Key Elements of Preparing Emergency Responders for Nuclear and Radiological Terrorism

An Overview of
NCRP Commentary No. 19

Objectives of this Presentation

- Provide an overview of the Commentary to allow audiences to become familiar with the material.
- Focus on key points discussed in the Commentary.
- Provide additional explanations for the recommendations.

Background

- Commentary was prepared at the request of the Department of Homeland Security (DHS).
- Recommendations are intended for DHS and state and local authorities who prepare emergency responders for terrorist incidents involving radiation or radioactive materials.

Background

- Commentary builds on previous NCRP reports
  - NCRP Report No. 65, *Management of Persons Accidentally Contaminated with Radionuclides* (1980).
  - NCRP Report No. 138, *Management of Terrorist Events Involving Radioactive Material* (2001).

Background

- Commentary No. 19 is limited to the key elements of preparing emergency responders for nuclear and radiological terrorism.
- Details of implementation are left to the DHS in concert with state and local authorities.

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Advice to DHS

- Prepared in response to the DHS statement of work.
- Commentary addresses three very specific areas.

Specific Advice

- The equipment requirements for emergency responders, including radiation detection and personnel protection equipment.

Specific Advice

- Radiation decontamination equipment, and medical supplies needed at the local level.

Specific Advice

- Content and frequency of training and exercises at the federal, state and local levels with regard to radiation protection aspects.

Advice to DHS

- Use of delineated radiation control zones.
- Use of “decision dose” for life-saving and other critical activities.
- Use of standard protective gear for radiation protection.
- Use of alarming personal radiation dosimeters.

Advice to DHS

- The influence of time, distance and shielding on radiation levels.
- The value of appropriate radiation-detection instruments.
- Health effects and risks associated with various radiation dose levels.
- Importance of individual radiation dose records and management of repeat exposures of emergency responders.

Emergency Responder

- This term refers to those individuals who in the early stages of an incident are responsible for the protection and preservation of life, property, evidence, and the environment.

Radiological & Nuclear Devices

- *Radiation exposure device* (RED)
  - consists of radioactive material, either as a sealed source or as material within some type of container, that exposes people to radiation.

Radiological & Nuclear Devices

- *Radiological dispersal device* (RDD)
  - uses conventional explosives or some other mechanism to spread radioactive contamination.

Radiological & Nuclear Devices

- *Improvised nuclear device* (IND)
  - incorporates nuclear materials designed to produce a nuclear explosion.

Radiation Protection Guidelines

Perimeters

- Establish an *outer perimeter* if any of the following are exceeded:
  - 10 mR h^{-1} exposure rate.
  - 60,000 dpm cm^{-2} for beta and gamma surface contamination.
  - 6,000 dpm cm^{-2} for alpha surface contamination.

The *Outer Perimeter*

- The appropriate actions inside this perimeter are:
  - Evacuate members of the public.
  - Isolate the area.
  - Ensure all emergency workers inside the area minimize their time spent in the area and follow appropriate protection guidelines.

The *Outer Perimeter*

- Outside this perimeter:
  - Locate the command post and other support functions.
  - Select locations for decontamination facilities.
  - Select locations for staging equipment and support personnel.

Perimeters

- Establish an *inner perimeter* at:
  - 10 R h^{-1} exposure rate.
- Exposure and activity levels within this perimeter have the potential to produce acute radiation injury.

The *Inner Perimeter*

- Actions should be restricted to time-sensitive, mission-critical activities (*e.g.*, life-saving).
- An alarming personal radiation dosimeter should be used by each emergency responder.

Radiation Control Zones

- The absorbed dose to emergency responders working in radiation zones must be controlled.
- The cumulative absorbed dose received by an emergency responder while working within or near the *inner perimeter* must be recorded.

The Decision Dose

- The cumulative absorbed dose that triggers a decision on whether to withdraw an emergency responder from within or near the *inner perimeter.*
- Decision dose is 50 rad (0.5 Gy)
- May also apply to the removal of an emergency responder from within the *outer perimeter.*

The Decision Dose

- The choice of the decision dose in this Commentary is based on the absorbed dose at which acute effects occur.
- As a population average, the threshold for most acute effects is ~100 rad (~1 Gy), following short-term whole-body radiation exposure.

The Decision Dose
(related information)

Short-term[a] Whole-Body Dose [rad (Gy)]	Acute Death[b] from Radiation without Medical Treatment (%)	Acute Death from Radiation with Medical Treatment (%)
50 (0.5)	0	0
100 (1)	<5	0
150 (1.5)	<5	<5
300 (3)	30 – 50	15 – 30
600 (6)	95 – 100	50
1,000 (10)	100	>90

[a] Short-term refers to the radiation exposure during the initial response to the incident. The acute effects listed are likely to be reduced by about one-half if radiation exposure occurs over weeks.
[b] Acute deaths are likely to occur from 30 to 180 d after exposure and few if any after that time. Estimates are for healthy adults. Persons with other injuries, and children, will be at greater risk.

The Decision Dose
(related information)

Short-term[a] Whole-Body Dose [rad (Gy)]	Acute Symptoms (nausea and vomiting within 4 h) (%)
50 (0.5)	0
100 (1)	5 – 30
150 (1.5)	40
300 (3)	75
600 (6)	100

[a] Short-term refers to the radiation exposure during the initial response to the incident. The acute effects listed are likely to be reduced by about one-half if radiation exposure occurs over weeks.

The Decision Dose
(related information)

Short-term[a] Whole-Body Dose [rad (Gy)]	Excess Lifetime Risk of Fatal Cancer due to Short-term Radiation Exposure[b] (%)
10 (0.1)	0.8
100 (1)	8
200 (2)	16
300 (3)	24[c]
600 (6)	>40[c]
1,000 (10)	>50[c]

[a] Short-term refers to the radiation exposure during the initial response to the incident.
[b] Lifetime risk of fatal cancer without radiation exposure is approximately 24 %. Most cancers are not likely to occur until several decades after exposure; although leukemia has a shorter latency period (<5 y).
[c] Applies to those individuals that survive the acute radiation syndrome.

Equipment Requirements for Radiation Detection and Personal Protection

Equipment Requirements

- Different for responding to the consequences of a radiological or nuclear incident.
- Equipment (*i.e.*, pre-incident) used to detect illicit radiation sources is not appropriate.
- Effective ranges of doses that can be measured with the pre-event equipment is too limited to support most emergency operations.

Equipment Requirements

- The first emergency vehicles on the scene of a suspicious event should be equipped with radiation-monitoring equipment to alert personnel to the presence of radiation.
- These instruments should be set to alert when the exposure rate reaches 10 mR h^{-1}.
- This alert level corresponds to the recommended value for the *outer perimeter*.

Equipment Requirements

- Emergency responders that cross the *outer perimeter* should be equipped with alarming personnel radiation dosimeters that:
  - Provide unambiguous alarms based on predefined levels.
  - Alarm at 10 R h^{-1} – the recommended value for the *inner perimeter*.
  - Alarm when the cumulative absorbed dose has reached 50 rad (0.5 Gy).

Equipment Requirements

- The first emergency responders to an incident should have a simple instrument to identify the presence of contamination at the scene and on individuals.
- The instrument should be able to detect:
  - 60,000 dpm cm^{-2} beta/gamma surface contamination
  - 6,000 dpm cm^{-2} alpha surface contamination

Other Considerations

- Standard protective clothing (*i.e.*, bunker gear) and respiratory protection devices are sufficient to protect emergency responders against personal contamination while conducting life-saving and other critical missions.

Other Considerations

- For response to incidents at established facilities, pre-existing site-specific radiation source information should be available to emergency responders.
- During the initial assessment, radiation levels should be communicated by the assessment team to the incident commander for evaluation.

Other Considerations

- Additional equipment and supplies will be required to screen large numbers of people for contamination at the scene.
- Additional equipment and supplies will be required to screen for possible initial decontamination at emergency facilities (*i.e.*, at designated reception centers and hospital facilities).

Decontamination Advice and Equipment, and Medical Supplies

On-Scene Activities

- A strategy should be developed for each radiation control zone at the incident scene to minimize the time to treatment.
- Emergency medical services (EMS) personnel should attempt to remove victims from the incident scene as promptly as possible while providing for their own safety.

On-Scene Activities

- Initial personal monitoring and decontamination efforts at the scene should focus on preventing acute radiation effects.
- Cross contamination is a secondary concern, especially when the contaminated site and the number of evacuees is large.
- Individuals with *spot* contamination >2.2 x 10^6 dpm should be given priority for decontamination.

On-Scene Activities

- Conversion of cpm to dpm or dpm cm^{-2}

  dpm = cpm/efficiency
  dpm cm^{-2} = cpm/(efficiency)(area)
  efficiency of probe (*e.g.*, 20 % or 0.20)
  area of probe (*e.g.*, 15 cm^2)

On-Scene Activities

- Nausea and vomiting are the earliest clinical signs of acute radiation syndrome.
  - Occur at absorbed doses >100 rad (1 Gy).
- If symptoms occur, individuals should be removed from the *inner perimeter.*
- However, symptoms may be caused by other agents – responders may be dealing with more than one agent in the incident.

Other Considerations

- Radioactive material contamination rarely represents immediate danger to the health of the victim or the responder.
- This reduces the need for immediate decontamination.
- This allows greater flexibility in selecting the decontamination options.

Other Considerations

- Federal, state and local emergency responders should develop plans, training and exercises to test and coordinate their capability to receive, stage, and dispense materials from the Strategic National Stockpile.

Other Considerations

- It is not a priority to contain all fluids generated during decontamination.
- The incident commander should be responsible for deciding to what degree fluids should be contained or released.
- This decision should be based on the severity of the incident, the immediacy of the decontamination need and the resources available.

Other Considerations

- EMS and hospitals should have detailed plans (prepared in advance) for patient care during a nuclear or radiological incident.
- Planning should include patient routing, facility requirements for treatment of emergent and trauma patients, and assistance for psychological casualties and individuals concerned about radiation contamination.

Other Considerations

- Each hospital should have a planned course of action for care of the victims.
- Should include provisions to continue functioning with low-levels of contamination.
- Plan should be part of the general hospital emergency plan.

Other Considerations

- Unless the hospital is a target, the danger of radiation exposure to emergency room personnel is minimal.
- The danger of significant contamination is also minimal.
- Focus should be on standard medical care.

Training and Exercises

Training Objectives

- Training for emergency responders should:
  - Enhance their ability to take appropriate measures to protect themselves and the public.
  - Increase their confidence about effectively managing an emergency involving radiation or radioactive materials.

Training

- All emergency responders should undergo initial training at a level corresponding to the duties and functions the responder is likely to perform during an incident.
- Responders likely to take part in life-saving activities should be trained at the operations level.

Key Training Messages

- Rescue and medical emergencies take precedence over radiological concerns.
- Nuclear and radiological incidents can be safely managed using the responder's equipment and protocols.

Key Training Messages

- Being contaminated is rarely life-threatening.
- Being exposed to radiation does not make a person radioactive.

Other Considerations

- Universal precautions in the emergency room are usually sufficient for treatment of victims of nuclear and radiological incidents.

Other Considerations

- In the hospital, multi-parameter triage offers the best early assessment of the victim's absorbed dose.
- Nasal swabs can be used to indicate the likelihood that radioactive material has been inhaled, if internal contamination is suspected.

Training

- Programs should be developed and organized to effectively integrate into the overall training requirements of the organization.
- Emergency responders should undergo annual refresher training to maintain proficiency.
- Should regularly involve all types of emergency responders, including first responders, first receivers, public and mental health experts, to maintain the proficiency of the emergency-response infrastructure.

Training

- Drills and exercises should be conducted at least annually.
- Full-field exercises are necessary only every three years.
- Should regularly involve all types of emergency responders to maintain proficiency of the emergency-response infrastructure.
- Should exercise access and distribution of SNS assets.

Summary

- Commentary No. 19 provides specific recommendations regarding emergency response to nuclear or radiological incidents.
- The recommendations apply only to an emergency and only until the designated authorities declare that the emergency is over.

Summary

- Commentary No. 19 provides a technical basis for the support of preparedness activities such as:
  - the development of responder protocols,
  - equipment procurement recommendations, and
  - the frequency and content of training and exercises.

Conclusions

- The numerical guidance provided in Commentary No. 19 is a mechanism to help planners and response organizations identify when further evaluation of the radiological situation is warranted.

Conclusions

- The numerical guidance should be considered as *decision points* for evaluating the risks of emergency responder activities against the benefits that those activities produce, under potentially hazardous radiation conditions.

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