

Dose Reconstruction Examples

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Dose Reconstruction for Claimant A

**Individual Worker Monitoring Data
(Underestimate)**



Background

- **Employment History**
 - DOE experimental reactor facility
 - Health and Safety Worker (1959-1986)

- **Duties**
 - Handled radioactive waste
 - Involved in clean up after reactor accident and experiments



Background (cont.)

- **DOE Reported Dose**
 - Photon deep dose = 22.6 rem
 - Shallow dose (photon + beta) = 28.1 rem

- **DOL Verified Cancer**
 - Chronic Granulocytic Leukemia
 - Diagnosed at 40 years of age



Information Used

- Reported deep dose of record from DOE
- Verified employment dates from DOL
- Verified cancer from DOL
- Diagnosis date from DOL



Dose Summary

- External Dose
 - Reported external deep dose alone results in probability of causation of ~72%
- Internal Dose
 - Although bioassay data indicated some internal exposure to cesium, dose was not calculated since PoC from external dose > 50%



Dose Reconstruction for Claimant B

Monitoring Data (Underestimate)



Background

- **Employment History**
 - Electrical and Instrument Mechanic (1951-1978)

- **Duties**
 - Limited information from survivor

- **Work Location**
 - Around reactors, dosimetry was worn



Background (cont.)

- DOL Verified Cancer
 - Larynx Cancer
 - Diagnosed in 1977 (prior to end of employment period)

- DOE reported dose
 - Monitored for external dose from 1952 - 1978
 - ~10 rem deep dose
 - Monitored for internal dose from 1961 - 1978
 - 4 positive uranium urinalyses from 1963 - 1973



Dose Assigned

- Internal Dose
 - Assumed 4 chronic intake periods
Each period assumed to begin at the midpoint between previous negative sample and positive sample

 - Solubility Assigned
Although both class M and class S were present in these areas, class S was assumed because it results in a higher PoC

 - Dose
Resulting dose was ~180 rem from initial employment until year of diagnosis



Dose Assigned (cont.)

➤ External Dose

- ~10 rem deep dose not included as the PoC was greater than 50% based on internal dose alone

➤ Missed Dose

- Missed dose not included as the PoC was greater than 50% based on internal dose alone

➤ Medical Dose

- Medical dose not included as the PoC was greater than 50% based on internal dose alone



Dose Summary

- Resulting PoC is 68.72%



Dose Reconstruction for Claimant C

Monitoring Data (Overestimate)



Background

- **Employment History**
 - Clerk (1981-1995)

- **Duties**
 - Processed time cards, scheduled vacations, typed reports

- **Work Location**
 - Dosimetry required



Background (cont.)

- DOL Verified Cancer
 - Ovarian Cancer
 - Diagnosed in 1985 (prior to end of employment period)

- DOE reported dose
 - Monitored for internal and external dose throughout career
 - 4 mrem deep dose
 - 0 dose recorded from 1 urinalysis and 2 in-vivo counts



Dose Assigned

- External dose
 - Dosimeter Dose
 - Assigned 4 mrem in 1984
 - Missed Dose
 - Assigned 40 mrem per year in a distribution
 - Based on quarterly dosimetry cycles with a LOD of 20 mrem/cycle
 - Assumed all radiation reached the ovary
 - Medical Dose
 - Assigned <.5 mrem each year



Dose Assigned (cont.)

➤ Internal dose

- Internal dose assigned was based on a hypothetical acute intake of 28 radionuclides as described in ORAUT-TIB-002, Maximum Internal Dose Estimates for Certain DOE Complex Claims

1981	3.814 rem
1982	1.613 rem
1983	1.460 rem
1984	1.419 rem
1985	1.394 rem



CDC

Dose Summary

- Resulting PoC is 1.44%



CDC

Dose Reconstruction for Claimant D

Co-worker Data (Overestimate)



Background

- Atomic Weapons Employer (uranium facility)
 - Employee worked from 1940 to 1980
 - Employment verified via affidavit
 - Died of esophageal cancer in 1986
 - Survivors unaware of specific work activities

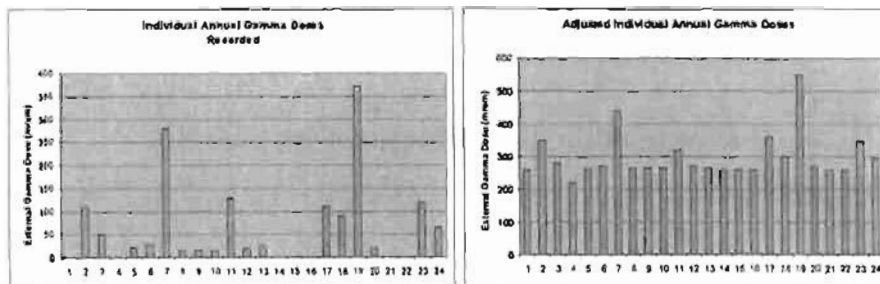


External Dose

- No record of film badge assigned to the employee
- Film badge data for only 2-year period
- Determined annual doses (accounting for missed dose) to each individual each year
- Used highest annual dose as employees dose for 11 years
- Resulted in 550 mrem per year being assigned



External Dose (cont.)



Internal Dose

- No record of employee being sampled
- Samples were not routine but did cover majority of time period
- First several years fairly consistent
- Incidents in 1960 and 1961 evident for several individuals



Internal Dose (cont.)

- Modeled as one chronic and two acute exposures based on highest individual from each scenario (three different individuals)
- Maximum annual esophagus dose was 16 mrem



Time Period

- Exposure assumed to begin on the first day of AEC contract
- Exposure assumed to end on the date of the post decontamination survey



Dose Assigned

- Values represent an upper bound so they were put into IREP as a constant distribution.
- External Dose = 5.590 rem
- Internal Dose = 0.381 rem from beginning of employment to date of diagnosis



Dose Summary

➤ Resulting PoC is 15.02%



Dose Reconstruction for Claimant E

Exposure Model
(Best Estimate)



Background

- **Model documented in a TBD**
- **Model based on exposure data for a few employees**
- **Same facility as the last example**



Background (cont.)

- **Two example cases**
 - **Employment History 1**
 - **Purchasing Agent (1939 - 1974)**
 - **Stomach cancer (1974)**
 - **Employment History 2**
 - **Tool and Die Maker (1950 – 1980)**
 - **Breast cancer (1998) & kidney cancer (1999)**



Dose Assigned

➤ External Dose

- Employee 1
 - 5.410 rem (stomach)
- Employee 2
 - 3.669 rem (kidney)
 - 19.071 rem (breast)

Breast included shallow dose component
Model dose = 335 mrem per year (most years)
Example D = 550 mrem per year



Dose Assigned (cont.)

➤ Medical Dose

- Employee 1
 - 1.173 rem (stomach)
- Employee 2
 - 1.173 rem (kidney)
 - 0.147 rem (breast)



Dose Assigned (cont.)

➤ Internal Dose

- Employee 1
 - 2.234 rem (stomach)

- Employee 2
 - 16.558 rem (kidney)
 - 1.557 rem (breast)

Example D = average 2.67 mg uranium per day

TBD = average 0.85 mg per day (median);

5.17 mg/day 95th percentile



Dose Summary

➤ Resulting PoC

- Employee 1
 - 22.73%

- Employee 2
 - 35.23% (kidney)
 - 28.10% (breast)
 - 53.43% combined



Dose Reconstruction for Claimant F

Monitoring Data (Best Estimate)



Background

- **Employment History**
 - Security Guard and Health Physics Monitor (1951-1983)

- **Duties**
 - Manned posts and rounds
 - Monitored work areas and spill cleanup

- **Work Location**
 - All over the site



Background (cont.)

- DOL Verified Cancer
 - Rectum Cancer (2004)
 - SCC arm (1993)

- DOE reported dose
 - Monitored for external dose from 1953 – 1982
 - ~13 rem deep dose
 - ~24 rem shallow dose
 - Monitored for internal dose from 1961 – 1983
 - 2 positive uranium urinalyses from 1966 and 1979
 - 1 positive lung count 1969



Dose Assigned

- Internal dose
 - Assumed intakes
 - Missed Pu intakes along with associated radionuclides.
 - Fitted plus missed uranium intakes based on urine and lung counts
 - Missed fission product intakes based on in-vivo analysis
 - Acute Np intake based on urinalysis and incident report
 - Fitted and missed tritium intakes based on urinalysis

 - Dose

Resulting dose was 2.229 rem (rectum) and 0.566 rem (skin) from initial employment until year of diagnosis



Dose Assigned (cont.)

➤ External dose

- Missed and measured photon dose = 18.522 rem (rectum) and 27.271 rem (skin)
- Missed and measured neutron dose = 15.865 rem (rectum) and 20.417 rem (skin)
- Missed and measured shallow dose = 1.274 rem (rectum) and 13.476 rem (skin)

➤ Medical Dose

- 2.890 rem (skin) and 0.481 rem (rectum)



Dose Summary

➤ Resulting PoC:

- 24.29% (rectum)
- 29.21% (skin)
- 46.40% combined



Dose Reconstruction for Claimant G

Monitoring Data (Partial Estimate - SEC)



Background

- **Employment History**
 - Industrial Safety (1952 - 1965)
- **Duties**
 - Inspection of pit assembly area
- **DOL Verified Cancer**
 - BCC ear (2003)
- **DOE reported dose**
 - Monitored for external dose in 1965
 - .030 rem deep dose
 - 0 rem shallow dose



Dose Assigned

➤ Internal dose

- The Advisory Board on Radiation Worker Health recommended that internal dose could not be estimated with sufficient accuracy.
- An SEC class was established for this site.
- No internal dose assigned



Dose Assigned (cont.)

➤ External dose

- Measured photon dose = 0.030 rem
- Missed photon and shallow dose = 0.065 rem
- DCF =1, all assigned to 30keV to 250 keV photon as a favorable assumption.

➤ Medical dose

- 4.915 rem



Dose Summary

➤ Resulting PoC is 27.24%



Questions?

