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Urban Area Decontamination

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Urban Area Decontamination

- **Decontamination and recovery from a radiological dispersal device (RDD) presents difficult and complex challenges.**
  - **Need for an expedient response**
  - **Desire to re-occupy contaminated areas in a timely manner**
  - **The need to satisfy the public that the area is clean.**
- **Preplanning can facilitate an expedient and effective response**

Large Scale Decontamination Challenges

- There are a wide variety of building material types in major metropolitan areas.
- Building materials are frequently high porosity
- Some assets may require non-destructive decontamination
- Some assets may not be cost effectively decontaminated or be amenable to decontamination
  - Computer systems, automobiles, etc.

Dispersal

- Can generally expect high, medium and low level areas of contamination.

- Depends on
  - Source Term
  - Blast characteristics
  - Local characteristics

Urban Impact

Contamination

- Loose Contamination
- Fixed Contamination
- Exterior
  - Building surfaces
  - Roadways, sidewalks, landscape, etc.
  - Water, sanitary and storm sewer systems
  - Ventilation systems
- Interior
  - Enters through ventilation, doors, windows, etc.

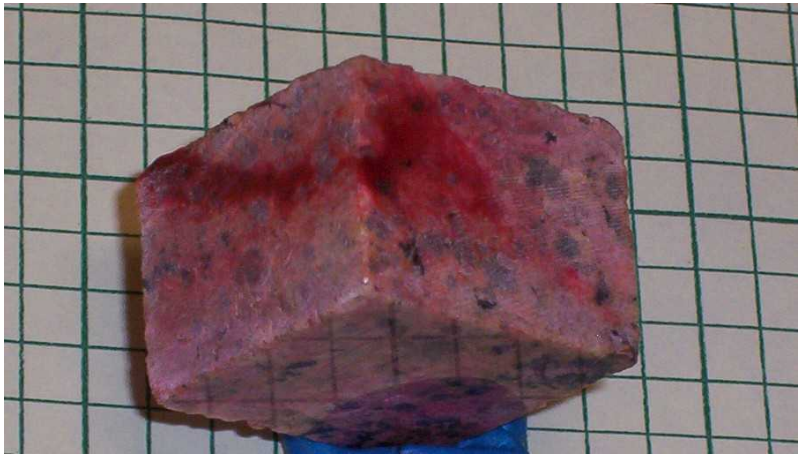
- People
  - Pets, animals
- Products
  - Merchandise, produce, money, etc.

Urban Area Decontamination

- Decontamination will require a very broad approach using many different technologies
  - A staged approach would be employed to reduce the radioactivity and dose to workers
  - This can be accomplished by initiating a gross decontamination to knock down initial dose
- For urban areas there will likely be facilities that require immediate re-occupancy to limit economical impacts
  - A tactical approach to decontamination of select areas may be possible
  - Must consider ingress and egress to the facilities and potential dose to the public as decontamination around these select areas continues
  - Multiple priorities
    - Critical Infrastructure
    - Political
    - Health and safety
- Need to understand extent of contamination to determine most appropriate decontamination methods

Factors Affecting Decontamination

- Wet deposition quickly enters materials
- Porosity of the material
  - Granite, marble, brick
  - Concrete, asphalt
  - Soil, landscaping
- Sorption Mechanism
  - Capillary action
  - Advection along fractures
  - Grain boundary migration

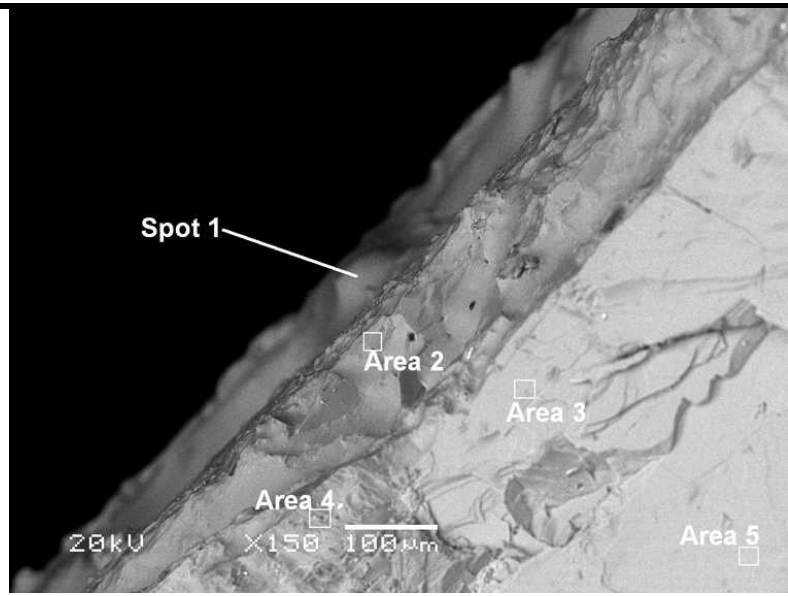


Dye showing imbibition and diffusion into Granite

Dye applied to a sample of marble showing diffusion into the matrix from fractures

Surface Contamination

- Surfaces generally appear smooth and easy to clean



- Radioactive material enters media through capillary action, advection along fractures, migration along grain boundaries, and diffusion into the porous media.

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Dry deposition testing

- Non-Radioactive Cesium Chloride
- Sealed & Unsealed Granite, Marble and Concrete Coupons
- Placed at various distances
- Flat and vertical positioning

Assessment of deposition characteristics

Post Deposition Assessment

- Dry deposition can be more readily decontaminated
- Becomes more difficult with time
- Emphasizes the need to respond quickly

Decontamination Technologies

Low Impact

- Remove loose and some fixed contamination
- Lower cost
- Expedient application
  - Clean larger areas faster
- Technologies
  - Wiping
  - HEPA vacuum
  - Strippable coatings
  - Pressure washing
  - Sponge jet

Decontamination Technologies

Low Impact

- Pressure washing
  - Quick
  - Cost effective
  - Available
  - Removes surface contamination
- Issues
  - Can cause further migration of contaminate into subsurface
  - Need to control rinse water

Decontamination Technologies

High Impact

- Remove fixed contamination
  - Destruction of material surface
  - Depth depends on application
  - Removes fixed surface contamination
  - Removes some subsurface contamination based on depth of application
- Higher cost
- Slower process
- Technologies
  - Sand blast
  - Scabbling
  - Co2 blast
  - others

Scrabble

Sandblast

Demolition and Disposal

- There is a cost and risk balance when deciding whether to decontaminate or dispose
  - Dose may be too great for workers
  - Cost may be more to decontaminate than demolish
- For some facilities and equipment that is contaminated above a certain threshold, disposal is the best option.

There must be a balance between benefit of decontamination and dose to workers

Existing Decontamination Experience

- There exists a wide range of expertise in decontamination.
- Extensive experience in decontamination, treatment, and disposal of radioactive waste from reactor facilities and non-reactor nuclear facilities, however:
  - These are typically not public facilities;
  - The projects are not generally driven by schedule;
  - The public involvement is limited.

Existing Decontamination Experience

- Decontamination at Sandia and other Department of Energy facilities is labor intensive and costly.
- Have used:
  - HEPA Vacuum
  - Scabbling
  - Needle gun
  - CO2 blasting
  - Sponge Jet
  - Strippable Coatings
  - Other

- Facilities frequently have many radionuclides and unknown or uncharacterized radiological, chemical, and industrial hazards.
- RDD decontamination will likely have one (1) or limited known contaminants.

Decontamination Technologies

Optimal technologies for interior and exterior decontamination will vary on the location, environmental constraints, proximity to the public, etc.

- **Easily Decontaminated**
  - Glass, ceramic tile: nonporous surface with little affinity for radionuclides
  - Metals: non-porous substrates with relatively thin oxide coatings which can be removed by chemical or mechanical methods.

- **Difficult to Decontaminate**
  - Wood, highly porous surfaces
  - Stone (marble, granite, etc.) may contain constituents with affinity for radionuclides of concern.
  - Brick, very porous rough surfaces
  - Concrete, reactive toward a number of radionuclides and moderately porous
  - Asphalt, easily penetrated, adheres to bitumen and aggregate.
  - Soil

Improving Decontamination Technologies

Commercially available.
Some National Laboratories working on improvements.

Removal of strippable coating from brick.

Polyvinyl alcohol (PVA) soil containment application developed to contain Pu contaminated soils.

Used to control depth of soil removed.

Other Decontamination Considerations

- Resuspension of contamination during response and recovery operations
- Variations in background radiation
- Options for lightly or partially contaminated structures
- Treatment and disposal

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Anticipate Large Waste Volumes

- Contaminated waste streams will include concrete, wood, asphalt, soil, brick, glass, metal, liquids, etc.
- Waste may include products, vehicles, electronics, produce, money, etc., that are items of value.
  - How to prevent illicit trade of contaminated product after an event.
- Lack of disposal capacity may drive need for treatment
  - Reduce disposal cost
  - Reduce disposal volume
  - Reduce packaging and transportation
  - Recycle
  - Free release

Radioactive debris from decommissioning

Solid Waste Treatment

- Sorting and Segregation
- Compaction
- Incineration
- Decontamination

Glove box used for segregation of waste types

Solid Waste Treatment Options

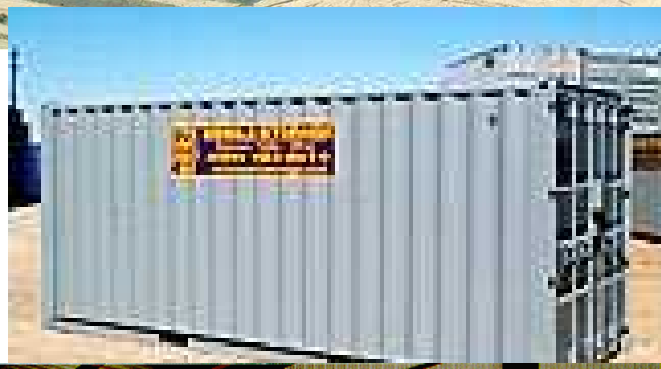
- **Low force compaction**
  - Relatively cheap
  - Low operation cost
  - Good volume reduction
  - Not effective on hard waste
- **Supercompaction**
  - Expensive
  - Requires extensive construction/operations
  - Similar volume reduction to low force for most materials
  - Effective on harder materials

Low force compaction reduces waste volume 5:1 to 10:1 depending on materials

Waste Management and Disposal

- Waste management can be developed, understood, and planned now.

- Waste Acceptance Criteria:
  - Chemicals, equipment, compressed gasses, asbestos, etc.
  - Characterization
    - Sampling
    - Analysis
    - Quality assurance
  - Large packaging will be convenient
    - Typical disposal packages are boxes and drums.
  - Will have unique considerations
    - Automobiles, electronics, money
    - Consumables (groceries, produce, etc.)
    - Animals
    - Other hazards



Summary

Decontamination will be labor intensive and costly

Proactive planning would reduce costs.

Opportunities

- Existing technologies can be identified for rapid response.
- Development of a waste characterization, management and disposal strategy can be planned ahead of time;
- Emerging technologies show promise in the speed of decontamination and reduction of risk to workers.

Issues

- Timeliness of decontamination
- Alleviate public fear and anxiety
- Illicit trade of contaminated materials
- Logistics of packaging and storage
- Below regulatory concern
- Security of valuable LLRW
- Release of clean areas and equipment