Challenges for Early Responders to a Nuclear / Radiological Terrorism Incident

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ABSTRACT

Even in the best of circumstances, most municipalities would face severe challenges in providing effective incident response to a large scale radiation release caused by nuclear terrorism or accident. Compounding obvious complexities, the effectiveness of first and early responders to a radiological emergency may also be hampered by an insufficient distribution of radiation detection and monitoring equipment, local policies concerning triage and field decontamination of critical victims, malfunctioning communications, inadequate inter-agency agility, and the psychological "fear" impact on early responders.

This paper examines several issues impeding the early response to nuclear terrorism incidents with specific consideration given to the on-going and forward-thinking preparedness efforts currently being developed in the Sacramento, California region. Specific recommendations are provided addressing hot zone protocols, radiation detection and monitoring equipment, hasty patient packaging techniques, vertically and horizontally integrated pre-event training, mitigating psychological fear, and protocols for the effective "hand-off" from first responders to subsequent early response-recovery teams.

INTRODUCTION

Whether from a radiological dispersion devise (RDD), improvised nuclear device (IND), or other scenario, it is widely recognized that a nuclear terrorism incident in an urban center is (1) not an unlikely threat, (2) not an overwhelming technical challenge for determined terrorists; (3) marginally impeded by the current barriers in accessing suitable radiological materials; (4) certain to instantly overwhelm all regional emergency response and health care surge capacities; and (5) a threat that responders currently are only marginally prepared to meet effectively.

First and early local responders will bear the major burden of coping with a nuclear terrorism incident response within the context of limited or uncoordinated external support until the goals of the Homeland Security Presidential Directive 8 (HSPD-8) are more fully realized.

There are an estimated 10,000 radioactive sources throughout the world that exceed 1,000 curies, and of these, an estimated one thousand sources exceed 100,000 curies. To help put these numbers into perspective, an unshielded 25-gram source of Cs-137 (which looks like about ¼ cup of table salt) has approximately 2,000 curies and would provide a lethal dose of gamma radiation to anyone who remained within 1-meter of it for one hour. This same mass of Cesium could be spread over as little as a city block where the dose rate would be significant for victims and responders, or spread over several city blocks (which is a more reasonable plume estimate for an RDD achievable by terrorists) thereby rendering the dose rate nowhere close to dangerous, let alone lethal. It should be noted however that there are some large sources (exceeding 220,000 curies) used in commercial food irradiation units that would result in dangerous doses rates even if distributed over 10 square city blocks.

POTENTIAL RADIATION RESPONSE SCENARIOS

Although the emphasis of this paper is towards RDD or IND radiological incidents, the emergency response to a radiation event can be anticipated in a variety of other scenarios. These include accidents and/or intentional sabotage of nuclear facilities, intentional sabotage of storage or transportation vessels, detonation of a tactical nuclear weapon, a Radiation Exposure Device (radiation source positioned to expose unsuspecting victims to harmful levels of radiation), improvised methods of distributing radiation (sprayers or other mechanical means), or the intentional poisoning from contaminated foods.

Because an RDD or IND incident is a terrorist attack, the response is substantially different than to a radiological accident. Accidents generally happen in radiation facilities where there is resident expertise and pre-planned response guidelines for specific releases of known radionuclides. Often there is a great deal of time in anticipation of the accident to activate pre-developed response plans.[1] Radioactive materials involved in accidents are generally well identified and the hazard is immediately known once an accident occurs. Both the transportation routes and location of fixed facilities for large radioactive sources are located in areas where accidents, generally, will impact the least amount of people.[2] Conversely, terrorist attacks will be intentionally committed in areas where the most impact will occur. The radionuclide or quantity will not be immediately known, and will remain unknown until responders arrive on scene with appropriate equipment to evaluate the hazard, and protective actions will be needed immediately without notice.

PHASES OF RADIATION RESPONSE

The DHS describes the timelines of a radiological incident in terms of three phases. The “Early Phase” (a.k.a., crisis or emergency phase) begins at the onset of the emergency and may have durations of hours to days. Initial protective actions are implemented by local public safety personnel including implementing the ICS, defining and securing the site perimeter, sheltering populations in place or initiating evacuations, decontamination of victims, and providing initial emergency medical treatment. *“The first people likely to respond to a radiation emergency are the same firemen, hazardous materials teams, emergency medical technicians and law enforcement personnel who respond to other emergencies.”*[3]

The intermediate phase will overlap with the early phase, but is usually assumed to begin once the initial control and protective action decisions have been made. During this time, more technical information is gathered regarding field measurements of total exposure and specific characteristics of the radioactive materials involved. The timeline for the intermediate phase is assumed to be weeks to months until the protective actions of the incident are concluded. This phase will overlap with the final phase of the incident where initial considerations for recovery and cleanup actions are considered.

The late phase is the final phase of the radiation incident. During this phase, actions to reduce the radiation levels in the environment to recover the affected area from the incident effects. In this period, there is no longer an “emergency situation.” The collaboration of community and regional leaders will be essential to the restoration of the site to encompass sound decisions in making cost-effective decisions. As currently provided by EPA standards, twice the background radiation levels is considered “contamination.” During the recovery stage of a radiation incident, it may become cost prohibitive to clean up a large area to such an exact standard, requiring the input of community stakeholders to make choices based on sound scientific data.[4]

Role of the First Responder

The events of 9/11 have necessitated that the emergency response community take a critical look at existing response programs, and develop a systems approach for the future. Terrorist groups will continue to attempt to obtain WMD material with the goal of attacking targets in the U.S. Consequently, response assets must be prepared to respond to such an event. Emergency responders will be the first on the scene where decisions made in the initial stages of the incident will contribute greatly the overall success of the response effort. They must be given the capability to detect radiological materials and be provided with timely technical information and

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[1] "Preparedness Directorate; Protective Action Guides for Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents," *Federal Register* 71, no. 1 (January 3, 2006): 175.

[2] Ibid.

[3] "The NCRP Releases Report No. 138, Management of Terrorist Events Involving Radioactive Material," *National Council on Radiation Protection and Measurements*, n.d., 2. www.ncrponline.org/138press.html [Accessed March 12, 2006].

[4] Department of Homeland Security, "Preparedness directorate; Protective Action Guidelines,” 176.

evacuation advice.[5] The term "systems" approach is understood by the authors to mean a collaborative, multi-discipline approach to complex emergency response scenarios. Response protocols must incorporate all stakeholder agencies. Individual response protocols that do not incorporate, and identify all responding agencies roles and responsibilities will be ineffective.

A terrorist attack utilizing a nuclear weapon or IND would most likely be initiated at the surface causing a tremendous amount of radiation fallout.[6] An RDD event would likely result in a less significant fallout. In either case, without a specific radiation response plan, emergency workers could readily become over committed in the contaminated areas and themselves become contaminated or exposed to harmful radiation doses. Response techniques must be structured so that the emergency responders are able to protect themselves while saving as many lives as possible.[7]

The following discussions address five key issues that pose challenges to the best use of emergency response assets during a nuclear/radiological incident, and offer recommendations for regional radiation protocols. Pre-incident development of rational procedures for decontaminating critical victims is essential to reduce confusion and unfounded anxiety that, as a result of existing policies, endanger timely implementation of live saving actions. An effective radiation response protocol must also address detection and dose capabilities, managing the psychological effects of radiological emergencies, proper utilization of protective clothing ensembles and/or hasty patient packaging techniques to minimize potential sources of radiation contamination to the first responders, and pre-incident coordination between local, state, and federal agencies.

Issue 1 – Victim Decontamination Policies

The current approach to responding and treating victims of a radiation incident falls within the response to generalized hazardous materials which, in the Sacramento region requires all contaminated victims to be decontaminated prior to medical treatment or transport. These existing policies are in place to protect the first responders and medical community from exposure hazards associated with hazardous materials. The Sacramento County Emergency Medical Service policy number 8029.05 states medical transportation units will only accept decontaminated patients from a HAZMAT team, and there are no provisions in place to accommodate transportation of critically injured, radiation contaminated patients.[8] Unlike decontamination procedures required for generalized hazardous materials, the critically injured patients at a radiological event must be triaged and treated for life threatening injuries prior to initiating time-consuming decontamination processes to remediate radiation contamination.[9] The existing procedures for treating critically injured patients at a radiological event, as called for in the current policy, will make it extremely difficult to save the lives of the critically injured contaminated patient due to the policies requiring decontamination of all contaminated patients prior to transportation to treatment facilities.

MEDICAL TRIAGE, TREATMENT AND TRANSPORT OF RADIOACTIVELY CONTAMINATED PATIENTS

The international, national and state standards of responding to a radiological incident provide for the immediate treatment of critical patients, this medical response has priority over decontamination. The International Atomic Energy Agency (IAEA) states,

> *In virtually all cases there will be little or no health risk to response personnel provided that, for response actions near any hazardous material, they follow the General part of the Personal Protection Guidelines (Figure 1). There would not be a health hazard to medical staff treating or transporting of contaminated persons provided that they protect themselves against the inadvertent ingestion of radioactive material by the use of normal barrier methods*

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5 John M. McBroom, "How the DOE/NNSA nuclear and biological search and response capability and the first responders across the nation can work together," testimony in House Armed Services Committee (Washington, D.C., March 5, 2002), http://www.house.gov/hasc/openingstatementsandpressrelease/107thcongress/02-03-05mcb [Accessed July 2, 2005].

6 Ferguson et al., *Four Faces*, 91.

7 Ibid.

8. "Policy 8029.5, Hazardous Materials," in *Sacramento County Emergency Medical System Response Protocol* (February 27, 2004), http://www.sacdhhs.com/download/pdfs/ems/ems_Policy%208029.05%20Hazardous%20Materials.pdf. [Accessed June 30, 2005].

9. U.S. Department of Justice, Office of Justice Programs, Office for Domestic Preparedness. *Weapons of Mass Destruction (WMD) Radiation/Nuclear Course for Hazardous Materials Technicians, Student Manual, version 5.1* (Washington, D.C.: Office for Domestic Preparedness, Department of Homeland Security, n.d.), 9-5.

(use of surgical gloves and mask) and take actions to prevent the spread of contamination (e.g., to cover the patient in a blanket or sheet), remove and store outer clothing.[10]

Figure 1 – Response Worker Guidelines

Total Effective Date Equivalent (TEDE) Guideline	Activity	Condition
5 rem	All occupational exposures	• All reasonably achievable actions have been taken to minimize dose.
10 rem*	Protecting valuable property necessary for public welfare	• Exceeding 5 rems unavoidable and all appropriate actions taken to reduce dose. Monitoring available to project or measure dose.
25 rem*	Lifesaving or protection of large populations	• Exceeding 5 rems unavoidable and all appropriate actions taken to reduce dose. Monitoring available to project or measure dose.

*For potential doses >10 rems, special medical monitoring programs should be employed, and exposure should be tracked in terms of the unit of absorbed dose (rad) rather than TEDE (rem).

**In the case of a very large incident such as an IND, incident commanders may need to consider raising the property and lifesaving response worker guidelines in order to prevent further loss of life and massive spread of destruction.

National standards stated by the U.S. Department of Transportation, Emergency Response Guidebook, page 163 states under "First Aid," the need to address medical considerations primarily in radiation incidents.

> *Medical problems take priority over radiological concerns; Use first aid treatment according to the nature of the injury; Do not delay care and transport of a seriously injured person; Injured persons contaminated by contact with released material are not a serious hazard to health care personnel, equipment or facilities; and Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination.*[12]

The California Specialized Training Institute (CSTI) also states that the need to treat and transport critical patients predominates over decontamination concerns. "*Exposure to radioactive contamination is very seldom life threatening. Medical attention to injuries should always take precedence over decontamination.*"[13]

As demonstrated above, the priority of medical treatment of radiological victims over decontamination is well defined in guidelines at the international, national and state levels. Training and cooperation at the local level emergency responders will be the key element of developing a regional response protocol that properly addresses contaminated patient issues.

The Sacramento County Emergency Medical System protocols are typical and do not have a clear delineation of response in regards to a radiation emergency. Policy number 8029.05 clearly states that pre-hospital care providers, including transporting ambulances will only accept decontaminated patients from the HAZMAT Team. "*ALL patients will undergo primary decontamination at the scene. There are no indications to transport contaminated patients.*"[14]

Sacramento County is not the only area of the state that has language addressing generalized hazardous materials without specifically addressing radiation. The County of Santa Clara Emergency Medical Services Agency, Policy 610 states, *"All potentially*

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[10] International Atomic Energy Agency, "Generic procedures for response to a radiological emergency," in *Part 1, Manual for First Responders and Local response, Rev. 16.2* (Vienna, Austria: IAEA, 2004): 18.

[11] "Preparedness Directorate; Protective Action Guides."

[12] U.S. Department of Transportation, Research and Special Programs Administration, *2004 Emergency Response Guidebook* (n.p., n.d.), 163.

[13] "Mass Casualty Decontamination, Guidance Document for Field Responders (Working Draft)" (California Specialized Training Institute, 5-14-01), 164.

[14] "Policy 8029.5, Hazardous Materials," in *Sacramento County Emergency Medical System Response Protocol* (February 27, 2004), http://www.sacdhhs.com/download/pdfs/ems/ems_Policy%208029.05%20Hazardous%20Materials.pdf. [Accessed June 30, 2005].

contaminated patients must be properly decontaminated by the trained HAZMAT responders before emergency medical responders can administer medical treatment or transport the patients to an emergency medical facility." [15]

PATIENT TRIAGE AND TREATMENT

The initial assessment and triage of patients in a radiological environment will be assigned to first arriving emergency units utilizing the Sacramento County mass casualty protocol. Upon detection of a radiation incident, emergency personnel will don appropriate protective clothing at the direction of the incident commander and radiation detection/dosimeter equipment. Patients will be assessed for medical needs, regardless of radiological contamination utilizing the simple triage and rapid treatment (START) triage method. Critical patients must be stabilized prior to initiating decontamination efforts. Delayed and minor patients will be decontaminated prior to treatment and/or transportation provided the time delay to facilitate decontamination does not exacerbate their medical condition.

PATIENT TRANSPORTATION

The transport of immediate patients whether contaminated or not will not be delayed for decontamination actions provided that there is not a chemical component to the contamination. (Chemically contaminated patients will be decontaminated prior to treatment or transportation. Unlike radiation contamination, chemical contamination does potentially pose a primary hazard to medical care providers.) Every effort to minimize the spread of radiation contamination will be made so long as the efforts do not delay transportation or medical treatment timelines. Such techniques may include the removal of a patients clothing to remove as much contamination as possible. Patients shall be wrapped in sheets to trap any remaining contamination and transportation assets will be prepared per MERRTT procedures to minimize contamination. The use of an issued radiation dosimeter will be utilized by ambulance crew members, (one per unit) to ensure radiation dose limits do not exceed recommended EPA standards. The dosimeter shall be placed in the treatment area of the ambulance to ensure the device is protecting personnel in the closest proximity to the potential radiation contamination. Ambulance personnel shall don, at a minimum, universal precautions PPE to include eye protection, respiratory protection, gloves and an outer disposable garment to enhance decontamination processes. Utilization of PPE ensembles that have been developed as biological PPE will facilitate the protective requirements for radiation emergencies in addition to biological emergencies. Utilizing the time, distance and shielding principles, personnel will reduce exposure to radiation to ALARA.

Command staff should consider the utilization of dedicated "dirty" ambulances on an on-going basis, providing the contamination level of the resource does not exceed safe radiation exposure levels for personnel. It should be noted that the dedication of "dirty ambulances should only be utilized if it does not delay the transport of critical patients due to a limited response capability. Limiting the number of ambulances and personnel that may require decontamination will ensure continuity of medical transport capability immediately following the incident and is consistent with the ALARA principle. Radiation contamination of an ambulance can be removed during cleanup or remediation efforts. Often ordinary clean-up procedures will remove radioactive contamination.[16] Exposed personnel and equipment will be surveyed for radiological contamination and exposure levels recorded prior to being release from duty, or reassigned.

PERSONNEL DECONTAMINATION

The nature of each event will dictate a course of action regarding the radiation decontamination procedures necessary. The following are guidelines to be balanced with specific incident considerations. Incident specific considerations may include, but are not limited to; weather conditions, ambient temperature, additional hazardous materials/hazards associated with the incident, and the logistical concerns of decontaminating large volumes of people in an expedient manner, and the geographic magnitude of the area of involvement.

- If resources allow, initial radiological survey procedures should be performed by trained personnel to detect contamination. Personnel surveys can be performed at the direction of hazardous materials response team personnel. Additionally, transportable radiation monitors called "portal monitors" may be used for the screening of large numbers of victims. Portal

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[15] *Private EMS Response: Hazardous Materials, Policy 610* (San Jose: County of Santa Clara, Emergency Medical Services Agency, 2004), 3. http://www.sccbuilding.org/scc/assets/doc/804278Prehospital%20Care%20Manual%202005-%20050204.pdf. [Accessed July 4, 2005].

[16] Jerrold T. Bushberg, Linda A. Kroger, Marcia B. Hartman, Edwin M. Leidholdt, Jr., Kenneth L. Miller, Robert Derlet, and Cheryl Wraa, "Nuclear/Radiological Terrorism: Emergency Department Management of Radiation Casualties," *Journal of Emergency Medicine* (University of California Davis Health System, in press), 17.

monitors can be accessed through the U.S. Department of Energy Radiation Assistance Program (RAP) teams or the National Guard Civil Support Teams. Commanders must factor a time delay of specialized detection equipment into response planning processes. Additionally, improvisation may be required to survey large numbers of concerned people. The utilization of radiation detection equipment found in the private sector may be utilized with proper coordination/collaboration with civilian infrastructure. An example would be the use of metal scrap yard radiation monitors. These facilities may become remote radiation survey centers utilized to minimize public hysteria or fear due to the possibility of being contaminated.

- Decontamination/radiation survey personnel must be made aware of the possibility that there may be people with internal radioactive material that is present because of medical diagnosis or treatment. Radioactive isotopes are often utilized as part of routine medical procedures. Such radionuclide will be detected by survey equipment utilized by emergency personnel. Routine medical history inquiries will illuminate the legitimacy of the presence of these radiopharmaceuticals. Additionally, field personnel will not be able to decontaminate internal radiation contamination. Persons with internal radiation contamination should be referred to medical authorities for follow-up medical treatment.
- Recommendations for decontamination are made by the decontamination unit leader to the hazardous materials group supervisor. These recommendations are to be submitted to the incident commander at the unified command center. Decontamination procedures minimize off-site consequences of radiological contamination. The decision to utilize wet versus dry procedures will incorporate environmental factors, numbers of affected victims, nature of the contamination and resources available to perform decontamination. The following decontamination control procedures are illustrated in the "Pre-Hospital Practices" module from the MERRTT program.[17]

Field Decontamination of Immediate Triaged Patients Who Have Not Undergone a Formal Decontamination Process

(1) Initiate ALS care as necessary
(2) Remove clothing if appropriate
(3) Wrap patient in a blanket to minimize contamination
(4) Only expose areas required to assess and treat patient
(5) If necessary, cut and remove the patients clothing away from the body being careful to avoid contamination to the unexposed skin
(6) Properly contain all removed clothing by placing it in a sealable bag
(7) Continue to reassess and monitor vitals while in route to a medical facility
(8) Contact with the patient may result in transfer of contamination, so change gloves as necessary

Dry Field Decontamination

(1) Dry field decontamination should be the first line of contamination control, and is performed in the contamination reduction zone, formerly known as the "warm zone," for patients that do not meet "immediate patient criteria.
(2) Removes the majority of contaminates
(3) Reduces the risks of contamination spread and inhalation hazard
(4) Allows contaminates to be left in the affected area

HOSPITAL POLICIES AND PROCEDURES ADDRESSING RADIATION INCIDENTS

The following recommendations will facilitate dissemination of information and development of capability in the medical community in response to a radiation incident of either an accidental nature or one of an intentional terrorist act utilizing a radioactive component. In the aftermath of a large radiation incident in the Sacramento region, it is unlikely that emergency response personnel would maintain control of all victims of the incident. As seen in past mass casualty incidents involving acts of terrorism, including the Oklahoma City bombing in 1995 and the Sarin attack in Tokyo, Japan, the majority of patients that are seen at medical facilities in the immediate aftermath of such incidents are self transported.[18] Medical facilities in the area, including hospitals, private medical offices or local clinics, will be impacted by self-initiated or privately transported victims.

The fear and misunderstanding of radiation in the general public also applies to health care professionals, necessitating awareness and training curriculum in addition to policies and procedures. Yet the instances of radiation incidents are very low, leading policy makers to potentially question the allocation of resources to prepare for such a low probability event.

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[17] Department of Energy, *Modular Emergency Response*, 16-6.

[18] James Smith, Ph.D., Radiological and Nuclear Terrorism: Medical Response to Mass Casualties, a Self-Study Training Program for Clinicians (Centers for Disease Control and Prevention, April 17, 2006), 10.

According to the Radiation Emergency Assistance Center Training Site (REAC/TS), only 428 major radiation accidents have been recorded between the years 1944 and 2005, resulting in 126 radiation-related deaths.[19] With such a low prevalence of emergencies resulting from radiation incidents, current policies addressing hazardous materials in general have been considered adequate in dealing with radiation emergencies. The potential threat of terrorist groups utilizing radioactive or nuclear weapons has prompted the emergency response and medical care providers to reassess their radiation response plans and procedures to address adequately radiation injury/contamination issues.[20]

Coordination and preplanning between first responders, transportation providers and hospitals prior to a response to a large scale radiation event will be necessary to facilitate accurate and timely patient triage, transport and subsequent treatment at the appropriate treatment facility. The transition of patients from the emergency scene to treatment facilities, in an expedient and organized manner, will likely result in the saving of more lives, and will require that the healthcare facilities and private transport providers are in collaboration with public emergency responders.

PATIENT ASSESSMENT IN THE HOSPITAL SETTING

The stabilization of medical conditions that are immediately life threatening is the primary consideration, prior to addressing radiation contamination concerns. It should be noted this is only applicable to radiation. The possibility of patients having both radiological contaminations in combination with either chemical or biological contamination should be considered. "*In situations involving other types of hazardous material, such as chemicals, decontamination of the victims typically occurs prior to transport to the emergency department.*"[21] A majority of patients might self-report to the emergency department, so hospital decontamination efforts must include decontamination procedures for delayed or minor radiological contaminated patients, or decontamination from chemical or biological agents.

Medical procedures should be ruled out if a person presents with above background radiation reading during a radiation survey. Recent nuclear medicine or oncology procedures may be the source of the radiation.[22]

"Hospitals with Nuclear Medicine or Radiation Oncology departments have radiation monitoring instruments."[23] Additionally, the Sacramento region has acquired radiation detection equipment along with decontamination equipment and training via the Health Resources Services Administration (HRSA) grants, so the resources required to manage a radiological event are available in the regional hospitals. The allocation of these resources may not be available to satellite clinics or physician offices. Therefore a coordinated medical plan will be necessary to develop a treatment procedure to incorporate potential large numbers of victims presenting at local health facilities.

"An exceptionally important triage strategy is that of establishing a secondary assessment center physically separate from the hospital. This is a basic step towards protecting the hospitals from being overwhelmed. It is also useful for pre-clinical screening, assessing exposure and contamination, and conducting triage and decontamination as well as reuniting families."[24] The staffing of these centers will be a challenge to any municipality. For example, in Goiania, Brazil, approximately 112,000 people were assessed at a local soccer stadium to screen for radiation contamination and associated injuries. The number of personnel to accomplish this screening operation was substantial. The pursuit of a specialized citizen emergency response team (CERT), which would be composed of trained professionals from radiological fields in the region, might be a useful solution to staff these centers during the initial period following a large radiation incident. The "Radiological CERT" team members might be drawn from private industry, power companies, universities or medical institutions from localities that are not directly impacted by the emergency. A civilian radiation expert would be an effective force multiplier to emergency response, or emergency department personnel and assist in the facilitation of screening of large volumes of "concerned" patients that are not necessarily contaminated. Additionally, these "Radiological CERT" members would be able to supervise lay personnel/volunteers providing such services as collection/distribution of contaminated clothing, and distribution of educational material. Psychological counseling will be an important aspect to minimize the fear aspect of the incident as well. Medical plans should incorporate a psychological response at the secondary assessment sites as well.

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[19] Bushberg et al., "Nuclear/Radiological Terrorism: Emergency Department Management of Radiation Casualties," 4.

[20] Ibid.

[21] Ibid., 8.

[22] Ibid., 11.

[23] Ibid., 4.

[24] The Centers for Disease Control and Prevention, "Radiological and Nuclear Terrorism: Medical Response to Mass Casualties," 10. http://www.orau.gov/hsc/RadMassCasualties/content/text_version.htm [Accessed June 26, 2006].

HOSPITAL DECONTAMINATION PROCEDURES AND MEDICAL COUNTERMEASURES

Each medical facility has a unique layout and internal policies to reduce the spread of contamination within their respective facilities. The author recommends the regional hospitals develop a common standard of practice based on recognized protocols which address radiation decontamination for hospitals. In the interim, all radiological cleanup operations should be facilitated at the direction of the radiological safety officer, per individual hospital policy and procedure.

Portal radiation monitors are often used in medical facilities to survey trash.[25] Portal monitors are useful and will potentially save vast amounts of time to quickly scan material to insure that contamination does not exceed two times the background, which is the EPA standard for radiological contamination. Additionally, portal monitors may be adapted to be used to quickly survey patients, at a central point of entry, to enhance the speed of radiological screening of patients. Generally, radiation contamination clean up can be facilitated by normal cleaning methods.[26]

The primary goal for emergency response and medical personnel is to utilize the aforementioned procedures to avoid becoming contaminated during the response to radiation emergencies. Should internal contamination occur, it is important for the response community to understand what medical interventions and medications are available for patient treatment. Knowledge of available medical interventions may assist in reducing the fear associated with radiation response. Additionally, policy makers must understand the availability of these medications and how to request them when needed.

Medications that are designed to prevent radiation damage to human tissues are called radioprotectants.[27] Radioprotectants are intended for pre-exposure use and have very little application after an exposure has taken place.[28] These pharmaceuticals are generally used for pre-cancer therapy so that the invasive radiation therapy does not injure healthy tissue.

Issue 2 – Detection and Dose Monitoring

The early notification and accurate assessment of a radiological event will be paramount in the management of a radiation emergency. In the Sacramento Region, the fire departments have been issued “pager style” radiation dosimeters to detect gamma radiation during the initial response to an emergency. The distribution of radiation pagers has not been consistent throughout the fire department agencies within the operational area. Some fire agencies in the nation have elected to retain their dosimeters to be deployed in the event of a declared radiological emergency. This clearly is going to be too late for their initial responders, who may be unaware of the presence of radiation environment during initial assessment of an incident. The Sacramento Metropolitan Fire District has placed the dosimeters on all first response vehicles including front-line engines, trucks, medics, battalion chief and assistant chief vehicles. Additionally, procurement and distribution of radiological dosimeters to the area law enforcement agencies is necessary. As shown in Figure 2, the Incident Commander is prone to assess a car bomb or suicide type bomb as a possible radiological event. In such cases the On-Scene Coordinator is likely to call in the event and request detection instruments to determine if alpha, beta, or gamma radiation is present in unusually high levels.

These typical assets will potentially be the first arriving emergency resources on scene, and need to have the early radiation detection capability to ensure the proper protective actions and notifications are made during the initial stages of a radiation incident. It should be the intent of any regional strategic protocol to facilitate radiation detection/dosimeters to all first responder apparatus in the region. This includes all law enforcement, fire, and emergency medical services (EMS) vehicles. The above logic presents the role that detection plays in first responder response to an RDD type event.

DOSE RATES DURING THE COURSE OF THE INCIDENT

Once a radiation dose has been received, there are no further protective actions to administer for that dose. A useful approach to evaluating a proposed action response with a radiation exposure is to ask the question: “How much radiation dose will be avoided by

[25] Bushberg et al., “Nuclear/Radiological Terrorism: Emergency Department Management of Radiation Casualties,” 17.

[26] Ibid.

[27] Dana A. Shea, "Radiological Dispersal Devices: Select Issues in Consequence Management," Congressional Research Service, Library of Congress, January 26, 2006, 3. www.fas.org/spp/starwars/crs/RS21766.pdf. [Accessed May 2, 2006].

[28] Ibid.

taking this action as compared to taking no action at all."[29] The protective action guideline (PAG) establishes four criteria that should be met during the first two phases of the radiation emergency, the early and intermediate phases respectively.

1. Acute health affects due to radiation exposure should be avoided;
2. Chronic health effects should not exceed a level that is judged to be acceptable during an emergency;
3. Any reduction of risk to public health, achievable at acceptable cost, should be done;
4. The risk to health from protective actions should not exceed the risk to the health from the dose avoided.[30]

Personal dosimeters are available that provide instant, self-reading data and that do not require external power supplies. Dosimeters are capable of measuring wide dose ranges (0.001-1,000 rem). Currently, many fire departments are equipped with SAIC PD-3 pager style dosimeters, and Canberra dosimeters that alarm at 1 mR/hr or 100 mR of dose. Dosimeters that not only give accurate rates and doses, but reinforce safety margins by computing safe work durations, potentially enhance user confidence thereby reducing the fear and anxiety of working in a radioactively contaminated environment. A self-reading/alarming dosimeter must be worn by a supervising member of each unit working in a radiation contaminated environment for the purposes of dose tracking of unit personnel

and to alert when dangerous levels are encountered during initial operations requiring personnel to enter radioactive fields to perform emergency duties such as rescue, or firefighting operations. The deployment of the dosimeter will be the responsibility of the supervisor or senior crew member if a supervisor is not assigned. To the extent possible, the dosimeter should be in the closest proximity to the highest activity source to ensure the dose reflected is the maximum dose. These measurements will be valuable in dose reconstruction efforts after the initial emergency is contained to account for each member working in the exclusion zone during initial emergency operations. Additionally, the utilization of thermo luminescence dosimeters (TLD) is beneficial to track long term exposure for individuals working in the contaminated areas during the intermediate and later phases of the incident. Regional hazardous material response team (HMRT) policies require all hazmat personnel to carry individual dosimeters for dose tracking purposes. HMRT personnel will be working in the most contaminated areas, but support personnel such as law enforcement officers, EMS and fire personnel will need to have dose tracking capability as well.

[29] Health Physics Society, "Background Information on 'Guidance for Protective Actions Following a Radiological Terrorist Event' Position Statement of the Health Physics Society*," http://hps.org/documents/RDDPAGs.Background.pdf. [Accessed May 3, 2006).

[30] Ibid.

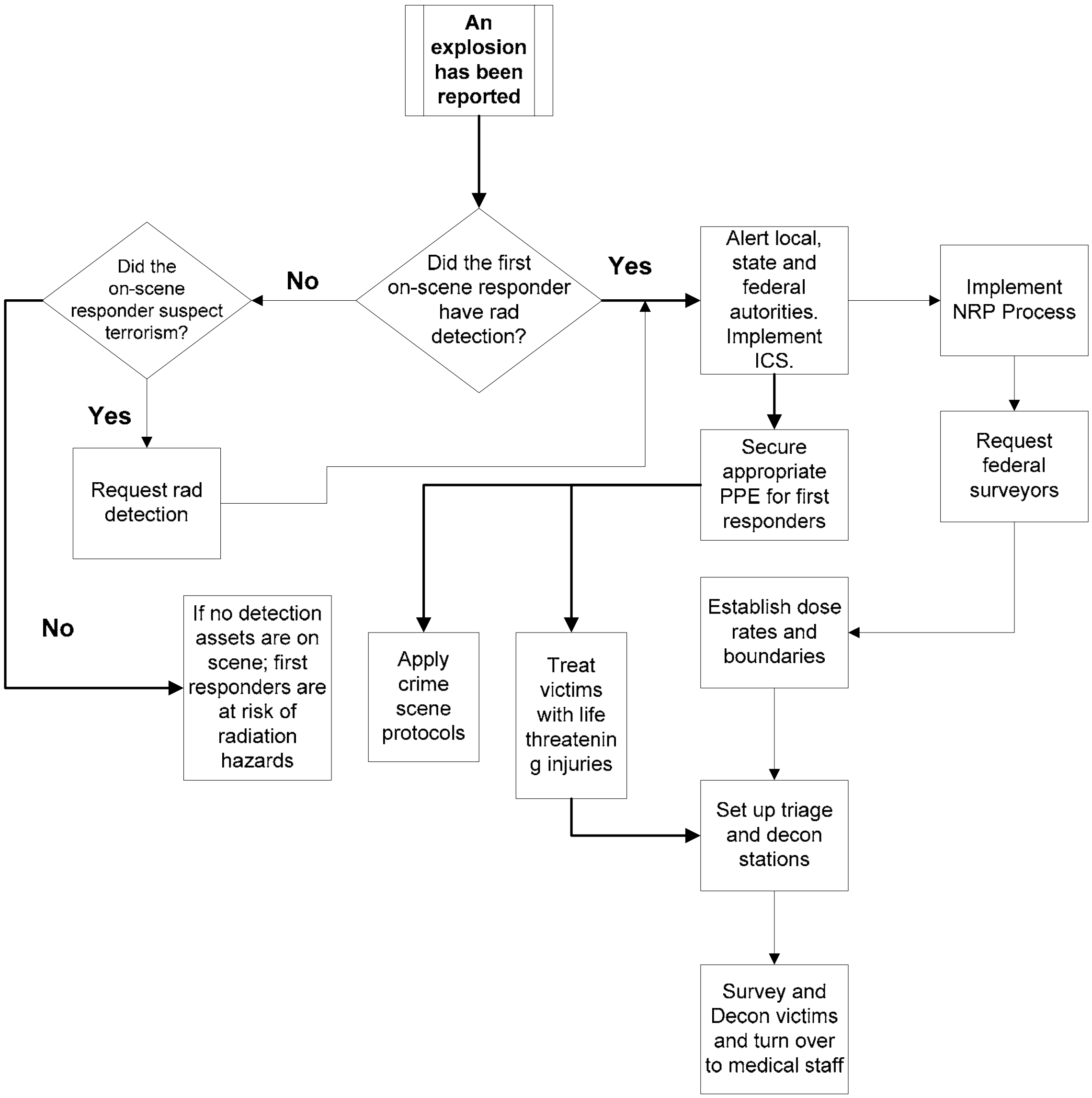

Figure 2- Expresses the logic that an Incident Commander would employ with and without proper detection assets.

POPULATION MONITORING AND DOSE RECONSTRUCTION

The term "population monitoring" consists of the immediate dose monitoring after an incident and the long term monitoring for health effects resulting from radiation exposure. The U.S. Department of Health and Human Services (DHHS), as outlined in the National Response Plan, has tasked the U.S. Center for Disease Prevention (CDC) with being the lead agency responsible for population monitoring.[31] CDC is also responsible for supporting local, state and tribal governments regarding decontamination of internal contamination, and providing guidance as to pharmaceuticals to remove internal contamination from the bodies of victims.[32]

31 Department of Health and Human Services, Centers for Disease Control and Prevention, "Population Monitoring After a Release of Radioactive Material" (June 2005): 1.

32 Ibid.

Dose reconstruction is utilized to provide estimated radiation dose exposures to individuals or populations in the aftermath of a radiation incident where dose monitoring was unavailable, incomplete or inconsistent.[33] Dose reconstructions may be utilized, for example, in the aftermath of a dirty bomb attack to estimate the accumulated dose to civilians in the immediate vicinity of the blast or directly affected by the radioactive plume. First responders, without sufficient early detection capability such as alarming dosimeters, would rely on dose reconstruction performed by radiation experts to assist in determining potential exposure prior to the arrival of detection or monitoring equipment.

Issue 3 – Addressing Psychological Effects of Radiological Emergencies

RADIATION AS A WEAPON OF FEAR

Radiation is a perfect weapon for a terrorist organization to maximize their impact in an act of terror. *"Even more than the events of the fall of 2001, an attack using nuclear materials, whether in a nuclear weapon, from a nuclear power plant, or from a radioactive source, would cause a residual fear in the population about their safety and the safety of their environment due to possible physical contamination, their own exposure to radiation, and the long-term effects of radioactive fallout."*[34] The opportunity to kill Americans, destabilizing public confidence in its leadership, and potentially instilling huge economic devastation, all while exploiting an instilled "irrational fear" of radiation of the American population makes utilization of radiation desirable to terror groups.[35]

Radiation is an effective method to instill terror in a population for several reasons. Since the development and use of the atomic bomb during World War II, followed immediately by the Cold War and the threat of nuclear annihilation, the American public has feared radiation. Additionally, Americans have a pre-conditioned fear of radiation based on an emotional perception and the advertised negative consequences due to radiation exposure, such as cancer, birth defects and the anticipated catastrophic outcomes of a radiological accident or attack. The invisible nature of radiation, undetectable without technical equipment, adds to the hysteria. The terms "nuclear," "radioactive," and "deadly," all contribute instilling an initial feeling of fear regarding radioactive materials. This fear can develop to a phobia which cause individuals to make decisions according to perceived fears of consequences based on "What if?" rather than "What is."[36]

Case History, Goiania, Federative Republic of Brazil

"Because of the extreme fears of radiation, it is anticipated that the number of citizens requesting surveys for radiological exposure will be several times greater than the number actually exposed."[37] This proved to be a gross underestimate in Goiania, Brazil, in 1987, following an accidental release of Cesium-137. The Brazilian officials used the Olympic soccer stadium in the city to screen approximately 112,800 people for radiation.[38] Of the 112,800 that were screened, 244 were found to be contaminated and 54 were hospitalized, and only five died.[39] The actual number of individuals contaminated or injured by the radiation exposure was exponentially less that those that were "worried." In addition to the 112,800 people screened for radiation, over eight thousand people requested radiation monitoring so that they might obtain a certificate of "clean." This was necessary due to transportation and hotels refusing to serve individuals from this region of Brazil for fear of radiation contamination.[40] Additionally, the economic impact to the region was significant. A 20 percent reduction in agricultural exports, a decrease in the gross domestic product of 15 percent and a reduction in tourism to almost zero, was a consequence of this accident.[41]

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33 Department of Health and Human Services (NIOSH), "NIOSH Fact Sheet: What a Claimant Should Know About Radiation Dose Reconstruciton,"1. www.cdc.gov/niosh/ocas/pdfs/misc/2002-138.pdf. [Accessed May 29, 2006].

34 Charles D. Ferguson et al., *The Four Faces of Nuclear Terrorism* (Monterey, Calif.: Center for Nonproliferation Studies, 2004),27.

35 Ibid.

36 Raymond H. Jr. Johnson, "Facing the Terror of Nuclear Terrorism," *Occupational Health & Safety*, 2006, 3. www.stevenspublishing.com/steven/ohspub.nsf/ [Accessed 3/25/2006].

37 Col. Janet M. Hairington and Col. Dan Jensen, "Assessing National Guard Readiness to Weapons of Mass Destruction Terrorist Events" (Carlisle Barracks, Penn.: U.S. Army War College, n.d.). knxupz.ad.nps.mil/homesec/docs/dtic/ADA415888.pdf [Accessed January 16, 2006].

38 Robert Johnston, "Goiania Orphaned Source Dispersal, 1987," *Johnston's Archive*, May 11, 2005, www.johnstonsarchive.net/nuclear/radevents/1987BRAZ1.html. [Accessed January 12, 2006].

39 NBC, "Case Study: Accidental Leakage of Cesium-137 in Goiania, Brazil, in 1987," www.nbc-med.org/SiteContent/MedRef/OnlineRef/CaseStudies/csGoiania.html. [Accessed January 12, 2006].

40 "Nuclear Nonproliferation: U.S. and International Assistance Efforts to Control Sealed Radioactive Sources Need Strengthening," United States General Accounting Office, May 2003, knxup2.ad.nps.navy.mil/homesec/docs/gao/d03638nukeprolifer.pdf. [Accessed January 16, 2006].

41 Ibid.

PSYCHOLOGICAL EFFECTS ON EMERGENCY RESPONSE PERSONNEL

Fear of radiation is not specific only to civilian populations, but impacts emergency responders as well. To operate effectively in a radiation incident, emergency responders must not only be properly equipped with protective ensembles and detection devices, but prepared mentally to understand and address the hazards of radiation.

The importance of recognizing the need to consider the psychological effects of terrorism on the general population, and that of emergency responders, is the first step in establishing an effective strategy for counter-terrorism. With respect to terrorism in general, and radiological terrorism specifically, it is important to recognize the psychological effects to the population will be significant, regardless of any adverse health effects which may result.[42] Just the mere threat of a radiological event will have a demonstrable impact on the psyche of the general population.[43]

"Federal efforts in developing medical RDD [radiation dispersal device] countermeasures might serve to reduce the psychological aspects of an RDD attack. Validated medical countermeasures might reduce public panic and concern about the exposure of first responders to radiation during treatment of casualties. Alternatively, a similar reduction in the psychological impact of an RDD attack might be achieved through continuing public outreach campaigns."[44] Additionally, compliance to a strict standard for exposure limits may actually reduce anxieties of the general public due to the skepticism of the credibility of the threshold limit theory mentioned previously. A draft guideline published by the Department of Homeland Security has been characterized as too lenient when assessing long term exposure limits in the aftermath of an RDD attack.[45]

Radiation training must be available for the general public; public officials; emergency response, hospital, and other support personnel. This training must focus both on the threats from various types of radiation incidents and the treatment, transport, and the evacuation of the injured and/or threatened public or emergency responders.

The development of decontamination and radiation exposure standards, which take into consideration both the economic consequences of a radiation incident and the health risks of exposed populations, must be addressed. This will be exceedingly important to have in place prior to a radiation incident so that the perceptions of government standards by the public are based on scientific principles, not on expediency in the wake of a terrorist attack.[46]

Role of Media

Terror groups utilize the media to maximize the desired harm of the terror acts, making the attacks personalized to individual citizens, who may be located thousands of miles from the actual incident. *"It is possible that media overreaction could make even a low-level or failed nuclear incident a success in terms of creating fear in the public, causing high-impact economic disruption, and bringing broad attention to the cause of the terrorists."*[47] Even a failed attempt at a high yield detonation, resulting in a low yield radiation release, could cause a great deal of fear or economic hardship.

In the aftermath of a radiological incident, the role of the media will play an essential role in the confidence of the public in the ability of community leaders and the government to respond to the incident. It is important that the media access factual information from credible sources such as the Center for Disease Control and Prevention, the U.S. Surgeon General, public health officials and other agencies having responsibility for response to the incident.[48] *"Newspaper editors, columnists, radio talk show personalities and television reporters who are known and respected will be followed carefully. These individuals should reinforce the messages delivered by the anonymous names and faces of government agencies."*[49]

During the event, information needs to be communicated by trusted community or civic leaders who enjoy the general respect or confidence of the general public. "*Equally important to informing the public is teaching the news media, first responders and federal, state, and local officials about the effects of radiation, radioactive materials, and RDDs and how to communicate credibly and*

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[42]Eva Hickey and John W. Poston Hickey, Sr., "An Overview of NCRP Report No. 138 on Terrorist Activities," E&ED: American Nuclear Society, Sessions on Radiological Terrorism, 2002, 4. eed.llnl.gov/ans/2002/hickey/hickey_paper.php/ [Accessed 3/30/2006].

[43] Ibid.

[44]Shea, "Radiological Dispersal Devices,"1.

[45] Ibid.

[46] Ferguson et al., *Four Faces*, 331.

[47] Ibid., 43.

[48]Hugh W. Wyatt, "The Role and Responsibility of the Media in the Event of a Bioterrorist Attack." *Journal of Public Health Management and Practice*, 6, no. 4 (July 2000): 64.

[49] Ibid.

effectively with the public."[50] The U.S. National Academy of Sciences recommended in 2002 that "pre-packaged" educational kits be distributed before an event and that the messages to be communicated to the public are pre-rehearsed and delivered by trained spokespersons, such as the Surgeon General, or someone that the public trusts.[51]

Issue 4 – PPE and Protective Clothing

Structural firefighting clothing, in combination with a full face respirator or self contained breathing apparatus, offers protection from alpha and beta radiation.[52] It is recommended that not only fire fighters have the appropriate protective clothing but that private ambulance providers to be equipped with radiation detection equipment to provide initial detection of radiation on an emergency scene. The authors recommend utilizing regional fire-based EMS transportation assets for triage, treatment and transportation of radiological patients in hazardous areas due to the availability of PPE that is carried by firefighters staffing the units. Private ambulance providers will function in the support zone once a radiation emergency is declared.

Issue 5 – Local, State and Federal Agencies

First responding agencies will need to interface with responding state and federal resources. The state resources that will assist in response and recovery of a large radiological incident will include, but not be limited to, the California Department of Health Services, Radiological Health Branch, California National Guard Civil Support Teams, and assistance from the California Office of Emergency Services.

The Radiological Health Branch of the California Department of Health has responsibility to investigate radiation incidents, and the surveillance of radioactive contamination in the environment.[53] There are two California, National Guard, and Civil Support Teams (CST). One team is based in northern California, the other in southern California. The CSTs are composed of 22-member teams whose mission is to assist local authorities in the event of an attack involving a weapon of mass destruction.[54]

The federal response would include the Department of Energy's (DOE), National Nuclear Security Administration (NNSA). NNSA's response assets include Atmospheric Release Advisory Capability (ARAC), Accident Response Group (ARG), Federal Radiological Monitoring and Assessment Center (FRMAC), Nuclear Emergency Support Team (NEST), Radiological Assistance Program (RAP), and the Radiation Emergency Assistance Center/Training Site (REAC/TS). "*The RAP is usually the first NNSA responder for assessing the emergency situation and deciding what further steps should be taken to minimize the hazards of a radiological emergency. Specific areas of expertise include assessment, area monitoring, air sampling, exposure and contamination control."*[55]

It is recommended that further interaction with the state and federal assets prior to an actual radiation emergency. An increased awareness of stakeholder agency capabilities along with dialog as to developed response plans and individual agency expectations will potentially promote a smooth transition of responsibility, and facilitate a better working relationship with each local, state or federal stakeholder agency.

The Sacramento Region Radiation Response Protocol

In the Sacramento region, a regional radiation protocol is being developed addressing the pre-identification of authority and the coordination of local, state and federal stakeholders to mitigate a radiological incident. The focus on coordination from the initial response through the final recovery and clearance of a radiation incident is intended to ensure the best utilization of available resources and to enhance the efficiency of emergency operations.

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[50] Ferguson et al., *Four Faces*, 309.

[51] Ibid.

[52] Department of Energy, *Modular Emergency Response,* mod 9-9.

[53] California Department of Health Services, "Radiological Health Branch," http://www.dhs.ca.gov/common/PrinterFriendly.asp/ [Accessed July 9, 2005].

[54] Seth Hettena, "Study Asks: Is California Ready for a Weapon of Mass Destruction," Sfgate.com, September 3, 2002. http://www.sfgate.com/cgi-bin/article.cgi?file=/news/archive/2002/09/03/state1910EDT013/ [Accessed July 2, 2005].

[55] U.S. Department of Energy, National Nuclear Security Administration, "Radiological Assistance Program," http://www.doeal.gov/opa/Emergency%20Public%20Information/RAP_Final_June2002.pdf. [Accessed July 9, 2005].

As part of the radiation response protocol, local, state and federal resources will be pre-identified. In collaboration with the associated responder training, the protocol will work to minimize radiation responder concerns associated with radiation exposure, treatment of radiation contamination from a first responder perspective, and concerns of lost resources due to contaminated assets and fixed facilities. A large component in responding to radiation incidents is to minimize the fear associated with radiation both in the response community and the public at large. The immediate and long-term ramifications of an interoperable regional emergency response protocol, to be used in planning, response and in the aftermath of a radiological accident or intentional radiation attack will equate to more lives saved, reduced anxiety for responders and facilitate effective operations in a radiation emergency.

As part of the radiation response protocol, local, state and federal recovery resources will be identified, and in concert with training, will alleviate concern of cost recovery associated with contaminated transportation assets and fixed facilities. The clarification of recovery stage cost reimbursement, and decontamination procedures will reduce the confusion and potential on-scene debate over which resources will be used. The development of the radiation response protocol in Sacramento will potentially be applicable to other regions of the country, furthering the radiation response capability throughout the nation.

LOCAL POLICY CHALLENGES

The response plans that have been developed since the events of 9/11 have added to the complexity of resource allocation, areas of expertise and oversight responsibility in regards to radiation incidents of national significance. The current California Terrorism Response Plan, which is an appendix to the State Emergency Plan, was last updated in February of 2001. As the events of September 11, 2001, transformed the nation's response plans and capabilities, such as the addition of the California National Guard, Civil Support Teams, development of the National Response Plan, Adoption of NIMS, it is the recommendation of the author that the nation's local and state plans must be updated as well to remain relevant.

In addition to the updating of response policies, the continuous, on-going training and exercise of these plans with local, state and federal agencies is paramount. The emergency response community is undergoing vast changes in leadership as a consequence of retiring senior members. Local, state and federal agency succession planning must incorporate continuous updating of institutional knowledge in regards to planning and responding to radiological incidents and incidents of national significance in general.

The Health Physics Society recommends sheltering-in-place (SIP) during the initial phase of a radiation incident due to terrorism. Local governments need pre-incident preparation to effectively deliver SIP warnings to the public upon very short notice. Persons evacuating into a plume will be exposed to potentially more radiation than if they shelter inside buildings. In an industrial accident, more advanced warning may be available; therefore, evacuation in advance of a plume is the recommended course of action.[56]

Victims or responders caught in a radiological plume should make attempts to minimize the inhalation of radiological contamination. Ideally, this information should be available in the pre-incident education strategies, or techniques will not be known until after inhalation of contamination has occurred. The following recommendations are proposed:

- Cover the mouth and nose with a dry cloth or handkerchief.[57] "In some cases, wet material could actually enhance the amount of inhaled particles."[58]
- There are recommendations to remove the improvised protection after thirty minutes following detonation.[59] The conditions on scene will ultimately dictate when improvised protection can be removed. The churning of dust due to erratic wind patterns in urban areas or vehicular/pedestrian traffic may cause re-agitation of settled dust causing conditions requiring the maintained use of improvised respiratory protection.

FEDERAL AND STATE RESPONSE PLANS

It is essential for policy makers to remain familiar with the outside assistance that will become readily available in the event that a radiation incident exceeds the capabilities of the local resources. As part of any protocol, a clear understanding of the responding agencies roles and responsibilities is necessary to understand how each agency will integrate with others, and thus identify who is ultimately responsible during each of the aforementioned response phases. Knowledge of these assisting agencies prior to the incident will enhance coordination and proper utilization of these resources upon arrival. Additionally, the inclusion of anticipated

[56] Health Physics Society, "Background Information," 11.

[57] Stephen V. Musolino and Frederick T. Harper, Emergency Response Guidance for the First 48 Hours after the Outdoor Detonation of an Explosive Radiological Dispersal Device (December 30, 2005), 383.

[58] Ibid.

[59] Ibid.

support agencies and timelines of response will be of assistance to local incident commanders and may assist in alleviating political "turf" battles which may arise if outside resources arrive without a thorough, pre-identified plan.

Many of the assisting agencies will require hours if not days to arrive on scene. For this reason, it is paramount for local commanders to recognize the potential for escalation of radiological emergencies beyond the capabilities of local response and request outside resources in the early stages of the emergency. Additionally, technical guidance and expertise can be gleaned from radiation response elements during their response.

"The Department of Homeland Security (DHS) is responsible for overall coordination of all actual and potential Incidents of National Significance, including terrorist incidents involving nuclear material."[60] This is done in accordance to Presidential Directive HSPD-5 and is described in the National Response Plan. Federal response to any specific incident is based on the local agencies ability to respond, identify the amount of material involved, the extent of the impact to the environment, or populations and the overall magnitude of the incident.[61] Local responders must understand that Federal agencies may self-dispatch within their own statutory authority, to assess hazards associated with a radiological event with the intent of decreasing time lags of notification.[62]

National Defense Area (NDA) or National Security Area (NSA) can be established by the U.S. Department of Defense (DOD), U.S. Department of Energy (DOE), or National Aeronautics and Space Administration (NASA) to safeguard classified information. The area involved will fall under Federal control for reasons of national security.[63]

The National Response Plan (NRP) describes how federal agencies and departments will collaborate with each other and with local, state, tribal governments and the private sector during incidents.[64] *"It establishes protocols to help protect the nation from terrorist attacks and other natural and manmade hazards; save lives; protect public health, safety, property and the environment; and reduces adverse psychological consequences and disruptions to the American way of life."*[65] All incidents are to be handled at the lowest level possible by the jurisdiction having authority. *"For those events that rise to the level of an Incident of National Significance, the Department of Homeland Security provides operational and/or resource coordination for Federal support to on-scene incident command structures.*[66] Further, the National Incident Management System (NIMS) provides a nationwide template enabling Federal, State, local and tribal governments and private-sector and nongovernmental organizations to work together effectively and efficiently to prevent, prepare for respond to, and recovery from domestic incidents regardless of cause, size, or complexity."[67]

The State of California has a robust mutual aid system implemented/managed through the Office of Emergency Services, utilizing a regional system for assistance to areas where capacity to respond has been overwhelmed, requiring additional resources or expertise to handle a particular emergency. The operational areas (OA) utilize all assets within their respective OAs. At such time the resources in the OA are not adequate to mitigate an emergency, a request to the Office of Emergency Services at the Regional Emergency Operational Center is made. OES coordinates a systematic draw-down of resources from other OAs within the state to facilitate the requests for resources.

Both cooperating agencies and coordinating agencies support DHS during an incident of national significance (INS). Coordinating agencies have the primary responsibility for Federal activities during a radiological event. The coordinating agency is the agency having oversight for the specific material or circumstances involved. Cooperating agencies assist as necessary with support functions, but are subordinate to the coordinating agency, lending support and technical assistance.

- Defining the hot zone is the most important first response, and a simple alarming dosimeter is the most useful piece of equipment for initial radiation response.

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[60] National Response Plan, *Nuclear/Radiological Incident Annex*, NUC-1. www.hps.org/documents/NRPNuclearAnnex.pdf. [Accessed March 12, 2006].

[61] Nuclear/Radiological Incident Annex, NUC-2.

[62] Ibid., NUC-4.

[63] National Response Plan, *Nuclear/Radiological Incident Annex*, (n.p., n.d.): NUC-5. www.hps.org/documents/NRPNuclearAnnex.pdf. [Accessed March 12, 2006].

[64] Department of Homeland Security, "Nation Response Plan Fact Sheet." www.dhs.gov/dhspublic/interapp/press_release/press/release_0581.xml/ [Accessed March 18, 2006].

[65] Department of Homeland Security, "Preparedness Directorate; Protective Action Guidelines," 176.

[66] Department of Homeland Security, "National Response Plan Local/Federal Response Strategies and Coordination Structures." www.dhs.gov/dhspublic/display?theme=14&content=4263&print=true/ [Accessed March 8, 2006].

[67] Federal Emergency Management Agency, "National Response Plan," FEMA, August 2004. www.training.fema.gov/EM1Web/IS/ICSResource/assets/NRPPallpages.pdf. [Accessed March 20, 2006].

- By following emergency response protocols for radiation, that are aligned with nationally recognized standards for allowable dose rates to radiation for emergency response, first responders can operate safely in the initial phase of a radiation incident.
- The greater the dispersion of material, the greater the affected area, but the lower the radiation dose rate.
- Individuals with no significant physical injuries should not be significantly contaminated.
- Firefighting PPE will be sufficient protection for alpha and beta radiation, nothing will be practical to wear to protect from gamma radiation. Utilizing time, distance and source shielding is the most practical approach to protection from gamma radiation.

RECOMMENDATIONS

The following recommendations are offered to assist state and regional or municipal first responders in tailoring policies that ensure the first responders to a nuclear or radiological incident are provided with the necessary procedures, training and tools to minimize the incident impact on the community.

1. Review and upgrade current procedures and protocols to incorporate radiological emergencies
2. Ensure detection assets are available, suitable for the task, and properly staged pre-incident
3. Provide thorough first responder training for radiological incidents including psychological effects and NRP protocols
4. Implement pre-incident education of public and media of true radiological risks and personal protection techniques
5. Ensure that policies and protocols allow for life saving medical attention prior to victim decontamination
6. Develop and empower a State or regional working group to guide policy decisions on nuclear/radiological incidents