Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

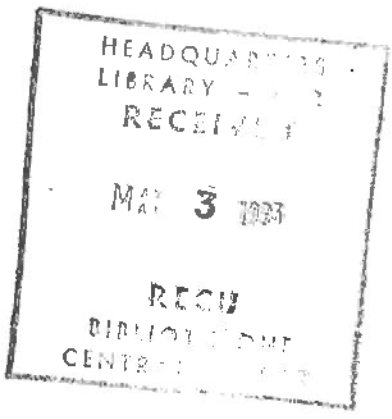
Program Evaluation Évaluation des programmes

Canada

REPORT NO.:
PE 148/1989

UPDATED PROGRAM EVALUATION COMPONENT PROFILES

March 1989



Program Evaluation Directorate
Department of Energy, Mines and Resources

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Preface

Treasury Board calls for an up-dating of departmental program evaluation component profiles to be submitted annually to the Office of the Comptroller General. The attached profiles pertain to those profiles prepared in fiscal year 1988/89. For further information on the selection of profiles and their relationship to the departmental Program-Activity Structure the following documents should be consulted:

- PE 75/1985, Current Program Evaluation Component Profiles;
- PE 96/1986, Updated Program Evaluation Component Profiles;
- PE 111/1987, Updated Program Evaluation Component Profiles; and
- PE 137/1987, Updated Program Evaluation Component Profiles.

I. BASICS OF A PROGRAM EVALUATION COMPONENT PROFILE

Part A: Background

1. Component Mandate: A statement of both the legal basis of the component and of what the component must and may do.

2. Component Objective: A statement of what impacts and effects the component is specifically designed to accomplish or contribute to.

3. Component Description: A short narrative explaining what the component involves: how it is delivered; the environment it operates in; the population served; and what it is to accomplish.

4. Relation to Estimates Program: The Estimates program or programs for which the component is funded should be identified and the relationship between the component's objective and that of the Estimates program explained.

5. Component Resources:
   (i) Fiscal Expenditures - The operating, capital and grants and contribution costs of the component as well as the authorized person-years devoted to the component.
   (ii) Capital Assets - An identification of the facilities and equipment other than office space devoted to the component.

Part B: Elements and Structure

1. Component Elements:
   (i) Activities - A list of the major work tasks and any powers or functions that characterize a given component and which are performed or administered by the component personnel.

   (ii) Outputs - A list of the goods and services which are produced or directly controlled by the component personnel and distributed outside the component organization, as well as any regulations or provisions in tax legislation produced by or monitored by component personnel.

   (iii) Expected Impacts and Effects - These are the further goods, services and regulations (if any) produced by others as a result of the program's outputs and the consequent expected chain of outcomes which occur outside the program on society or part thereof.

2. The Components Structure: A description and chart showing the linkages among the component elements; i.e. a program model.

SECTION II

PROGRAM COMPONENT PROFILES

PROGRAM EVALUATION COMPONENT PROFILE

CANADA CENTRE FOR MINERAL AND ENERGY TECHNOLOGY

(CANMET)

Program Evaluation Directorate
Energy, Mines & Resources

Source:
PE138/1988
February 1989

CHAPTER 1: BACKGROUND

The component profile provides a factual description of the program delivered by CANMET and the environment in which it is operating. It also describes the legislative basis of the program and how this has evolved over time. The program resources, its objectives, the organizational structure and the program activity structure are also described.

1.1 OVERVIEW

CANMET was established in 1907 as the Mines Branch to assist the mining and metallurgical industries in Canada. Its responsibilities as outlined in the 1988/89 Main Estimates include: conducting research and engineering development in mineral and energy technology; promoting, coordinating and supporting R&D in industry, universities and research institutes in the mineral and energy fields; identifying technological opportunities in mining, metallurgy, and energy; and transferring technology to the private sector. Mineral and energy technology, includes: mining; mineral extraction and processing; metallurgy; utilization of metals and materials; and the supply, conversion and utilization of heavy oil, oil sands, coal, uranium and other fuels, together with selected areas of energy conservation and energy fuels transportation.

CANMET operates under a project management system in its five main laboratories (and 15 sub-laboratories).

1) Mining Research Laboratories (MRL)
2) Mineral Sciences Laboratories (MSL)
3) Metals Technology Laboratories (MTL)
4) Energy Research Laboratories (ERL)
5) Coal Research Laboratories (CRL)

The laboratories carry out research in: mining technology; resource assessment; mineral processing; standards and specifications; bitumen, heavy oil and synthetic crude oil upgrading; coal preparation, combustion,

gasification and liquefaction; improvements to domestic gas heating furnaces; processing of radioactive ores; and developing steels for petro-chemical processing, oil and gas pipelines and offshore structures. Intimately associated with the quest for technological efficiency are commitments to enhance the occupational health and safety aspects of industrial workers and to minimize the negative impact of industrial activity on the environment. Some of the CANMET laboratories are located outside of the National Capital Region. A mining research laboratory is located at Elliot Lake, Ont., a coal research laboratory is situated in Sydney, N.S., and the Coal Research Laboratory is headquartered in Devon, Alberta. In addition, a small two person field unit with the Mining Research Laboratories was recently established in Sudbury, Ontario. An energy diversification research laboratory has also recently been established at Varrenes in Quebec.

The laboratories are supported by the Policy, Planning and Services Branch which assists in planning, controlling and evaluating projects, and marketing the technology developed.

CANMET research has been classified as supporting government policy development (called "policy R&D"), health, safety, environmental control, standards and regulation (collectively named "protection R&D"), and industrial productivity and economic and regional development ("productivity R&D"). The distribution is approximately: policy - 10%, protection - 30% and productivity - 60%, although the distinction between the "Three P's" is not clear cut.

About $16 million is contracted out to industry, universities and other institutions for R&D to support CANMET's programs and joint technology development and transfer programs with industry. This represents approximately 27% of the total CANMET budget. Attempts are being made to increase industry contribution to the contracted out R&D. In response to government policies CANMET is attempting to double the current annual value of cost-recovery work.

An important aspect of CANMET's work is its participation in several international technology exchange agreements such as with the International

Energy Agency and others.

The Minister's National Advisory Council to CANMET (MNACC) and its five subcommittees provide advice on the thrust of CANMET's operations.

1.2 HISTORY

Ignatieff[1] has presented a very rich and detailed history of CANMET from which the following material is taken.

The Geology and Mines Act of 1907 (assented to April 27, 1907) was the founding Act of the Mines Branch and some of its provisions are still in force. This Act described one of the functions of the Mines Branch as:

> "6(d) To make such chemical, mechanical and metallurgical investigations as are found expedient to aid the mining and metallurgical industry of Canada."

The Department of Mines and Resources Act assented to on June 23, 1936 brought the Mines Branch and the Geological Survey together in the Mines and Geology Branch.

The Department of Mines and Technical Surveys Act enacted in 1949 created the Department of Mines and Technical Surveys, with a distinct Mines Branch. The duties of the Mines Branch are interspersed throughout the Act, but in totality did not significantly change the nature of the work. For example, in the above quote the words "other researches" was added after the word "metallurgical" and the words "as are found expedient" were replaced by "as are necessary or desirable to carry out the purposes and provisions of the Act...".

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[1] Ignatieff, A, A Canadian Research Heritage. Minister of Supply and Services Canada, Ottawa, 1981.

The Government Organization Act changed the name of the department to Energy, Mines and Resources. The Act, besides other things, empowered the Minister to:

(a) conduct applied and basic research programs and investigations and economic studies in relation to such resources, and for that purpose maintain and operate research institutes, laboratories, observatories and other facilities for exploration and research related to the source, origin, properties, development or use of such resources; and

(b) study, keep under review and consider recommendations with respect to matters relating to the exploration for or the production, recovery, manufacture, processing, transmission, transportation, distribution, sale, purchase, exchange or disposition of, any such resources and matters relating to the sources thereof within or outside Canada.

The federal government has recently announced several policies which have a direct bearing on the operations of CANMET: the Science and Technology Decision Framework, InnovAction and the Technology Centres Policy. These policies are dedicated to optimizing the use of science and technology to enhance industrial productivity and economic development.

1.3 MANDATE

The role of the Government of Canada regarding minerals and metals arises principally from its broad constitutional responsibilities for management of the economy, international and interprovincial trade, and matters affecting the national interest. In addition, certain activities can be carried out more efficiently and comprehensively at the national level, e.g., in areas of research and development, establishing standards, and gathering economic and scientific information.

The legislative authority for the majority of the activities of the Minerals and Earth Sciences Program (MESP) can be found in the Department of Energy,

Mines & Resources Act and the Resources and Technical Surveys Act noted above. Under the provisions of these Acts, the Minister is responsible for: coordinating, promoting and recommending national policies concerning energy, mines, minerals and other non-renewable resources; formulating plans to conserve, develop and use these resources; and developing agreements with the provincial governments under the Economic and Regional Development Agreements Program. In addition, the Minister is authorized to establish and operate scientific laboratories, to conduct research and technical surveys related to the assessment of mineral and energy resources, to prepare and publish maps, and to conduct scientific and economic research related to the mining and metallurgical industries of Canada. Finally, the Minister is charged with ensuring the collection and publication of statistics on mineral and metal production.

1.4 THE MINERAL AND EARTH SCIENCES PROGRAM

The Mineral and Earth Sciences Program (MESP) consists of eight activities: Mineral Policy and Programs, Administration of the Canada Explosives Act, Mineral and Energy Technology, Geological Surveys, Polar Continental Shelf, Surveying and Mapping, Remote Sensing and Program Support which are delivered by four sectors: Mineral Policy; Mineral and Energy Technology: Geological Survey of Canada; and Surveys, Mapping and Remote Sensing. The four sectors report through their respective Assistant Deputy Ministers to the Associate Deputy Minister.

The Mineral and Energy Technology Sector includes CANMET, the Office of Energy Research and Development (OERD) and the Explosives Branch

MESP Objective

The objective as stated in the 1988-89 Main Estimates Part III is:

> "To ensure the timely availability of mineral policies, strategies and programs designed to maximize the contribution of the minerals

and metals sector to the Canadian economy, and to provide timely scientific knowledge, data, technologies and expertise in the earth and minerals related sciences, with emphasis on the mineral and energy resources of the Canadian landmass and offshore areas."

Minerals and Energy Technology Activity Objective

The objective as stated in the 1988-89 Main Estimates is:

"To ensure the availability to Canada of needed technology for the extraction, processing and utilization of mineral and energy resources."

This broad objective is implemented through nine sub-activities, the responsibility for each sub-activity being generally assigned to a laboratory or other organizational unit within CANMET. (See Table 3 for a list of the sub-activities and their resources.) Although there is a certain amount of overlap of sub-activities between laboratories it is small enough that the discussion below, in chapters 2 and 3 of the report, can be organized by laboratories and organizational units.

1.5 RESOURCES & EXPENDITURES

Table 1, following, gives a historical perspective on resources available to CANMET.

TABLE 1

MAIN ESTIMATES - MINERAL AND ENERGY TECHNOLOGY
(millions of dollars)

	81/82	82/83	83/84	84/85	85/86	86/87	87/88
Salaries & Wages	19.84	22.2	27.1	28.9	30.3	30.9	31.4
Other O&M	9.41	24.2	22.3	32.6	34.2	39.9	34.5
Grants & Contributions	0.19	.4	0.2	0.5	0.1	0.4	1.0
Capital	3.19	6.9	11.0	12.4	10.1	6.9	6.2
TOTAL $	32.64	53.7	60.6	74.4	74.7	78.1	73.1
Person-Years	713	759	801	797	803	787	769

Source: 1) 81/82 from A Base Review; and
2) 83/84 to 85/86 from Task Force on Program Review "Services & Subsidies to Business

Table 2, following, provides an allocation of resources by the CANMET organization structure. The source of the financial information contained in this report, unless otherwise indicated, is the 1988/89 Resource Allocations Report prepared by the Research Program Office, April 19, 1988.

TABLE 2

CANMET 1988/89 RESOURCES BY ORGANIZATION STRUCTURE

RC	Organization	PY	$
126	**OFFICE OF THE ASSISTANT DM**	5	529.3
	POLICY, PLANNING AND SERVICES BRANCH		
129	Director General's Office	2	188.0
130	Admin. & Financial Services	16	2601.0
131	Research Program Office	17	15043.7
132	Office of Technology Transfer[2]	14	1015.0
134	Technical Services Division	54	2858.0
135	Technology Information Division[2]	33	2731.0
694	**TOTAL PP&SB**	**136**	**24436.7**
	MINERAL TECHNOLOGY BRANCH		
140	Director General's Office	2	107.0
695	Mineral Sciences Labs.	189	12734.5
697	Mining Research Labs.	89	6115.5
698	Metals Technology Labs.	132	9190.0
699	**TOTAL MTB**	**412**	**28147.0**
	ENERGY TECHNOLOGY BRANCH		
155	Director General's Office	0	0
700	Coal Research Labs.	61	5915.0
701	Energy Research Labs.	165	14667.0
702	**TOTAL ETB**	**226.0**	**20582.0**
821	**TOTAL CANMET**	**779.0**	**73695.0[3]**

Table 3, following, identifies the 1988/89 resources by source of funds for each sub-activity.

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[2] Mandates and organizations modified during 1988:
a) Office of Technology Transfer now called Technology Marketing Division
b) Technology Information Division now called Library and Documentation Services Division

[3] A revised Total Funding figure for 1988/89 is $75.025 million. See Table 3 footnotes.

TABLE 3

CANMET 1988/89 RESOURCES BY PROGRAM ACTIVITY STRUCTURE AND SOURCE OF FUNDS

$(000)

		Regular Base		Energy R&D		MDA		Total	
	Sub-Activity	PY	$	PY	$	PY	$	PY	$
1400	Mining	70	5002	1	250	1	1417.5	72	6669.5
2000	Coal Mining & Preparation	49	3630	9	3145			58	6775.0
3000	Mineral Processing	176	11927	5	1291	4	932.5	185	14150.5[4]
5000	Fuels Technology	97	5427	76	16750			173	22177.0
7000	Metals and Materials	123	7995	11	2258			134	10253.0
8000	Technology Information Service	33	1857	0	1014			33	2871.0
8500	Technical Services Division	54	2260	0	598			54	2858.0
9000	Management & Support	50	3753	4	2146	2	73.0	56	5972.0
1100	Explosives Testing & Research	14	847					14	847.0[5]
	Total - All Funding	666	42698	106	27452	7	2423.0	779	72573.0
	Grants & Contributions		68		1054				1122.0
	CANMET TOTAL FUNDING		42766		28506				$73695.0[6]

[4] A further allocation of $330,000 from the Biotechnology Fund to the Mineral Processing sub-activity was made during the fiscal year.

[5] Sub-Activity 1100 Explosives Testing & Research is not part of this Assessment.

[6] Also, a Capital Pool of $1 million is not included in the Total based on April 19, 1985 numbers. Therefore, a revised Total Funding figure for 1988/89 is $75.025 million.

There are two main sources of funding for CANMET activities: the **A-Base** funds which are approved by Parliament on a yearly basis and described in the Main Estimates; and the funds obtained from the **Inter-Departmental Panel on Energy Research and Development.** The Panel funds provide support for salaries, operating costs, contract funds as well as for capital costs.

Table 4, following, identifies resources by sub-activity for each of the five main CANMET laboratories.

1.6 ORGANIZATION

An organization chart for CANMET is given in Figure I, following. CANMET is headed by an Assistant Deputy Minister (ADM), who has three Director Generals (DG) each with specific responsibilities as follows:

(i) DG, Policy, Planning and Services who is responsible for:
- Administrative and Financial Services;
- Technical Services Division;
- Library and Documentation Services Division;
- Technology Marketing Division; and
- Research Program Office.

(ii) DG, Minerals Technology who is responsible for:
- Metals Technology Laboratories;
- Mining Research Laboratories; and
- Mineral Sciences Laboratories.

(iii) DG, Energy Technology who is responsible for:
- Energy Research Laboratories; and
- Coal Research Laboratories.

Each laboratory is headed by a director, and the sub-laboratories are headed by laboratory managers. The sub-laboratories are further divided into sections with section managers in charge.

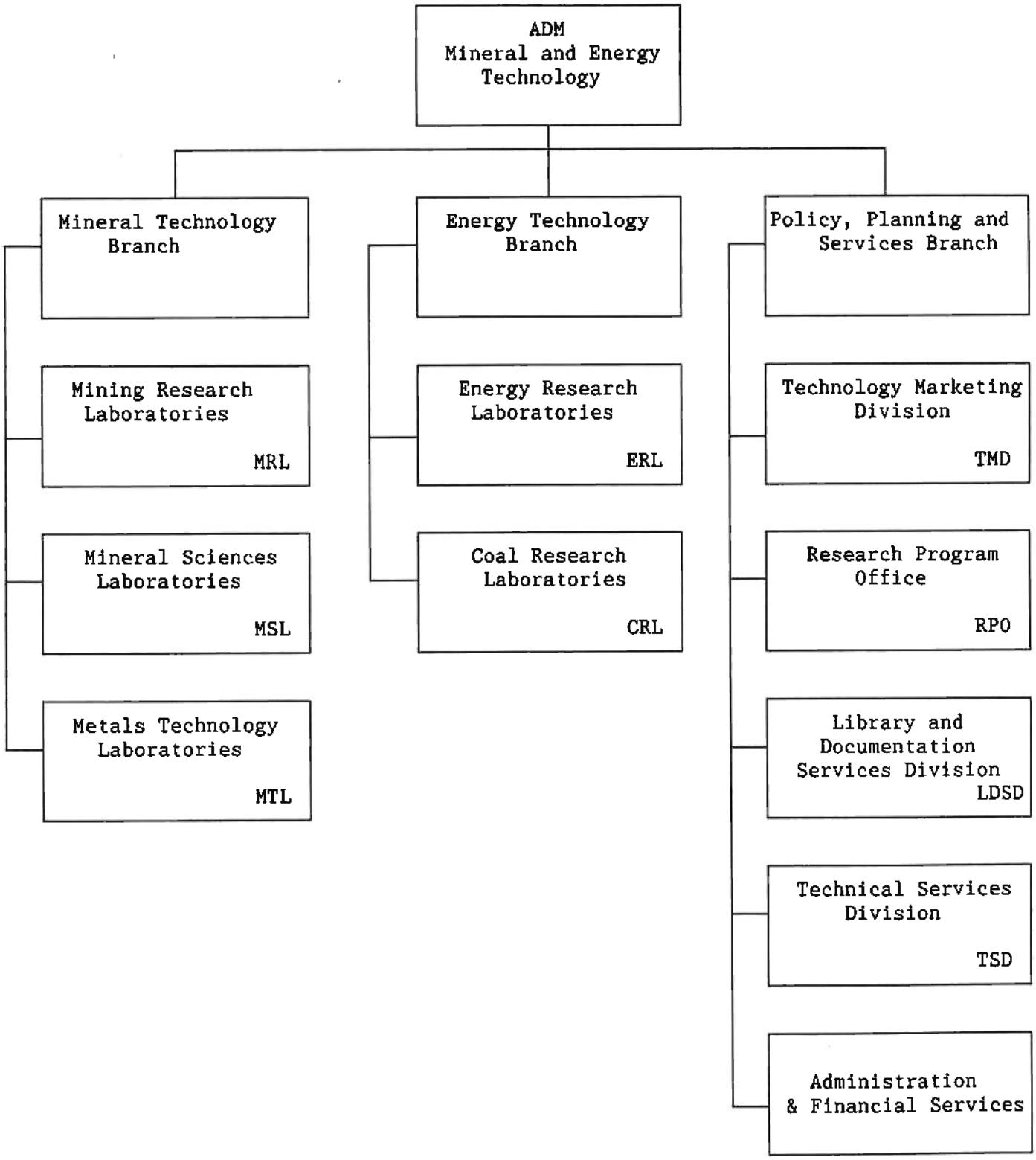
TABLE 4

CANMET 1988/89 RESOURCES

BY SUB-ACTIVITY AND LABORATORIES

	Mineral Technology Branch						Energy Technology Branch					
	Mineral Sciences		Mining Research		Metals Tech.		Coal		Energy Research		Totals	
Sub-Activity	**PY**	**$**	**PY**	**$**	**PY**	**$**	**PY**	**$**	**PY**	**$**	**PY**	**$**
1400 Mining			72	5094.5							72	5,094.5
2000 Coal Mining & Preparation	3	485					55	5072			58	5,557
3000 Mineral Processing	182	11954.5	3	174							185	12,128.5
5000 Fuels Technology	2	187					6	843	165	14667	173	15,697
7000 Metals & Materials	2	108			132	9190					134	9,298
1100 Explosives			14	847							14	847
Total	189	12734.5	89	6115.5	132	9190	61	5915	165	14667	636	48,622

Figure I
CANMET ORGANIZATIONAL STRUCTURE



1.7 PROGRAM PLANNING

This section gives a brief overview of the planning process in use at CANMET and the influences on the planning process. It also looks at the management calendar and the various documents produced during the process.

The formulation of the CANMET R&D program is carried out by CANMET with formal advice from the **Minister's National Advisory Council to CANMET** (MNACC) and the **Inter-Departmental Panel on Energy Research and Development** (PERD).

Program planning is a continuous process with the sub-sub-activity leaders taking the lead role in developing new projects based on the initiatives of CANMET scientists, MNACC recommendations and suggestions of the PERD Committees.

Minister's National Advisory Council to CANMET (MNACC)

The purpose of MNACC, which was formed in 1987, is to advise the Minister on:

- programs and research work at CANMET;
- managerial performance of CANMET;
- coordination of federal research programs with others; and
- R & D policy and trends.

The structure of MNACC consists of the Main Committee and six Subcommittees:

(i) Mining;
(ii) Coal;
(iii) Mineral Processing;
(iv) Oil and Gas;
(v) Metals and Materials; and
(vi) Business.

Staff from the Research Program Office provide secretarial services to all of the MNACC committees.

MNACC is the successor to the National Advisory Committee on Mining and Metallurgical Research (NACMMR), which had been established in 1968 by order-in-council.

Inter-Departmental Panel on Energy Research and Development (PERD)

The Office of Energy Research and Development (OERD), located within EMR, acts as the secretariat to PERD. Periodically, PERD submits its R&D program to the Cabinet for approval. Funds are provided on a yearly basis to PERD on the basis of the approved program.

For 1988/89 CANMET was allocated about $28.5 million of program funding from the Panel on Energy Research and Development. This constitutes almost 39% of its total budget. The Panel's work in relation to CANMET is organized around research areas/programs as given below:

Program 2.1 Oil Sands/Heavy Oil
Program 2.2 Coal Supply
Program 2.3 Coal Combustion
Program 5.1 Direct Liquefaction
Program 5.4 Gasification
Program 6.5 Materials for Offshore Structures

Federal/Provincial Mineral Development Agreements (MDAs)

The current agreements in place with nine provinces and two territories came into effect in 1984/85. Most agreements are for a five year period. Although CANMET provides scientific and technical expertise to all, its direct responsibility is for agreements with Newfoundland, Nova Scotia, New Brunswick, Ontario, Manitoba and Saskatchewan. For 1988/89, the MDAs provide funding of almost $2.5 million to the mining and mineral processing sub-activities.

1.7.1 PLANNING CYCLE

Division Directors are expected to conduct quarterly meetings to review project progress, and to provide the RPO with one to two page reports on significant variances. **CANMET Progress Reports** provide for the milestones and progress in terms of per cent completion for each project.

Program reviews are carried out on a quarterly basis. The semi-annual and annual review meetings are chaired by the ADM. A **Report On Variances** is prepared for each technology area by project, outlining the progress in meeting the milestones and providing highlights of significant achievements.

Attendance at the meetings is limited to: Directors General, Division Directors, the Assistant Program Directors from the RPO and specialists, as required. For the quarterly meetings, **Controlled Goals Reports** are also provided by the Division Directors, and these relate to the achievement of Controlled Goal Milestones listed in the annexes of the **Activity Approval Documents.**

The Long Term Plan is a five year plan compiled by RPO staff, towards the end of the fiscal year, from documentation provided by the divisions. It is organized by sub-sub-activities and projects for which it provides the objectives, description, outputs and resources.

Several reports are produced during the process:

- Project Authorization Sheets;
- Activity Approval Document;
- CANMET Progress Report;
- Mid-year variances;
- ADM mid-year review;
- SSA Fact Sheet;
- Long Term Plans; and
- PERD proposal submission.

Project Authorization Sheets are one page documents which provide the project code, title, SSA leader, objective, milestones, and resources for each project.

The **Long Term Plan** and the comments on it offered by the Minister's National Advisory Council to CANMET are considered by the PERD Program Committees set up for each task. The PERD Committees are chaired by RPO staff or other EMR personnel from the policy areas, and members are drawn from various departments. The Committees provide advice and guidance on proposed projects and the funding levels. These Committee deliberations are useful to the PERD in requesting funding from the Treasury Board, and are required to be considered by CANMET in deciding on the R&D program to be pursued.

The Inter-Departmental Panel on Energy R&D

The committees of the Panel meet as required to outline the research areas that they will support under each of the tasks. Meetings are also held with CANMET staff to review project progress and suggestions for new projects.

Minister's National Advisory Council to CANMET (MNACC)

At a meeting in May, the Main Committee is given an overview of the environment in which CANMET must operate, government policies affecting research, the business climate and the general economic situation. The six subcommittees meet during the following two months to review the current CANMET research programs and plans. Each subcommittee produces a critique and a set of recommendations for the chairman to carry to the Main Committee at a meeting in October. At the Fall meeting, CANMET responds to the recommendations of the MNACC committees describing how it has revised its plans or why revisions would be inappropriate.

CANMET's Business Plan

The October meeting results in an approved version of the CANMET Business Plan which sets the objectives for the fiscal year beginning the following April. The Business Plan includes three-year strategic performance targets and administrative actions to respond to government policies.

During the winter months, the research program for the next fiscal year is developed in more detail by the RPO and the Laboratories in response to the approved version of the Business Plan.

CHAPTER 2: POLICY, PLANNING & SERVICES (PP&S) BRANCH

2.1 INTRODUCTION

The PP&S Branch does not have an overall objective statement. Rather, each of the four main divisions have their own objectives. These are noted in the narrative below.

The PP&S provides a central service and support for all of CANMET as well as providing services to those outside of the Centre. It is comprised of a Technical Services Division, a Library and Documentation Services Division, a Research Program Office and a Technology Marketing Division. An Administrative Services Division is also included, although this latter organization has not been included in this evaluation assessment. Resources for PP&SB as of April 1988 are provided in the following table.

TABLE 5
PP&S RESOURCES (PY+$000)
1988/89

	PY	Salary	Operating	Capital	Contract	Total
Source of Funds						
Regular Base	130	5179	2081	93	1346	8699
Energy R&D	4	200	2879	236	9284	12599
MDAs					2063	2136
Energy R&D Contributions	2	73			1003	1003
TOTAL	136	5452	4960	329	13696	24437
Allocation of Funds						
Office of D.G.	2	96	89	3		188
Tech. Services	54	1890	875	93		2858
Tech. Infor.	33	1281	1390	60		2731
RPO	17	806	394	148	13696	15044
OTT	14	678	322	15		1015
Admin & Fin.	16	701	1890	10		2601
TOTAL	136	5452	4960	329	13696	24437

Source: Research Program Office, as of April 19, 1988. (The significant organizational changes at PPSB since April 19, 1988 are reflected in new budgets for the various Divisions which are noted in the following PPSB unit profiles).

2.2 TECHNICAL SERVICES DIVISION (TSD)

2.2.1 TSD OBJECTIVES

The Technical Services sub-sub activity is centred in CANMET's Technical Services Division. The objectives of the Division, as noted in CANMET's Business Plan 1988-1991, are[7]:

> "To provide effective engineering, technical and operational services in support of CANMET research and development projects as well as supporting similar endeavours in other EMR sectors".

Mission Statement

A mission statement for the TSD was approved by the ADM (S&T) in August of 1983, in response to an audit recommendation that such a statement be adopted. This mission statement is as follows:

> "The Technical Services Division provides engineering, technical and operational services to support the research programs and projects of CANMET as well as supporting similar endeavours in other EMR scientific research branches. The planning, design and execution of industrial, mechanical, manufacturing and fabrication, electrical, electronic instrumentation and control systems is available solely to research and development, and does not apply to related infrastructure such as buildings and services under the mandate of Public Works Canada. The Technical Services Division is accountable for the safety, reliability and cost effectiveness of its services and is subject to the federal or provincial safety and/or installation codes applicable."

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[7] The objective for TSD included in the long term plan for CANMET (Long Term Plan 1987-1992) is essentially the same.

2.2.2 TSD DESCRIPTION AND OUTPUTS

There are three major activities that TSD is engaged in as follows:

i) administration;
ii) resource control; and
iii) production.

Although the current organization is not categorized according to these three main groupings, they represent the major work activities and as such provide a helpful means of describing the Division. The outputs of the various activities are those associated with the specific work carried out. These outputs are comprised of services as well as physical products designed and manufactured for users. The following narrative summarizes the services provided to CANMET researchers and others.

2.2.2.1 Administration

The administration activity is comprised of a small administration unit, including financial transactions input, as well as personnel involved in nontechnical support functions, i.e. transportation and trades support, and stores and procurement.

1. Administrative Support
   (not included in assessment)

2. Transport and Trades Support
   This section provides the pick up and delivery of CANMET mail and supplies as well as the transportation of equipment and machinery. The moving and placement of heavy machinery and machine tools and the loading and unloading of tractor trailer units is also carried out. Equipment employed in the above includes vans to 10 ton trucks as well as fork lifts, pay loaders, etc. This section also moves office and laboratory furniture and equipment and provides trades support

such as floor sweeping, cleaning and changing oil in the industrial machines.

3. Stores and Procurement

This activity involves the control, issue, and upkeep of technical supplies for CANMET (excluding chemicals and electronic components), the purchase of stock items, shipping, receiving and documentation, and the loan of passenger and general transport vehicles (eleven) to CANMET personnel."

2.2.2.2 Resources Control

The resource control activities are comprised of: work and resources planning and control; methods analysis and estimation; facilities services and liaison; and engineering design and graphics.

1. Work and Resources Planning and Control

This activity involves internal TSD cost accounting and expenditure control, and the Divisions management information system. The activity provides reports for accountability and statistics. Specific information produced includes: labour charges, work project costs, and on line information on the status of stocked items. Reports produced include an inventory catalogue listing, TSD annual report and a vehicle summary report.

2. Methods Analysis and Estimations

This activity involves analyzing work orders and providing estimates. Specifically, incoming work orders are reviewed in terms of the time and resource commitments required, and, in consultation with the client, the best method to complete the work is agreed upon. Tradesmen are consulted and the cost and availability of equipment suppliers and material is established.

3. Facilities Services and Liaison

This activity provides a liaison function as well as conducting coordination and inspection activities. Specifically, the staff: acts as liaison between CANMET divisions, the Property, Planning and Management Division of EMR, and Public Works Canada; coordinates and inspects activities related to the upkeep of buildings, services and facilities for technical, operational and safety requirements, e.g. air conditioning, ventilation, fume exhaust, water supply, gas, etc.; reviews special, non-routine work requests; analyzes the feasibility and justification of requests, estimates incoming requisitions in terms of technical requirements, costs, time, etc.; and monitors work performance to ensure contract requirements are being adhered to.

4. Engineering Design and Graphics

This activity involves the provision of technical drawings and sketches,print ready art and graphics. Specifically, the activity uses a Computer Aided Design system (CAD system) as well as mechanical drawings to produce electrical schematics and wiring diagrams, graphs of experimental results to use in reports, working drawings of prototypes, etc. Final drawings must be readily interpretable. Advise on presentation format and possible changes in design details are given to users.

2.2.2.3 Production

1. Vehicle Maintenance

This activity involves the repair and preventative maintenance of all EMR vehicles and the modification of special purpose vehicles. Over 200 vehicles of various types are maintained, e.g. cars, pick-up's, 4X4 vans, trucks, fork lifts, payloaders, etc. Vehicles are fuelled by diesel, gasoline or liquid propane. Garage facilities include a computerized analysis station, hoists, etc. Modifications include adapting motors for better efficiency or different requirements, adaption of survey vehicles and rebuilding of truck boxes to hold fuel tanks, etc.

2. Carpentry

This activity involves cabinet making, pattern making, painting and finishing, furniture modification and repair and construction carpentry. Specific services provided include the custom building of carpentry items that cannot be bought such as fume hood enclosures, display cabinets and shelving, special storage racks, etc.

This section also provides patterns for the vacuum forming and sand casting of unique manufactured items, e.g. protective plates for machines. A brush and spray painting facility is provided, e.g. for the painting of electrical boxes. Lastly, modifications and repairs to salvageable furniture are made.

3. Electrical/Electronics Instrumentation

This activity involves the servicing and maintenance of electrical/electronic equipment; the installation of such equipment; engineering design and fabrication and the retrofit of existing equipment. Examples of specific services offered have included the following: the installation and retrofit of power distribution systems in laboratory and pilot-plant equipment; electronic control and monitoring systems for processes and equipment; control equipment for heat treating extensions in the CANMET foundry; correction of electrical defects; computerized trigger mechanisms to open the valve of a hydrogen gas detector, etc. Adherence to the Canadian Electrical Code and to Ontario Hydro inspection standards are maintained.

4. Industrial Mechanical, Plant Engineering and Sheet Metal

This activity involves the provision of welding, fabrication and sheet metal services. The planning and set-up of mills and their machinery is carried out, as is the installation of refrigeration and compressed air systems. Examples of specific services offered include: plant engineering associated with pilot plant and laboratory structures; welding of non-ferrous metals; installation of custom sheet metal items such as fume hoods and special counters; manufacturing of parts for various equipment, (e.g. pumps, milling machines), hydraulic installation and repair, etc.

5. Prototype Development and Design

This unit is involved in the design and manufacture of prototypes. In conjunction with research scientist services provided are: the provision of scientific apparatus and research equipment designs that cannot be purchased on the commercial market; the manufacturing, assembly, installation, subsequent testing and debugging of prototypes; and the provision of solutions to technical problems. Examples include a trigger mechanism for a drop weight testing machine and a measurement tool for the tire prints of earth movers in tar sands.

6. Manufacturing

This activity involves tool making and manufacturing as well as quality assurance work. Examples of specific services provided include: the manufacture of metallurgical test specimens, e.g. corrosion test specimens fabricated for large pipes; machining and fitting of custom moulds, punch and die sets; quality control done to ensure adherence to specifications, e.g. optical compactor, surface compactor, toolmakers microscope, etc.

7. Priority Setting and Work Distribution

There are essentially three major ways by which technical and engineering services can be obtained by CANMET laboratories. The laboratories pay for, and supervise, their own contracts; they can pay for the work but obtain TSD assistance to supervise the contract, or they may ask TSD to perform the work, in which case TSD incurs the cost. Regarding the first two of these methods, TSD does not obtain or retain a record of the expenditure made. (In this regard it should be noted that CANMET laboratories obtain such technical services outside of CANMET for various reasons). Currently, TSD's workload is such that approximately 60,000 hours are being performed in-house and about 6,000 hours are contracted out.

The priority setting for TSD services used to be on a first-come, first-served basis. The current procedure is such that every three months the CANMET divisions are asked to identify those upcoming projects consisting of 100 hours of work or more. Within each division there is a

coordinator who establishes the priorities of the divisions along with the division's director. Within TSD an estimate of the time required for each project and the likely target date for completion are identified. This task is handled by the responsible individual in each of the TSD service areas, e.g. electrical, mechanical, carpentry, etc. Finally, where there are requirements which cannot be reached by the TSD service disciplines, given the divisions priorities and the work time required, the division coordinators involved are contacted and asked to make compromises.

The TSD "Work Order" is the primary vehicle by which divisions communicate the initiation of a request for TSD services.

2.2.3 TSD RESOURCES

The resource allocations for the TSD in 1988/89 are as follows:

TABLE 6
TSD RESOURCES (PY & $000)
1988/89

	PY	Salary	Operating	Capital	Total
Regular Funds	54	1890	350	20	2260
Energy R&D	—	—	525	73	598
TOTAL	54	1890	875	93	2858

2.3 LIBRARY AND DOCUMENTATION SERVICES DIVISION (LDSD)

2.3.1 COMPONENT OBJECTIVES

The technology information services sub-activity is centered in CANMET's Library and Documentation Services Division. The objectives of the Division, as noted in CANMET's Business Plan 1988-1991 (as amended October 1988), are:

1. to plan, establish and maintain research library collections and services capable of meeting CANMET research information requirements; and

2. to facilitate improved access by Canadians to scientific and technical information in mineral and energy technology, through a combination of technical literature documentation, and technical publications dissemination services.

2.3.2 COMPONENT DESCRIPTION

The LDSD carries out three major functions. They are: (1) provision of library services, (2) technical literature documentation and (3) sales and distribution of CANMET publications. The principal client group of the LDSD is CANMET's research staff. The external client group includes engineering, technical and management personnel in the mining, processing, metallurgical and energy industries, in technology-based government departments and agencies, as well as researchers in universities.

2.3.3 COMPONENT RESOURCES

In 1988/89 the resource allocation for LDSD is as follows:

TABLE 7

	PY	SALARY	OPERATING	CAPITAL	CONTRACT	TOTAL
Regular Funds	19.0	789.0	305.0	20.0	0.0	1114.0
Energy R&D	0.0	0.0	680.0	105.0	140.0	925.0
TOTAL	19.0	789.0	985.0	125.0	140.0	2039.0

Source: CANMET Resource Allocations 1988/89 (as amended December 1988).

2.3.4 ACTIVITIES

As noted earlier, the LDSD carries out three major activities: (1) library services, (2) technical literature documentation and (3) sale and distribution of CANMET publications.

A. Library Services, includes:

The objectives of the Library Services sub-sub activity are:

1) To ensure the availability of library materials and services required to support research and development activities of CANMET staff; and

2) To serve as a node in the national science-technology information dissemination network, by providing public access to rarely held specialized publications in mineral and energy technology.

The CANMET Library was established in 1913 and currently contains CANADA's largest single collection of literature on mining, metallurgy and mineral processing. Total holdings are: 45,000 books, 110,000 volumes of serials, 25,000 reports and translations and several thousand reports on microfiche. Approximately 2,000 journals are acquired by paid subscriptions annually, in addition to 200 through exchange and mailing lists.

The Main CANMET library is in Ottawa which serves CANMET scientists in the NCR as well as research facilities in Elliot Lake, Ontario, Sydney, N.S. and in Devon, Alberta. A library reading room is also located at the Bells Corner Complex. Small library collections are also maintained at all out-of-town locations.

The Main Library is divided into two basic sections: technical services, which focuses on building and maintaining the collection, and public services which exists to assist the user.

Selection of materials for purchase is a joint responsibility between LDSD and CANMET laboratory staff. The costs of purchases are normally assumed by LDSD, although for expensive items the requesting division may be asked to contribute. A list of new acquisitions is distributed monthly.

The Library also provides multi-lingual translation, inter-library lending/borrowing, and general reference services, as well as an

automatic serial circulation service. (50,000 individual journal issues are circulated to CANMET staff each year).

B. Technical Literature Documentation, includes:

(a) Monitoring world literature to identify, select, index and abstract suitable documents for inclusion in machine-readable data bases in mining technology and mineral processing:

(b) Monitoring Canadian literature to identify, select, index and abstract suitable documents for inclusion in machine-readable data bases in coal technology and energy technology.

The objective of the Technical Literature Documentation sub-sub activity is:

To facilitate computer-assisted access to the periodical and report literature of mining, mineral processing, and energy technology in Canada, and other disciplines as may be required, to CANMET staff and external clients from industry, government and academic institutions.

Data Bases

Data bases developed by LDSD include MINTEC (mining technology) and MINPROC (mineral processing). These data bases are publicly accessible through QL Systems Ltd., via the DATAPAC telecommunications network. MINTEC was established in 1967 and currently contains 35,000 records. Subjects of direct relevance to mining technology are included in MINTEC. In 1978, MINPROC was established; it now contains 15,000 records on subjects of direct relevance to mineral processing. Any organization in CANADA or the world can access these data bases if they use a valid QL Systems Ltd., password. LDSD staff will conduct computer searches for a fee of $26.00 per search. For an additional fee, the actual documents are also available from LDSD.

CANPUB is a data base of CANMET publications reaching back to the organizations' beginnings. It contains approximately 10,000 records of reports authored by CANMET personnel and contractors. At present, CANPUB is used primarily for document identification by CANMET staff; it is not directly accessible to the public.

Other data bases to which LDSD provides Canadian input are: (1) IEA/COAL PRO, a computer-based international inventory of current or recent research projects in coal science and technology as reported by governments, universities, industries and research establishments of most coal producing countries. The data base is compiled by IEA Coal Research in the U.K.; (2) IEA/COAL is a computerized version of Coal Abstracts, also compiled by IEA Coal Research from input by member country operating agents. It contains references to books, journals, reports, dissertations and conference proceedings on coal science and technology as supplied by member countries. The IEA COAL Data Base is also accessible to Canadians through the facilities of CISTI/CAN-OLE.

The Energy Technology Data Base IEA/ETDB is a multinational data base that contains energy technology literature from twelve countries, including Canada. Canada, along with other countries, submits data on magnetic tape monthly to the Office of Scientific and Technical Information in Oak Ridge, Tennessee, U.S.A. A master tape is produced and provided to each participant. In Canada, the ETDB is managed by LDSD. Canadians can access the ETDB on-line through Dialog Information Services, Mead Data Central or STN International.

LDSD staff also provide assistance to CANMET staff and external clients in obtaining the CAN/SDI service for current awareness of new technical literature, coordinated by the Canada Institute for Scientific and Technical Information (CISTI). In addition, specialized bibliographies on all manner of technical subjects are provided through access to various external data bases.

C. Sale and Distribution of Publication

Major CANMET publications, i.e. those in the CANMET REPORTS and the SPECIAL PUBLICATIONS series, are sold by the Division's Publications Sales and Distribution Office through a consignment arrangement with the Canadian Government Printing Centre (DSS).

Contract reports represent the results of research and development work sponsored by CANMET but performed by external contractors. Copies of these reports are available on demand in paper or microfiche format, from LDSD at the cost of reproduction.

Unpublished divisional reports, and copies of documents related to the CANMET databases are also made available to clients on the same basis.

LDSD produces and distributes, OPEN FILE REPORTS, a bimonthly announcement bulletin, to a wide cross section of the industrial and research community to keep them abreast of new publications. Additional promotion of CANMET research reports is also done through displays at conferences, workshops, seminars, as well as through informational advertising in scientific technical/journals.

2.4 TECHNOLOGY MARKETING DIVISION (TMD)

2.4.1 TMD OBJECTIVES

The objectives of TMD are:

To facilitate, foster, encourage and monitor mechanisms to aid and accelerate the technology transfer process whereby R&D results are fully utilized by all CANMET clients, including the private sector, the public, agencies, departments and universities.

To provide a centralized service for major and corporate publications and marketing activities that is more efficient and cost effective than having separate individual fully developed services within each of the operating divisions.

To develop and implement a program to raise the level of awareness of CANMET among its clients through publications, press releases, promotional material, conferences and other means, and to develop a corporate identity within CANMET.

To gather, record, analyze, and report information on CANMET activities relevant to technology transfer, particularly CANMET-client relations, as required by senior management.

2.4.2 TMD DESCRIPTION

The TMD is located in CANMET headquarters in Ottawa. It is comprised of three main groups dealing with:

1. Patents, Licenses and Technology Transfer,
2. Publications and Marketing, and
3. Industrial Liaison (new).

2.4.3 TMD RESOURCES

TABLE 8
TMD RESOURCES (PY & $000)
1988/89

PY'S	SALARIES	OPERATING	CAPITAL	TOTAL
27	1065	757	25	1847

TABLE 9
TMD PY RESOURCES BY GROUP
1988/89

	PY
1. Patents, Licensing and Technology Transfer	8
2. Publications and Marketing	13
3. Industrial Liaison (new)	4
4. Director and Secretary	2
TOTAL	27

2.4.4 TMD ACTIVITIES

The recent re-organization at PPSB and the creation of TMD was influenced by the new Technology Centres Policy which emphasises a fostering of stronger relationships with the private sector. This goal is to be advanced by conducting activities which improve the services provided to the operating divisions at CANMET, e.g. providing seminars to division staff on specific topics such as intellectual property management, while also providing services to divisional clients in the private sector.

The major activities of TMD include the following:

1. Patents, Licensing and Technology Transfer

Provision of technology transfer services e.g. intellectual property management; provision of assistance to the private sector to access technology and expertise in CANMET and from other public and private sources, and to access government programs; facilitation of intellectual property agreements with the private sector and the tracking of such agreements and related references, e.g. licences, patents, disclosures, etc.

2. Publications and Marketing

The editing and publication activities include: text processing and editing of major reports, preparation of camera - ready copy and printing of major reports, printing of divisional reports and other unpublished documents, and official language translation.

Marketing, a newly created function at CANMET, includes: the preparation of a marketing and communications plan for CANMET senior management, the coordination of promotional activities e.g. brochures, feature articles, conferences and exhibits, with Communications EMR and laboratory Business Development Offices, and provide marketing advice to the divisions and the setting of promotional guidelines.

3. Industrial Liaison

The industrial liaison group will be developing a comprehensive client data base including: information on CANMET contacts with firms, on-going joint projects and the challenges facing firms. Information packages and promotional material will also be distributed to clients. The client profile data base is expected to be completed by the end of 1989-90, although divisions will be able to access available information sooner.

Outputs

The major outputs of the various activities are as follows:

a) Provision of technology transfer services including: transfer strategies, client search and selection, feasibility studies, market studies, state-of-the art studies, and the provision of information concerning access to government programs.

b) Development of promotional publication includes: press releases, dissemination of literature on CANMET activities and technology transfer efforts.

c) Assistance to the private sector to access technology including access to NRC's IRAP program.

d) Training seminars and guidelines to upgrade technology transfer and presentation skills.

e) A manual covering guidelines and procedures on handling intellectual property including standard agreements for negotiating intellectual property for cost recovery and joint projects.

f) Project management for CANMET sponsored projects under IRAP.

g) Information from the client profile data base.

2.5 RESEARCH PROGRAM OFFICE (RPO)

2.5.1 RPO OBJECTIVES

The RPO has four objectives as follows:

i) To coordinate the planning, monitoring and evaluation of CANMET's R&D activities consistent with the Department's energy and minerals policies, the federal government's S&T policies and the technology needs of the private sector and to allocate the required resources to each of CANMET's Divisions to achieve specified technology-related and administrative goals.

ii) To provide centralized administration of contracts by acting as a link between the operating R&D Divisions and Supply and Services

Canada and to ensure the optimum use of contract funds to meet technology-related goals and financial targets.

iii) To provide centralized management and control of the CANMET Management Information System through cooperation with CANMET Divisions and the Financial Management Branch.

iv) To serve as Secretariat to Minister's National Advisory Council to CANMET (MNACC) and its Program and Business Subcommittees and to increase the effectiveness of this industry advisory mechanism by increased and more effective liaison between MNACC and CANMET.

2.5.2 RPO DESCRIPTION

Organizationally, the RPO is divided into three primary groups dedicated to:

i) coordination of program planning, monitoring and evaluation;
ii) contract administration; and
iii) operation and control of the CANMET Management Information System.

Research scientists are seconded from the laboratories to perform the program coordination function.

2.5.3 RPO RESOURCES

The resource allocations for the RPO in 1988/89 are as follows:

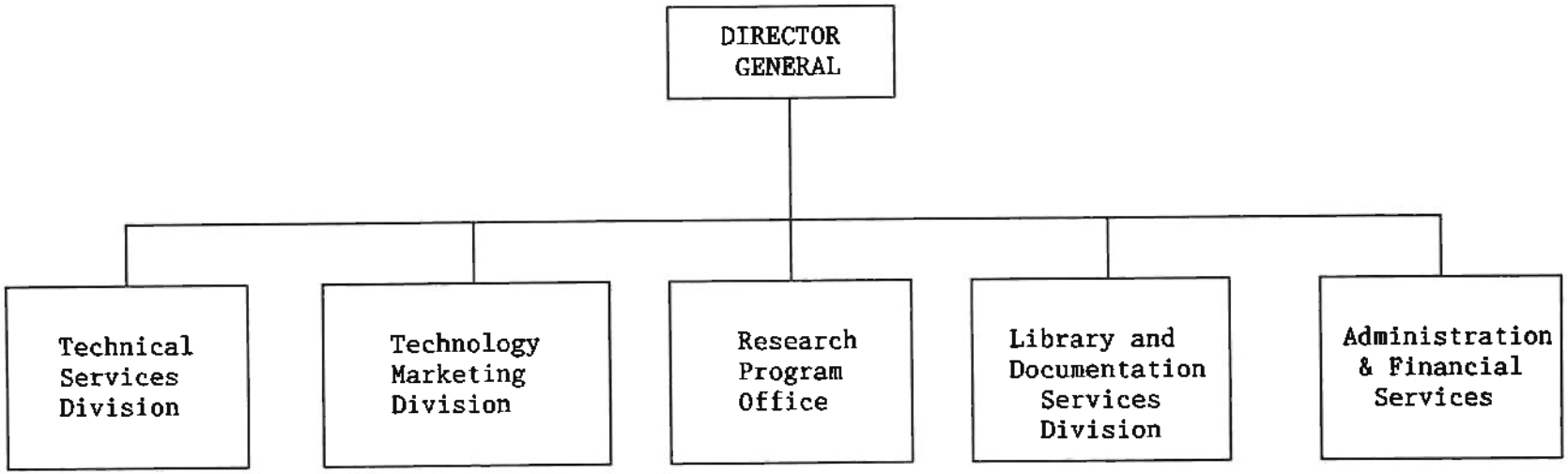
TABLE 10
RPO RESOURCES (PY & $000)
1988/89

	PY	Salary	Operating	Capital	Contract/ Contrbt'n	Total
Source of Funds						
Regular funds	11	533	85	40	1346	2004
Energy R&D	4	200	309	108	9284	9901
MDAs	2	73		2063	2136	
Energy R&D Contribt'ns	—	—	—	—	1003	1003
Total	**17**	**806**	**394**	**2211**	**13696**	**15044**

2.5.4 RPO Activities

The RPO assembles a CANMET Long Term Plan and Branch Plan which includes in-house and contracted out projects. The progress of R&D projects is reviewed. The budgetary and personnel resource allocations for each CANMET sub-sub-activity are established consistent with the Long Term and Branch Plans. The contract budget for CANMET R&D is administered and liaison with Supply and Services Canada maintained. The Office also provides centralized coordination and control of the Branches' management information system through co-operation with the Divisions and EMR's Financial Management Branch. Lastly, the RPO acts as secretariat to MNACC. The Director of the RPO acts as secretary to the Main Committee and the Assistant Program Directors within RPO act as secretaries to the MNACC technical subcommittees.

Figure II
CANMET - POLICY, PLANNING AND SERVICES BRANCH



*Policy, Planning and Services Branch has been extensively re-organized with the Technology Marketing Division and the Library and Documentation Services Division being newly created.

CHAPTER 3: THE LABORATORIES

This chapter deals with each of the five main CANMET laboratories separately. Each section covers the objectives, description, organization, resources and program structure of a main laboratory. The work within each laboratory is described by the sub-sub-activities. However, some of the sub-sub-activities do cut across the laboratories, that is the work under a sub-sub-activity is performed in more than one laboratory. In these instances the work of the sub-sub-activities is described under the laboratory which is primarily responsible for the sub-activity, as shown in the following table. In those cases where the secondary laboratory performs the bulk of the work for the sub-sub-activity the description appears under both the primary and secondary laboratory.

Sub-Activity	Primary Laboratory	Secondary Laboratory
1400 Mining	Mining Research	
2000 Coal Mining & Preparation	Coal Research	Mineral Sciences
3000 Mineral Processing	Mineral Sciences	Mining Research
5000 Fuels Technology	Energy Research	Coal and Mineral Sciences
7000 Metals and Materials	Metals Technology	Mineral Sciences
1100 Explosives	Mining Research	

The following table indicates the sub-sub-activities which in 1988/89 cut across the laboratories and the resources allocated to the secondary laboratories for these sub-sub-activities.

			SECONDARY LABORATORY		
PRIMARY LABORATORY	SUB-SUB-ACTIVITY		Coal Research	Mineral Science	Mining Research
Coal Research	2079	Coal Desulphurization		485	
Mineral Sciences	3086	Environmental Controls			174
Energy Research	5003	Tment Bitu/Oil Emuls & Effl Water	843		
Energy Research	5051	Metallurgical Fuels	0		
Energy Research	5062	Fluidized Bed Combustion		187	
Metals Technology	7004	Foundry Technology		55	
Metals Technology	7015	Steel		53	

3.1 MINING RESEARCH LABORATORIES (MRL)

3.1.1 MRL OBJECTIVES

The strategic objectives of the MRL are closely related to the major activities of the laboratory. These objectives are:

To develop technology to assist the Canadian mining industry (with the exception of coal and hydrocarbons, whose needs are addressed by CRL) to improve mining methods; to measure and control health and safety hazards associated with mines; to provide policy support.

To maintain the national facility to confirm the safety characteristics of all explosives submitted for authorization under the Canada Explosives Act, and to advance technology related to the manufacture, storage, transportation, and use of explosives.

To maintain a national centre of excellence for rockburst research, established with co-support from the mining industry of Ontario and the Provincial government, at the Elliot Lake Laboratory.

To provide technical support to the Ontario industry on mine backfill properties through the Sudbury backfill laboratory.

To encourage, by means of in-house and contracted-out R&D, the development of improved equipment and materials to reduce risks to the health and safety of underground miners owing to the presence of: explosive concentrations of mine dusts, fire hazards, toxic diesel emissions, and other industrial dusts.

To provide the national service for the testing and certification of fire-resistant materials, electrical equipment and other apparatus and materials to be used in explosive atmospheres.

To meet national policy information requirements by carrying out studies of the mineability of mineral deposits, to estimate present and future mine production capacities, and to carry out related technology reviews.

To develop techniques for the application of rock mechanics to underground and open pit mine design; to investigate underground and open pit stability, with particular reference to rockbursts; to study alternative layouts and means of support which could alleviate failures; to investigate underground instabilities caused by geological structure; and to develop empirical, statistical deterministic models to predict stable structures.

To develop technology for the improvement of the underground environment and mining productivity (underground and open pit) while reducing risks to workers owing to the presence of radiation, dust, soot, noxious gases, and other hazards.

To provide regular updates of economically mineable uranium reserves and associated inferred resources; to determine the reserves of specified mineral deposits to meet departmental information requirements; and to develop new ore reserve evaluation methodologies for the assessment of reserves and related economic evaluations.

To develop methods/technology for the management of mine/mill wastes to reduce environmental impact by determining solution transport and contaminants migration pathways from tailings, evaluating the effectiveness of various covers and surface stabilization techniques and developing contaminants migration models which can be used in the selection of management practices (Project under MSL sub-sub-activity "Environmental Controls").

3.1.2 MRL DESCRIPTION

The Mining Research Laboratories are composed of five laboratories:

i) Canadian Explosives Atmospheres Laboratory;

ii) Canadian Explosives Research Laboratory;

iii) Elliot Lake Laboratory;

iv) Canadian Mine Technology Laboratory; and

v) Sudbury Laboratory.

These individual laboratories carry out a number of major activities involving: mining methods and equipment, rock mechanics, mine environments, mineral reserves assessment, explosives atmospheres, equipment safety certification, environmental controls and explosives technology. The headquarters of MRL is situated in Bells Corners, Ontario. See Figure III, following, for the MRL organization chart.

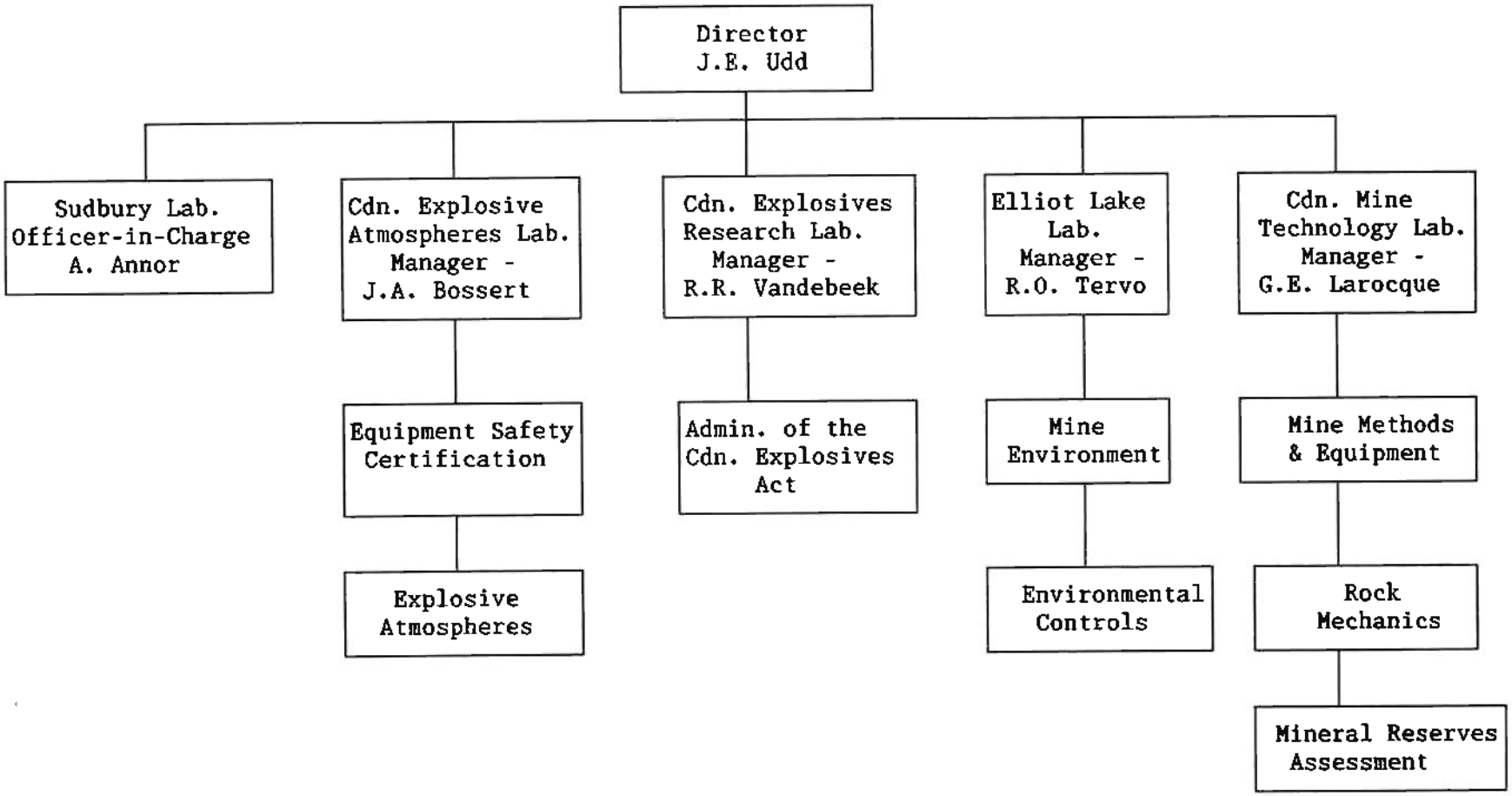
3.1.3 MRL RESOURCES

The resource allocations for MRL in 1988/89 are shown in the following table:

TABLE 11
MRL RESOURCES (PY & $000)
1988/89

	PY	Salary	Operating	Capital	Total
Source of Funds					
Regular Funds	87	4646	1003	234	5883
Energy R&D	1	50	40	40	130
MDA's	1	37	36	30	103
TOTAL	89	4733	1079	304	6116
Allocation of Funds					
1409 Mining Methods and Equipment	8.1	437	125	5	567
1425 Rock Mechanics	25.9	1381	464	162	2007
1439 Mine Environment	8.0	432	86	25	543
1453 Mineral Reserves Assessment	2.0	108	28	0	136
1467 Explosive Atmospheres	7.0	374	108	40	522
1482 Equipment Safety Certification	7.0	378	121	0	499
1495 Management and Support	14.0	756	36	29	821
3086 Environmental Controls	3.0	149	20	5	174
ADMINISTRATION OF CANADA EXPLOSIVES ACT					
1107 Explosives Technology	14.0	718	91	38	847
R.C. 697 All Funding Totals:	89.0	4733	1079	304	6116

Figure III
Mining Research Laboratories



3.1.4 MRL ACTIVITIES

The MRL is responsible for, or otherwise participates in, the following sub-sub-activities:

1409 Mining Methods and Equipment;
1425 Rock Mechanics;
1439 Mine Environment;
1453 Mineral Reserves Assessment;
1467 Explosives Atmospheres;
1482 Equipment Safety Certification;
3086 Environmental Controls; and
1107 Explosives Technology.

3.1.4.1 Mining Methods and Equipment (1409)

The objectives of this sub-sub-activity are to meet policy information requirements by carrying out studies of the mineability of mineral deposits; estimate present and future mine production capacities; and carry out related technology reviews. The focus of this sub-sub-activity is on the review and promotion of innovative concepts and developments in mining methods and equipment. Technology oriented developmental projects in Canadian mineral organizations are reported on; investigations of electronic control systems for mine equipment automation are carried out; operational technologies, productivity indices and maintenance systems are studied, as are studies to estimate national uranium production capability. Research also focuses on the use of CAD/CAM systems in designing and planning underground mines, especially small mines. The use of mathematical modelling, simulations, and mine sensors are also studied. Evaporite mining studies, in Saskatchewan and New Brunswick, focus on problems of regional mine stability. Projects associated with this sub-activity are:

140901 - Mine Methods and Evaluation;
140902 - Advanced Mine Equipment Technology;

140903 - Canadian Mining Technology Coordination; and
140904 - Materials Handling and Operations Research.

3.1.4.2 Rock Mechanics (1425)

The objective of this sub-sub activity is, on an ongoing basis, to: develop techniques for the application of rock mechanics to mine design; investigate underground stability, including rockbursts; study alternative layouts and means of support which could alleviate failures; investigate underground instabilities caused by geological structure; and develop empirical, statistical, deterministic models to predict stable structures.

The major focus for research related to rock mechanics is ground control in mines. Activities focus: on the evaluation of pillar stability in hardrock mines; the evaluation of support systems (e.g. backfill) on rock mass stability; establishing the properties (e.g. strength) of rock types; developing numerical models and software packages for evaluating the stability of underground openings and mining related structures; the determination of the thermal-mechanical properties of rocks vis-a-vis nuclear waste management programs; and developing field geotechnical instrumentation. In addition, this sub-sub-activity includes participation in a rockburst research program (participants include Canada, Ontario, and the mining industry). The sub-sub-activity also involves work on two Mineral Development Agreements, with Ontario and Manitoba.

Specific individual projects associated with this sub-activity include:

142501 - Mine and Regional Stability;
142502 - Rock Mass Characterization;
142503 - Rock Properties and Support Systems;
142504 - Numerical Model Development;
142505 - Underground Nuclear Waste Repository;
142506 - Fragmentation;
142507 - Instrumentation Development;

142508 - Manitoba Mineral Development Agreement;
142509 - Rockburst Research;
142510 - Ontario Mineral Development Agreement;
142511 - Fill Studies (Sudbury); and
142512 - Evaporite Mining Methods.

3.1.4.3 Mine Environment (1439)

The objectives of this sub-sub-activity are to develop technology for the improvement of the underground environment, and reduce risks to workers due to the presence of radiation, dust, soot, and noxious gases. The work associated with this sub-sub-activity is centred in MRL's Elliot Lake Laboratory, although work is also conducted in Ottawa. Efforts with respect to respirable dust/ventilation studies are to: evaluate the quality and quantity of respirable dust produced in various mining operations; identify the major factors affecting dust production; and develop control methods capable of reducing dust concentrations to acceptable levels. A dust test facility has been installed at the Elliot Lake Laboratory.

MRL's work in uranium mines is to: identify major sources of radiation; identify the major factors affecting the release of radiation; develop control methods to reduce radiation levels to acceptable personal dose exposures; and develop and test radiation instrumentation to carry out the above studies. Another objective is the establishment of a national radon/thoron test facility (RTTF). Projects associated with this sub-activity are:

143901 - Ventilation and Respirable Dust; and
143903 - Radiation.

3.1.4.4 Mineral Reserves Assessment (1453)

The objectives of this sub-sub-activity are to provide regular updates of economically mineable uranium reserves and associated inferred resources; to determine the reserve of specified mineral deposits to meet departmental

information requirements; and to develop new ore reserve evaluation methodologies for the assessment of reserves and related economic evaluations. The work associated with this sub-sub activity is centred in MRL's Canadian Mine Technology Laboratory (CMTL) in Bells Corners Ontario. This activity involves the periodic assessment of the national reserves of uranium and the impacts of price levels upon these reserves. Evaluations are also made of the impacts of evolving production technologies and of mineability.

145301 - Reserve Assessments

3.1.4.5 Explosives Atmospheres (1467)

The objectives of this sub-sub-activity are to encourage, by means of in-house and contracted-out R&D, the development of improved equipment and materials to reduce risks to the health and safety of underground miners due to the presence of: explosive concentrations of mine gases and dusts, other industrial dusts, fire hazards, and toxic diesel emissions. The work associated with this sub-sub activity is performed primarily by the Canadian Explosive Atmospheres Laboratory (CEAL) in Bells Corners. The work of the Laboratory is focused on two main areas: 1) R&D associated with the explosions of gas/dust; 2) diesel emissions reduction and mine environment assessment. With regard to #1, the Laboratory investigates the hazards of coal and other commodities such as sulphide ore and agricultural/industrial dusts. With respect to #2 above, work has focused on diesel exhaust emissions reduction technology, specifically, the research and development of a ceramic filter and a venture scrubber.

Specific projects include:

146701 - Fire and Explosion Hazard R&D
146702 - Diesel Flameproof and Emissions R&D
146703 - Diesel Environmental Control

3.1.4.6 Equipment Safety Certification (1482)

The objectives of this sub-sub-activity are to provide a national service for the testing and certification of fire-resistant materials, electrical equipment and other apparatus and materials to be used in explosive atmospheres, e.g., coal mines, petro-chemicals, and other dangerous industrial environments, and to participate in the development and updating of relevant standards.

Also on a continuing basis, to investigate the safety of equipment and materials used in underground coal mines and other environments involving an explosive gas and/or dust hazard and the fire hazard of materials used in all underground mines to encourage safety improvements in equipment and materials for these environments through participation in the standards-making process; and to revise existing standards to accommodate changes in technology of certified products. The work associated with this sub-sub activity is performed primarily by the Canadian Explosive Atmospheres Laboratory (CEAL) in Bells Corners. Testing and certification focuses on flameproof mining equipment, electrical devices, mine ducting, hydraulic fluids, and conveyor belts. Specific projects include the following:

148201 - Equipment Certification and Testing
148202 - Quality Assurance
148203 - Standards Development

3.1.4.7 Environmental Controls (3086)*

The objectives of this sub-sub-activity are to: develop demonstrably effective technology for controlled tailings disposal and management to meet

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* The sub-sub-activity Environmental Controls, which belongs to the Mineral Processing sub-activity, is repeated in the description of the Mineral Science Laboratories.

environmentally acceptable effluent quality criteria which enable the stabilization and ultimate abandonment of mine/will waste with emphasis on base metal potash and uranium tailings; and to establish technologies required for the control of air and water pollution for mining and mineral processing operations to meet regulatory guidelines. Mineral processing produces a wide variety of waste materials: slag, tailings, sludges, process water and stack gases. Cost effective disposal of these wastes, in an environmentally benign manner, is a concern which CANMET has addressed in a variety of ways with projects on water and air pollution. MRL's Elliot Lake Laboratory conducts the work associated with this sub-sub activity. Both laboratory investigations and field work are required. The Elliot Lake Laboratory conducts field studies of uranium tailings and develops techniques for tracing solution transport and contaminant migration. Base metal and potash tailings are also investigated. Vegetative cover and chemical surface stabilization techniques are evaluated as are the treatment of liquid and gaseous effluents and their impacts.

The Reactive Acid Tailings Stabilization (RATS) program and a similar program involving potash tailings (POTS) are two cooperative initiatives involving CANMET, the provinces and the mineral industry.

Specific projects included under this sub-sub activity include the following:

308601 - Tailings Characterization and Treatment
308602 - Mine Waste Management
308603 - Water Pollution Control
308604 - Air Pollution Control
308699 - Cost Recovery

3.1.4.8 Explosives Technology (1107)

The objectives of this sub-sub-activity are to confirm the safety characteristics of all explosives submitted for authorization under the Canada Explosives Act, and to advance technology related to the manufacture, storage, transportation and use of explosives.

The work associated with this sub-sub-activity is focused on two areas: the testing of explosives for authorization under the Canada Explosives Act and research into the properties of explosives. The Canadian Explosives Research Laboratory at Bells Corners evaluates new explosives, at the request of the Chief Inspector of Explosives, and recommends them for authorization, i.e. for manufacturing, importation, etc. In addition, new test methods are developed, technical advice is provided to other government departments and agencies and accidental explosions are investigated. A new fume testing facility has been constructed at Bells Corners to permit development of an improved industrial fume standard.

Research includes new types of explosives and the special hazards of pyrotechnics and propellants. Other initiatives currently worked on, or planned, include: hazards associated with electric detonators used in mine exploration and around radio towers; and use of detonators and explosives in civil engineering.

Specific projects associated with this sub-sub-activity are as follows:

110701 - Certification and Technical Advice
110702 - Explosives R&D

3.1.5 MRL PROGRAM STRUCTURE

FIGURE 1 - PROGRAM MODEL OF MINING RESEARCH (Includes Environmental Controls and Explosives Technology)

MAIN ACTIV-ITIES	MINING METHODS & EQUIPMENT	ROCK MECHANICS	MINE ENVIRONMENT	MINERAL RESERVE ASSESSMENT	EXPLOSIVES ATMOSPHERE	EQUIPMENT SAFETY CERTIFICA.	ENVIRONMENTAL CONTROLS	EXPLOSIVES TECHNOLOGY
SUB-ACTIV-ITIES	1. Mine Methods & Evaluation 2. Advanced Mine Equip. Tech. 3. Cdn. Mining Tech. Coord. 4. Materials Handling & Operat. Res. 5. N.B. MDA*	1. Mine & Reg. Stability 2. Rock Mass Characteriza. 3. Rock Prop. & Support System 4. Numeric Model Devel. 5. Undergrnd. Nucl. Waste Rep. 6. Fragmentation 7. Instrumentation Dev. 8. Manitoba Min.Dev.Agmt. 9. Rockburst Research 10.Ont. Min. Dev. Agmt. 11.Fill Studies (Sudbury) 12.Evaporite Min. Methods	1. Ventilation & Resp. Dust 2. Radiation 3. Noise & Vibration	1. Reserves Assess-ment	1. Fire & Explosion Hazards R&D 2. Diesel Flame-proof & Emissions R&D 3. Diesel Environmental Control	1. Equip-ment Certif. & Testing 2. Quality As-surance 3. Stan-dards Develop.	1. Tailings Character. & Treatment 2. Mine Waste Mgmt. 3. Water Pollution Control 4. Air Pollution Control 5. Cost Recovery 6. Secretariat (RATS & POTS)	1. Certifica-tion & Tech. Advice 2. Explosives R&D
OUTPUTS	- Reports, cost models, mine eval. tech. - Mine systems, demonstra-tions, index of min.tech., manual, soft-ware, pubs.	- Case histor., guidelines - Handbook on surface crown pillars, models, scientific pubs, oral presentations - Reports, software pkgs. - Field exper., tests, geotechnical studies - Geotechnical instrum. - Vertical Block Method guide-lines & other re Man. mines. - Rockburst manual, eval. of seismic systems - Contractors studies - Backfill studies	- Field studies, dust tunnel facility, ventila. & other studies - Techniques to control radiation in mines, national test facility - Reports on noise & vibration	Reports	- Scientific papers, standards, seminars,stud. - Demonstra., air quality index, mono-graph, ceramic filter system, venturi scrub. sys.,licenses. - Characterized air quality re diesel workings	- Reports, certifi-cates, courses, advice, list of certif. equip. - Inspec-tion visits & retest of equip. & materials - Standards	- Studies, reports pathway analysis, evals., contaminant migration model. - Increased cost recovery projects	- Eval. reports, - tech. advice - investiga-tions - standards - new facilities - analysis - math. models
IMMEDIATE IMPACTS	- More realistic production cost data re mining operations. - Usage of more advanc. equip. & tech. in Cdn. mines. - Improved tech. interchange re mining in Can. - Optimize: mine mater. handling, heat transfer, haulage & mine design.	- Improved mine stability designs - Improved design of surface crown pillars - Improved knowledge of rock properties & support systems - Improved modelling (num. rather than phys.) of undergrnd. openings. - Improved knowledge by reg. agencies of nuclear waste storage options. - Reduced blasting instability - Usage-geotech. instrum. - Improved min. methods & communication in Man. mines. - Improved knowledge of seismic systems for rockburst prediction. - Improved sand & rock backfill in Ont. mines. - Increased potash recov.	- Improved control methods to minimize dispersion of dust. - Improved knowledge of mine radiation levels & personal exposure levels & performance of monitoring instrum. - Reduced risk to workers from noise & vibration.	- Realistic assessment of Canada's uranium reserves.	- Improved understanding of dust explosive characteris-tics. - Improved underground mine air quality.	- Safer under-ground mining equip. & materials	- Improved knowledge of physical/chem. char. of tailings & their interaction with environ. - Methods/tech. for mgmt. of mine/mill waste. - Ident. of prob. & solutions related to metallurg. proc. liq. waste streams. - Improved control of noxious elements from pyrometallurg. processes. - Increased partic. of indus. in environ. control work.	- Authorized explosives - Improved inves-tigations & other in-quiries. - Improved knowledge of exp.
ULTIMATE IMPACTS	- More productive Cdn. mines	- Safer Cdn. hardrock mines. - Safe storage of nuclear waste - Improved productivity in U/G (e.g. potash) mines. - Improved safety & prod. of Manitoba mines. - Improved prod. & safety of Ont. hardrock mines. - Increased productiv. of Sask.& N.B. potash mines	- Improved air quality & safety of mining employees. - Improved safety of uran. mine person. - Improved safety of mine workers.	- Better policy decisions re domestic & export quotas & granting of licences.	- Safer Cdn. mines	- Safer under-ground mines	- Improved control & disposal of contam. from mine/mills. - Reduced environ. impact of waste. - Improved water pollution control. - Reduced cost to gov't. of environ. control work.	- Safer ex-plosives used in Can.

* Dispersed throughout MRL sub-activities.

3.2 COAL RESEARCH LABORATORIES (CRL)

3.2.1 CRL OBJECTIVES

The strategic objectives of the CRL are:

> "To develop technology to assist the Canadian mining industry to improve mining methods; to measure and control health and safety hazards associated with mines.
>
> To develop technology to optimize the recovery and utilization of Canadian fossil fuels in an environmentally-acceptable manner."

3.2.2 CRL DESCRIPTION

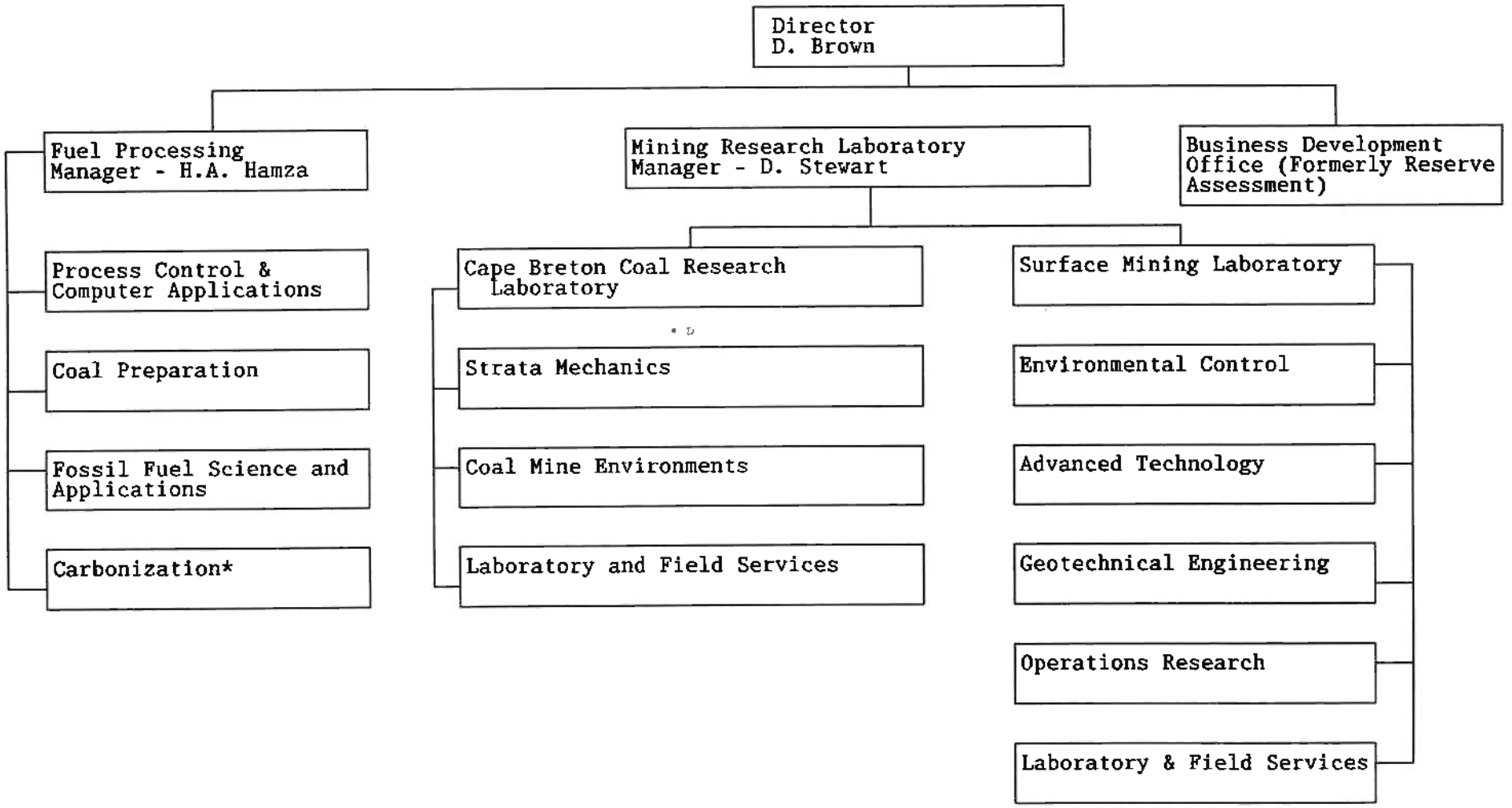
The Coal Research Laboratories are comprised of an underground mining laboratory in Cape Breton, Nova Scotia, a surface mining laboratory in Devon, Alberta and a fuel processing laboratory, also in Devon. In addition, it is responsible in Ottawa for the definition of Canada's coal reserves. Major activities also focus on oil sands mining and the resolution of problems in oil emulsion technology. Figure V, following, is an organization chart for CRL.

3.2.3 CRL RESOURCES

The resource allocations for CRL in 1988/89 are shown in table 12.

FIGURE V

Organization Chart - Coal Research Laboratory



*Transferred to CANMET'S Energy Research Laboratory, Ottawa, August 1988.

TABLE 12
CRL RESOURCES (PY & $000)
1988/89

Source of Funds	PY	Salary	Operating	Capital	Total
Regular Funds	48	2592	440	208	3240
Energy R&D	13	655	1360	660	2675
TOTAL	61	3247	1800	868	5915
Allocation of Funds					
2008 Coal Reserves Assessment	1	81	35	0	116
2028 Surface Coal & Oil Sands Mining	13	685	350	196	1231
2033 Underground Coal Mining	13	729	350	152	1231
2056 Coal Preparation	16	850	540	220	1610
2079 Coal Desulphurization	0	0	90	100	190
2095 Management and Support	11	594	100	0	694
5003 Tment Bitu/Oil Emuls & Effl Watr	6	308	335	200	843
5051 Metallurgical Fuels	0	0	0	0	0
R.C. 700 All Funding Totals:	61	3247	1800	868	5915

The activities of CRL can be grouped into: activities which provide information and assistance in government policy development (policy); activities which provide assistance related to environmental control, health, safety standards and regulation (protection); and activities related to industrial productivity and economic and regional development (productivity). The approximate resource allocations for CRL activities, according to these three groupings, is estimated by CRL as follows:

Policy - 10%, predominantly Reserves Assessment[9]
Protection - 25%, predominantly Underground Mining
Productivity - 65%, Surface Mining, Coal Preparation and Oil Emulsion Technology.

3.2.4 CRL ACTIVITIES

The CRL are involved in the following sub-sub-activities.

2008 Coal Reserves Assessment (Now Business Development Office. Note comments under 3.2.4.1);
2028 Surface Coal & Oil Sands Mining;
2033 Underground Coal Mining;

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[9] Resources recently re-directed to the Business Development Office.

2056 Coal Preparation;
2079 Coal Desulphurization (Note transfer to ERL in August 1988);
2095 Management & Support;
5003 Treatment of Bitumen/Oil Emulsions & Effluent Waters & Tailings; and
5051 Metallurgical Fuels.

3.2.4.1 Coal Reserves Assessment (2008)

The objective of this sub-sub-activity is to prepare periodic reference reports that list significant operational and technical information about the Canadian coal mining industry and Canada's coal reserves and resources. This activity is essentially a publishing effort with the data for reports being updated by contacts with provincial coal officials and visits to mine sites.

Following recent redirection of CANMET R&D into a dominantly industry responsive mode of operation, a new Office of Business Development was created in April 1988. The support for this activity, has been taken from the Reserve Assessment portfolio.

3.2.4.2 Surface Coal and Oil Sands Mining (2028)

The objective of this sub-sub-activity is to contribute to the enhanced economic viability of Canada's surface coal and oil sands mining industries through technical contributions in the areas of operations research, advanced technology, geotechnical engineering and spontaneous combustion. The work of this sub-sub-activity is entirely performed by the Surface Mining Laboratory in Alberta, which was formally located in Calgary. In Calgary the Laboratory focused its activities on underground coal mining. Symposiums and seminars are conducted and research is published in divisional reports.

Specific projects with designations, which have been used in past years, are as follows:

202801 - Spontaneous Combustion (Mine Environmental Studies);
202802 - Geotechnical Engineering (Strata Mechanics);
202803 - Advanced Technology (Surface Mining); and
202804 - Operations Research (Mine Simulation & Model/Validation).

3.2.4.3 Underground Coal Mining (2033)

The objective of this sub-sub-activity is to contribute to improved occupational safety and health by in-house and cooperative-with-industry research on underground coal mining methods, systems and equipment that will promote the general well being of the industry and those who work in it.

The work of this sub-sub-activity is primarily performed by CRL's eastern laboratory (Cape Breton Coal Research Laboratory - CBCRL) located in Sydney, Nova Scotia. The work of CBCRL is heavily oriented toward safety in mining operations, although productivity related activity is also engaged in. Specific initiatives include: computer applications for the remote control and monitoring of both equipment and environment; strata mechanics investigations, e.g., gate road closure patterns; better support methods for main roadway intersections; strata reinforcement of roadways; interaction effects between multiple overlying seams; and the determination of appropriate pillar sizes for seam extraction. Data collection for the measurement of seafloor subsidence is carried out, as is the investigation of methane emissions, by remote continuous sampling sensors. The characterization of respirable dust exposures and their sources is also performed. The Cape Breton Development Corporation is the chief client of CBCRL.

Specific projects associated with this sub-sub-activity include:

203301 - Strata Mechanics;
203302 - Coal Mine Environments; and
203303 - Technology Demonstrations (Advanced Technology).

3.2.4.4 Coal Preparation (2056)

The objective of this sub-sub-activity is to develop and demonstrate technology which will improve upon both coal recovery and processing economics while meeting environmental standards and producing clean or upgraded coal products suitable for existing and potential markets. An additional objective is to develop, co-operatively with industry, a program that contributes to reducing the cost of transportation of coal to markets within Canada and abroad.

Laboratory facilities are available in Devon, Alberta. Test work is carried out on a bench, mini-plant or pilot-plant, scale. Specific work associated with this activity includes: demonstration of fine coal cleaning assessment capabilities; assessment of column flotation vs standard flotation practices (cleaning); developing/defining technologies for improving the handleability of coal products, particularly for transportation; evaluation of technologies for the upgrading of low rank coal (including an economic assessment); defining methods for optimizing fine coal processing in Canadian preparation plants; and developing the potential for the intensive cleaning of fine coals.

The above noted activities have been identified as those most appropriate in the 1988-1993 time period. To carry these out a re-alignment of R&D activities associated with this sub-sub-activity is being carried out.

Canadian coal producers are the primary clients of coal preparation R&D.

Current projects (marked with an *), as well as recent past projects, associated with this sub-sub-activity include:

205601 - Coal Characterization;
205602 - Coal Process Control* (Process Control Development);
205603 - Field Testing and Demonstration;
205604 - Process Development;
205605 - Handleability;
205606 - Coal Slurry Transport;

205607 - Industry-Initiated Field Testing* (Industry-Focused Field Testing);
205608 - Upgrading of Low-Rank Coal*;
205609 - Deep Cleaning & Coal-Water Mixtures Tech.;
205610 - Fine Coal Processing*; and
205611 - Transportation Related Technologies*.

3.2.4.5 Coal Desulphurization (2079)

The objective of this sub-sub-activity is to develop and demonstrate technology which will enhance the production and utilization potential of products from the high sulphur coals of Eastern Canada. Research in this area focuses on the processes of removal of sulphur (pyrite) by grinding. The main clients for this work are eastern Canadian coal producers, especially the Cape Breton Development Corporation. The project associated with this sub-sub-activity is: 207901 - High Sulphur Coals.

3.2.4.6 Treatment of Bitumen/Oil Emulsions and Effluent Waters and Tailings (5003)[10]

The objective of this sub-sub-activity is to develop improved processes for the treatment of wellhead fluids, effluent waters and tailings, produced by in-situ recovery of bitumen and heavy oil and during the surface mining and processing of tar sands. The work is done in co-operation with industry and environmental agencies. The construction of the miniplant to test emulsions is expected in 1988.

The ERL has developed expertise in: the application of membrane technologies for the treatment of effluent streams from heavy oil recovery processes to produce water for steam generation; steam injection processes; and firefloods to enhance recovery of heavy oil.

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[10] This sub-sub-activity, which belongs to the Fuels Technology sub-activity, is repeated in the description of the Energy Research Laboratory.

The Fuel Processing Laboratory at CRL (Devon) conducts in-house and contracted out studies related to the above objective. A 10-70 barrel per day physical/chemical emulsion/effluent treatment miniplant has been constructed at the Devon laboratory.

Clients for this research include oil companies, reagent and polymer manufacturers and equipment developers.

The projects associated with this sub-sub-activity are:

500301 - Fundamentals of Emulsion/Effluent Characterization and Treatment;
500302 - Process Development for Emulsion/Effluent Treatment;
500304 - Field Testing of New/Improved Unit Processes for Emulsion/Effluent Treatment;
500305 - Development of Separation Processes for Emulsion/Effluent Treatment; and
500306 - Treatment of Tailings and Sludges from Oil Sands/Heavy Oil Operations.

3.2.4.7 Metallurgical Fuels (formerly Carbonization) (5051)[11]

The objectives of this sub-sub-activity are to: develop metallurgical fuel technologies that extend energy resources, improve coke quality and conserve energy; and determine the coking characteristics of Canadian and North American coals in support of resource evaluation, export markets, and the Canadian steel industry. This sub-sub-activity was primarily carried out by CANMET's Energy Research Laboratory (ERL) in Ottawa. At CRL in Devon, coking coal evaluations are conducted to American Society for Testing and Materials (ASTM) or JIS (Japanese Institute of Steel) standards. Reports are written for the Canadian coal industry.

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[11] The sub-sub-activity Metallurgical Fuels is discussed further in the section on Energy Research Laboratories.

The project associated with this sub-sub-activity at CRL is 505106-Coking Coal Evaluation. This project was transferred, in its entirety, to CANMET (ERL) at Bells Corners in August 1988.

3.2.5 CRL PROGRAM STRUCTURE

In summary, the Coal Research Laboratory attempts to achieve its objectives by identifying coal reserves, structuring its organization to reflect the nature of the coal industry and its inherent problems and focusing on specific activities associated with the mining, preparation, desulphurization and carbonization of coal. Given its location and involvement in fossil fuel oriented research, CRL is also involved in research on the treatment of bitumen/oil emulsions and their effluent waters and tailings. The structure of these activities at CRL and their intended effects are depicted in the following general program model.

FIGURE VI
PROGRAM MODEL OF COAL RESEARCH

MAIN ACTIVITIES	COAL RESERVES ASSESSMENT	SURFACE COAL & OIL SANDS MINING	UNDERGROUND COAL MINING	COAL PREPARATION	COAL DESULPHUR-IZATION	TREAT.BIT/ OIL EMULS. & EFFL.WATER	CARBONIZA-TION "METALLURG-ICAL FUELS"***
SUB-ACTIVITIES	1. Coal Reserves Assessment	1. Spontaneous Combustion Research 2. Geotechnical Engineering R&D 3. Advanced Technology R&D 4. Operations Research R&D	1. Strata Mechanics Research 2. Coal Mine Environment Research 3. Technology Demonstrations	1. Coal Characterization 2. Coal Process Control R&D* 3. Field Testing & Dem. 4. Process Development 5. Handleability 6. Coal Slurry Trans. 7. Indus.-Initiated Field Testing* 8. Upgrading Low Rank Coal* 9. Deep Cleaning Coal Water Mixture 10. Fine Coal Proc.* 11. Trans.Related Tech.*	1. High Sulphur Coals R&D	1. Emuls/ Effl. Characteriza-tion 2. Process Dev. for Emuls/ Effl. Treatment 3. Field Test. Unit Processes for Emuls./Effl Treatment 4. Dev. Separation Proc. for Emuls/ Effl. Treatment 5. Treat.-Tailings & Sludges from Oil Sands/H.O. Operations	1. Coking Coal Evaluation
OUTPUTS	1. Reports	Reports, technical papers, model, workshop. Position paper, technology symposia. Demonstration manual. Lab. test apparatus, pilot plant, case histories.	Reports,demonstra., field trials, tracer gas techniques, methane emis. models, data bases, stress measurements, site-specific data	Reports, publications, cleaned coal products. Demonstrations, bench scale reactors, bench scale evaluations.	Reports	Reports, Publications. Presentations (Conference) Miniplant Emulsions tests, field visits	Reports (Coking) coal evaluations.
IMMEDIATE IMPACTS	Realistic assessments of Canada's coal reserves & commercial coal quality	- Improved understanding, control of spontaneous combustion,methane,etc - Improved design, monitoring & stabilization of surface coal & oil sand structures. - Improved surface mining methods & system - Improved coal industry production schedules.	- Improved ground control in East. Cdn. Mines. - Improved control of respirable airborne dust, ventilation & methane gas emissions. - Changes in Mine Plans & Operating Procedures	- Improved character. of coals as to their upgrading potential to meet market requirements. - Improved processing of coal through on-line monitoring & control tech. & other technologies. - Improved transport, storage & handling of coal.	- Commercial Upgrading of high sulphur coals.	Improved processing of bitumen/heavy oil & effluent waters.	Internationally recognized eval. of Cdn. coking coal qualities.
ULTIMATE IMPACTS	More knowledgeable understanding by prov., fed. & internat. organ. of Can. coal reserves & productivity	Improved safety of coal industry employees & financial position of Can. coal producers as well as improvements in Canada's export trade.	Enhanced health, safety & productivity in Eastern Cdn. mines.	- Improved financial position of coal producers, & equip. manufacturers. - Balance of payments improvement through reduced importation of coal.	Improved fin. posi-tion of E. Cdn. coal producers. Alternative feedstock for power plant operators. Cleaner air for Cdns.	- Improved finan. position of oil companies and reagent/polymer manufacturers. - Bal. of payments improvements through reduced importation of energy. - Increased Env. Acceptability of Oil Sands/Heavy Oil Processes	-Improved financial position of companies producing coking coal for export. -Improved balance of payments.

* = Current
** Transferred to CANMET's Energy Research Laboratory, Ottawa, August 1988.

3.3 MINERAL SCIENCES LABORATORIES (MSL)

3.3.1 MSL OBJECTIVES

The MSL are responsible primarily for the Mineral Processing Sub-Activity the objective of which is:

> "To develop technology to assist Canadian industry in the assessment, more efficient extraction and refining of mineral resources; to minimize energy consumption and environmental impact in mineral processing; and to provide policy support."

3.3.2 MSL DESCRIPTION

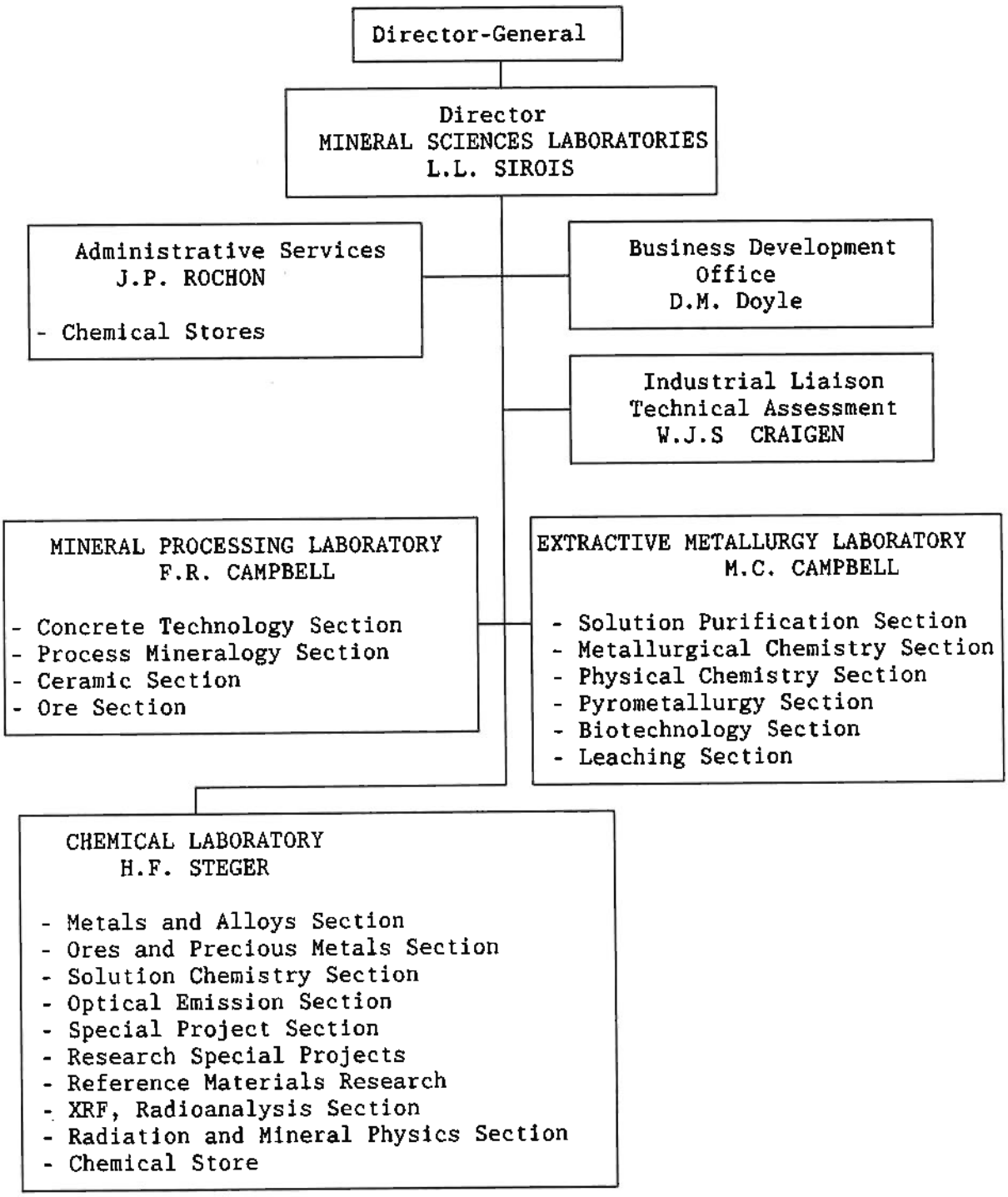
An organization chart for MSL is provided in Figure VII, following.

The MSL is headed by a director with responsibility for three sub-laboratories, all located in Ottawa:

- Mineral Processing Laboratory;
- Extractive Metallurgy Laboratory; and
- Chemical Laboratory.

In addition, MSL includes the offices of the Senior Advisor, Metallurgical Technology.

FIGURE VII
ORGANIZATION AND PROFESSIONAL STAFF
CANMET - MINERAL SCIENCES LABORATORIES



3.3.3 MSL RESOURCES

The resource allocations for MSL in 1988/89 are as follows:

TABLE 13
MSL RESOURCES (PY & $000)
1988/89

	PY	Salary	Operating	Capital	Total
Source of Funds					
Regular Funds	179	9661	1477	322	11460
Energy R&D	6	300	405	385	1090
MDAs	4	141	44		185
TOTAL	189	10102	1926	707	12735 [12]
Allocation of Funds					
2079 Coal Desulphurization	3	162	75	248	485
3005 Minerals Evaluation	11	575	77	10	662
3013 Beneficiation - Metallic	20	1080	166	45	1291
3021 Beneficiation - Industrial Minerals	12	631	166	60	857
3029 Treatment - Ceramics	18	960	233	55	1248
3037 Treatment - Industrial Minerals	14	748	187	74	1009
3046 Enabling Technologies	10	540	127	10	677
3052 Extraction - Common Metals	28	1473	275	60	1808
3061 Extraction - Rarer Metals	17	918	125	10	1053
3069 Standards and Specifications	16	864	125	35	1024
3086 Environmental Controls	14	769	131	44	944
3095 Management and Support	22	1188	194	0	1382
5062 Fluidized Bed Combustion	2	97	40	50	187
7004 Foundry Technology	1	49	3	3	55
7015 Steel	1	48	2	3	53
R.C. 695 MSL All Funding Totals:	189	10102	1926	707	12735

The Mineral Sciences Laboratories are involved and have some responsibility in four other sub-sub-activities. Therefore the work of these sub-sub-activities is described under the laboratory which is primarily responsible as follows:

Sub-Sub-Activity	Primary Laboratory
2079 Coal Desulphurization	Coal Research
5062 Fluidized Bed Combustion	Energy Research
7004 Foundry Technology	Metals Technology
7015 Steel	Metals Technology

[12] A further allocation of $330,000 from the Biotechnology Fund to the Mineral Processing sub-activity (3000 series) was made during the fiscal year.

Capital Resources

The data for the capital resources is taken from a draft of a TB submission prepared for the 1988-89 Main Estimates. The value of the MSL capital inventory is estimated at $13,163,600 excluding major items whose replacement cost exceeds $1,000,000. It also does not contain capital equipment acquired through the Energy R&D Program.

Industrial participation targets are outlined in table 5.2 of the Business Plan for 1988-91 and are:

	1988/89	1989/90	1990/91
Cost recovery ($ 000)	625	1,120	1,610
Secondments (PY Allocation)	3	4	6
Joint Funding ($ 000)	1750	2125	2500

Future plans include the publishing of an Annual Mineral Processing Index in conjunction with Canadian Mineral Processors (CMP) and the Mineral Industry Technology Council (MITEC), to report on all R&D being conducted in Canada in mineral processing and extractive metallurgy and the establishment of a commercial placer laboratory in the Yukon.

MSL is undertaking new initiatives in areas identified as priorities in national science planning. These include advanced industrial materials, biotechnology and artificial intelligence. Work on materials relates to developing indigenous sources of high quality source materials, testing and quality assurance, and enhanced applications. In biotechnology, there is a strong push to apply known technology and to identify constraints to application. The extension of simulated processing of ore and coal (SPOC) into expert systems and the elaboration of process phenomena by mineralogy, chemistry and physical characterization is aiding in improving process understanding and control. Two major initiatives combining these last two specialities are being developed jointly with industry to implement improved process control in the iron ore industry and to advance column flotation technology in the base metals industry.

The mineral industry is under increasing pressure to render all wastes benign. The concept of being able to "walk away" from a mine site upon closure is a target. With sulphide minerals this is difficult at best. The joint government/industry group MEND (Mine Environment Neutral Drainage) while led by industry has been organized and supported through major efforts by CANMET to conduct research and field trials to attain waste disposal systems which can be abandoned. Few of the Canadian mining companies have the expertise to solve this puzzle on their own. A concerted national effort is required.

3.3.4 MSL ACTIVITIES

The activities of MSL are carried out by three sub-laboratories which are described below.

i) Mineral Processing Laboratory;
ii) Extractive Metallurgy Laboratory; and
iii) Chemical Laboratory.

3.3.4.1 Mineral Processing Laboratory (MPL)

The MPL is responsible for the following sub-sub-activities, which are described below:

a) 3005 Minerals Evaluation;
b) 3013 Beneficiation - Metallic;
c) 3021 Beneficiation - Industrial Minerals;
d) 3029 Treatment - Ceramic;
e) 3037 Treatment - Industrial Minerals; and

a) Minerals Evaluation (3005)

The objective of the Minerals Evaluation sub-sub-activity is to determine the behaviour of minerals during processing operations and to assist industry to increase metal recoveries by developing techniques of mineralogical evaluation.

Minerals Evaluation employs advanced instrumental techniques such as scanning electron microscopy, electron microprobe analysis, and electron beam based image analysis, and others for the determination of mineralogy and metal distributions in various ore types to define the optimum processing conditions to improve the metal recovery. Special computer programs such as MATBAL and BILMAT are used along with mineral liberation data from image analysis to obtain a complete 'map' of the deportment of valuable minerals during mineral beneficiation and extraction operations. This knowledge is useful in improving existing processes and developing new mineral beneficiation and concentration processes. At present the thrust is directed at the determination of rare earth and precious metals concentrations of ores.

The main projects associated with this sub-sub-activity are:

300502 Mineralogical Evaluation of Process Products; and
300503 Mineralogical Characterization of Ores.

b) Beneficiation Metallic (3013)

The objective of the Beneficiation Metallic sub-sub-activity is to develop improved beneficiation technology to enhance the productivity of Canadian operations through increased recovery, more efficient processing techniques and improved product quality. Computer programs have been developed to simulate the processing of ore and coal. The next step is seen as the incorporation of the techniques of expert systems which is one of the government strategic objectives. An Iron Ore Task Force with industry representatives advises CANMET on projects related to improving the iron ore processing. Work is also

pursued on the development of column flotation processes for the beneficiation of complex and refractory ores.

The projects associated with this sub-sub-activity are:

301301 - Computer Aided Mineral Processing;
301302 - Iron Ore Processing; and
301307 - Beneficiation of Complex and Refractory Ores.

c) Beneficiation - Industrial Minerals (3021)

The objective of the Beneficiation - Industrial Minerals sub-sub-activity is to develop technology for Energy Conservation, lower cost and improved quality production of industrial minerals and non-metallic minerals. The industrial minerals typically are used as structural materials, e.g., clay products, cement, lime, sand and gravel, stone, etc. The non-metallic minerals group includes asbestos, barite, gypsum, mica, nepheline syenite, potash, salt, silica, sulphur, talc, along with many minor minerals, e.g., bentonite, spodumene, wollastonite, zeolites, etc. There are over 100 non-metallic mines and quarries in operation in Canada.

In the past CANMET has provided assistance to industry in the development of high purity silica for silicon chip manufacture, under this sub-sub-activity.

The two main projects are:

302101 Energy Conservation in Industrial Mineral Processing; and
302102 Beneficiation/Grinding Studies of Selected Minerals.

d) Treatment - Ceramic (3029)

The objective of the Treatment - Ceramic sub-sub-activity is to develop diverse ceramic materials through development of new materials for specific applications and the technology for their fabrication and characterization.

CANMET is developing materials technology for both functional and structural ceramics. The work done in this sub-sub-activity deals with the production of advanced materials which is another strategic objective of the government.

The results of in-house and contracted R&D are transferred to the industrial sector in a number of ways including the IRAP/PILP route and other similar federal and provincial programs, by active participation in the activities of both the Canadian Ceramic Society and the Canadian University-Industry Council on Advanced Ceramics and by maintaining a close link and sometimes a direct collaboration with members of both the university and industrial sectors either on an individual basis or as a member of an industrial consortium. Increasingly, direct collaboration of CANMET in joint programs is being sought (such as the Ontario Hydro/AECL program on hydrogen-conducting ceramics) and in some cases this involves the secondment of industrial staff to CANMET.

The two main projects currently under way are:

302901 - Preparation and Characterization of Advanced Ceramic Materials; and
302905 - Refractories for Steelmaking.

e) Treatment - Industrial Minerals (3037)

The objective of this sub-sub-activity is to perform research to improve the properties of materials derived from non-metallic minerals such as concretes formulated from materials such as granulated blast furnace slag, fly ash, and silica fume without sacrificing the durability, reliability and safety of concrete under exposure to severe environmental conditions, such as offshore structures required in the development of hydrocarbon resources. Another objective is the provision of engineering data to support Canadian industry and regulatory agencies of governments.

The projects underway are:

303701 - Performance of Concrete Incorporating Supplementary Cementing Materials;
303702 - Concrete for Offshore Structures; and
303703 - Aggregate/Concrete Testing and Standards.

3.3.4.2 Extractive Metallurgy Laboratory

The Extractive Metallurgy Laboratory is responsible for the following sub-sub activities, which are described below:

- 3046 Enabling Technologies;
- 3052 Extraction - Common Metals;
- 3061 Extraction - Rarer Metals; and
- 3086 Environmental Controls.

a) Enabling Technologies (3046)

The objective is to enhance the understanding and applicability of emerging technologies in the processing of minerals in Canada. The main effort is in biotechnology with smaller effort in plasma technology and photoelectrochemistry.

The federal government through the Ministry of State for Science and Technology has identified biotechnology as one of several strategic technologies for Canada. Research is conducted to identify, quantify, test and apply biological phenomena to improve metal recovery processes to enhance recovery of fossil fuels, to reduce environmental impact of industrial operations to acceptable levels, and to maintain a network of communications between the research and industrial communities. A very important initiative is the publication of a quarterly newsletter, BIOMINET, for the interested community. The BIOMINET steering committee is comprised of members from industry, from provinces, from universities and from CANMET. The membership has now passed the 450 mark.

Plasma technology is seen as a possible means of increasing energy efficiencies and of substituting electrical energy for fossil fuels in the pyrometallurgical processes widely used in Canadian industry. Work is underway on the applicability of Plasma Smelting to ferroalloys, speciality steels, steelmaking wastes and direct reduction of iron ores.

Under photoelectrochemistry work is underway on the use of semiconductor suspensions for the removal of environmental pollutants such as $S^{=}$, CN^{-} and S_2O_3 from metallurgical effluents.

The projects underway are:

304601 - Biotechnology;
304602 - Plasma Technology; and
304603 - Photoelectrochemistry.

b) Extraction - Common Metals (3052)

The objective of the Extraction - Common Metals sub-sub-activity is to improve existing processes and develop new, cheaper ones with less environmental impacts for the common metals such as copper, nickel, zinc, lead, cobalt and iron. The research has very significant funding from DRIE, IRAP and NSERC, and the Mineral Development Agreements.

Work is being done in co-operation with the Canadian Copper Industry to develop processes for higher quality copper and to reduce electrorefining costs, and with the Canadian Zinc Industry to improve zinc tracking, iron rejection, impurity control, and electrolysis.

Processes are also being developed to maximize the recovery of high value products and by-products, while minimizing the environmental problems and the costs associated with the control of sulphur oxides and other gaseous, liquid and solid effluents. A generic chloride metallurgy process is being developed

which would be applicable to Canadian sulphide ores of zinc, lead, copper, silver, nickel, cobalt and precious metals.

There are four projects associated with this sub-sub-activity:

305205 - Reduction of Impurities in Copper Refining;
305207 - Non-Ferrous Smelter Technology;
305208 - Zinc Processing; and
305209 - Chloride Metallurgy.

c) Extraction - Rarer Metals (3061)

The objective is to develop lower cost and less environmentally damaging technologies for the beneficiation, recovery and purification of rarer metals such as gold, uranium, platinum group, lanthanides, nuclear materials and others. In the past significant work has been done on uranium, gold and several rare metals such as vanadium, gallium, indium, chromium, manganese, niobium , etc. Current projects which are targeted at the recovery processes for gold, platinum group metals and oxide ores are:

306102 - Gold;
306103 - Platinum Group Metals; and
306105 - Oxide Ores.

d) Environmental Controls (3086)

The objectives of this sub-sub-activity are to: develop demonstrably effective technology for controlled tailings disposal and management to meet environmentally acceptable effluent quality criteria which enable the stabilization and ultimate abandonment of mine/mill waste with emphasis on base metal, potash and uranium tailings; and establish technologies required for the control of air and water pollution for mining and mineral processing operations to meet regulatory guidelines. Mineral processing produces a wide variety of waste materials: slag, tailings, sludges, process water and stack gases. Cost

effective disposal of these wastes, in an environmentally benign manner, is a concern which CANMET has addressed in a variety of ways with projects on solid, water and air pollution. MRL's Elliot Lake Laboratory is associated with this sub-sub-activity in which both laboratory investigations and field work are required.

Recently the mineral industry has expressed interest in developing a more coherent co-operative research program with CANMET and the provinces in addressing the problems of acid generating and potash tailings. A co-operative research program called the Mine Environment Neutral Drainage (MEND) is underway. A similar program on potash tailings has been dubbed POTS. Co-operative projects are underway and will be in keeping with comprehensive plans developed by the participants.

The treatment of liquid and gaseous effluents is a continuing challenge as the impact of contaminants is more fully recognized. Priority has been given to the removal and containment of arsenates, cyanide, thiosalts, and heavy metals, and the sludges resulting from treatment. In the area of gaseous emissions, work will concentrate on the control and capture of sulphur, arsenic and other metal oxides form dilute systems either by optimizing existing processes or developing new approaches.

Specific projects associated with this sub-sub-activity are:

308601 - Tailings Characterization and Treatment;
308602 - Mine Waste Management;
308603 - Water Pollution Control;
308604 - Air Pollution Control; and
308699 - Cost Recovery.

3.3.4.3 Chemical Laboratory

The Chemical Laboratory has only one sub-sub-activity, Standards and Specifications (3069).

The objectives of the Standards and Specifications sub-sub-activity is to: carry out analytical support services for, and research in the development of analytical methodology for CANMET's Mineral and Earth Sciences Program; provide a consulting service and technical assistance in the field of analytical chemistry to other federal and provincial government departments and agencies and to industrial organizations and universities; prepare, certify and distribute reference materials to improve quality control in the Canadian minerals processing industry; participate in committee work for national and international organizations; and provide the sole Canadian analytical umpire service for uranium determination in uranium concentrates to resolve disputes between suppliers and refiners.

CANMET became involved in the preparation and certification of reference materials in 1955. The Chemical Laboratory participates actively in the work of the International Organization for Standardization (ISO) and of other standards bodies. The reference materials are sold world-wide and the aim is to prepare and certify three new materials per year.

There are two projects associated with this sub-sub-activity:

306901 - Reference Materials; and
306902 - Analytical Methodology.

3.3.5 MSL PROGRAM STRUCTURE

The structure of these activities at MSL and their intended effects are depicted in the following program structure chart.

FIGURE VIII
PROGRAM STRUCTURE
MINERAL SCIENCES LABORATORIES - MINERAL PROCESSING LAB

OBJECTIVE: To develop technology for: (i) more efficient extraction and refining of minerals; and (ii) to minimize energy consumption and environmental impact.

ACTIVITIES	MINERALS EVALUATION	BENEFICIATION METALLIS	BENEFICIATION INDUSTRIAL MINERALS	TREATMENT CERAMICS	TREATMENT INDUSTRIAL MINERALS	ENABLING TECHNOLOGIES
	Mineralogical Evaluation of Process Products. Mineralogical characterization of Ore.	Computer Aided Mineral Processing. Iron Ore Dressing. Beneficiation of Complex and Refractory Ores.	Energy Conservation. Beneficiation/ Grinding Studies.	Preparation and Characterization of Advanced Ceramic Materials. Refractories for Steel Making.	New Concrete formulations. Concrete for Offshore Structures. Aggregate/ Concrete Testing and Standards.	Biotechnology. Plasma. Photoelectro-chemistry.
OUTPUTS	. Reports . Presentations at technical meetings and conferences	. Reports, Seminars, workshops . Sale of patents and Information . Index of Mineral Processing R&D activities in Canada . joint projects . providing technologies	. Reports, seminars, joint project demonstrations . joint projects . producing technologies	. New advanced materials . Reports on ZrO_2 and SiC Ceramics . New producing technologies . Demonstrations and field trial with IRAP/PILP funds . Increased interaction with industrial association	. Reports, workshops, seminars, courses conferences . Distribution of round-robin cement testing samples . New usage for cementations materials	. Public presentations, published papers . Operation of communication networks
IMMEDIATE IMPACTS	. New quantitative knowledge on liberation of minerals from ores . Application of mineralogical techniques to specific ones . Cost recovery . Industrial cost savings . Improved producing	. Practibility of personal computer programs for optimizing mineral and energy processes . Assistance to iron ore plants . New knowledge on use of gravity and column flotation techniques for fines recovery . Cost recovery . Industrial cost savings	. Increased efficiency of energy use in processing of industrial products such as: cement, bricks, asbestos, potash and others . New knowledge and improved processes for a range of industrial minerals . Cost recovery . Industrial lost savings	. New ceramic materials for functional & structural use . Fabrication methodologies . Performance characterization . New knowledge on mechanisms of degradation of refractories . NDT testing equipment . Industrial cost savings . Cost recovery	. New concretes for hostile environments . New monitoring and testing equipment . Data banks of engineering properties.New knowledge and understanding of advanced technologies . New processing and extraction technologies . Industrial costs savings . Cost recovery	
ULTIMATE IMPACTS	. Improved mineral separation and concentration processes . Improved competitiveness of industry	. Improved competitiveness of mineral and energy industries	. Improved competitiveness and new sources of raw materials for the industrial minerals sector	. New ceramic based industries, processes, and applications . Improved competitiveness of manufacturers	. Increased durability, reliability and safety of concrete structures in severe environments . Increased competitiveness of Canadian consulting companies	. To keep Canada in the forefront of new developing technologies . Increased competitiveness of existing industries . Developments of new industries

FIGURE VIII (Cont'd)
PROGRAM STRUCTURE
MINERAL SCIENCES LABORATORIES - EXTRACTIVE METALLURGY LAB

OBJECTIVE: To develop technology for: (i) more efficient extraction and refining of minerals and;
(ii) to minimize energy consumption and environmental impact.

	EXTRACTION COMMON METALS	EXTRACTION RARER-METALS	ENVIRONMENTAL CONTROLS	STANDARDS AND SPECIFICATIONS
ACTIVITIES	1. Removing Imparities in Copper Refining 2. Non-Ferrous Smelter Technology 3. Zinc Processing 4. Chloride Metallurgy	1. Gold Processing 2. Platinum Group Metals 3. Oxide Ores	1. Tailings Characterization and Treatment 2. Mine Waste Management 3. Water Pollution Control 4. Air Pollution Control	1. Reference Materials
OUTPUTS	. Reports, published papers, conference presentations, seminars, courses workshops . New extraction technologies . Cost recovery . Joint projects	. Reports, published papers, conference presentations, seminars, courses, workshops . New extraction of recovery technologies . Cost recovery . Joint projects	. Workshops, seminars, field studies, technical papers . New tailings management technology . New wastes and air pollution abatement technology . Joint projects	. Canadian reference materials . Input to international organizations . Reports, journal publications conference presentations, reports to standards organization
IMMEDIATE IMPACT	. Improved efficiency of existing processes . Recovery of by-product minerals from waste streams . Generation of new knowledge of the physical and chemical principles involved . Cost recovery . Advice on smelter modernization . Industrial cost savings	. Development of innovative processes . Improvements to existing processes	. Improved knowledge of the dynamics of base metal and potash tailings . Development of cost effective technology	. Improved precision of analysis . Development of new innovative analytical techniques . Cost recovery (sale & production of reference materials) . Improvement of commercial analytical quality control
ULTIMATE IMPACTS	. Improved competitiveness of firms involved in the recovery of CU, Ni Zu, Pb, Co and Fe . Improved life expectancy of mines	. To assist firms involved in the recovery of gold, uranium, platinum group metals, lanthanides, electronic and alloying metals . Establishment of new companies in the field . Improve competitiveness	. Lower water and air pollution from mining and metallurgical operation . Increased health and safety . Improve competitiveness of industry	. Facilitate international trade and commerce . Assistance to Canadian exports

3.4 ENERGY RESEARCH LABORATORIES (ERL)

3.4.1 ERL OBJECTIVES

The primary responsibility of the ERL is the Fuels Technology sub-activity, the objective of which is:

> "To develop technology to optimize the recovery and utilization of Canadian fossil fuels in an environmentally acceptable manner; to produce synthetic fuels from non-conventional sources; to integrate synthetic fuels into the end-use system support; and to provide policy support."

3.4.2 ERL DESCRIPTION

The ERL is headed by a Director with responsibility for four sub-laboratories, each of which is headed by a manager:

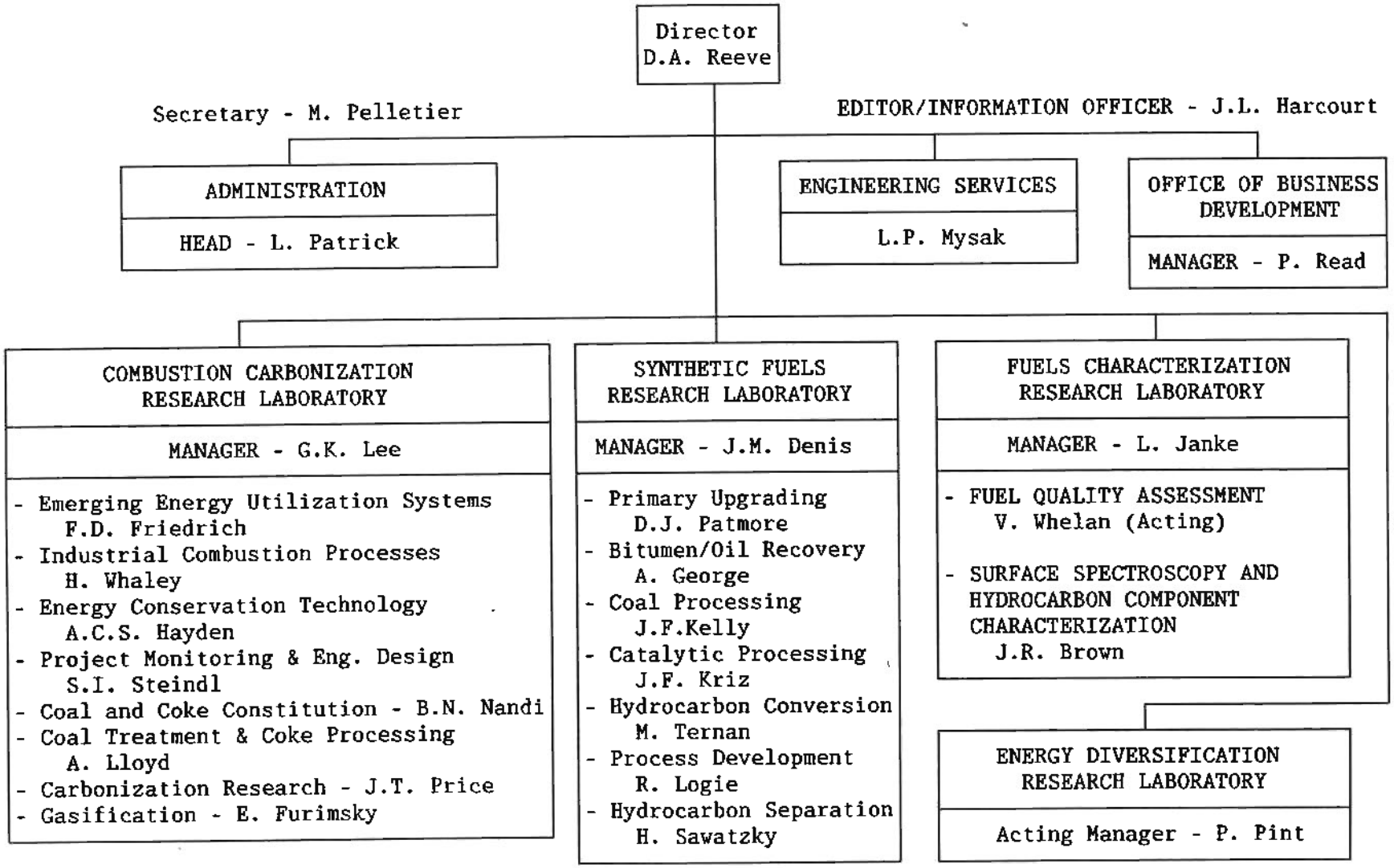
- Combustion and Carbonization Research Laboratory;
- Synthetic Fuels Research Laboratory;
- Fuels Characterization Research Laboratory; and
- Energy Diversification Research Laboratory.

The activities of the four sub-laboratories of the Energy Research Laboratories are discussed in section 3.4.4, following.

An organization chart for ERL is provided in Figure IX.

FIGURE IX

CANMET - ENERGY RESEARCH LABORATORIES



3.4.3 ERL RESOURCES

The resource allocations for ERL in 1988/89 are as follows:

TABLE 14
ERL RESOURCES (PY & $000)
1988/89

	PY	Salary	Operating	Capital	Total
Source of Funds					
Regular Funds	94	4957	270		5227
Energy R&D	71	3570	3472	2398	9440
TOTAL	165	8527	3742	2398	14667
Allocation of Funds					
5003 Tment of Bitu\Oil Emuls & Effl Watr	0.0	0	25	0	25
5006 Recovery of Bitumen and Heavy Oil	3.0	162	110	17	289
5012 Development of Upgrade Technology	30.0	1577	535	520	2632
5018 Upgrade of Synth Crudes & Distill	17.0	872	368	334	1574
5031 Conversion - Mat Gas to Liq Fuel	6.5	335	304	118	757
5041 Devel of Coprocessing Technology	23.0	1175	502	428	2105
5046 Gasification	5.5	285	418	74	777
5051 Metallurgical Fuels	20.0	1080	210	60	1350
5057 Pulverized Coal & H.Oil Combustion	14.0	724	339	161	1224
5062 Fluidized-Bed Combustion	11.0	577	254	359	1190
5068 New Coal-Based Fuels	2.0	104	150	74	328
5073 Combust Tech Pollution Abatement	2.0	104	204	84	392
5078 Conserv in Resid and Indust System	8.5	447	256	119	822
5084 Biomass Fuels for Res and Ind Util	3.5	185	67	50	302
5095 Management and Support	19.0	900	0	0	900
R.C. 701 All Funding Totals:	165.0	8527	3742	2398	14667

Note In November 1988 the government announced the opening of the new Energy Diversification Research Laboratory in Varrenes, Quebec. The 1988-89 resources for the laboratory (all from PERD funds) are salaries $100,000, operating $160,000, and capital $90,000 for a total of $350,000 and 2 pys. These resources would be in addition to the ERL Resources in Table 12.

There are 15 sub-sub-activities with a total of 62 projects. The research under SSA 5003 - Treatment of Bitumen/Oil Emulsions and Effluent Waters and Tailings is essentially carried out at the Coal Research Laboratory where all the person-years allocated to this SSA are located. However, since ERL is the primary laboratory responsible for sub-activity 5000 - Fuels Technology, the work of Treatment of Bitumen/Oil Emulsions and Effluent Waters and Tailings is also discussed under this laboratory.

ERL consumes approximately 30% of the CANMET budget. The resources of the sub-activity vary from $302,000 for SSA 5084 - Biomass Fuels for Residential and Industrial Utilization, to $2,632,000 for SSA 5012 - Development of Upgrading Technology.

Capital Resources

The data source for the following capital resources is a draft TB submission prepared for the 1988-89 Main Estimates. The value of the inventory is estimated at $7,040,700 and it does not contain major items whose replacement cost exceeds $1,000,000. It also does not contain capital equipment acquired through the Energy R&D Program.

Industrial Participation Targets

These are outlined on page 73 of the Business Plan for 1988-89 as follows:

	1988/89	1989/90	1990/91
Cost-Recovery ($ thousands)	700	1400	1700
Secondments (PY Allocation)	1	2	3

It is anticipated that the ERL budget will continue to be supplemented by leveraged private sector expenditures.

3.4.4 ERL ACTIVITIES

3.4.4.1 Combustion and Carbonization Research Laboratory (CCRL)

This laboratory has eight broad areas of research, also referred to as sub-sub-activities (SSA), which are briefly outlined below:

a) 5046 Gasification;
b) 5051 Metallurgical Fuels;

c) 5057 Pulverized Coal and Heavy Oil Combustion;
d) 5062 Fluidized Bed Combustion;
e) 5068 New Coal Based Fuels;
f) 5073 Combustion Technologies for Pollution Abatement;
g) 5078 Conservation in Residential, Commercial and Industrial Systems; and
h) 5084 Biomass Fuels for Residential and Industrial Utilization.

a) Gasification (5046)

The objective of the Gasification sub-sub-activity is to develop new technologies for the gasification of solid feedstocks such as coal, coke, coal rejects, and vacuum residues, for the thermal generation of steam and electricity at higher efficiencies, lower pollution levels, and lower costs than existing technologies. A major emphasis is on the conversion of coal to electricity using an integrated gasification-combined cycle (IGCC) process.

An entrained bed gasifier is being designed and erected to allow in-house evaluation of Canadian coals, oil sand coke and other feedstocks. Research is also directed at developing new physical and chemical analytical procedures for testing the various streams involved.

The projects of this sub-sub-activity address priorities identified by the Coal Gasification Technical Committee, an advisory group drawn from the private sector, provincial research and government agencies and the federal government.

The projects associated with this sub-sub-activity are:

504601 - Hot Gas Clean-Up of Gasification Products;
504602 - Gasification of Non-Reactive Feedstocks; and
504609 - Analysis of Gasification Feedstocks and Byproducts.

b) Metallurgical Fuels (5051)

This sub-sub-activity is directed at determining coking characteristics of Canadian and North American coals in support of resource evaluation, export markets, and the Canadian steel industry. Research is also undertaken to develop coke making technologies and energy conservation in coke making. Another application is the development of electrodes for electrowinning of metals.

An important aspect is to participate in the deliberations of national and international standardization bodies to promote the development and dissemination of coal and coke standards which are in harmony with Canadian interests.

Exports of Canadian metallurgical coal in 1986 were approximately 1.5 billion dollars with a further 0.9 billion dollars of coal being consumed in Canadian steel mills. Conventional international test methods for assessing and predicting coking characteristics under estimate the quality of Western Canadian Coals. Development of appropriate tests and characterization studies assist Canadian exports of metallurgical coal. Emphasis is on the development of methods for more rigorously relating Western Canadian coal properties to coke quality and for reproducing industrial oven performance in technical-scale ovens.

About 10 reports per year are prepared on behalf of the Canadian coal and steel industries from research in Ottawa based laboratories and another five reports per year are produced by the Edmonton laboratory.

The research is carried out in co-operation with the Canadian Carbonization Research Association (CCRA). The products of the research in the form of reports are distributed at meetings of the CCRA and CANMET. Cost recovery is estimated at 25% for 1988/89.

There are several projects under this sub-sub-activity:

505101 - Characterization of Coking Coals;
505102 - Fuels and Carbon for Metallurgical Processes;
505103 - Influence of Coal Properties on Carbonization;
505104 - Development of Methods to Predict Coke Quality;
505105 - Conventional Cokemaking;
505106 - Coking Coal Evaluation (Edmonton)[13]; and
505107 - Chemical and Physical Analysis of Coking Coal.

c) Pulverized Coal and Heavy Oil Combustion (5057)

The objective is to produce data on the combustion performance and emission characteristics of Canadian coals destined for power generation, via conventional technology, for the domestic and export markets. The emphasis is on the evaluation of the combustion performance of bituminous and Western low-grade coals for electricity generation. Research is also planned on the combustion properties of heavy oil residual.

Research is also conducted to develop non-intrusive probing techniques for clean flames and theoretical methods for characterizing heat transfer. Non-intrusive laser probing techniques are being developed which would lead to improved coal combustion models. A small-scale furnace for studying pulverized coal flame reactions is being developed. Reports on the development of advanced spectroscopic and column techniques are planned.

The projects in this sub-activity are primarily of an applied nature although long-term fundamental R&D is also involved. Canada participates in an IEA Agreement on Coal Combustion/Science for exchange of data. CANMET reports that much of the work is through cost-shared collaborative programs with industry. A number of specialised pieces of equipment being developed could be marketable.

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[13] This project was transferred, in its entirely, to CANMET (ERL) at Bells Corners, in August 1988.

The project titles give a good indication of the work being done and are as follows:

505701 - Thermal Coal for Electricity Generation;
505703 - Development of Procedures for Flame Diagnostic and Heat Transfer Characterization;
505704 - Flame and Heat Transfer Characteristics for Canadian Coals;
505705 - Flame Furnace Development;
505706 - Combustion Processes in Coal;
505707 - Characterization of Coal-based Fuels and Combustion Products; and
505708- Flame and Heat Transfer Characteristics of Heavy Oil Residual.

d) Fluidized Bed Combustion (FBC) (5062)

The objective is to expedite the application of fluidized-bed technology in Canada.

Fluidized bed technology can handle high sulphur coals, unreactive fuels and petroleum residues without the high pollution emissions associated with traditional power plants. FBC boilers are versatile in the fuel used but are more expensive than conventional boilers. Research is focused on delineating the parameters important in the performance of coals, pitch residues from oil sands/heavy oil residues, etc.

Plans are underway to erect and commission a circulating FBC pilot plant at CANMET, which will be used to develop databases on the performance of coals, limestones, and trace elements. An important aspect would be the development of a mathematical model for the prediction of FBC performance characteristics. The pilot plant would also be used to study erosion problems

The active projects associated with this sub-sub-activity are:

506201 - Bubbling Bed Performance Parameters;
506203 - Circulating Bed Combustion Systems;
506204 - Chatham Coal/Oil Shale Demonstration;
506205 - Characterization of FBC Feedstocks, Additives and Residues;
506206 - FBC Systems for Coal; and
506207 - FBC Systems for Petroleum and Industrial Wastes.

e) New Coal Based Fuels (5068)

The objective is to develop and evaluate technology for coal liquid mixture and micronized coal utilization in utility boilers, and also in industrial and process combustors. These technologies offer the potential of replacing oil or natural gas in existing boilers and industrial combustors, while avoiding the capital costs of burner retrofit and on-site facilities for coal storage handling normally required, while at the same time holding out possibilities for lower environmental pollution. Another aspect is to support participation in the IEA Coal-Liquid Mixture Technology Agreement.

Advice and assistance is being provided to the Charlottetown demonstration of CLM technology, through the application of CANMET/NRC burner.

The projects under way are:

506801 - Coal-Liquid Mixture Combustion (CLM);
506802 - Coal-Liquid Mixture (CLM) Demonstrations; and
506803 - New Coal Combustion Developments.

f) Combustion Technologies for Pollution Abatement (5073)

The Combustion Technologies for Pollution Abatement sub-sub-activity involves fundamental research in the formation of NOx and SOx compounds during the burning of coal, and seeks to minimize the formation of pollutants, which are

regarded as the precursors of acid rain, through redesign of combustors and/or through the use of sorbents.

The effectiveness of staged combustion with sorbent injection for SOx and NOx reduction is being tried in a burner of special design. Support is also being provided to TransAlta Utilities in assessing a proprietary slagging burner, in participation with the Canadian Electrical Association.

Research is also conducted to delineate the distribution of trace elements across fuel, fuel ash and solid combustion residues employing advanced analytical techniques and accepted standard test methods.

The projects are:

507301 - Gagetown Low NOx/SOx Burner;
507302 - Utility Boiler Evaluation and Conversion;
507303 - Novel Burner Control Technology; and
507304 - Trace Element Pathways.

g) Conservation in Residential, Commercial and Industrial Systems (5078)

The objective is to increase the utilization efficiency of fuels for space and process heating. The major emphasis is directed at the evolution of technology and strategies to increase the efficiency of fuel utilization in residential and industrial combustion systems. Reduction of the formation and emission of pollutants during the burning of conventional and synthetic liquid fuels is another goal of the research.

The emphasis is on use of lower quality petroleum fuels, design of hybrid heating systems, high efficiency tap water heating, and guidelines for the safe venting of combustion appliances.

In the case of industrial processes the objective is to assist energy savings with the provision of suitable handbooks, retrofit condensing systems and advanced computer modelling.

Advice and assistance is provided to public and private sector associations, to foster efficient energy usage and novel conservation systems such as combined cycles, load levelling, heat storage and transport, low-grade heat recovery and hybrid heating applications. Emphasis is on the development of district heating systems and heat pumps.

As new equipment designs are produced and test measures developed these are transmitted to standards writing agencies, testing laboratories, manufacturers and government agencies.

The projects under way are:

507801 - Residential Heating Systems;
507802 - Industrial Process Heating; and
507803 - Energy Systems.

h) Biomass Fuels for Residential and Industrial Utilization (5084)

The objective is to increase the efficient utilization of combustible renewable resources both in residential and industrial use. This is done by the optimization of design parameters for safe, efficient combustion of biomass-derived fuels in space heating applications. The current emphasis is on the development of: advanced catalyst appliances for wood combustion; retrofit systems to increase efficiency and decrease emissions of residential wood burning appliances; guidelines for the use of wood burning appliances in air tight housing; and burner components.

There are two main projects:

508401 - Space Heating Systems; and
508402 - Industrial Combustion Technology.

3.4.4.2 Synthetic Fuels Research Laboratory (SFRL)

This laboratory is organized into seven sections:

(i) Bitumen/Oil Recovery;
(ii) Primary Upgrading;
(iii) Coal Processing;
(iv) Process Development;
(v) Catalytic Processing;
(vi) Hydrocarbon Conversion; and
(vii) Hydrocarbon Separation.

These sections concentrate their efforts on the following six sub-sub-activities.

a) 5003 Treatment of Bitumen/Oil Emulsions, Effluent Waters and Tailings.
b) 5006 Recovery of Bitumen and Heavy Oil;
c) 5012 Development of Technologies for Upgrading Bitumen;
d) 5018 Upgrading of Synthetic Crude Distillates;
e) 5031 Conversion of Natural Gas to Liquid Fuels; and
f) 5041 Development of Coprocessing Technology.

Further discussion of the SFRL is by these sub-sub-activities which are described below.

a) Treatment of Bitumen/Oil Emulsions, Effluent Waters and Tailings (5003)

The objective of this sub-sub-activity is to develop improved processes for the treatment of wellhead fluids, effluent waters and tailings, produced by in-situ recovery of bitumen and heavy oil and during the surface mining and processing

of tar sands. The work is done in co-operation with industry and environmental agencies. The construction of the miniplant to test emulsions is expected in 1988.

The ERL has developed expertise in: the application of membrane technologies for the treatment of effluent streams from heavy oil recovery processes to produce water for steam generation; steam injection processes; and firefloods to enhance recovery of heavy oil.

The Fuel Processing Laboratory at CRL (Devon) conducts in-house and contracted out studies related to the above objective. A 10-70 barrel per day physical/chemical emulsion/effluent treatment miniplant has been constructed at the Devon laboratory.

Clients for this research include oil companies, reagent and polymer manufacturers and equipment developers.

The projects associated with this sub-sub-activity are:

500301 - Fundamentals of Emulsion/Effluent Characterization and Treatment;
500302 - Process Development for Emulsion/Effluent Treatment;
500304 - Field Testing of New/Improved Unit Processes for Emulsion/Effluent Treatment;
500305 - Development of Separation Processes for Emulsion/Effluent Treatment; and
500306 - Treatment of Tailings and Sludges from Oil Sands/Heavy Oil Operations.

b) Recovery of Bitumen & Heavy Oil (5006)

The objectives of the Recovery of Bitumen & Heavy Oil sub-sub-activity are to develop improved technologies for the extraction of bitumen and heavy oil, and

to promote their commercial demonstration in co-operation with industry, and provincial and foreign government agencies.

The resources of bitumen and heavy oil in Alberta and Saskatchewan are reported to be tenfold greater than the conventional resources of western Canada. Only 10% of these resources could be mined, however, with the presently available surface-mining technologies. In-situ recovery technology, using thermal, chemical and miscible displacement processes, could increase the amounts recovered substantially. At present, the available in-situ techniques are recovering as much oil as the surface mining technologies.

Work is conducted jointly with AOSTRA and industry in projects such as the application of the Taciuk thermal technology for extraction and upgrading of bitumen and heavy oils from sludges, residues and heavy oil wastes. Another area of co-operation is the field trials of novel concepts such as the horizontal well in-situ recovery at the AOSTRA Underground Test Facility in the Fort McMurray area of the Athabasca deposit. The "CANMET Energy Conversion Cost-Shared Program" funds projects to develop new recovery technologies and to enhance knowledge of in-situ recovery through mathematical modelling. Currently about 16 projects are underway, through contracts.

Generic R&D is also being conducted under an existing Memorandum of Understanding for Bilateral Research between EMR/AOSTRA/Saskatchewan Energy and Mines on the Canadian side and with the US Department of Energy.

The objective is achieved through projects such as:

500601 - Application of New Generation Technology For Recovery of Athabasca Bitumen and Heavy Oils Project;
500603 - Critical-Gap In-Situ Recovery R&D; and
500604 - Cooperative Generic R&D with AOSTRA, other provinces and the U.S.A.

c) Development of Technologies for Upgrading Bitumen, Heavy Oils and Residuals (5012)

The objectives are to evaluate, develop and facilitate the transfer of upgrading technologies, to industry, in order to ensure efficient utilization of Canada's bitumen and heavy oil reserves.

Improved hydrocracking processing schemes provide for the maximization of the yield of distillate product while reducing additive requirements and hydrogen consumption. The emphasis is on improving the economics of hydrocracking processes by investigating novel concepts such as two-stage hydrocracking as a means of improving hydrocracking selectivity and recycle of heavy end solids to reduce additive consumption rate.

An important objective is to support Petro-Canada in the application of CANMET developed hydrocracking technology on limited tasks over the next two years. This work involves pilot plant and bench scale experiments to address specific demonstration plant operation problems and to optimize long term operability and product yields. Client service work is carried out under a cost recovery agreement.

Several novel processes are under development to convert heavy feedstocks to lighter liquid products suitable for pipelining to a refinery. The processes under investigation include: assessment of vacuum pyrolysis technology for refinery waste disposal with Ultramar; influence of ultrasound in upgrading; application of biotechnology and membrane separation technologies; assessment of rotary drum coking process being developed by a private company; development of catalysts, and others.

Clients for the results of the sub-sub-activity are the oil companies, universities, and provincial research laboratories.

The output consists of patents, publications, presentations on novel processes, catalysts and characterization methods.

Several projects are under way:

501201 - Fundamental Studies for Upgrading of Bitumen, Heavy Oils and Residuals;
501202 - Process Development of Hydrocracking Technologies;
501203 - CANMET Hydrocracking Support;
501204 - Development of New Upgrading Processes;
501205 - Development of Catalytic Upgrading Processes; and
501206 - Physico-Chemical Analysis of Heavy Oil/Upgraded Liquid Products and Catalyst Systems.

d) Upgrading of Synthetic Crude Distillates and Utilization of Residues (5018)

Synthetic crude oils from oil sands, heavy oils, and coprocessing of coal/bitumen present special problems due to the presence of high aromatics, sulphur and nitrogen containing compounds, and heavy metals. Problems are encountered in upgrading these crudes/distillates to meet fuel specifications. Less severe processes and improved catalysts are seen to be the answer. This SSA concentrates on utilizing the synthetic crude distillate fraction, through conversion to high value products by developing new catalysts and processes.

Catalysts are used widely in upgrading, and studies are underway to minimize their deactivation. One method is to develop separation processes for the selective removal of catalyst poisons (N, S and O heteroatoms) from synthetic crude fractions prior to gas oil hydrocracking, FCC and middle distillate hydrofinishing. Less severe processes such as membrane technology for the separation of aromatic hydrocarbons in the upgrading of middle distillates are also being developed.

Research is also performed on the utilization of unreacted processing residues (pitches) for the purposes of roofing and road asphalt blends.

The outputs of the sub-sub-activity consist of reports, patents, conference presentations on new processes, new catalysts, new catalyst fabrication methods, and new analytical techniques for the characterization of distillates and residues. The laboratories are equipped with some of the most advanced equipment for conducting studies of synthetic and conventional crude refining, catalyst surface and bulk analysis, and distillate and residue characterization.

The current projects are as follows:

501801 - Hydrogenation of Aromatics and Conversion of Napthenes in Synthetic Crude Distillates for Diesel and Jet Fuel Production;
501802 - Novel Concepts for Refining Synthetic Crude Distillates;
501803 - Laboratory Separation of Synthetic Crude Distillate Fractions
501804 - Production and Testing of Asphalt Blends Containing Residuals from Advanced Bitumen/Heavy Oil Conversion Processes (CANMET Hydrocracking, LC Fining, Coprocessing);
501805 - Characterization of Refining Catalysts and Compositional Analysis of Distillates and Residues;
501806 - Demonstration of Low Severity Processes for Synthetic Diesel and Jet Fuel Production;
501807 - Development of Novel Separation Technologies; and
501808 - Upgrading of 1990 Synthetic Distillates to Meet Ideal Fuel Specification Requirements.

e) Conversion of Natural Gas to Liquid Fuels (5031)

The strategic objective of this sub-sub-activity is to promote the development and commercialization of novel technologies for the conversion of natural gas into fuels, fuel additives and petrochemical feedstocks.

This program was established in 1981/82 to identify suitable processes for the conversion of natural gas to gasoline and other high value fuels, such as diesel, and into high value products such as acetylene, carbon fibres, etc. The work thus far has concentrated on a review of the technologies in use, and of other possible technologies which could lead to lower capital and operating cost facilities.

CANMET is planning to become a member of the co-operative research project underway at the Gas Research Institute (GRI) in Chicago and is also seeking to assemble a government/industry consortium to undertake technology development in Canada.

There are two active projects:

503114 - Design and Evaluation of Novel Processes for the Direct Conversion of Natural Gas into Liquid Fuels; and

503116 - Conversion of Light Hydrocarbons.

f) Development of Coprocessing and Coal Conversion Technologies (5041)

The objective is to develop technologies for the processing of coal and heavy oil/bitumen to produce transportation fuels and heavy distillates.

In-house bench scale research, initiated in 1980, has demonstrated the feasibility of coprocessing western heavy oil deposits and refinery residuals with coal to produce synthetic fuels for transportation. To develop the process further, a two barrel per day (240 kg/day) pilot plant is scheduled for completion in 1988. The process, if successful, will lead to the utilization of large quantities of coal and low value heavy oil and oil bottoms, with production of synthetic fuels for Canada and the export of Canadian coals for use in similar processes in countries such as Japan.

Participation with the Nova Scotia Research Foundation and demonstration studies in Japan are also planned. The work with Japan falls under the

Canada/Japan Science and Technology Agreement. Japan is testing coals from various countries for their suitability with the direct hydroliquefaction process under development.

There are several projects underway:

504101 - Coprocessing Research and Development;
504102 - Coprocessing Pilot Plant;
504104 - Additives for Hydroprocessing Heavy Oil with Coal;
504105 - Characterization and Analysis of Feeds, Distillates and Residues from Coprocessing; and
504106 - Coal Liquefaction.

3.4.4.3 Fuels Characterization Research Laboratory (FCRL)

This laboratory performs the analytical services required by the other units within the Energy Research Laboratories. There are no sub-sub-activities assigned to this laboratory.

3.4.4.4 Energy Diversification Research Laboratory (EDRL)

This laboratory was recently announced and has a temporary office in Varrenes, Quebec. By 1991, it will have 20 PY, and a budget of 3025K, all from PERD. No sub-sub-activities have been assigned at this point. Areas of research will be:

- energy conservation;
- heat pumps;
- biomass fuels;
- hydrogen;
- solar;
- wind.

3.4.5 PROGRAM STRUCTURE

The research program of ERL is targeted both at the supply and demand sides of the energy equation. On the supply side it seeks to enhance the use of both Eastern and Western coal; co-processing of coal and heavy oil/tar sand derivates, and through improvement of technologies and catalysts to improve yields from heavy oil/tar sand bitumen. On the demand side it seeks to reduce energy through improvements to fuel burning appliances. Some work is also done on biomass fuels.

The structure of these activities with their ultimate aim of increasing self-reliance and assistance to Canadian exports is shown in the following program structure model.

FIGURE X
PROGRAM STRUCTURE ENERGY RESEARCH LABORATORIES

Objective: To develop technology to (i) optimize recovery and utilization of fossil fuels in an environmentally acceptable manner.
(ii) to produce synthetic fuels from non-conventional sources
(iii) to integrate synthetic fuels into the end-use system
(iv) to provide policy support

	NEW COAL BASED FUELS	COMBUSTION TECHNOLOGIES FOR POLLUTION ABATEMENT	CONSERVATION	BIOMASS FUELS
ACTIVITIES	Development of Technology for: . Coal-Liquid mixture combustion . Assistance to clients . Research on micronized coal and other developments	. Gagetown low NOx/SOx burner . Utility boiler evaluation and conversion . Novel burner control technology . R&D on trace elements	. Residential Heating System . Industrial Process Heating . R&D on Energy Systems	. Space heating systems . Industrial combustion technology
OUTPUTS	. Reports, papers . Assistance to Charlotte town boiler . Assistance to private sector . Participation in international effort in the area	. Reports, papers, presentations . Participation in IEA Research Agreements . Participation in demonstration	Reports, handbooks, codes, papers, conference presentation	Reports, paper, conference presentation, seminars, videos
IMMEDIATE IMPACT	. Low cost conversion of existing boilers to burn low grade fuels with high sulphur contents	. Improved burners . Knowledge of solvents . Development of mathematical models	. New burner designs . industrial scale chemical heat pumps . High efficiency hot water systems . Development of computer models . Development of novel energy conservation systems	. Utilization of log fuel . Fundamental knowledge of pulverized wood combustion, . Testing procedures and data for standards development
ULTIMATE IMPACTS	. Cost-effective solutions to burning high sulphur coal for utility boilers, cement kilns, pulp mills and others	. Decreased emissions of SOx, NOx from existing boilers	. More efficient and safer heating systems . Ability to use lower grade fuels	. More efficient and lower cost boilers for paper and pulp mills . Decreased oil consumption

FIGURE X (Cont'd)
PROGRAM STRUCTURE ENERGY RESEARCH LABORATORIES

	GASIFICATION	METALLURGICAL FUELS	PULVERIZED COAL AND HEAVY OIL COMBUSTION	FLUIDIZED BED COMBUSTION
ACTIVITIES	. Hot gas clean-up of gasification products . Gasification of non-reactive feedstocks e.g. oil sand coke, coal . Development of analytical techniques	. Characterization of Coking coals . Use of pulverized coal for steel making . Methods to predict coke quality . Evaluation of coking coals	. Thermal coal for electricity generation . Development of procedures for analysis of flames, and heat transfer . Flame furnace development . Combustion Processes in Coal . Characterization of Coal-based fuels and products . Flame and heat transfer Characterization of heavy oil residue	. Research on bubbling beds, circulatory beds, and other . Assistance to Chatham demonstration . Characterization of feedstocks, additives and residue . Research on FBC systems for coal, petroleum and industrial wastes
OUTPUTS	. Reports, published paper, conference presentations, patents	. Reports, published paper, conference presentation, patents	. Reports, published paper, conference presentation	. Assistance to CFB Summerside . Assistance to Chatham FB
IMMEDIATE IMPACTS	. Development of technology . Greater understanding of processes	. Improved coke quality . Data bank on Coke tests . Development of Coke making technologies for lower grade coals	. Data bank on combustion performance of coals . Increased fundamental knowledge . Development of analytical techniques	. To advance knowledge of fluidized beds . Availability of Database on candidate fuels
ULTIMATE IMPACTS	. Lower cost electricity generation with low pollution emissions	. Assistance to Canadian steel industry . Increased exports of coal . Reduced imports of metallurgical coals	. Utilization of lower grade sources of coal, and expression of supply base	. Increased use of high sulphur coal in an environmentally benign manner . Increased use of wastes for steam and electricity generation

FIGURE X (Cont'd)
PROGRAM STRUCTURE ENERGY RESEARCH LABORATORIES

	RECOVERY OF BITUMEN AND HEAVY OIL	DEVELOPMENT OF TECHNOLOGIES FOR UPGRADING BITUMEN	UPGRADING OF SYNTHETIC CRUDE DISTILLATES	CONVERSION OF NATURAL GAS TO LIQUID FUELS	DEVELOPMENT OF COPROCESSING TECHNOLOGY
ACTIVITIES	. Technology for recovery of Athabasca Bitumen and Heavy Oils . In-Situ Recovery R&D . Co-operative R&D with AOSTRA, other provinces and USA	. Upgrading of Bitumen, Heavy Oils and Residuals . Development of Hydrocracking Technologies . CANMET Hydrocracking Support . Development of New Upgrading Processes . Development of catalytic Upgrading Processes . Physico-Chemical Analysis	. Conversion of Synthetic Diesel and Jet fuel . Novel Concepts for Defining Synthetic Crude Distillates . Separation of Synthetic Crude Distillate Fraction . Asphalt Blends from Bitumen/Heavy Oil Processing . Characterization of Catalysts and Product Streams . Low Severity Processes for Diesel and Jet-Fuel . Novel Separation Technologies . Upgrading of 1990 Synthetic Distillates to meet fuel specs.	. Novel Processes for Direct Conversion of Natural Gas into Liquid Fuels . Conversion of Light Hydrocarbons	. Coprocessing research and development through investigation of raw materials, additives, processes and analytical techniques . Coal liquefaction
OUTPUTS	. Reports, published papers, conferences presentation, patents	. Reports, field visits, published papers, conference presentation	. Reports, conference presentations, published papers, patents	. Reports, published papers, conference presentations	. Reports, published papers, conference presentations, patents
IMMEDIATE IMPACTS	. Development of new technology such as horizontal well drilling, extraction and upgrading of heavy oil sludges and residues, in-situ recovery	. Development of basic knowledge related to catalytic and non-catalytic upgrading processes . Transfer of technology to private sector	. Development of basic knowledge of chemical processes involved . Development of analytical methods . Development of new processes and products	. Increased knowledge and conversion technologies	. Development of technology . International co-operation with Japanese/US/ Germany . Development of fundamental knowledge
ULTIMATE IMPACTS	. Increased efficiency of existing processes . Development of novel methodologies with improved economics and reduced pollution	. Efficient utilization of Canadian reserves of bitumen and heavy oil . Increased reliance on Canadian resources . Set up of Canadian catalytic industry . Development of new products and industries	. Improved economics of converting synthetic crudes to transportation fuels, by increasing conversion efficiencies . Increased reliance on Canadian resources	. Set up of new industries to produce transportation fuels from natural gas	. Reliance on Canadian resources for liquid fuels . Greater exports of Canadian coals

3.5 METALS TECHNOLOGY LABORATORIES (MTL)

3.5.1 MTL OBJECTIVES

The Metals Technology Laboratories are responsible for the Metals and Materials sub-activity (7000), the objective of which is:

> To develop technology to enhance Canadian capability and efficiency in the production, fabrication, and utilization of metals and materials; to increase the competitiveness and reliability of products; and to provide policy support.

3.5.2 MTL DESCRIPTION

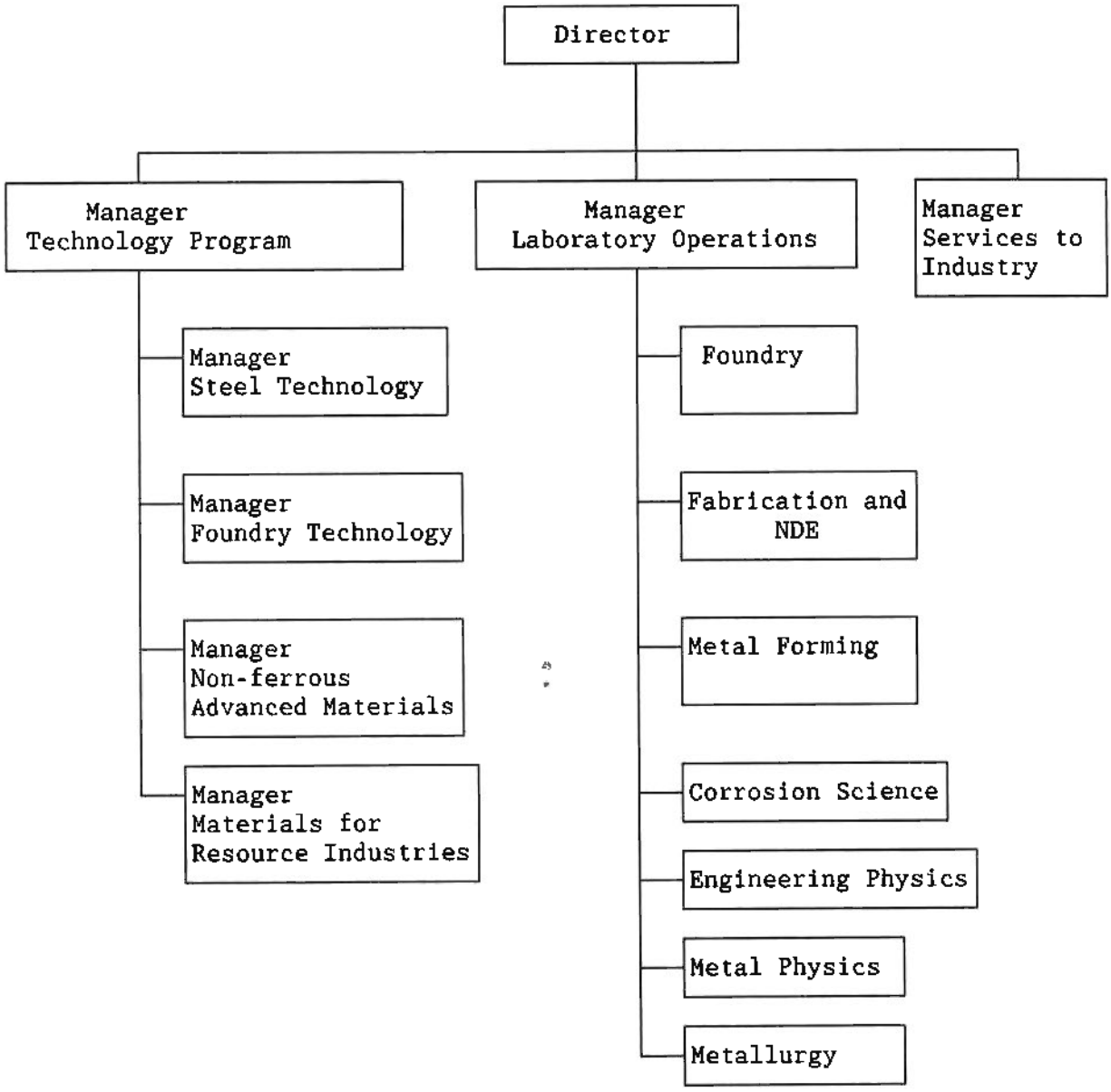
The MTL was formerly known as the Physical Metallurgy Laboratories. The change in name more accurately reflects the activities of this research division. In accordance with the 1987-88 Annual Report of the Metals Technology Laboratories the research program of the laboratory has been reorganized into four sub-sub-activities which cross over section lines: (i) Steel Technology; (ii) Foundry Technology; (iii) Non-Ferrous Advanced Materials; and (iv) Materials for Resource Industries. To provide guidance for project development technical advisory groups, composed of experts from industry and universities, have been established for each of the four programs. The work of these four sub-sub-activities is carried out in the seven sections into which the laboratory has been divided. The seven sections are:

1. Foundry;
2. Fabrication and Nondestructive Evaluation;
3. Metal Forming;
4. Corrosion Science;
5. Engineering Physics;
6. Metal Physics; and
7. Metallurgy.

The Metals and Materials Subcommittee of MNACC, along with the Technical Advisory groups, provide advice and guidance on the direction and priorities of the MTL program.

Following the reorganization of the sub-sub-activity structure, MTL has adopted a matrix management structure, with a Manager, Technology Program, a Manager, Laboratory Operations and a Manager, Services to Industry. MTL has a staff of about 130. Of these about 55 are scientists and engineers and the rest is support staff. In addition MTL has as many as 25 visiting staff of students, postdoctoral fellows and workers from industry.

Organization Chart
Metals Technology Laboratory[14]



[14] The organization structure is under review.

3.5.3 MTL RESOURCES

TABLE 15[15]
MTL RESOURCES (PY & $000)
1988/89

	PY	Salary	Operating	Capital	Total
Source of Funds					
Regular Funds	123	6545	750	377	7672
Energy R&D	11	556	775	187	1518
TOTAL	134	7101	1525	564	9190
Allocation of Funds					
7004 Foundry Technology	18	974	178	0	1152
7015 Steel	35	1896	216	0	2112
7026 Materials for Resource Industries	36	1909	863	170	2942
7038 Non-Destruct, Testing Certification	3	162	19	0	181
7042 Non-Ferrous Advanced Materials	18	972	109	0	1081
7082 Services to Industry	3	162	19	0	181
7095 Management & Support	19	1026	121	394	1541
R.C. 698 All Funding Totals:	132	7101	1525	564	9190

The 7 sub-sub-activities above support 15 projects.

The Mineral Sciences Laboratories utilize 1 PY for each of the two sub-sub-activities, 7004 Foundry Technology and 7015 Steel.

Capital Resources

The data for the capital resources are taken from a draft of a TB submission prepared for the 1988/89 Main Estimates. The value of MTL CARP-eligible inventory (not including equipment acquired under PERD, and equipment whose replacement cost exceeds $1,000,000) is $14,181,000.

[15] The Resource Allocations provided in Table 13 are taken from the RPO document Resource Allocation for FY 1988/89 and do not reflect the Activity Structure currently being developed.

3.5.4 MTL ACTIVITIES

MTL is responsible for the following sub-sub-activities which will be described separately below:

7004 Foundry Technology;
7015 Steel;
7026 Materials for Resource Industries;
7038 Non-Destructive Testing Certification; and
7042 Non-Ferrous Advanced Materials.

3.5.4.1 Foundry Technology (7004)

The objective of this sub-sub-activity is to enable Canadian foundries to become more competitive and provide higher quality castings to Canadian resource, transportation and machinery industries by critically examining and improving existing foundry technology, and developing and transferring new technology.

The foundry industry has $1 billion in annual sales, and provides direct employment for 20,000 persons. The industry is composed mainly of small, regional foundries with limited financial and technical resources. The Foundry Industry Technical Advisory Group was formed in 1986 to provide industry input into planning, implementing and delivering the CANMET foundry research program.

The main effort is in process control and process development.

Operation of the CANMET Mobile Foundry Laboratory has been transferred to the Associations of Provincial Research Organizations (APRO), whose personnel have been trained by CANMET.

Methods of technology transfer include the CANMET Foundry Newsletter which is published periodically, workshops, presentations and formal technical reports.

The projects include:

700403 - Foundry Process Development;
700405 - Foundry Process Control; and
700410 - Cost Recovery.

3.5.4.2 Steel (7015)

The objective of this sub-sub-activity is to support the Canadian Steel industry in the development of advanced process and product technologies.

The steel industry is under pressure due to more efficient use of steel, the substitution of steel by other materials, and the maturing of manufacturing and construction industries which consume steel and competition from offshore steel producers.

The major current thrusts in steel manufacturing are:

Process - step elimination - The focus is on continuous processing and elimination of unnecessary process steps.

Clean steels and inclusion engineering - The reduction of impurities in steel such as sulphur, phosphorous, oxygen, hydrogen, and nitrogen leads to steels with improved properties.

Microalloyed thermodynamically processed steels - For lower production costs and improved mechanical properties.

Modelling steel manufacturing processes - Development of computer based mathematical models to relate mechanical and metallurgical properties to manufacturing processes.

Process Product Integration - To develop an integrated approach to link steel processing variables, product manufacturing properties, and service performance properties.

MTL participates in the Canadian Steel Industry Research Association (CSIRA) with two people on the board of directors. CSIRA maintains a strategic plan which is continuously updated.

A Steel Technical Advisory Group has been formed to support medium and long-term cost shared projects with industry.

There are three projects:

701501 - Continuous Casting Processes;
701502 - Flat Rolled Steel Products; and
701503 - Shaped Products.

3.5.4.3 Materials for Resource Industries (7026)

The objective of this sub-sub-activity is to support Canadian industry to develop fabrication, inspection and failure control technologies for using engineering materials in the economic and environmentally safe production and transportation of mineral and energy resources.

The exploitation of Canada's mineral and energy resources calls for metals to operate in very harsh environments. Examples include: new materials and fabrication techniques for offshore platforms for oil and gas recovery on the East Coast and in the Arctic; improved fabrication methods for Arctic icebreakers; methods for detecting and preventing degradation by corrosion in oil and gas pipelines; new materials for petrochemical reactor vessels for treating of bitumen and sulphur laden coals; and others.

The CANMET work in these areas supports the development of Canadian codes and standards to ensure safe operation of structures in harsh environments.

The work is carried out with the cooperation, guidance and cost sharing of industry committees such as:

. CANMET Task Force on Welding Consumable Development;
. United Kingdom Offshore Steels Research Project;
. Canadian Standards Association Sour Service Task Force; and
. Interdepartmental Liaison Group on Marine Materials.

The projects are:

702601 - Fatigue and Fracture of Welded Joints for Offshore Structures;
702602 - Fabrication, Inspection and Repair of High Temperature Petro Chemical Reactors;
702603 - Corrosion Control and Defect Acceptance Criteria for Pipelines;
702604 - Materials for Marine Vessels; and
702605 - Materials for Mining and Mineral Processing.

3.5.4.4 Non Destructive Testing (NDT) Certification (7038)

The objective of this sub-sub-activity is to operate a national certification program for non-destructive testing personnel according to the standards set by the Canadian General Specifications Board.

Since 1968 EMR has operated the national NDT Certification program, as requested by the Canadian General Specifications Board, for certifying the competence of NDT personnel in certain areas of NDT technology. These are:

- radiography;
- magnetic particle;
- eddy current;
- ultrasonics; and
- dye penetrant.

About 70% of the costs for this service are recovered. A Ministerial Task Force is to examine this function, to establish whether it should be transferred to some other organization.

3.5.4.5 Non-Ferrous Advanced Materials (7042)

The objective of this sub-sub-activity is to support Canadian non-ferrous industry to assess market opportunities for advanced materials and to develop and implement new materials processing technologies.

Five broad areas of research have been identified and these are outlined below:

Rapid Solidification Technology (RST) Techniques are being developed for strip casting and producing reactive metal powders and flake. Several alloys have been identified which could be manufactured by these techniques. If Canadian industry exhibits sufficient interest, further work will be undertaken.

Metal Matrix Composites (MMC's) There are several problems in the production of MMC's which need to be resolved. If successful it could open up new Canadian industries such as the manufacture of tungsten carbide tipped mine drilling equipment.

Advanced Processing Techniques A variety of new techniques are being experimented with for the development of cheaper and better materials. Some of the techniques are: use of lasers, ion implantation, and vapour deposition. The laser work is conducted jointly with NRC.

Non-Metallic Materials This is a program to develop advanced ceramics for both structural and functional uses.

Non-Ferrous Products Projects are underway or are planned for high purity copper (in cooperation with Mineral Sciences Labs.), magnesium and nickel aluminide.

The projects are:

704201 - Rapid Solidification Technology;
704202 - Metal- Matrix Composites;
704203 - Advanced Processing Techniques;
704204 - Non - Metallic Materials; and
704205 - Non - Ferrous Products.

3.5.4.6 Cost Recovery (7091)

The objective of this sub-sub-activity is to increase research performed for industry on a complete or partial cost recovery basis in accordance with departmental policy.

3.5.5 MTL PROGRAM STRUCTURE[16]

The structure of these activities at MTL and their intended effects are depicted in the following program structure chart.

[16] The organization structure is under review.

FIGURE XII
PROGRAM STRUCTURE
METALS TECHNOLOGY LABORATORIES

Objective: To develop technology (i) to enhance Canadian capability and efficiency in the production, fabrication, and utilization of metals and materials
(ii) to increase the competitiveness and reliability of products
(iii) to provide policy support.

ACTIVITIES	FOUNDRY TECHNOLOGY	STEEL	NON-FERROUS ADVANCED MATERIALS	MATERIALS FOR RESOURCE INDUSTRIES	NON-DESTRUCTIVE TESTING CERTIFICATION
	. Foundry Process Development . Foundry Process Control	. Continuous Casting Processes . Flat Rolled Steel Products . Shaped Products	. Rapid Solidification . Metal-Matrix Composites . Advanced Processing Techniques . Advanced ceramics . Non-Ferrous Products	. Welded joints for off-shore structures . High temperature Petro-Chemical Reactors . Corrosion Control-Pipelines . Marine Vessels - Materials . Mineral Processing and Mining - Materials	. Certifying competence of NDT personnel
OUTPUTS	In-plant trials, demonstrations, workshops, presentations, reports, papers	. Products & processes . Reports, papers . Symposia, monographs, conference	. Workshops, seminar . Reports	. Workshops, seminar . Reports, papers	. Trained personnel
IMMEDIATE IMPACT	. Higher quality castings . Trained personnel . Improved standards	. Improved knowledge and application of steel processing . Mathematical models . Steels for automobiles and consumer products, off-shore and arctic environments	. New products and processes	. Improved fabrication, inspection and failure control technologies	. Availability of trained manpower
ULTIMATE IMPACTS	. Competitive Canadian foundry industry	. Improved technology and competitiveness in production of steel products . Ability of Canadian companies to supply special steels	. Competitive Canadian industry	. Development of standards . Increased use of Canadian steels for special applications . Increased safety	. Availability of trained manpower

PROGRAM EVALUATION COMPONENT PROFILE
CANADA CENTRE FOR REMOTE SENSING
(CCRS)

Program Evaluation Directorate
Energy, Mines & Resources

Source:
PE147/1989
March 1989

PART A. BACKGROUND

1. MANDATE

In 1971, the government approved the National Program in Remote Sensing and Energy Mines and Resources was given the responsibility to direct this program.

2. OBJECTIVE

The primary objective of the Remote Sensing activity is:

To improve remote sensing technology; to facilitate the acquisition and dissemination of remotely-sensed data and derived information needed for the management of Canadian natural resources and for the monitoring of human activity; and to assist the development of the Canadian remote sensing industry.

3. DESCRIPTION

In pursuing the above objective the Canada Centre for Remote Sensing has the following sub-activities (with the related sub-objectives):

i)	Satellite Data	To ensure the timely availability of remotely-sensed data from satellites for resource management and environmental monitoring.
ii)	Airborne Program	To establish and demonstrate improved airborne remote sensing technologies for resource management and environmental monitoring.
iii)	Data Applications	To establish and demonstrate improved remote sensing information extraction techniques and systems, as well as to develop and demonstrate practical applications of remotely-sensed data for resource management and environmental monitoring.

iv)	Application Services and Technology Transfer	To provide analysis facilities as well as information and advisory services to assist users in applying remote sensing technology to resource management problems; to increase the operational use of remote sensing data through technology transfer to resource management agencies; and to provide Canadian industry with technical assistance to facilitate the development of remote sensing products and services for domestic and export markets.

4. RELATION TO THE ESTIMATES PROGRAM[1]

The remote sensing activity is part of the Minerals and Earth Sciences Program which has the overall objective to ensure the timely availability of mineral policies, strategies and programs designed to maximize the contribution of the minerals and metals sector to the Canadian economy, and to provide timely scientific knowledge, data, technologies and expertise in the earth - and mineral-related sciences, with emphasis on the mineral and energy resources of the Canadian landmass and offshore areas.

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[1] This description is accurate at time of writing. Planned changes in the Program Activity Structure (PAS) will be taken into account during the evaluation study.

5. RESOURCES

i) Fiscal Expenditures

The approved and proposed cash flows and PY's for the program sub-activities are shown in the following table.

TABLE 1
PROGRAM CASHFLOWS AND PY'S
(000's)

		88-89	89-90	90-91	91-92
Satellite Data	$	38,536	22,117	9,765	7,407
	PY	47	50	26	26
Airborne Program	$	4,492	5,149	4,637	4,833
	PY	24	23	22	23
Data Applications	$	4,394	4,004	3,948	3,901
	PY	17	18	18	18
Application Services and Technology Transfer	$	3,281	3,414	3,448	3,299
	PY	20	16	16	15
Activity Management and Support	$	3,697	3,894	3,719	3,719
	PY	43	44	44	44
TOTAL	$	54,400	38,578	25,517	23,159
	PY	151	151	126	126

Included in the above cashflows is an annual allocation of $3.4 M for capital.

ii) Capital Assets

This activity uses an extensive set of capital assets composed primarily of electronics instrumentation and computing equipment, and also including a Convair CV-580 aircraft. In addition to the offices and laboratories situated in the National Capital Region, these assets are also deployed at the Prince Albert Satellite Station and the Gatineau Satellite Station.

PART B. ELEMENTS AND STRUCTURE

1. ELEMENTS

i) Activities

The Remote sensing activity is composed of the following sub-activities (and sub-sub-activities):

a) SATELLITE DATA

Objectives: - To ensure the timely availability of remotely sensed data from satellites for resource management and environmental monitoring.

1) Ground Segment Operations and Products

- Operate, through contract, ground stations for full coverage of Canadian territory for the regular, continuous reception and archiving of remote sensed satellite data.

2) Satellite Data Acquisition and Processing R&D

- Conduct research into new sensor data characteristics, storage media, processing techniques and distribution technology.

- Develop reception, archiving, processing and distribution technology for new satellite data (e.g. MOS-1, LANDSAT-6, ERS-1, RADARSAT).

- Develop new and upgraded systems with industry.

3) Space Programs R&D

- Develop a Canadian role in the space segment of international remote sensing satellite programs.

4) Space Programs (ESA)

- Exploit Canadian participation in ESA's ERS-1 Program and maintain continuity of SAR data through participation in ERS-2, or ESA Polar Platforms.

b) AIRBORNE PROGRAM

Objective: - To establish and demonstrate improved airborne remote sensing technologies for resource management and environmental monitoring.

1) Microwave Sensor R&D

- Develop new airborne and satellite microwave sensor and processing systems and transfer technology/ expertise to industry (e.g. IRAP).

2) Air Operations and Data Processing

- Ensure the provision of airborne microwave and electro-optical data, and maintain a national research facility for the development of new remote sensing technologies and applications development (e.g. RDDP).

3) Visible and Infra-Red Sensor Development

- Develop and commission new airborne and satellite passive electro-optical sensor systems.

c) DATA APPLICATIONS

Objectives: - To establish and demonstrate improved remote sensing information extraction techniques and systems, as well as to develop and demonstrate practical applications of remotely sensed data for resource management and environmental monitoring.

1) Information Extraction R&D

- Conduct research into digital methodologies (e.g. Artificial Intelligence) for information extraction from remote sensing data and its integration into other data sets.
- Conduct research into the electromagnetic properties of the Earth's surface and atmosphere to provide a scientific basis for future system development.

2) Land Applications Development

- Agriculture - Establish a crop information system integrating remote sensing with other data sets to provide quantitative yield information.
- Forestry - Conduct research into the relationship of microwave data and forest data requirements.
- Geology - Conduct research on microwave and optical data applications to mining and exploration operations.

- Establish a Geoscience Information Centre to provide integrated databases to the geoscience community.
- Hydrology - Conduct research into the value of SAR data for runoff prediction, reservoir management and flood mapping.
- Develop information systems to incorporate SAR data into hydrological information systems.
- Environment - Conduct research into the application of remote sensing data for environmental change detection.

3) Ice and Oceans Applications Development

- Upgrade ice information systems for operational use of satellite SAR data in 1990's.
- Develop an ocean information system incorporating SAR and optical satellite data.
- Conduct research into the relationship of remote sensing data and ice/ocean parameters.

4) Cartography Applications Development

- Develop collaborative and complementary R&D programs to exploit remote sensing data and technology for cartographic applications and export development.
- Undertake joint R&D and demonstration projects with the mapping community to develop map revision techniques both analogue (e.g. TM) and digital (SPOT); to extract cartographic features from remote sensing data; and to develop and evaluate DTM's using optical and SAR data.

d) APPLICATIONS SERVICES AND TECHNOLOGY TRANSFER

Objectives: - To provide analysis facilities as well as advisory services to assist users in applying remote sensing technology to resource management problems, and to increase the operational use of remote sensing data through technology transfer to resource management agencies and to provide Canadian industry with technical assistance to facilitate the development of remote sensing products and services for domestic and export markets.

1) Support to Industry

- Support the development of Canadian sources for remote sensing technology and services to the domestic market, and of a strong Canadian presence in world export markets.

2) Information and Liaison Services

- Provide users with information of remote sensing products and services.
- Promotion of Canadian remote sensing technology to the Canadian public.

3) Support to Provinces/Territories

- Support the development of effective operational use of remote sensing data in provincial/territorial resource management agencies under terms of MOU.
- Coordinate joint RDDP research programs with provincial agencies.

4) EDP Services

- Provision of image analysis and data processing infrastructure essential to national remote sensing program.

e) MANAGEMENT AND SUPPORT PROGRAM

Objectives: - To provide managerial direction and support services to the organization of the activity.

ii) Outputs

a) SATELLITE DATA

1) Ground Segment Operations and Products

- 1 000 000 LANDSAT, 250 000 SPOT scenes in current archive.
- ERS-1 imagery by 1991.
- Capacity for 2,500 processed images annually.
- Projected 1989-90 sales of $1,000,000.
- Regional distribution of EMR programs.

2) Satellite Data Acquisition and Processing R&D

- Technology to meet user needs for remote sensing data.
- MOS-1 Imagery in 1988.
- MOS-1 and SPOT Quicklook on Video Disk in 1988.
- ERS-1 Ground System installed in 1990.

3) Space Programs R&D

- RADARSAT: - Data sales of $200 million.

4) Space Programs (ESA)

- Access to technical information, data, and application experiment results.
- Continuity in technology/market development until RADARSAT.

b) AIRBORNE PROGRAM

1) Microwave Sensor R&D

- Fully operational x-Band SAR on CV-580.
- Canadian industry with state-of-the-art technology in 1988.

2) Air Operations and Data Processing

- 240 flying hours of CV-580.
- Capacity for 200 additional hours with external user funding.
- 35 hours of electro-optical data from industry.
- Processed imagery to clients (2500 to 3500 products annually).
- Polimetric SAR Capability in 1991.

3) Visible and Infra-Red Sensor Development

- Research papers.
- Data processing parameters.
- Proposals for joint sensor development.

c) DATA APPLICATIONS

1) Information Extraction R&D

- Upgraded facilities capable of dealing with basic methodology R&D of 1990's.
- Information extraction algorithms and techniques.

2) Applications Development - General

- Research support to CCRS and industry.

3) Land Applications Development

- Regional crop yield information by 1992.
- SAR application expertise in agriculture, forestry and geology by ERS-1 launch in 1990.
- Establishment of a Geoscience Information Centre in GSC.
- Value-added products.
- Algorithm for soil moisture determination from SAR.

4) Ice and Oceans Applications Development

- Ice Information System at AES ready for pilot operational program by ERS-1 launch.
- Data integration methodology in place to demonstrate ocean information products and sea-state forecasting ERS-1 launch.
- Specification of an operational Ocean Information System.

5) Cartography Applications Development

- Specifications for a MEIS-C sensor and cartography data formats for E/O and SAR.
- Improved map revision methodology for short-term commercial exploitation.
- Algorithms for cartographic feature extraction and DTM generation.
- National standards to facilitate the integration of remote sensing and other thematic data with the NDTDB in future GIS.
- Specifications for a PC-based cartographic workstation incorporating remote sensing data.

d) APPLICATIONS SERVICES AND TECHNOLOGY TRANSFER

1) Support to Industry

- Exchange of staff between industry and CCRS.
- IRAP assistance.
- Technical and funding advice to industry.
- Marketing promotion through media and trade missions.

2) Information and Liaison Services

- Telephone and computer access to CCRS services
- Library and bibliographic reference service.
- Reports, newsletters.

3) Support to Provinces/Territories

- Trained provincial staff.
- Demonstration of value of remote sensing applications.

4) EDP Services

- Over 2000 CPU hours on TSS to 150 active users.
- State-of-the-art image analysis and GIS facilities for remote sensing program development.
- Back-up for data processing systems in CCRS, and industry.

e) MANAGEMENT AND SUPPORT PROGRAM

-Planning, monitoring and reporting administrative services (property management, telecommunications, contract management).

iii) Impacts and Effects

a) SATELLITE DATA

1) Ground Segment Operations and Products

- accurate and timely information.

2) Satellite Data Acquisition and Processing R&D

- innovation in Canadian remote sensing industry to maintain and strengthen its place in world markets;

- evidence of government commitment to remote sensing technology, leading to further commercial activity and international confidence.

3) Space Programs R&D

- Canada a high profile full partner in international remote sensing;

- application and industrial benefits of $1.8 billion;

- continuity in technology advancement of remote sensing industry, essential to increase share of world market;

- Canadian influence on choice of new sensor's to user and industry's benefit.

4) Space Programs (ESA)

- increase industrial expertise and export capabilities in European and other world markets;

b) AIRBORNE PROGRAM

1) Microwave Sensor R&D

- accurate and timely information.

2) Air Operations and Data Processing

- expert advice/technology/facilities for technology transfer and development support.

3) Visible and Infra-Red Sensor Development

- maintenance and development of state of the art knowledge of VIR sensor.

c) DATA APPLICATIONS

1) Information Extraction R&D

- demonstrated value of advanced information extraction methods to operational users;
- technology transfer of software, hardware and scientific expertise.

2) Applications Development - General

- maintenance and development of scientific expertise.

3) Land Applications Development

- encouraged domestic use and export of services by Canadian industry;
- SAR imagery used in hydrology applications, ice form detection and flood mapping;
- domestic and export market potential of products and services.

4) Ice and Oceans Applications Development

- future domestic and export market potential for products and services.

5) Cartography Applications Development

- domestic and export market potential for products and services.

d) APPLICATION SERVICES AND TECHNOLOGY TRANSFER

1) Support to Industry

- industry more competitive internationally.

2) Information and Liaison Services

- CCRS activities and information is more accessible to any interested party.

3) Support to Provinces/Territories

- provincial research and resource management agencies prepared to exploit ERS-1 data.

4) EDP Services

- efficient services provided to CCRS and industry.

e) MANAGEMENT AND SUPPORT PROGRAM

-well managed and efficiently run program.

2. STRUCTURE

The Remote Sensing Program Structure Chart, Figure 1, illustrates the relationships associated with the activities, outputs, impacts and effects, and objectives. Its goal is to reflect the basic linkages of the program and to provide a summary of those items detailed in the text.

FIGURE 1
REMOTE SENSING PROGRAM STRUCTURE CHART*

	SATELLITE DATA	AIRBORNE PROGRAM	DATA APPLICATIONS	APPLICATION SERVICES & TECH. TRANSFER
ACTIV-ITIES-	- Operate ground stations for reception & archiving of rs data. - Research into new sensor data char., storage & proc. techniques. - Develop reception, archiving & proc. tech. for new satellite data. - Develop a Cdn. role in space segment of internat. rs satellite prog.	- Develop new airborne & satellite micro-wave sensor systems & transfer tech/ expertise to indus. - Provision of airborne data research facility for devel. of new rs tech. & applications - Develop & commission new airborne & satellite systems.	- Conduct research into: methodol. for extracting rs data & integrating into other data sets; - Applications for: forestry oper.; mining & explor. indus; environ. change detection; cartographic & export devel. - Undertake joint R&D & demo. projects. - Establish & upgrade info. systems which integrate rs data with other data to provide info. on: agriculture, forestry, geology, hydrology, & envir. - Ice & ocean info. systems.	- Support development of: Cdn. sources for transfer of rs tech. & services to Cdn & export markets; & oper. use of rs data. - Provide users with info. on rs prod. & services . - Promote Cdn. rs tech. to Cdn. public. - Provide image analysis & data processing support.
OUTPUTS	- 1 Million Landsat & 150,000 Spot Scenes. - MOS-1 imagery in 1988. ERS imagery by 1990. - Annual capacity of 2500 processed images & $1M sales. - Tech. to meet user needs for rs data. - Radarsat data sales of $200M. - Access to technical info., data & experiment results from space program.	- Operational X-Band SAR on CV-580. - State of art microwave sensor tech. in Cdn. indus. by 1988. - 240 flying hours of CV-580 & 35 hours of electro-optical data from indus. - Processed imagery to clients. - Visible & infrared sensor dev.	- Upgraded info. extraction facil. & algorithms & techniques. - Devel. research support to CCRS & industry. - S&R expertise in agricul., forestry & geology. - Establishment of Geoscience Info. Centre in GSC. - Value-added prods. - Info. system for ice & ocean info. - Improved map revision methodology for short term commercial exploitation. - Specs. for PC-based cartographic work station incorp. rs data.	- Staff exchange between indus., gov't & CCRS. - IRAP assistance - Marketing promotion through media & trade missions. - Telephone & computer access to CCRS services. - Library & bibliographic reference service. - Reports, newsletters, etc. - >2000 CPU hours on TSS to 150 users. - State of art image analysis facilities for rs program devel. - Back-up for data proc. sys. in CCRS & indus.
IMPACT & EFFECTS	- Accurate & timely ground segment info. - Application & indus. benefits of $1.8 Billion. - Cdn. influence on choice of new sensors to users & indus. benefit & increas. indus. expertise & export capabil. in world mrkts.	- Accurate & timely information. - Expert advice/ tech./facil. for tech. transfer & devel. support. - Maintenance & devel. of state of art knowledge of VIR sensor.	- Demonstrated value of advanced info. extraction methods to operational users. - Tech. transfer of software, hardware & sci. expertise. - Maintenance & devel. of sci. applic. expertise. - SAR imagery used in hydrology applications, ice form detection & flood mapping. - Domestic & export market potential for products & services.	- Indus. more internationally competitive. - CCRS activ. & info. more accessible to interested parties. - Prov. research & resource mgmt. agencies prepared to exploit ERS-1 data. - Efficient EDP services provided to CCRS & indus.
SUB OBJEC-TIVES	To ensure timely avail of rs data from satellites.	To establish & demonstrate improved airborne rs tech.	To establish & demonstrate improved rs info. extract. techniq. & sys; & develop & demonstrate applications of rs data.	To provide anal. facil., & advisory services. To increase operational use of rs data through tech. transfer.

REMOTE SENSING PROGRAM* — To improve remote sensing technology; to facilitate acquisition & dissemination of remotely-sensed data & derived information needed for mgmt. of Cdn. natural resources & for monitoring of human activity; & to assist devlpmnt. of Cdn. remote sensing indus.

MINERALS & EARTH* SCIENCES PROGRAM — To ensure timely availability of mineral policies, strategies & programs designed to maximize the contribution of minerals & metals sector to Cdn. economy, & to provide timely scientific knowledge, data, tech. & expertise in earth & min. related sciences, with emphasis on min. & energy resources of Cdn. landmass & offshore areas.

* This description is accurate at time of writing. Planned changes in the Program Activity Structure (PAS) will be taken into account during the evaluation study.

PROGRAM EVALUATION COMPONENT PROFILE
NATIONAL CONSERVATION AND ALTERNATIVE ENERGY INITIATIVE
(NCAEI)

Program Evaluation Directorate
Energy, Mines & Resources

Source:
PE140/1988
Sept. 1988

PROGRAM PROFILE

1. DESCRIPTION OF NCAEI

NCAEI was designed to address barriers to energy conservation and the use of alternative energy sources in the major end-use sectors of the economy through a range of methods including information dissemination, demonstrations, research and technology transfer. These activities replaced contribution programs (such as the Canadian Home Insulation Program (CHIP) and the Canada Oil Substitution Program (COSP)). This initiative targeted specific barriers and stressed cooperative federal provincial delivery via MOU's. Private sector investment and the development of its ability to promote their own projects was emphasized.

Federal-provincial/territorial MOU's have been signed with the following: Newfoundland, Nova Scotia, New Brunswick, Qu bec, Ontario, Manitoba, Alberta and the Northwest Territories. There are basically two ways in which activities may be carried out within the terms of the MOU: a **joint** activity is one in which the interested parties work cooperatively and share costs; or a **complementary** activity in which one party performs the activity but there is consultation and exchange of information between both parties.

2. CONSTITUENT PROGRAMS

NCAEI acts as an umbrella for most of the conservation and renewable energy programs administered through the Energy Programs Sector as well as some transportation programs administered through the Energy Commodities Sector. The following constituent programs fall under the NCAEI umbrella (see Appendix C for further details):

1. Forest Industry Renewable Energy (FIRE)
   (1979/80 to 1988/89 Total expenditure* $95.2M)

2. Natural Gas Stations T**
   (1983/84 to 1986/87 Total expenditure $6.1M)

* includes actual expenditures and forecast to end date
**T indicates that the program has terminated

3. Natural Gas Vehicle Grant Program T
(1983/84 to 1988/89 Total expenditure* $8.2M)

4. Propane Vehicle Grant Program (Road Vehicle to Propane) T
(1983/84 to 1985/86 Total expenditure $31.3M)

5. Federal Propane Vehicle Program
(1981/82 to 1988/89 Total expenditure* $8.2M)

6. Federal Energy Management Program (FEMP) (including FIRP and FIOOP) T (1980/81 to 1987/88 Total expenditure $145.3M)

7. Solar Energy Demonstration Program
(1983/84 to 1989/90 Total expenditure* $22.7M)

8. Remote Community Demonstration Program (RCDP)
(1984/85 to 1989/90 Total expenditure* $10.9M)

9. Alternate Energy Development Program (AEDP-ERDA)
(1984/85 to 1990/91 Total expenditure* $7.8M)

10. Low Cost Initiatives
(1981/82 to 1989/90 Total expenditure* $11.1M)

11. National Housing Program
(1985/86 to 1989/90 Total expenditure* $4.4M)

12. Joint Housing Program
(1985/86 to 1988/89 Total expenditure* $2.7M)

13. Super Energy Efficient Home Program (SEEH or R-2000)
(1984/85 to 1990/91 Total expenditure* $47.4)

14. Industry Energy Research and Development Program (IERD)
(1978/88 to 1987/88 Total Federal Funding* $33.9M)

* includes actual expenditures and forecast to end date

15. ENERDEMO

(1984/85 to 1989/90 Total expenditure* $40.5M)

16. Atlantic Energy Conservation Investment Program (AECIP) T

(1981/82 to 1985/86 Total expenditure $20.0M)

17. Industrial Conversion Assistance Program (ICAP) T

(1983/84 to 1986/87 Total expenditure $28.2M)

18. Canada Energy Audit Program (CEAP) T

(1984/85 to 1985/86 Total expenditure $12.3M)

19. BIOSYN Contribution (R&D) T

(1981/82 to 1987/88 Total expenditure $5.9M)

20. Motor Vehicle Fuel Consumption Standards

(1983/84 to 1990/91 Total expenditure* $2.9M)

21. Class 34 Capital Cost Allowance (1977 to 1989)

	Deferred Tax ($M1984)	Program Cost ($M1984)
to 1984	26.0	1.4
1985-1988*	8.0	.5
Total*	34.0	1.9

3. Relation to Estimates Program

NCAEI is the umbrella under which a variety of programs are delivered in order to meet the following Conservation and Renewable Energy Program objective: "To promote energy conservation and the development of renewable energy resources to meet Canada's energy requirements, and other economic, social, regional and environmental objectives."

* includes actual expenditures and forecast to end date

4. Resources

NCAEI received governmental approval in 1985. A total of $305.6 million over the three years of 1985-86 to 1987-88 and wind down costs of $133.3 million in 1988-89 and 1989-90 was approved. The related person-years and costs are shown in Tables 1 and 2 respectively. For further detail see Appendix C.

TABLE 1

NATIONAL CONSERVATION AND ALTERNATIVE ENERGY INITIATIVE

PERSON-YEAR REQUIREMENT 1985-86 TO 1989-90

BRANCH & DIVISION	1985-86 REF. LEVEL Main Est.	1986-87 REF. LEVEL Main Est.	1987-88 REF. LEVEL Main Est.	1988-89 WIND DOWN Main Est.	1989-90 WIND DOWN Main Est.
ECOS BRANCH	140	108	98	91	82
REGIONAL OPERATIONS	206	159	141	130	120
RENEWABLE ENERGY	51	45	44	42	39
TRANSPORTATION ENERGY	27	27	27	26	25
TOTAL NCAEI	424	339	310	289	266

TABLE 2
NATIONAL CONSERVATION AND ALTERNATIVE ENERGY INITIATIVE
FUNDING LEVELS 1985-86 TO 1989-90 ($000)[4]

BRANCH	1985-86 APPROVED RESOURCES	1986-87 APPROVED RESOURCES	1987-88 APPROVED RESOURCES	TOTAL 1985-86 TO 1987-88	1988-89 WIND-DOWN MAIN EST.	1989-90 WIND-DOWN REF. LEVELS
ECOS - TOTAL	66,300	49,700	47,100	163,100	29,728	21,502
RENEWABLE ENERGY	36,457	47,885(1)	35,314(1)	119,656	23,222(1)	18,764
- LESS NON-NCAEI	-	(4,727)	(3,929)	(8,656)	-	-
TRANSPORTATION ENERGY	14,300	13,205(2)	6,005(2)	33,510	8,821	7,119
- LESS NON-NCAEI	-	(1,005)	(1,005)	(2,010)	-	-
TOTAL NCAEI	117,057	105,058	83,485	305,600	61,771	47,385
REGIONAL OPERATIONS	9,193(3)	8,746(3)	8,797(3)	26,736	9,246(3)	8,359
TOTAL NCAEI & REGIONS	126,250	113,804	92,282	332,336	71,017	55,744

NOTES:

(1) Includes additional approved R&D panel funds.
(2) Includes $1,005K in each year 1986-87 to 1987-88 ($650K in 1987-88 and $550K in 1988-89 to 1989-90) from R&D panel for hydrogen research.
(3) Not included in NCAEI.
(4) Contributions to employee benefit plans are not included in the amounts above.