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Canada Centre for Mineral and Energy Technology
Centre canadien de la technologie des minéraux et de l'énergie

Mining Research Laboratories
Laboratoires de recherche minière

PROGRESS DURING THE SECOND HALF OF 1989 IN THE UNDERGROUND URANIUM MINE AND SURFACE RADIATION ENVIRONMENT PROJECTS OF THE MINING RESEARCH LABORATORY (CANMET)

J. BIGU ELLIOT LAKE LABORATORY

DIVISION REPORT MRL 89-125(OP) Nov.1989

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ABSTRACT

The summary of activities described in this report is designed to acquaint members of the Joint Panel on Occupational and Environmental Research for Uranium Production in Canada with the main project element objectives and outputs of the environment projects (underground and surface) carried out by the Mining Research Laboratory (ELL, CANMET, EMR).

This report covers major outputs achieved by the technical staff of MRL from the last meeting of the Joint Panel, Saskatoon, Saskatchewan, June 14-15, 1989 to the present. Information on past outputs can be found in the following reports: MRP/MRL 79-46(OP), MRP/MRL 79-96(OP), MRP/MRL 80-78(OP), MRP/MRL 80-119(OP), MRP/MRL 81-72(OP), MRP/MRL 81-136(OP), MRP/MRL 82-56(OP), MRP/MRL 82-133(OP), MRP/MRL 83-50(OP), MRP/MRL 83-102(OP), MRP/MRL 84-59(OP), MRP/MRL 84-108(OP), MRP/MRL 85-90(OP), M&ET/MRL 86-1(OP), M&ET/MRL 86-72(OP), MRL 87-9(OP), MRL 87-83(OP), MRL 87-134(OP), MRL 88-65(OP), MRL 88-123(OP), and MRL 89-73(OP).

The descriptions that follow are pertinent to two areas of particular interest to members of the Joint Panel:

a) Radiation Source Identification, Measurement and Control;

b) Methods of Treating Tailings and Control of Effluents.

The project element number that appears on the right hand side of the headings refers to CANMET numbers. Other numbers, i.e., JP ..., refer to Joint Panel project numbers. Information regarding CANMET research projects is given at the end of this report.

Key words: Environment; Radioactivity.

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14.39.02 RADIATION (JP 500-507,512,513)

The main project element objectives are: to develop radiation instrumentation, and to undertake radiation studies to determine radiation levels produced in various mining operations; to identify the major factors affecting the release of radioactive products in mine air; to develop control methods capable of reducing radiation to acceptable levels; and to develop and operate test and calibration facilities for radon, thoron, and their daughters, and long-lived radioactive dust.

NATIONAL RADON/THORON TEST FACILITY (RTTF) (Project No. 143902-11-2,JP 506)

The National Radon/Thoron Test Facility (NRTTF) of Energy, Mines and Resources Canada in Elliot Lake has reached an agreement with the Bureau of Radiation and Medical Devices of Health and Welfare Canada to cooperate on a quality assurance program for the measurement of radon in homes in Canada. The Elliot Lake Laboratory, site of the NRTTF, agrees, among other things, to:

1. Produce (generate) and maintain accurate reference atmospheres of radon and its progeny for the qualification of radon and radon progeny measuring devices.
2. Provide expertise, time, staff and supervision at the Elliot Lake Laboratory Radon/Thoron Test Facility for the qualification of radon and radon progeny measuring devices.
3. Test radon and radon progeny measuring devices in the Radon/Thoron Test Facility according to protocols agreed with the Bureau.
4. Receive, catalogue and administer radon and radon progeny measuring devices sent to the test facility by the initial sender for the purpose of qualification. Return these devices to the original sender after the tests are completed.

The first radiation compliance program for radon and radon progeny instrumentation to be used in radon and radon progeny evaluation was

specifically designed for the qualification of charcoal canisters although other 'passive' radon devices were also tested.

LONG-LIVED RADIOACTIVE DUST TEST FACILITY (LLRDTF)

Anticipating the need for a laboratory facility to test instrumentation in LLRD atmospheres, such as those occurring in underground uranium mines and uranium mills, the Elliot Lake Laboratory (E.L.L.) has completed construction of a Long-Lived Radioactive Dust Test Facility (LLRDTF). This installation is also intended for simulation studies and is made up of three main sections of different cross-sectional areas. This allows independent, and simultaneous, tests to be carried out under widely different airflow conditions and LLRD concentrations.

The above installation is particularly useful for intercomparing the performance of LLRD sampling instrumentation, for testing contamination of personal dosimeter sampling heads, and to investigate the electrical and particle size characteristics of LLRD under a variety of environmental conditions. An added and unique feature of this installation is that its special design enables injection of radon and thoron, in addition to LLRD.

The LLRDTF is at present under extensive technical evaluation, and it is, therefore, operating on an experimental basis. The initial tests and results of this evaluation indicate that the LLRDTF is operating according to the design specifications. The above facility will be used shortly in conjunction with a research project entitled "Comparison of Radioactive Aerosol Sampling Instrumentation", under contract to CANMET by the AECB (see below).

CHARACTERIZATION OF RADON (THORON) PROGENY AND LONG-LIVED RADIOACTIVE DUST

Studies of electrical charge and particle size distribution of Long-Lived Radioactive Dust (LLRD), radon progeny, and thoron progeny are being

continued in the laboratory and in underground mines. Electrical charge and size distribution studies of uranium mine and tailings dust will continue in the laboratory, particularly with dusts of high ^{226}Ra content. These studies will be conducted at the new LLRDTF (see above).

The instrumentation used for the above studies was designed and built at the Elliot Lake Laboratory and consisted of parallel plate and split-flow elutriators and diffusion batteries. Cascade impactors and other ancillary instrumentation were also used in these studies.

A program to determine alpha-particle activity (LLRD) in silica dust samples from local underground uranium mines has been re-activated (Rio Algom and Denison). Studies on LLRD and radioactive dust (RD) will be extended as part of a long-term research program aimed at investigating their radiological impact on uranium industry workers.

UNDERGROUND ENVIRONMENT CONTROL PROGRAM (JP 502)

At present, the following projects have either been completed or initiated:

1. Use of chemical and radioactive tracers to investigate radioactivity and airflow conditions in underground uranium mines and mills.
2. Use of wet scrubbers, electrostatic precipitators, e.g., charged water sprays, and mechanical filtration systems to reduce and control LLRD, and radon (thoron) progeny levels in underground uranium mines.
3. Use of ventilation and recirculation as a means of controlling radiation levels in underground uranium and non-uranium mines.
4. Removal of discrete radioactive sources to improve working radiation conditions in underground mines.
5. Electrical charge characterization of LLRD from various mining operations.

Great emphasis has been placed on radiation control methods and techniques and an extension of the above projects in a number of different

types of uranium and non-uranium mines is being considered for the near future.

OTHER PROJECTS

In addition to the above a number of other projects have been undertaken by the Elliot Lake Laboratory, as shown below:

1. A study on the diffusion characteristics of thoron progeny using graded metal wire screens and parallel screens is proceeding as planned. This work is conducted in collaboration with the U.S. Bureau of Mines (Denver Research Center, Denver, CO). The parallel screens work will be carried out in collaboration with the USBM and the Lovelace Toxicology Laboratory (Albuquerque, NM).
2. A full investigation of the desorption of radon and thoron progeny from surfaces by recoil mechanisms and other mechanisms is almost complete.
3. A major program sponsored by AECB (under contract with the Elliot Lake Laboratory) on the use of tracer gas techniques to evaluate airflow conditions in underground uranium mines is well underway. The program consists of concurrent measurements of airflow characteristics by radioactivity and tracer gas techniques (Project No. 143902-01-5, JP 504).
4. A contract by AECB to determine the sources of airflow errors in measurements with air sampling instrumentation (Project No. 143902-01-02, JP 505).
5. A contract by AECB to compare (and calibrate) the performance of several instruments for rapid evaluation of the WL in underground uranium mines. (Project No. 143902-07-5, JP 512).
6. Phase III of the project Radiation Surveys at St. Lawrence Fluorspar Ltd. (Project No. 143902-15-2) has been postponed indefinitely (JP 507).
7. A contract by AECB has been awarded to the Elliot Lake Laboratory for the intercomparison of radioactive aerosol sampling instrumentation (Project

No. 143902-14-4, JP 513).

143911 TAILINGS MANAGEMENT TO MINIMIZE ENVIRONMENTAL IMPACT

The project element objective is to develop methods of tailings disposal and surface stabilization of inactive tailings piles to reduce the detrimental effects of contaminant transport via wind and water erosion, surface runoff, and groundwater infiltration as a subsurface seepage.

DEVELOPMENT OF WET BARRIERS ON PYRITIC URANIUM TAILINGS (Rio Algom)
(Project No. 143911-01-3, JP 508)

The project objective is to establish a saturated hydrologic condition at the surface of pyritic uranium tailings and develop an appropriate wetland vegetative cover to:

a) act as an oxygen barrier and hence control acid generation;

b) stabilize the surface; and

c) minimize surface water contamination.

Laboratory lysimeter and small scale field 'plot' tests are being carried out on various tailings sites to monitor the effects of the individual or combined effects of treating the tailings by: flooding; leaving them unflooded; treating them with applications of limestone or some other surface ameliorating chemical/substance revegetation; and leaving them fallow to revegetate naturally.

Procedures and methodologies will be developed to carry out a large scale demonstration on a 40 ha. section of the Quirke Mine tailings (western end).

Over a 3-year period, both field and laboratory investigations will be undertaken in order to evaluate the hydrogeochemistry of pyritic uranium tailings with various types of wet barriers.

CONTAMINANTS MIGRATION FROM SULPHIDE AND URANIUM TAILINGS (Rio Algom, Denison, AECB, Laurentian University) (Project No. 143911-15-3, JP 511)

Techniques are being developed to assess migration of contaminants from uranium tailings via air and water pathways. Migration of contaminants from tailings to vegetation, to herbivores and insects, and various other food chains are also being studied to evaluate their ultimate impact on man.

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JOINT PANEL ON OCCUPATIONAL AND ENVIRONMENTAL RESEARCH
FOR URANIUM PRODUCTION IN CANADA

DATE	REPORT ON PROJECT PROGRESS	PROJECT #
December 1989		504

TITLE	MATRIX LOCATION
TRACER GAS METHOD FOR ASSESSING VENTILATION EFFICIENCY IN UNDERGROUND URANIUM MINES AND MILLS.	

PROGRESS/STATUS

Phase I of this project is complete. A report on techniques, methods, and instrumentation was submitted to AECB in March 1989 for review, and in compliance with the terms of the contract. The field phase, or phase II, is now under way and results will be reported shortly. A number of experimental underground situations are investigated. This study is carried out in conjunction with radioactivity measurements using the natural environment, i.e., radon, thoron, and their progeny, as 'natural' radioactive tracers.

CHANGES	ANTICIPATED COST
	60K
	ANTICIPATED COMPLETION DATED
	March 1990

SPONSOR(S)	CONTACT
Atomic Energy Control Board	J. Bigu, CANMET

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JOINT PANEL ON OCCUPATIONAL AND ENVIRONMENTAL RESEARCH
FOR URANIUM PRODUCTION IN CANADA

DATE	REPORT ON PROJECT PROGRESS	PROJECT #
DECEMBER 1989		505

TITLE	MATRIX LOCATION
ASSESSMENT OF ERRORS IN AIRFLOW MEASURING INSTRUMENTS	

PROGRESS/STATUS

Flowrate measurements using a variety of flowrate instrumentation such as mass flowmeters, dry gas test meters, wet gas test meters, and automated bubble test cells have been carried out with several kinds of sampling pumps commonly used by the AECB for sampling radon and thoron daughters in underground uranium mines. Measurements have been conducted with filters of different types, e.g., glass fibre and Millipore, and with varying lengths of plastic tubing at the intake and the exhaust of the pump. Other tests and experiments are also in progress.

CHANGES	ANTICIPATED COST
	35K
	ANTICIPATED COMPLETION DATED
	March 1990

SPONSOR(S)	CONTACT
Atomic Energy Control Board	J. Bigu, CANMET

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JOINT PANEL ON OCCUPATIONAL AND ENVIRONMENTAL RESEARCH
FOR URANIUM PRODUCTION IN CANADA

DATE	REPORT ON PROJECT PROGRESS	PROJECT #
DECEMBER 1989		512

TITLE	MATRIX LOCATION
RAPID DETERMINATION OF RADON DAUGHTER CONCENTRATION	

PROGRESS/STATUS

Several radon daughter instruments used for the rapid determination of radon daughter concentrations in underground uranium mines and uranium mills will be tested thoroughly, starting Nov. 1989, in the new Radon/Thoron Test Facility (RTTF) at the Elliot Lake Laboratory. The tests will be conducted under a variety of environmental and radioactivity conditions likely to be encountered under field conditions. Extensive ground work and preparation have been initiated in anticipation of these laboratory tests. Field tests will follow tests under laboratory-controlled conditions.

CHANGES	ANTICIPATED COST
It may be some delay with this project because the instruments to be tested have not yet been received as of Nov. 15, 1989.	25K
	ANTICIPATED COMPLETION DATED: March 1990

SPONSOR(S)	CONTACT
Atomic Energy Control Board	J. Bigu, CANMET

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JOINT PANEL ON OCCUPATIONAL AND ENVIRONMENTAL RESEARCH
FOR URANIUM PRODUCTION IN CANADA

DATE	REPORT ON PROJECT PROGRESS	PROJECT #
December 1989		513

TITLE	MATRIX LOCATION
INTERCOMPARISON OF RADIOACTIVE AEROSOL SAMPLING INSTRUMENTS	

PROGRESS/STATUS

This project has been initiated recently (Nov. 1989). A literature search has been initiated with regards to instrumentation in common use, and sampling and calibration techniques. The Long-Lived Radioactive Dust Test Facility (LLRDTF) designed for this project is in full operation and preliminary data is at present being collected.

CHANGES	ANTICIPATED COST
	90 K
	ANTICIPATED COMPLETION DATED
	March 1991

SPONSOR(S)	CONTACT
Atomic Energy Control Board and CANMET	J. Bigu, CANMET

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