Federal Register

Tuesday,

January 3, 2006

Part II

Department of Homeland Security

Preparedness Directorate; Protective Action Guides for Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents; Notice

DEPARTMENT OF HOMELAND SECURITY

Z–RIN 1660–ZA02

Preparedness Directorate; Protective Action Guides for Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents

AGENCY: Preparedness Directorate, Department of Homeland Security.

ACTION: Notice of draft guidance for interim use with request for comment.

SUMMARY: The Preparedness Directorate of the Department of Homeland Security (DHS) is issuing guidance entitled, ''Application of Protective Action Guides for Radiological Dispersal Devices (RDD) and Improvised Nuclear Device (IND) Incidents'' for Federal agencies, and as appropriate, State and local governments, emergency responders, and the general public who may find it useful in planning and responding to an RDD or IND incident. The guidance recommends ''protective action guides'' (PAGs) to support decisions about actions that may need to be taken to protect the public when responding to or recovering from an RDD or IND incident. It also outlines a process to implement the recommendations and discusses operational guidelines that may be useful in the implementation of the PAGs. The full text of the document is included in this Notice. This guidance is provided for interim use and will be revised based on comments received. The Preparedness Directorate is seeking input on the appropriateness, implementability and completeness of the guidance.

DATES: The draft guidance contained in this notice is released for interim use effective January 3, 2006. Comments on this draft guidance should be received on or before March 6, 2006.

ADDRESSES: You may submit comments, identified by Docket Number DHS–2004–0029 and Z–RIN 1660–ZA02, by one of the following methods:

- Federal eRulemaking Portal: *http://www.regulations.gov*. Follow the instructions for submitting comments.
- E-mail: *FEMA-RULES@dhs.gov*. Include Docket Number DHS–2004–0029 and Z–RIN 1660–ZA02 in the subject line of the message.
- Fax: 202–646–4536.
- Mail/Hand Delivery/Courier: Rules Docket Clerk, Office of the General Counsel, Federal Emergency Management Agency, Room 840, 500 C Street, SW., Washington, DC 20472.

Instructions: All submissions received must include the agency name and docket number (if available) or Regulatory Information Number (RIN) for this rulemaking. All comments received will be posted without change to *http://www.regulations.gov*, including any personal information provided.

Docket: For access to the docket to read background documents or comments received, go to *http://www.regulations.gov*. Submitted comments may also be inspected at 500 C Street, SW., Room 840, Washington, DC 20472.

FOR FURTHER INFORMATION CONTACT: Craig Conklin, Chief, Nuclear and Chemical Hazards Branch, Preparedness Division, Department of Homeland Security, NAC, Washington, DC 20528, 703–605–1228 (phone), 703–605–1198 (facsimile), or *craig.conklin@dhs.gov* (e-mail.)

SUPPLEMENTARY INFORMATION:

(a) Introduction

(1) Background on the Guidance

Since the terrorist events in the United States on September 11, 2001, there has been increased worldwide effort to avert and respond to terrorist attacks. In addition, based on intelligence information, the potential for terrorist attacks in the United States involving radiological materials or a nuclear device has grown. The Federal Government has responded with an aggressive approach to planning and preparedness, utilizing the resources and expertise found in departments and agencies across the government. Prior to September 11, radiological emergencies were considered bounded by potential nuclear power plant accidents. However, new terrorist scenarios have emerged that offer new and different response challenges.

In order to prepare for potential attacks, DHS held a Federal interagency ''dirty bomb'' exercise as part of the Top Officials–2 Exercise (TOPOFF–2) in Seattle, Washington, May 12–16, 2003. The exercise brought to light a number of issues in Federal radiological emergency response and recovery. One of the most important issues raised was how long-term site restoration and cleanup would be accomplished following an act of radiological terrorism. This question was part of a larger discussion of Federal Government protective action recommendations following acts of radiological or nuclear terror. The Environmental Protection Agency (EPA) published PAGs in the ''Manual of Protective Action Guides and Protective Actions for Nuclear Incidents'' (EPA 400–R–92–001, May 1992), in coordination with the Federal Radiological Preparedness Coordinating Committee (FRPCC). However, the EPA Manual, often called the PAG Manual, was not developed to address response actions following radiological or nuclear terrorist incidents. Also, the PAG Manual does not address long-term cleanup.

In 2003, DHS tasked an interagency working group to address these issues. The working group consisted of senior subject matter experts in radiological/nuclear emergency preparedness, response, and consequence management. The following Federal departments and agencies were represented on the working group: DHS, EPA, Department of Commerce (DOC), Department of Energy (DOE), Department of Defense (DOD), Department of Labor (DOL), Department of Health and Human Services (HHS), and the Nuclear Regulatory Commission (NRC).

The result of the interagency working group process is the following Federal consensus guidance entitled, ''Application of Protective Action Guides for Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents.'' (June 1, 2004). In it, the Federal agencies support the use of existing early and intermediate phase PAGs, as found in the EPA PAG Manual, for acts of radiological and nuclear terrorism. The working group also developed late phase guidance, also contained in the consensus guidance, for the cleanup and restoration of a site following an act of radiological or nuclear terrorism that is based on the principle of site-specific optimization.

In developing this draft guidance, DHS convened a focus group of representatives from 13 State agencies with expertise in radiological emergency response and consequence management. The State representatives were asked to review the draft guidance and provide detailed comments on its content, structure, and presentation. DHS was particularly interested in how States would make use of the guidance and how well the guidance would serve to facilitate Federal and State (or local) government interactions during a radiological terrorism response. Overall, the State representatives responded very positively to the guidance. A number of improvements suggested by the States were incorporated into the draft guidance being published today.

The purpose of this guidance is to aid Federal decision makers in protecting the public and emergency responders from the effects of radiation during an emergency and to provide guidelines and a process for site cleanup and recovery following an RDD or IND incident. This guidance is designed to be compatible with the National Incident Management System (NIMS) and the National Response Plan (NRP).

This guidance presents levels of radiation exposure at which the Federal Government recommends that actions be considered to avoid or reduce radiation dose to the public from an RDD or IND incident. The intended audience for this document is principally Federal Government emergency response planners and officials; however, this document should also be useful to State and local governments for response planning. The protective action guides incorporate guidance and regulations published by the EPA, the Food and Drug Administration (FDA), and the Occupational Safety and Health Administration (OSHA), and address key health protection questions faced in the various phases (early, intermediate, and late) of response to an incident.

These PAGs are not absolute standards and are not intended to define ''safe'' or ''unsafe'' levels of exposure or contamination. Rather, they represent the approximate levels at which the associated protective actions are recommended. This guidance may also be used by State and local decision makers, and provides flexibility to be more or less restrictive as deemed appropriate based on the unique characteristics of the incident and local considerations.

This guidance is not intended for use at site cleanups occurring under other statutory authorities such as EPA's Superfund program, the NRC's decommissioning program, or other Federal or State cleanup programs. In addition, the scope of this guidance does not include situations involving United States nuclear weapons accidents.

(2) Characteristics of RDD and IND Incidents

An RDD is any device that causes the purposeful dissemination of radioactive material across an area without a nuclear detonation. The mode of dispersal typically described as an RDD is an explosive device coupled with radioactive material. An RDD poses a threat to public health and safety and the environment through the spread of radioactive materials, and any explosive device presents an added immediate threat to human life and property. Other means of dispersal, both passive and active, may be employed. Dissemination of radioactive material not carried out via a device would still be treated like an RDD by responders and decision makers.

There is a wide range of possible consequences that may result from an RDD depending upon the type and size of the device, the type and quantity of radioactive material, and how dispersion is achieved. The consequences of an RDD may range from a small, localized area (e.g., a street, single building or city block) to large areas, conceivably several square miles. However, most experts agree that the likelihood of a large impacted area is low. In most plausible scenarios, the radioactive material would not result in acutely harmful radiation doses and the public health concern from the radioactive materials would likely focus on the chronic risk of developing cancer among exposed individuals. Hazards from fire, smoke, shock, shrapnel (from an explosion), industrial chemicals and other chemical or biological agents may also be present.

An IND is an illicit nuclear weapon bought, stolen, or otherwise originating from a nuclear State, or a weapon fabricated by a terrorist group from illegally obtained fissile nuclear weapons material that produces a nuclear explosion. The guidance does not apply to acts of war between nation-states involving nuclear weapons. The nuclear yield achieved by an IND produces extreme heat, powerful shockwaves, and prompt radiation that would be acutely lethal for a significant distance. It also produces potentially lethal radioactive fallout, which may spread far downwind and deposit over very large areas. An IND would result in catastrophic loss of life, destruction of infrastructure and contamination of a very large area. If nuclear yield is not achieved, the result would likely resemble an RDD in which fissile weapons material was dispersed locally.

(3) RDD and IND Incidents v. Accidents

Acts of radiological and nuclear terrorism differ from radiological and nuclear accidents in several key ways. Accidents occur almost exclusively at well-characterized fixed facilities, or along prescribed transit routes. Facility operators have a good understanding of the kinds of radiological incidents that may occur, and have developed safeguards, plans, and procedures to deal with them. Exercises are regularly held to practice emergency plans and procedures, and improvements are made where necessary. Local communities, such as those around nuclear power plants (NPPs) or weapons production facilities, are informed and involved in emergency planning, including development of public communication strategies, practicing shelter-in-place, and orderly evacuation along prescribed routes. Accidents may also occur along transit routes, but these are relatively rare and substantial contingency planning and exercising occurs for transportation accidents as well.

Acts of radiological and nuclear terrorism, on the other hand, may occur virtually anywhere. Major cities are potential targets of such incidents. The number of potential targets and the diverse circumstances of potential attacks make focused response planning almost impossible. Even a rural setting could fall victim, if for example, a device were to go off prematurely. Most nuclear facilities are located in semi-rural settings around which the number of people affected would be less and the amount of critical infrastructure impacted is likely to be less.

The scope of potential accidents is limited and fairly well understood. Facilities tend to have fixed quantities of licensed radioisotopes or well characterized types of radionuclides on site that may be released in an accident. The number of ways accidents can occur (within reason) is limited, making possible effective contingency planning and improved safety. Accidents of any magnitude are limited to a relatively small number of facilities, and these tend to have highly trained personnel, advanced security, advanced process designs with the most rigorous safeguards and back-up systems, and the most aggressive contingency planning. The design of commercial nuclear power reactors in the United States, for example, precludes a Chernobyl-type of nuclear accident. Smaller facilities, such as radiopharmaceutical or radiation source manufacturers, generally possess much less radioactive material (or only short half-life materials) that may be involved in an accidental release.

Finally, an RDD or IND incident may be initiated without any advance warning and the release would likely have a relatively short duration. With a major NPP accident, the most severe type of incident previously considered, there is likely to be several hours or days of warning before the release starts and the release may be drawn out over many hours. The benefit of time is critical. Advance notice affords time to make appropriate decisions, communicate to the public, and execute orderly evacuation, if necessary, or other protective actions. This difference means that most early and some intermediate phase protective actions must be made more quickly and with less information in an RDD or IND incident if they are to be effective.

(4) Phases of Response

Typically, the response to an emergency can be divided into three time phases. Although these phases cannot be represented by precise time periods and may overlap, they provide a useful framework for the considerations involved in emergency response planning. The early phase (or emergency phase) is the period at the beginning of the incident when the source (e.g., fire or contaminated plume) at the incident is active, field measurement data are limited or not available, and immediate protective action decisions are required. Exposure to the radioactive plume, short-term exposure to deposited materials and inhalation of radioactive material are generally included when considering protective actions for the early phase of a radiological emergency. The response during the early phase includes the initial emergency response actions to retrieve and care for victims, stabilize the scene, and public health protective actions (such as sheltering-in-place or evacuation) in the short term. Life-saving and first aid actions should be given priority.

In general, early phase protective actions need to be made very quickly, and the protective action decisions can be modified later as more information becomes available. If an explosive RDD is deployed without warning, there may be no time to take protective actions to reduce plume exposure. In the event of a covert dispersal, discovery or detection may not occur for days or weeks, allowing contamination to be dispersed broadly by foot, vehicular traffic, wind, rain or other forces. If an IND explodes, there would only be time to make early phase protective action recommendations to protect against exposure from fallout in areas miles downwind from the explosion.

The intermediate phase of the response may follow the early phase response within as little as a few hours, up to several days. The intermediate phase of the response is usually assumed to begin after the incident source and releases have been brought under control and protective action decisions can be made based on some field measurements of exposure and radioactive materials. Activities in this phase typically overlap with early and late phase activities, and may continue for weeks to many months until protective actions are terminated. During the intermediate phase, decisions must be made on the initial actions needed to begin recovery from the incident, reopen transportation systems and critical infrastructure, and return to some state of normal activities.

The late phase is the period when recovery and cleanup actions designed to reduce radiation levels in the environment to acceptable levels commence and ends when all the recovery actions have been completed. In the late phase, decision makers will have more time and information to allow for better data collection and options analyses. In this respect, the late phase is no longer a response to an "emergency situation," as in the early and intermediate phases, and is better viewed in terms of the long-term objectives of cleanup and restoration of the site to meet the needs and desires of the community and region. With the additional time and increased understanding of the situation, there will be opportunities to involve key stakeholders in providing sound, cost-effective recommendations.

(5) Protective Action Guides

A PAG is the projected dose to a reference individual from an accidental or deliberate release of radioactive material at which a specific protective action to reduce or avoid that dose is recommended. Thus, protective actions, such as evacuation or sheltering-in-place, should normally be taken before the anticipated dose is realized. The PAG Manual, published by EPA in coordination with the FRPCC, provides the basis for this proposed guidance and may be referred to for additional details. The EPA PAGs achieve the following criteria and goals: (1) Prevent acute effects, (2) reduce risk of chronic effects and, (3) require optimization to balance protection with other important factors and ensure that actions taken cause more benefit than harm.

The PAG Manual was written to address the kinds of nuclear or radiological incidents deemed likely to occur. While intended to be applicable to any radiological release, the PAGs were designed principally to meet the needs of commercial nuclear power plant accidents, the worst type of incident under consideration in the PAGs. This is important for two reasons: commercial nuclear power plant accidents are almost always signaled by preceding events, giving plant managers time (hours or days) to make decisions, and local emergency managers time to communicate with the public and initiate evacuations if necessary; and, the suite of radionuclides is well-known, and is dominated by relatively short-lived isotopes. As a result of September 11, the Federal Government has reevaluated the PAGs for their applicability to RDD and IND incidents.

The PAGs are non-regulatory, and are meant to provide a flexible basis for decisions under varying emergency circumstances. Many factors should be considered when deciding whether or not to order an action based on the projected dose to a population. For example, evacuation of a population is much more difficult and costly as the size of the subject population increases. Further, there is a statistical increase in casualties directly related to the size of the population evacuated that must be taken into consideration. Thus, considering incident-specific factors like these, actual projected doses at which action is recommended may vary up or down.

(b) Developing the Proposed Guidance

(1) Use of Existing PAGs

In deriving the recommendations contained in this guidance, new types of incidents and scenarios that could lead to environmental radiological contamination were considered. The working group determined that the existing PAGs for the early and intermediate phases, including worker protection guides, published in the EPA PAG Manual, are also appropriate for use in RDD and IND incidents. The proposed recommendations are provided in Table 1 in Section D.3 of the following guidance. Appendix 1 of the following guidance provides additional details regarding worker protection recommendations and includes additional Response Worker Guidelines in Table 1B.

(2) Guidance for Late Phase Site Cleanup and Restoration

The working group evaluated existing Federal dose and risk-based standards, guidance and benchmarks for site cleanup and restoration as possible guidance for use after an RDD or IND. Standards considered included those of the EPA under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and DOE and NRC standards under the Atomic Energy Act of 1954, as amended. In addition, cleanup guidance and benchmarks issued by national and international radiation advisory bodies (such as the International Commission on Radiological Protection and the International Atomic Energy Agency) were considered.

The working group also examined variations of these standards, guidance and benchmarks by explicitly considering the possibility of achieving more or less stringent risk or dose levels, and by using target ranges.

The working group determined that the nature of potential impacts from radiological and nuclear terror incidents was extremely broad. Because of the broad range of potential impacts that may occur from RDDs and INDs ranging, for example, from light contamination of a street or building, to widespread destruction of a major metropolitan area, a pre-established numeric guideline was not recommended as best serving the needs of decision makers in the late phase. Rather, a site-specific process is recommended for determining the societal objectives for expected land uses and the options and approaches available to address RDD or IND contamination. For example, if the incident is an RDD of limited size, such that the impacted area is small, then it might reasonably be expected that a complete return to normal conditions can be achieved within a short period of time. However, if the impacted area is very large, then achieving even very low criteria for remediation of the entire area and/or maintaining existing land uses may not be practicable.

The process recommended in the guidance was based on the risk management framework discussed in Appendix 2. This process may be implemented through engaging knowledgeable technical experts and key stakeholders to provide decision makers with advice on the options, costs and implications of various courses of action. The guidance recommends that the level of effort and resources invested be scaled to the significance of the incident, scope of contamination, potential severity of economic impact, technical feasibility, and resource constraints. This process should result in the selection of the most appropriate solution that is sensitive to the range of involved stakeholders. Such a process where multiple factors are considered in developing options and deciding on action is often referred to as optimization.

Optimization is a concept that is common to many State, Federal and international risk management programs that address radionuclides and chemicals, although it is not always referred to as such. Broadly speaking, optimization is a flexible, multi-attribute decision process that seeks to consider and balance many factors. Optimization analyses are quantitative and qualitative assessments applied at each stage of site restoration decisionmaking, from evaluation of remedial options, to implementation of the chosen alternative. The evaluation of cleanup alternatives, for example, should factor all relevant variables, including; areas impacted (e.g., size, location relative to population), types of contamination (chemical, biological, and radioactive), human health, public welfare, technical feasibility, costs and available resources to implement and maintain remedial options, long-term effectiveness, timeliness, public acceptability, and economic effects (e.g., on residents, tourism, business, and industry).

The optimization process is an approach that may accommodate a variety of dose and/or risk benchmarks identified from State, Federal or other sources (e.g., national and international advisory organizations) as goals or starting points in the analysis of remediation options. These benchmarks may be useful for analysis of remediation options and levels may move up or down depending on the site-specific circumstances and balancing of other relevant factors.

(3) Implementation of Site Cleanup and Restoration

The guidance presents an implementation plan for long-term site cleanup and restoration analysis and decisionmaking that is described in detail in Appendix 3 of the guidance. The implementation plan was designed principally to describe Federal interactions with State and local governments and public stakeholder representatives. For purposes of this guidance, it is assumed that the RDD or IND incident is significant in size and scope of contamination and that the Federal Government will be the primary source of funding for site cleanup and restoration. This plan is compatible with NIMS and the NRP, and should be seen as a framework for assessing a site, evaluating technologies and remediation options, assessing costs and timeframes, and incorporating local input on current and future land uses so that site cleanup and restoration may be approached in a fair and open manner.

The plan describes a collaborative and iterative approach in which two work groups, one of stakeholders and one of technical subject matter experts, interact to develop cleanup options for the site under the supervision and oversight of a team of senior local, State and Federal management officials. The stakeholder workgroup would represent local interests, and relate local land use preferences and public health and welfare concerns. The technical work group would perform analyses, evaluate technologies and options, assess cost-effectiveness, and estimate timelines for completion. Ongoing discussions between the groups should result in a remediation solution and cleanup criteria for site restoration that are generally acceptable to involved stakeholders. The options and recommended decision would be forwarded up to decisionmakers for final approval so that cleanup can commence.

The constitution of the groups and the interactions among them may be shaped to meet specific local needs and concerns. For example, larger, more complex incidents may require a number of technical experts with specific skills and knowledge, and the location may warrant varying stakeholder group composition. The implementation plan is scalable to the situation.

The goal of the whole process is to reach an agreed upon approach to site cleanup and restoration within a reasonable timeframe that is effective, achievable, and meets the needs of local stakeholders. The final decision must be approved by local, State and Federal decision makers.

(c) Tools and Guidelines To Support Application of the PAGs

The need for protective action will be based on a determination of whether PAGs will be exceeded. To facilitate first responder activities and the use of PAGs in the field, operational guidelines are needed which can be readily used by local decision makers and by responders. Radiation doses are not directly measurable and must be calculated based on measurable quantities such as exposure rates, radiation count rates or decays per unit surface area, or radioactivity per unit volume. Operational guidelines are levels of radioactivity or concentrations of radionuclides that can be accurately measured by radiation detection and monitoring equipment and related or compared to the dose-based PAGs to quickly determine if protective actions need to be implemented. Appendix 4 of the guidance provides examples of existing operational guidelines, and those being developed.

Federal Government agencies are continuing development of the operational guidelines to support the application of the protective action guides in this document, as well as tools that will help in the development of incident-specific operational guidelines when they are needed. As the Federal agencies develop these guidelines and tools, they will be made available for review on the internet at the DOE's Web site at *http://www.ogcms.energy.gov.* This webpage will provide the status of operation guideline development and contain or provide a link to downloadable documents and tools related to the guidelines.

(d) Specific Questions for Reviewers

The Preparedness Directorate/DHS welcomes any comments and suggestions regarding the subject document. However, we would appreciate if reviewers specifically address the following issues:

• Is the presentation and format of the document useful and appropriate for its intended purpose? If not, why not and how should it be changed?

• Is the implementation process in Appendix 3 of the proposed guidance clear and appropriate for its intended purpose? Are roles and responsibilities sufficiently defined in the document?

• Does the guidance provide the appropriate balance between (a) public health and environmental protection goals; and (b) the flexibility needed for the decision makers to conduct emergency response actions and address public welfare needs, costs and benefits, technical feasibility and societal interests during response to and recovery from an incident? If not, how should the guidance be changed to provide the appropriate balance?

• Are the proposed PAGs for the early and intermediate phases implementable? Are they appropriate? If not, why not and what alternatives do you recommend?

• Is the discussion on worker protection and response worker protection helpful? Does Appendix 1 of the proposed guidance provide an adequate discussion of expectations and the use of the alternate response worker guidelines for life and property saving situations? If not, what additional information is needed to make the discussion adequate?

• Are the operational guidelines being developed and discussed in Appendix 4 of the proposed guidance useful? Are the groupings clear and appropriate? Are there additional operational guides that should be developed?

• Is the optimization process proposed for late phase site restoration and cleanup reasonable and sufficiently flexible to address RDD and IND situations? If not, what changes need to be made to improve the process?

• Is a flexible process without pre-established limits an appropriate method for site recovery? Would a flexible process with goals, ranges or limits be more appropriate?

• What other guidance or tools are needed to assist in the implementation of the recommendations?

(e) References

''National Response Plan'' (NRP), January 2005.

''National Incident Management Plan'' (NIMS), March 1, 2004

''Manual of Protective Action Guides and Protective Actions for Nuclear Incidents'' (EPA PAG) EPA 400–R–92–001, May 1992.

Complete Text of the Guidance

Application of Protective Action Guides for Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents

Prepared by the Department of Homeland Security in coordination with the Department of Commerce, Department of Defense, Department of Energy, Department of Labor, Department of Health and Human Services, Environmental Protection Agency, Nuclear Regulatory Commission.

Table of Contents

Preface

Homeland Security Presidential Directive 5 (HSPD–5), Management of Domestic Incidents, states, ''to prevent, prepare for, respond to and recover from terrorist attacks, major disasters, and other emergencies, the United States Government shall establish a single, comprehensive approach to domestic incident management.'' It also assigns the Secretary of the Department of Homeland Security (DHS) the role of Principal Federal Official for domestic incident management.

DHS coordinated the development of this document in order to address the critical issues of protective actions and protective action guides (PAGs) to mitigate the effects caused by terrorist use of a Radiological Dispersal Device (RDD) or Improvised Nuclear Device (IND). This document was developed to provide guidance for site cleanup and recovery following an RDD or IND incident and affirms the applicability of existing PAGs for radiological emergencies. The intended audience of this document is Federal radiological emergency response and consequence management officials. In addition, State and local governments may find this document useful in response and consequence management planning. These guides are not intended for use at site cleanups occurring under other statutory authorities such as the Environmental Protection Agency (EPA) Superfund program, the Nuclear Regulatory Commission's decommissioning program, or other Federal and State cleanup programs. In addition, the scope of this document does not include situations involving United States nuclear weapons accidents.

Underlying the development and implementation of the recommendations in the report is a risk management framework for making decisions to provide for public safety and welfare. Appendix 2 provides a summary of the framework based upon the report, ''Framework for Environmental Health Risk Management,'' published in 1997 by the Commission on Risk Assessment and Risk Management. The stages in this framework—(1) Defining the problem and putting it into context, (2) analyzing the risks, (3) examining the options, (4) making decisions about which options to implement, (5) taking action, and (6) conducting an evaluation of the results—are applicable to each of the stages of response to an RDD or IND incident. However, the recommended guidelines for early and intermediate phase actions already incorporate consideration of the first four stages, so that action can be taken immediately to respond to the incident. All of the stages of the risk management framework will be applicable in the process of establishing the criteria for the late phase of the response, as described later in this report, because each situation will have its own unique problems, risks, options, and decisions.

The Consequence Management, Site Restoration/Cleanup and Decontamination (CMS) Subgroup of the DHS RDD/IND Working Group accomplished this effort. The CMS Subgroup consists of subject matter experts in radiological/nuclear emergency preparedness and response. In addition to DHS, the following departments and agencies contributed to this effort: Department of Commerce (DOC), Department of Defense (DoD), Department of Energy (DOE), Department of Labor (DOL), Department of Health and Human Services (HHS), Environmental Protection Agency (EPA), and Nuclear Regulatory Commission (NRC).

(a) Introduction

For the early and intermediate phases of response, this document presents levels of radiation exposure at which the Federal Government recommends that actions be considered to avoid or reduce adverse public health consequences from an RDD or IND incident. These PAGs incorporate guidance and regulations published by the EPA, Food and Drug Administration (FDA), and the Occupational Safety and Health Administration (OSHA). For the late phase of the response, this document presents a process to establish appropriate levels based on site-specific circumstances. This document addresses the key questions at each stage of an incident (early, intermediate, and late) and constitutes advice by DHS to Federal, State, and local decision makers.

The objectives of the guides are to aid decision makers in protecting the public, first responders, and other workers from the effects of radiation, while balancing the adverse social and economic impacts following an RDD or IND incident. Restoring the normal operation of critical infrastructure, services, industries, business, and public activities as soon as possible can minimize adverse social and economic impacts.

These guides for RDD and IND incidents are not absolute standards. The guides are not intended to define "safe" or "unsafe" levels of exposure or contamination, but rather they represent the approximate levels at which the associated protective actions are justified. The guides give State and local decision makers the flexibility to be more or less restrictive as deemed appropriate based on the unique characteristics of the incident and local considerations.

The PAGs can be used to select actions to prepare for, respond to, and recover from the adverse effects that may exist during any phase of a terrorist incident—the early (emergency) phase, the intermediate phase, or the late phase. There may be an urgent need to evacuate people; there may also be an urgent need to restore the services of critical infrastructure (e.g., roads, rail lines, airports, electric power, water, sewage, medical facilities, and businesses) in the hours and days following the incident—thus, some response decisions must be made quickly. If the decisions on the recovery of critical infrastructure are not made quickly, the disruption and harm caused by the incident could be inadvertently and unnecessarily increased. Failure to restore important services rapidly could result in additional adverse public health and welfare impacts that could be more significant than the direct radiological impacts.

(b) Characteristics of RDD and IND Incidents

A radiological incident is defined as an event or series of events, deliberate or accidental, leading to the release, or potential release, into the environment of radioactive material in sufficient quantity to warrant consideration of protective actions. Use of an RDD or IND is an act of terror that produces a radiological incident.

(1) Radiological Dispersal Device

An RDD poses a threat to public health and safety through the spread of radioactive materials by some means of dispersion. The mode of dispersal typically conceived as an RDD is an explosive device coupled with radioactive material. The explosion adds an immediate threat to human life and property. Other means of dispersal, both passive and active, may be employed.

There is a wide range of possible consequences that may result from an RDD, depending on the type and size of the device, and how dispersal is achieved. The consequences of an RDD may range from a small, localized area, such as a single building or city block, to large areas, conceivably many square miles. However, most experts agree that the likelihood of impacting a large area is low. In most plausible scenarios, the radioactive material would not cause acutely harmful radiation doses, and the primary public health concern from those materials would be chronic risk of cancer to exposed individuals. Hazards from fire, smoke, shock (physical, electrical or thermal), shrapnel (from an explosion), industrial chemicals, and other chemical or biological agents may also be present.

(2) Improvised Nuclear Device

An IND is a nuclear weapon originating from an adversary State or fabricated by a terrorist group from illicit special nuclear material that produces a nuclear explosion. The nuclear yield achieved by an IND produces extreme heat, powerful shockwaves, and prompt radiation that would be acutely lethal for a significant distance. It also produces radioactive fallout, which may spread far downwind and deposit over very large areas. If nuclear yield is not achieved, the result would likely resemble an RDD in which fissile weapons material was utilized.

(3) Differences Between Acts of Terror and Accidents

Most radiological emergency planning has been conducted to respond to potential nuclear power plant accidents. RDD and IND incidents may differ from a nuclear power plant accident in several ways, and response planning should take these differences into account. First, the severity of an IND incident would be dramatically greater than any nuclear power plant accident (although an RDD would likely be on the same order of magnitude as a nuclear power plant accident). An IND would have vastly greater radiation levels and would create a large radius of severe damage from blast and heat, which could not occur in a nuclear power plant accident.

Second, the release from an RDD or IND may start without any advance warning and would likely have a relatively short release duration. With a major nuclear power plant accident there is likely to be several hours of warning before the release starts, and the release is likely to be drawn out over many hours. This difference means that most early, and some intermediate phase, protective action decisions must be made more quickly (and with less information) in an RDD or IND incident if they are to be effective.

Third, an RDD or IND incident is more likely to occur in a major city with a large population. Because of the rural setting in which many nuclear facilities are located, the number of people affected by a nuclear power plant incident may be less and the amount of critical infrastructure impacted is also likely to be smaller.

Fourth, large nuclear facilities have detailed emergency plans that are periodically exercised, including specified protective action sectors, evacuation routes, and methods to quickly warn the public on the protective actions to take. This would not be the case in an RDD or IND incident. This level of radiological emergency planning typically does not exist for most cities and towns without nuclear facilities.

Fifth, the type of radioactive material involved could and probably will be different from what is potentially released for a nuclear power plant incident.

(c) Phases of Response

Typically, 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—that are generally accepted as being common to all nuclear incidents. Although these phases cannot be represented by precise time periods and may overlap, they provide a useful framework for the considerations involved in emergency response planning.

(1) Early Phase

The early phase (or emergency phase) is the period at the beginning of the incident when immediate decisions for effective use of protective actions are required and actual field measurement data is generally not available. Exposure to the radioactive plume, short-term exposure to deposited materials, and inhalation of radioactive material are generally included when considering protective actions for the early phase. The response during the early phase includes initial emergency response actions to protect public health and welfare in the short term. Priority should be given to lifesaving and first-aid actions.

In general, early phase protective actions should be taken very quickly, and the protective action decisions can be modified later as more information becomes available. If an explosive RDD is deployed without warning, there may be no time to take protective actions to reduce plume exposure. In the event of a covert dispersal, discovery or detection may not occur for days or weeks, allowing contamination to be dispersed broadly by foot, vehicular traffic, wind, rain, or other forces. If an IND explodes, there would only be time to make early phase, protective action recommendations to protect against exposure from fallout in areas many miles downwind from the explosion.

(2) Intermediate Phase

The intermediate phase of the response may follow the early phase response within as little as a few hours. The intermediate phase of the response is usually assumed to begin after the source and releases have been brought under control and protective action decisions can be made based on measurements of exposure and radioactive materials that have been deposited as a result of the incident. Activities in this phase typically overlap with early and late phase activities, and may continue for weeks to many months, until protective actions are terminated.

During the intermediate phase, decisions must be made on the initial actions needed to recover from the incident, reopen critical infrastructures, and return to a general state of normal activity. In general, intermediate phase decisions should consider late phase response objectives. However, some intermediate phase decisions will need to be made quickly (i.e., within hours) and should not be delayed by discussions on what the more desirable permanent decisions will be. All of these decisions must take into account the health, welfare, economic, and other factors that must be balanced by local officials. For example, it can be expected that hospitals and their access roads will need to remain open or be reopened quickly. These interim decisions can often be made with the acknowledgement that further work may be needed as time progresses.

(3) Late Phase

The late phase is the period when recovery and cleanup actions designed to reduce radiation levels in the environment to acceptable levels are commenced, and it ends when all the recovery actions have been completed. With the additional time and increased understanding of the situation, there will be opportunities to involve key stakeholders in providing sound, cost-effective recommendations. Generally, early (or emergency) phase decisions will be made directly by elected public officials, or their designees, with limited stakeholder involvement due to the need to act within a short timeframe. Long-term decisions should be made with stakeholder involvement, and can also include incident-specific technical working groups to provide expert advice to decision makers on impacts, costs, and alternatives.

The relationship between typical protective actions and the phases of the incident response are outlined in Figure 1. Plainly, there is overlap between the phases, and this framework should be used to support a timely decisionmaking process, irrespective of the perception of which incident phase might be applicable.

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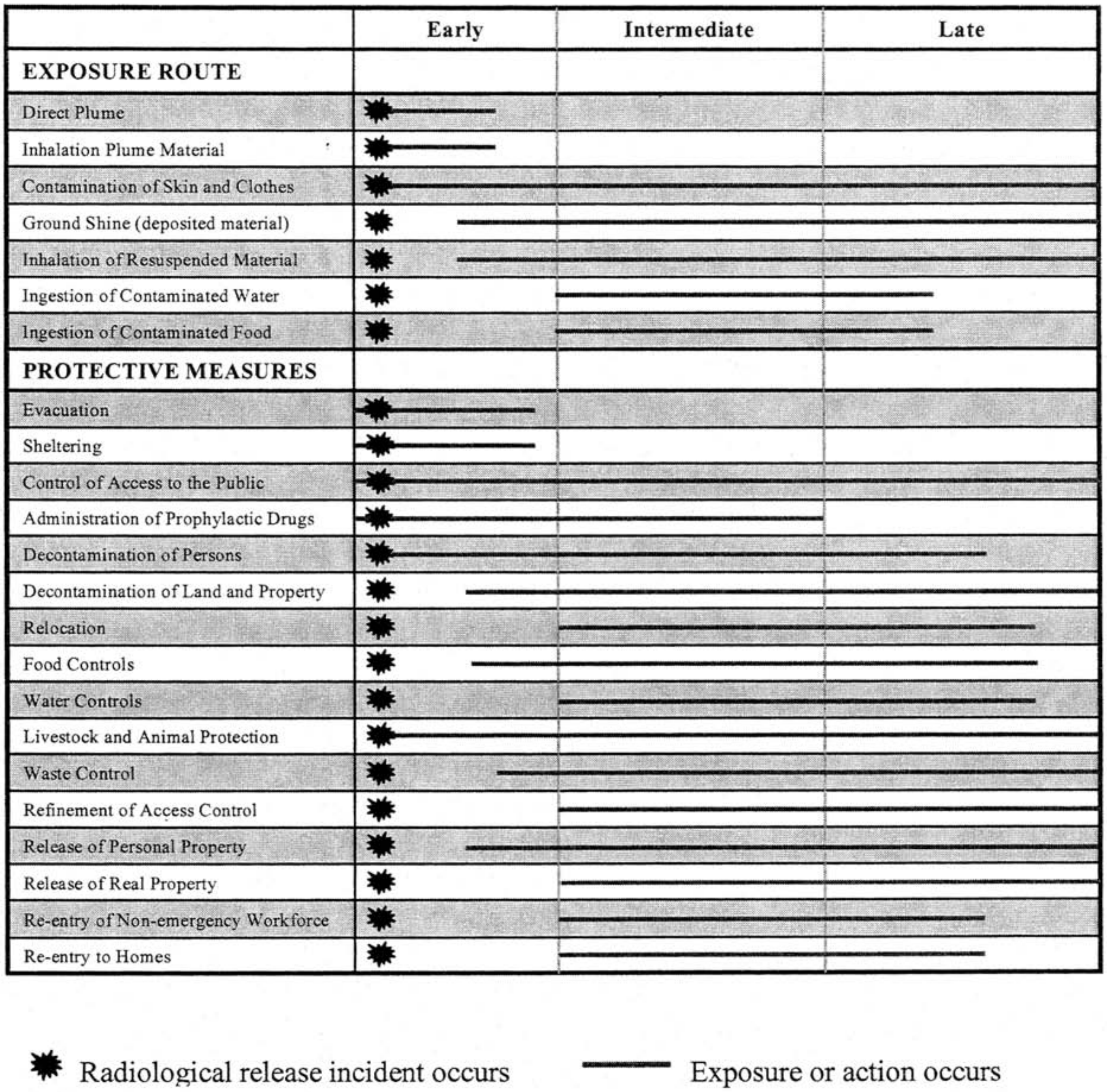
Figure 1. Relationship between Exposure Routes, Protective Measures, & Timeframes for Effects[1]



[1] For some activities, the figure indicates that protective actions may be taken before a release occurs. This would be the case if authorities have forewarning about a potential RDD/IND incident.

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(d) Protective Actions and Protective Action Guides for RDD and IND Incidents

(1) Protective Actions

Protective actions are activities that may be conducted in response to an RDD or IND incident in order to reduce or eliminate exposure to members of the public to radiation or other hazards. These actions are generic and are applicable to RDDs and INDs. The principal protective action decisions for consideration in the early and intermediate phases of an emergency are whether to shelter-in-place, evacuate, or relocate affected or potentially affected populations. Secondary actions include administration of prophylactic drugs, decontamination, use of access restrictions, and use of restrictions on food and water. In some situations, only one protective action needs to be implemented, while in others, numerous protective actions should be implemented.

(2) Protective Action Guides

PAGs are the projected dose to a reference individual, from an accidental or deliberate release of radioactive material at which a specific protective action to reduce or avoid that dose is recommended. Thus, protective actions are designed to be taken before the anticipated dose is realized. The ''Manual of Protective Action Guides and Protective Actions for Nuclear Incidents'' [1] published by the EPA (also known as the EPA PAG Manual) provides a significant part of the basis

[1] ''Manual of Protective Action Guides and Protective Actions for Nuclear Incidents,'' U.S. Environmental Protection Agency, May 1992, EPA–400–R–92–001.

of this document and may be referred to for additional details.

The existing PAGs meet the following principle criteria and goals: (1) Prevent acute effects, (2) reduce risk of chronic effects, and (3) require optimization to balance protection with other important factors and ensure that actions taken cause more benefit than harm.

In this document, PAGs are generic criteria based on balancing public health and welfare with the risk of alternatives applied in each of the phases of an RDD or IND incident. The PAGs are specific for radiation and radioactive materials, and must be considered in the context of other chemical or biological hazards that may also be present. Though the PAGs are values of dose avoided, published dose conversion factors and derived response levels may be utilized in estimating doses, and for choosing and implementing protective actions. Other quantitative measures and derived concentration values may be useful in emergency situations; for example, for the release of goods and property from contaminated zones, and to control access in and out of contaminated areas.

Because of the short time frames required for emergency response decisions, it is likely there will not be opportunities for local decision makers to consult with a variety of stakeholders before taking actions. Therefore, the early and intermediate phase EPA PAGs have been based on the significant body of work done in the general context of radiological emergency response planning, and represent the results of public comment, drills, exercises, and a consensus at the Federal level for appropriate emergency action.

In order to use the PAGs to make decisions about appropriate protective actions, decision makers will need information on suspected radionuclides; projected plume movement and depositions; and/or actual measurement data or, during the period initially following the release, expert advice in the absence of good information. Sources of such information include: on-scene responders as well as monitoring, assessment, and modeling centers.

(3) Protective Action Guides for RDD and IND Incidents

The PAGs for RDD and IND incidents are generally based on the following sources: the PAGs developed by EPA in coordination with other Federal agencies through the Protective Action Guide Subcommittee of the Federal Radiological Preparedness Coordinating Committee; guidance developed by the FDA for food and food products and the distribution of potassium iodide; and OSHA regulations.

In order to use this guide, there may be a need to compare the PAG to the results of a risk assessment or dose projection. It should be emphasized that, in general, when making radiation dose projections, realistic assumptions should be used so the final results are representative of actual conditions.

Table 1 provides a summary of the key actions and suggested PAGs for an RDD or IND incident.

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. For further discussion see Appendix 1.
[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*).

(i) Early Phase PAGs

For the early phase, the existing PAGs for evacuation, sheltering, relocation, and protection of emergency workers are appropriate for RDD and IND incidents. FDA guidance on the administration of stable iodine is also considered appropriate (only useful for an IND or NPP incident involving radioiodine release). The administration of other prophylactic drugs should be evaluated on a case-by-case basis and depend on the nature of the event and radioisotopes involved. It can be expected that an initial zone will be established and controlled around the site of the incident, as is the case for other crime scenes and hazards. These guides allow for the refinement of that area if the presence of radiation or radioactive material warrants such action.

The response during the early phase includes initial emergency response actions to protect public health and welfare in the short term. Priority should be given to lifesaving and first-aid actions. Incident commanders should define and enforce an allowable emergency dose limit in accordance with the immediate risk situation. Following IND detonation, the highest priority missions will include suppression of ignited fires to prevent further loss of life. High radiation doses to emergency personnel in IND situations, substantially exceeding the nominal occupational level of 5 rem may be unavoidable. While every effort to employ as low as reasonably achievable (ALARA) principles after an

IND event will be made, medically significant exposures may also be unavoidable (see Appendix 1, Section E). Medical evaluation of emergency response personnel after such exposure is recommended.

(ii) Intermediate Phase PAGs

The decisions in the intermediate phase will focus on the return of key infrastructure and services, and the rapid restoration of normal activities. This will include decisions on allowing use of roads, ports, waterways, transportation systems (including subways, trains, and airports), hospitals, businesses, and residences. It will also include responses to questions about acceptable use and release of real and personal property such as cars, clothes, or equipment that may have been impacted by the RDD or IND incident. Many of the activities will be concerned with materials and areas that were not affected but for which members of the public may have a concern. Thus, the PAGs serve to guide decisions on returning to impacted areas, leaving impacted areas, and providing assurance that an area or material was not impacted. See Appendix 1 for a discussion of occupational safety and health standards.

For the intermediate phase, relocation of the population is a protective action that can be used to reduce dose. Relocation is the removal or continued exclusion of people (households) from contaminated areas in order to avoid chronic radiation exposure, and it is meant to protect the general public. For the intermediate phase, the existing relocation PAGs of 2 rems in the first year and 500 mrems in any year after the first are considered appropriate for RDD and IND incidents. However, for some IND incidents, the area impacted and the number of people that might be subject to relocation could potentially be very large and could exceed the resources and infrastructure available. For example, in making the relocation decision, the availability of adequate accommodations for relocated people should be considered. Decision makers may need to consider limiting action to those most severely affected, and phasing relocation implementation based on the resources available.

The relocation PAG applies principally to personal residences but may impact other facilities as well. For example, it could impact work locations, hospitals, and park lands as well as the use of highways and other transportation facilities. For each type of facility, the occupancy time of individuals should be taken into account to determine the criteria for using a facility or area. It might be necessary to avoid continuous use of homes in an area because radiation levels are too high. However, a factory or office building in the same area could be used because occupancy times are shorter. Similarly, a highway could be used at higher contamination levels because the exposure time of highway users would be considerably less than the time spent at home.

The intermediate phase PAGs for the interdiction of food and water are set at 500 mrem/yr each for RDD and IND incidents. These values are consistent with those now used or being considered as PAGs for other types of nuclear incidents.

The use of simple dose reduction techniques is recommended for personal property and all potentially contaminated areas that continue to be occupied. This use is also consistent with the PAGs developed for other types of nuclear incidents. Examples of simple dose reduction techniques would be washing of all transportation vehicles (e.g., automobiles, trains, ships, and airplanes), personal clothing before reuse, eating utensils, food preparation surfaces before next use, and other personal property, as practicable and appropriate.

(iii) Late Phase PAGs

The late phase involves the final cleanup of areas and property with radioactive material present. Unlike the early and intermediate phases of an RDD or IND incident, decision makers will have more time and information during the late phase to allow for better data collection, stakeholder involvement, and options analysis. In this respect, the late phase is no longer a response to an ''emergency situation,'' and is better viewed in terms of the objectives of site restoration and cleanup.

Because of the extremely broad range of potential impacts that may occur from RDDs and INDs (e.g., ranging from light contamination of one building to widespread destruction of a major metropolitan area), a pre-established numeric guideline is not recommended as best serving the needs of decision makers in the late phase. Rather, a process should be used to determine the societal objectives for expected land uses and the options and approaches available, in order to select the most acceptable criteria. For example, if the incident is an RDD of limited size, such that the impacted area is small, then it might reasonably be expected that a complete return to normal conditions can be achieved within a short period of time. However, if the impacted area is large, then achieving even low cleanup levels for remediation of the entire area and/or maintaining existing land uses may not be practicable.

The Risk Management Framework described in Appendix 2 provides such a process and helps assure the protection of public health and welfare. Decisions should take health, safety, technical, economic, and public policy factors into account. Appendix 3 utilizes the framework to manage Federal RDD and IND site cleanup and restoration.

Optimization (broadly defined) is a concept that is common to many State, Federal, and international risk management programs that address radionuclides and chemicals, although it is not always identified as such. Optimization is a flexible approach where a variety of dose and/or risk benchmarks may be identified from State, Federal, or other sources (e.g., national and international advisory organizations). These benchmarks may be useful for analysis of remediation options and levels may move up or down depending on the site-specific circumstances and balancing of other relevant factors.

Optimization activities are quantitative and qualitative assessments applied at each stage of site restoration decisionmaking, from evaluation of remedial options, to implementation of the chosen alternative. The evaluation of options for the late phase of recovery after an RDD or IND incident should balance all of the relevant factors, including:

- Areas impacted (e.g., size, location relative to population)
- Types of contamination (chemical, biological, and radiological)
- Other hazards present
- Human health
- Public welfare
- Ecological risks
- Actions already taken during the early and intermediate phases
- Projected land use
- Preservation or destruction of places of historical, national, or regional significance
- Technical feasibility
- Wastes generated and disposal options and costs
- Costs and available resources to implement and maintain remedial options
- Potential adverse impacts (e.g., to human health, the environment, and the economy) of remedial options
- Long-term effectiveness
- Timeliness
- Public acceptability, including local cultural sensitivities
- Economic effects (e.g., tourism, business, and industry)

The optimization process provides the best opportunity for decision makers to gain public confidence through the involvement of stakeholders. This process may begin during, and proceed independently of, intermediate phase protective actions.

The Recovery Management Team (see Appendix 3) should develop a schedule with milestones for conducting the optimization process as soon as practicable following the incident. While the goal of the team should be to complete the initial optimization process within six months of the incident, the schedule must take into consideration incident-specific factors that would affect successful implementation. It should be recognized that this schedule may need to represent a phased approach to cleanup and is subject to change as the cleanup progresses.

(e) Federal Implementation

This guidance describes the approach the Federal Government will take in making protective action recommendations and provides guidance for long-term site restoration following radiological and nuclear terror incidents. Appendix 3 provides additional details on the process that will be used to implement this guidance, focusing on describing the role of the Federal Government and how it will integrate its activities with State and local governments and the public. In particular, Appendix 3 addresses the scenario in which the Federal Government is expected to be the primary funding entity for cleanup and restoration activities. It should be recognized that for some radiological terror incidents, States might take the primary leadership role in cleanup and contribute significant resources toward restoration of the site. The appendix does not address such a scenario.

(f) Operational Guidelines

Implementation of the PAGs is supported by operational guidelines that can be readily used by decision makers and responders in the field. Operational guidelines are levels of radiation or concentrations of radionuclides that can be accurately measured by radiation detection and monitoring equipment, and then related or compared to the PAGs to quickly determine if protective actions need to be implemented. Federal agencies are continuing development of operational guidelines to support the application of protective action recommendations in this document.

Some values already exist that could potentially serve as operational guidelines for RDD and IND recovery operations. However, there are many more operational guidelines that need to be developed or applied in order to provide decision makers and responders with the capability to quickly determine that the suite of PAGs for RDDs and INDs are being met. Appendix 4 presents a summary of the potential types of operational guidelines likely needed for RDD and IND response operations.

Some examples of existing values that could be used as operational guidelines for RDD and IND response operations include:

(i) Derived Response Levels

The PAG Manual published by the EPA contains guidance and Derived Response Levels (DRLs) for use with the early phase PAGs. These values serve as operational guidelines to readily determine if protective actions associated with the PAGs need to be implemented. If concentrations of radionuclides obtained through field measurements are less than the DRLs, the PAGs will not be exceeded and, thus, a protective action may not need to be taken.

(ii) Derived Intervention Levels for Food

The FDA has developed Derived Intervention Levels (DILs) for implementation of the PAGs for food. These DILs establish levels of contamination than can exist on crops and in food products and still maintain exposure levels below the food PAGs, and could therefore be used as operational guidelines for RDD and IND events.

(iii) Radiation Levels for Control of Access to Radiation Areas

Another example of an operational guideline is a 2mR/hr radiation level that can be established for control of access to radiation areas during the response. The rationale for this operational guideline is that first responders need an easily measurable dose rate for restricting access to more highly contaminated areas. The operational guideline would not limit access by emergency workers performing duties such as rescuing victims, but it would allow the establishment of a hot zone boundary for an area to which unnecessary access should be prevented. While emergency workers' total doses would be monitored and decisions made accordingly, the 2mR/hr operational guideline is also useful to control access for non-emergency workers and members of the public who are subject to lower dose constraints. For example, non-emergency workers may need limited access to infrastructure and facilities within the contaminated zone, and residents may need access to homes for limited time periods.

Additional operational guidelines for use with PAGs in each phase of recovery will need to be developed for a wide range of personal and real property. Appropriations language from House Report 108–076, Making Emergency Wartime Supplemental Appropriations for the Fiscal Year 2003, and for Other Purposes, directs the DOE ''to develop standards for the cleanup of contamination resulting from a potential RDD event.'' Accordingly, DOE is leading an effort to develop needed standards, in the form of operational guidelines, for a wide range of personal (e.g., vehicles, equipment, personal items, debris) and real (e.g., buildings, roads, bridges, residential and commercial areas, monuments) property types likely to be impacted by an RDD or IND incident. The work is being coordinated with other Federal agencies, and an inter-agency work group has been established to foster collaboration and acceptance of the operational guidelines upon completion. The goal is to arrive at the needed set of operational guidelines that can then be incorporated into appropriate Federal response documents and used by decision makers and responders.

Appendix 1—Radiation Protection for the Responder and Planning for Implementation of the Protective Action Guides

The purpose of this appendix is to discuss the context for the PAGs and to provide guidance for their application, particularly for the protection of emergency responders. Response organizations need to develop plans and protocols that address radiation protection during an RDD or IND incident and that ensure appropriate training for responders and decision makers. Although this appendix discusses some of the important issues and information that must be communicated, it is not intended to provide a comprehensive discussion of the topic. Other detailed reports on radiation risk, risk management decisionmaking, training, and public communication should be consulted in the development of plans, protocols, and training materials. Organizations that have published such reports include the National Council on Radiation Protection and Measurements, the International Commission on Radiological Protection, the International Atomic Energy Agency, the American Nuclear Society, and the Health Physics Society.

(a) The Protective Action Guides and Operations Guidelines Into Perspective

The recommendations in this report were developed to assist decision makers and responders in planning for radiological emergencies, in particular, those related to terrorist incidents using RDDs and INDs. Decisions regarding protective actions for workers and the public during such incidents are risk management decisions, and the recommendations in this report are provided in that context. In all cases, all practical and reasonable means should be used to reduce or eliminate exposures that are not necessary to protect public health and welfare.

(b) The Difference Between PAGs for Emergencies and Other Operations

Worker and public protection guidance and standards for normal operations are typically developed through risk management approaches and are documented in Federal and State regulations (e.g., 10 CFR part 20; 10 CFR part 835; 29 CFR 1910.1096). However, many factors or decision criteria differ during a radiological emergency versus normal operations. Some of the key decision criteria differences between emergency PAGs and typical occupational and public protection standards are shown in Table 1A.

Although there are times when implementation of standards or guidelines can cause or enhance other risks, these secondary risks normally can be controlled. Standards for normal operations provide a margin of safety that is greater than that in guidelines for emergency response because that margin can be provided in a manner that ensures no significant increase in public health risk or detriment to the public welfare. Currently, the development of standards and guidelines for normal operations is done in a manner that provides reasonable assurance that implementation of the standards will not cause more risk than it averts.

TABLE 1A.—DIFFERENT 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.	Key elements to radiation protection are to contain radioactivity and confine access to it.
Actions must be taken as soon as possible to minimize exposures even when information on the risks is incomplete.	There is adequate time to fully characterize situations and determine risks and mitigating measures.
Lack of action—due to unclear, overly complicated, or reactive guidelines—have a high possibility of causing unintended consequences.	Inaction or delays may increase costs but rarely results in consequences that cannot be mitigated.
During emergencies, the undesired consequences can be significant, uncontrollable, and unpredictable.	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.

During the early phase of an emergency response, however, tradeoffs are not only cost-related but may directly impact public health and welfare. It is difficult to ensure that implementation of recommendations does not result in more harm than good.

Guidelines that prevent or restrict a responder's ability to provide medical assistance based on an uncertain cancer risk may result in loss of life of incident victims. If the PAGs delay firefighters' ability to control fires, resulting property damage can seriously affect overall public welfare or even cause an increase to health risks associated with the incident. The decision maker's use of public protection PAGs also must consider secondary risks. Evacuation of the public could result in loss of life and injury as a result of the evacuation process that exceeds the increased public risk should the evacuations not occur. These and other considerations require that the PAGs and associated operational guides be developed so that decisions can appropriately consider risks, detriments, and costs associated with an RDD or IND incident, as well as those associated with implementation of the protective action to, on balance, benefit the public welfare.

Emergency response actions should be carried out following a careful consideration of both the benefits to be achieved by the ''rescue'' or response action (e.g., the significance of the outcome to individuals, populations, property, and the environment at risk considering their likely impaired status following an incident), and the potential for additional health impacts to those conducting the emergency response operation. That is, in making an emergency response decision, the potential for the success of the response/rescue operation and the significance of its benefits to the community should be balanced against the potential for rescuers to be exposed to new and significant health and safety risks.

Actions should be based on balancing risks and benefits. Nothing in this guidance should be construed to imply that appropriate steps should not be taken to minimize dose to workers and the public, consistent with the ALARA principle applied to radiation protection activities in the United States. However, actions similarly should not restrict lifesaving or property-saving actions necessary for protection of public and public welfare.

(c) Controlling Occupational Exposures and Doses to First Responders

This section provides guidance for first responders concerning occupational doses of radiation, during an emergency response. In many emergency situations, actual exposure of workers, including first responders, may be controlled to low doses when proper precautions are taken. However, it is important to recognize that conditions that exist during an RDD or IND incident may limit the effectiveness of these precautions for some first responders. One of the major radiation protection controls used for normal operations is containment of the radioactive material. Another is to keep people away from the sources. However, during an RDD or IND incident, use of these controls may not be possible. As a result, radiation exposures, particularly to first responders, may be unavoidable and may have the potential to exceed limits used for normal operations. Nonetheless, every reasonable effort should be made to control doses to levels that are as low as practicable.

(d) Maintaining the ''As Low As Reasonably Achievable'' Principle

To minimize the risks from exposure to ionizing radiation, employers of first responders should prepare emergency response plans and protocols in advance to keep worker exposures as low as reasonably achievable. These protocols should include, to the extent they can be employed, the following health physics and industrial hygiene practices:

- Minimizing the time spent in the contaminated area (e.g., rotation of workers);
- Maintaining the maximum distance from sources of radiation;
- Shielding of the radiation source from the receptor;
- Tailoring of hazard controls to the work performed;
- Properly selecting and using respirators and other personal protective equipment (PPE) may be useful to prevent exposure to internally deposited radioactive materials (e.g., alpha and beta emitters); and
- Using prophylactic medications, where medically appropriate, that either block the uptake or reduce the retention time of radioactive material in the body.

The incident commander should be prepared to identify, to the extent possible, all hazardous conditions or substances and to perform appropriate site hazard analysis. Emergency management 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 and ways to control them, and medical monitoring.

(e) Understanding Dose and Risk Relationships

Responders and incident commanders should understand the risks associated with radiation. PAG recommendations in this document provide a guideline level of 5 rems for worker protection and alternative response worker guidelines [2] (see Table 1B) for certain activities where exposures below 5 rems cannot be maintained.

for certain activities where exposures below 5 rems cannot be maintained.

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.

* For potential does >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).

** 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.

It is likely during most RDD incidents that the radiation control measures discussed above will be able to maintain doses below the 5 rem occupational exposure PAG in almost all situations, including fire fighting; general emergency response; and transport to, and medical treatment of, contaminated victims at hospitals. However, in those situations in which victims are injured or trapped in high radiation areas or only be reached via high radiation areas, exposure control options may be unavailable or insufficient, and doses above 5 rem may be unavoidable.

Response decisions allowing actions that could result in doses in excess of 5 rems can only be made at the time of the incident, under consideration of the actual situation. In such situations, incident commanders and other responders need to understand the risk posed by such exposures in order to make informed decisions. The Response Worker Guidelines for life and property saving activities in Table 1B are provided to assist such decisions.

The catastrophic event represented by an IND can cause other immediate widespread physical hazards such as firestorm and building instability; emergency intervention will be integral to preventing further loss of life and additional destruction. This intervention may result in increased exposure to emergency response personnel. Exceeding the Response Worker Guidelines in Table 1B in such an event may be unavoidable.

Persons undertaking an emergency mission covered under the alternative occupational PAG levels should do so with full awareness of the sub-chronic and chronic risks involved, including knowledge of numerical estimates of the risk of delayed effects, and they should be given reasonable assurance that normal controls cannot be utilized to reduce doses below the general 5 rem occupational exposure PAG. The 25 rem lifesaving Response Worker Guidelines provide assurance that exposures will not result in detrimental deterministic health effects (i.e., prompt or acute effects). If, due to extensive public health and welfare benefits (i.e., optimization considerations), response actions are deemed necessary that cause exposures that may exceed the 25 rem alternative Response Worker Guideline, such response actions should only be taken with an understanding of the potential acute effects of radiation to the exposed responder (Table 1C) and based on the determination that the benefits of the action clearly exceed the associated risks.

[2] Alternative response worker guidelines are applicable only during emergency situations. They typically apply during the early phase of the emergency but may also be applicable in later phases under emergency situations such as a fire or a structure failure that puts life and property at risk. In addition to the obvious life saving situation, other examples of where the guidelines may be applicable include situations where it is necessary to access controls to prevent or mitigate explosions, fires or other catastrophic events. The alternative response worker guidelines are not applicable to normal restoration or cleanup actions.

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.

The following paragraph is presented to help illustrate how certain toxicity information may be relevant in response decisionmaking during emergencies. It is important to note that the approach used below to translate dose to risk in this discussion is a simplistic approach useful in developing rough estimates of risks for comparative purposes given limited data. However, other more realistic approaches are often used in assessing risks for risk management decisions (other than for emergencies) when more complete information about the contaminants and the potential for human exposure is available. These other approaches rely on radionuclide-specific risk factors (e.g., Federal Guidance Report #13 [3] and EPA Health Effects Assessment Summary Tables).

The estimated risk of fatal cancer [4] for workers exposed to 10 rem is 0.6 percent (six cases per thousand exposed). Workers exposed to 25 rem have an estimated risk of fatal cancer of 1.5 percent (15 cases per thousand exposed). Because of the latency period of cancer, younger workers face a larger risk of fatal cancer than older workers (for example, when exposed to 25 rem, twenty to 30 year-olds have a 9.1 per thousand risk of premature death, while 40 to 50 year-olds have a 5.3 per thousand risk of premature death).[5]

(f) Incident Commanders and Responders Need to Proper Training in Advance

When the 5-rem guideline is exceeded, workers should be provided the following:

- Medical follow-up
- Training with respect to the risk associated with exposure to ionizing radiation
- A thorough explanation of the latent risks associated with receiving exposures greater than 5 rems.

In addition, these PAGs represent dose constraint levels (e.g., when this level of dose is accumulated, the responder should not take part in the later stages of the response that may significantly increase their dose). It is assumed that doses acquired in response to a radiological incident would be ''once in a lifetime'' doses, and that future radiological exposures would be substantially less.

Incident commanders and responders need a thorough understanding of the worker exposure guidelines for radiological emergency response, including the associated risks and specific worker protection procedures. The reader is referred to the EPA PAG Manual and Protective Actions for Nuclear Incidents (May 1992), and the Federal Radiological Monitoring and Assessment Center (FRMAC) Radiological Emergency Response Health and Safety Manual (May 2001).[6]

(g) Occupational Standards

Under the provisions of the Occupational Safety and Health Act, and equivalent statutes in the 26 States that operate OSHA-approved State plans, each employer is responsible for the health and safety of its employees. In accomplishing this, employers are expected to comply with the requirements of the Federal OSHA or State plan occupational safety and health standards applicable in the jurisdiction in which they are working. States with State plans enforce standards, under State law, which are ''at least as effective as'' Federal OSHA standards, and therefore may have more stringent or supplemental requirements. There are currently 22 States and jurisdictions operating complete State plans (covering both the private sector and State and local government employees, including State and local emergency responders). Four of these State plans cover public (State and local government) employees only. Federal OSHA administers the safety and health program for the private sector in the remaining States and territories, and also retains authority with regard to safety and health conditions for Federal employees throughout the nation, but it does not have enforcement jurisdiction over State and local government employees.

The primary occupational safety and health standard for emergency response is the Hazardous Waste Operations and Emergency Response (HAZWOPER) standard (29 CFR 1910.120). The EPA has a Worker Protection (40 CFR 311) standard that applies the HAZWOPER standard to State and local workers in States that do not have their own occupational safety and health program.

[3] ''Risks from Low-Level Environmental Exposure to Radionuclides,'' Federal Guidance Report #13, U.S. Environmental Protection Agency, January 1998, EPA 402–R–97–014.

[4] Risk per dose of a fatal concern is assumed to be about 6×10^{-4} per rem. Cancer incidence is assumed to be about 7×10^{-4} per rem. (See Federal Guidance Report #13.

[5] Federal Guidance Report #13.

[6] Available at *http://www.nv.doe.gov/programs/frmac/DOCUMENTS.htm.*

For emergency response, the OSHA standard (among many other requirements) states that ''the individual in charge of the incident command system shall identify to the extent possible, all hazardous substances or conditions present and shall address as appropriate site analysis, use of engineering controls, maximum exposure limits, hazardous substance handling procedures, and use of any new technologies'' (29 CFR 1910.120(q)). As part of emergency preparedness activities, individuals authorized as incident commanders should receive the necessary training and planning prior to the incident, use the hazard information available, consult relevant standards, and apply all feasible and useful measures to minimize hazards to emergency responders.

OSHA's ionizing radiation standard (29 CFR 1910.1096), which may also apply in certain circumstances, limits quarterly dose [7] and includes other requirements such as monitoring, recordkeeping, training, and reporting.

The worker exposure levels are not PAGs but instead are regulatory limits that cannot be exceeded except under certain conditions. These occupational limits allow workers to receive radiation exposure during the course of performing their jobs. This limit offers the possibility that industrial and manufacturing facilities, critical infrastructures and other business operations could be reopened without having to be cleaned up, as long as they are in compliance with the 5 rem dose limit and other OSHA requirements found in 29 CFR 1910.1096. Otherwise, the relocation PAGs could be used by decision makers to protect their citizens.

DOE employees and contractors are subject to DOE radiation protection regulations, and requirements for worker protection from radiation exposure are contained in 10 CFR part 835. These requirements apply to all DOE employees and contractors that may be exposed to ionizing radiation as a result of their work for DOE, including work relating to emergency response activities. Section 835.3(d) indicates that nothing in the regulation ''shall be construed as limiting actions that may be necessary to protect health and safety.'' This clause is intended to recognize the fact that during emergencies, lifesaving or property-saving actions may necessitate actions that have the potential to cause doses in excess of the Department's radiation dose limits. Subpart N of section 835 provides direction for emergency exposure situations and indicates that:

- The risk of injury should be minimized.
- Actual and potential risks should be weighed against benefits of such actions causing exposures.
- No individual should be forced to perform a rescue action that involves substantial personal risk.
- Individuals authorized to perform emergency actions that may result in exposures exceeding DOE dose limits should receive prior training and briefing on known or anticipated hazards.

Under all circumstances, doses should be maintained as low as is reasonably achievable. Under DOE requirements, emergency response doses are not included with worker doses measured and calculated to demonstrate compliance with 10 CFR Part 835 dose limits.

Requirements for the protection of NRC employees are covered by NRC Management Directive 10.131, ''Protection of NRC Employees Against Ionizing Radiation.'' Section VI, Guidance for Emergency Exposure Controls During Rescue and Recovery Activities, deals specifically with radiation exposure control during emergencies. Section VI adopts the dose limits in the EPA PAG Manual (EPA 400–R–92–001) for exposure of NRC employees during emergencies. Similarly, NRC and Agreement State licensees have established on-site exposure guidelines consistent with EPA PAGs.

For an IND incident, the radiological consequences could be so severe that many workers would be exposed in activities, such as emergency lifesaving functions, that would result in doses in excess of the 5 rem limit for normal occupational activities.

Appendix 2—Risk Management Framework for RDD/IND Incident Planning

This appendix contains a description of a risk management framework for making decisions to protect public health and welfare in the context of cleanup and site restoration following an RDD or IND incident. The framework is based on the report, ''Framework for Environmental Health Risk Management,'' mandated by the 1990 Clean Air Act Amendments published by the Commission on Risk Assessment and Risk Management in 1997. This appendix provides specific material for RDD and IND incidents, and reference to the report is encouraged for the details of the general framework. Details of a plan for implementing this framework for certain RDD and IND incidents are provided in Appendix 4.

The ''Framework for Environmental Health Risk Management'' is considered generally suitable for addressing the long-term recovery issues for RDDs and INDs. Given the time frames following an RDD or IND incident, there is generally not sufficient time in the early and intermediate phases to conduct full risk assessment and get stakeholder involvement. Therefore, in order for the framework to be effective for these phases, it must be used in planning and preparing for a radiological or nuclear incident. As a result, many of the principles have already been incorporated into the establishment of the PAGs for RDD and IND incidents on a generic basis.

The framework is designed to help decision makers make good risk management decisions. The level of effort and resources invested in using the framework should be scaled to the importance of the problem, the potential severity and economic impact of the risk, the level of controversy surrounding the problem, and resource constraints. In the context of an RDD or IND incident, the risk management decisions involve responding to the consequences of a particular incident. The risks that must be considered are both radiation risks and potentially chemical or biological agents. Other factors to be considered include the continued sense of uncertainty and disruption in normal activities; the loss of, or limited access to, critical infrastructure and health care; and general economic disruption.

The framework relies on the three key principles of broad context, stakeholder participation, and iteration. Broad context refers to placing all of the health and environmental issues in the real-world context following an RDD or IND incident, and is intended to assure that all public welfare related factors and impacts are taken into account. Stakeholder participation is critical to making and successfully implementing sound, cost-effective, risk-informed decisions. Iteration is the process of continuing to refine the information available, and therefore the decisions and actions that can be taken at any point in time. Together these principles outline a fair, responsive approach to making the decisions necessary to effectively respond to the impacts of an RDD or IND incident.

Risk management is the process of identifying, evaluating, selecting, and implementing actions to reduce risk to public health and the environment. The goal of risk management is scientifically sound, cost-effective, integrated actions that reduce or prevent risks while taking into account social, cultural, ethical, public policy, and legal considerations. In order to accomplish this goal, information will be needed on the nature and magnitude of the risks present as a result of the incident, the options for reducing or eliminating the risks, and the effectiveness and costs of those options. Decision makers also consider the economic, social, cultural, ethical, legal, and public policy implications associated with implementing each option, as well as the unique safety and health hazards facing emergency workers and community health, or ecological hazards the cleanup actions themselves may cause. Often a stakeholder advisory group can provide the advice needed to consider all of the relevant information.

Stakeholders can provide valuable input to decision makers during the long-term recovery effort, and the key decision makers should establish a process that provides for appropriate stakeholder input. Identifying which stakeholders need to be involved in the process depends on the situation. In the case of a site contaminated as a result of an RDD or IND incident, stakeholders may include those whose health, economic well-being, and quality of life are currently affected or would be affected by the cleanup and the site's subsequent use. They may also include those who are legally responsible for the site's contamination and cleanup, those with regulatory responsibility, and those who may speak on behalf of environmental considerations or future generations.

Stakeholder input should be considered throughout all stages of the framework as appropriate, including analyzing the risks,

[7] 1.25 rems or rems if cumulative lifetime dose is less than 5(n–18), where n is the worker's age at the last birthday, and adequate past and current exposure records are maintained to show exposures do not exceed the standard's radiation levels (29 CFR 1910.1096).

identifying potential cleanup options, evaluating options, selecting an approach, and evaluating the effectiveness of the action afterwards. Their input will assist decision makers in providing a reasonable basis for actions to be taken. Further information on the importance and selection of stakeholders can be found in the Framework for Environmental Health Risk Management.

Decision makers can also benefit from the use of working groups that can provide expert technical advice regarding the decisions that need to be made during the long-term recovery process. Further information on how to incorporate the use of technical working groups is provided later in this appendix.

(a) The Stages of the Risk Management Framework for Responding to RDD and IND Incidents

The ''Framework for Environmental Health Risk Management'' has six stages:

1. Define the problem and put it in context.
2. Analyze the risks associated with the problem in context.
3. Examine options for addressing the risks.
4. Make decisions about which options to implement.
5. Take actions to implement the decisions.
6. Evaluate results of the actions taken.

Risk management decisions under this framework should do the following:

- Clearly articulate all of the problems in their public health and ecological contexts, not just those associated with radiation.
- Emerge from a decisionmaking process that elicits the views of those affected by the decision.
- Be based on the best available scientific, economic, and other technical evidence.
- Be implemented with stakeholder support in a manner that is effective, expeditious, and flexible.
- Be shown to have a significant impact on the risks of concern.
- Be revised and changed when significant new information becomes available.
- Account for their multi-source, multimedia, multi-chemical, and multi-risk contexts.
- Be feasible, with benefits reasonably related to their costs.
- Give priority to preventing risks, not just controlling them.
- Be sensitive to political, social, legal, and cultural considerations.

(1) Define the Problems and Put Them in Context

In the case of RDDs, the initial problem is caused by the dispersal of radioactive material. This dispersion may also result in the release of other types of contaminants (chemical or biological) or create other types of public health hazards. Individuals exposed may include workers and members of the public, and there may be different associated assumptions; for example, how long the individuals will be exposed in the future.

The potential for future radiation exposure must be considered within the context of the societal objectives to be achieved, and must examine the options in the context of all of the other sources, hazards, and impacts the community faces. There may also be broader public health or environmental issues that local governments and public health agencies have to confront and consider. Understanding the context of a risk problem is essential for effectively managing the risk.

The goals of the recovery will extend well beyond the reduction of potential delayed radiation health effects, and may include:

- Public health protection goals, including acute hazards, long-term chronic issues, and protection of children and other sensitive populations.
- Social and economic goals, such as minimizing disruption to communities and businesses, maintaining property values, and protecting historical or cultural landmarks or resources.
- National security goals, such as maintaining and normalizing use of critical arteries, airports, or seaports for mass transit; maintaining energy production; and providing for critical communications.
- Public welfare goals, including maintaining hospital capacity, water treatment works, and sewerage systems for protection of community health; assuring adequate food, fuel, power, and other essential resources; and providing for the protection or recovery of personal property.

(2) Analyze the Risks

To make effective risk management decisions, decision makers and other stakeholders need to know what potential harm a situation poses and how great is the likelihood that people or the environment will be harmed. The nature, extent, and focus of a risk assessment should be guided by the risk management goals. The results of a risk assessment—along with information about public values, statutory requirements, court decisions, equity considerations, benefits, and costs—are used to decide whether and how to manage the risks.

Risk assessments can be controversial, reflecting the important role that both science and judgment play in drawing conclusions about the likelihood of effects on public health and the environment. It is important that risk assessors respect the objective scientific basis of risks and procedures for making inferences in the absence of adequate data. Risk assessors should provide decision makers and other stakeholders with plausible conclusions about risk that can be made on the basis of the available information, along with evaluations of the scientific support for those conclusions, descriptions of major sources of uncertainty, and alternative views.

Stakeholders' perception of a risk can vary substantially depending on such factors as the extent to which the stakeholders are directly affected, whether they have voluntarily assumed the risk or had the risk imposed on them, and whether they are connected with the cause of the risk. For this reason, risk assessments should characterize the scientific aspects of a risk and note its subjective, cultural, and comparative dimensions. Stakeholders play an important role in providing information that should be used in risk assessments and in identifying specific health and ecological concerns that should be considered.

(3) Examine the Options

This stage of the risk management process involves identifying potential recovery management options and evaluating their effectiveness, feasibility, costs, benefits, cultural or social impacts, and unintended consequences. This process can begin whenever appropriate, after defining the problem and considering the context. It does not have to wait until the risk analysis is completed, although a risk analysis often will provide important information for identifying and evaluating risk management options. In some cases, examining risk management options may help refine a risk analysis. Risk management goals may be redefined after decision makers and stakeholders gain some appreciation for what is feasible, what the costs and benefits are, and what contribution reducing exposures and risks can make toward improving human and ecological health.

Once potential options have been identified, the effectiveness, feasibility, benefits, detriments, and costs of each option must be assessed to provide input into selecting an option. Key questions include determining (1) the expected benefits and costs; (2) who gains the benefits and who bears the costs; (3) the feasibility of the option given the available time; resources; and any legal, political, statutory, and technology limitations; and (4) whether the option increases certain risks while reducing others. Other adverse consequences may be cultural, political, social, or economic—such as economic impacts on a community, including reduced property values or loss of jobs; environmental justice issues; and harming the social fabric of a town or tribe by relocating the people away from a contaminated area.

Many risk management options may be unfeasible for social, political, cultural, legal, or economic reasons—or because they do not reduce risks to the extent needed. For example, removing all the soil from an entire valley that is heavily contaminated with radioactive material may be infeasible. On the other hand, the costs of cleaning up an elementary school may be considered justified by their benefits: protecting children and returning daily activities to a sense of normalcy. Of course, the feasibility and cost-effectiveness of an option may change in the future as technology is improved or as society's values change.

(4) Make a Decision

A productive stakeholder involvement process can generate important guidance for decision makers. Thus, decisions may reflect negotiation and compromise, as long as risk management goals and intent are met. In some cases, win-win solutions are available that allow stakeholders with divergent views to achieve their primary goals.

Decision makers must balance the value of obtaining additional information against the need for a decision, however uncertain. Sometimes a decision must be made primarily on a precautionary basis. Every effort should be made to avoid ''paralysis by analysis,'' in which the need for additional information, or the inability to reach consensus, is used as an excuse to avoid or postpone decisionmaking. When sufficient information is available to make a risk management decision, or when additional information or analysis would not contribute significantly to the quality of the decision, the decision should not be postponed. ''Value-of-information'' techniques can be used to provide perspective on the next steps to be taken.

(5) Take Action To Implement Decision

When options have been evaluated and decisions made, a plan for action should be developed and implemented. Traditionally, implementation of protective actions is driven by decision makers' responsibilities to protect the public and the environment. State and local officials, business leaders, private industries, and the general public are generally the implementers of these protective actions. Actions may take considerable time for completion, and additional decisions may often be necessary as the actions proceed.

(6) Evaluate the Results

Decision makers and other stakeholders must continue to review what risk management actions have been implemented and how effective these actions have been. Evaluating effectiveness involves monitoring and measuring, as well as comparing actual benefits and costs to estimates made in the decisionmaking stage. The effectiveness of the process leading to implementation should also be evaluated at this stage. Evaluation provides important information about: Whether the actions were successful; whether they accomplished what was intended; whether the predicted benefits and costs were accurate; whether any modifications are needed to the risk management plan to improve success; whether any critical information gaps hindered success; whether any new information has emerged that indicates a decision or a stage of the framework should be revisited; whether the process was effective; how stakeholder involvement contributed to the outcome; and what lessons can be learned to guide future risk management decisions or to improve the decisionmaking process.

Evaluation is critical to accountability and to ensure wise use of valuable but limited resources. Tools for evaluation include environmental and health monitoring, research, disease surveillance, analyses of costs and benefits, and discussions with stakeholders.

(b) Technical Advisory Groups

Making decisions on the appropriate cleanup approaches and levels following an RDD or IND incident of any significant size will undoubtedly be a challenging task for decision makers. As already noted, the technical issues may be complex, many potentially competing factors will need to be carefully weighed, and public anxiety can be expected to be high in the face of a terrorist act involving radioactive materials. In addition, it is recognized that different regulatory authorities and organizations historically have taken different cleanup approaches for radioactively contaminated sites. Given this context, decision makers will need to determine how best to obtain the necessary technical input to support these decisions and demonstrate to the public that the final decisions are credible and sound.

There are a variety of ways this approach may be accomplished, and decision makers will need to tailor a process best suited to particular site circumstances. This section describes one process that is available to decision makers, which is based on the ''ad hoc'' mechanisms used for coordinating interagency expertise and assessing the effectiveness in general of the cleanup in response to the 2001 anthrax attacks. The anthrax cleanup involved the use of two technical groups that were used to advise key decision makers: a technical working group and a technical peer review advisory committee. (Unlike the other steps described in this appendix, these concepts are not described in the 1997 framework and are thus described in greater detail here.)

(1) Technical Working Group

Decision makers may choose to convene a technical working group to provide multi-agency, multi-disciplinary expert input to the planning and implementation of the cleanup effort, especially in setting appropriate cleanup goals and developing strategies for meeting them.

The group would be an ad hoc technical advisory group, not a decisionmaking body. It may include representatives from Federal, State, local, and tribal agencies. It may also include experts from the private sector or universities. Inclusion of a qualified local physician or health official also helps enhance the credibility of the working group within the community.

The composition of the group and the scope of its charter will vary depending on the needs of the situation and the nature of the contamination. For example, expertise in chemical or radiation toxicology will be needed for attacks involving chemical or radioactive agents. In some cases (e.g., where there is simultaneous release of similar contamination at numerous locations), one working group may be charged with providing national-level advice to be applied locally at multiple individual sites. In other cases (i.e., where contamination is minimal or exposure is unlikely), a technical working group may not be necessary.

A technical working group can provide expert input in the form of cross-agency coordination on technical issues, analysis of relevant requirements and guidelines, review of data and plans, and recommendations that will aid in ensuring that cleanup will be adequate. The group may also provide technical information to the Joint Information Center (JIC) to explain public health or environmental impacts to the public and the press. This group, like the advisory committee discussed below, reports to the decision maker, however, and not directly to the public. A technical working group can complement other ''special teams'' that may assist in the recovery effort, and representatives from these other special teams may be members of the technical working group.

(2) Technical Peer Review Advisory Committee

For significant decontamination efforts, the key decision makers may choose to convene an independent committee of technical experts to conduct a deliberative and comprehensive post-decontamination review. The committee would evaluate the effectiveness of the decontamination process and make recommendations on whether the decontaminated areas or items may be reoccupied or reused. It is important to note that although this review may enhance the scientific credibility of the final outcome, final cleanup decisions rest with decision makers.

The committee may consist of experts from the involved Federal agencies, State and tribal public health and environmental agencies, universities and private industry, the local health department, and possibly representatives of the employees and the community. To maximize objectivity, the committee would be an independent group that will advise and report to the decision makers, but not be a part of the decisionmaking team.

The scientific expertise in the committee should reflect the needs of the decision makers in conducting a peer review of all aspects of the decontamination process (e.g., environmental sampling, epidemiology, risk assessment, industrial hygiene, statistics, and engineering). Agencies on the committee may also have representatives on the technical working group, but in order to preserve the objectivity of the committee, it is best to designate different experts to serve on each group. The chair and co-chair of the committee should not be a part of the decisionmaking group at the site.

The decision makers should develop a charter for the committee, specifying the tasks committee members are intended to perform, the issues they are to consider, and the process they will use in arriving at conclusions and recommendations. The charter should also specify whether the individual members are expected to represent the views of their respective agencies or just their own opinions as independent scientific experts. Consensus among committee members is desirable but may not be possible. If consensus cannot be achieved, the charter should specify how decision makers expect the full range of opinions to be reflected in the final committee report. All members of the committee should agree to the terms of charter and sign it before participating.

In general, the technical peer review committee would evaluate pre- and post-decontamination sampling data, the decontamination plan, and any other information key to assessing the effectiveness of the cleanup. Based on this evaluation, the committee would make recommendations to the decision makers on whether cleanup has reduced contamination to acceptable levels, or whether further actions are needed before re-occupancy.

Appendix 3—Federal Implementation

This appendix provides an implementation plan for the protective action recommendations in the body of this document. It also describes how to implement the risk management framework for recovery after a radiological or nuclear incident described in Appendix 2. This implementation plan presents the Federal role in long-term site restoration, and how Federal departments and agencies will interact with State and local government counterparts and the public. The plan does not attempt to provide detailed descriptions of State and local roles and expertise. It is assumed those details would be provided in State-, area-, and local-level planning documents that address radiological/nuclear terrorism incidents.

This site cleanup implementation plan is intended to function under the National Response Plan (NRP) with Federal agencies performing work consistent with their established roles, responsibilities and capabilities. Agencies should be tasked to perform work under the appropriate Emergency Support Function, as a primary or support agency, as described in the NRP.

This plan is designed to be compatible with the Incident Command/Unified Command (IC/UC) structure embodied in the National Incident Management System (NIMS). The functional descriptions and processes in this plan are provided to address the specific needs and wide range of potential impacts of an RDD or IND incident. During the intermediate phase, site restoration planners should begin the process described below, in coordination with the on-site IC/UC. Coordination of Federal activities may organize along IC/UC functional lines coordinating with the on-site organization to avoid redundancy. After early and intermediate phase activities have come to conclusion, and only long-term cleanup and site restoration activities are ongoing, the IC/UC structure may continue to support planning and decisionmaking for the long-term cleanup. The IC/UC may make personnel changes and structural adaptations to suit the needs of a lengthy, multifaceted and highly visible remediation process. For example, a less formal and structured command, more focused on technical analysis and stakeholder involvement, may be preferable for site restoration than what is required under emergency circumstances. Some of the Teams described below, such as the Decision Team or the Recovery Management Team may be coordinated from, or coincident with, functional portions of the IC/UC at the site. Although the makeup of the Teams may vary, the functions should remain the same.

Radiological and nuclear terrorism incidents cover a broad range of potential scenarios and impacts. For the sake of this appendix, it is assumed that the incident is of sufficient size to trigger a State request for Federal assistance, and that the Federal Government is the primary funding agent for site restoration. In particular the process, described for the late phase in Section D.3.3 of this document, assumes an incident of larger size. For smaller incidents, all of the elements in this section may not be warranted. The process should be tailored to the circumstances of the particular incident. It should be recognized that for some radiological/nuclear terrorist incidents, States will take the primary leadership role and contribute significant resources toward restoration of the site. This section does not address such a scenario.

As described earlier in the document, radiological/nuclear emergency responses are often divided roughly into three phases: (1) The early phase, when the plume is active and field data are lacking or not reliable; (2) the intermediate phase, when the plume has passed and field data are available for assessment and analysis; and (3) the late phase, when long-term issues are addressed, such as restoration of the site. For purposes of this appendix, the response to a radiological or nuclear terrorism incident is divided into two separate, but interrelated and overlapping, processes. The first is comprised of the early and intermediate phases of response, which consist of the immediate on-scene actions of State and local first responders under Incident Command/Unified Command (IC/UC), as well as those of Federal teams and officials, to perform incident stabilization, lifesaving activities, access control and security, emergency decontamination of persons and property, ''hot spot'' removal actions, dose reduction actions for members of the public and emergency responders, and resumption of basic infrastructure functions.

The second process pertains to environmental restoration, which is initiated soon after the incident (during the intermediate phase) and continues into the late phase. The process starts with the convening of stakeholders and technical subject matter experts to begin identifying and evaluating options for the restoration of the site. The environmental restoration process overlaps the intermediate phase activities described above and should be coordinated with those activities.

This implementation plan does not address law enforcement coordination during terrorism incident response, including how the Federal Bureau of Investigation (FBI) and DHS will manage on-scene actions immediately following an act of terror. Also, victim triage and other medical response aspects are not addressed. The plan presented in this appendix is not intended for use at site cleanups occurring under other statutory authorities such as EPA's Superfund program, the NRC's decommissioning program, or State-administered cleanup programs.

(a) Response and Recovery Activities Overview

The following are actions expected to occur according to existing plans, protocols, and capabilities. These early activities are primarily for context and are not intended to be exhaustive. The major change from current operating plans and protocols is the assumption of Federal leadership by DHS. The early phase of the response will be run at the scene by State and local responders, who are likely to make protective action decisions for the protection of public health, property, and environment early in the incident based on judgment, protocol, and what limited data are available. As Federal response assets arrive on scene, they will be incorporated into the on-scene incident command established by State and local officials and then become part of the unified command structure. Other Federal assets will be located in the Joint Field Office (JFO), co-located with a State/local Emergency Operations Center (EOC), if possible, to support the local incident management activities.

(1) Early Phase

0–3 hours.

- Local incident command established
- Radiation detected and a terrorism incident recognized
- DHS Homeland Security Operations Center (HSOC) notified of incident and mobilized to provide support and coordination until JFO is operational
- DHS determines if this incident is an Incident of National Significance, as defined in the NRP
- Initial protective actions ordered (downwind shelter-in-place/evacuation)

Comments:

- Some Federal assets will self-deploy under their own authority (HHS, FBI, OSHA, EPA, DOE)
- Protective actions by locals likely to occur before Federal assets arrive

6 hours.

- DHS designates a Principal Federal Official (PFO)
- Nuclear Incident Response Team (NIRT) activated by DHS (i.e. Radiological Assistance Program (RAP), Aerial Measuring System (AMS), FRMAC, Radiation Emergency Assistance Center/Training Site (REAC/TS), Radiological Emergency Response Team (RERT))
- Initial dispersion plots developed, other analyses done, and initial Federal protective action recommendations may be provided
- Domestic Emergency Support Team (DEST) deploys

Comments:

- An ''Initial PFO'' may be named until the PFO can arrive at the site
- The PFO may deploy with the DEST
- The PFO is responsible for coordinating Federal assets in collaboration with other Federal officials

6–12 hours.

- Initial JFO established to include FBI Joint Operations Center (JOC)
- Advance FRMAC stood up, field measurements being taken
- AMS arrives, provides initial deposition data to JFO

12–24 hours.

- JFO operational
- Federal teams in place (NIRT, DEST, Advisory Team for Food and Health)
- PAG being provided by JFO to State and local decision makers
- State requests, and is granted, a major disaster or emergency declaration

Early phase activities are expected to proceed as described under existing plans and agreements. If DHS declares an Incident of National Significance, the PFO will coordinate Federal activities from the JFO and integrate Federal activities in support of the State and local response. A Robert T. Stafford Disaster Relief and Emergency Assistance Act declaration will facilitate funding for public and individual assistance, and for recovery operations.

In general, the primary agencies expected to be represented in the unified command for an RDD or IND response incident are the agencies with primary response authority and include DHS, FBI, DOE, EPA, and other Federal, State, and local government agencies, as appropriate. Other Federal agencies (e.g., NRC, OSHA, U.S. Army Corps of Engineers, and DoD) will be requested to support the response in accordance with the NRP and NIMS.

(2) Intermediate Phase

During the intermediate phase, actions initiated in the early phase will continue as needed, such as lifesaving, fire suppression, perimeter security, and field data collection and analysis. Preliminary shelter-in-place or evacuation may occur within the first hours at the order of local incident command, but as data become available, Federal, State, and local officials will have better information with which to make protective action decisions, assist emergency workers, and inform the public.

Federal protective action recommendations will be provided to State and local governments on public dose constraints, restrictions regarding consumption of food and water, and dose reduction actions. Intermediate phase actions may include relocation, control of public access, decontamination of persons, decontamination/removal of ''hot spots,'' response worker dose monitoring, population monitoring, food and water controls, and clearance of personal property. Public information and communication programs should be implemented as soon as practicable. Federal officials will work with State and local officials to develop information for the public in coordination with the JIC. (See the ''Application of PAGs for RDD or IND Incidents'' for more information on intermediate phase protective actions and recommendations.)

(3) Late Phase—Recovery and Site Restoration Activities Process Overview

As noted earlier, the long-term recovery process should be initiated during the intermediate phase. This process is interrelated with the ongoing intermediate phase activities, and the intermediate phase protective actions continue to apply through the late phase until cleanup is complete. However, the long-term recovery phase is likely to involve separate individuals who can focus on long-term restoration issues while others continue working on intermediate phase activities.

Cleanup planning and discussions should begin as soon as practicable after an incident to allow for selection of key stakeholders and subject matter experts, planning, analyses, contractual processes, and cleanup activities. States may choose to pre-determine stakeholders. These activities should proceed in parallel with ongoing intermediate phase activities, and coordination between these sets of activities should be maintained. Preliminary remediation activities carried out during the intermediate phase—such as emergency removals, decontamination, resumption of basic infrastructure function, and some return to normalcy in accordance with intermediate phase guidelines—should not be delayed for the final site remediation decision.

Presented below is a process for addressing environmental contamination that applies an optimization process for site cleanup. Optimization (described more fully in the ''Application of PAGs for RDD or IND Incidents'') is a flexible process in which numerous factors are considered to achieve an end result that balances local needs and desires, health risks, costs, technical feasibility, and other factors. The general process outlined below provides decision makers with input from both technical experts and stakeholder representatives, as well as providing an opportunity for public comment. The extent and complexity of the process for an actual incident should be tailored to the needs of the specific incident; for smaller incidents, the teams discussed below may not be necessary.

The goals of the process described below are: (1) Transparency—the basis for cleanup decisions should be available to stakeholder representatives, and ultimately to the public at large; (2) inclusiveness—representative stakeholders should be involved in decisionmaking activities; (3) effectiveness—technical subject matter experts should analyze remediation options, consider dose and risk benchmarks, and assess various technologies in order to assist in identifying a final solution that is optimal for the incident; and (4) shared accountability—the final decision to proceed will be made jointly by DHS, State, and local officials.

If Federal agencies do not have their own authorities to enable them to participate in the overall recovery and restoration process, then DHS would issue mission assignments to the involved Federal agencies to participate in the overall recovery and restoration process. Additional funding may be provided to State/local governments to perform response/restoration activities through other mechanisms. The components of the process are as follows:

(i) Teams

(A) Decision Team

Makeup: The Decision Team consists of the Secretary of DHS, the governor of the State, the mayor or equivalent, and the head of the lead Federal agency (or their respective designated representatives with authority to commit resources on behalf of affected persons).

Function: The function of the Decision Team is to make the final decision on recommendations received from the Recovery Management Team, commit resources, and commence cleanup activities. The Decision Team will raise unresolved national level policy issues to the Interagency Incident Management Group (IIMG) and/or to the Assistant to the President for Homeland Security, as appropriate.

(B) Recovery Management Team

State and DHS officials should select a Recovery Management Team as soon as possible after the incident. The size and makeup of the team will be dependent on the incident, but would be expected to consist of senior-level officials. The Recovery Management Team will normally be located at the JFO in order to enhance information flow and response coordination.

Makeup: The Recovery Management Team should include DHS, affected State and/or local representatives, and the Federal lead technical agency. The Recovery Management Team should be co-chaired by a DHS and State official. The makeup is flexible and may accommodate other individuals, as necessary.

Functions: The functions of the Recovery Management Team are to select participants for the Stakeholder and Technical Working Groups; provide facilitation, oversight and guidance during the cleanup analyses and decisionmaking process; oversee working group interactions; maintain communications between working groups; receive and review options and recommendations; ensure the development and implementation of community involvement and public information strategy; and prioritize recommendations when they are forwarded to the Decision Team for action.

(C) Stakeholder Working Group

The Stakeholder Working Group should be convened as soon as practicable, normally within weeks of the incident.

Makeup: The Stakeholder Working Group should include selected Federal, State, and local representatives; local non-governmental representatives; and local business interests. The exact selection and balance of stakeholders is incident specific. The Stakeholder Working Group should be co-chaired by DHS and State and/or local representatives.

Function: The function of the Stakeholder Working Group is to provide input to the Technical Working Group and the Recovery Management Team concerning local needs and desires for site restoration, proposed cleanup options, and recommendations for recovery.

(D) Technical Working Group

The Technical Working Group should be convened as soon as practicable, normally within weeks of the incident.

Makeup: The Technical Working Group should include selected Federal, State, local, and private sector subject matter experts in such fields as environmental fate and transport modeling, risk analysis, technical remediation options analysis, cost risk and benefit analysis, health physics/radiation protection, construction remediation practices, and relevant regulatory requirements. The exact selection and balance of subject matter experts is incident specific. The Technical Working Group should be chaired by the Federal lead technical agency assigned responsibility for performing cleanup operations and co-chaired by the State/local technical agency.

Function: The Technical Working Group provides expert input on technical issues, analysis of relevant regulatory requirements and guidelines, risk analyses, and evaluation of options as directed by the Recovery Management Team. The actual technical analyses will be the responsibility of the Federal lead technical agency for cleanup. The Technical Working Group should also receive input from the Stakeholder Working

Group. Technical Working Group written products are provided to the Recovery Management Team.

(ii) Activities

(A) Optimization and Recommendation (Lasts Weeks to Months)

The Recovery Management Team, in consultation with the Stakeholder Working Group and Technical Working Group, will develop a process for the three teams to work together in order to provide the opportunity for local concerns to inform the work of the Technical Working Group. The Technical Working Group and Recovery Management Team should assist in answering questions the Stakeholder Working Group may have regarding technical issues and provide information regarding cleanup options.

The Stakeholder Working Group should present local goals, needs, and desires for the use of the site, and prioritize current and future potential land uses and functions, such as utilities and infrastructure, light industrial, downtown business, and residential land uses. The lead technical agency will oversee technical optimization analyses for site cleanup in collaboration with the Recovery Management Team, Technical Working Group, and Stakeholder Working Group. The Technical Working Group will analyze assumptions, review risk analyses for various proposed remediation options, assess technical feasibility and cost of the options, and identify the estimated time to complete restoration options and their potential impacts on the local community.

The Stakeholder Working Group will provide input to the Technical Working Group, but may also provide options and recommendations directly to the Recovery Management Team. The Technical Working Group will consider input from the Stakeholder Working Group in its analyses, and provide input to the Recovery Management Team on remediation options and recommended approaches and rationale. It is important that the Technical Working Group and the Stakeholder Working Group maintain confidentiality concerning all aspects of the analyses. All outside contacts, such as press interviews, concerning the ongoing work and deliberations should be coordinated through the Recovery Management Team.

As the Technical Working Group completes its analyses and formulates its recommendations, it will present this information to the Recovery Management Team for final review. The Recovery Management Team will present the Decision Team with options, recommendations for final action, and supporting documentation.

(B) Public Review of Decision

The Decision Team should publish a summary of the process, the options analyzed, and the recommendation for public comment. Public meetings may also be convened as appropriate. Public comment should be considered and incorporated as appropriate. A reconvening of the Recovery Management Team, Stakeholder Working Group, and Technical Working Group may be useful for resolving some issues.

(C) Execute Cleanup

Assuming a Presidential declaration of a major disaster or emergency, DHS may issue mission assignments to the Federal departments and agencies that have the capability to perform the required cleanup or remediation activities. For significant decontamination efforts, decision makers may choose to employ a technical peer review advisory committee to conduct a review of the effectiveness of the cleanup.

(b) Implications of DHS as Lead Federal Agency

In both the early and intermediate phases of the response, activities are expected to proceed as described under existing plans and agreements, except that the Federal response will be coordinated by DHS through the PFO. Anticipated actions include the following:

- When NIRT assets are called upon by the Secretary of DHS, they will come under the ''authority, direction, and control'' of the Secretary or his designee for the duration of the response. As such, they will not work for State or local governments, nor will they work independently under their agency of origin (either DOE or EPA), as they may under existing plans. A DOE senior energy official will act as the single point of contact for tasking of DOE nuclear/radiological support requested by the PFO or Federal Coordinating Office (FCO).
- Federal, State, and local field teams and experts should coordinate data collection and analysis through the FRMAC (now a DHS-directed asset) once it is operational.
- All Federal information—such as protective action recommendations, analyses, projections, and information to be provided to the public—is expected to pass through the PFO or FCO, in coordination with State and local officials, prior to its release to the press and the public. A JIC may be established to provide the organizational structure for coordinating and disseminating official information to the public. It is recognized, however, that in some cases, on-scene responding Federal agencies may need to communicate directly with the media/public on tactical operations and matters affecting public health and safety, particularly early in the response.

Appendix 4—Operational Guidelines for Implementation of the Protective Action Guides During RDD or IND Events

As noted in Section F of the document, operational guidelines are levels of radiation or concentrations of radionuclides that can be accurately measured by radiation detection and monitoring equipment, and then related or compared to the PAGs to quickly determine if protective actions need to be implemented. In most situations, the guidelines will be given in terms of external gamma rates or media-specific radionuclide concentration units. Both external and internal exposure potential will be considered in their development.

This appendix describes examples of measurable guidelines that will be developed by groups or categories to assist decision makers and response workers in deciding on and applying protective actions. This appendix discusses the guidelines qualitatively and does not provide actual values. The operational guidelines will be developed to provide reasonable assurance that the PAGs, the dose levels recommended in this report, can be met for appropriate situations under assumed circumstances. The guidelines will also consider the impact of protective actions, such as rinsing of vehicles to remove contamination, and when control of wash water is necessary. Actual conditions may warrant development of incident-specific guides, and this document does not preclude such development. Part of the development process will include the development of tools to allow for the preparation of site-specific operational guidelines that can be tailored to the emergency and the required response.

At this time, the operational guidelines are subdivided into six groups. They are:

- Access Controls During Emergency Response Operations (Group A)
- Relocation Areas (Group B)
- Critical Infrastructure Utilization in Relocation Areas (Group C)
- Temporary Access to Relocation Areas for Essential Activities (Group D)
- Transportation and Access Routes (Group E)
- Property Control for Release of Property to Non-impacted Areas (Group F)

The purpose of operational guidelines for each of these groups is discussed in the following paragraphs, along with examples of specific operational guides that are needed for each group. However, as discussed in Section F, some operational guidelines have been previously developed and are available (e.g., EPA PAG Manual [8] and ''Radiological Emergency Response Health and Safety Manual'' [9]). At this time, the appendix contains no recommendations for actual values. As they are developed, information on recommended operational guidelines and associated tools will be made available for review.

(a) Access Controls During Emergency Response Operations (Group A)

The operational guidelines in this group are intended for use during emergency response operations. They guide responders in establishing radiological control zones or boundaries in affected areas where response activities are being conducted. These operational guides are not intended to restrict emergency responder access but rather to inform responders of potential radiological hazards existing in the areas and to provide tools for those responsible for radiation protection during response activities. Group A operational guidelines may be used to restrict access of non-essential personnel and members of the public to specific areas.

These guidelines are most applicable during the early and intermediate phases of

[8] ''Manual of Protective Action Guides and Protective Actions for Nuclear Incidents,'' U.S. Environmental Protection Agency, May 1992, EPA–400–R–92–001.

[9] ''*Radiological Emergency Response Health and Safety Manual,*'' May 2001, available at *http://www.nv.doe.gov/programs/frmac/DOCUMENTS.htm.*

the emergency when the situation has not been fully stabilized or characterized and may therefore need to be applied initially with limited data and then revised (e.g., areas reclassified or remarked), as appropriate. Group A operational guidelines are generally for the areas directly impacted by the RDD or IND incident where first responders and emergency response personnel are working. However, they may also be applicable in contaminated areas where unrelated accidents or emergencies occur after the RDD or IND situation has been stabilized. Group A operational guidelines are not intended to restrict emergency response or lifesaving actions, but they are rather intended to help focus radiological protection resources on areas of highest priority. They do, however, define areas that should be restricted to the public and non-essential personnel. Examples of operational guidelines being developed in this group include those for the following:

(1) Life and Property Saving Measures

Areas exceeding guidance levels pose a significant radiological hazard even if access is for short periods. Access should be permitted only when there is a significant benefit associated with the activity to be conducted that outweighs the associated radiological risks. The PAGs applied for development of these operational guides include the 25 rem lifesaving response worker guidelines (Table 1B in Appendix 1) and the property-saving guidelines that are applicable when it is not possible to limit response worker dose to the 5 rem worker PAG.

(2) Emergency Worker Demarcation

Areas exceeding these guides should not be used to restrict response worker access. However, the public and non-essential personnel should not be allowed general access to the areas exceeding these levels. To the extent time and resources permit and do not interfere with response actions, officials responsible for radiation protection should establish procedures to monitor worker access and exposures in these areas. In most situations, the worker protection PAG of 5 rems is applicable (Table 1 in the main text and Table 1B in Appendix 1).

(b) Relocation Areas (Group B)

The operational guidelines for this group are intended as screening values to delineate areas that exceed the relocation PAGs. These, or similar operational guides, have been developed or are presented in the FRMAC manual (Volume II) and will be assessed. Examples of operational guidelines being developed in this group include:

(1) Relocation From Residential Areas

Areas exceeding these levels pose a significant possibility of causing doses that exceed relocation PAGs under normal residential use, and unless specific assessments indicate otherwise, the public should be relocated from the areas. The 2 rems in the first year and 0.5 rem/yr thereafter (Table 1) are applicable for the development of these operational guidelines. Temporary access may be consistent with Group D, Temporary Access Operational Limits.

(2) Relocation Considerations for Commercial/Industrial Areas

Areas exceeding these guides pose a significant likelihood for causing doses that exceed public relocation PAGs under normal industrial or commercial use scenarios and should be considered for relocation. The 2 rems in the first year and 0.5 rem/yr thereafter (Table 1) are applicable for the development of these operational guidelines unless the employers have radiation protection programs in place to protect workers consistent with applicable requirements (e.g., OSHA 29 CFR 1910.1096, NRC 10 CFR 20, DOE 10 CFR 835), or unless site-specific analyses justify other operational limits. Temporary access for essential activities should be guided by operational guides in Group D. Or, if the facility is providing a service necessary to maintain public welfare, Group C operational limits should serve as a guide.

(3) Other Areas

These operational guides apply to areas that are not used as residences and are not normal work places (e.g., parks, cemeteries, monuments). The value of these guidelines will likely differ from the relocation areas previously mentioned because of differing occupancy and use, although the dose guidelines remain 2 rems in the first year and 0.5 rems/yr thereafter (Table 1). Access to such areas should be limited if the guides are exceeded.

These relocation operational guidelines will provide reasonable assurance that the worker or the public, as appropriate, will not exceed PAGs, and that appropriate radiological protection supervision is available in, and focused on, the higher risk areas so as to provide protection and oversight for emergency responders.

(c) Critical Infrastructure Utilization in Relocation Areas (Group C)

The operational guidelines for this group are intended as screening values to ensure facilities critical to the public welfare can continue to operate if needed. These guides only apply to facilities in areas that exceed relocation PAGs and, as a result, have been closed for general use and access. The operational guidelines are generally applicable during intermediate phase activities.

During the emergency activities, Group A operational guidelines will generally be applicable or in use. Group C operational guides assume a generally stable and characterized situation. The levels are derived assuming employees spend two thousand hours per year (a more realistic value may be employed if known) on the job and that the maximum dose will be less than 5 rems/yr. Facilities that exceed these operational guides and are essential for overall public welfare may need to be assessed to identify specific conditions and possible mitigation controls. In the following list of possible operational guidelines, a number of different guides have been identified, and future analyses may indicate that the same operational guidelines may be used for all or some of the facilities so that the list may be compressed.

(1) Hospitals

These guidelines are recommended to allow continued use of health care facilities and services that are in areas that exceed relocation criteria. If alternative facilities and services are available, they should be employed before applying these guidelines.

(2) Airports, Railroads, and Ports

These guidelines are recommended to allow use of transport facilities located in areas exceeding relocation guidelines that are essential to providing services and products necessary for the welfare of the region.

(3) Water and Sewer Facilities

These guidelines are for utilities in relocation areas that are necessary to provide services for the region.

(4) Power and Fuel

These guidelines are for utilities in relocation areas that are necessary to provide services for the region.

It is emphasized that these guidelines only apply when continuous operation of these and other facilities are essential to maintaining the public welfare and when this cannot be achieved under Group B or Group D guidelines for relocation and temporary access decisions, respectively.

(d) Temporary Access to Relocation Areas for Essential Activities (Group D)

The public, or employees of businesses, may need to have temporary access to residences or commercial, agricultural, or industrial facilities in order to retrieve essential records or equipment, conduct maintenance to protect the facility, prevent environmental damage, attend to animals, or retrieve pets. These operational guides are levels at which these actions can be taken without radiological supervision. The public or employees may occasionally access (a few days per month) the areas not exceeding these guides. Temporary access to relocation areas that exceeds the levels should only be permitted under the supervision, or with the permission of, radiation protection personnel. These operational guidelines will be derived to provide assurance that the doses will be below the 0.5 rem relocation PAG (Table 1, after the first year) for the following:

(1) Worker Access to Businesses for Essential Actions

Areas meeting these levels may be accessed for limited periods to retrieve essential materials or perform essential functions (e.g., perform facility maintenance, attend to animals, maintain security).

(2) Public Access to Residences for Retrieval of Critical Property, Pets, or Records

Areas in relocation areas meeting these criteria may be accessed by the public for limited periods to attend to important maintenance, retrieve needed records, or retrieve pets.

(e) Transportation and Access Routes (Group E)

The operational guidelines for this group are intended to assist in determining if transportation routes or access ways may be used by the public for general, limited, or restricted use. The relocation PAGs are used as the basis for operational guidelines for general access. Restricted use may be based on other guidelines as well. For example, operational guides may be defined for industrial/commercial use of various roads, bridges, or access ways. These may be necessary to allow for access between non-relocation areas via a relocation area or to allow for emergency recovery access in the immediate area of the RDD or IND incident. These operational guides assume regular or periodic use and are not appropriate for one-time events, such as evacuation or relocation actions. In general, these operational guidelines need to be developed giving consideration to the relocation PAGs, worker protection guidelines, and potential for combined doses. Three examples of operational guidelines for this group are discussed as follows, and as these are developed, it is possible that all or some of the categories can be consolidated.

(1) Bridges

Bridges meeting these operational guidelines are acceptable for public vehicular use (or restricted use, where appropriate).

(2) Streets and Thoroughfares

Streets and thoroughfares meeting these operational limits are acceptable for general vehicular passage or restricted vehicular passage, as appropriate.

(3) Sidewalks and Walkways

These operational limits are for non-vehicular access (e.g., individuals walking from parking lots or trains to places of business, or workers delivering goods). They should also apply to bridges and streets if significant non-vehicular passage is anticipated.

(f) Release of Property From Radiologically Controlled Areas (Group F)

During response and recovery operations, property (vehicles, equipment, and waste) will need to be cleared from controlled areas. The operational guidelines in this group will be developed to support such actions. Because retrieval of cleared or released properties would be difficult, wherever practicable, these levels should be similar to those likely to define late phase goals. For this reason, they should not be applied to property that will remain in use in controlled areas. Many areas may not exceed relocation PAGs and therefore, they will be accessible to the public at levels considerably above the operational guides in this group. Use of such property should not be assumed unacceptable merely because it exceeds these guides. These operational guidelines should also be used for screening property that was outside the controlled area. In general, the operational guides in this group provide reasonable assurance that the property cleared is acceptable for long-term, unrestricted use (or designated disposition in the case of wastes) without further or future reassessment. Property includes the following:

(1) Personal Property (Except Waste)

These operational guides will apply to property to be permanently cleared from the affected area for general reuse. They should not be used for property that will continue to be used in the affected areas (e.g., areas where residual activity is significantly above background).

(2) Waste

The RDD or IND incident may generate significant quantities of waste that contain small amounts of radioactivity. This waste may be rubble resulting from the device or from demolition associated with recovery, or it may be in the form of municipal waste or industrial waste from areas that are contaminated at levels below the relocation PAGs and associated operational guidelines. Waste meeting these operational limits may be considered for disposal in normal landfills, and waste exceeding these limits should be disposed at appropriate low-level radioactive waste sites.

(3) Hazardous Waste

Hazardous waste resulting from the RDD or IND or associated recovery operations will contain varied levels of residual radioactive material. Waste meeting these criteria may be considered for treatment and disposal to a legally permitted facility. Waste exceeding these concentrations should be managed as mixed waste.

(4) Real Property

Relocation PAGs and associated operational guides will be developed for application to the management of real property, but it is recognized that the optimization process applied during late phase activities (which will likely overlap with the intermediate phase) will be applied to areas that contain residual radioactive material at concentrations below the operational guides for relocation. Until the optimization process determines the target cleanup levels, it is not possible to generically define release operational guidelines for release of real property. Tools and unit concentrations to dose factors may be developed that can be applied on a site-specific basis by decision makers involved in the optimization to help define interim, or even final, operational guides for certain areas. However, no suggested or recommended generic operational guidelines can be developed before optimization process considerations.

Group F operational guides are intended to provide guidance for permanent clearance of property leaving radiologically controlled areas. These guides are developed to provide reasonable assurance that attaining them will minimize or eliminate the need for further response actions. It will be difficult to collect or re-call ''released property'' should late phase decisions about ''safe exposures'' identify more restrictive levels than those used to release property in the early and intermediate phases. Therefore, the property control operational guides (Group F) will be based on potential doses that are a fraction of the intermediate phase PAGs. Wherever practicable, these levels should be similar to those likely to define late phase goals. As with all the operational guidelines, alternative levels may be developed and used if conditions and needs justify. Group F operational guides are not applicable to continued use of property in impacted areas.

Note: Although agencies have identified values for selected operational guides, none have reached consensus. The development of these values will continue as part of an interagency process. Several sources exist that contain useful operational guidelines or information to support the development of operational guidelines that will eventually be included directly, or by reference with, the recommendations in this document and subsequent reports documenting the operational guidelines. The interagency workgroup developing these guidelines will consider these and other materials being developed by Federal agencies and other groups, such as the American National Standards Institute (ANSI) and National Council on Radiation Protection and Measurement (NCRP). Consistent with direction from Congress in FY2003 Supplemental Appropriations Legislation, the DOE is conducting analyses and developing models to support the completion of operational guidelines identified in this appendix. A significant fraction of the operational guidelines were completed and submitted for interagency review in late FY2005. Completion of the analyses and revisions based on interagency input (and peer review) is anticipated in the middle of FY2006. As the operational guidelines are developed and worked through the interagency process, they will be made available for review on the Internet.

Appendix 5—Acronyms/Glossary

AMS

Aerial Measuring System—A DOE technical asset consisting of both fixed wing and helicopter systems for measuring radiation on the ground; a deployable asset of the NIRT.

ALARA

As low as reasonably achievable—A process to control or manage radiation exposure to individuals and releases of radioactive material to the environment so that doses are as low as social, technical, economic, practical, and public welfare considerations permit.

ANSI

American National Standards Institute.

CFR

Code of Federal Regulations.

CMS

Consequence Management Site Restoration, Cleanup and Decontamination Subgroup.

DEST

Domestic Emergency Support Team—A technical advisory team designed to pre-deploy and assist the FBI Special Agent in

Charge. The DEST may deploy after an incident to assist the FBI and the PFO.

DHS

Department of Homeland Security.

DIL

Derived Intervention Level—the concentration of a radionuclide in food expressed in Becquerel/kg which, if present throughout the relevant period of time (with no intervention), could lead to an individual receiving a radiation dose equal to the PAG.

DOD

Department of Defense.

DOE

Department of Energy.

DRL

Derived Response Level—A level of radioactivity in an environmental medium that would be expected to produce a dose equal to its corresponding PAG.

EOC

Emergency Operations Center.

EPA

Environmental Protection Agency.

FBI

Federal Bureau of Investigation.

FCO

Federal Coordinating Officer.

FDA

Food and Drug Administration.

FRMAC

Federal Radiological Monitoring and Assessment Center—A coordinating center for Federal, State, and local field personnel performing radiological monitoring and assessment—specifically, providing data collection, data analysis and interpretation, and finished products to decision makers. The FRMAC is a deployable asset of the NIRT.

HHS

Department of Health and Human Services.

HAZWOPER

Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120).

HSOC

Homeland Security Operations Center—DHS headquarters to integrate and provide overall steady-state threat monitoring and situational awareness for domestic incident management on a 24/7 basis.

HSPD

Homeland Security Presidential Directive.

IC/UC

Incident Command/Unified Command—A system to integrate various necessary functions to respond to emergencies. The system is widely used by local responders. Under Unified Command, multiple jurisdictional authorities are integrated.

IIMG

Interagency Incident Management Group—A headquarters-level group to facilitate national-level domestic incident management and coordination of Federal operations and resources for certain incidents defined in HSPD–5 or in anticipation of such incidents.

IND

Improvised Nuclear Device—Nuclear weapons that are fabricated by an adversary State or terrorist group from illicit nuclear material and that could produce nuclear explosions.

JFO

Joint Field Office—The operations of the various Federal entities participating in a response at the local level should be collocated in a Joint Field Office whenever possible, to improve the efficiency and effectiveness of Federal incident management activities.

JIC

Joint Information Center—A focal point for the coordination and provision of information to the public and media concerning the Federal response to the emergency.

JOC

Joint Operations Center—The focal point for management and coordination of local, State and Federal investigative/law enforcement activities.

NCRP

National Council on Radiation Protection and Measurement.

NIMS

National Incident Management System—The Homeland Security Act of 2002 and HPSD–5 directed the DHS to develop a NIMS. The purpose of the NIMS is to provide a consistent nationwide approach for Federal, State, and local governments to work effectively and efficiently together to prepare for, respond to, and recover from domestic incidents.

NIRT

Nuclear Incident Response Team—Created by the Homeland Security Act of 2002, the NIRT consists of radiological emergency response assets of the DOE and the EPA. When called upon by the Secretary for Homeland Security for actual or threatened radiological incidents, these assets come under the ''authority, direction, and control'' of the Secretary.

NRC

Nuclear Regulatory Commission.

NRP

National Response Plan—The Homeland Security Act of 2002 and the HPSD–5 directed the DHS to develop an NRP. The purpose of the NRP is to integrate Federal Government domestic emergency prevention, preparedness, response, and recovery plans into one all-discipline, all-hazards plan.

OSHA

Occupational Safety and Health Administration.

PAG

Protective Action Guide—Provides the projected dose to a reference individual, from an accidental or deliberate release of radioactive material at which a specific protective action to reduce or avoid that dose is recommended.

PFO

Principal Federal Official—The PFO will act as the Secretary of Homeland Security's local representative, and will oversee and coordinate Federal activities for the incident.

PPE

Personal Protective Equipment.

R

Roentgen—Measure of exposure in air.

RAD

Radiation absorbed dose.

RAP

Radiological Assistance Program—A DOE emergency response asset that can rapid deploy at the request of State or local governments for technical assistance in radiological incidents. RAP teams are a deployable asset of the NIRT.

RDD

Radiological Dispersal Device—A device or mechanism that is intended to spread radioactive material from the detonation of conventional explosives or other means.

REAC/TS

Radiation Emergency Assistance Center/Training Site—A DOE asset located in Oak Ridge, TN, with technical expertise in medical and health assessment concerning internal and external exposure to radioactive materials. REAC/TS is a deployable asset of the NIRT.

rem

The conventional unit of dose equivalent. The product of the absorbed dose in rad, a quality factor related to the biological effectiveness of the radiation involved and any other modifying factors.

RERT

Radiological Emergency Response Team—An EPA team trained to do environmental sampling and analysis of radionuclides. RERT provides assistance during responses and takes over operation of the FRMAC from DOE at a point in time after the emergency phase. RERT is a deployable asset of the NIRT.

TEDE

Total Effective Dose Equivalent—The sum of internal and external doses.

Dated: December 5, 2005.

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[FR Doc. 05–24521 Filed 12–30–05; 8:45 am]

BILLING CODE 9110–21–P