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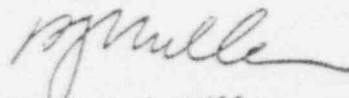
Mr. Don Groelsema  
 U. S. Department of Energy  
 Office of Nuclear Waste Management  
 Mailstop B-107  
 Washington, D. C. 20545

Dear Mr. Groelsema:

Enclosed please find a marked up copy of  
 Source Terms & Transport Modeling outline,  
 which you sent to us November 3, 1980.

I have also enclosed a bibliography of source  
 literature used in our radiological analysis.  
 I hope that the marked up comments and the  
 bibliography will be of use.

Sincerely, -



Hubert J. Miller  
 Section Leader  
 Uranium Recovery  
 Licensing Branch

Enclosures:  
 As stated

*M/4-5-3-7*

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11/19/80 OFFICE ▶ WMUR  
 SURNAME ▶ HJMiller:mb  
 DATE ▶ 11/ /80

OECD - NEA

September 29, 1980

1. SOURCE TERMS AND TRANSPORT MODELING

1.1 Introduction

(Discussion of the scope of the section and terminology used)

1.1.1 Define Terminology

- Source terms
- Source term models
- Transport models
- Special regimes
  - Atmospheric-near field and inside structures
  - Atmospheric-far field
  - Surface water
  - Groundwater
- Time regime
  - Present operations
  - Long term
- Computer Codes
- Model Mill/Tailings Sites

1.1.2 Scope of the Chapter

- Describe sources of radiation from uranium tailings and mill
- Discuss mathematical models for describing sources and transport of radiation through atmospheric and water pathways
- Describe computer codes for source and transport calculations
- Develop model uranium tailings/mill sites to be used as examples in the report

1.2 Source Terms and Models

1.2.1 Airborne Release

- Radon
- Particulates

1.2.2 Waterborne Release

- Dissolved/undissolved radionuclides

1.2.3 Gamma Radiation

*Should discuss releases from air and water tailings over water*

*Seepage water should be of primary concern*

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### 1.3 Transport Models

#### 1.3.1 Atmospheric Pathway

Near Field  
Gaussian Plume  
Dispersion  
Inside Structures  
Far Field - Wedge, NOAA Trajectory

#### 1.3.2 Water Pathway

Surface water  
Groundwater  
Decay  
Adsorption  
Saturated flow  
Unsaturated flow  
One, two and three dimensional models

#### 1.3.3 Gamma Radiation

Attenuation

### 1.4 Computer Codes for Source Terms and Radiation Transport

Each subsection will contain descriptions of computer codes-  
Applicability  
Capability  
Parameters considered-input required  
Code Output  
Availability of Code

#### 1.4.1 Atmospheric Pathway

#### 1.4.2 Water Pathway

#### 1.4.3 Gamma Radiation

### 1.5 Model Mill/Tailings Sites

#### 1.5.1 Arid Climate

Mill Parameters  
Mill output (process rate)  
Process type  
Ore grade  
Release limitations-regulations — ?  
Gamma radiation at boundaries

Tailings Parameters

- Area
- Depth
- Construction - liner, dikes
- Radium content and chemical form
- Particle size and distribution of tailings
- Method of placing tailings in pond
- Diffusion coefficient and emanation coefficient of tailings
- Diffusion coefficient & radium content of cover material
- Moisture content of tailings
- Moisture content of cover
- Leach constants of radionuclides, metals and complexes of interest in the tailings

long + short term moisture retention

Climate

- Precipitation - amount, form, and frequency
- Wind Rose
- Evaporation rate
- Temperature records
- Regional, national, and global weather patterns

Site Characteristics

- Surface water - location
- Groundwater location, depth beneath tailings
- Geological information - stratigraphy - characteristic of strata between tailings and aquifer
- Aquifer characteristics - permeability, adsorption coefficients
- Saturation conditions
- Water use and location of wells
- Population distribution with respect to site - nearest neighbor distance
- Land use
- Background radiation characteristics: air, soil, water...

Wet Climate

(Similar parameters)

1.6 Dose Calculations

1.6.1 Models - NRC Regulatory Guide 1.109

Task RM-802-4

1.6.2 Codes - MILDOS

- TRUST

Groundwater computer code examples - are these the ones we need? - will regulatory guide

Approximate estimates would be standard tech routine to models which are to be used; it is necessary to be recorded in a format which can be input into a computer code.

FINAL GEIS  
esp chapters 4, 5, and 6  
E-100-1  
3  
-100-1

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REFERENCE LIST FOR RADIOLOGICAL PARAMETERS  
AND SOURCE TERMS

I. U. S. Nuclear Regulatory Commission Regulatory Guides

1. Regulatory Guide 1.23, "Onsite Meteorological Programs"
2. Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I"
3. Regulatory Guide 3.8, "Preparation of Environmental Reports for Uranium Mills"
4. Draft Regulatory Guide Task RH 802-4, "Calculational Models for Estimating Radiation Doses to Man from Airborne Radioactive Materials Resulting from Uranium Milling Operations"

II. EPA Publications

1. Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions, EPA-450-13-77-010.
2. Compilation of Air Pollutant Emission Factors EPA/AP-42.
3. C. W. Fort, et al., Radioactive Emissions from Yellowcake Processing Stacks at Uranium Mills (Draft).
4. Mixing Heights, wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States. EPA Office of Air Programs No. AP-101.

III. Oak Ridge National Laboratory Documents (and NRC)

1. McDowell-Rover, L. L., et al., Review and Recommendation of Dose Conversion Factors and Environmental Transport Parameters for  $^{210}\text{Pb}$  and  $^{226}\text{Ra}$ . NUREG/CR-0574, ORNL/NUREG-56.
2. Sears, M. B., et al., Correlation of Radioactive Waste Treatment Costs and the Environmental Impact of Waste Effluents in the Nuclear Fuel Cycle for Use in Establishing "As low as Practicable" Guides--Milling of Uranium Ores. ORNL-TM-4903, Vol. 1.
3. Travis, C. C., et al., A Radiological Assessment of Radon-222 Released from Uranium Mills and Other Natural and Technologically Enhanced Sources. NUREG/CR-0573, ORNL/NUREG-55.

IV. Argonne National Laboratory Documents (and NRC)

1. Descriptions of United States Uranium Resource Areas  
A Supplement to the Generic Environmental Impact Statement on Uranium Milling. NUREG/CR-0597 ANL/ES-75.
2. M. Momeni, et al., The Uranium Dispersion and Dosimetry (UDAD) Code, NUREG/CR-0553, ANL/RES-72
3. Holtzman, R. B., et al., Contamination of the Human Food Chain by Uranium Mill Tailings Piles. NUREG/CR-0758, ANL/ES-59.
4. M. Momeni, et al., Radioisotopic Composition of Yellowcake NUREG/CR-126, ANL/ES-84.
5. M. Momeni, et al., Measured Concentrations of Radioactive Particulates in Air in the Vicinity of the Anaconda Uranium Mill. NUREG/CR-1320, ANL/ES-89.

V. Battelle Northwest Laboratory (PNL)

1. Jackson, P. D., et al., Radon-222 Emissions in Ventilation Air Exhausted from Underground Uranium Mines. NUREG/CR-0628, PNL-2888
2. Nielson, K. K., Prediction of the Net Radon Emission from a Model Open Pit Uranium Mine. NUREG/CR-0628, PNL-2889.
3. Schwendiman, L. C., A Field and Modeling Study of Windblown Particulates from a Uranium Tailings Pile. NUREG/CR-0629, PNL-2890.
4. Kalkwarf, D. R., Solubility Classifications of Airborne Products from Uranium Ores and Tailings Piles. NUREG/CR-0530, PNL-2870.

VI. Miscellaneous

1. U. S. Nuclear Regulatory Commission, Generic Environmental Impact Statement on Uranium Milling. (~~Draft~~) NUREG-0511, Vol. I ~~and III~~. *FINAL 0706*
2. APCD Mining Worksheet, prepared by William Reef, Colorado Department of Health, for Enviro-Test, Ltd., March, 1978.
3. Turner, B. D., Workbook of Atmospheric Dispersion Estimates. U. S. Department of Health Education and Welfare. Public Health Service No. 999-AP-26
4. Environmental Assessment for the Bokum Resources Corporation Marquez Mill Facility. U.S. NRC/NMSS/WMUR.
5. Report of the Radiological Assessment of the Proposed Gulf Mineral Resources, Mt. Taylor Uranium Mill Project, U.S. NRC/NMSS/WMUR.
6. Rogers, V. C., et al., Characterization of Uranium Tailings Cover Materials for Radon Flux Reduction NUREG/CR-1081, FEDU-218-2.