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PROGRESS DURING THE FIRST HALF OF 1990 IN THE UNDERGROUND URANIUM MINE AND SURFACE RADIATION ENVIRONMENT PROJECTS OF THE MINING RESEARCH LABORATORY (CANMET)

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MINING RESEARCH LABORATORY
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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 environmental 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, Hamilton, Ontario, December 6-7, 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-123(OP), MRL 89-73(OP), and MRL 89-125(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)

An intercomparison of radon daughter instrumentation has recently been completed. This work was requested by the AECB under the project entitled "Rapid Determination of Radon Daughter Concentrations". Four instruments have been tested, calibrated and intercompared, namely, the MDA IWLM, the Mimil II Alpha Monitor, Pylon WLM Model UL-1000C, and the EDA WLM-30. The instruments were tested under a variety of environmental conditions such as radon progeny concentration, relative humidity, temperature, and aerosol concentration. In addition, the performance of the above instrumentation under γ-ray fields of up to 10 mR/h has been investigated. Results are presently being analyzed and a report on these data will soon be forthcoming.

LONG-LIVED RADIOACTIVE DUST TEST FACILITY (LLRDTF)

Anticipating the need for a laboratory facility to test instrumentation in Long-Lived Radioactive Dust (LLRD) atmospheres, such as those occurring in underground uranium mines and uranium mills, the Elliot Lake Laboratory (ELL) has completed construction of a Long-Lived Radioactive Dust Test Facility (LLRDTF) which has been operating for some time already. This installation is also being used 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.

A technical evaluation of the LLRDTF has recently been completed. A technical report on the performance of this installation is near completion. The LLRDTF is being fully used at present 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 continue in the laboratory, particularly with dusts of high ^{226}Ra content. These studies are conducted in 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 LLRD alpha-particle activity in silica dust samples from local underground uranium mines has been re-activated (Rio Algom and Denison). Studies on LLRD and radioactive dust (RD) have been extended as part of a long-term research program aimed at investigating their radiological impact on uranium industry workers.

Two special studies have recently been undertaken by the Elliot Lake

Laboratory for Denison Mines Ltd. on a cost sharing basis. The purpose of these studies is to investigate the:

1) relationship between radon progeny and thoron progeny;

2) relationship between Long-Lived Radioactive Dust (LLRD) and quartz dust.

Both studies are of great practical interest from the occupational exposure standpoint and will contribute to a better understanding of the underground mine environment. In addition, they offer the opportunity for calculating 1) thoron progeny concentrations from experimentally determined values for the radon progeny concentration, and 2) Long-Lived Radioactive Dust concentrations from experimentally determined values of silica dust concentrations. Items 1 and 2 would result in considerable time savings and great simplification of operational procedures for mine personnel since radon progeny and silica dust samples are taken at U/G locations on a routine basis by personnel at the ventilation department for compliance purposes.

UNDERGROUND ENVIRONMENT CONTROL PROGRAM (JP 502)

At present, the following projects are in progress:

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 being 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 now 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 somewhat delayed because of practical difficulties by the mining company in providing adequate locations for the tests. The program consists of concurrent measurements of airflow characteristics by radioactivity and tracer gas techniques (Project No. 143902-01-05, 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) has been completed.
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. 143902-07-05, JP 512) has been completed.
6. Phase III of the project Radiation Surveys at St. Lawrence Fluorspar Ltd. (Project No. 143902-15-02) has been postponed indefinitely (JP 507).
7. A contract has been awarded to the Elliot Lake Laboratory by AECB for the intercomparison of radioactive aerosol sampling instrumentation (Project No. 143902-14-04, JP 513). Phase I has been completed.

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 effect of contaminated 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. 143911-01-03, 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. 143911-15-03, 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 have also been studied to evaluate their ultimate impact on man. Although this work is now complete, a continuation of these studies is being considered.

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

DATE	REPORT ON PROJECT PROGRESS	PROJECT #
June 1990		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 underway and results will be reported shortly. A number of experimental underground situations are being 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
There has been some delays in completing the field work because of some practical difficulties by the mining company in providing adequate locations for the tests.	60K
	ANTICIPATED COMPLETION DATED: July 1990

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

DATE	REPORT ON PROJECT PROGRESS	PROJECT #
June 1990		505

TITLE	MATRIX LOCATION
ASSESSMENT OF ERRORS IN AIRFLOW MEASURING INSTRUMENTS	

PROGRESS/STATUS

Flowrate measurements using a variety of flow rate 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 have also been completed.

CHANGES	ANTICIPATED COST
No change. Project completed.	35K
	ANTICIPATED COMPLETION DATED: March 1990

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

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

DATE	REPORT ON PROJECT PROGRESS	PROJECT #
June 1990		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 have been tested thoroughly, starting March 1990, in the Radon/Thoron Test Facility (RTTF) at the Elliot Lake Laboratory. The tests have been conducted under a variety of environmental and radioactivity conditions likely to be encountered under field conditions. Because of the present situation at the local mines, underground instrumentation testing will be difficult and may have to be cancelled.

CHANGES	ANTICIPATED COST
Experimental phase completed. Results are being analyzed and a report will soon be forthcoming.	25K
	ANTICIPATED COMPLETION DATED: August 1990

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

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

DATE	REPORT ON PROJECT PROGRESS	PROJECT #
June 1990		513

TITLE	MATRIX LOCATION
INTERCOMPARISON OF RADIOACTIVE AEROSOL SAMPLING INSTRUMENTS	

PROGRESS/STATUS

This project was initiated on Nov. 1989. A literature search has been completed (and a report submitted) 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
	90K
	ANTICIPATED COMPLETION DATED
	March 1991

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