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

PROGRESS DURING THE FIRST HALF OF 1987 IN THE ENVIRONMENT PROJECTS OF THE CANMET MINERALS PROGRAM

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by

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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 MSL, MRL, and the National Uranium Tailings Program Office, from the last meeting of the Joint Panel, Hull, Quebec, November 25-26, 1986, to the present. Information on past outputs can be found in the following reports: MRP/MRL 79-46(OP), MRL/MRP 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), MRL/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), and MRL 87-9(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 appear on the right hand side of the headings refer to CANMET members. Information regarding CANMET research projects is given at the end of this report.

Key words: Environment; Radioactivity.

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RÉSULTATS DES PROJETS DE RECHERCHE SUR L'ENVIRONNEMENT RÉALISÉS DANS LA PREMIÈRE MOITIÉ DE L'ANNÉE 1987, DANS LE CADRE DU PROGRAMME DE RECHERCHE SUR LES MINÉRAUX DE CANMET

par

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Le résumé des activités présentées dans ce rapport s'adresse aux membres du Comité conjoint de recherche sur les conditions environnementales et le milieu de travail des employés qui oeuvrent dans le domaine de la production d'uranium au Canada. Il vise à les renseigner sur les objectifs de chaque élément du projet principal et sur les résultats des projets visant l'amélioration de l'environnement (mines à ciel ouvert) réalisés par CANMET (EMR).

Le rapport couvre les principales réalisations du personnel technique de LSM, LRM et du Bureau du Programme national de recherche sur les résidus d'uranium, à compter de la dernière réunion du Comité mixte, qui s'est tenue à Hull (Québec), les 25 et 26 novembre 1986, à ce jour. L'information sur les réalisations antérieures est incluse dans les rapports suivants :

PRM/LRM 79-46(OP), LRM/PRM 79-96(OP), PRM/LRM 80-78(OP), PRM/LRM 80-119(OP), PRM/LRM 81-72(OP), PRM/LRM 81-136(OP), PRM/LRM 82-56(OP), PRM/LRM 82-133(OP), LRM/LRM 83-50(OP), PRM/LRM 83-102(OP), PRM/LRM 84-59(OP), PRM/LRM 84-108(OP) PRM/LRM 85-90(OP), M&ET/LRM 86-1(OP), M&ET/LRM 86-72(OP), et LRM 87-9(OP).

Les descriptions qui suivent touchent deux secteurs d'intérêt particulier pour les membres du Comité mixte :

a) Identification des sources de rayonnement. Mesure et contrôle;

b) Méthodes de traitement des résidus et contrôle des effluents.

Le numéro de l'élément de projet qui apparaît à la droite des titres fait rapport aux numéros de CANMET. L'information sur les projets de recherche de CANMET est présentée à la fin du rapport.

Mots-clé : Environnement; Radioactivité.

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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; and to develop control methods capable of reducing radiation to acceptable levels.

INSTRUMENT DEVELOPMENT AND TECHNICAL EVALUATION (EMR 500)

A laboratory and field evaluation of a radon daughter monitor using Dynamic Random Access Memory (DRAM) as a radon daughter detector has been completed. The instrument is commercially available under the name Radon Sniffer. This monitor is manufactured by Thomson and Nielssen (Ottawa), and represents the second generation of an earlier prototype developed under contract with CANMET.

A contract to CANMET was awarded by the AECB to evaluate a new radon daughter instant Working Level monitor (IWLM) developed by the CEA and known under the name Mimil. The IWLM has been tested in the laboratory and in an underground uranium mine.

A passive radon gas monitor, using diffused-junction detector technology, has been developed by alpha-NUCLEAR with the technical collaboration of CANMET. The instrument is in the prototype stage and has been evaluated in the Radon/Thoron Test Facility (RTTF) along with the Radon Sniffer and the IWLM Mimil referred to above.

NATIONAL RADON/THORON TEST FACILITY (RTTF)

A radon/thoron test facility (RTTF) to be used as the National facility for testing and calibrating radiation instrumentation used for AECB compliance purposes, and other purposes, has been designed. The RTTF has been installed

at the new CANMET/Elliot Lake Laboratory site. Full operation of this facility is expected sometime in 1987.

The RTTF will feature a wide range of operating conditions such as:

1. Radon, thoron and arbitrary mixtures of both;
2. Radon daughters, thoron daughters and arbitrary mixtures of both;
3. Variable temperature;
4. Variable relative humidity;
5. Variable aerosol type, concentration and size distribution; and
6. Variable air flow rate.
7. Capabilities have been provided for injecting long-lived radioactive dust to simulate underground uranium mine atmospheres. However, no instrumentation for this purpose has been acquired because of lack of funding.

In addition, the RTTF can be operated in a flow-through fashion or in a recirculating mode. Special provisions have been made to allow for automatic, unattended, control of the radiation level by means of a computer system, dedicated sensors, and a specially developed software package.

Although a number of modifications have yet to be introduced, the RTTF has been operating on an experimental basis since late 1986.

ENVIRONMENTAL RADIATION LEVEL DETERMINATION (EMR 501)

Because Long-Lived Radioactive Dust (LLRD), and radioactive dust (RD) in general, have become important in radiological protection and health physics, their characterization and quantification cannot be stressed adequately. CANMET has carried out numerous studies of LLRD and RD in Ontario and Saskatachewan uranium mines and mills, in collaboration with interested mining companies.

Recent studies on LLRD and RD, apart from the ones reported elsewhere,

include studies conducted in conjunction with a charged water spray system and a large exhaust fan/double filter system used to control dust and radiation in uranium mines.

Long-lived radioactive dust measurements carried out to date include concentration, size distribution, activity level, MMAD and AMAD. Identification has been carried out by means of α-spectroscopy, γ-spectroscopy and fluorometry. The above variables permit the exposure risk from this radiological hazard to be estimated. This work is, therefore, of great practical interest from the radiological protection point of view.

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 major study aimed at investigating the relationship between radon progeny Working Levels, WL(Rn), and thoron progeny Working Levels, WL(Tn), in underground uranium mines has been carried out at Rio Algom Ltd. (Quirke II, Stanleigh and Panel Mines). In general, a reasonably good correlation between WL(Tn) and WL(Rn) has been established. Hence, measurements of WL(Rn) alone could be used in principle to estimate WL(Tn). This procedure would result in considerable savings in manpower requirements and time. Knowledge of WL(Tn) is important to calculate the total health risk associated with personal exposure in uranium mines. Total radiation exposure in uranium mines is composed of the following contributions: radon progeny, thoron progeny, long-lived radioactive dust, and gamma-radiation.

The results of the above investigation have been compared with data collected since 1979, the year when a systematic study of this problem was initiated by the Elliot Lake Laboratory radiation group. Several thousand measurements of WL(Rn) and WL(Tn) have been carried out during the period 1979 to 1987.

The study on WL(Rn) and WL(Tn) indicated above has been complemented by an investigation in local underground uranium mines, of 'overall average' radon and thoron source terms determined from direct experimental measurements aided by a theoretical radiation mine model developed at the Elliot Lake Laboratory and measurement of air residence time by tracer gas (SF_6) techniques.

UNDERGROUND ENVIRONMENT CONTROL PROGRAM (EMR 502)

Radiation, respirable dust and ventilation are three research areas relevant to underground uranium mines. The Elliot Lake Laboratory has recently undertaken a series of combined studies on these areas in collaboration with the local underground uranium mines at Elliot Lake. At present the following projects are being carried out or have been completed:

1. Use of wet scrubbers, electrostatic precipitators, e.g., charged water spray, and mechanical filtration systems to reduce and control LLRD, dust, and radon (thoron) progeny levels in underground uranium mines.
2. Use of recirculation as a means of controlling radiation levels in underground uranium mines.

Great emphasis has been placed on radiation control methods and techniques and an extension of the above projects in other mines is being considered for the near future.

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. No further work on uranium tailings has been conducted by the Elliot Lake

Laboratory surface environment group other than the work reported on Joint Panel report MRP/MRL 85-90(OP).

NATIONAL URANIUM TAILINGS PROGRAM (NUTP)

The National Uranium Tailings Program has issued over the last few years a number of contracts. A status report from the NUTP was given in the last report. A final status report will be given at the next meeting of the Joint Panel.

RESEARCH PROJECT

No.

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 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.	1988
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 recently been completed. Results will be published in a forthcoming report.

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Energy, Mines and Resources Canada.

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DATE

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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 uranium 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 and other mining operations on U/G radiation levels.	to
3. To conduct LLRD studies in U/G uranium mines and uranium mills.	1988

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 uranium 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 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 uranium mines after testing, if possible, their feasibility under laboratory-controlled conditions.	1984 to 1988

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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