



XA0300679

Occupational exposure to NORM in South Africa

**TCM on the Assessment of Occupational Protection Conditions in Workplaces
with High Levels of Exposure to Natural Radiation, 7-11 May 2001**

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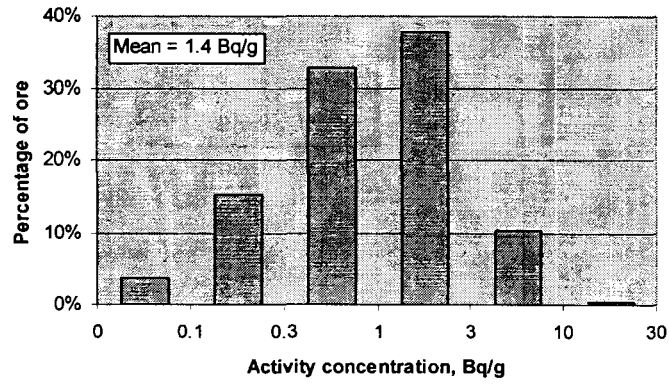
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- **Activity concentrations and worker doses**
 - Mining of the Witwatersrand gold deposits
 - Coal mining
 - Coal ash
 - Mining of the Phalaborwa Igneous Complex copper deposits
 - Phosphate industry

- **Issues**
 - What needs to be regulated?
 - If regulated, what controls are needed?

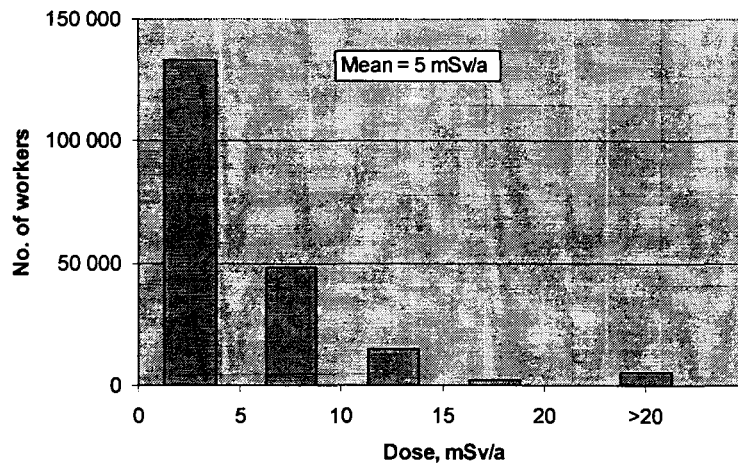
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Distribution of uranium-238 activity concentrations in Witwatersrand gold reefs



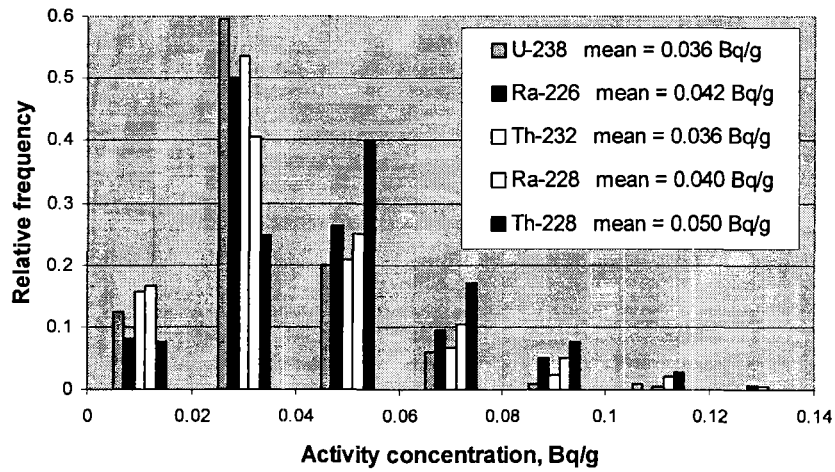
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Worker doses in the South African gold mining industry



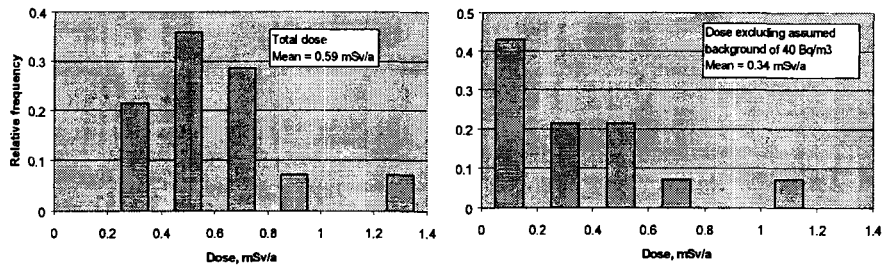
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Distribution of radionuclide activities in South African coal



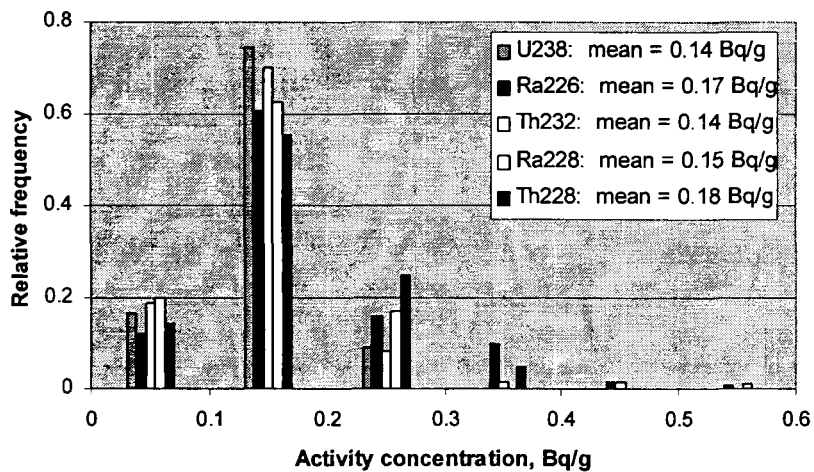
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Worker doses in South African coal mines, estimated from average radon concentrations



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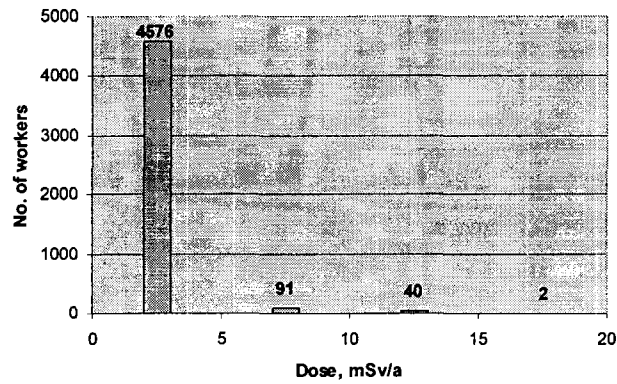
Distribution of radionuclide activities in ash from South African coal



Activity concentrations in ores of the Phalaborwa Igneous Complex

- **Outer zone:**
 - Uranium-238 concentration 0.5 Bq/g
 - Thorium-232 concentration 0.4 Bq/g
- **Inner zone**
 - Uranium-238 concentration 1.5 Bq/g
 - Thorium-232 concentration 2.5 Bq/g

Worker doses in Phalaborwa Igneous Complex copper mine



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South African phosphate industry

- Phosphate rock (phoscorite, containing apatite) is open-cast mined from the Phalaborwa Igneous Complex
- Uranium-238 concentrations: 0.1 to 0.2 Bq/g
- Thorium-232 concentrations: 0.3 to 0.5 Bq/g
- Processing
 - crushing, wet milling, flotation, drying, despatch
 - production of phosphoric acid and fertilizer
 - gypsum waste contains ^{226}Ra , ^{228}Ra at 0.07 to 0.3 Bq/g
 - ammonium phosphate contains U (+ some Th) at 0.2 to 1 Bq/g

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South African phosphate industry (continued)

Occupational exposures:

- mining and processing of phosphate rock: data not yet available**
- phosphoric acid, fertilizer production: all doses are less than 5 mSv/a**

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Issues

Issues fall into 2 basic groups:

- What should be regulated - what are the criteria?**
- If regulated, what controls are appropriate?**

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Issues

1. What should be regulated?

Workplaces involving radon exposures

- The use of the radon action level in mines depends on whether the ore is “radioactive”. But how is “radioactive” defined?
- Mines with very low U grades may still produce uranium as a by-product, whereas others with higher U grades may not produce uranium

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Issues

1. What should be regulated?

Workplaces involving non-radon exposures

- How does one decide what is *excluded* from regulation? A dose criterion is the only sure way, but whose responsibility is it to do the necessary dose assessment? Can be a huge burden on a large number of industries. EU guidance says it is the responsibility of the national authority, not the operator
- BSS excludes exposure from unmodified concentrations of radionuclides in most raw materials. What are “most raw materials”?
- How does one avoid regulating “natural background”? How is “natural background” defined? The EU for instance refers to the exclusion of “aboveground exposure to radionuclides present in the undisturbed earth’s crust” and defines what is meant by “undisturbed”

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Issues

1. What should be regulated?

Workplaces involving non-radon exposures (continued)

- The coal ash issue
 - regardless of the level of hazard associated with coal ash, it is not feasible to regulate its use in informal communities (e.g. burning coal as fuel, use of ash to make bricks)
 - to restrict the use of coal ash would in any case cause extreme hardship

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Issues

1. What should be regulated?

Workplaces involving non-radon exposures (continued)

- Exemption criteria
 - The 10 $\mu\text{Sv/a}$ criterion will probably never be met for NORM industries and is inappropriate as an exemption level
 - The 1 man.Sv criterion is also inappropriate, e.g. collective dose from use of fertilizer is 10 000 man.Sv per year
 - ICRP60 has a *second* criterion that is not based on trivial dose: “(287) no reasonable control procedures can achieve significant reductions in individual and collective doses”. This is not reflected in IAEA guidance
 - EU guidance: 300 $\mu\text{Sv/a}$? 1 mSv/a?

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Issues

2. What controls are appropriate?

- **The grey area between “practices” and intervention”**
 - EU guidance uses a 3rd category - “work activities” for which the principles for practices and/or intervention may apply in whole or in part. This is useful, but who decides, and on what basis?
 - Examples of difficulties
 - Old underground mines, previously unregulated, with high radon levels. Enforcement of dose limits could force closure and massive unemployment. “Special circumstances” clause may not help because it only gives temporary relief. Is this an intervention situation?
 - Old mine residue deposits on previously unregulated mines that are still operating. Enforcement of public dose limits could be financially prohibitive. ICRP82 says these deposits should be treated according to intervention principles, i.e. ALARA but no dose limitation

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Issues

2. What controls are appropriate?

- For NORM industries, control measures needed are usually relatively simple, e.g. dust minimization, changes to working practices. Guidance needed, in order to avoid unnecessarily complex, nuclear-facility-type controls. See ICRP75
- Dilution of waste - for nuclear waste this is not considered acceptable, but for NORM it is often nothing more than re-establishing the original natural concentration of the ore (see EU draft guidance on exemption/clearance)
- The ICRP recommends a facility-specific dose constraint of 300 $\mu\text{Sv/a}$. For NORM, a higher value up to 1 mSv is probably more appropriate (EU guidance on exemption/clearance)

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