PROGRESS DURING THE SECOND HALF OF 1988 IN THE ENVIRONMENT PROJECTS OF THE CANMET MINERALS PROGRAM

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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 CANMET (E.M.R.).

This report covers major outputs achieved by the technical staff of MRL from the last meeting of the Joint Panel, Regina, Saskatchewan, June 21-22, 1988 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), and MRL 88-65(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 Tailings Effluents.

The project element number that appears on the right hand side of the headings refers to CANMET numbers. Information regarding CANMET research projects is given at the end of this report.

Key words: Environment; Radioactivity.

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14.39.03 RADIATION (EMR 500,501,502)

The 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.

INSTRUMENT DEVELOPMENT AND TECHNICAL EVALUATION (EMR 500)

Several apparatuses have been designed and built to measure the size and electrical charge distribution of:

1. radon progeny and thoron progeny;
2. non-radioactive submicron size aerosols; and
3. long-lived radioactive dust.

These devices include parallel plate elutriators and split flow elutriators with electrical charge deposition capabilities, and diffusion batteries of different geometrical configurations. The above apparatuses have been tested and evaluated in the laboratory using the Radon/Thoron Test Facility (RTTF), and in an underground uranium mine.

No calibration or testing of new instrumentation (monitors, etc.) for radon, thoron, and their progenies have been conducted since the last meeting because no new instruments were available.

NATIONAL RADON/THORON TEST FACILITY (RTTF)

Extensive modifications in the airflow system and the air conditioning system have been introduced. Eleven new sampling ports, and other improvements

have been added since the last meeting. Although the RTTF still requires extensive modifications to meet the original specifications, it will start operating shortly on an experimental basis, and some preliminary testing and calibration work will be conducted. Work will be initiated by exposing, for instance, charcoal canisters, an operation that requires far less a degree of complexity than testing and calibration of radon daughters and thoron daughters instrumentation. This reduced operation scheme will also give an idea of the practical problems to be encountered in the near future in the testing of a large number of radiation instruments.

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

Studies on electrical charge and particle size distribution of Long-Lived Radioactive Dust (LLRD) and thoron progeny have been conducted in an underground uranium mine. Electrical charge and particle size distribution determination of radon progeny has been carried out in the laboratory (RTTF).

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.

The instrumentation used for the above studies was designed and built at the Elliot Lake Laboratories 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 α-particle activity (LLRD) in silica dust samples from local underground uranium mines has been re-activated (Rio Algom). Studies on LLRD and RD will be extended as part of a long-term research program aimed at investigating its radiological impact on uranium industry workers.

A research contract entitled "Assessment of Errors in Airflow Measuring

Instruments (U-Mines)" has been awarded to the Elliot Lake Laboratory (CANMET) by the AECB.

UNDERGROUND ENVIRONMENT CONTROL PROGRAM (EMR 502)

Radiation, respirable dust and ventilation are three research areas relevant to underground mines. The Elliot Lake Laboratory is committed to a series of combined studies on these areas in collaboration with the local underground uranium mines at Elliot Lake and other non-uranium mines elsewhere. At present, the following projects have either been completed or are about to be initiated:

1. Use of wet scrubbers, electrostatic precipitators, e.g., charged water sprays, and mechanical filtration systems to reduce and control LLRD, dust, and radon (thoron) progeny levels in underground uranium mines.
2. Use of ventilation and recirculation as a means of controlling radiation levels in underground uranium and non-uranium mines.
3. Removal of discrete radioactive sources to improve working radiation conditions in underground mines.
4. 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 batteries of metal wire screens of different sizes is proceeding as planned. This

work is conducted in collaboration with the U.S. Bureau of Mines (Denver Research Center, Denver, CO):

2. A full investigation on the transfer of radon and thoron progeny to surfaces by recoil mechanisms and other, arguably, mechanisms is underway.
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 will consist of concurrent measurements of airflow characteristics by radioactivity and tracer gas techniques.

30.86.02 TAILINGS MANAGEMENT TO MINIMIZE ENVIRONMENTAL IMPACT (EMR 503)

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.

Consolidation and strength characteristics of pyritic uranium tailings stabilized with lime, carbon dioxide and blast furnace slag cement were measured for backfill and in situ consolidation applications. The ultimate compressive strengths for tailings/lime stabilization were comparable to that of tailings/cement with no noticeable effect of the carbon dioxide mixing environment. The highest compressive strength and modulus of elasticity were obtained for blast furnace slag cement where the presence of aluminum oxide and silica provided additional binding and strength with the formation of hydrated alumino silicates.

The geochemistry of a thickened tailings pile at the Denison tailings site in Elliot Lake was evaluated to determine its chemical stability. The results have shown that the pile has been completely oxidized with the unsaturated zone pH ranging between 2-3 with elevated metal and sulphate

levels.

The revegetated potential of a previously reclaimed and flood damaged section of the Nordic tailings site in Elliot Lake was evaluated for the established volunteer vegetation growth. About 50% of the damage area has a vegetation cover with a bio-yield of 30% compared to that of the undamaged vegetated section.

Future Work

With the cooperation of Denison and Rio Algom mines in Elliot Lake, studies on the thickened tailings pile and future close-out options will be continued.

In cooperation with Laurentian University, Sudbury, migration of radionuclides from uranium tailings via various environmental pathways will also be pursued.

RESEARCH PROJECT

No. 6

TITLE

INSTRUMENT DEVELOPMENT AND TECHNICAL EVALUATION

CODE EMR 500

REF.

SCALE

TOTAL PROJECT		CURRENT YEAR	
EST. COST	ELAPSED TIME	MAN YEARS	BUDGET
$	YEAR OF	PROF. TECH.	$

OBJECTIVE

To improve and standardize radiation instrumentation and measurement techniques.

PURPOSE OF WORK

RELEVANCE - JUSTIFICATION - RATIONALE

Radon, thoron and their decay products found in uranium and non-uranium mine atmospheres pose a health hazard to miners. The development of measuring techniques and reliable instrumentation to accurately determine radiation levels is of great importance and the major aim of this study.

WORK PLAN

TASKS - ACTIVITIES - DECISIONS

	MILESTONE DATES
1. To complete the development of a mine-based continuous monitoring system, with video terminal link to surface via phone line, for the measurement of radon/radon daughters/meteorological variables.	1989
2. To evaluate U/G new personal alpha-dosimeters of the active/passive type using DJ, DRAM technology, and other technologies.	1988
3. To improve radon (thoron) and radon daughter/thoron daughter monitors to be interfaced with IBM-compatible microcomputers.	1987/88

CURRENT STATUS

1. Modified radiation detectors, and considerably modified software and hardware are now being incorporated into the new continuous monitoring system prototype.
2. Laboratory tests on the final prototypes have been conducted. Instruments have been tested in underground environments.
3. Some contracts to that effect have been completed.

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Energy, Mines and Resources Canada.

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RESEARCH PROJECT

No.

TITLE

ENVIRONMENTAL RADON (THORON) DAUGHTER AND RADIOACTIVE DUST DETERMINATION.

CODE EMR 501

REF.

SCALE

TOTAL PROJECT		CURRENT YEAR	
EST. COST	ELAPSED TIME	MAN YEARS	BUDGET
$	YEAR OF	PROF. TECH.	$

OBJECTIVE

To determine radon (thoron) daughter levels in conjunction with (a) ventilation and meteorological parameters and (b) aerosol and dust load and size distribution in underground mines for different mining operations; (c) determine (identification and characterization) of radioactive dust, including long-lived radioactive dust (LLRD).

PURPOSE OF WORK

RELEVANCE - JUSTIFICATION - RATIONALE

Radon (thoron) decay products, dust and diesel particulates, in the respirable size range, and LLRD pose a health hazard to miners. Radiation and dust levels are controllable and/or dependent on ventilation conditions, meteorological variables and mining operations. Hence, an understanding of underground atmospheres can only be gained by determining the above variables simultaneously, and by investigating their inter-relationships. The final objective is to monitor the different variables of interest in a continuous fashion by means of a multisensor continuous monitoring system, and to compare radiation levels with theoretical predictions:

WORK PLAN

TASKS - ACTIVITIES - DECISIONS

	MILESTONE DATES
1. To investigate several mine radiation models and compare theoretical predictions with experimental data.	1987
2. To investigate the effect of backfill, leaching, and other mining operations on U/G radiation levels.	to
3. To conduct LLRD studies in U/G uranium mines and uranium mills.	1990

CURRENT STATUS

A considerable amount of work has already been done on the above items. Data are available in the form of technical reports and papers. Several oral presentations have also been made. Item 2 was initiated in November 1983. Items 1 and 3 are being continued.

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RESEARCH PROJECT

No.

TITLE

CONTROL STRATEGY DEVELOPMENT

CODE: EMR 502

REF.

SCALE

TOTAL PROJECT		CURRENT YEAR	
EST. COST	ELAPSED TIME	MAN YEARS	BUDGET
$	YEAR OF	PROF. TECH.	$

OBJECTIVE

To identify radon and thoron sources, and sources of long-lived radioactive dust, in Canadian mines and to control, or reduce, these sources at the workplace.

PURPOSE OF WORK — RELEVANCE - JUSTIFICATION - RATIONALE

Radon and thoron gases, through their decay products, largely determine the radiation hazards associated with alpha-radiation to uranium and non-uranium miners. It is, therefore, important to:

a) identify the sources of radiation by adequate measurement techniques, e.g. continuous monitoring, and

b) to control these sources by appropriate methods in conjunction with continuous monitoring of radiation levels (see item a) to determine the effectiveness of control techniques.

WORK PLAN — TASKS - ACTIVITIES - DECISIONS

	MILESTONE DATES
To apply radiation control methods and techniques in underground mines after testing, if possible, their feasibility under laboratory-controlled conditions.	1984 to 1990

CURRENT STATUS

A great deal of work has been done. Results have been published in technical reports, papers in Journals and presentations at international meetings.

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