Idaho National Laboratory

#### **RDD Decontamination: Methods and Development**

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#### What the Heck is RDD Contamination?

- It could be a "Dirty Bomb"
  - What happens when you blow up radioactive material
- It could be something else
  - Non-explosive devices, inhalation, ingestion, injection (I<sup>3</sup>)
- Let's look at what we know about radiological contamination



#### What is contamination? Particles Coolant Corrosion Release Ni<sup>++</sup> $+ \leftarrow + + Colloids$ Particulates lons Co+i Oxide Fe++ Substrate Fe-Cr-Ni imbibition ≡ (courtesy EPRI) diffusion

(INL simplified model)





# **Potential Building Surface Issues**

#### • Building Materials

Concrete, marble, granite, brick, wood, tile, steel, aluminum, glass, rubber

#### Radionuclides

- Cs-137, Co-60, Sr-90, Ir-192
- Am-241, P-32, Pu-238/239, U-238/235, Th-228

#### • Material Characterization

- Chemical: Mineralogy, CEC
- *Physical*: Roughness, porosity, density

#### • Chemistry

 AIOH, FeOH, SiOH distribution proportional to mineral stoichiometry, precipitation/dissolution, surface complexation, ion exchange

#### Transport

- Porosity, diffusion controls mass transport during decontamination



### How Do We Decontaminate?

- Decontamination methods
  - Chemical
    - Dissolution, "re-dox", chelation (etc)
  - Mechanical
    - Abrasion, ablation, vacuuming (etc)
- Determine method by criteria, requirements, analysis (etc)



### "Decon Toolbox" (101 ways to Decon)



### **Evolution of Decontamination**





# **High Pressure and Hot Water**

- Cheap and easily available
- Fairly effective, particularly on "loose" contaminants





### Chemical Decontamination (SIMCON SS example)







### **Abrasive and Liquid Abrasive Grit**

- Advantages of abrasives
  - Very effective and fast
  - LAG "Cushioned" removal
  - LAG reduced airborne
- Disadvantages
  - Can be large waste



Results

Technology	SIMCON 1-Cs % Removal	SIMCON 1-Zr % Removal	SIMCON 2-Cs % Removal	SIMCON 2-Zr % Removal
Plastic grit	100	100	80	93
Glass Beads	99	100	96	100
Alumina Grit	100	100	92	100
Dissolvable grit	*	*	91	97





### **Traditional Strippable Coatings**

- Latex coatings for pre-contamination
- Removes some loose contaminants
- Very useful for some applications
- Very low waste (non-liquid)



Type of Coating	Type of Contamination	Average Loose Contaminant Removal	Average Fixed Contaminant Removal
ALARA 1146 <sup>2</sup>	Savannah River Fuel Fabrication Facility	82%	N/A
ALARA 1146 <sup>3</sup>	SIMCON I and II	80%	58%
TLC Stripcoat <sup>3</sup>	SIMCON I and II	77%	61%
TLC Stripcoat <sup>4</sup>	NFS, Irwin. TN	88%	N/A



Results

# **Scabbling and Spalling**

- Scabbling
- Spalling
- Inexpensive
- Labor intensive
- Microbial "scabbling"
- Mature techniques, lots of support





## **RDD Decon Development**

- DARPA program
  - INL
  - LANL
  - SNL
  - ISOTRON
- LLNL LDRD
  - Urban grime
  - Simulated blast
- DTRA
- Other commercial efforts
- EPA (John's talk)





### Idaho RDD Decon Development

- Focus on foam methods
- Developed clay method







### Idaho RDD Decon Development (II)





### **Historical Urban Decontamination**

- Chernobyl and Goiannia are two prime examples
  of urban radiological decontamination
- "High technology" was not generally applied
- Results were mixed at best



#### **Primary Chernobyl Cleanup Technologies** (5/86)





# **Chernobyl Cleanup Effectiveness**

Technique	Effectiveness, % removed	Age of contamination
Low Impact		
Grass Cutting	32 (wet deposition)	recent
Firehosing of buildings	0 - walls, 30 - roofs	recent
Firehosing of buildings	0 - walls, 25 - roofs	old
Firehosing of roads	0	old
Sweeping roads	20	recent
Ammonium nitrate treatment of buildings	15 - walls, 20 - roofs	recent and old
Medium Impact		
Sandblasting buildings	40	
Firehosing of roads	45 (wet deposition)	
Grass cutting	65 (dry deposition)	
Vacuum-sweeping roads	50	
High Impact		
Washing, vacuuming indoor surfaces	80	
Soil removal to 10 cm	80	
Road planning	100	
Firehosing of roads	95 (dry deposition)	
Sandblasting buildings	100	
Roof replacement	100	
Plowing soil to 30 cm	2-73	up to 1 year

# Goiania Cleanup (I)

Basic cleanup technology





# Goiania Cleanup (II)

- Move from least to most contaminated
- Contents removed and HEPA Vac'd
- Stripped paint, acid/prussian blue decon agent
- Roofs pressure washed (20% decon)
- Fruit, livestock, vegetation destroyed
- Contaminated soil replaced







### **Available Resources**

- DOE, EPRI and IAEA technology development
- RAPIC data base, technology logic diagrams
- DOE Laboratories
- CRC Handbook on Treatment of Hazardous and Radioactive Wastes



# Summary

- RDD contamination is varied
- Contamination is surface and bulk phenomenon
- Many decontamination methods
- Follow engineering principles to evaluate method
- Decontamination development improvements
- Lessons from previous urban decontamination
- Problem is solvable

