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DEPARTMENT OF HOMELAND SECURITY

Federal Emergency Management Agency

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Planning Guidance for Protection and Recovery Following Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents

AGENCY: Federal Emergency Management Agency, DHS.

ACTION: Notice of final guidance.

SUMMARY: The Department of Homeland Security (DHS) is issuing final guidance entitled, "Planning Guidance for Protection and Recovery Following Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents" (the Guidance). This Guidance is intended for Federal agencies, State and local governments, emergency management officials, and the general public who should find it useful in developing plans for responding to an RDD or IND incident. The Guidance recommends "protective action guides" (PAGs) to support decisions about actions that should be taken to protect the public and emergency workers when responding to or recovering from an RDD or IND incident. The Guidance outlines a process to implement the recommendations, discusses existing operational guidelines that should be useful in the implementation of the PAGs and other response actions, and encourages federal, state and local emergency response officials to use these guidelines to develop specific operational plans and response protocols for protection of emergency workers responding to catastrophic incidents involving high levels of radiation and/or radioactive contamination.

DATES: This notice is effective upon publication in the *Federal Register*.

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SUPPLEMENTARY INFORMATION:

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Background

This Guidance was developed to address the critical issues of protective actions and protective action guides (PAGs) to protect human health and to mitigate the effects caused by terrorists' use of a Radiological Dispersal Device (RDD) or Improvised Nuclear Device (IND). This document provides guidance for site cleanup and recovery following an RDD or IND incident, and affirms the applicability of existing 1992 EPA PAGs for radiological emergencies.

The development of this Guidance was directed by the White House, Office of Science and Technology Policy, through the National Science and Technology Council, Committee on Homeland and National Security, Subcommittee on Standards (SoS). In 2003, the SoS convened a senior level Federal working group, chaired by DHS, to develop guidance for response and recovery following a radiological dispersal device (RDD) or improvised nuclear device (IND) incident. The working group consisted of senior subject matter experts in radiological/nuclear emergency preparedness, response, recovery, and incident 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 Nuclear Regulatory Commission (NRC).

On January 3, 2006, DHS issued the "Preparedness Directorate; Protective Action Guides for Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents; Notice" (71 FR 174, Jan. 3, 2006), and requested public comments on this interim Guidance. Some changes to the Guidance were made as a result of these comments. A summary of the comments on the interim Guidance document and responses are available at Docket ID No. FEMA-2004-0004 at http://www.regulations.gov.

In addition to the issuance of this Guidance, in response to interagency working group discussions and public comments, further guidance will be provided for the consequences that would be unique to an IND attack. This Guidance was not written to provide specific recommendations for a nuclear detonation (IND), but to consider the applicability of existing PAGs to RDDs and INDs. In particular, it does not consider very high doses or dose rate zones expected following a nuclear weapon detonation and other complicating impacts that can significantly affect life-saving outcomes, such as severely damaged infrastructure, loss of communications, water pressure, and electricity, and the prevalence of secondary hazards. Scientifically sound recommendations for responders are a critical component of post-incident life-saving activities, including implementing protective orders, evacuation implementation, safe responder entry and operations, and urban search and rescue and victim extraction. In the interim, this Guidance should be used until the IND guidance is developed.

The intended audience of this document is Federal, State, and local radiological emergency response and incident management officials. This Guidance is not intended to impact site cleanups occurring under other statutory authorities such as the Environmental Protection Agency's (EPA) Superfund program, the Nuclear Regulatory Commission's (NRC) decommissioning program, or other Federal and State cleanup programs. In addition, the scope of this Guidance does not include situations involving U.S. nuclear weapons accidents.

In addition to the issuance of this Guidance, further guidance is being planned for the devastating consequences that would be unique to INDs. In the interim, the present document will provide general RDD and IND guidance.

By agreement with the Environmental Protection Agency (EPA), the Guidance being published today is final and its substance will be incorporated without change into the revision of the 1992 EPA Manual of Protective Actions Guides and Protective Actions for Nuclear Incidents (the PAG Manual). This notice of final guidance will therefore sunset upon publication of the new EPA PAG Manual (see, http://www.epa.gov/radiation/rert/pags.html). The reader will then be directed to the new EPA PAG Manual, where these provisions may be found.

(a) Introduction

For the early and intermediate phases of response, this document presents levels of projected radiation dose at which the Federal Government recommends that actions be considered to avoid or reduce adverse public health consequences from an RDD or IND incident. This document incorporates 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 Guidance presents a process for establishing appropriate exposure levels based on site-specific circumstances. This Guidance addresses key radiological protection questions at each stage of an RDD or IND incident (early, intermediate, and late) and constitutes advice by the Federal government to Federal, State, and local decision makers.

The objective of the Guidance is to aid decision makers in protecting the public, first responders, and other emergency workers from the effects of radiation, and cleaning up the affected area, 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.

This Guidance for RDD and IND incidents is not a set of absolute standards. The guides 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 justified. The Guidance provides Federal**,** 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.

This RDD/IND Guidance 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 affecting 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 results in a radiological incident.

(1) Radiological Dispersal Device (RDD)

An RDD poses a threat to public health and safety through the malicious spread of radioactive material 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 several square miles. However, most experts agree that the likelihood of impacting a very large area is low. In most plausible scenarios, the radioactive material would not result in acutely harmful radiation doses, and the primary public health concern from those materials would be increased risk of cancer to exposed individuals. Hazards from fire, smoke, shock (physical, electrical, or thermal), shrapnel (from an explosion), hazardous materials, and other chemical or biological agents may also be present.

(2) Improvised Nuclear Device (IND)

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 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 and deposit over very large areas. If a 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 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. An IND would have grave consequences for the human population and create a large radius of severe damage from blast and fires, which could not occur in a nuclear power plant accident.

Second, the radiological release from an RDD or IND may start without any advance warning and would likely have a relatively short duration. In a major nuclear power plant accident, there is likely to be several hours or days of warning before the release starts, and the release is likely to be drawn out over many hours. This difference means that most early phase, and some intermediate phase, protective action decisions, which may be made in timely fashion during power plant incidents, must be made much 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 center with a large population. Because of the rural setting in which many nuclear facilities are located, the lower number and density of people affected by a nuclear plant incident would be less, making evacuations much more manageable, and the amount of critical infrastructure impacted is also likely to be smaller.

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

Fifth, the radioactive material releases from a nuclear power plant incident would be well known in advance based on reactor operational characteristics whereas releases associated with an RDD or IND would not.

Sixth, in an act of terrorism, the incident scene becomes a crime scene. As such, the crime scene must be preserved for forensic investigation. This may impact emergency responders during the early and intermediate phases of response. It should be noted that other personnel responding to the incident (i.e., law enforcement, security personnel) will be involved in addition to emergency responders.

(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 radiological incidents. The phases represent time periods in which response officials would be making public health protection decisions. 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 protective actions are required, and when actual field measurement data generally are not available. Exposure to the radioactive plume, short-term exposure to deposited radioactive materials, and inhalation of radioactive material are generally taken into account 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, considering a time period for protective actions of hours to a few days. 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, however, there may be no time to take protective actions to significantly reduce plume exposure. Also, 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 may only be time to make early phase protective action recommendations (e.g., evacuation, or shelter-in-place) many miles from the explosion to protect areas against exposure to fallout. Areas close to the explosion will be devastated, and communications and access will be extremely limited. Assistance will likely not be forthcoming or even possible for some hours. Self-guided protective actions are likely to be the best recourse for most survivors (e.g., evacuation perpendicular to the plume movement if it can be achieved quickly, or sheltering in a basement or large building for a day or more after the incident[1]). Due to the lack of communication and access, outside guidance and assistance to these areas can be expected to be delayed. Therefore, response planning and public outreach programs are critical measures to meet IND preparedness objectives.

(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 incident 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 can be terminated.

During the intermediate phase, decisions must be made on the initial actions needed to recover from the incident, reopen critical infrastructure, and return to a state of relatively 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. Local officials must weigh public health and welfare concerns, potential economic effects, and many other factors when making decisions. For example, it can be expected that hospitals

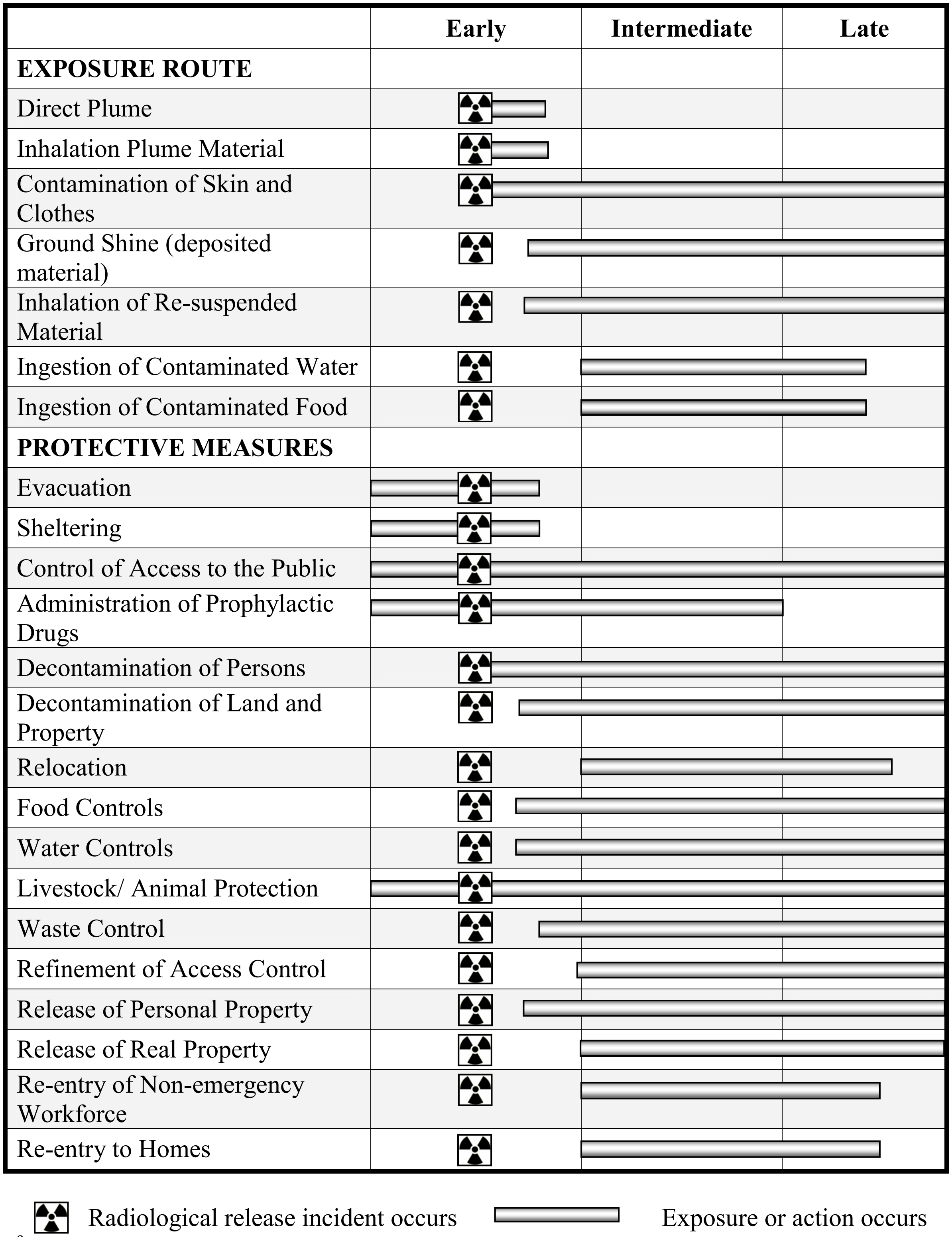
[1] Additional protective action guides and recommendations are needed for the close-in zones after an IND. A follow-on Federal effort is underway to address this critical need.

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.

<u>(3) Late Phase</u>

The late phase is the period when recovery and cleanup actions designed to reduce radiation levels in the environment to acceptable levels are commenced. This phase ends when all the remediation actions have been completed. With additional time and increased understanding of the situation, there will be opportunities to involve key stakeholders in providing sound, cost-effective cleanup recommendations that are protective of human health and the environment. 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 alternatives, costs, and impacts. The relationship between typical protective actions and the phases of the incident response are outlined in Figure 1. There is overlap between the phases; this framework should be used to inform planning and decision-making.

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



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

[b] In certain circumstances, food and water interdiction may occur in early phases. In addition, some exposure routes (e.g., ingestion of contaminated food) may occur earlier than depicted in the figure, depending on the unique characteristics of the incident.

(d) Guidance for RDD and IND Incidents

This section defines protective actions and protective action guides, and provides guidance for their implementation in RDD and IND incidents. In addition, this section provides guidance for protection of emergency workers, and a strategy for devising cleanup plans, criteria, and options.

(1) Protective Actions

Protective actions are activities that should be conducted in response to an RDD or IND incident in order to reduce or eliminate exposure 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 medical countermeasures, decontamination (including decontamination of persons evacuated from the affected area), 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. Many factors should be considered when deciding whether or not to order a protective 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 population increases.

(2) Protective Action Guides (PAGs)

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 are designed to be taken before the anticipated dose is realized.

The Environmental Protection Agency (EPA) has 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). The PAGs presented in this manual, hereafter referred to as the 1992 EPA PAGs, are non-regulatory. They are designed to provide a flexible basis for decisions under varying emergency circumstances. The 1992 EPA PAGs meet the following principal 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 result in more benefit than harm.

The 1992 EPA PAG Manual, however, was not developed to address response actions following radiological or nuclear terrorist incidents and does not address long-term cleanup. The 1992 EPA 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 1992 EPA PAGs were designed principally to address the impacts of commercial NPP accidents, the worst type of incident under consideration at that time. This is important for two reasons: commercial nuclear power plant accidents are almost always signaled by preceding events, giving plant managers time to make decisions, and giving local emergency managers time to communicate with the public and initiate evacuations if necessary. In addition, the suite of radionuclides present at nuclear power plants is well-known, and is dominated by relatively short-lived isotopes.

The 1992 EPA PAG Manual provides a significant part of the basis of this document and should be referred to for additional details. In deriving the recommendations contained in this Guidance, new types of incidents and scenarios that could lead to environmental radiological contamination were considered. The interagency working group determined that the 1992 EPA PAGs for the early and intermediate phases, including emergency responder guidelines, are also appropriate for use in RDD and IND incidents. This Guidance is intended to supplement the 1992 EPA PAG Manual for application to RDD and IND incidents, including providing new late phase guidance.

The RDD/IND Guidance provides generic criteria based on balancing public health and welfare with the risk of various protective actions applied in each of the phases of an RDD or IND incident. The RDD/IND Guidance is specific to radiation and radioactive materials, and must be considered in the context of other chemical or biological hazards that may also be present. Though the early and intermediate PAGs in this Guidance are values of dose to be 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 into and out of contaminated areas.

Because of the short time frames required for emergency response decisions in the early and intermediate phases, it is likely there will not be opportunities for local decision makers to consult with a variety of stakeholders before taking actions. Therefore, this Guidance incorporates the significant body of work done in the general context of radiological emergency response planning from the development of the 1992 EPA PAGs, and represents the results of scientific analysis, public comment, drills, exercises, and a consensus at the Federal level for appropriate emergency action.

In order to use the early and intermediate phase PAGs to make decisions about appropriate protective actions, decision makers will need information on suspected radionuclides; projected plume movement, and radioactive 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) Early and Intermediate Phase Protective Action Guides for RDD and IND Incidents

The early and intermediate phase RDD/IND PAGs are generally based on the following sources: the 1992 EPA PAGs developed by EPA in coordination with other Federal agencies through the Federal Radiological Preparedness Coordinating Committee; guidance developed by the FDA for food and food products and the distribution of potassium iodide. Table 1 provides a summary of the early and intermediate phase PAGs for protection of the general public in an RDD or IND incident and key protective actions.

Table 1.— Protective Action Guides for RDD and IND Incidents

Phase	**Protective Action Recommendation**	**Protective Action Guide**
Early	Sheltering-in-place or evacuation of the public[a]	1 to 5 rem (0.01-0.05 Sv) projected dose[b]
	Administration of prophylactic drugs - potassium iodide[c, e] Administration of other prophylactic or decorporation agents[d]	5 rem (0.05 Sv) projected dose to child thyroid[c, e]
Intermediate	Relocation of the public	2 rem (0.02 Sv) projected dose first year. Subsequent years, 0.5 rem/y (0.005 Sv/y) projected dose[b]
	Food interdiction	0.5 rem (0.005 Sv) projected dose, or 5 rem (0.05 Sv) to any individual organ or tissue in the first year, whichever is limiting
	Drinking water interdiction	0.5 rem (0.005 Sv) projected dose in the first year

[a]Should normally begin at 1 rem (0.01 Sv); take whichever action (or combination of actions) that results in the lowest exposure for the majority of the population. Sheltering may begin at lower levels if advantageous.
[b]Total Effective Dose Equivalent (TEDE) - the sum of the effective dose equivalent from external radiation exposure and the committed effective dose equivalent from inhaled radioactive material.
[c]Provides thyroid protection from radioactive iodine only.
[d]For other information on other radiological prophylactics and medical countermeasures, refer to http://www.fda.gov/cder/drugprepare/default.htm, http:/www.bt.cdc.gov/radiation, or http://www.orau.gov/reacts.
[e]Committed Dose Equivalent (CDE). FDA understands that a KI administration program that sets different projected thyroid radioactive dose thresholds for treatment of different population groups may be logistically impractical to implement during a radiological emergency. If emergency planners reach this conclusion, FDA recommends that KI be administered to both children and adults at the lowest intervention threshold (i.e., > 5 rem (0.05 Sv) projected internal thyroid dose in children) (FDA 2001).

In the early and intermediate phases of an RDD or IND incident there may not be adequate information to determine radiation levels or make dose projections because there may be little or no advance notice of an attack, the characteristics of the RDD or IND may not be immediately known, monitoring equipment may not be available to make measurements, or there may not be time to do measurements or projections before emergency response actions need to be initiated. Therefore, to use this guide to determine whether protective action is needed in a particular situation, it may be necessary to compare the PAGs to results of a dose projection. In general, it should be emphasized that realistic assumptions, based on incident-specific information, should be used when making radiation dose projections so that the final results are representative of actual conditions rather than overly conservative exposures. It is very important that local officials responsible for carrying out emergency response actions conduct advance planning to ensure that they are adequately prepared if such an incident were to occur.

(A) Early Phase PAGs

For the early phase, the 1992 EPA PAGs for evacuation and sheltering-in-place are appropriate for RDD and IND incidents (see Table 1). Early phase protective action decisions in an RDD or IND must be made quickly, and with very little confirmatory data. While sheltering-in-place should be carried out at 1 rem (0.01 Sv) sheltering-in-place can begin at any projected dose level.

FDA guidance on the administration of stable iodine is also considered appropriate (useful primarily for NPP incident involving radioiodine release). The administration of other medical countermeasures should be evaluated on a case-by-case basis and depend on the nature of the event and radionuclides involved.

The initial zone should be established and controlled around the incident site, as is the case for other crime scenes and hazards. This Guidance allows for the refinement of that area if the radiation exposure levels warrant such action. Advance planning by local officials for messaging, communications, and actions in the event of an RDD or IND are strongly encouraged.

(B) Intermediate Phase PAGs

The decisions in the intermediate phase will focus on the return of key infrastructure and services, and the rapid return to 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 concern. Thus, the RDD/IND Guidance serves to guide decisions on returning to impacted areas, leaving impacted areas, and providing assurance that an area was not impacted. The intermediate phase is also the period during which planning for long-term site cleanup and remediation should be initiated.

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 rem (0.02 Sv) in the first year and 0.5 rem (0.005 Sv) in any subsequent year are considered appropriate for RDD and IND incidents. However, for 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 relocation decisions, the availability of adequate accommodations for relocated people should be considered. Decision makers may need to consider limiting action to those areas most severely affected, phasing relocation implementation based on the resources available.

The relocation PAGs apply principally to personal residences, but may impact other locations as well. For example, these PAGs 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 individual occupancy time 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 by residents in a home.

The intermediate phase PAG for the interdiction of food is set at 0.5 rem (0.005 Sv) projected dose in the first year, and the intermediate phase PAG for the interdiction of drinking water is set at 0.5 rem (0.005 Sv) projected dose for the first year for RDD and IND incidents. These values are consistent with those now used or being considered as PAGs for other types of nuclear/radiological incidents.

The use of simple dose reduction techniques is recommended for personal property and all potentially contaminated areas that continue to be occupied. This technique is also consistent with the 1992 EPA PAGs developed for other types of nuclear/radiological incidents. Examples of simple dose reduction techniques would be washing all transportation vehicles (e.g., automobiles, trains, ships, and aircraft), personal clothing, eating utensils, food preparation surfaces, and other personal property before next use, as practicable and appropriate.

(4) Late Phase Guidance

The late phase involves the final cleanup of areas and property at which radioactive material is 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 cleanup and site recovery.

Because of the extremely broad range of potential impacts that may occur from RDDs and INDs (e.g., light contamination of one building to widespread destruction of a major metropolitan area), a pre-established numeric cleanup 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 and the impacted area is small, 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, achieving low cleanup levels for remediation of the entire area, and/or maintaining existing land uses, may not be practicable.

It should be noted that an intermediate phase PAG is not equivalent to a starting point for development of the late phase cleanup process. However, contamination and radiation levels existing after an incident (e.g., concentrations, or dose rates), as well as actions already taken, provide practical starting points for further action and cleanup. The goal of cleanup is to reduce those levels as low as is reasonable. It is possible that final criteria for reoccupation at a given incident site may be either below or above the intermediate phase PAG dose value, since no dose or risk cap for the late phase is explicitly recommended under this Guidance.

Late phase cleanup criteria should be derived through a *site-specific optimization* process, which should include potential future land uses, technical feasibility, costs, cost-effectiveness, and public acceptability. 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. 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 as a basis for RDD and IND site cleanup planning.

Broadly speaking, optimization is a flexible, multi-attribute decision process that seeks to weigh many factors. Optimization analyses are quantitative and qualitative assessments applied at each stage of site recovery decision-making, from evaluation of remedial options to implementation of the chosen alternative. The evaluation of cleanup alternatives, for example, should factor in all relevant variables, including areas impacted (e.g., size and location relative to population), types of contamination (chemical, biological, and/or radioactive), human health, public welfare, technical feasibility, costs, and available resources to implement and maintain remedial options, short-term effectiveness, long-term effectiveness, timeliness, public acceptability, and economic effects (e.g., on residents, tourism, and business, and industry).

Various Federal, and State agencies, along with other organizations (e.g., national and international advisory organizations), already have guidance and tools that may be used to help establish cleanup levels. The optimization process allows local decision makers to draw on the thought processes used to develop the dose and/or risk benchmarks used by these State, Federal, or other sources. These benchmarks, though developed within different contexts, may be useful for analysis of cleanup options. Decision makers might reasonably determine that it is appropriate to move up or down from these benchmarks, depending on the site-specific circumstances and balancing of other relevant factors.

In developing this Guidance, the Federal Government recognized that experience from existing programs, such as the EPA's Superfund program, the NRC's standards for decommissioning and decontamination to terminate a plant license, and other national and international recommendations, may be useful in planning the cleanup and recovery efforts following an RDD or IND incident. This Guidance allows the consideration and incorporation, as appropriate, of any or all of the existing environmental program elements.

The site-specific optimization process includes quantitative and qualitative assessments applied at each stage of site cleanup decision making, from initial scoping and stakeholder outreach, to evaluation of cleanup options, to implementation of the chosen alternative. The evaluation of options for the late phase of recovery after an RDD or IND incident should consider 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 risk
- Public welfare
- Ecological risks
- Actions already taken during the early and intermediate phases
- Projected land uses
- 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
- Short-term effectiveness
- Long-term effectiveness
- Timeliness
- Public acceptability, including local cultural sensitivities
- Economic effects (e.g., on employment, tourism, and business)
- Intergenerational equity

The site-specific optimization process provides the best opportunity for decision makers to gain public confidence through the involvement of stakeholders. This process should begin during, and proceed independently of, intermediate phase protective action activities.

Appendix 3 provides additional details on a process that may be used to implement this Guidance, describing the role of the Federal Government and how it could integrate its activities with State and local governments and the public. For some radiological terror incidents, States may take the primary leadership role in cleanup and contribute significant resources toward recovery of the site.

As explained in Appendix 3, the Incident Command or Unified Command should develop a schedule with milestones for conducting the optimization process as soon as practicable following the incident. While the goal should be to complete the initial optimization process as soon as possible following an incident (depending on the size of the incident), the schedule must take into consideration incident-specific factors that would affect successful implementation. This schedule may need to reflect a phased approach to cleanup and is subject to change as the cleanup progresses.

(5) Emergency Worker Guidelines

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. Following an IND detonation in particular, the highest priority missions should also include actions such as suppression of fires that could result in further loss of life.

For the purposes of this Guidance, "emergency worker" is defined as any worker who performs an early or intermediate phase work action. Table 2 shows the emergency worker guidelines for early phase emergency response actions. In intermediate and late phase actions (i.e., cleanup and recovery), standard worker protections, including the 5 rem (0.05 Sv) occupational dose limit, apply.

Table 2.—Emergency Worker Guidelines in the Early Phase[2]

Total effective dose equivalent (TEDE) [a] guideline	Activity	Condition
5 rem (0.05 Sv)	All occupational exposures.	All reasonably achievable actions have been taken to minimize dose.
10 rem (0.1 Sv)	Protecting valuable property necessary for public welfare (e.g., a power plant).	• All appropriate actions and controls have been implemented; however, exceeding 5 rem (0.05 Sv) is unavoidable. • Responders have been fully informed of the risks of exposures they may experience. • Dose >5 rem (0.05 Sv) is on a voluntary basis. • Appropriate respiratory protection and other personal protection is provided and used. • Monitoring available to project or measure dose.
25 rem (0.25 Sv) [b]	Lifesaving or protection of large populations. It is highly unlikely that doses would reach this level in an RDD incident, however, worker doses higher than 25 rem (0.25 Sv) are conceivable in a catastrophic incident such as an IND incident.	• All appropriate actions and controls have been implemented; however, exceeding 5 rem (0.05 Sv) is unavoidable. • Responders have been fully informed of the risks of exposures they may experience. • Dose >5 rem (0.05 Sv) is on a voluntarily basis. • Appropriate respiratory protection and other personal protection is provided and used. • Monitoring available to project or measure dose.

[a] The projected sum of the effective dose equivalent from external radiation exposure and committed effective dose equivalent from internal radiation exposure.
[b] EPA's 1992 PAG Manual states that "Situations may also rarely occur in which a dose in excess of 25 rem for emergency exposure would be unavoidable in order to carry out a lifesaving operation or avoid extensive exposure of large populations." Similarly, the NCRP and ICRP raise the possibility that emergency responders might receive an equivalent dose that approaches or exceeds 50 rem (0.5 Sv) to a large portion of the body in a short time (Limitation of Exposure to Ionizing Radiation, National Council on Radiation Protection and Measures, NCRP Report 116 (1993a). If lifesaving emergency responder doses approach or exceed 50 rem (0.5 Sv) emergency responders must be made fully aware of both the acute and the chronic (cancer) risks of such exposure.

[2] In the intermediate and late phases, standard worker protections, including the 5 rem occupational dose limit, would normally apply.

This Guidance document and the emergency worker guidelines were developed for a wide range of possible radiological scenarios, from a small RDD that may impact a single building to an IND that could potentially impact a large geographic region. Therefore, the 5, 10 and 25 rem guidelines (Table 2) should not be viewed as inflexible limits applicable to the range of early phase emergency actions covered by this Guidance. Because of the range of impacts and case-specific information needed, it is impossible to develop a single turn-back dose level for all responders to use in all events, especially those that involve lifesaving operations. Indeed, with proper preparedness measures (training, personal protective equipment, etc.) many radiological emergencies addressed by this document, even lifesaving operations, may be manageable within the 5 rem (0.05 Sv) occupational limit. Moreover, Incident Commanders should make every effort to employ the "as low as reasonably achievable" (ALARA) principle after an incident. Still, in some incidents medically significant doses above the annual occupational 5 rem (0.05 Sv) dose limit may be unavoidable. For instance, in the case of a catastrophic incident, such as an IND, Incident Commanders may need to consider raising the lifesaving and valuable property (i.e., necessary for public welfare) emergency worker guidelines in order to prevent further loss of life and prevent the spread of massive destruction. Ensuring that emergency workers have full knowledge of the associated risks prior to initiating emergency action and medical evaluation of emergency workers after such exposure is essential. (See Appendix 1 for additional discussion of ALARA.)

Ideally, the Incident Commanders should define and enforce the emergency dose limits in accordance with the immediate risk situation and the type of emergency action being performed (see Table 2). However, in the case of an attack it may not be possible to conduct dose measurements or projections before initiating emergency response activities. Therefore, it is crucial that officials responsible for carrying out emergency response actions in the early phase conduct thorough advance planning to ensure that they are adequately prepared if such an incident occurs. Planning should include evaluating data and information on possible or anticipated radiation exposures in RDD or IND incidents, developing procedures for reducing and controlling emergency responder exposures to allowable dose limits (Table 2), obtaining appropriate personal protective equipment (e.g., respirators, clothing) for protecting emergency responders who enter contaminated areas, and developing appropriate decision-making criteria for responding to catastrophic incidents that may involve high radiation exposure levels. Planning should also include informing and educating emergency workers about emergency response procedures and controls as well as the acute and chronic (cancer) risks of exposure, particularly at higher dose levels. Effective advance planning will help to ensure that the emergency worker guidelines are correctly applied and that emergency workers are not exposed to radiation levels that are higher than necessary in the specific emergency action.

In addition, as part of advance planning, officials should develop a process for assessing hazards and for determining appropriate actions in incidents that may involve high radiation doses. Decisions regarding emergency response actions in incidents involving high radiation exposures require careful consideration of the benefits to be achieved by the "rescue" or response action (e.g., the significance of the outcome to individuals, large populations, general welfare, or valuable property necessary for public welfare), and the potential health impacts (i.e., acute and chronic) to emergency workers. The planning for a potential high radiation exposure incident should consider how to weigh the potential for and significance of the success of the emergency response/rescue operation against the potential for and significance of the health and safety risks to the emergency workers. Federal, state and local emergency response officials should use these guidelines to develop specific operational plans and response protocols for protection of emergency response workers.

(e) Operational Guidelines for Early and Intermediate PAGs

Implementation of the early and intermediate PAGs may be 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 whether actions need to be implemented. Federal agencies are continuing development of operational guidelines to support the application of this Guidance, and other site-level decisions, therefore, they are provided here in overview only.

Some values already exist that could potentially serve as operational guidelines for RDD and IND response and recovery operations, and there are various tools available to help derive operational guidelines for response planning. Appendix 4 presents a summary of the types of operational guidelines for RDD and IND response operations currently under development.

Additional tools and assessment methodologies to aid in planning and development of operational guidelines for use with PAGs for a wide range of situations are available from the Federal Radiological Monitoring and Assessment Center (FRMAC). These tools and methods are written to support FRMAC operations during radiological and nuclear emergency responses. The FRMAC manuals provide detailed methods for computing Derived Response Levels (DRLs) and doses based on measurement or modeling results and suggest input parameters for various situations[3].

[3] These materials and additional information on the FRMAC can be obtained at http://www.nv.doe.gov/nationalsecurity/homelandsecurity/frmac

Some examples of existing values that can be used as operational guidelines for RDD and IND response operations and tools that could be used to establish site-specific operational guidelines include**,** derived response levels, derived intervention levels for food, and radiation levels for control of access to radiation areas.

(1) Derived Response Levels (DRLs)

The 1992 EPA PAG Manual contains guidance and Derived Response Levels (DRLs) for various potential exposure pathways, including external exposure, inhalation, submersion, ground shine, and drinking water, for application in the early and intermediate phases. These values serve as, or can be adapted to serve as, operational guidelines to readily determine if protective actions need to be implemented. The summed ratios of radionuclide concentrations obtained through field measurements can be compared to the DRLs to determine whether the PAGs are likely to be exceeded. If concentrations of radionuclides obtained through field measurements are less than the DRLs, the PAGs are not likely to be exceeded and, thus, a protective action may not need to be taken.

(2) Derived Intervention Levels (DILs) for Food

The FDA has developed Derived Intervention Levels (DILs) for implementation of the early and intermediate PAGs for food. These DILs establish levels of contamination that can exist on crops and in food products and still maintain dose levels below the food PAGs, and could therefore be used as operational guidelines for RDD and IND incidents. More information on DILs can be found in "Accidental Radioactive Contamination of Human Food and Animal Feeds: Recommendations for State and Local Agencies" (U.S. Department of Health And Human Services, Food and Drug Administration, August 13, 1998).

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

Additional operational guidelines for use in the early and intermediate phases of response are being developed for issues such as clearance of personal and real property, land and facility access, and for response actions. A DOE project supported by an interagency effort is developing needed tools and operational guidelines that address continued use, or necessary control for personal property (e.g., vehicles, equipment, personal items, debris) and real property (e.g., buildings, roads, bridges, residential and commercial areas, national monuments and icons) that may be impacted by an RDD or IND incident. The effort includes consideration of short and long term use or access to areas. A DOE report[4] is available for review, and use as appropriate. The report includes proposed operational guidelines and their technical derivation, and provides tools such as the computer model RESRAD-RDD[5] for calculating incident-specific guidelines and worker stay-time tables for access control, and dose-based soil and building contamination levels to assist in the site-specific optimization process. The goal of the DOE report is to provide sufficient information to assist decision makers and responders in executing their responsibilities in a safe way. Appendix 4 of this Guidance provides a more detailed overview of the operational guidelines contained in the DOE draft report and their intended applications.

Appendix 1—Planning for Protection of Emergency Workers Responding to RDD and IND Incidents

The purpose of this appendix is to provide Federal, state, and local decision makers with information on how to prepare for, and implement emergency worker guidance in RDD and IND incidents. Because there may not be adequate information or time for determining radiation

[4] Preliminary Report on Operational Guidelines Developed for Use in Emergency Preparedness and Response to a Radiological Dispersal Device Incident, DOE/HS-0001. The report and associated material will be available at http://www.ogcms.energy.gov.

[5] RESRAD-RDD is derived from RESRAD, which is a computer model designed to estimate radiation doses and risks from residual radioactive materials. The RESRAD model has been applied to determine the risk to human health posed at over 300 sites in the United States and abroad that have been contaminated with radiation.

levels or making dose projections in the early phase of an RDD or IND incident, it is very important that emergency management officials conduct worker health and safety planning and training in advance to ensure they are adequately prepared if such an incident occurs.

Planning should include evaluating data and information on possible or anticipated radiation exposures in RDD and IND incidents and on acute and chronic risks of radiation exposures, developing procedures for reducing and controlling emergency worker exposures, obtaining appropriate personal protective equipment (e.g., respirators, protective clothing) to help protect emergency workers who enter exposure areas, and developing appropriate decisionmaking criteria for responding in catastrophic incidents, such as an IND, that may involve high exposure levels. Planning should also include training and educating emergency workers about emergency response procedures in radiological environments, radiation exposure controls and the risks of exposure, particularly at higher levels. Effective planning and training will help to ensure that exposures to emergency workers are kept to the lowest radiation levels necessary for the particular emergency response action.

This appendix provides information to assist local, State, and Federal authorities, and emergency workers in planning for radiological emergencies, in particular those related to terrorist attacks using RDDs and INDs. The appendix is not intended to provide comprehensive training guidance. Other information useful in the planning process may be available from the following organizations:

- the National Council on Radiation Protection and Measurements,
- the International Commission on Radiological Protection,
- the International Atomic Energy Agency,
- the American Nuclear Society,

- the Health Physics Society, and
- the Conference of Radiation Control Program Directors.

(a) Guidelines for Emergency Workers in Responding to RDD and IND Incidents

Table 2 in Section (d)(5) of the Guidance shows the emergency worker guidelines for the early phase. In the intermediate and late phases, standard OSHA and other worker health and safety standards apply. The DOE and NRC also have standards that govern worker health and safety for normal operations at their owned or licensed facilities. OSHA's occupational radiation dose limit (1.25 rem (0.0125 Sv) per annual quarter, or 5 rem (0.05 Sv) total in one year) minimizes risk to workers consistent with the Occupational Health and Safety Act (29 USC651 et. seq.).

In many radiological incidents, particularly RDD situations, the actual dose to emergency workers may be controlled to less than 5 rem (0.05 Sv). However, in other radiological incidents precautions may not be sufficient or effective to keep emergency worker doses at or below 5 rem (0.05 Sv), because of the magnitude of the incident and because certain measures typically used to control exposures in normal operations may not be applicable. For example, one of the major radiation protection controls used in normal radiological operations is containment of the radioactive material. Another is to keep people away from the source material. During emergency response to an RDD or IND incident use of these controls may not be possible due to the nature of the incident and the urgency of response actions. As a result, high radiation exposures for emergency responders may be unavoidable and have the potential to exceed regulatory limits used for normal operations. Therefore, the 5, 10 and 25 rem guidelines found in Table 2 should not be viewed as absolute standards applicable to the full range of incidents covered by this guidance, but rather serve as decision points for making worker protection decisions during emergencies.

Emergency response actions in catastrophic incidents that involve high exposure levels require careful consideration of both the benefits to be achieved by the “rescue” or response action (e.g., the significance of the benefit to individuals, populations, valuable property necessary for general welfare), and the potential for acute and chronic health impacts to individuals 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 weighed against the potential for, and significance of, the health and safety risks to workers.

(b) Controlling Occupational Exposures and Doses to Emergency Workers

Appropriate measures should be taken to minimize radiation dose to emergency workers responding to an RDD or IND incident. With proper preparedness measures (e.g., training, personal protective equipment), many emergencies that this document addresses, including lifesaving actions, may be possible to manage within the 5 rem (0.05 Sv) occupational limit. Emergency management officials responsible for an incident should take steps to keep all doses to emergency workers “as low as reasonable achievable” (ALARA). Protocols for maintaining ALARA should include the following health physics and industrial hygiene practices:

- Minimizing the time spent in the contaminated area (e.g., rotation of emergency responders);
- Maintaining distance from sources of radiation;
- Shielding of the radiation source;
- Using hazard controls that are applicable to the work performed;

- Properly selecting and using respirators and other personal protective equipment (PPE), to minimize exposure to internally deposited radioactive materials (e.g., alpha and beta emitters); and
- Using prophylactic medications, when appropriate, that either block the uptake or reduce the retention time of radioactive material in the body.

To minimize the risks from exposure to ionizing radiation, all emergency responders should be trained and instructed to follow emergency response plans and protocols and be advised on how to keep exposures as low as reasonably achievable. Health physics and industrial hygiene practices should include the use of dosimetry for monitoring of individual exposure with real-time readings (i.e., real-time electronic dosimeters) and permanent records (e.g., film badges, optically stimulated luminescent [OSL], or thermoluminescent dosimeters [TLDs]). Also, employers should (1) develop procedures and training that relate measurements to dose and risk, (2) understand and practice ALARA procedures with workers, and (3) address other issues related to performing response in a radiological environment.

(c) Understanding Radiation Risks

If there is the possibility that emergency workers would receive a radiation dose higher than the 5 rem (0.05 Sv) guideline, emergency workers should be trained to understand the risk associated with such doses, including a thorough explanation of the latent risks associated with receiving doses greater than 5 rem (0.05 Sv), and acute risks at higher doses. Emergency workers should be fully aware of both the projected acute and chronic risks (cancer) they may incur in an emergency response action. Furthermore, emergency workers cannot be forced to perform a rescue action involving radiation doses above regulatory limits, and they should be given reasonable assurance that normal controls cannot be utilized to reduce doses to less than 5 rem (0.05 Sv). After the event, it is essential that emergency workers be provided with medical follow up.

The estimated risk of fatal cancer[6] for healthy workers who receive a dose of 10 rem (0.10 Sv) is about 0.46 percent over the worker's lifetime (i.e., 4-5 fatal cancers per 1000 people, or 0.4-0.5 percent). The risk scales linearly. For workers who receive a dose of 25 rem (0.25 Sv), the risk is about 1.1 percent. The risk is believed to be greater for those who are younger at the time of exposure. For example, for 20-30 year olds the estimated risk of fatal cancer at 25 rem (1.75 percent) is about twice as large as the risk for 40-50 year olds (0.8 percent).

Above 50 rem (0.5 Sv) acute effects are possible. Where lifesaving actions may result in doses that approach or exceed 50 rem (0.50 Sv), such as in an IND incident, emergency workers need to have a full understanding of the potential acute effects of the expected radiation exposure, in addition to the risk of chronic effects. The decision to take these lifesaving actions must be based on the estimation that the human health benefits of the action exceed the safety and health risks to the emergency workers.

It is important to note that the approach used to translate dose to risk in this discussion is a simplistic approach for developing rough estimates of risks for comparative purposes. Other more realistic and accurate 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 approaches rely on radionuclide-specific risk factors (e.g., found in Federal Guidance Report No. 13 and EPA Health Effects Assessment Summary Tables), and are typically used in long-term assessments, such as environmental cleanup.

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[6] Risk per dose of a fatal cancer for members of the general public is assumed to be about $6x10^{-4}$ per rem. Cancer incidence is assumed to be about $8x10^{-4}$ per rem (see Federal Guidance Report No. 13). Occupational risk coefficients are slightly higher.

(d) Preparedness

To prepare for large radiological disasters, local officials and Incident Commanders will need to have a decision-making process already developed and ready to implement when they can no longer use standard occupational dose limits or when there is the possibility that they may face decisions involving exposures approaching or exceeding 25 rem (0.25 Sv) for lifesaving operations. Preparedness entails investigating the nature of the RDD and IND incident for which local officials must be prepared, having appropriate worker health and safety plans and protocols for such incidents, and training and exercises to assure a level of readiness among officials and responders.

Incident Commanders and emergency responders should thoroughly understand the emergency worker guidelines for radiological emergency response, including specific emergency responder health and safety procedures and ALARA principles. The reader is referred to the EPA PAG Manual (May 1992), the FRMAC Radiological Emergency Response Health and Safety Manual (May 2001), and the Hazardous Waste Operations and Emergency Response (HAZWOPER) regulations. The EPA has a Worker Protection (40 CFR part 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.

The HAZWOPER regulations, found in 29 CFR 1910.120 and 1926.65, were promulgated to protect personnel working at a hazardous waste site, or a treatment, storage, or disposal facility, or performing emergency response. This standard also covers employers whose employees are engaged in emergency response without regard to the location of the hazard (unless specifically exempted or where a more protective safety and health standard applies). If an employer anticipates that their employees will respond to a potential hazard, HAZWOPER requires such actions as (1) the development of an emergency response plan (including personnel roles, lines of authority, training, communication, personal protective equipment, and emergency equipment), (2) procedures for handling a response, (3) specific training requirements based on the anticipated roles of the responder, and (4) medical surveillance. For specific interpretations regarding HAZWOPER and/or other occupational safety and health standards, employers should consult the appropriate implementing agency (e.g., appropriate Federal agencies, State Occupational Safety and Health Programs, or State Radiation Control Programs).

Appendix 2—Risk Management Framework for RDD and 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 recovery 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. A plan for implementing this framework for RDD and IND incidents is provided in Appendix 4.

The "Framework for Environmental Health Risk Management" is considered generally suitable for addressing the long-term cleanup issues for RDDs and INDs. Given the time frames following an RDD or IND incident there is generally not sufficient time in the early phase to conduct a full risk assessment and get stakeholder involvement. In order for the framework to be most useful it must be used in planning and preparing for a radiological or nuclear incident. Many of the basic risk management principles were also used in development of the 1992 EPA PAGs.

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 commensurate with the significance of the problem, the potential severity and economic impact, the level of controversy surrounding the problem, and resource constraints The health and environmental hazards that must be considered are radiation hazards, and potentially chemical or biological hazards. Other factors to be considered include the continued disruption in normal activities, loss of, or limited access to critical infrastructure and health care and general economic damage.

The framework relies on the three key principles of (1) broad context, (2) stakeholder participation, and (3) iteration. Broad context refers to placing all of the health and environmental issues in the full range of impacts and recovery factors following an RDD or IND incident, and is intended to assure that all aspects of public welfare 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 analysis base on information available, and improve 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 public health impacts 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 hazard present as a result of the incident, the options for reducing risks, and the effectiveness and costs of those options. Decision makers also compare the economic, social, cultural, ethical, legal, and public policy implications associated with each option, as well as the unique safety and health hazards facing emergency responders and ecological hazards the cleanup actions themselves may cause. Often a stakeholder working group can provide input needed to consider all of the relevant information.

Stakeholders can provide valuable input to decision makers during the long-term cleanup 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 individuals 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, or nonprofit organizations representing such individuals. They may also include those who have regulatory responsibility, and those who may speak on behalf the environment generally, business and economics, or future generations.

Stakeholder input should be considered throughout all stages of the framework as appropriate, including analyzing the risks, 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 reasoned 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 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 decision-making 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. The incident 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 emergency 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 of the public from the site must be considered within the context of the societal objectives to be achieved, and must examine cleanup options in the context of other risks members of the community face. There may also be broader public health or environmental issues that local governments and public health agencies have to confront and consider.

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

- Public health protection goals, including mitigating acute hazards and long-term chronic issues, and protecting 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 highways, 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 sewage 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.

<u>(2) Analyze the Risks</u>

To make effective risk management decisions, decision makers and other stakeholders need to know what potential harm a situation poses and how great the likelihood is that people or the environment will be harmed. The nature, extent, and focus of a risk analysis should be guided by the risk management goals. The results of a risk analysis—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 analyses 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 both the scientific foundation of risks and the procedures for making inferences about risks 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. They should also provide decision makers with evaluations of the scientific support for their 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 the nature of their connection with the cause of the risk. For this reason, risk analyses 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 analyses and in identifying specific health and ecological concerns.

(3) Examine the Options

This stage of the risk management process involves identifying potential cleanup 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 how the process of reducing exposures and risks can improve 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 the best option. Key questions include determining (1) the expected benefits and costs, (2) distribution of benefits and costs across the impacted community, (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. Adverse economic consequences may include impacts on a community, such as 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 an 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 necessary. For example, removing all the soil from an entire valley that is 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 to daily activities and a sense of normalcy. Of course, the feasibility and cost-effectiveness of an option may change in the future.

(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 intentions are met. In some cases, win-win solutions that allow stakeholders with divergent views to achieve their primary goals are possible. Decision makers should allow the opportunity for public comment on proposed decisions.

Decision makers must weigh the value of obtaining additional information against the need for a decision, however uncertain the decision may be. Sometimes a decision must be made primarily on a precautionary basis. 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.

(5) Take Action to Implement the Decision

When options have been evaluated and decisions made, a plan for action should be developed and implemented. The issuance of protective action recommendations is the responsibility of local officials to protect the public and the environment during emergencies: long-term cleanup decisions have the same basic risk management framework, but entail substantially more analysis and stakeholder involvement. When government officials and stakeholders have agreed on a strategy, cleanup activities should commence. It may take considerable time for these actions to be completed, 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 decision-making stage. The effectiveness of the process leading to implementation should also be evaluated at this stage. Evaluation provides important information about the following: 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 which indicates that a decision or stage of the framework should be revisited; whether unintended consequences have emerged; how stakeholder involvement contributed to the outcome; and what lessons can be learned to guide future risk management decisions, or to improve the decision-making process.

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

(b) Technical Advisory Committee

Making decisions on the appropriate cleanup approaches and levels following an RDD or IND incident 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 decision makers should expect public anxiety in the face of a terrorist act involving radioactive materials. Different regulatory authorities and organizations historically have taken different cleanup approaches for radioactively contaminated industrial 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 to approach this situation, and decision makers will need to tailor the process to particular site circumstances. This section describes one approach 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 in Washington, DC. 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 Federal agencies, State and tribal public health and environmental agencies, universities and private industries, the local health department, and possibly representatives of local workers and the community. To maximize objectivity, the committee should be an independent group that will provide input to the decision makers, not be a part of the decision-making team.

The scientific expertise in the committee should reflect the needs of the decision makers in all aspects of the decontamination process (e.g., environmental sampling, epidemiology, risk assessment, industrial hygiene, statistics, health physics, 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 decision making group at the site.

The decision makers should develop a charter for the committee that specifies 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.

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 Cleanup Implementation

This appendix provides a federally-recommended approach for environmental cleanup after an RDD or IND incident to accompany the risk management principles outlined in Appendix 2. This approach describes how State and local governments may coordinate with Federal agencies, and the public, consistent with the National Response Framework (NRF). The approach does not attempt to provide detailed descriptions of State and local roles and expertise. It is assumed those details will be provided in State and local level planning documents that address radiological/nuclear terrorism incidents.

This site cleanup approach is intended to function under the NRF 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 NRF. This plan is also 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 approach are provided to address the specific needs and wide range of potential impacts of an RDD or IND incident. During the intermediate phase, site cleanup planners should begin the process described below, under the direction of the on-site IC/UC, and in close coordination with Federal, State and local officials. After early and intermediate phase activities have come to conclusion and only long-term cleanup activities are ongoing, the IC/UC structure may continue to support planning and decision-making 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 extended site cleanup than what is required under emergency circumstances.

Radiological and nuclear terrorism incidents cover a broad range of potential scenarios and impacts. This appendix assumes that the Federal Government is a primary funding agent for site cleanup. In particular, the process described for the late phase in section (d)(4) of this document assumes an incident of relatively large 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. Decision makers should recognize that for some radiological/nuclear terrorist incidents, States will take the primary leadership role and contribute significant resources toward cleanup of the site. This section does not address such a scenario, but states may choose to use the process described here.

This implementation plan does not address law enforcement coordination during terrorism incident responses, including how the FBI will manage on-scene activities immediately following an act of terror. Agencies' roles and responsibilities will be implemented according to the NRF and supporting documents. Also, victim triage and other medical response procedures are beyond the scope of this Guidance. The plan presented in this appendix is not intended to impact site cleanups occurring under other statutory authorities such as EPA's Superfund program, the NRC's decommissioning program, or State-administered cleanup programs.

Cleanup Activities Overview

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 cleanup 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 consists of the immediate and near-term on-scene actions of State, local, and Federal emergency responders under the IC/UC. On-scene actions include incident stabilization, lifesaving activities, dose reduction actions for members of the public and emergency responders, access control and security, emergency decontamination of persons and property, "hot spot" removal actions, and resumption of basic infrastructure functions.

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

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-select stakeholders for major incident recovery coordination. These activities should proceed in parallel with ongoing intermediate phase activities, and coordination between these activities should be maintained. Preliminary remediation activities during the intermediate phase—such as emergency removals, decontamination, resumption of basic infrastructure function, and some return to normalcy in accordance with intermediate phase PAGs—should not be delayed for the final site remediation decision.

A process for addressing environmental contamination that applies an optimization process for site cleanup is presented below. As described in this document, optimization is a flexible process in which numerous factors are considered to achieve an end result that considers 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, and also provides 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 workgroups 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 to the public at large; (2) inclusiveness—representative stakeholders should be involved in decision-making activities; (3) effectiveness—technical subject matter experts should analyze remediation options, consider established 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 Federal, State, and local officials.

Under the NRF, FEMA may issue mission assignments to the involved Federal agencies, as appropriate, to assist in response and recovery. Additional funding may be provided to State/local governments to perform response/recovery activities through other mechanisms. The components of the process are as follows:

(a) General Management Structure

Planning for the long-term cleanup should begin during the intermediate phase, and at that time, a traditional NIMS response structure should still be in place. However, NIMS was developed specifically for emergency management and may not be the most efficient response structure for long-term cleanup. If the cleanup will extend for years, the IC/UC may decide to transition at some point to a different long-term project management structure.

Under the NRF and NIMS, incidents are managed at the lowest possible jurisdictional level. In most cases, this will be at the level of the Incident Command or Unified Command (IC/UC). The IC/UC directs on-scene tactical operations. Responding local, State, and Federal agencies are represented in the IC/UC and Incident Command Post in accordance with NIMS principles regarding jurisdictional authorities, functional responsibilities, and resources provided. For INDs, and large RDDs, multiple Incident Command Posts (ICPs) may be established to manage the incident with an Area Command or Unified Area Command supporting the ICPs and prioritizing resources and activities among them. If the RDD/IND incident happens on a Federal facility or involves Federal materials, the representatives in the UC may change appropriately and the response will be conducted according to the applicable Federal procedures.

Issues that cannot be resolved at the IC/UC or Unified Area Command level may be raised with the JFO and JFO Unified Coordination Group for resolution. The JFO coordinates and prioritizes Federal resources, and when applicable, issues mission assignments to Federal agencies under the Stafford Act. Issues that cannot be resolved at the JFO level may be raised to the DHS NOC, senior-level interagency management groups, and the White House Homeland Security Council.

Day-to-day tactical management, planning, and operations for the RDD/IND cleanup process will be managed at the IC/UC level, but for large-scale cleanups, it is expected that the

JFO Unified Coordination Group will review proposed cleanup plans and provide strategic and policy direction. The agency(s) with primary responsibility for site cleanup should be represented in the JFO Unified Coordination Group. The IC/UC will need to establish appropriate briefing venues as the cleanup process proceeds, including the affected mayor(s) and Governor(s).

The discussion below assumes a traditional NIMS IC/UC structure; if the IC/UC transitions later to a different management structure for a longer-term cleanup, the IC/UC would need to determine the appropriate way to incorporate the workgroups described below into that structure.

Appendix 2 presented the general steps in the cleanup process: analyze the risks, examine the options, make and implement a decision, evaluate the results. This process will be managed by the IC/UC, who ultimately determines the structure and organization of the Incident Command Post, but the discussion below provides one recommended approach for managing the cleanup process within a NIMS ICS response structure. The Incident Command Post Planning Section has the lead for response planning activities, working in conjunction with other sections, and would have the lead for development of the optimization analysis, working closely with the Operations Section. The NIMS describes the units that make up the Planning Section, and allows for additional units to be added depending on site-specific needs. NIMS states that for incidents involving the need to coordinate and manage large amounts of environmental sampling and analytical data from multiple sources, an Environmental Unit may be established within the Planning Section to facilitate interagency environmental data management, monitoring, sampling, analysis, assessment, and site cleanup and waste disposal planning. RDD/IND incidents would involve the collection of not only large amounts of radiological data, but also data related to other environmental and health and safety hazards, and would therefore likely warrant the establishment of an Environmental Unit in the Planning Section. Planning for FRMAC radiological sampling and monitoring activities will be integrated into the Planning Section, and coordinated with other Situation and Environmental Unit data management activities.

The IC/UC would assign the responsibility for coordinating and development of the optimization analysis to a specific unit. For incidents in which the contaminated area is small and the analysis is straight forward, the IC/UC may choose to assign such responsibilities to the Environmental Unit. On the other hand, for large incidents requiring more complicated trade offs or the evaluation of cleanup goals with broad implications, the IC/UC may choose to establish a separate unit in the Planning Section (for example, a Cleanup Planning Unit) to coordinate the development of the optimization analysis. The IC/UC may then convene a technical working group and a stakeholder working group, managed by the Environmental or Cleanup Planning Unit, to analyze cleanup options and develop recommendations. The Environmental or Cleanup Planning Unit would coordinate working group processes and interactions and report the results of the optimization analysis and workgroup efforts to the IC/UC through the Planning Section Chief.

The development and completion of the optimization analysis is expected to be an iterative process, and for large incidents, the cleanup will likely proceed in phases, most likely from the "outside in" toward the most contaminated areas. The extent of the analysis and process used to develop it would be tailored to the needs of the specific incident, but the following working groups may be convened by the IC/UC to assist decision makers in the optimization process, particularly for large or complex cleanups.

(1) Technical Working Group

A technical working group should be convened as soon as practicable, normally within days or weeks of the incident. The technical working group would be managed by the Planning Section Unit that is assigned responsibility for the optimization analysis. The technical working group may or may not be physically located at the ICP. The group may review data and documents, provide input electronically, and meet with incident management officials. The group may also be asked to participate in meetings with the JFO Unified Coordination Group if needed.

Function: The technical working group provides multi-agency, multi-disciplinary expert input on the optimization analysis, including advice on technical issues, analysis of relevant regulatory requirements and guidelines, risk analyses, and development of cleanup options. The technical working group would provide expert technical input to the IC/UC; it would not be a decision-making body.

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 Advisory Team for the Environment, Food, and Health is comprised of Federal radiological experts in various fields who may warrant representation on the technical working group.

(2) Stakeholder Working Group

The stakeholder working group should be convened as soon as practicable, normally within days or weeks of the incident. The stakeholder working group would be managed by the

Planning Section Unit that is assigned responsibility for the optimization analysis. The IC/UC may direct the Public Information Officer (who would coordinate with the JIC) to work with the group, including establishing a process for the group to report out its recommendations. How and where the stakeholder working group would meet to review information and provide its input would need to be determined in conjunction with the group members. The stakeholder working group may also be asked to participate in meetings with the JFO Unified Coordination Group if needed.

Makeup: The stakeholder working group should include selected Federal, State, and local representatives; local non-governmental representatives; and local/regional business stakeholders. The exact selection and balance of stakeholders is incident specific.

Function: The function of the stakeholder working group is to provide input to the IC/UC concerning local needs and desires for site recovery, proposed cleanup options, and other recommendations. The group should present local goals for the use of the site, prioritizing current and future potential land uses and functions, such as utilities and infrastructure, light industrial, downtown business, and residential land uses. The stakeholder working group would not be a decision-making body.

(b) Activities

(1) Optimization and Recommendations

The IC/UC directs the management of the optimization analysis through the Planning Section. Technical and stakeholder working groups assist in performing analyses and developing cleanup options and provide input to the IC/UC, and may be asked to participate in meetings with the JFO Unified Coordination Group if needed. The IC/UC reviews the options described in the optimization analysis and selects a proposed approach for site cleanup, in close coordination with Federal, State and local officials. Again, depending on the incident size, it may be necessary to conduct the cleanup in phases. Thus, decisions on cleanup approaches may also be made in phases. As appropriate for the magnitude of the cleanup task, the IC/UC would brief relevant Federal, State, and local government officials on proposed cleanup plans for approval. This may involve the office of the affected mayor and Governor. At the Federal level, it may involve the JFO Unified Coordination Group and higher-level officials.

(2) Public Review of Decision

The IC/UC should work with the POI and JIC to publish a summary of the process, the options analyzed, and the recommendations for public comments. Public meetings should also be convened at appropriate times. Public comments should be considered and incorporated as appropriate. A reconvening of the stakeholder and/or technical working groups may be useful for resolving some issues.

(3) Execute Cleanup

Cleanup activities should commence as quickly as practicable, and allow for incremental reoccupation of areas as cleanup proceeds. For significant decontamination efforts, the IC/UC may choose to employ a technical peer review advisory committee to conduct a review of the effectiveness of the cleanup. The technical peer review advisory committee is discussed in more detail in Appendix 2.

Appendix 4—Operational Guidelines for Implementation of Protective Action Guides and Other Activities in RDD or IND Incidents

During all phases of an incident, many decisions will need to be made at the field-level, such as making protective action decisions, opening critical infrastructure, limited re-entry of citizens to homes or businesses, release of personal property, and others. This appendix presents operational guidelines being developed to assist decision makers and emergency responders in implementing protective actions and making other on-site decisions[7]. Operational guidelines are levels of radiation or concentrations of radionuclides that can be accurately measured by radiation detection and monitoring equipment that can then be compared to PAGs, or field-level radiation dose decision points (such as for the release of personal property) to quickly determine what action should be taken. In most situations, the operational guidelines will be given in terms of external gamma rates or media-specific (e.g., surfaces, soil, or water) radionuclide concentration units. Both external and internal exposure potential were considered in the development of the operational guidelines.

This appendix discusses the operational guidelines qualitatively and does not provide actual numeric values. The operational guidelines are being developed to provide reasonable assurance that field-level radiation dose decision points and the PAGs recommended in this document can be met under different circumstances. The operational guidelines also address, to some extent, the impact of protective actions, such as controlling wash water after rinsing vehicles to remove contamination. Actual conditions may warrant development of incident-specific guidelines. To support this need, the RESRAD-RDD[8] software tool was developed to allow for easy and timely calculation of site-specific operational guidelines that can be tailored to the specific emergency and the required response.

The operational guidelines are organized into seven groups that are generally categorized by the phase of emergency response in which they would be implemented or used for planning purposes. Individual groups are further categorized into subgroups as appropriate. Table 3

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[7] For purposes of this appendix, "relocation area" refers to an area that local officials have determined is not safe for prolonged occupation by the public, based on the intermediate phase PAGs, and have recommended that the public be relocated.

[8] RESRAD-RDD is a computer modeling tool developed by the U.S. Department of Energy for calculating radiation concentrations on different media, and doses and dose rates following an RDD incident.

summarizes operational guideline groups and subgroups. A summary description of these groups and subgroups is provided below. Detailed descriptions of the operational guidelines, to include their technical derivation, intended application, and tools to assist in their application, are provided in the Preliminary Report on Operational Guidelines Developed for Use in Emergency Preparedness and Response to a Radiological Dispersal Device Incidents (DOE/HS-0001, available at http://www.ogcms.energy.gov).

TABLE 3.—Operational Guidelines: Groups and Subgroups

Groups	Subgroups
A. Access control during emergency response operations	1. Life- and property-saving measures 2. Emergency worker demarcation
B. Early-phase protective action	1. Evacuation 2. Sheltering
C. Relocation from different areas and critical infrastructure utilization in relocation areas	1. Residential areas 2. Commercial and industrial areas 3. Other areas, such as parks and monuments 4. Hospitals and other health care facilities 5. Critical transport facilities 6. Water and sewer facilities 7. Power and fuel facilities
D. Temporary access to relocation areas for essential activities	1. Worker access to businesses for essential actions 2. Public access to residences for retrieval of property, pets, records
E. Transportation and access routes	1. Bridges 2. Streets and thoroughfares 3. Sidewalks and walkways
F. Release of property from radiologically controlled areas	1. Personal property, except wastes 2. Waste 3. Hazardous waste 4. Real property, such as lands and buildings
G. Food consumption	1. Early-phase food guidelines 2. Early-phase soil guidelines 3. Intermediate-phase soil guidelines 4. Intermediate- to late-phase soil guidelines

(a) Group A: Access Control during Emergency Response Operations

These operational guidelines are designed to assist responders in decision making for worker health and safety in the early to intermediate phases of response when the situation has not been fully stabilized or characterized. They are designed to guide responders in establishing radiological control zones or boundaries for the areas directly impacted by the RDD or IND incident where first responders and emergency response personnel are working. They are not intended to restrict emergency worker access, but rather to inform workers of potential radiological hazards that exist in the area and to provide tools to those responsible for radiation protection during response activities. These operational guidelines may be used to restrict the access of nonessential personnel and members of the public to specific areas. Examples of operational guidelines developed in this group include life- and property-saving measures and emergency worker zone demarcation.

Group A operational guidelines are expressed as a series of reference "stay time" tables for responders who may have only limited health physics information and personal protective equipment at the time of the response. For example, the health physics information available to them could include or be limited to measurements of the external exposure rate, gross alpha surface contamination, beta/gamma surface contamination, and/or air concentration. Radionuclide-specific correction factors as well as radionuclide-specific and respiratory protection-specific tables are also provided. Stay times are provided for a range of doses (i.e., 0.1 rem (.001 Sv), 0.5 rem (.005 Sv), 1 rem (.01 Sv), 2 rem (.02 Sv), 5 rem (.05 Sv), 10 rem (.10 Sv), 25 rem (.25 Sv), 100 rem (1 Sv), many of which correspond to guidelines used for workers and the public).

(b) Group B: Early-Phase Protective Action (Evacuation or Sheltering)

Group B operational guidelines are designed to help decision makers make timely protective action decisions, such as whether to evacuate or shelter the general public in the early phase. These operational guidelines are similar to values presented in the FRMAC Assessment Manual for evacuation and sheltering. Group B operational guidelines are typically expressed as limiting concentrations of radioactivity in surface soil.

(c) Group C: Relocation and Critical Infrastructure Utilization in Affected Areas

These operational guidelines are intended for early- to intermediate-phase protective actions. They are designed for use in deciding whether to relocate the public from affected areas for a protracted period of time. Screening values are provided to delineate areas that exceed the relocation PAGs. These areas include residential areas, commercial/industrial areas, and other areas such as parks, cemeteries, and monuments. Group C operational guidelines also assist in efforts to ensure that facilities critical to the public welfare can continue to operate, if needed. These facilities include hospitals, airports, railroads and ports, water and sewer facilities, and power and fuel facilities. These operational guidelines are typically expressed as soil, building, or street-surface contamination concentrations (e.g., pCi/m^2).

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

Group D operational guidelines pertain to intermediate phase protective actions. They are designed to assist in determining constraints necessary to allow for temporary access to restricted (relocation) areas. For example, the public, or owners/employees of businesses, may need temporary access to residences, or commercial, agricultural, or industrial facilities in order to retrieve essential records, conduct maintenance to protect facilities, prevent environmental damage, attend to animals, or retrieve pets. These operational guidelines describe the level and timeframes at which these actions can be taken without supervision or radiological protections.

The public or employees may occasionally (e.g., a few days per month) access areas that do not exceed these guidelines. Temporary access to relocation areas that exceed these levels should be permitted only under the supervision, or with the permission of, radiation protection personnel. The guidelines are typically expressed in terms of stay-times during which the public or employees may access the areas without receiving a predetermined dose.

(e) Group E: Transportation and Access Routes

These operational guidelines apply to intermediate phase actions. They are designed to assist in determining whether transportation routes (e.g., bridges, highways, streets) or access ways (e.g., sidewalks and walkways) may be accessed by the public for general, limited, or restricted use. The relocation PAGs serve as the basis for these operational guidelines. For example, operational guidelines may be defined for industrial or commercial use of various roads, bridges, or access ways. These may be necessary to allow for access between non-relocation areas via a highway that passes through a relocation area or for access to recovery areas in the immediate area of an incident. These operational guidelines assume regular or periodic use and are not appropriate for one-time events, such as evacuation or relocation actions. They are typically expressed as surface contamination concentrations (e.g., pCi/m^2).

(f) Group F: Release of Property from Radiologically Controlled Areas

Group F operational guidelines are intended for intermediate to long-term recovery-phase protective actions. During response and recovery operations, property and wastes must be cleared from radiologically controlled areas (relocation areas). Property includes personal property, debris and non-radiological wastes, hazardous waste, and real property (e.g., buildings and lands). These operational guidelines support such actions. Because subsequent retrieval of cleared, or released, properties will be difficult, these levels should be consistent with late-phase cleanup goals wherever practicable. For this reason, they should not be applied to property that will continue to be used within controlled areas. These operational guidelines should also be used for screening property that was located outside the controlled area for possible contamination. In general, the operational guidelines in this group provide reasonable assurance that the cleared property is acceptable for long-term, unrestricted use (or appropriate disposition, in the case of wastes) without further radiological reassessment or control.

For personal property such as vehicles and equipment, the operational guideline values were derived using the ANSI N13.12 standard clearance screening levels[9]. These draft operational guidelines are available for review and use as appropriate at http://www.ogcms.energy.gov. The guidelines establishes three property categories: at greater than 200 times ANSI N13.12 screening levels, monitored remediation or control is recommended; at levels between 10 and 200 times the levels, self-remediation (conventional washing) of the property is recommended as soon as practical; and below the self remediation levels, no control or protective action is necessary.

Operational guidelines for real property (buildings and lands) are designed to assist on-scene decision-making, and in development of the cleanup options described in section (d)(4), Late Phase Guidance, of this document. Section (d)(4) on long-term cleanup incorporates the principle of site-specific optimization, and highlights stakeholder involvement and shared accountability. The guidelines for real property are unique in that there is no one specific, predefined numeric criterion (i.e., expressed in terms of concentration, dose, or risk) on which to base decisions. These guidelines are intended to be utilized in the optimization process, which will likely consider the magnitude and extent of the contamination and the radionuclide(s)

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[9] The American National Standards Institute (ANSI) produces consensus based national standards. ANSI standard N13.12, Surface and Volume Radioactivity Standards for Clearance, can be found at http://hps.org/hpssc/N13_12_1999.html.

involved, the proposed long-term land and building use in the affected areas, the need for expedited recovery, public welfare issues, the cost impacts for each proposed cleanup option, the ecological considerations, and other factors. Real property operational guidelines are provided as reference values (e.g., soil and building-surface concentrations or risks) that can be used as a starting point for evaluating options and impacts relative to a range of dose or risk-based benchmarks (e.g., 500, 100, 25, or 4 millirem per year; lifetime risk ranges, and others) that could be considered as part of cleanup options analysis. Thus, they are not regulatory dose limits or criteria, but serve as concentration values that provide support to the optimization analyses.

(g) Group G: Food Consumption

Group G operational guidelines apply to early through long-term recovery phase protective actions, as needed. They are designed to aid in decision making about the need for placing restrictions on consumption of contaminated foods or on agricultural products during and following an RDD or IND incident. Four subgroups were developed (Subgroups G.1-G.4; see Table 4A), which are intended for use in conjunction with the operational guidelines in other groups. Subgroup G.1 guidelines pertain to food consumption in the early response phase immediately after an incident. These guidelines can be used to screen against measured concentrations taken from previously harvested food or from animal products exposed during the incident. Subgroup G.1 guidelines also can be used to determine the need for a food embargo, or restrictions on consumption of contaminated foods. Subgroup G.2 guidelines, soil guidelines, also apply to the early phase of response, but they are intended for use in evaluating crops or animal products exposed during the RDD incident (e.g., after the plume has passed). They serve as a comparison with measured concentrations taken from surface soil in which plant foods and fodder had been growing during the incident. Subgroups G.3 and G.4 are intended for use of soil in the intermediate to long-term recovery phases and can be used for placing land use restrictions on agricultural activities after an RDD incident. They can be used to determine if crops can be grown on residually contaminated soil to produce a harvest that would be acceptable for public consumption.

(h) Derivation of Operational Guidelines

Operational guidelines for each group are being derived through a systematic approach in which, (1) applicable release/exposure scenarios for each group were defined, (2) appropriate human receptors for each scenario were identified, and (3) the receptor doses from applicable exposure pathways were estimated. Operational guidelines (Groups A-G; see Table 4A), which correspond to specific PAGs, were derived for 11 potential RDD radionuclides[10]: Am-241, Cf-252, Cm-244, Co-60, Cs-137, Ir-192, Po-210, Pu-238, Pu-239, Ra-226, and Sr-90. The concepts and overarching methodology used to derive operational guidelines for RDD-related radionuclides could also be generally applied, with modifications, to radionuclides associated with an IND.

Additional RDD or IND incident scenarios were analyzed to support the derivation of the operational guideline groups and subgroups described above. Two of these additional scenarios involve the use of water to flush streets and clean vehicles. Accordingly, operational guidelines for street flushing and cleaning contaminated vehicles are also provided. The operational guidelines will be submitted in the Federal Register for comment prior to finalization.

Appendix 5—References and Resources

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[10] These radionuclides were determined by a joint DOE and NRC study to be the most likely sources available for potential terrorist use in an RDD (Interagency Working Group on Radiological Dispersal Devices, May 2003) (DOE/NRC 2003).

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"Standards for Cleanup Of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites." Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings. 40 CFR part 192.10-12.

"Standards for Protection Against Radiation." Nuclear Regulatory Commission. 10 CFR part 20.

"Surface and Volume Radioactivity Standards for Clearance." American National Standards Institute (ANSI), N13.12 (1999).

Appendix 6—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.

ARS Acute Radiation Syndrome.

CERCLA Comprehensive Environmental Response, Compensation, and Liability Act, commonly known as Superfund. This legislation was enacted by Congress in 1980 to protect households and communities from abandoned toxic waste sites.

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.

DHS U.S. 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 U.S. Department of Defense.

DOE U.S. 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.

EMP Electromagnetic Pulse – Electromagnetic radiation from a nuclear explosion.

EMS Emergency Medical Service.

EOC Emergency Operations Center – A response entity's central command and control center for carrying out emergency management functions.

EPA U.S. Environmental Protection Agency.

ESF Emergency Support Function – The ESFs provide the structure for coordinating Federal interagency support for domestic incident response.

FBI Federal Bureau of Investigation, U.S. Department of Justice.

FCO Federal Coordinating Officer – Appointed by the Director of the Federal Emergency Management Agency, on behalf of the President, to coordinate federal assistance to a state affected by a disaster or emergency.

FDA Food and Drug Administration, U.S. Department of Health and Human Services.

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 administered by DOE. For more information, see http://www.nv.doe.gov/nationalsecurity/homelandsecurity/frmac/default.htm

FRN Federal Register Notice.

Gy One gray is equal to an absorbed dose (mean energy imparted to a unit of matter mass) of 1 joule/kilogram. 1 gray (Gy) = 10,000 erg/g = 100 rad.

HHS U.S. Department of Health and Human Services.

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

HSPD Homeland Security Presidential Directive – Executive Order issued to the Federal agencies by the President on matters pertaining to Homeland Security.

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.

ICP Incident Command Post – The field location where the primary functions are performed. The ICP may be co-located with the incident base or other incident facilities.

ICRP International Commission on Radiological Protection.

ICS Incident Command System – A standardized, on-scene, all-hazard incident management concept. ICS is based upon a flexible, scalable response organization providing a common framework within which people can work together effectively.

IND Improvised Nuclear Device – An illicit nuclear weapon that is bought, stolen, or otherwise obtained from a nuclear State, or a weapon fabricated by a terrorist group from illegally obtained fissile nuclear weapons material and produces a nuclear explosion.

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.

JFO Unified Coordination Group JFO structure is organized, staffed and managed in a manner consistent with NIMS principles and is led by the Unified Coordination Group. Personnel from Federal and State departments and agencies, other jurisdictional entities and private sector businesses and NGOs may be requested to staff various levels of the JFO, depending on the requirements of the incident.

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.

KI Potassium Iodide.

LNT or LNT model Linear no-threshold dose-response for which any dose greater than zero has a positive probability of producing an effect (e.g., mutation or cancer). The probability is calculated either from the slope of a linear (L) model or from the limiting slope, as the dose approaches zero, of a linear-quadratic (LQ) model.

MERRT Medical Emergency Radiological Response Team – Provides direct patient treatment, assists and trains local health care providers in managing, handling, and treatment of radiation exposed and contaminated casualties, assesses the impact on human health, and provides consultation and technical advice to local, State, and Federal authorities.

NCP National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR part 300) – The Plan provides the organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances, pollutants, and contaminants.

NCRP National Council on Radiation Protection and Measurements.

NIEHS National Institute for Environmental Health Sciences.

NIMS National Incident Management System – The Homeland Security Act of 2002 and HPSD-5 directed the DHS to develop 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.

NOC National Operations Center.

NPP Nuclear Power Plant.

NRC U.S. Nuclear Regulatory Commission.

NRF National Response Framework – The successor to the National Response Plan. The Framework presents the doctrine, principles, and architecture by which our nation prepares for and responds to all-hazard disasters across all levels of government and all sectors of communities.

OSHA Occupational Safety and Health Administration, U.S. Department of Labor.

PAG Protective Action Guide – 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.

PIO Public Information Officer – The PIO acts as the communications coordinator or spokesperson within the Incident Command System.

PPE Personal protective equipment.

R Roentgen - Measure of exposure in air.

Rad Radiation absorbed dose. One rad is equal to an absorbed dose of 100 erg/gram or 0.01 joule/kilogram. 1 rad = 0.01 gray (Gy).

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 – Any device that causes the purposeful dissemination of radioactive material, across an area with the intent to cause harm, without a nuclear detonation occurring.

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 Roentgen Equivalent Man; the conventional unit of radiation dose equivalent. 1 rem = 0.01 sievert (Sv).

REMM Radiation Event Medical Management – A web-based algorithm providing just-in-time information for medical responders. It is also useful for education and training. Developed by the Office of Assistant Secretary for Preparedness and Response and the National Library of Medicine. Available at http://www.remm.nlm.gov.

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.

Shelter-in-Place The use of a structure for radiation protection from an airborne plume and/or deposited radioactive materials.

SI International System of Units.

Stakeholder A stakeholder is anybody with an interest (a 'stake') in a problem and its solution. The involvement of stakeholders (i.e., parties who have interests in and concern about a situation) is seen as an important input to the optimization process. It is a proven means to achieve incorporation of values into the decision-making process, improvement of the substantive quality of decisions, resolution of conflicts among competing interests, building of shared understanding with both workers and the public, and building of trust in institutions. Furthermore, involving all concerned parties reinforces the safety culture, and introduces the necessary flexibility in the management of the radiological risk that is necessary to achieve more effective and sustainable decisions.

Sv Sievert; the SI unit of radiation dose equivalent. 1 Sv = 100 rem.

TEDE Total effective dose equivalent – The sum of the effective dose equivalent from external radiation exposure and the committed effective dose equivalent from internal exposure.

Dated: ______________

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Michael Chertoff
Secretary, U.S. Department of Homeland Security