

Community Management of Low-dose Radiological Events

**Satellite Conference and Live Webcast
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**Produced by the Alabama Department of Public Health
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Overview

- Risk
- The radiological threat
- Priorities and responsibilities
- Radiological attack
- Radiological accident
- Community actions

Cultures in Conflict

“Envy and dislike of the U.S. have fueled rage against the country even as the ability to build a nuclear device has spread.”

“We’re going to have ...a major nuclear event in this country.”

Cultures in Conflict

“Whether it will happen in 10 years or 10 minutes...it’s virtually a certainty.”

**Warren Buffett, Chairman, Berkshire-Hathaway
May 6, 2002**



Not A Matter of If, But of When

- U.S. response following RDD attack
- Testimony on "The Status of U.S. Response Following an RDD Attack" before the House Committee on Homeland Security Deputy Undersecretary Dr. Steven Aoki, November 15, 2007



World Summit Turning Attention to Nuclear Threats

- President Barack Obama and other leaders of the Group of Eight major industrial countries were scheduled to open their second day of talks focused on nuclear standoffs with Iran and North Korea

International Strategic Nuclear Risks

"Iran would be raising the risk of a 'World War III' if it came to possess nuclear weapons."

President Bush, 2007

"Iran puts the world at nuclear risk."

Hillary Clinton, May 2010

International Strategic Nuclear Risks

"Israel must be wiped off the map."

Iranian President Mahmoud Ahmadinejad



CIA

- Al-Qaida is interested in radiological dispersal devices (RDDs) or "dirty bombs"
 - Construction of an RDD is well within its capabilities
- Radiological materials are relatively easy to acquire from industrial or medical sources

CIA

- May try to launch conventional attacks against the nuclear industrial infrastructure of the United States in a bid to cause contamination, disruption, and terror



World Nuclear Association



World Nuclear Association

- 38 states, particularly those in the east half and the west coast have a full power, licensed reactors
- Nearly three million Americans live within 10 miles of an operating nuclear power plant

International Atomic Energy Agency and World Health Organization



- Between 1944 and 1999 in 405 accidents worldwide, approximately 3,000 persons were injured, with 120 fatalities
 - Including the 28 Chernobyl victims

International Atomic Energy Agency and World Health Organization

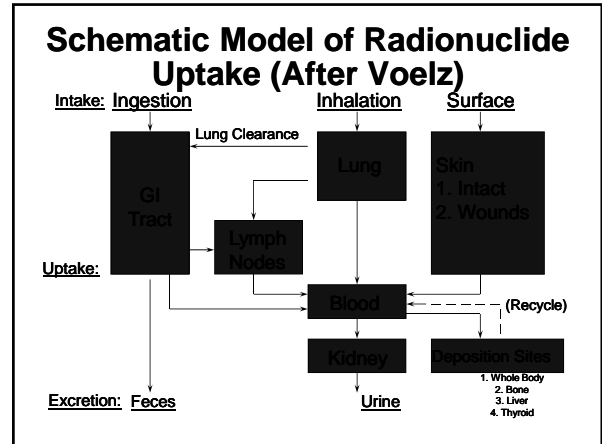
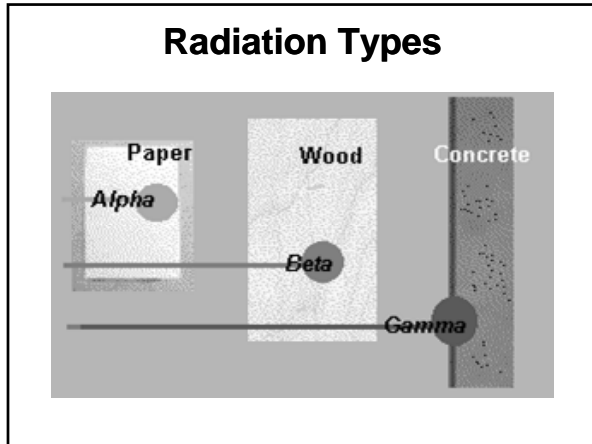
- Recently, the number of accident involving radiation sources has increased
- Often the victims are unaware that they may have been exposed to radiation

Every High-dose Event is Someone Else's Low-dose Event

- Per capita thyroid doses in the continental United States resulting from all atmospheric nuclear tests conducted at the Nevada Test Site from 1951-1962

Every High-dose Event is Someone Else's Low-dose Event





Irradiation and Contamination

- Irradiation
 - Exposure to a dose of radiation
- Contamination
 - Radioactive particles on the skin (external)
 - Particles inside the body organs (internal)

Irradiation and Contamination

- Decontamination
 - Remove Clothing (95%)
 - Wash with soap and water
- Incorporation
 - The uptake of radioactive materials by body cells, tissues, and target organs

Psychological Factors in Radiation Threats

- Characteristics of Ionizing Radiation
 - Odorless
 - Colorless
 - Penetrating
 - Continuing

Chernobyl

Delayed Psychological Effects

- Survivor guilt
- Psychosomatic complaints
- Acute stress disorder
- Traumatic stress disorders
 - 11% of uninjured
 - 8% of moderately injured
 - 31% of severely injured

Federal Response is Based on Many Factors

- Ability of state, local, and tribal officials to respond
- Type and/or amount of radioactive material involved
- Extent of the impact or potential impact on the public and environment
- Size of the affected area



EPA Radiological Responsibilities

- Establishing Protective Action Guides
 - Tell emergency responders how to minimize the impact of a radiological incident
- Helping state agencies develop emergency response



EPA Radiological Responsibilities

- Establishing emergency radiation detection and measurement systems in cooperation with the Nuclear Regulatory Commission

EPA Coordination

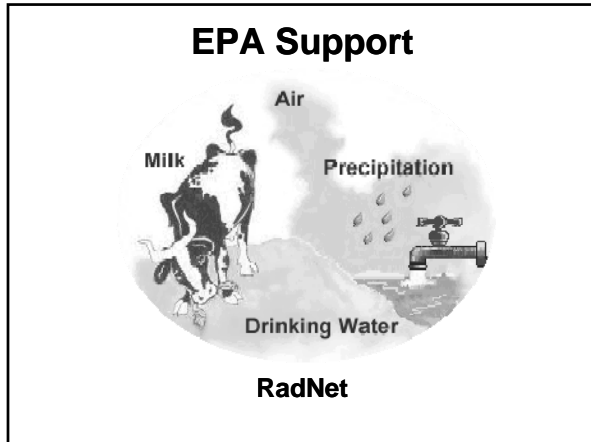
- Response for radiological materials not regulated by another federal agency
- Lost radiation sources, sources of unknown origin, and naturally occurring materials such as radium

EPA Coordination

- U.S. response to foreign radiological accidents or events that have the potential to affect the United States

EPA Support

- Conducting environmental monitoring, sampling, and data analysis
- Assessing the national impact of any release on public health and the environment through the Agency's RadNet System



- EPA Support**
- Providing technical advice on containment and cleanup of radiological contamination
 - Assisting in site restoration and recovery

- Department of Homeland Security Coordination**
- A federal agency has requested assistance under the National Response Plan
 - State and local authorities have requested federal assistance when overwhelmed
- 

- Department of Homeland Security Coordination**
- Multiple federal agencies have become substantially involved
 - The President uses the authority of the Stafford Act to declare a disaster

- Potential Low-dose Events**
- Intentional
 - Contaminating food/water with radioactive material
 - Spreading radioactive material into the environment
 - Using conventional explosives - dirty bomb
 - Using wind currents or natural traffic patterns

- Potential Low-dose Events**
- Bombing or destroying a nuclear reactor
 - Causing a truck/train carrying nuclear material to spill
 - Accidental
 - Nuclear reactor accidents

Potential Low-dose Events

- Transportation accidents
 - Unintentional spill of radioactive material from a truck, train or plane
- Human error

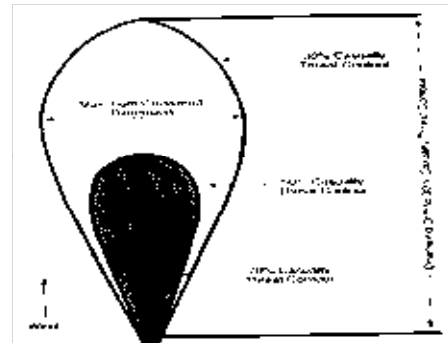
Attack!

- What
 - HD/LD
- Wind
 - E - SE @ 10 Kt
- Weather
 - Dry

Attack!

- Who
 - Crisis/consequence
- Way
 - Safe route
 - Hospital

Attack!

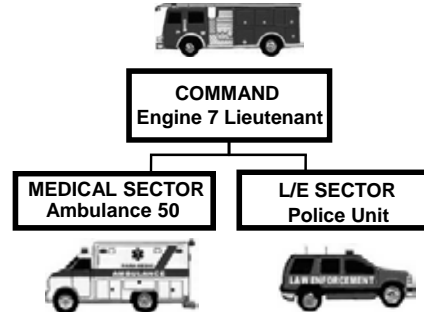


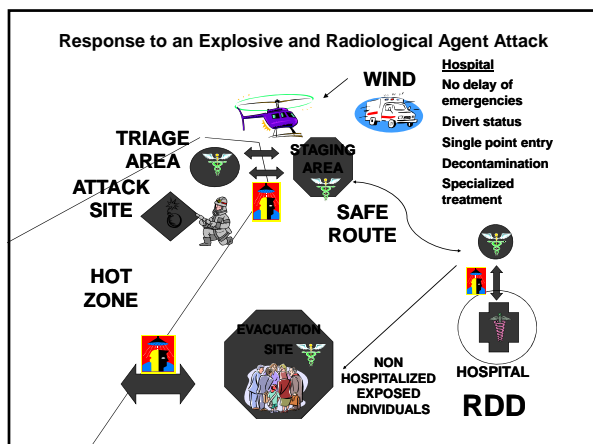
Attack!



Command Structure

Initial ICS Structure





Guidelines for Incident Command

- Approach site with caution
- Position personnel, vehicles, and command post at a safe distance upwind and uphill of the site, if possible
- For nuclear weapons, rescue injured only and establish a 2,500-foot exclusion zone around the weapon

Guidelines for Incident Command

Broken Arrow



Ensure Safety of Responders

- Identify all hazards
 - Danger of fire, explosion, toxic fumes, electrical hazards, structural collapse, etc.
- Identify cargo
- Obtain information concerning the cargo from placards, labels, shipping documents

Ensure Safety of Responders

- Consult DOT Emergency Response Guidebook
- Keep upwind of smoke, fumes, etc.
- Follow protocols for respiratory protection and protective gear
- Monitor changing conditions



Rescue

- Locate victims and facilitate extrication, emergency care and transportation of the injured, following EMS guidelines
- Medical problems take priority over radiological concerns
- Do not delay rescue or transport of a seriously injured, contaminated patient

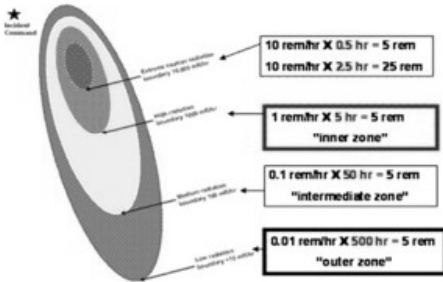
Communications

- Notify hospital of possible contamination/exposure of victim
- Notify state radiological assistance (emergency response center) of accident conditions

Establish a Control Zone

- Reroute traffic
- Mark controlled area
- Limit entry to rescue personnel only
- Order evacuation or sheltering
- Prevent/fight fires

Establish a Control Zone



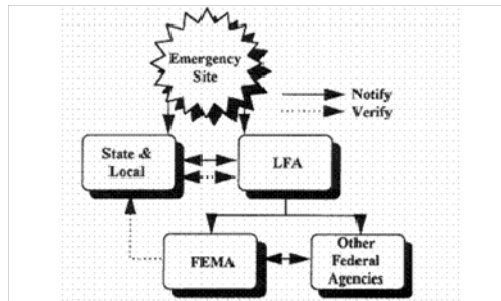
Hazmat Team



Hazmat Team

- Unified command
- Hazard identification
- Risk assessment
- Plume
- Mitigation

Hazmat Team Notification Process



Radiation Protection and Contamination Control

- Do not allow eating, drinking, or other activities within contaminated areas that might lead to intake of radioactive material
- Avoid direct contact with radioactive materials where possible

Radiation Protection and Contamination Control

- Utilize protective clothing and anything available for remote handling
 - Shovels, branches, ropes, etc.

Radiation Protection and Contamination Control

- Limit time near radioactive materials to the minimum necessary
 - Rotate staff
- Determine radiation levels within controlled area and monitor rescue personnel with individual dosimeters



Radiation Protection and Contamination Control

- Evacuate personnel from the immediate downwind area
- Detain personnel who were in the accident area until they can be checked by radiological monitors

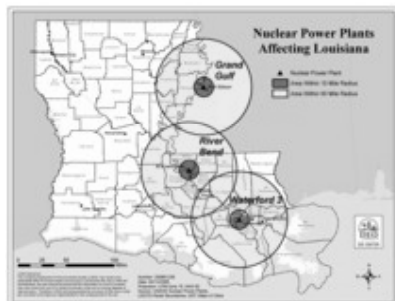
Radiation Protection and Contamination Control

- Follow instruction of radiation authority
- Remove protective gear/clothing at the control line
- Isolate all clothing, tools, etc. used in the controlled area, and retain them until they can be cleared by radiation authority

Radiation Protection and Contamination Control

- Contain all accident debris in the control zone until cleanup is achieved
- Prevent unnecessary handling of incident debris

Radiation Protection and Contamination Control



Don't Panic

- Do not be overly concerned with the presence of radioactive material or allow it to disrupt usual response activities
- Unlikely that emergency personnel will receive any radiation injury
- Obtain instruction from radiation authority

Don't Panic

- Coordinate cleanup with public officials
- Response actions may be performed before any radiation measurements
 - Some radioactive materials cannot be detected by commonly available instruments

Emergency Management Medical Issues

- Treatment of victims
 - Surgical and medical emergencies
 - Specific threat-related care
 - Decontamination
 - Medical therapy
 - Isolation
 - Medical evacuation

Initial Questions



- What to do?
 - Nuclear Regulatory Commission Consultants
 - DOE: Interagency Rad. Assistance Plan (IRAP)

Initial Questions

- Regional Coordination Offices (Oak Ridge, TN)
 - Radiological Assistance Team
 - REAC/TS Emergency No. (865) 576-1005
- State Dept. of Health/Emergency Management

Basics of Response

- Focus on treating the injuries
- Large numbers of frightened people
- Identify patients needing hospital care
- Set-up a treatment area
- Act as if patient contaminated with sewage



Basics of Response

- Avoid spreading radioactive contamination
 - Double sheet and stretcher
- Recognize and treat significant exposures
- Know Government agencies and how to contact
- Plan to evaluate and counsel non-injured exposed at a location outside of the hospital

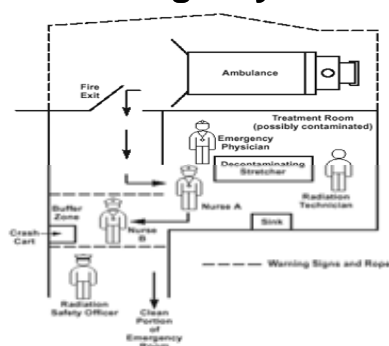
Radiological Incident Medical Consultation

- REAC/TS has designed protocols for medical management
- Serious medical problems always have priority over radiological concerns

Radiological Incident Medical Consultation

- Deployable specialized response teams consisting of a physician, nurse/paramedic and a health physicist

Radiation Emergency Room



Radiological Emergency Response Team

- Team coordinator
 - Leads and coordinates
- Physician
 - Emergency medical care
 - Can function as coordinator or triage officer

Radiological Emergency Response Team

- Triage officer
 - Performs triage
- Nurse
 - Assists physician
- Technical recorder
 - Documents

Radiological Emergency Response Team

- Radiation safety officer
 - Supervises monitoring and contamination control
- Radiation safety personnel
 - Contamination and exposure control
 - Maintain survey equipment

Radiological Emergency Response Team

- Public information officer
- Administrator
 - Coordinates hospital response
- Security
 - Secure area and control crowds
- Maintenance personnel
- Laboratory tech
 - Analysis of samples

RDD Ingredients

- Most likely
 - Cobalt-60, Strontium-90, Cesium-137, and Americium-241
- Less likely
 - Phosphorus-32 and Radium-226



RDD Ingredients

- Obtained from military, medical, industrial, academic or research sources
 - Cobalt 60
 - Food and mail irradiation
 - Americium 241
 - Smoke detectors and oil exploration

Detonation of a “Dirty Bomb”

- Explosive dispersal of radioactive material in the environment
- Blast injuries, burns, and trauma, with possible entrapment of some victims
- Possible localized radiation injuries due to radioactive material blown onto skin or embedded in wounds

Detonation of a “Dirty Bomb”

- Internal contamination of victims if material is vaporized or dispersed in fine particles

Detonation of a “Dirty Bomb”

- Acute radiation syndrome not likely unless victims are trapped near high activity sources emitting penetrating gamma radiation
 - Such as Ir-192, Cs-137, Co-60
- Widespread psychological trauma



Detonation of a “Dirty Bomb”

- Vaporization/aerosolization of radioactive materials and subsequent dispersal by wind and weather

Response to an RDD

1. Immediate life-saving measures, such as treating blast victims and evacuating areas as indicated
 - e.g., based on radioactivity levels
2. Evaluating the extent of contamination and taking measures to control further contamination and minimize exposures

Response to an RDD

3. Recovery and cleanup efforts, including decontamination and remediation of contaminated property

DHS Interagency Working Group

- For the cleanup of areas contaminated by an RDD, it is expected that local stakeholders and decision makers would follow a process to develop cleanup plans tailored to the specific characteristics of the given situation

**Izmaylovsky Park
Moscow, 1995**



**Izmaylovsky Park
Moscow, 1995**

- Terrorists from Chechnya
- Buried, but did not detonate
- RDD
- Dynamite and Cesium-137
- Removed from cancer treatment equipment.
- Reporters were tipped off about its location and it was defused

**Long-term Contamination Due to
Cesium Bomb in Washington, DC**



Inner Ring: One cancer death per 100 people due to remaining radiation (.5% increase)

**Long-term Contamination Due to
Cesium Bomb in Washington, DC**



Middle Ring: One cancer death per 1,000 people due to remaining radiation (.5% increase)

**Long-term Contamination Due to
Cesium Bomb in Washington, DC**



Outer Ring: One cancer death per 10,000 people due to remaining radiation (.05% increase): EPA recommends decontamination or destruction

**U.S. Response Following an
RDD Attack**

- Radiological Assistance Program (RAP)
 - Provide a flexible, around the clock response capability

U.S. Response Following an RDD Attack

- **Aerial Measuring System (AMS)**
 - Provide rapid response to radiological emergencies with helicopters and fixed-wing aircraft equipped to detect and measure radioactive material deposited on the ground

U.S. Response Following an RDD Attack

- **National Atmospheric Release Advisory Capability (NARAC)**
 - Develop predictive plots



U.S. Response Following an RDD Attack

- **Federal Radiological Monitoring and Assessment Center's (FRMAC)**
 - Coordinate and manage all federal radiological monitoring and assessment



U.S. Response Following an RDD Attack

- **Center/Training Site (REAC/TS)** located in Oak Ridge, Tennessee
 - Providing rapid medical attention to people involved in radiation accidents



Individual RDD Response

- While the explosive blast will be immediately obvious, the presence of radiation will not be known until personnel with specialized equipment are on the scene
- Avoid or limit exposure

Individual RDD Response

- Particularly true of inhaling radioactive dust that results from the explosion
 - If there is visual dust, breathe through the cloth of your shirt or coat

Individual RDD Response

- Proximity to radioactive particles may still result in some exposure
- Find out from officials if any public buildings in your community have been designated as fallout shelters
- If none, make your own list of potential shelters near your home, workplace, and school

Individual RDD Response

- Basements or the windowless center area of middle floors in high-rise buildings, as well as subways and tunnels
- If you live in an apartment building or high-rise, talk to the manager about the safest place in the building for sheltering and about providing for building occupants

Individual RDD Response

- During periods of increased threat increase your disaster supplies to be adequate for up to two weeks

RDD Event Outdoors

- Seek shelter indoors immediately in the nearest undamaged building
- If appropriate shelter is not available, move as rapidly as is safe upwind and away from the location of the explosive blast
 - Then, seek appropriate shelter as soon as possible

RDD Event Outdoors

- Listen for official instructions and follow directions

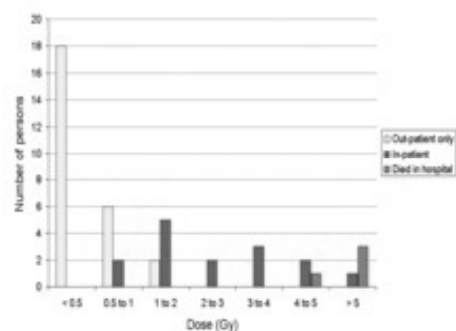
Radiological Accident



Goiania, Brazil

- 50 had ingested cesium - increased risk of cancer
- 2 men, 1 woman, and 1 child died from acute exposure

Goiania, Brazil



Goiania, Brazil

- In addition to the human toll, contamination had been tracked over roughly 40 city blocks
- Of the 85 homes found to be significantly contaminated, 41 were evacuated and 7 were demolished

Goiania, Brazil

- Through routine travels, within that short time people had cross-contaminated houses nearly 100 miles away
- Cleanup generated 3,500 m³ radioactive waste at a cost of \$20 million

Goiania, Brazil



Goiania, Brazil

- Psychological effects included fear and depression for a large fraction of the city's inhabitants
- Neighboring provinces isolated Goiania and boycotted its products
- The price of their manufactured goods dropped 40% and stayed low for more than a month

Goiania, Brazil

- Tourism collapsed and recent population gains were reversed by business regression
- Economic losses of hundreds of millions of dollars
- Need for a broader understanding of radiation

Goiania, Brazil



Nuclear Power Plant Accidents

- A meltdown or explosion could release a large amount of radioactive material
- People at the facility would probably be contaminated with radioactive material and possibly be injured
- Those people who received a large dose might develop acute radiation syndrome

Nuclear Power Plant Accidents

People in the surrounding area could be exposed or contaminated



CHERNOBYL

Three Mile Island

- On March 28, 1979, there was an accident at the Three Mile Island nuclear power station near Harrisburg, Pennsylvania
- There were no injuries or adverse health effects to the public

Three Mile Island

- Radioactive gas released was not enough to cause any dose above regular background levels to local residents
- Conflicting information released during the event exacerbated the public's fears

What Happened

- A meltdown is the most dangerous type of nuclear power accident
- At Three Mile Island (TMI), there was a "loss of coolant" accident, meaning that cooling water that surrounds the core and keeps it cool was lost
- The temperature of the core rose so high that the materials actually melted

What Happened

- Some radioactive gases did escape to the atmosphere
- Average dose to area residents was about 1 millirem



Hypothesized Unit-2 Core Damage

What Will Prevent Another "Three Mile Island"?

- Plant design and equipment requirements
- Operator training and staffing,
- Fitness-for-duty programs to guard against alcohol or drug abuse
- Early detection of problems

What Will Prevent Another "Three Mile Island"?

- Public information about plant performance
- Regulatory controls and enforcement
- Self policing by the industry
- Emergency preparedness



Chernobyl

- On April 26, 1986 the world's most severe nuclear reactor accident occurred in Chernobyl, Ukraine
- An area of about 5 million hectares was contaminated and 160,000 people had to be permanently evacuated

Chernobyl

- Radioactive material affected not only the Ukraine but also Western Europe

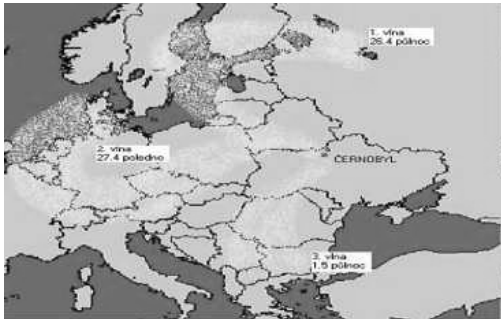
Chernobyl



Chernobyl

- Fewer than 50 deaths directly attributed to radiation almost all being highly exposed rescue workers
- UN report predicts that up to 4,000 people could eventually die of the long-term effects

Chernobyl



Chernobyl EPA Response

- Monitored radioactivity levels in the U.S.
- Established a group to provide advice on preventing contamination of the food supply and protecting public health
- Established an information center to gather and distribute facts and data

Chernobyl EPA Response

- Arranged daily press conferences to keep the public up-to-date and answer concerns



Media Public Information Tactical Considerations

1. Targeted
2. Specific
3. Authoritative
4. Concise

Contamination Risk Communications

1. Get out of the immediate area quickly
2. Remove the outer layer of your clothing
 - If possible, place the clothing in a plastic bag or leave it in an out-of-the-way area

Contamination Risk Communications

3. Wash all of the exposed parts of your body using lots of soap and lukewarm water to remove contamination

Contamination Risk Communications

4. After authorities determine that internal contamination may have occurred, you may be able to take medication to reduce the radioactive material in your body

Community Actions

- Be prepared to evacuate or find shelter in your home
- Develop an emergency communication plan
- Listen to the radio or television for official information

Community Actions

- Remember your neighbors who may require special assistance
 - Infants
 - Elderly people
 - People with disabilities

If Advised to Remain at Home

- Bring pets inside
- Close and lock windows and doors
- Turn off air conditioning, vents, fans, and furnace
- Close fireplace dampers
- Go to the basement

If Advised to Remain at Home

- Stay inside until authorities say it is safe
- If you must go out, cover mouth and nose
- Be prepared to evacuate

When Coming in from Outdoors

- Shower and change clothing and shoes
- Put items worn outdoors in a plastic bag and seal it

When Coming in from Outdoors



View of Chernobyl Taken from Pripyat

If Advised to Evacuate

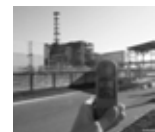
- Listen to a radio or television for information on evacuation routes, temporary shelters, and procedures
- Minimize contamination in house
- Close and lock windows and doors

If Advised to Evacuate

- Turn off air conditioning, vents, fans, and furnace
- Close fireplace dampers
- Take disaster supplies

If You Live Near a Nuclear Power Plant

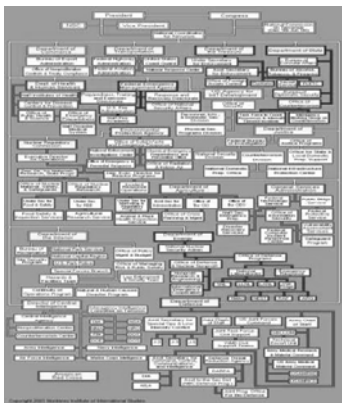
- 10 miles
- Learn the emergency warning systems
- Contact the utility company for information



If You Live Near a Nuclear Power Plant

- The company is required by law to have plans in place for contacting people in the community during an emergency
- The company must inform the community each year of its evacuation plans and routes

Antiterrorism Disaster



Herding Cats



Summary

- Risk
- The radiological threat
- Priorities and responsibilities
- Radiological attack
- Radiological accident
- Community actions

Summary

“Plans are nothing, planning is everything.”

General George Patton

