FEMA

Modeling and Data Working Group

Role of Data and Models in Supporting Planning and Response to an Improvised Nuclear Device (IND) Detonation

Phase I: Timeline of Events and Response Activities

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Executive Summary

Effective emergency management relies on senior level decision makers, first responders, and the public having access to the information they need when they need it. Ready access to critical information directly supports resiliency, informing the decisions that, if made efficiently and effectively, can prevent an emergency from becoming a disaster. The recent proliferation of data resources and modeling tools has led to a rapid expansion in the amount of information that is available to decision-makers during an emergency. However, the information produced is not always available in a timely, readily-digestible format that will facilitate operational decision making. Just as the activities, roles, and responsibilities of those involved in emergency planning and response are part of emergency management plans, so must the data, models, and analysis tools available to inform response activities be identified and incorporated into interagency emergency management plans and Concept of Operations (CONOPS). Only if those involved in emergency management have ready access to and have experience using these resources will the information be successfully leveraged during an event.

In recognition that informed decision making is key to successful emergency management, the Emergency Support Function Leadership Group (ESFLG) established the Modeling and Data Working Group (MDWG), led by the Federal Emergency Management Agency (FEMA), to engage stakeholders from across the interagency to identify and catalogue the data and modeling resources available to support decision making for policy makers and those responsible for emergency management operations. The inventory produced as a result of this effort will include resources required during all phases of emergency management, from preparedness and planning, to response, recovery and mitigation.

The MDWG is supported by Gryphon Scientific, whose role is to identify data and modeling resources from across the federal interagency and determine when and how these resources are used in the context of emergency management. In support of the MDWG, and on behalf of Lawrence Livermore National Laboratory, the methods, ontology, and previously-identified data and modeling resources available to inform decision making during emergency management in the context of hurricane and earthquake scenarios will be applied and expanded to an Improvised Nuclear Device (IND) detonation scenario. The resources and the linkages that characterize the flow of information between those resources will be identified through a series of interviews with IND program and emergency managers, subject matter experts, and senior level decision makers. Network analysis of the resources will identify gaps and redundancies in the available resources, and define the existing federal interagency relationships necessary to support and facilitate the flow of information. The final product will be an inventory of data and modeling resources available to inform operationally-relevant decision making prior to, during, and following detonation of an IND in the U.S.

The report below describes the event and response timelines following an IND detonation. These timelines will be used as the foundation for a subsequent analysis of the critical information requirements for emergency management. These critical information requirements will, in turn, be used to inform an elicitation of the data and modeling resources currently available to fill these requirements during the next phase of the project. In total, this effort will support the development of information processing tools that will help ensure that the information required to support decision making during planning and response to an event is available in a readily accessible and timely manner.

Introduction

A nuclear terrorism incident, such as a detonation of an improvised nuclear device (IND), will undoubtedly have devastating large-scale consequences to public health and safety. In the immediate area, the blast will cause mass casualties, destroy infrastructure, damage utilities systems, and stall immediate emergency response activities. Critical decisions will have to be made quickly to save lives and minimize the impact of the disaster. However, appropriate decisions cannot be made without timely, accurate, and well-coordinated information.

What is an IND?

- An nuclear explosive device typically expected to be detonated by a sub-national group
- Contains special nuclear material, such as highly enriched uranium or plutonium, combined with a means of rapidly assembling fissionable material that exceeds a critical mass and causes a nuclear explosion[1]
- Emergency management would require immediate mass casualty management, mass evacuations, and broad-scale decontamination in a limited-resource environment with heavy infrastructure damage.[1]

An effective response to any disaster will rely upon the accurate synthesis of, access to and timely dissemination of information to facilitate decision making at all levels. While there has been a rapid expansion of information available to decision-makers during emergencies, the information produced is not always available in a timely, readily-digestible format designed to facilitate operational decision making. In addition, insufficiently verified information or conflicting results have undermined the utility of the information for decision-makers. As illustrated by the 2011 Fukushima Daiichi nuclear power plant disaster, an effective response to the crisis was hampered by poor communication, such as delays in releasing data on dangerous radiation leaks at the facility and suppression of information on the direction of the radioactive plume. Lessons learned from this disaster articulated the need for a transparent decision making process and accurate and timely information-sharing between all sectors of society. [2, 3]

To facilitate operational decision making during an emergency, the data, models, and analysis tools available to inform response activities must be identified and incorporated into interagency emergency management plans and Concept of Operations (CONOPS). Only if these resources are made readily available, exercised, and incorporated into the experience of emergency managers will the information they provide be successfully leveraged during an event.

1 Buddemeier B (Summer 2010) Reducing the Consequences of a Nuclear Detonation. *The Bridge* 40

2 INPO (Institute of Nuclear Power Operations) (August 2012) Lessons Learned from the Nuclear Accident at the Fukushima Daiichi Nuclear Power Station.

3 NEA (Nuclear Energy Agency), OECD (Organisation for Economic Co-operation and Development) (2013) The Fukushima Daiichi Nuclear Power Plant Accident.

Project Overview

Recognizing that informed decision making is key to successful emergency management, the Emergency Support Function Leadership Group (ESFLG) established the Modeling and Data Working Group (MDWG), led by the Federal Emergency Management Agency (FEMA), to engage stakeholders from across the interagency to identify and catalogue the data and modeling resources available to support high-level, operationally-relevant decision making. This catalogue will not only include resources required during the time-sensitive response period, but also those required during all phases of emergency management, from preparedness and planning, to response, recovery and mitigation.

The MDWG is supported by Gryphon Scientific, whose role is to collect the information required to identify data and modeling resources and determine when and how these resources are used in the context of emergency management. To gain a comprehensive understanding of the data and modeling requirements during emergency management of all hazards, the MDWG focused initially on large-scale hurricane and earthquake disaster scenarios to identify the data and modeling requirements, develop the methodology, build an ontology, and characterize the available resources used across the interagency to support operational decision making.

In support of the MDWG, and on behalf of Lawrence Livermore National Laboratory, the methods, ontology, and previously-identified data and modeling resources available to inform decision making during all-hazards emergency management will be applied and expanded to those resources available to support planning and response to an IND detonation. The resources and the linkages that define the flow of information through them will be identified through a series of interviews with IND program and emergency managers, subject matter experts, and senior level decision makers. Network analysis of the resources will identify gaps and redundancies in the available resources, define the existing federal interagency relationships necessary to support, and ultimately facilitate the flow of information. This effort will produce an inventory of data and modeling resources used during all stages of emergency management to inform and facilitate operational decision making prior to, during, and following detonation of an IND in the U.S.

This report describes the timeline of events and response activities to highlight the time-sensitive decisions that need to be made over the course of an IND detonation, as well as the information required to support effective planning and response activities to such an event across all emergency support functions and as part of all phases of emergency management.

[4] REMM. Radiation Emergency Medical Management. http://www.remm.nlm.gov/rdd.htm. Last Update 30 August 2013. Accessed 24 October 2013.

Timeline of Events After an IND Detonation

A clear understanding of the expected effects of an IND detonation is critical for effective emergency management. Detonation of 10-kiloton (kT) IND in a major US city, as described in the National Planning Scenarios,[5] would cause large-scale and long-lasting damage, severely stressing national capabilities and requiring a concerted, time-critical, whole-community response to mitigate the disaster. In the immediate area, there would be few survivors and buildings would be leveled. The nuclear explosion can also produce fallout, which is generated when dust and debris created by the explosion are combined with radioactive fission products. This material can be drawn several miles upward into the atmosphere; as the cloud cools, highly radioactive particles fall creating dangerous radiation levels up to 20 miles and detectable contamination for a hundred or more miles downwind of the explosion.

A more detailed description of an IND detonation and expected outcomes can be found in a series of reports, including the Planning Guidance for Response to a Nuclear Detonation and Buddemeier, B. et al, November 2011.[6,7] The overview provided here is intended as a short description of the expected timeline of events following an IND detonation to outline the information required to support operationally-relevant decision making for emergency management across the interagency.

Figure 1 depicts the expected timeline of events that would occur after a ground detonation of a 10kT nuclear explosive in a densely populated city in the U.S. For the purposes of this report, these events have been categorized into Prompt, Delayed, and Health Effects, as described below.

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5 DHS (Department of Homeland Security) (March 2006) National Planning Scenarios.

6 NSS (National Security Staff) Interagency Policy Coordination Subcommittee for Preparedness and Response to Radiological and Nuclear Threats (June 2010) Planning Guidance for Response to a Nuclear Detonation.

7 Buddemeier B *et al* (November 2011) National Capital Region Key Response Planning Factors for the Aftermath of Nuclear Terrorism. Lawrence Livermore National Laboratory.

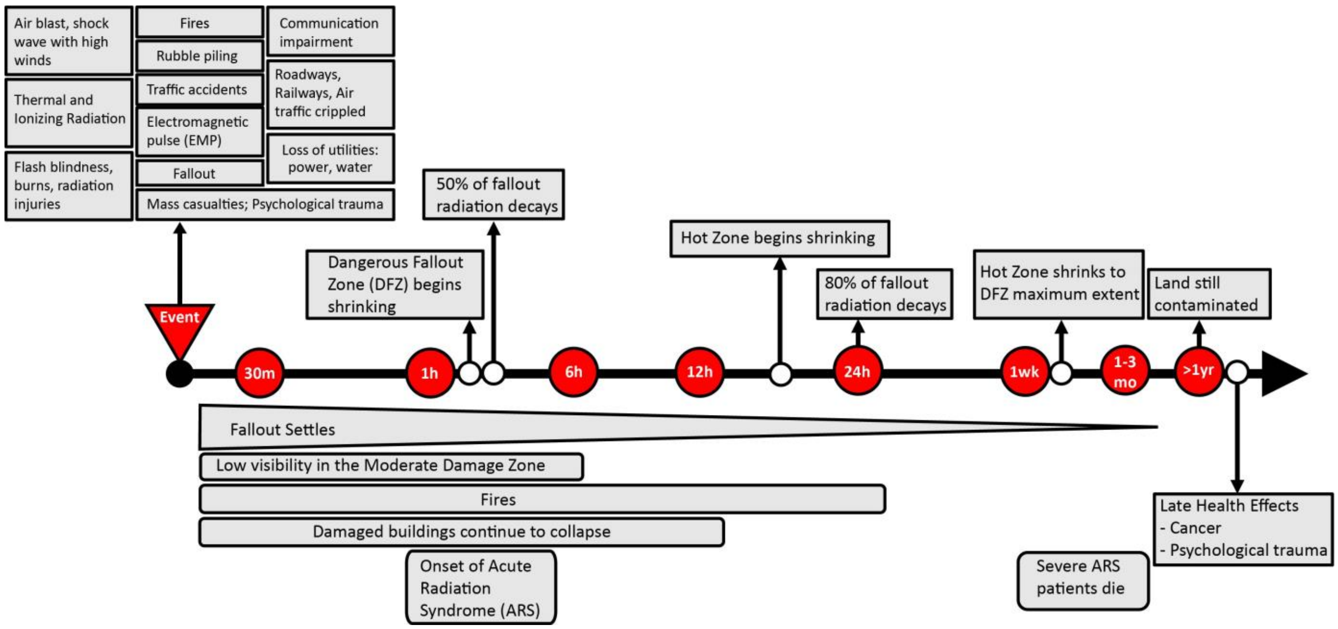

Figure 1. Expected timeline of events after a 10kT IND detonation

Prompt effects

The prompt effects of an IND detonation consist of physical phenomena produced by the detonation usually within the first minute including an intense flash of light, a blast wave, heat, radiation, fires, and an electromagnetic pulse. The immediate consequences of prompt effects include rubble piling, traffic accidents, fires, communication impairment, infrastructure and utility damage and mass casualties. An overview of these effects in the context of how this information can be used in operational decision making is described below.

Blast Effects

An IND blast is measured by the overpressure expanding in all directions from the detonation and the dynamic pressure related to the wind generated by the passing pressure wave. The combination of these two forces produces extensive physical damage to structures.[8] The amount of damage caused by the blast wave after an IND explosion can be described in zones, as shown in Figure 2, defined by the amount of observable damage (severe, moderate or light) that are used for planning and prioritizing response actions.[9] Within the severe damage zone (SDZ) most buildings will be destroyed and few survivors will be expected. In the Moderate Damage zone (MDZ), many buildings will be severely damaged or destroyed. The MDZ is expected to have the greatest number of “At-Risk” individuals,

8 Samuel Glasstone, Philip J. Dolan (1977) The Effects of Nuclear Weapons, 3rd edn. Lexington, KY: Knowledge Publications.
9 NSS (National Security Staff) Interagency Policy Coordination Subcommittee for Preparedness and Response to Radiological and Nuclear Threats (June 2010) Planning Guidance for Response to a Nuclear Detonation.

defined as that population at risk for injuries with a mortality rate between 5 and 95 percent.[10] This population will benefit most from medical intervention, and it is recommended that rescue efforts initially concentrate on the MDZ.[9] Damage in light damage zone (LDZ) is caused by shock waves, and windows may be blown in up to 10 miles away.[10] The majority of injuries in the LDZ are expected to be relatively minor, caused by projectile glass, with high survivability even without immediate medical care.

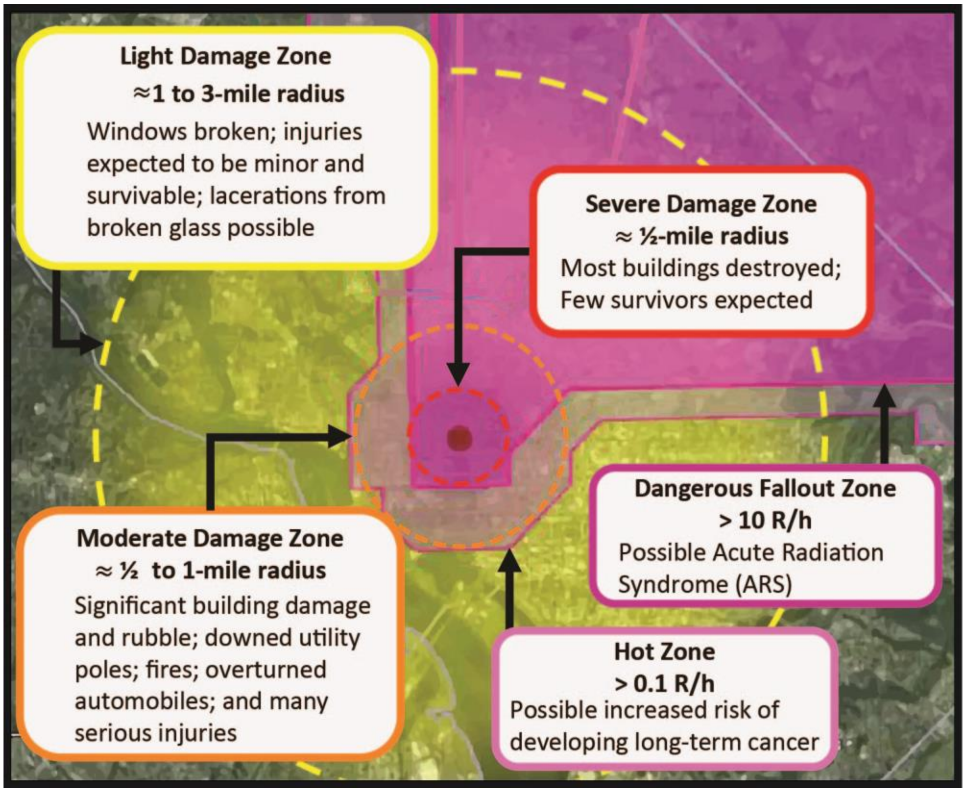

Figure 2. Depiction of blast and fallout zones after a 10-kT IND detonation. [11]

A clear understanding of the basic differences in scope of impact between these zones can significantly increase the ability of emergency managers and first responders to effectively prioritize response activities, whether during planning for or responding to the event. Models can be used to estimate the approximate area and size of the different blast zones, which can be used to inform early response activities. These data can help define anticipated fallout deposition patterns, identify the regions most likely to be affected by fires, predict degrees of building damage and the amount of rubble from damaged and collapsed structures in each blast zone. These data in turn can be used to inform and

10 Buddemeier B *et al* (November 2011) National Capital Region Key Response Planning Factors for the Aftermath of Nuclear Terrorism. Lawrence Livermore National Laboratory.

11 Figure adapted from Buddemeier B et al, November 2011.

prioritize response activities such as identifying available evacuation routes, medical centers, and shelter facilities.

Thermal Radiation Effects

In contrast to more traditional explosives, an IND detonation releases significant thermal radiation. Approximately 35% of the energy released upon detonation will be thermal, resulting in a rapidly expanding fireball.[12] The fireball is created by the release of energy by the fission fragments, x-rays, and beta particles into the immediate vicinity of the explosion. Temperatures within the fireball are in the range of tens of millions of degrees Celsius with pressure many orders of magnitude greater than atmospheric pressure.[13] The intensity of the thermal pulse depends on distance from ground zero, the height of burst, and the urban environment, all of which affect the degree of shielding from the radiation. A dense urban environment will most likely mitigate the effects of prompt thermal radiation from a ground level detonation, and is expected to result in a "starburst" effect as radiation moves down streets with a clear line of sight.[14, 15] Victims within a direct line of sight of the burst are subject to burn injuries up to two miles away from ground zero, with severity directly related to distance and available shielding. Models can help predict what types of burn injuries will be most common in the blast zones surrounding the blast and help inform medical triage plans and the development or purchasing of medical countermeasures to help treat the expected injuries. Those who have the detonation in their field of view may receive retinal burns that impair vision 10 or more miles away.

In addition to causing burns, thermal radiation will ignite material within the radius of the fireball.[16] While an urban environment is predicted to reduce the area subjected to thermal radiation, [17] flammables inside buildings destroyed by the blast are likely to cause additional fires, and new fires will appear as damaged buildings collapse. Fires are expected to spread unless extinguished by first responders. While a firestorm like those caused during previous nuclear detonations are unlikely given the shift in building materials from wood to less flammable materials (concrete, metal, and glass), models can be used to predict the relative likelihood of fires in specific areas, particularly as they relate to building collapse.

12 NSS (National Security Staff) Interagency Policy Coordination Subcommittee for Preparedness and Response to Radiological and Nuclear Threats (June 2010) Planning Guidance for Response to a Nuclear Detonation.

13 Samuel Glasstone, Philip J. Dolan (1977) The Effects of Nuclear Weapons, 3rd edn. Lexington, KY: Knowledge Publications.

14 Buddemeier B *et al* (November 2011) National Capital Region Key Response Planning Factors for the Aftermath of Nuclear Terrorism. Lawrence Livermore National Laboratory.

15 Marrs R *et al* (June 2007) Thermal Radiation from Nuclear Detonations in Urban Environments. Lawrence Livermore National Laboratory.

16 National Academies (2005) Nuclear Attack. Factsheet created for News and Terrorism: Communicating in a Crisis.

17 Marrs R *et al* (June 2007) Thermal Radiation from Nuclear Detonations in Urban Environments. Lawrence Livermore National Laboratory.

Prompt Radiation Effects

Prompt or ionizing radiation, also released during a nuclear detonation, is a direct result of the nuclear fission process. Like thermal radiation, ionizing radiation poses a significant risk to anyone close to the burst site. The spectrum and flux of ionizing radiation at any given point is dependent on the bomb design, distance from ground zero, and atmospheric conditions. Victims located outside in the SDZ at the time of the blast are expected to receive a lethal dose of prompt radiation. Shielding from a dense urban environment can substantially reduce the number of expected radiation-related casualties in the MDZ. Models that predict the area of prompt radiation would allow identification of populations that exhibit radiation exposure symptoms and help determine the supplies required to treat them.

Flash Blindness

Prompt effects of an IND detonation include a brilliant flash of light that can cause up to a minute of temporary blindness, often 10 or more miles from the detonation.[18] Poor atmospheric visibility can reduce the range of this effect; however reflection off clouds and buildings can create indirect exposures that do not require the victim to be looking in the direction of the detonation to be flash blinded. This sudden loss of vision for drivers could cause traffic accidents in a large radius surrounding the detonation, blocking roads and causing serious injuries. Recognizing the effect of flash blindness on roadways and estimating the resulting traffic accidents could assist in planning alternate evacuation routes out of the affected region and alternate access routes into the blast zones for emergency responders and supplies.

Electromagnetic Pulse (EMP)

An IND explosion also releases a short electromagnetic pulse (EMP) of energy, which has the potential to damage electronic equipment.[19] EMP is primarily a concern for high-altitude, high yield detonations. While there is some disagreement regarding how significantly EMP would affect the communications and electrical infrastructure,[20] for a 10kT, ground-level detonation, disruption of electronics can be expected as far as five miles from the detonation. It is reasonable to assume that electricity and land-line communication would be disabled within this region, which suggests that response plans should include alternate means of communications after an IND detonation.

Damage to Infrastructure and Utilities

A wide range of critical infrastructure and utilities in the area surrounding the IND detonation will likely be damaged or destroyed by the prompt effects of an IND detonation, including the blast wave and thermal radiation. The loss of these assets will influence the allocation of disaster relief supplies and the suitability of locations to be designated as shelters or medical centers. For example, communications

18 NSS (National Security Staff) Interagency Policy Coordination Subcommittee for Preparedness and Response to Radiological and Nuclear Threats (June 2010) Planning Guidance for Response to a Nuclear Detonation.

19 ibid.

20 Casagrande R (2011) Brief: Possible Causes for Divergent Estimates of EMP Consequences.

infrastructure in the severe and moderate damage zones will likely be damaged or destroyed. Cellular networks may be overwhelmed as tens of thousands attempt to locate loved ones. EMP could limit or disable electronic communications devices. Roadways, railways and air traffic will likely be crippled. Roadways situated closer to ground zero will be blocked by increasingly large amounts of rubble and traffic accidents caused by flash blindness. Many railways and other public transportation infrastructure will be disabled as stations and tracks are obstructed or destroyed, communications are disrupted, and electricity fails. Security concerns, lack of visibility, and communications failure will potentially ground aircraft. The explosion is likely to damage or destroy power lines, water pipes, and other types of utility infrastructure.[21] It may take several weeks to restore electricity to SDZ and MDZ. In total, the wide-spread impacts to critical infrastructure will limit effective communication with the public, the distribution of disaster relief supplies, and access to shelters and medical providers, among others. These impacts could be mitigated by effective pre-event planning driven and informed by supply-chain modeling, critical infrastructure contingency planning, and mechanisms to ensure that information regarding the immediate impacts to critical infrastructure will be readily available and widely-shared following an event.

Delayed effects

In addition to prompt effects, a nuclear blast will generate delayed effects, most generally caused by fallout. Fallout is produced when radioactive particles adhere to dust and debris as part of the initial explosion and are drawn up several miles into the atmosphere as part of the fireball. These particles, which emit radiation, will begin to fall out of the cloud and settle on horizontal surfaces. Unlike prompt effects, which occur too rapidly to avoid, health effects from fallout can be mitigated by taking shelter. Sheltering in place to avoid exposure is recommended for the first 12 to 24 hours after the plume extends into a given area.[22, 23]

The region affected by fallout is divided into two categories based on the danger of radiation exposure as measured by dose rates. These categories are the dangerous fallout zone (DFZ) and hot zone (HZ), illustrated in Figure 2. The fallout pattern is determined in good part by local meteorological conditions, including the prevailing winds that determine the direction the plume will travel and precipitation, which directly affects the rate and pattern of the fallout deposition. Precipitation can cause “hot spots,” where higher rates of fallout accumulate; radiation may be further concentrated in gutters or sewers by continued precipitation or spread further by deposition in streams or other bodies of water. The fallout zones are also directly affected by the decay rate of the radioactive material itself, as described in Figure 3. Ongoing modeling of the radioactive plume, measurements of radioactive material, and calculations

21 National Academies (2005) Nuclear Attack. Factsheet created for News and Terrorism: Communicating in a Crisis.
22 Buddemeier B *et al* (November 2011) National Capital Region Key Response Planning Factors for the Aftermath of Nuclear Terrorism. Lawrence Livermore National Laboratory
23 NSS (National Security Staff) Interagency Policy Coordination Subcommittee for Preparedness and Response to Radiological and Nuclear Threats (June 2010) Planning Guidance for Response to a Nuclear Detonation.

indicating decay rates for the types of radioactivity released can all be used to directly inform planning and response activities.

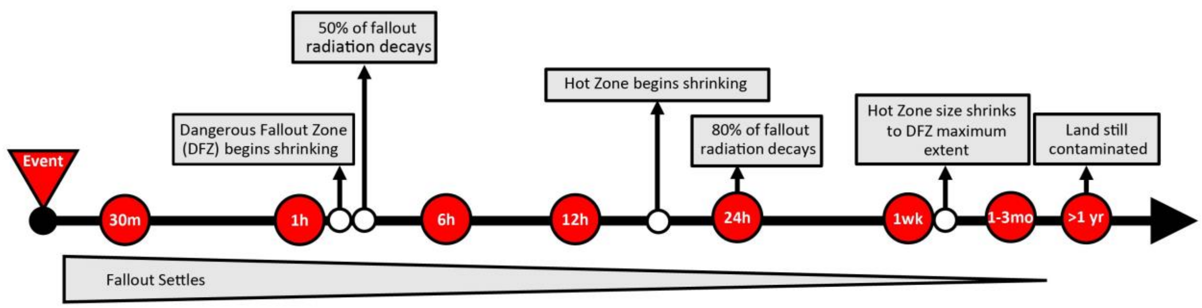

Figure 3. Expected timeline for decay of fallout after a 10-kT IND detonation

Although the high radiation levels that present an immediate danger will rapidly decrease after the first few days, long term, low-level radiation will persist in the area for years. Land is expected to remain contaminated at least one year after the event.[22] Even though the long-term risk posed by such radiation levels is believed to be limited, it is likely that people will continue to avoid the affected areas. In addition, the public may lose confidence in agricultural products originating from these areas. Data and modeling resources that can accurately map this area will inform appropriate public messaging and long-term recovery efforts.

Health effects

Prompt and Delayed effects most commonly describe the physical effects of an IND detonation. The human health effects associated with such an event are described in Figure 4. The immediate health effects include those caused by the thermal and ionizing radiation and by secondary health effects, such as trauma from car accidents caused by flash blindness, building collapse, or burns from fires ignited by the blast, and psychological trauma. Many patients, particularly those in the MDZ, are likely to present with complex injuries caused by a combination of radiation exposure, burns, and injuries due to trauma.

Populations within the fallout zones are expected to have an increased risk for radiation injury. For those outside of a robust shelter, acute radiation injury is highly likely in the DFZ. Therefore, modeling and data resources that can predict the number of individuals exposed to acute radiation will be necessary to determine the medical facilities and supplies required for treatment. Acute radiation effects are unlikely in the HZ, but minimizing exposure will reduce long-term cancer risks. Data and modeling resources that map the HZ will also be important to determine the number of individuals at risk for developing cancer in the long term, such that these populations can be monitored in the recovery phase and receive appropriate treatment.

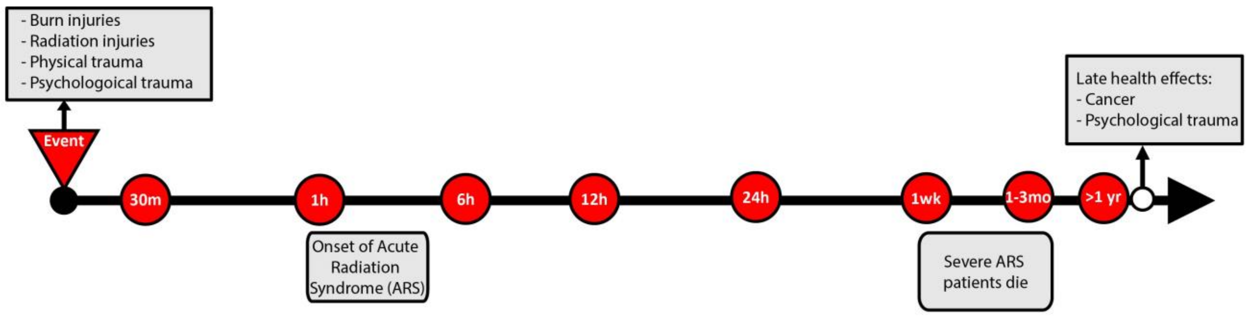

Figure 4. Timeline of expected health effects after an IND detonation

Health effects can continue to manifest over the days and weeks following the event. High doses of full-body exposure to ionizing radiation causes acute radiation syndrome (ARS), which manifests over a period of hours to weeks with the rate of onset proportional to the amount of acute radiation exposure. Most ARS victims will experience nausea and vomiting within 24 hours of radiation exposure, although symptoms of ARS may continue for months. Depending on the amount of radiation exposure, patients with severe ARS will die starting at one week post-exposure.[24] This delay in ARS symptoms can cause confusion because those with significant exposure may initially appear to recover, only to present with more severe symptoms at a later date.[25] Deaths usually results from infection due to hemorrhage, cardiovascular system failure, infection, dehydration, or electrolyte imbalance. Supportive care, including blood transfusions and antibiotics, is usually indicated.[24] Modeling can help identify the approximate number of potential ARS victims, an important factor in determining the quantity and types of medical supplies and the number of medical facilities that will be required throughout the response and recovery phases.

Long-term health effects are predominantly radiation-induced carcinogenesis, which takes years to develop, [26] and psychological conditions, including posttraumatic stress disorder, generalized anxiety, panic, depression, and others, which could persist for several years.[27] The on-going response and recovery phases should include continued medical surveillance of individuals to manage long-term

24 CDC (Centers for Disease Control and Prevention). CDC Radiation Emergencies | Acute Radiation Syndrome: A Fact Sheet for Physicians. http://www.bt.cdc.gov/radiation/arsphysicianfactsheet.asp. Last Update March 18, 2005. Accessed October 11.

25 Buddemeier B *et al* (November 2011) National Capital Region Key Response Planning Factors for the Aftermath of Nuclear Terrorism. Lawrence Livermore National Laboratory.

26 Tenforde TS *et al* (Summer 2010) Health Aspects of a Nuclear or Radiological Attack. *The Bridge* 40
Institute of Medicine (2009). Board on Health Sciences Policy. Assessing Medical Preparedness to Respond to a Terrorist Nuclear Event.

psychological trauma and to detect cancer.[28] Therefore, resources that can identify and track potential victims can facilitate the recovery process.

Timeline of response activities after an IND Detonation

Detonation of an IND would require an immediate large-scale emergency response and recovery effort to save lives, stabilize the affected area, limit extended impacts, and return the region to normalcy. This section outlines the timeline of anticipated response activities corresponding to the event timeline described in the previous section. To put these activities in the context of response and recovery operations, the timeline depicted in Figure 5 is described on the basis of the phased approach to how federal response operations are organized as described in the Response Federal Interagency Operational Plan (FIOP), which is currently being updated.[29]

The discussion in this section describes the response activities required following an event. This focus on response is specifically designed to guide planning activities: a clear description of the necessary response activities provides an outline of the information required to perform those activities efficiently and effectively and provides a guide for planning that would directly support response and recovery activities. The data, models, and analysis tools available to inform response activities must be identified and incorporated into interagency emergency management plans and Concept of Operations (CONOPS), just as are the activities, roles, and responsibilities for response. Only if these resources are made readily available, exercised, and incorporated into the experience of emergency managers will the information they provide be successfully leveraged during an event.

Notably, this timeline does not include the period prior to the detonation, such as any activities undertaken by federal authorities if a credible, imminent threat of an IND were identified or predicted. These activities, typically referred to as consequence management, are covered in a series of ongoing efforts within the federal interagency. The data and models used to help guide the emergency management aspects of consequence management are expected to be largely similar to those used during planning efforts and during response to an event. Certainly, much of the information required would be similar: information identifying which populations and infrastructure could be affected; the degree of expected damage; and what actions could and should be prioritized to most effectively and efficiently provide support to those impacted.

The timeline of a response is shown in Figure 5. The section below describes these response activities as they relate to the event timeline described previously in this document and as they can be used to

[28] National Academies (2005) Nuclear Attack. Factsheet created for News and Terrorism: Communicating in a Crisis.
[29] DHS (June 2013) Response Federal Interagency Operational Plan - Draft for Approval.

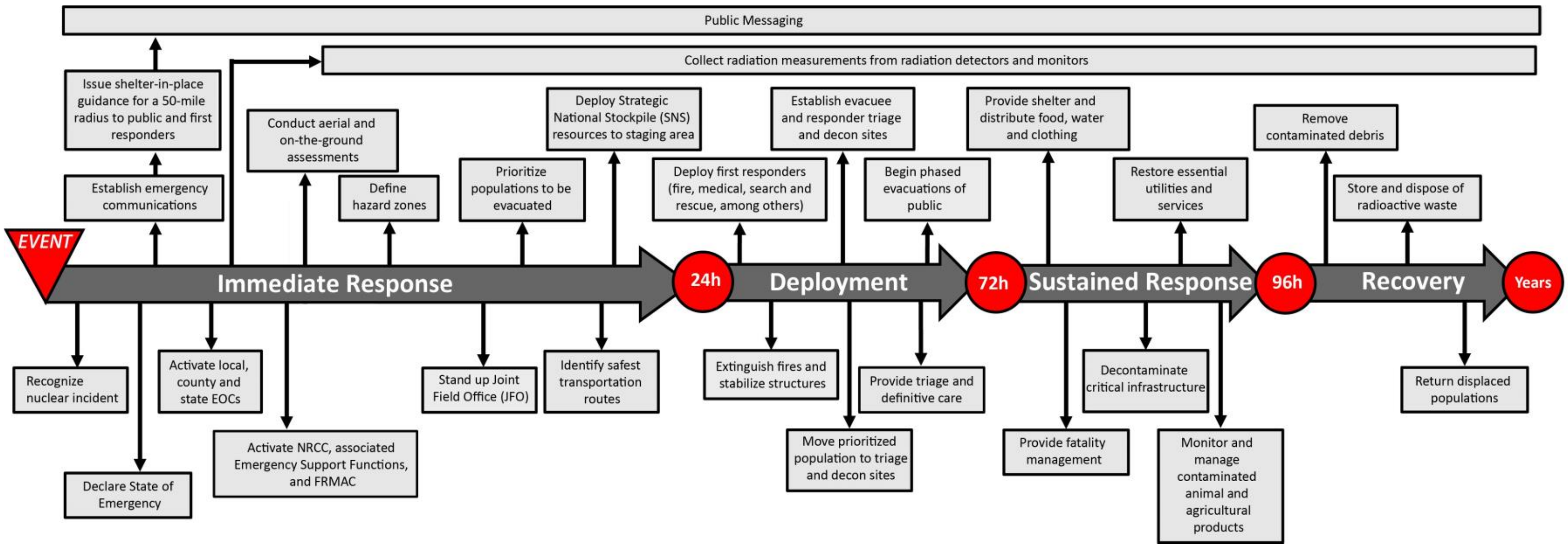

Figure 5. Timeline of response activities after an IND detonation

define the corresponding information required to support data driven, operationally-relevant decision making.

Immediate Response: 0 to 24 hours

A review of planning and policy documents suggests that most on-the-ground federal response activities are unlikely to occur within the first 24 hours after an IND detonation.[30, 31] However, this period will be critical for federal activities related to evaluating the situation, gathering information about the event, and preparing to deploy all available assets to the affected area once it is reasonably safe to do so. Figure 6 illustrates the activities expected to occur during this period. These proactive efforts will ensure that resources reach the impacted area in time to provide assistance.

Although federal assets will take time to arrive on the scene, state and local responders, such as Fire and Emergency Medical Services, are likely to attempt rescue operations immediately. Data and modeling resources that can provide information to these first responders about blast zones, fallout zones and protection factor of buildings will help to identify areas where response efforts can proceed with minimal risk to responders.

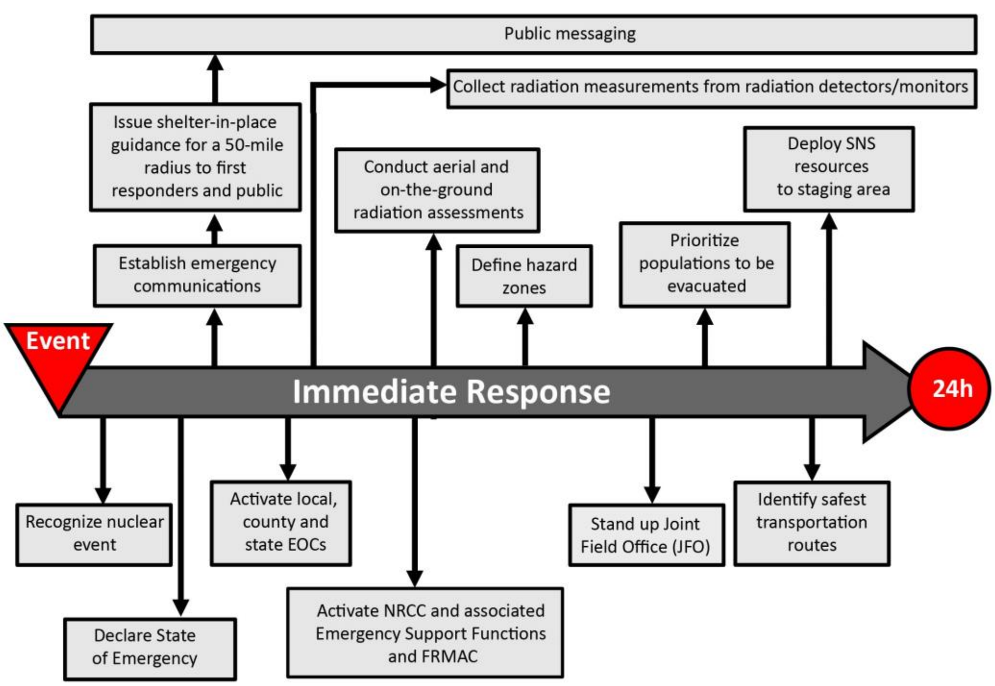

Figure 6. Response activities that will likely take place during the immediate response phase

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30 Garwin RL (Summer 2010) A Nuclear Explosion in a City or an Attack on a Nuclear Reactor. *The Bridge* 40

31 NSS (National Security Staff) Interagency Policy Coordination Subcommittee for Preparedness and Response to Radiological and Nuclear Threats (June 2010) Planning Guidance for Response to a Nuclear Detonation.

Event Recognition

The radiation generated by a nuclear explosion demands a specialized response approach. The majority of response efforts, such as a phased evacuation or medical treatment, cannot proceed without first recognizing the nuclear nature of the incident. Widespread destruction, the flash of light, and the subsequent fallout cloud, among other indicators, will indicate that a nuclear detonation has occurred. Concurrently, fixed or portable radiation monitors will provide an indication of radiation contamination.[31] Resources, such as Rad Responder[32], that collect, transmit and map radiation levels will be essential in providing ongoing information such as the deposition of fallout, which can be used to estimate the relative health effects expected in affected areas and track radiation exposure to first responders and others. All these data can be used to directly support decision-making for emergency managers, but can also be used to update the parameters of models used for ongoing predictions regarding the scope and scale of the event.

Emergency Communications

Current policy and planning documents advise that first responders and the public shelter-in-place for a 50-mile radius from ground zero until more information is obtained about the extent of the blast and fallout hazards.[33] However, this guidance is expected to be refined based on a combination of atmospheric dispersion modeling and radiation assessment data, such as data collected by real-time monitoring, which, taken together, will allow identification of areas where response activities can commence in the blast zones that are not contaminated with radiation. As the weather changes, aerial and on-the-ground assessment data, updated predictions regarding the trajectory of the radioactive plume, and information about the decay rates of the material released will be combined to refine the shelter-in-place guidance and provide estimates about the number of people affected and the types of medical care they will require once shelter-in-place guidance has been lifted.

Although shelter-in-place is advised within a 50-mile radius of ground zero, first responders outside of this area will mobilize and deploy to the affected area immediately. Therefore, it is crucial that data and modeling resources that provide information regarding contaminated areas also be disseminated to these groups as early as possible after an IND detonation. This information will help guide activities outside the immediate impact area toward those regions that will require the greatest support, while protecting the responders themselves.

Emergency communications post-event are necessary to effectively provide health and safety instructions to the public and first responders and are a critical factor in building trust, comforting the nation, saving lives, and minimizing injury.[34] The information must be disseminated broadly, providing

32 RadResponder Network. https://www.radresponder.net/ Accessed 11 November 2013

33 Buddemeier B *et al* (November 2011) National Capital Region Key Response Planning Factors for the Aftermath of Nuclear Terrorism. Lawrence Livermore National Laboratory.

34 NSS (National Security Staff) Interagency Policy Coordination Subcommittee for Preparedness and Response to Radiological and Nuclear Threats (June 2010) Planning Guidance for Response to a Nuclear Detonation.

guidance on protective activities such as shelter-in-place as well as information regarding where to seek medical care and longer term shelter. While there are systems in place to provide emergency communications, including the Emergency Alert System (EAS) and the Integrated Public Alert and Warning System (IPAWS),[35] the real challenge will lie in determining what information to provide to whom, when, and where. "Improvised Nuclear Device Response and Recovery: Communicating in the Immediate Aftermath" is one resource that can be used for emergency communications, providing key messages and anticipated questions and answers to be used during the initial 72-hour period after an IND detonation. The document is housed in the National Preparedness Resource Library[36] and is available for use by all emergency responders and federal, state, local, tribal and territorial officials communicating with the public.

Notably, compromised communications infrastructure is likely to complicate emergency communications efforts. While messaging by radio, television, and text messaging through cellular systems may be optimal, alternative messaging methods should also be considered. On-going assessments or estimates of the impacts to communications infrastructure will be required to inform these activities, ensuring that all available communications methods are leveraged to disseminate information to the public throughout the event.

Coordination of Response Activities: Government Emergency Operations

An efficient and effective response will rely heavily on well-coordinated government emergency response activities. Immediately following an IND detonation, all affected local, county and state EOCs are expected to be activated immediately. Federal emergency assets will be leveraged once the affected states declare a state of emergency. Once a federal emergency is declared, the National Response Coordination Center (NRCC) will be activated and a Joint Field Office will be established as close to the detonation as possible within a safe area.[37] As laid out in the National Response Framework (NRF), the Emergency Support Functions (ESFs) will be coordinated through the NRCC to provide support for anticipated and identified response and recovery activities.

Coordination of efforts and initial events, including the declaration of a federal emergency and establishing a safe location for the Joint Field Office to stand-up, will rely heavily on the sharing and dissemination of information regarding the anticipated and assessed impacts of the event. This information is likely to be provided by a combination of assessment data collected post event with ongoing predictive modeling used to refine initial estimates of the event and its impacts. Groups such as the Federal Radiological Monitoring and Assessment Center (FRMAC) and the Interagency Modeling and Atmospheric Assessment Center (IMAAC) will provide radiological assessments and modeling

35 Buddemeier B *et al* (November 2011) National Capital Region Key Response Planning Factors for the Aftermath of Nuclear Terrorism. Lawrence Livermore National Laboratory.

36 Federal Emergency Management Agency. National Preparedness Resource Library. http://www.fema.gov/national-preparedness-resource-library. Last Update 2013. Accessed 2013.

37 DHS (Department of Homeland Security) (April 2006) Joint Field Office Activation and Operations.

information to predict the trajectory of the plume and monitor radiation upon activation. As organized and coordinated by FRMAC, resources such as fire stations, aerial measurements taken by aircraft, on-the-ground radiation assessment teams, and first responders equipped with dosimeters will likely be reporting continuous time-stamped and geo-tagged dose rate measurements. These data could be collated and used to inform and refine modeling efforts to demarcate the blast and fallout zones. Such measurements allow fallout zones to be charted, providing a comprehensive situational awareness to emergency managers. Optimally, this information would be coordinated through the NRCC, shared with the state and local EOCs, and distributed to each of the ESFs to ensure that all these groups are operating under the same assumptions regarding the situation on the ground.

To facilitate response operations, blast and fallout zones will need to be characterized within a few hours of the explosion. The blast zones can be recognized by visual inspection, but they tend not to have distinct boundaries.**Error! Bookmark not defined.** Geo-tagged aerial imagery and reports from responders should serve as the basis for blast zone identification. The fallout zones may be recognized by a combination of aerial measurements, on-the-ground measurements, and modeling information. The shelter-in-place guidance up to a 50-mile radius is a blanket guidance in the early hours that is designed to prevent additional casualties due to radiation exposure. However, identifying the hazard zones within the 50-mile radius not contaminated by radioactive fallout would allow first responders to continue search and rescue operations outside the DFZ in the early hours after an IND detonation. Although most life-saving response missions are unlikely to begin in the DFZ for at least 24 hours post-event, identifying these hazard zones will be crucial as the greatest fraction of injured people whose lives can be saved by medical care will be in the moderate damage zone.[38] Demarcating this zone early will save time and lives by allowing relief assets to be pre-staged for deployment. In addition, actual dose rate measurements from assessment data can be used to refine modeling parameters that predict the path of the fallout cloud. Such information will be vital to the planning of evacuation routes and location of triage centers.

Evacuation

While plans suggest that the public will be advised to shelter-in-place for 12 to 24 hours following detonation of an IND, extensive planning to guide evacuation efforts will be required during this time. Timely and organized evacuation is one of the most complex issues associated with a large-scale emergency and requires the merging of a large amount of information from a wide range of sources. Population, infrastructure, and event characterization information (e.g. type of blast, sources and types of contamination) will need to be collated and overlaid to understand the likely impacts of the event even before assessment data collected on the group are available. For example, impacts to transportation infrastructure such as bridge stability, traffic flow through streets or freeways blocked by

[38] Buddemeier B *et al* (November 2011) National Capital Region Key Response Planning Factors for the Aftermath of Nuclear Terrorism. Lawrence Livermore National Laboratory.

traffic accidents, and debris-filled roads must all be considered.[39] Evacuation of the affected populations must be coordinated with the influx of emergency response vehicles, and those evacuating must have information regarding their final destination and whether that location can provide medical care, long term shelter, or both. Only once the blast and fallout zones have been identified can emergency managers prioritize the populations within the zones for evacuation based on the number of people estimated to be in each zone and the risk of radiation exposure and secondary hazards (i.e. fire, chemical release) in the zone.[40] Notably, all these activities rely heavily on the information about the event and its impacts. Without shared situational awareness, effective coordination of these activities would be impossible.

Medical Supplies and Services

Local and regional medical providers and supplies are likely to be immediately overwhelmed in the aftermath of an IND. Deployment of medical supplies from the Strategic National Stockpile (SNS) and the establishment of the onsite medical triage centers will be required to provide medical care and supplies to the affected populations and to support the response efforts. As these resources can require 24 hours to arrive, decisions regarding the extent to which they will need to be leveraged must be determined nearly immediately after the event.[41] This information, like that required to define the evacuation plan, will require the rapid collation of both predictive modeling results and aerial and on-the-ground assessment data collected immediately after the event to ensure a rapid and appropriate response. Notably, dose rate data collected by radiation detectors and monitors near the event can inform the quantity of supportive care products (e.g. antibiotics and neutropenia treatments) needed to combat ARS.[42]

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39 Buddemeier B *et al* (November 2011) National Capital Region Key Response Planning Factors for the Aftermath of Nuclear Terrorism. Lawrence Livermore National Laboratory.

40 NSS (National Security Staff) Interagency Policy Coordination Subcommittee for Preparedness and Response to Radiological and Nuclear Threats (June 2010) Planning Guidance for Response to a Nuclear Detonation.

41 Benjamin GC (Summer 2010) Medical Preparedness and Response to Nuclear Terrorism. *The Bridge* 40

42 CDC (Centers for Disease Control and Prevention). CDC Radiation Emergencies | Acute Radiation Syndrome: A Fact Sheet for Physicians. http://www.bt.cdc.gov/radiation/arsphysicianfactsheet.asp. Last Update March 18, 2005. Accessed October 11.

Deployment: 24 to 72 hours

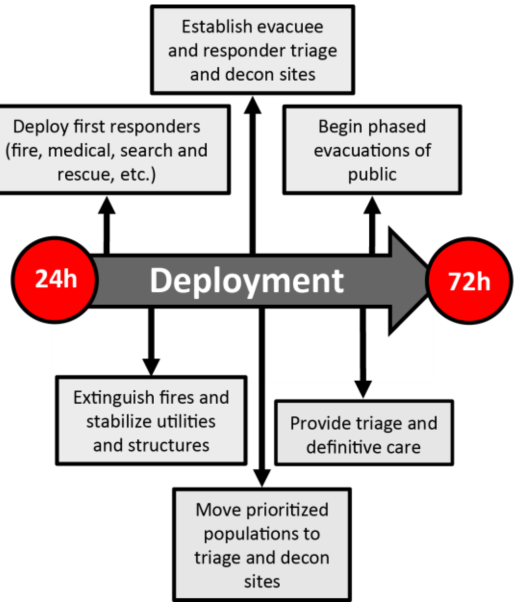

Figure 7. Response activities during the deployment phase

After detonation of an IND, current plans suggest that shelter-in-place guidance for the general public would be lifted after 24 hours. At that point, more regional and federal assets would arrive and response and recovery activities would accelerate, as shown in Figure 7. As fire, medical, search and rescue, and other response activities escalate safe triage and decontamination sites must be chosen and outfitted to provide care for victims. While triage and medical care would ideally be provided at hospitals, resource constraints are likely to require expanding beyond traditional care providers to allow the largest numbers of casualties to be treated as rapidly as possible. Patient care is likely to be complicated by contamination issues: decontamination including guidance as simple as brushing fallout particles off clothing and removing and/or replacing clothing will need to be accomplished in addition to eventually washing.[43,44] The care of medical patients would need to be prioritized and triage hierarchies implemented. Disaster relief supplies such as food, water, and clothing would be distributed to evacuees as they assemble at shelter sites. Phased evacuations would commence as fires are extinguished, roads are cleared, and utilities and structures are stabilized.

All the activities implemented in the deployment period are time-sensitive and interdependent, requiring a great deal of coordination and the dissemination of clear information to guide prioritization, ensure safety, and save as many lives as possible. Large volumes of data are likely to be collected as first

43 Benjamin GC (Summer 2010) Medical Preparedness and Response to Nuclear Terrorism. *The Bridge* 40
44 National Academies (2005) Nuclear Attack. Factsheet created for News and Terrorism: Communicating in a Crisis.

responders enter the affected regions, federal resources arrive onsite, and at least some communications infrastructure are restored or emergency communications systems are deployed. Whereas many of the decisions in the first 24 hours after the event are likely to rely heavily on information provided by predictive modeling, decision making during the deployment activity will shift to relying more on assessment data. In order for the assessment data to be used effectively to guide response activities, they must be collated, validated, processed, and made readily accessible to those on the ground. This process is a challenge even during much smaller events and highlights the need to incorporate detailed guidance for data and information management into emergency response plans, so these activities can be validated and practiced along with the response and recovery activities they inform.

Sustained Response: 72 hours to 30 days

The federal emergency management community aims to stabilize any major disaster by 72 hours after the event, termed the Sustained Response phase of the event (see Figure 8). Stabilization marks a transition from life-saving activities to life-sustaining activities and a shift of focus toward the sustained response and, eventually, to recovery.

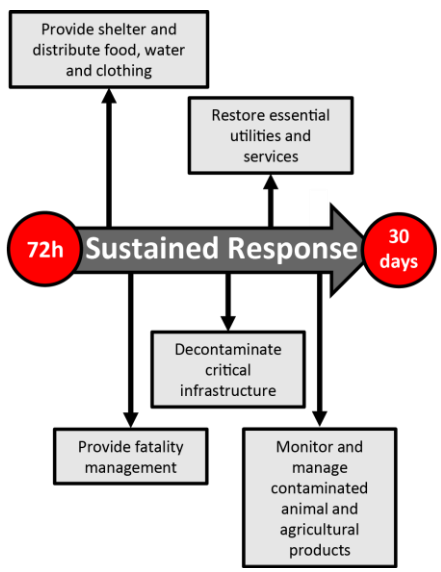

Figure 8. Response activities in the sustained response phase

Mass Care

The transition into sustained response includes a focus on mass care. Long term shelter facilities for displaced populations will need to be established, along with the food and medical services, required for those populations. Due to the expected extended length of the recovery period, issues such as long term schooling solutions will need to be reached early in the sustained response phase so as to disrupt the lives of the displaced populations as little as possible. The long term solutions for displaced populations will need to be developed on the basis of information about the specific populations affected, their needs, and their levels of resilience.

Human Health

As the situation on the ground is stabilized, medical providers will transition from triage into longer term life-support and ongoing treatment of patients suffering from radiation exposure (most notably ARS), all of which will require individual dose reconstruction. Determining the radiation dose received by victims will require biodosimetry tools and models, contamination maps, and reconstruction of victim location and movement patterns. Burn patients will require long term treatment, often requiring extended intensive care. Fatality management will need to be initiated, including the recovery, decontamination, identification, and interment of remains.[45] Information regarding treatment regimens, hospital bed space, available health care and supportive care providers, and necessary supplies to support long term medical care will all be critical to ensure that this care can be provided. In addition, medical providers will need to be ready to diagnose and treat the psychological impacts of a nuclear attack, which could range from posttraumatic stress disorder to generalized anxiety, and could continue for a protracted period.

Environmental Contamination

For an event the magnitude of an IND detonation, decontamination and restoration efforts are projected to cost billions of dollars and will last years, but planning for these activities must be initiated during the first week following the event.[46, 47] Critical infrastructure and utilities will need to be restored as well as the decontamination of land and buildings before displaced populations are permitted to return home. Transportation infrastructure, including roads and bridges, are required to support restoration activities. These activities will rely heavily on data indicating when and where workers can safely re-enter to begin restoring services. Furthermore, any materials or rubble produced by the explosion must be cleared before reconstruction of the blast zones can begin, as proper disposal of these contaminated debris is essential to prevent recontamination of people and resources.[48] The ongoing collection and analysis of data will be critical to informing these efforts.

In addition to the effects of the blast and radiation contamination to the area immediately surrounding the explosion, fallout could settle on farmland as far as 100 miles downwind of ground zero.[49] Animal and agricultural products in the path of the fallout plume maybe unfit for consumption. As illustrated by the public response to the Fukushima Daiichi nuclear release, public confidence in these agricultural and animal products may take longer to reinstate. It will be critical to continue appropriate public messaging

45 NSS (National Security Staff) Interagency Policy Coordination Subcommittee for Preparedness and Response to Radiological and Nuclear Threats (June 2010) Planning Guidance for Response to a Nuclear Detonation.
46 DHS (Department of Homeland Security) (March 2006) National Planning Scenarios.
47 National Academies (2005) Nuclear Attack. Factsheet created for News and Terrorism: Communicating in a Crisis.
48 Benjamin GC (Summer 2010) Medical Preparedness and Response to Nuclear Terrorism. *The Bridge* 40
49 Buddemeier B *et al* (November 2011) National Capital Region Key Response Planning Factors for the Aftermath of Nuclear Terrorism. Lawrence Livermore National Laboratory.

as information becomes available regarding these products. Such messaging and the development of appropriate guidelines will, again, rely heavily on ongoing monitoring and assessments.

Recovery: 30 days to years

The recovery phase for an IND is likely to last years or decades (see Figure 9). As critical infrastructure and utilities are restored, much of the effort will need to focus on cleanup and restoration of contaminated sites. Models that predict occupational exposure and the fate and transport of radioactive material in the environment will be important recovery planning tools. Contaminated debris cleared from the fallout region will need to safely managed, overwhelming existing radioactive waste removal protocols. [48,49] Once the blast zones are rebuilt and contamination is either removed or falls to safe levels, displaced populations may begin to return home, if they have not already permanently relocated. Ongoing data collection, analysis, and publication will be critical to support these efforts and restore public confidence in their safety.

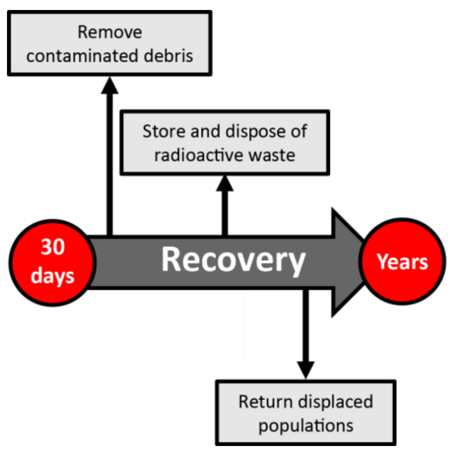

Figure 9. Response activities during the recovery phase

Conclusions and Next Steps

The US emergency response community has never responded to a nuclear detonation; however, an outline of the event and the subsequent response, as described here, can help guide the development of response plans. Particularly in the absence of previous experience, the effectiveness and efficiency of the response will depend heavily on the outputs of models, the collection of assessment data, and the processing of those data into useful decision support information. Operational plans need to include a detailed and robust analysis of the time-critical information required during each phase of a response, informed by the IND event timeline which will provide a backbone for when and how response and recovery activities are conducted.

The next phase of the project will use the event and response activities timelines described here as a foundation to determine the critical information requirements to support emergency management activities after an IND detonation. Subject matter experts, senior-level decision makers, and emergency management personnel will be interviewed to elicit both general and specific information to identify data and modeling resources necessary to provide that information and determine how the information is used during all phases of emergency management. This effort will support the development of information processing tools that will help ensure that those making decisions during planning and response to an event have ready access to the information they need when they need it.

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Appendix 1: The ESFLG Modeling and Data Working Group (MDWG) CHARTER

August 6, 2012

1.0 PURPOSE

This charter provides the framework for the establishment and structure of the Modeling and Data Working Group (MDWG). The MDWG is comprised of Emergency Support Function Leadership Group (ESFLG) members or designees and chaired by the Director of FEMA's Planning Division, Response Directorate. The MDWG will:

- Analyze the catastrophic scenarios to be addressed and prioritized;
- Define and assess information requirements for response planning and operational decision-making;
- Evaluate existing modeling resources to support the range of scenarios and determine modeling input and output requirements;
- Identify gaps and recommend solutions to meet the modeling input and output requirements.

2.0 MISSION

The MDWG mission is to identify consistent, reliable, authoritative models and data sets for response planning and operational decision making for catastrophic events.

3.0 BACKGROUND

Scientific based models and empirical information products and programs are increasingly used to predict the effects of and inform response planning and operations, particularly when faced with complex, cascading "maximum of maximums" threats and incidents. These models and programs enable decision makers with enhanced situational awareness and heightened visualization of the operational environment to prepare and assess the response to catastrophic events. For example, the benefits of prompt and accurate modeling include improved incident warning, reduction of public anxiety through effective risk communications, and delineation of hazard areas. Both real world events and exercises alike have highlighted a need to standardize these processes and products. However, currently no central mechanism exists to address the doctrine, organizational, training, materiel and leadership requirements necessary to exploit the effective use and coordination of such models and products.

The lack of a formal and standardized approach to integrating scientific modeling and coordinating related technical programs is a challenge to information sharing as well as to the development of effective preparedness plans and responses. The need to develop a standardized framework of modeling across the Emergency Support Function Leadership Group (ESFLG) structure is essential to closing core capability gaps, and improving the overall effectiveness of models for both planning and operations. The MDWG will address modeling and analysis requirements and the most effective ways to exploit emerging data generation products, to include scientific modeling and data sets to meet those requirements.

4.0 MEMBERSHIP

The Modeling and Data Working Group (MDWG) members were nominated by the Emergency Support Function Leadership Group (ESFLG) and will meet on a monthly basis. A list of the voting organizations of the MDWG is attached. The MDWG will address the most effective ways to exploit emerging data generation products, to include scientific modeling and data sets. The working group will determine the most effective programs to incorporate into the ESFLG structure as well as to evaluate implementation success.

5.0 ROLES AND RESPONSIBILITIES

- The MDWG voting members will provide primary and alternate representatives to contribute throughout the process.
- Each primary organization of the MDWG will have a voting responsibility when dealing with modeling and data issues that affect the interagency working group.
- The MDWG gathers and assesses modeling and information requirements for catastrophic scenarios and will provide regular updates to the ESFLG for evaluation.
- The ESFLG will then use the information compiled to work with the Office of Science and Technology Policy (OSTP) and the National Security Staff (NSS) to develop and formalize interagency modeling capability governance and coordination.

6.0 DELIVERABLES

The working group will provide an update status to the ESFLG on a monthly basis.

The working group will provide the following deliverables:

1. Identify and analyze the catastrophic scenarios to be addressed and prioritized;
2. Define and assess information requirements for response planning and operational decision-making;
3. Define information requirements for response planning and operational decision making.
4. Develop criteria to evaluate and determine modeling and data source that support requirements
5. Evaluate authoritative modeling and data sources to support catastrophic scenarios; and
6. Identify gaps and recommend solutions to solve the identified modeling and information requirements.
7. Utilize the results from each scenario to inform subsequent scenarios.

7.0 RESOLUTION OF ISSUES AT MDWG MEETINGS

- The working group will utilize the ESFLG structure to resolve interagency coordination issues.
- Any interagency issues that cannot be resolved at the ESFLG level will consult the National Security Staff (NSS) and the Office of Science and Technology Policy (OSTP) for resolution of policy issues.
- Finalize resolution of policy issues will be handled by the Domestic Readiness Group (DRG).

8.0 ESFLG WORKING GROUPS

The MDWG is an ESFLG working group, in accordance with the ESFLG Charter. ESFLG working groups will include appropriate expertise and representation to guide the development of the requisite procedures for response and recovery activities under the National Response Framework (NRF) and National Disaster Recovery Framework (NDRF), as well as Federal Interagency and National planning efforts. Representation on working groups will be open to selected departments and agencies and FEMA Regions as appropriate.

The working group's purpose is to:

- Convene on an ad-hoc basis as designated for specific issues, and disband upon completion of the specific assigned task;
- Address issues that require appropriate department/agency participation for researching and developing procedures to operationalize and execute policy decisions;
- Identify and suggest process improvements to the ESFLG for approval;
- Provide input from subject matter experts; and
- Provide expertise to the Federal response community to address tasks including the research and development of potential options/courses of action and drafting of documents, recommendations, and procedures to improve Federal interagency coordination, integration, and incident response.

9.0 MDWG Primary Voting Organizations

Department of Agriculture

Department of Agriculture/Forest Service

Department of Commerce

National Oceanic and Atmospheric Administration

Department of Defense (OSD, Joint Staff)

Department of Defense/U.S. Army Corps of Engineers

Department of Energy

Department of Energy/National Nuclear Security Administration

Department of Health and Human Services

Department of Homeland Security

- Federal Emergency Management Agency
- U.S. Coast Guard
- Transportation Security Administration
- Immigration and Customs Enforcement
- Customs and Border Protection
- United States Secret Service
- Office of Science & Technology
- United States Citizenship & Immigration Services

Department of Housing and Urban Development

Department of the Interior

Department of the Interior/National Park Service

Department of Justice

Department of Transportation

Environmental Protection Agency

Small Business Administration

Appendix 2: The ESFLG Modeling and Data Working Group Project Plan

DHS/FEMA

The ESFLG Modeling and Data Working Group (MDWG)

Project Plan

RD-Planning/ESFLG/MDWG/MDWG Project Plan.doc/svc
8/6/2012

Introduction

In July of 2012, both the Department of Homeland Security (DHS) and Federal Emergency Management Agency (FEMA) agreed that FEMA would coordinate the creation and implementation of an interagency Modeling and Scientific Workgroup (MDWG), with the full support and involvement of the Emergency Support Function Leadership Group (ESFLG). At the July 19, 2012 ESFLG meeting, there was concurrence by the ESFLG to form the Modeling and Data Working Group (MDWG) and designate a representative from their department/agency to participate on the MDWG. On July 31, 2012, the MDWG was formed from ESFLG nominations and the August 6th kickoff meeting was announced. The MDWG will assess the current state of modeling systems used, including their owners, requirements, consumers, production processes and means of public messaging. The working group will utilize the ESFLG structure to resolve routine interagency coordination issues. The working group will consult the National Security Staff (NSS) for resolution of policy issues. The purpose of the MDWG will be information gathering – regular updates will be provided to the ESFLG. The ESFLG will then use the information compiled to work with the NSS to develop and formalize interagency modeling capability governance and coordination.

Background

Scientific based models and data generation products and programs are increasingly used to predict the effects of and inform response planning and operations, particularly when faced with complex, cascading "maximum of maximums" threats and incidents. These models and programs enable decision makers with enhanced situational awareness and heightened visualization of the operational environment to prepare and assess the response to catastrophic events. For example, the benefits of prompt and accurate modeling include improved incident warning, reduction of public anxiety through effective risk communications, and delineation of hazard areas. Both real world events and exercises alike have highlighted a need to standardize these products, programs, and processes. A need exists to understand the strengths and constraints of each scientific model and related technical program; enabling the closing of core capability gaps, however, currently no central mechanism exists to address the doctrine, organizational, training, materiel and leadership requirements necessary to exploit the effective use and coordination of such models and products.

The lack of a formal and standardized approach to integrating scientific modeling and coordinating related technical programs is a challenge to information sharing as well as to the development of effective preparedness plans and responses. The need to develop a standardized framework of modeling across the Emergency Support Function Leadership Group (ESFLG) structure is essential to closing core capability gaps, and improving the overall effectiveness of their use in both planning and operations.

Project Plan

The MDWG will address the most effective ways to exploit emerging data generation products, to include scientific modeling, data requirements, and geospatial analysis for catastrophic scenarios. The working group will determine the most effective modeling and data products to incorporate into the ESFLG structure as well as to evaluate implementation success. Further, Presidential Policy Directive #8 (PPD-8), and specifically the response core capabilities, will inform this process and support this effort.

The MDWG will:

- Analyze catastrophic scenarios to be addressed;
- Assess data requirements for response planning and operational decision-making;
- Evaluate existing resources to support scenarios and address data requirements;
- Identify gaps and recommend solutions to solve the data requirements.

Roles/Responsibilities

- The MDWG voting members will provide primary and alternate representatives to contribute throughout the process.
- Each primary organization of the MDWG will have a voting responsibility when dealing with modeling and data issues that affect the interagency.
- The MDWG gathers and assesses modeling and data requirements for catastrophic scenarios and will provide regular updates to the ESFLG for evaluation.
- The ESFLG will then use the information compiled to work with the OSTP and NSS to develop and formalize interagency modeling capability governance and coordination.

Project Management

1. The membership group will establish a charter.
2. The membership group will establish a work plan.
3. The MDWG will meet monthly to discuss working issues.
4. The MDWG Chair will provide an update to the ESFLG on a monthly basis.
5. The MDWG will provide a formal status update to the ESFLG annually.
6. The MDWG voting members will provide primary and alternate representatives to contribute throughout the process.

Deliverables

The MDWG will provide an update status to the ESFLG on a monthly basis.

The MDWG will provide the following deliverables:

1. Identify and analyze the catastrophic scenarios to be addressed and prioritized
    a. Review the 15 National Planning Scenarios
    b. Review other catastrophic scenarios (i.e. flooding, tsunami, solar storms)
    c. Prioritize scenarios and choose pilot scenarios
    d. Establish process and rating scheme for prioritizing scenarios

2. Define and assess data requirements for response planning and operational decision-making
    a. Map the data requirements for the pilot scenarios
    b. Identify the response organizations for each pilot scenario
    c. Collect input from the response organizations on their current modeling and data requirements supporting these pilot scenarios
3. Evaluate authoritative modeling and data sources to support pilot catastrophic scenarios
    a. Review the modeling and data requirements of each response organization
    b. Define the lead agency responsible for the modeling and data products
    c. Identify the consumers of each modeling and data product
4. Identify gaps and recommend solutions to meet the identified modeling and data requirements
    a. Determine if the existing modeling and data products are meeting the needs of the response organizations and stakeholder groups (e.g. White House, Public, etc.) in assisting them to make informed decisions.
    b. Develop a matrix to determine gaps in modeling and data requirements for each pilot scenario
    c. The MDWG will vote upon solution sets for each gap identified and recommend these solutions to the ESFLG for review and approval
5. Utilize the results from the pilot scenarios to inform subsequent catastrophic scenarios
6. Provide a formal briefing to the ESFLG annually on work accomplished during the fiscal year.