Radiation Dose Reconstruction

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"Challenges in Initiating and Conducting Long-Term Health Monitoring of Populations following Nuclear and Radiological Emergencies in the United States"

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science › environment › community

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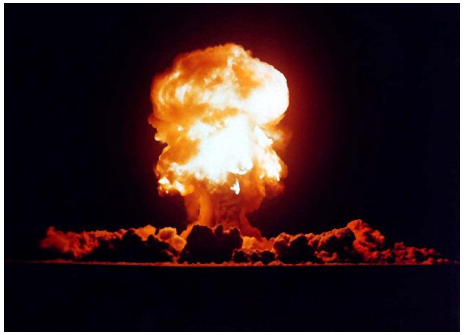
Three Topics

- Advances in the science of radiation dose reconstruction
- Information needed for radiation dose reconstruction
- Radiation dose reconstruction as a foundation for health monitoring

Off-site Radiation Exposure Review Project—OREP (DOE) 1979-1986

- NTS offsite exposures from atmospheric nuclear weapons testing
- Doses to specific individuals
- Database for external exposure based on location
- Dynamic food-chain model for fallout ingestion



Krey and Beck 1983
Whicker and Kirchner 1987

Utah Fallout Project (NCI) 1982-1990

- Dose reconstruction linked with epidemiology
- Leukemia case-control study (n=1177/5330) and a thyroid cohort study (n=3545)
- Use of surveys to obtain milk production and exposure scenario data
- Individual dose uncertainties used in epidemiology

Stevens et al. 1990
Simon et al. 1990
Kerber et al 1993
Till et al. 1995

Hanford Environmental Dose Reconstruction Project (CDC) 1988-1995

- Implemented methodologies developed in OREP and Utah Fallout Project
- Proactive involvement of public and Native Americans (8 tribes)

RAC Historical Dose Reconstructions

Hanford

Idaho National Engineering Lab

Apollo

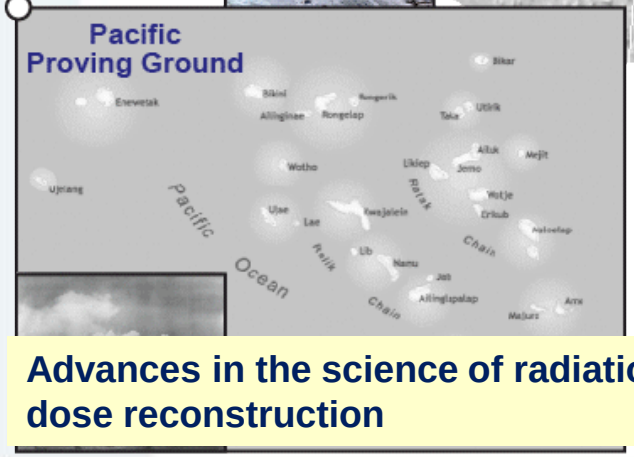
Fernald

Uravan

Rocky Flats

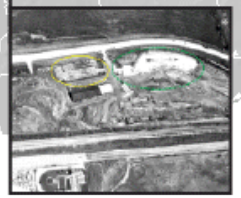
Nevada Test Site

Atomic Veterans Study



Los Alamos

Mallinckrodt Residue Storage Sites



Savannah River Site

Advances in the science of radiation dose reconstruction

Elements of Radiation Dose Reconstruction

$$\text{Dose} = (S \bullet T \bullet E \bullet D)_{u \not{v} pc}$$

where

S = source

T = transport

E = exposure

D = dose coefficient

u = uncertainty

~~*v* = validation~~

p = participation of stakeholders

c = communication

Information needed for radiation dose reconstruction

Till 1997
Till and Grogan 2008
Till 2013

What to Expect when Gathering Information for Radiation Dose Reconstruction

- **Incompatible data**
- **Incomplete data (data gaps)**
- **Undocumented data**
- **Inaccessible data**
- **Insufficient data (modeling will be required)**

Grogan et al. 2006

What We Need for Gathering Information

- A central repository for data supporting radiation dose reconstruction that is web accessible
- Integration of technical methods for radiation dose reconstruction with source, transport, and exposure scenario information
- We must develop new techniques to accelerate and facilitate estimates of dose

Information needed for radiation dose reconstruction

Till et al. 2012

What Radiation Dose Reconstruction Can Tell Us about Health Monitoring Following a Radiological Emergency

- Is there a justification for health monitoring?
- Pathways of exposure, potential for disease, disease types
- Dose mitigation strategies
- Core information to plan health monitoring and long term epidemiology
- Potential for implementing biodosimetry and other dosimetric techniques

Conclusions

- The science of radiation dose reconstruction has advanced significantly over the past 40 years and continues to evolve as technology improves
- Information gathering for radiation dose reconstruction following a radiological emergency will be challenging and needs more emphasis in the future
- Creative approaches are needed to integrate measurement and exposure scenario data with methods for rapidly estimating dose
- Radiation dose reconstruction is a fundamental component in establishing health monitoring following a radiological emergency