Reconstruction of Doses at the Bethlehem Steel Corporation

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Discussion Topics

- Types of Radiation Exposure
- Properties of Uranium
- The Bethlehem Steel Site Profile (Technical Basis Document)
- An Example Calculation
- The Residual Contamination Report

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Types of Radiation Exposure

- Internal Exposure
  - From uranium deposited in the body
  - Pathways are inhalation, ingestion, or absorption
- External Exposure
  - From exposure to uranium metal outside the body such as uranium billets or rods
  - Skin dose much greater than organ doses

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Properties of Uranium

- Emits alpha, beta, and gamma radiation
- With the exception of skin, external dose to body is fairly low
- Concentrates in only a few internal organs
- When inhaled, dose to lung can be very large
- Absorption from GI tract is low (0.2% for insoluble forms)

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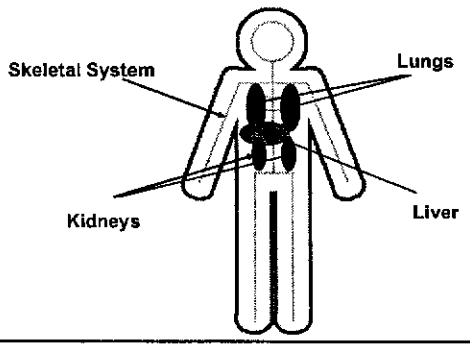
Distribution of Uranium in the Body



Site Profiles / Technical Basis Documents

- Serve as guides for Health Physicists doing dose reconstructions
- Ensure a standard, consistent approach for each case
- Data collected from a number of sources
- Reviewed and approved by NIOSH
- Living Documents

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Bethlehem Steel Technical Basis Document (TBD)

- Covered employment period is 1949 though 1952
- NIOSH research found evidence for 13 individual rollings during 1951 and 1952
- TBD assumes 48 rollings (one per month) between 1949 and 1952
- Estimates inhalation intake using existing air concentration data
- Assigns a distribution of values up to 1,000 times the maximum allowable concentration

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Bethlehem Steel Technical Basis Document (continued)

- Assumes a 10 hour work day with heavy breathing
- Uses claimant favorable solubility values for types of uranium
- External exposure estimate based on known radiation properties of uranium
- Ingestion pathway not explicitly addressed
  - NIOSH is currently revising the TBD to include this pathway
  - Not expected to substantially increase doses

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Calculation of Internal Dose using Upper Limit Air Concentration

- Assumptions
  - Worker was employed during the entire four year covered period
  - Regardless of job classification was present during all 48 modeled rollings
  - Worked 10 hour days at a heavy breathing rate
  - Inhaled worse case solubility type of uranium

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Total Internal Dose to Selected Organs 30 Years after Inhalation

Organ	Effective Dose (rem)
Lungs	3165
Bone	216
Kidney	90
Liver	31
Colon	7
Pancreas	6
Stomach	6
Bladder	6

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Probability of Causation

- Determination of the chance that a cancer is the result of exposure to uranium at Bethlehem Steel
- Calculated at the 99% credibility level
- Based on NCI Interactive Radioepidemiology Program (IREP)
- Incorporates the effect of many variables on the outcome such as cancer type, age at diagnosis, and time since first exposure

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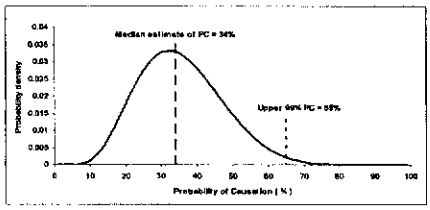
PC uncertainty for leukemia

example: man exposed to 11 rem age 40, diagnosed age 50



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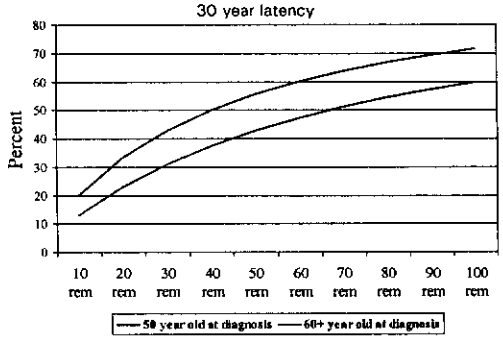
Prostate Cancer

30 year latency



Probability of Causation (continued)

- Organs that concentrate uranium (ie., have a higher internal dose) have much higher PC values than those that don't
- Contribution of external dose to PC for internal organs is small
- Although skin doesn't con centrate uranium, external exposures can be high, thus resulting in high PC values

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Residual Contamination Report Error

- Draft report received from NIOSH's contractor on May 19, 2003
- NIOSH received Congressional request to insert dates of contamination periods on May 15, 2003
- NIOSH evaluated each facility and modified text for 96 out of 219 facilities in the report
- A cut and paste error inadvertently identified BSC as having residual contamination outside the covered period

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Additional Information

- Contact the NIOSH Office of Compensation Analysis and Support (OCAS) at 800-356-4674 or 513-533-6800
- Visit our website at:
  www.cdc.gov/niosh/ocas
- E-mail us at ocas@cdc.gov