Current Implementation of the Graded Decision Guidelines (Phase 2)

Tom Gesell, PhD
Professor of Health Physics
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Background

- Phase 1 of the Exposure Study began in June 1996
- By early 1998…
  - community surveys completed
  - individual participation requests met
  - inquiries and participation requests much reduced
  - level of effort much reduced
- Phase 2 replaced Phase 1 of the Study on Jan 1, 1999
  - most field work to be done by local consultant
  - oversight by Auxier & Associates, Inc (A&A Inc)
- Procedures essentially the same as for Phase 1
  - Auxier & Associates remains responsible for maintaining records, developing reports and interfacing with the Companies
- If survey backlogs develop, A&A Inc to supplement local consultant's field work

Residential and Facility Screening Surveys

- Participation is voluntary
- Contact is Southeastern Idaho Public Health
- Contact information obtained from participant
  - entered into a database
  - transmitted to the Site Survey Manager (A&A Inc)
  - given to the local consultant
- Local consultant schedules survey
- Prior to entering a home, owner required to give permission via a signature
- Screening measurements are performed with a calibrated instrument according to written procedure

Residential and Facility Screening Surveys

- Locations are screened for dose rates greater than or equal to 20 µrem/h
  - this criterion based on the Graded Decision Guideline of 100 mrem/y above background
- A dose rate of 20 µrem/h indicates slag may be present
- Source is presumed to be slag if not shown otherwise

Residential and Facility Screening Surveys

- Follow-Up Recommended Form is submitted if dose rates greater than or equal to 20 µrem/h
- No Follow-Up Recommended Form submitted if
  - no dose rates greater than or equal to 20 µrem/h, or
  - an isolated source, not typical of the rest of the construction, is found to be greater than or equal to 20 µrem/h but all others are less than 20 µrem/h
- Form is signed by person(s) performing survey
- Original is forwarded to the Document Control Officer for review and entry into project files
- A copy is given to the participant

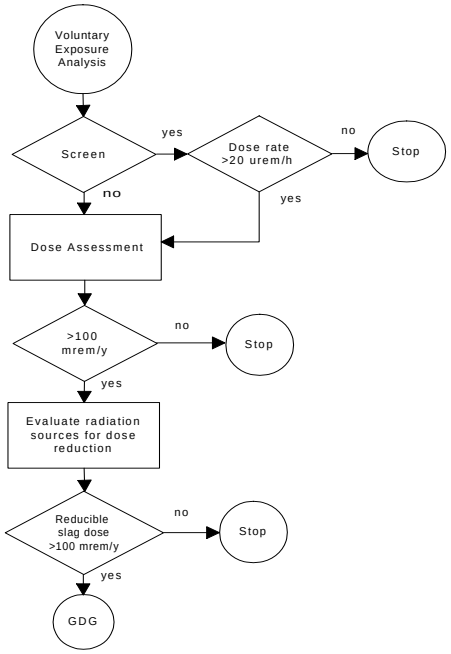
Individual Dose Assessments

- Individual dose assessments offered to persons whose exposure screening indicates possible above-background gamma dose from slag
  - Participants can request a dose assessment without prior screening
- Preferred method of dose assessment is by dose rate meter and time of exposure
- Thermoluminescent dosimetry (TLD) could be used for circumstances where the dose rate/time log method is not practical or possible

Source & Dose Reduction Evaluations

- If a dose of less than 100 mrem/y above background is assessed, individuals will advised that no further assessment is recommended
- If the dose assessment indicates doses greater than or equal to 100 mrem/y, a specific source evaluation will be offered to determine if there are reducible slag doses of greater than or equal to 100 mrem/y
- Those having reducible slag doses greater than or equal to 100 mrem/y will receive dose reduction evaluations under the Graded Decision Guidelines
- Inclusion of residential slag locations in a report would require permission by the owner or proper authority

Flow Chart Summarizing Process



Community Surveys

- Locations of slag within the communities for purposes of disposal considerations were determined during Phase 1 studies
- Additional locations could be evaluated in Phase 2 if requested by local officials
- Locations greater than or equal to 20 µrem/h indicate the possibility of slag
- Identification would be as slag-containing gravel, asphalt, or concrete
- Locations could be added to the existing inventories if requested by proper authority

Potential Radiation Exposure to Street Operations Staff from Inhaling Fugitive Dust that Includes Slag Particles

Tom Gesell, PhD
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Outline

- Radiation dose to the public from natural and other radiation sources
- Approach to estimating radiation dose from slag dust
- Results of estimations
- Comparison with natural radiation sources and the dose standard for the public

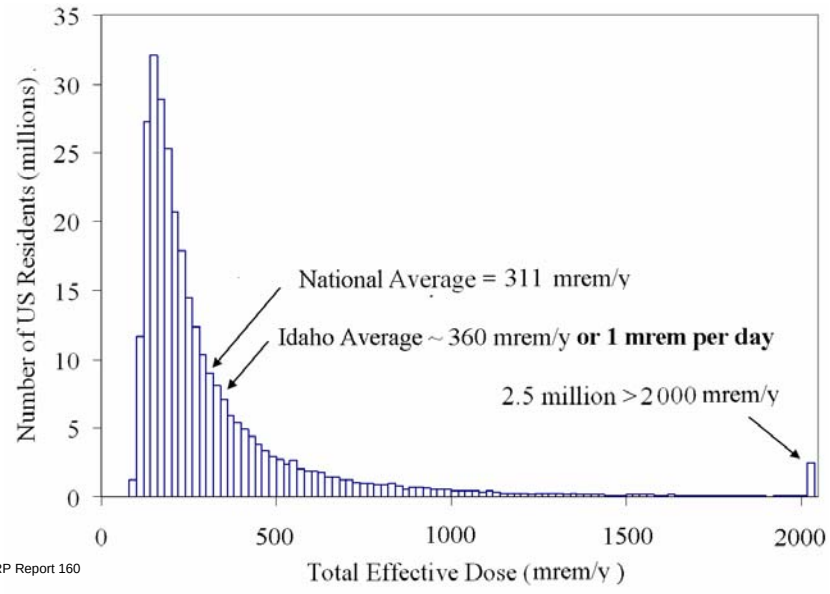
Radioactive Material

- **Radioactivity** is a measure of the rate at which a radionuclide **decays**
- A convenient unit is the **picocurie (pCi)**
  - 2.2 decays per minute
  - Houses usually contain a few pCi of radon per liter of air
  - The rocks and soil of the earth typically contain several pCi of natural radionuclides per gram
  - Phosphorus Slag contains the radionuclides that occur naturally in all earthen materials, but at somewhat higher levels than occur in most in rocks and soils

Radiation

- Radionuclides emit **radiation** upon decay
- A useful measure of the radiation absorbed by a human is effective **dose**
- A convenient unit is the **millirem (mrem**)
  - **Natural** sources deliver about **1 mrem per day**
  - Typical **range** is 0.5 to 1.5 mrem per day

Distribution of Dose from Natural Sources



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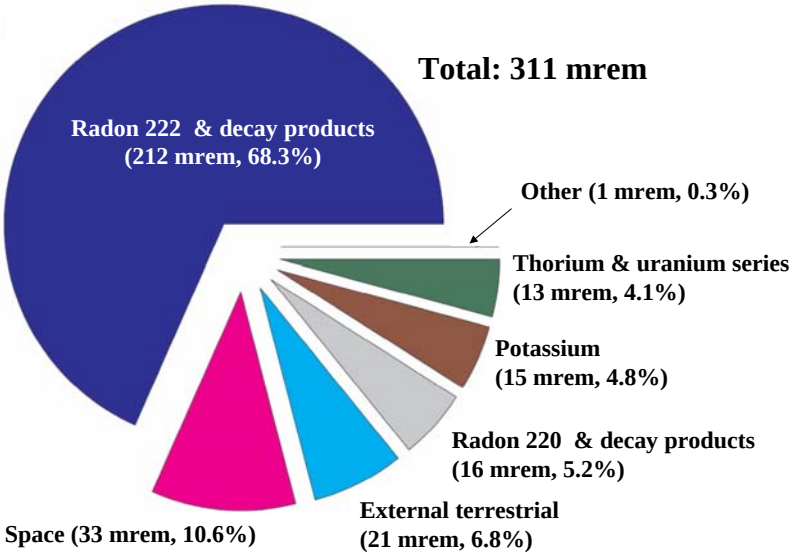
Natural Background Dose to US Residents



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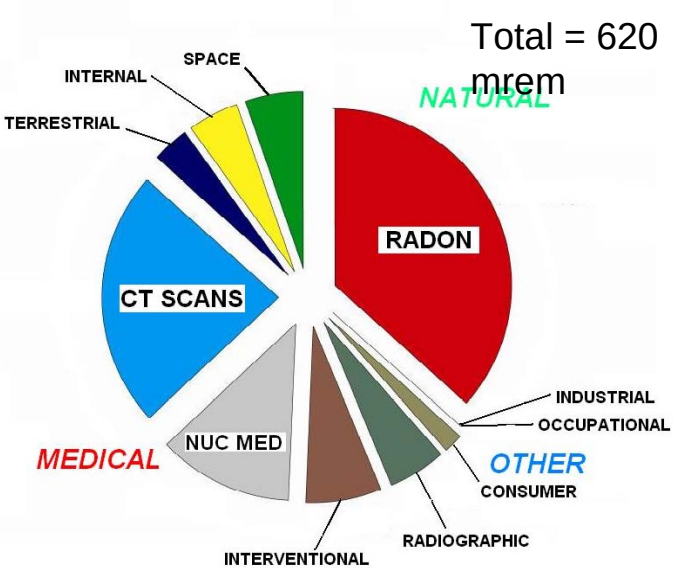
All Dose to US Residents



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Approach to Estimating Radiation Dose from Slag Dust

1. Concentration of fugitive dust in a worker's breathing zone
2. A worker's respiration rate
3. Hours per year that workers are exposed to fugitive dust
4. Annual mass intake of fugitive dust
5. Concentrations of natural radionuclides in slag
6. Radionuclide intake from fugitive slag dust
7. Annual radiation dose expected from intake of fugitive slag dust

Estimate Concentration of Fugitive Dust in a Worker's Breathing Zone

- EPA has a 24-hour standard of 0.15 milligrams per cubic meter (mg/m^3) for coarse particles including those from the construction and demolition industries
  - For 4 hours of work per day, exposure could be **up to 0.9 mg/m^3**
- OSHA has a Permissible Exposure Limit (PEL) for dust (Particulates Not Otherwise Regulated, PNOR) of 5 mg/m^3 respirable fraction
- Fugitive dust can contain silica, which is regulated. Standards for pure silica are
  - OSHA: 0.1 mg/m^3
  - NIOSH: 0.05 mg/m^3
  - ACGIH: 0.025 mg/m^3
- If the fugitive dust contains 5% silica, a total dust concentration of
  - **2 mg/m^3** would meet OSHA standard
  - **1 mg/m^3** would meet NIOSH standard
  - **0.5 mg/m^3** would meet ACGIH standard
- A fugitive dust calculation for utility workers used in the Supplemental Human Health Risk Assessment leads to an estimate of **1.34 mg/m^3**

Estimate Concentration of Fugitive Dust in a Worker's Breathing Zone

- Based on these numbers, **2 mg/m^3** is used in the estimate of dose from slag dust for street construction workers
- Street sweeper operators work on streets chip-sealed with slag in a cab equipped with a filter identified as 80% efficient
  - Dry street sweeping could raise more dust than construction work, but this is offset by the filtration
  - **2 mg/m^3** is also used for street sweeper operators

Estimate a Worker's Respiration Rate

- People not engaged in strenuous activities are usually assumed to breath in about 20 cubic meters of air per day or an average of 0.83 cubic meters per hour.
- Constructions workers have been found to breath in 1.7 cubic meters per hour
  - **1.7 cubic meters per hour** is used for street construction workers
  - **1 cubic meter per hour** is used for street sweeper operators

Estimate Hours per Year that Workers are Exposed to Fugitive Dust

- Street Operations Staff
  - Construction: 300 hours per year
  - Street sweeping: 600 hours per year

Estimate Annual Mass Intake of Fugitive Dust

Factor	Units	Street Construction Worker	Street Sweeper Operator
Breathing rate	m^3 per hour	1.7	1
Working time	hours per year	300	600
Estimated dust concentration	mg/m^3	2	2
Inhaled mass	grams per year	1.02	1.20

Determine Concentrations of Natural Radionuclides in Slag

- Measured Concentrations from the Supplemental Human Health Risk Assessment (pCi per gram)

Nuclide	# of samples	Min	Max	Midpoint
Uranium-238	32	21.3	37.9	29.6
Radium-226	26	6.8	34.8	20.8
Lead-210	95	5.0	19.8	12.4
Polonium-210	22	8.3	23.7	16.0

- Concentrations chosen for this analysis

Nuclide	Nominal value
Uranium-238	30.0
Radium-226	25.0
Lead-210	25.0
Polonium-210	25.0

Estimate Radionuclide Intake from Fugitive Slag Dust

Factor	Units	Street Construction Worker	Street Sweeper Operator
Inhaled mass	grams per year	1.02	1.2
U-238 concentration	pCi/g	30.0	30.0
U-234 concentration	pCi/g	30.0	30.0
Th-230 concentration	pCi/g	30.0	30.0
Ra-226 concentration	pCi/g	25.0	25.0
Pb-210 concentration	pCi/g	25.0	25.0
Po-210 concentration	pCi/g	25.0	25.0
Total U-238	pCi/year	30.6	36.0
Total U-234	pCi/year	30.6	36.0
Total Th-230	pCi/year	30.6	36.0
Total Ra-226	pCi/year	25.5	30.0
Total Pb-210	pCi/year	25.5	30.0
Total Po-210	pCi/year	25.5	30.0

Estimate Annual Radiation Dose Expected From Intake of Fugitive Slag Dust

Factor	Units	Street Construction Worker	Street Sweeper Operator
Total U-238	pCi/year	30.6	36.0
Total U-234	pCi/year	30.6	36.0
Total Th-230	pCi/year	30.6	36.0
Total Ra-226	pCi/year	25.5	30.0
Total Pb-210	pCi/year	25.5	30.0
Total Po-210	pCi/year	25.5	30.0
EPA Dose Coefficient U-238	mrem/pCi	0.011	0.011
EPA Dose Coefficient U-234	mrem/pCi	0.013	0.013
EPA Dose Coefficient Th-230	mrem/pCi	0.052	0.052
EPA Dose Coefficient Ra-226	mrem/pCi	0.013	0.013
EPA Dose Coefficient Pb-210	mrem/pCi	0.004	0.004
EPA Dose Coefficient Po-210	mrem/pCi	0.012	0.012
U-238 annual dose	mrem	0.32	0.38
U-234 annual dose	mrem	0.39	0.46
Th-230 annual dose	mrem	1.58	1.86
Ra-226 annual dose	mrem	0.33	0.38
Pb-210 annual dose	mrem	0.10	0.12
Po-210 annual dose	mrem	0.31	0.36
Total Annual dose	**mrem**	**3.04**	**3.58**

Some Reasons Why these Results are Likely to be Overestimates

- The dust is assumed to be pure slag but in most cases the slag component of dust will be diluted with other materials or the dust may not contain slag
- Workers will likely not be exposed to the estimated dust concentration for all of their working hours
- A fraction of the dust particles are likely to be too large to deposit in the lung

Comparison with Natural Radiation and the Public Dose Limit

- The estimates for street operations staff are **a little over 3 mrem per year**
- This is a very small fraction of the variable exposure of the public to natural radiation which averages about **1 mrem per day**
- It is also a small fraction of the Nuclear Regulatory Commission's public dose limit of 100 mrem per year
- I do not consider the risk to be significant, but any reduction in exposure of workers to dust that contained slag would provide a corresponding reduction in dose