.
Cm-244 (Curium) Or Cf-252 (Californium)	Neutron source used in research and measuring instruments	Sources are small, and those in instruments are shielded.

Radiological Dispersal Devices:
Report to the Nuclear Regulatory Commission and the Secretary of Energy,
By the DOE/NRC Interagency Working Group on RDD's
May 2003

APPENDIX 5

DISPERSION METHODOLOGIES

Prior to September 11, 2001, approaches to controlling radioactive materials were generally oriented to beneficial uses, and protecting workers and the public from unnecessary radiation dose. However, the nation's concerns regarding the use of radioactive materials for a malevolent act have been heightened, and many actions have been taken to strengthen safeguards to ensure the security and authorized use of materials.

Of particular concern is the nation's ability to control inventories of radioactive materials that could be used in a radiological dispersal device (RDD). An RDD is a device combining conventional explosive material for detonation, to effect dispersal of radioactive material over an area. Lethality and serious injury would affect those in the immediate vicinity of the blast, but probability of delivering sufficient radiation dose to create serious injury is low. RDD's have been described as "weapons of mass disruption", because they are unlikely to result in many deaths, but are likely to cause panic, spread radioactive contamination requiring significant clean up, and potentially disrupt operations for an extended period of time. The economic impact of such disruption would be considerable if an RDD were exploded in a major transportation hub, entertainment venue or other mass gathering.

A second methodology for dispersing radiation from radioisotopes is an improvised nuclear device (IND). Such a device would utilize fissile radioactive material to initiate a nuclear chain reaction (explosion associated with a nuclear bomb). Such a device could be used as a weapon of mass destruction, that would result in many deaths, many cases of acute radiation syndrome, and ultimately, for many years following the explosion, elevated incidence rates and mortality from radiation-related cancers among survivors, as well as increased incidence of birth defects, cancer and/or mental retardation for offspring exposed *in utero*.

A third methodology is dispersing radiation from radioisotopes surreptitiously so that recognition of the contamination event might occur sometime later, after significant spread of the radioactive material. An example is introducing radioactive particulates or aerosols in the ventilation intake of a building or other facility (e.g. transportation hub). Factors that make this scenario less likely include: very low probability of lethality or serious injury, technology needed to aerosolize radioisotopes (make them available for inhalation) is technology/cost-intensive, and quantity of aerosolized radioisotope used would limit the magnitude of exposure (area affected is dependent on quantity of radioisotope available).

Radiological Dispersal Devices: Report to the NRC and Secretary of Energy, By the DOE/NRC Interagency Working Group on RDD's, May 2003

APPENDIX 6

MAJOR ROUTES OF EXPOSURE

External Irradiation

Radiation dose delivered to the skin from external irradiation. External irradiation can occur to an individual located in close proximity to a radioactive source emitting high energy, highly penetrating radiation (eg. gamma or x-rays or neutrons). External irradiation can also occur to an individual coming into contact with a radioactive plume (airborne release of particulate or gaseous radioactive material).

Inhalation

Radiation dose can be delivered and internalized by breathing in air containing radioactive gases or particulates, such as a radioactive plume. Inhalation exposure can also occur by inspiring radioactive residue deposited on surfaces, and then re-suspended in air.

Ingestion

Radiation dose delivered to the gastrointestional tract by ingesting radioactive material, as residue or contamination of crops/foodstuff or as contamination from radioactive particulate matter deposited on surfaces (e.g. food eaten with contaminated hands).

Internalization

Radioactive material may be inhaled, either as gases or particulates. Some may be ingested, from mouth contamination, ciliary movement in the bronchial system that moves particulates to the mouth, or the eating and drinking of contaminated food. In addition, radioactive shrapnel from the destruction of a sealed source of radioactive material of RDD can become embedded in a wound. Radioisotopes that deliver radiation dose while internalized are said to be "incorporated." Medical treatment to reduce residence time, bind or compete with radioisotopes and/or encourage excretion is called "decorporation".

Radiological Dispersal Devices: Report to the NRC and Secretary of Energy, By the DOE/NRC Interagency Working Group on RDD's, May 2003

APPENDIX 7

SIGNIFICANCE/CREDIBILITY AS AN AGENT OF TERRORISM

Radioisotopes are unstable chemicals, whose radioactivity is measured by the number of atoms disintegrating per unit time. A disintegrating atom can emit a beta particle, an alpha particle, a gamma or x- ray, or some combination, which disrupts molecules in living cells, and deposits energy in tissues, causing damage.

Radioisotopes have a number of beneficial uses, such as medical imaging, diagnosing disease and treating cancer, generating electricity via nuclear power, conducting biomedical research and development, industrial uses such as measuring material thickness and density, and increasingly, for homeland security purposes such as imaging of shipping containers at Ports of Entry to the U.S.

Radiation has been described as having a "higher perceived risk" than some other potential terror agents due to a number of factors: radiation is a source of public dread (nuclear weapons, nuclear power), is not observable, is unknown to the exposed, chronic effects are insidious, effects are not equitable, exposure is involuntary, consequences are potentially fatal, and exposure to parents presents potential genetic risk to future generations. High-risk groups for psychosocial harm in a radiological terror scenario are: children, mothers with young children, pregnant women, emergency/clean-up workers, and their families.

Certain radioisotopes are considered more likely to be of interest as agents of terror, due to their high-energy emissions, long half-life (duration of radioactive emissions), and/or the relatively large number of sources distributed throughout medical, academic, industrial and research facilities. "Isotopes of greatest concern" were identified in 2003 by the federal government based on relative dose impacts & potential for dispersion (material index) and relative attractiveness for access i.e. number of facilities with greater than threshold values & level of facility security (attractiveness index).

Radiological Dispersal Devices: Report to the Nuclear Regulatory Commission and the Secretary of Energy, By the DOE/NRC Interagency Working Group on RDD's
May 2003

APPENDIX 8

DIVISION OF PUBLIC HEALTH
PRE-EVENT PLANNING MESSAGE: DIRTY BOMB

The goal of risk communication during a crisis is to assist the public to become aware of the nature of events that have taken place, what steps they can take to protect themselves, and what steps are being taken by others to mitigate the incident and alleviate concerns.

According to risk communication experts, perception of risk is often very different from actual risk. Risks that are perceived as less acceptable, or "worse" can be characterized as:

- Involuntary
- Insidious (odorless, colorless, tasteless)
- Long-term effects
- Manmade
- Catastrophic
- Affects children more than adults
- Risk to future generations
- Poorly understood by the public.

Radiation risk is characterized by all of the criteria above, and is considered to present a considerably higher "perceived risk" than many other hazards. In addition, radiation evokes a widespread sense of dread, due to the collective memory of the nuclear bombs dropped on Hiroshima and Nagasaki and the Chernobyl nuclear reactor accident in the Ukraine.

Communicating messages about radiation risk to the public requires effective pre-planning, to increase the probability that members of the public are productively informed, and know what steps to take to minimize risks to themselves, and others.

The Association of State and Territorial Health Officials (ASTHO) is the source for the concept of the "message map" for risk communication. The concept calls for focusing on a few simple questions that the public would be most likely to need answers to, and identifying supporting facts for each of the key message elements. Such a message map provides a framework for effective risk communication.

The following is an example of a recommended message map for communicating messages about a radiological incident to the public.

APPENDIX 8 (continued)

What is the health risk to the community from a Dirty Bomb?

Key Message Fact 1	**Key Message Fact 2**	**Key Message Fact 3**
Health risks from a dirty bomb are death or physical injury in the vicinity of the blast, and exposure to radiation from contaminated dusts released during the blast.	A dirty bomb is an improvised weapon that combines a conventional explosive such as dynamite, with radioactive material.	We can protect ourselves from a dirty bomb by moving away from the incident scene, tuning to public announcements, and staying indoors with ventilation systems turned off.
Supporting Fact 1-1	**Supporting Fact 2-1**	**Supporting Fact 3-1**
Death and serious injury from a dirty bomb are the same risks as for a conventional bomb using explosives such as dynamite .	A dirty bomb is **not** a nuclear bomb – these two types of explosive weapons are very different.	A dirty bomb will release contaminated dusts into the air and onto surfaces, in the vicinity of the blast.
Supporting Fact 1-2	**Supporting Fact 2-2**	**Supporting Fact 3-2**
The amount of radiation contamination would depend on the size and nature of the bomb, and the location where it was detonated.	A dirty bomb would release radioactive dusts into the air, and onto surfaces. Once such dusts are washed away (such as laundering clothes and showering), radiation exposure from the blast would be alleviated.	Those caught in the vicinity of the incident scene should move to a clean area, remove clothing and seal it in a trash bag, and shower to remove contaminated dusts.
Supporting Fact 1-3	**Supporting Fact 2-3**	**Supporting Fact 3-3**
The amount of radiation exposure to individuals in the vicinity of the blast would be measurable, but very low when compared with a nuclear bomb	The greatest impact from a dirty bomb would be disruption of operations in the vicinity of the blast, and performing clean-up to return the area to it's previous condition.	Providing first aid and lifesaving is the highest response priority. Preventing or cleaning up radioactive contamination from a dirty bomb is an important recovery priority.

Daniel J. Barnett, MD, MPH of the Johns Hopkins Center for Public Health Preparedness is acknowledged for content in this attachment derived from his presentation on "Risk Communication and Radiation Terror", at the Dirty Bomb Seminar presented in Dover, DE on December 13, 2004.

APPENDIX 9

PLAN DISTRIBUTION LIST

AGENCY

U.S. Nuclear Regulatory Commission, Regional State Liaison Officer

U.S. Department of Energy Brookhaven Office

U.S. Environmental Protection Agency Philadelphia Office

Delaware State Fire School, Director

Delaware State Police, Superintendent

Department of Health and Social Services (DHSS), Secretary

- Division of Public Health, Director
- Division of Public Health, Health Systems Protection, Section Chief
- Division of Public Health, Office of Radiation Control, Administrator
- Division of Public Health, Environmental Health Evaluation Administrator

Department of Natural Resources and Environmental Control (DNREC), Secretary

- Division of Air & Waste Management, Director
- Division of Air & Waste Management, Emergency Prevention & Response Branch, Program Mgr
- Division of Air & Waste Management, Enforcement Chief
- Division of Water Resources, Senior Science Advisor

Department of Safety and Homeland Security (DSHS), Secretary

- DEMA Director
- DEMA Deputy Director
- DEMA Principal Planner
- DEMA Technological Planner Supervisor
- DEMA Duty Officer
- DEMA Operations

New Castle County Administrator

New Castle County Department of Public Safety, Director

New Castle County Office of Emergency Management, Director

Kent County Administrator

Kent County Emergency Operations Center, Director

Sussex County Administrator

Sussex County Emergency Operations Center, Director

City of Wilmington, Mayor

City of Wilmington Office of Emergency Mgt., Director

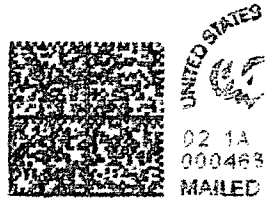
911 Centers

DEMA
DELAWARE EMERGENCY
MANAGEMENT AGENCY
Partners for Protection and Response

165 Brick Store Landing Road
Smyrna, DE 19977

State of Delaware
Department of Safety & Homeland Security

"Official Business, Penalty for
Private Use $300"
40-0130



PAT
McGRADY-FINNERAN -03C10

U.S. Nuclear Regulatory Commission
Regional State Liaison Officer
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738