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Appendices: Technology Transfer from Federal Laboratories to Industry : App v.2

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Appendices: Technology Transfer from Federal Laboratories to Industry

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PROGRESS ON THE IMPLEMENTATION

OF

TECHNOLOGY TRANSFER

BY

DEPARTMENTS & AGENCIES

ATOMIC ENERGY OF CANADA LTD. (AECL)

The major objective of AECL remains the development and exploitation of a sound Canadian nuclear infrastructure capable of exploiting atomic energy in the national interest. AECL considers technology transfer as one of a number of tools to achieve its mission-oriented objectives. In the course of its mission, it has been necessary to transfer technology for the following purposes:

- to develop competent Canadian fuel and nuclear component supplies;
- to develop other Canadian nuclear-related businesses;
- to develop competent nuclear customers and regulators.

Approximately $5 million has been spent in industry in each recent year by the AECL Research Company for specific contract research. These expenditures have resulted in the transfer of technology from the laboratories to industry to help in the development of specific nuclear products. The industrial capability is now such that 80% of the value of the nuclear components of a CANDU plant are supplied by Canadian industry.

The most striking example of the successful transfer of technology has been that to the Canadian CANDU fuel manufacturers who now have annual sales of about $27 million (excluding the cost of the uranium oxide). Since nuclear fuel is mined, produced and manufactured in Canada, new Canadian jobs have been created. AECL is exploring ways to identify the companies which could most benefit for a number of years from the transfer of technology, not just those which could supply a small number of initial units (or provide a service) at the lowest initial cost. The main purposes of AECL's licence arrangements is intended to be: (i) to promote Canadian industry; (ii) to retain the control of the technology in Canadian hands; and (iii) to generate additional development funds.

The sectors of industry presently identifying their needs to AECL are Canadian utilities, some foreign organizations who often work on behalf of foreign utilities, and Canadian businesses involved in manufacturing, consulting or the service industries. Generally, these groups approach AECL to utilize the unique skills and test facilities of the research establishments.

AECL has undertaken a number of programs of research and development under contract for both domestic and foreign clients in areas where it has competence, and where such work serves to support its current nuclear program or strengthen its technological base. AECL considers that work of this nature presents an opportunity:

- to strengthen its technical skills and research facilities;
- to develop a greater appreciation within the Research Company for the needs of the nuclear industry;

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- to improve company's skills in project management, costing and scheduling;
- to bring work into Canada which otherwise might not come;
- for additional sub-contracting and with it the transfer of technology.

The laboratory staff encompasses a complete spectrum of technical disciplines and has had experience spanning the complete innovative process from conception through to demonstration and technological support. The facilities include AECL's research reactors, hot cells, and fundamental and applied laboratories.

Since AECL's recent reorganization, the need for Commercial Operations Offices at each Research Laboratory has been identified. A General Manager, Commercial Operations has been appointed at the Chalk River Nuclear Laboratory (CRNL). An office will be started at Whiteshell Nuclear Research Establishment (WNRE) in due course. The purpose of these offices is to pull together all of the commercial activities involving industry into one group at each site and to co-ordinate marketing, contract negotiations, pricing and licensing activities in a more business-like manner.

Technology transfer, as such, both within or external to the company, is a matter of day-to-day management and operating procedure. Although AECL has never acknowledged technology transfer as an objective in itself, it intends to continue to transfer its technology to industry in line with the government decision.

AGRICULTURE CANADA

Agriculture Canada describes technology transfer as one of the main objectives in its research and development programs - an established performance indicator of the department's research objective. The primary route of this transfer is through provincial extension departments to the producer, the farmer. Engineering and food processing technology is transferred to Canadian companies via contract and support programs.

The department identifies six recipients of its technology transfer efforts: the scientific community, producers, industry, other government agencies, the general public and international aid programs. In each case, different kinds of mechanisms are involved for developing interfaces with different users, ranging from scientific publications to contract programs.

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Cooperative Projects With Industry (COPI)

The department has sought the assistance of the COPI program to facilitate the transfer of technology developed in its laboratories to industry. Since April, 1979, as a part of this cooperative program, five contracts with a total value of $660,000 are in place. Six projects with a total value of $480,000 are in the process of contract negotiation, and five more proposals have been identified and are in various stages of development and evaluation. Two of the contracts are nearing completion and chances of commercial success are described as promising.

In addition, three other programs have also been developed. These are (i) a contract program to stimulate R&D in the processing, distribution and retail sectors of the food system, (ii) cost shared agriculture development subsidiary agreement, and (iii) farm development program.

Contract Program to Stimulate Research and Development in the Processing, Distribution and Retail Sectors of the Food System (PDR Program)

This program, which has the purpose indicated in the title, was initiated in 1978. It is administered by Agriculture Canada on behalf of five other federal departments (Industry, Trade and Commerce; Consumer and Corporate Affairs; National Health and Welfare; Fisheries and Oceans; National Research Council). An interdepartmental Approval Board exercises general supervision. Funding in 1979/80 was $900,000.

In the course of the first year in operation, approximately 120 proposals were reviewed and evaluated. Out of this number, the Approval Board has selected 48 proposals with a total value of $2.1 million. To date, 26 contracts have been let and 22 projects are in the process of contract negotiations.

Technology Transfer Projects Implemented Under Cost-shared Agricultural Development Subsidiary Agreements (1979-80)

The projects are administered by the provinces, and funded by DREE and the provinces. Agriculture Canada is represented on the management committees and is aiming towards national consistency in the terms and conditions of the programs, and a

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coordinated exchange of project information between provinces. The Research Branch of Agriculture Canada has provided lists of items of new technology that have been researched on its stations across the country and are ready for testing and development "in the field".

During 1979 about 140 technology transfer projects were at various stages of development under cost-shared agreements in six provinces. In British Columbia, the agreement was amended to include a technology transfer program in October, 1979. As of November, 1979, three projects are being approved and prepared for implementation. A subsidiary agreement with Saskatchewan was signed in May, 1979 with a technology transfer element. Eleven projects have been launched, about half of which involved demonstration activities on several farm sites. Winter wheat, special crops, vegetables and saline soils are covered by the program. Most of the Manitoba programs are of the technology transfer type. So far, fourteen projects have been started, almost all of which are on farms. A high proportion of the projects have demonstration activities, on a total of 126 sites. The commodities implicated are corn, soybeans, potatoes, forage, pasture, beef, hogs and some special crops. Soil and drainage methods are also included. In Nova Scotia, New Brunswick and Newfoundland there are over 100 projects being implemented, covering most commodities. Alberta, Ontario, Quebec and Prince Edward Island do not yet have technology transfer programs in their cost-shared agreements.

Technology Transfer for Agriculture Canada Farm Development Division

The Farm Development Division in Agriculture Canada came into being in April, 1979. It will contribute to the technology transfer process for Canadian agriculture. The Division is focused on farm level decision-making and will be providing various types of information to farmers and individuals who work with farmers to facilitate efficient management of Canadian farmers. Information regarding new or recently introduced technology will clearly form part of the total package. In addition, the Division continues to operate the Feed Freight Assistance Adjustment Funds. Elements of these programs in British Columbia and Ontario particularly contribute to the dissemination of new technology relating to livestock and poultry feeds and feeding.

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Policy and Program Development

In Agriculture Canada, Branch Heads are accountable for their successes and failures in implementing all departmental policies, including technology transfer. In the new Managerial Accountability System every Branch Head must have an Annual Work Plan and a Long-Term Plan (4 years). The work plans include not only planned operational results, resource cost estimates but also achievements or failures that are measured by performance indicators and standards.

In every appropriate Branch Sub-objective, one of the performance indicators must be the transfer of technology. With this built-in assurance that effective transfer of technology is part of every Branch "Objective" having elements of research and development, it is not considered necessary to write a separate work plan or objective for technology transfer.

Under the new Managerial Accountability System in the department more emphasis is placed on operational control. The control focuses on planned operational results and resource cost estimates. Since technology transfer is one of the criteria used in determining the degree of achievements or deviations in research work plans, the mechanism is in place for the assessment of technology transfer.

The department encourages its scientists to transfer technological findings and information. This activity is one of the six criteria used in rating scientists in the department. It also supports the transfer of scientists between government and industry laboratories to encourage the exchange of information and ideas. Negotiations are underway with the food industry for an exchange program of S&T personnel.

With respect to future potential in technology transfer, this may or may not be reflected in the Annual Work Plans. The latter are short-term goals and achievements are focused on results of the past year. The Long-Term Work Plan should expose future potential in technology transfer in those Departmental Sub-objectives having elements of research and development.

With regard to the involvement of the departmental laboratories, long-range procurement planning by Agriculture Canada, the nature of capital procurement in Agriculture Canada is stated to be such that this policy measure does not generally apply. However, the department acknowledges the awareness of this policy and the Source Development Fund.

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COMMUNICATIONS

The Department of Communications describes itself as committed to industry development through technolgy transfer.* The R&D work of the department is carried out under its two branches: Research and the Space Program.

Research

The responsibility of the Research Branch is to aid in the development of new communications systems, and to ensure that an adequate level of communications R&D capability is maintained in Canada. Its major research facility, the Communications Research Centre (CRC), has been responsible for several promising industrial initiatives, including the development of image technology and new home service 'Telidon' (previously known as the Canadian Videotex system).

Protection of the public interest in providing access to the communications system requires coordinating telephone companies, broadcasters and cablecasters, and the manufacturers of equipment as well as knowledge of the technology developed in its laboratory. DOC is currently involved jointly with the private sector in conducting field trials on the Telidon system, and anticipates the development of electronics production, standardization and system studies in the future.

Space

The DOC Space sector has been particularly successful in technology transfer because it has been pursuing a policy of:

(i) selective contracting-out in areas which have potential for saleable products or capabilities;

(ii) directing its technology transfer to companies which are particularly capable of consolidating and rationalizing those technologies with their existing capabilities or products;

(iii) supporting industry to further develop or produce prototypes, the feasibility of which has been already established;

(iv) working closely with, and understanding, certain segments of the electronics industry to promote and encourage a Canadian industrial capability to meet current and future space system requirements; and

*For detailed examination of the nature of technology transfer processes within DOC, see MOSST-DOC joint study entitled Technology Transfer from Department of Communications Laboratories: A Study of Eight Innovations, Government Projects Division, MOSST, March 1980

(v) maintaining an adequate R&D base.

Over 40% of the overall research budget and 85% of DOC's space budget has been committed regularly over the last few years to contracting-out. The department has also recently made use of the Cooperative Program with Industry (COPI) for technology transfer purposes.

Technology transfer is now recognized as an important aspect of appraisals of DOC scientists.

Interfaces with industry have been developed through the Directors of industrial programs in both the Research and the Space Program branches. The department has also in place an "industrial exchange program" to encourage exchanges of scientific personnel between government laboratories and the private sector.

DOC laboratories are used by industry for testing and quality control purposes. The facilities at the David Florida Laboratory, for example, are predominantly used by the space and electronics industry for vacuum testing and integrating the components of space subsystems.

In line with the recommendations made by the Communications Research Advisory Board (CRAB) to DOC, the department is intending to develop a memorandum to Cabinet, requesting an expanded mandate for DOC to develop a leadership role in the communications sector. The document will include specific reference to the transfer of technology to industry.

With regards to the procurement, DOC does not have identifiable "major" procurement programs. The department, however, under an interministerial agreement, does have some influence on the Department of National Defence procurement, but this interface is essentially advisory in nature.

ENERGY, MINES & RESOURCES (EMR)

Technology transfer is described by the department as having always been at the forefront of EMR policy.

A review of a number of EMR Branch activities on technology transfer was called for in August, 1978. The transfer potential of R&D work at the Canada Centre for Minerals and Technology (CANMET), for example, over the past eight to ten years, has been regularly monitored at review meetings held quarterly. The issue

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of technology transfer is now a part of EMR's structure of strategy objectives and long-range plans. Rather than develop a separate set of plans to cover technology transfer, EMR has included the transfer of technology as a specific item in each program where appropriate. At CANMET, sixteen separate and distinct methods of transfer have been identified, and are taken into consideration during program review and development exercise. Some of the other science-oriented branches of the department use different procedures but the need for technology transfer is recognized, and is regarded as essential in the effective use of R&D sources.

As a result of a recognized need to involve industry in the development of new systems and processes, EMR embarked on an expanded contracting-out program for energy-related R&D in 1974-75 with special emphasis on engineering design, pilot plant and prototype production. As industrial appreciation of the opportunities has grown since 1975, EMR's fully funded programs have now been modified to more and more cost-shared arrangements. The effectiveness and potential of technology transfer is considered greatest on cost-shared projects. The department has recently also made use of the Cooperative Projects with Industry (COPI) program and has found this program to be an effective mechanism for technology transfer.

ENVIRONMENT CANADA

Technology transfer is viewed by the Department of Environment as an essential part of its scientific activities since the department considers it in its own interest to have the private sector equipped to understand, to measure and to alleviate environmental problems.

In December 1978, in response to the Cabinet decision, the Department promulgated a policy directive concerning technology transfer aimed at its research laboratories. See Appendices V and VI. DOE recognizes that, for enhancing transfer, it may be necessary to modify administrative arrangements, a step which it is in the process of taking after having had some experience with implementation of the new policy.

Technology transfer, as a criterion, is used for judging the performance of the individual scientist.

Research managers are now informed that technology transfer should be considered as an integral part of their research planning. All DOE laboratories have been requested to analyze their performance in this area with a view to making improvements wherever opportunities

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can be identified. In addition to transfer mechanisms such as publications, seminars, training sessions and personnel exchange, DOE has also recently made use of financial incentives through the Cooperative Projects with Industry (COPI) program to achieve technology transfer objectives. As a measure of the effectiveness of transfer mechanisms within the department, a list of recent and current technology transfers is provided as Appendix VI. The list is not exhaustive but meant to be representative of the various types of transfer taking place within the department.

The Wastewater Technology Centre in Burlington and its Forestry Laboratories have been described by DOE as examples of its research establishments which predominantly exist for the purpose of achieving technology transfer. The Forest Products Laboratories, however, as of April 1, 1979, have been transferred to the newly created, nonprofit private corporation, FORINTEK CANADA.

FISHERIES AND OCEANS

The department has embodied in its objectives the government's objective concerning the transfer of intramural technology to Canadian industry. Fisheries and Oceans implements this objective through its annual program planning. As a part of the annual program review and evaluation process, laboratories are required to prepare an analysis of yearly contract commitments. Long range procurement planning is covered by the five-year vessel acquisition strategic plan, and through a comprehensive contracting-out analysis of the scientific programs of the east and west coast laboratories, prior to expanding any capital facilities.

Fisheries and Oceans also makes allowances for technology transfer in its operational and budgetary planning, particularly where follow-on commitments have been made under the DSS bridge financing program. Occasionally, technology transfer also requires "contracting-in" arrangements. To assist industry in the new initiatives, S&T equipment can be loaned; agreements are specific to each case.

HEALTH AND WELFARE CANADA

The Department of Health and Welfare considers itself committed to the policy of technology transfer as set forth in the Cabinet decision. All laboratories of the Health Protection Branch include the transfer of technology to industry among their objectives. In areas such as disease control (Laboratory Centre for Disease Control), contributions are made to technology in provincial and hospital clinical laboratories as well as in spin-offs of methodology to the private sector.

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The department sees the potential for the application of technology transfer initiatives in its food, drug and environmental health laboratories. In the food field, apart from undertaking research projects of industrial interest, the transfer effort includes the transfer of methodology and exchange of samples for analysis; short training courses for personnel from industry in, for example, food handling; brief residence of industry staff in federal laboratories to observe techniques; service as export consultants to industrial organizations whose recommendations affect industry; and service on joint industry - government technical bodies and working groups.

In the field of drugs, recognition of the value of technology transfer to industry has been embodied in the role and objectives of individual bureaus; and their work plans define on an annual basis, subject to annual review, the precise steps planned. The Health Protection Branch/Industry Research Seminars date back to 1967. Topics of importance to the drug industry are chosen and a series of one-day meetings developed to permit information transfer.

In another area of operations, Environmental Health laboratories have been able to proceed with technology transfer on a number of fronts. For example, in the field of chemical hazards, departmental officials have been successful in encouraging the creation of non-government testing facilities for use by industry. Through direct transfer of information and expertise, three laboratories have been developed to undertake mutagenicity tests (predictive of carcinogenicity) and one to undertake pathology studies on laboratory animals used in product testing. Similarly in the field of radiation protection, technology transfer has been achieved in the development of methodology for the measurement of uranium in the lungs of nuclear fuel workers, in the provision of advice to industry on the planning, organization and methodology of bioassay programs, and in the continuing exchange of ideas and analytical methods with radio-pharmaceutical manufacturers.

Technology transfer is described as a major element of merit for research staff and is viewed as an objective for senior managers. Laboratory directors review past performance and make plans for the future in technology transfer in the course of scientist appraisal, project review and approval and formulation of budgets.

Most of the procurement needs of the department are satisfied by standard items available commercially, but some laboratory needs are defined by staff, and made to order by Canadian industry, particularly in the area of animal caging and automated microbiological equipment.

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The department is of the view that there is a potential for conflict of interest and mission in that its first priority must be the formulation and enforcement of technologically sound and health protecting regulatory positions. However, in practice, the S&T personnel, wherever appropriate, do get involved in assisting industry to meet requirements for safe products. The techniques used include consultation on specific problems at the manufacturer's request, sometimes in the context of inspection, recall or enforcement action.

INDIAN AFFAIRS AND NORTHERN DEVELOPMENT (IAND)

There are only two laboratories in IAND. These two, which are the responsibility of IAND's Northern Affairs Program are located at Inuvik and Igloolik in the Northwest Territories. The responsibility of IAND with respect to these laboratories is administrative only. Laboratory facilities are provided to other departments and universities for research that they are undertaking in these geographic areas.

The department also relies on the publication of reports and papers as a mechanism for transferring technology.

NATIONAL DEFENCE

The Department of National Defence (DND) utilizes technology transfer as a means of maintaining and expanding the capability of the industrial base on which to draw for contracted-out research and development for the department. Technology transfer has thus been one of the department's objectives for some considerable time, and is viewed as an integral part of the planning process for DND's technical programs. The 1977 NDHQ Policy Directive P22, "DND Research and Development Policy" identifies, among the guidelines for selecting development projects, the contribution to the establishment, maintenance or growth of industrial technology in Canada.

The Defence Research laboratories have examined their existing programs and are looking into ways in which their technology transfer activities can be improved within budgetary and staff limitations and priorities.

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Technology transfer is among one of the major functions of the DND's Research and Development Branch (CRAD), where in most cases it has been considered as an integral part of the overall research-development-production process and is funded, where necessary, as part of R&D costs; or on a shared cost basis. Each case is treated according to its own merits. Funding is usually allocated from the R&D Branch budget, and is mainly a responsibility of a designated directorate of the branch, working in conjunction with technical, patent and military sales directorates of the Department, and in close accord with the Departments of Industry, Trade and Commerce and Supply and Services. In some cases "chosen instruments" have been utilized to facilitate transfer.

The Defence Research laboratories and the Headquarters scientific directorates are required to report to the Chief, Research and Development (CRAD) whenever a technology development has reached a stage that it should be considered for transfer to industry. This is usually at the proven feasibility or working prototype stage. Within the CRAD Branch, a Directorate of Industrial and International Research and Development has been instituted to identify and coordinate the implementation of technology transfer to industry. This directorate operates under the terms of reference formerly utilized by the Director General, Technology Transfer, as instituted in 1972. An arrangement has been made with the Department of Industry, Trade and Commerce (DITC) for direct liaison with the DND CRAD Branch to assist in identifying those in-house R&D projects that are suitable for exploitation, particularly by reason of high export potential.

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NATIONAL RESEARCH COUNCIL (NRC)

NRC Mandate and Industrial R&D

In recent years, NRC has been engaged in the systematic policy development of its role in supporting Canadian industry. The Blue-book objective of its 'Scientific and Industrial Program' is:

> "To provide a national foundation upon which to build for the creation, application and use of knowledge derived from the natural sciences and engineering".

Based on this objective, NRC has evolved its role to support Canadian industry as follows:

> "The application and use of engineering and the natural sciences to assist industry in Canada with the development of new and improved processes, methods, products, systems, techniques and services".

With respect to the implementation of the above, the following activity has been developed by the Council:

> "Research in Direct Support of Industrial Innovation and Development - Performance and promotion of exploratory and applied research in selected areas for the advancement of technology required for Canadian industrial development, through effective methods of technology transfer, financial assistance and selected cooperative projects on processes, systems, materials and products, to strengthen the research, development and innovative capacity of industry in Canada".

As an illustration of the magnitude of this specific activity, the budget in 1978-79 Main Estimates was $65 million, or approximately 36% of the total estimated NRC expenditures.

In response to NRC's mandate with respect to enhancing research and development in Canadian industry, several internal policies at the laboratory level have evolved over the past few years. They are now put together in the NRC policy document, Laboratory Role in Industrial R&D (See Appendix IV). The document was approved as an official statement of the NRC role in industrial R&D at the October, 1978 meeting of the NRC Council.

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Technology Transfer Programs and Mechanisms

Apart from the specific policies that are described in the above document, it is NRC practice that all program forecast proposals contain a discussion on the potential for extramural involvement. Plans are also underway to incorporate the evaluation of technology transfer as part of the review process of other related NRC programs, the Industrial Research Assistance Program (IRAP), and the Pilot Industry Laboratory Program (PILP).

PILP is a specific example of mechanisms evolved by NRC to facilitate the transfer of technology from federal laboratories to industry. Others include industrial liaison via the NRC Industrial Program Office, Technical Information Service (TIS) and laboratory R&D on behalf of industry such as the operations of the Division of Building Research and the National Aeronautical Establishment.

Last year, NRC initiated a new program with significant technology transfer ramifications - the "Incubator Program", which is aimed at fostering the growth of selected small, Canadian-owned, high technology industries by making NRC's premises and facilities available to them for the conduct of research and development. Joint projects are often conducted during which a company places its staff in NRC laboratories. In addition, NRC is currently considering a proposal for encouraging NRC staff to work for private sector employers or form their own companies while on a leave of absence from the Council for a period of up to three years. The performance of industrial liaison and technology transfer is now part of the formal promotional criteria for NRC's Research Officers.

PUBLIC WORKS CANADA

Public Works Canada (PWC) completed the phase-out of its Technological Research and Development Laboratories in October, 1978. Technological development and transfer is now the responsibility of the Assistant Deputy Minister, Design and Construction, and more particularly the Technology Directorate within that Branch. S&T policy review is underway in the department and on its completion the department is planning to issue a departmental directive on technology transfer, including an element related to transfer to the private sector.

A special study is also underway on the department's technical documentation activity. Policies on types of documents to be created, standards to be maintained, peer-review processes, and appropriate distribution within and beyond the department will be developed.

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Costs related to technology transfer are included in managers' budgets, and thus are borne by the relevant program. This practice will likely continue to ensure adequate and appropriate planning and accountability for technology transfer.

Mechanisms being used to facilitate the transfer of technology from Public Works Canada to the private sector include:

- publications;
- active participation of scientists in seminars, forums and conferences, and delivery of papers on their works and findings;
- training programs (Energy Systems Analysis and Government Master Specifications (GMS) - Thermography);
- subsidized access to computer programs (Meriwether Energy Systems Analysis);
- participation in the development of technology and assistance to industry (Purchase and use of Solar Heating Program of Assistance to Solar Equipment Manufacturers, the Low Energy Building Design Awards programs, and Computer Aided Design (CAD));
- liaison with private sector consultants;
- development of standards and systems (Government Master Specifications to National Master Specifications);
- coordinator/catalyst role (Chairing the Intergovernmental Design and Construction Committee on Metric Conversion);
- "Profile of Interest" Survey - to define target audiences for publications;
- reference to technology transfer in appropriate job descriptions.

TRANSPORT CANADA

The R&D function within Transport Canada has recently undergone a reorganization. A new directorate has been established to draw together certain of the R&D functions and provide a linkage between R&D and the department's Strategic Planning function. A key role of the directorate is the leadership responsibility to ensure sufficient information and awareness throughout the transportation community, and promote a coordinated, efficient national TR&D program.

The Transportation Development Centre (TDC), while not a laboratory, provides the focus for technological development within the department and has, as a core role, the responsibility to enhance technology transfer. The department has, in addition, eleven laboratories with unique missions as testing facilities in support of Transport Canada's regulatory functions. As such they do not, in general, contribute to "state-of-the-art" research.

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A significant mode of technology transfer with Transport Canada is through the contracting-out of the departmental requirements in science and technology to the private sector. At present, over 60% of the department's R&D requirements are contracted out.

The department has also set up four R&D advisory boards. These are the Aeronautical Advisory Board, the Highway Advisory Board, the Marine Advisory Board and the Rail Advisory Committee. The function of these boards is to provide direct contact with industry in both advising Transport Canada on the progress and problems in transportation research and development in industry and conversely, acting as a forum for the department to inform all performance sectors of related developments taking place within the department. Some of the boards have indicated the need for centralized information collection and dissemination, and projects have been initiated to locate and identify information sources and review the potential for centralized services.

The Transport Development Centre (TDC) of Transport Canada brings out an annual project directory which describes all of its projects and other significant activities. The directory is widely circulated to the transportation industry, followed up with a bimonthly news bulletin containing news of recent transportation developments. To support TDC, the department has a specialized library on transportation matters which handles a large and growing number of industry requests.

The Research Planning and Coordination Branch (DRPC), as part of its role in support of the Interdepartmental Panel on Transportation Research and Development, has developed and is maintaining a centralized data bank of ongoing and planned Transportation research and development throughout government, universities, and industry. In cooperation with the Roads and Transportation Association (RTAC), this data bank has been used to produce the latter's widely distributed annual Transportation Research in Canada document. Similarly, a directory of laboratories and testing facilities throughout Canada with potential for R&D is nearing completion. Its aim is to promote a closer linkage between government and industry and encourage, where appropriate, federal use of industry capabilities.

DRPC has also initiated an R&D planning process, the Planning Guidelines for Transportation Research and Development, that actively seeks advice from, consultation with, and participation of other government and private sector carriers and manufacturers in the development of R&D priorities.

APPENDIX II

SCIENTIFIC MANPOWER IN THE FEDERAL GOVERNMENT*** (PHASE II)

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SUMMARY

***The study comprising four working papers was released in April 1979, and was sent to science departments and central agencies for information and necessary action. One of these papers, "Recent Science Policy Initiatives and the Role of the Scientist and Research Manager in the Public Service", was also published separately and circulated widely within science departments.

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BACKGROUND

Over the past decade, several surveys and studies have been carried out to identify problem areas related to personnel policy in federal science organizations. In December 1970, a report entitled "A Study of Scientific Personnel in the Federal Government" was submitted to the Task Force which had been set up to review the organization of federal natural science. This report concluded that the research manager was the key figure in government science and, consequently, considerable emphasis should be placed on an analysis of his role as well as on the need for making him more effective as a manager of scientific activities.

A Public Service Commission study which followed in March 1974 recommended a "unified and coordinated approach to the training and development" of research managers. The study led to the establishment of a two-week PSC executive development course entitled, "Management Development for Research Managers".

MOSST involvement in this area resulted from both the recommendations of the Special Committee of the Senate on Science Policy (Lamontagne Committee) and the April 1978 Cabinet decision on the enhancement of technology transfer from government laboratories to industry. The latter specifically asked MOSST, among other initiatives, to examine related personnel policy issues in conjunction with TBS, PSC and science departments in order to facilitate implementation of government policy in this area.

In November 1977, MOSST released a report, entitled "Scientific Manpower in the Federal Government (Phase I)", which was circulated to major science departments for comment. While drawing a profile of the federal scientific community, the report confirmed the presence of most problems which had been identified in previous reports. The need to address these problems had, over the years, become more pressing in view of increasing budgetary restraints on all federal departments, the necessity for better accountability of federal programs, and the crucial role of the managers in the public service.

As a result of the response of the Treasury Board Secretariat, the Public Service Commission and science departments to the phase one report, it was decided that MOSST should first develop, in general terms, the government expectations of its scientists and research

managers. This was to be examined in terms of both their ongoing and new functions. It was considered that such a statement would provide the basic principles for developing procedures and standards for major phases of personnel management: staffing, job assignment, performance appraisal, training and development, promotion and transfer policies. In addition, this statement should also be useful in implementing personnel policy aspects of the April 1978 Cabinet decision on the transfer of technology.

Phase two of the MOSST study of "Scientific Manpower in the Federal Government" thus had the following terms of reference:

> "Prepare a statement of principles governing the role and performance of scientific personnel in the Public Service within the context of new policy directives and current constraints; and to develop mechanisms to enhance the mobility of scientists with a view to improving science and technology transfer to outside the government".

For purposes of this study, contacts were established in major science departments, the Treasury Board Secretariat and Public Service Commission. These contacts were particularly useful in discussing the first paper of the report which seeks to define the role of the government scientist and science manager. Extensive consultations were held with science departments in order to evolve a reasonably balanced perspective on new and ongoing functions of federal science organizations. The resulting paper was discussed at the January 1979 meeting of the Committee of Science ADMs so that it now reflects the consensus of the major science departments.

Comments of TBS and PSC participants were also helpful in examining the feasibility of implementing mechanisms for managerial innovations at departmental and central agency levels within existing administrative and budgetary constraints. Useful suggestions were made to develop mechanisms for enhancing technology transfer through the mobility of scientists within and outside government, as well as through evolving management training and development programs for scientific personnel.

PROJECT DISCUSSION

In view of new and ongoing expectations of government for its science missions, this report, prepared as a collection of four papers,* deals with the need for suitable modifications and innovations in the personnel management system related to scientific personnel in the public service. Its major aim is to provide senior managers with the flexibility to respond adequately to recent federal science policy and program thrusts. Each paper stands by itself, examining the need for improvements in various spheres of personnel management, and identifying a range of mechanisms and opportunities available to the managers for training and development of their scientific personnel.

In this summary, the four papers are briefly described along with their major conclusions. This is followed by a separate section which presents the recommendations for all the papers. The first one, entitled "Recent Science Policy Initiatives and the Role of the Scientist and Research Manager in the Public Service", develops a statement of government expectations of its science missions. It seeks to ensure that S&T-related policy and program thrusts are considered in the development of procedures and standards for staffing, training and assessment of scientific personnel. In the context of new and ongoing functions expected of science missions, appropriate recognition should be given to desirable organizational objectives as well as employee objectives; and both excellence and productivity (relevance to the mission) should be used in appraising all scientific activities - scientific research, research management or technology transfer.

The central theme of the second paper, "Training and Development of Research Managers in the Public Service", is that although the broad aims of management development are no different from those of non-scientists, in the management of science functions, particular types of management abilities and attributes are required. Science management within federal science-oriented departments is organized in terms of various functional levels, and the skills and talents to fulfil these functions vary from one level to the other. Departments, in conjunction with the Public Service Commission, should consider developing modules in the training and educational programs which would meet the functional needs of science organizations at all levels of management.

*Presented under separate cover entitled "Background Papers".

The third paper, "Temporary Movement of Scientists Between Government Laboratories and Canadian Industry", was prepared with a view to enhancing the transfer of federal know-how to industry through scientific personnel exchange programs. It was found that the movement of S&T personnel between government and industry has been largely confined to executive management development rather than technology transfer to industry through the exchange of scientific personnel at the laboratory level. The departmental efforts in this direction have been limited with no major initiative for enhancing technology transfer or for obtaining better customer/user orientation in the research work of their laboratories.

The final paper, "Renewable Term and Rotational Appointments", like the earlier one on temporary transfer of scientific personnel, has been included because of a recommendation in the Cabinet decision of April 1978 on technology transfer. MOSST, in this decision, was asked to examine the feasibility of renewable term appointments for research heads, with single term appointments becoming normal practice and technology transfer a criterion for renewability of the term. This paper shows that although the idea has certain advantages, the laboratory director in mission departments, unlike the department head at a university, is a line manager responsible for all aspects of managing the personnel and assets of the laboratory, and is accountable for the achievement of program results for which he is judged on a wide range of criteria such as relevance, timeliness and communicability of results, as well as their scientific quality. The conclusion is developed that the use of such appointments would offer no real advantage to departments. Two alternatives are examined. First, departmental laboratories require a major review of their work at least every five years to ensure that they continue to respond to departmental missions. At the same time the position and performance of the laboratory director would be assessed according to the above criteria in addition to the regular appraisal procedure. External monitors could be included to examine the quality of work performed. Second, the use of rotational assignments at two levels, involving primarily coordination functions, is proposed for the purpose of training and development of scientific personnel.

Several assumptions are common to all four papers. Firstly, the science manager is the key figure in the government science system. The quality of the management of

science in federal laboratories is fundamentally dependent on the quality of the science managers. Secondly, to be an effective science manager, knowledge of general management is necessary but not sufficient. Special skills and attributes are needed to manage science activities and highly qualified personnel. An appropriate mix of talents and skills will have to be achieved comprising the specialized knowledge and experience for research management with the aptitude and skills for general management. Thirdly, any training and development of scientific personnel in the public service must meet the objectives of a federal science organization, the department and the government as a whole. Finally, the organization and nomenclature of science units within federal departments and agencies vary according to their functions, size, geographical dispersion, and the nature of their clients.

The study has not discovered new problems. Those problem areas identified earlier by a task force to examine scientific personnel in government [2] continue to exist. Due to slow progress over the years in modifying structural mechanisms, the desirable flexibility for senior managers in meeting their organizational objectives has not been achieved. This report provides an overview of the situation by bringing together four major issue areas pertaining to improving the effective utilization of highly qualified personnel in science organizations. In each area several mechanisms are examined with the conclusion that the choice of one over the other, or of two or more in combination, would vary from department to department, depending on the preference of the various managers concerned as well as organizational needs.

[1] For a detailed discussion of trends in this direction, see:

Public Service Commission, Public Service and Public Interest, Ottawa, 1978.

[2] W.L. Ellis, A Study of Scientific Personnel in Government, a report prepared for the Task Force to review government's natural science organization (Chairman: Dr. Pierre R. Gendron), December 1970, Ottawa.

RECOMMENDATIONS

Recommendations resulting from this study are summarized below and are identified by each paper.

Recent Science Policy Initiatives and the Role of the Scientist and Research Manager in the Public Service

Recommendation 1 : *Science-oriented departments and agencies, in conjunction with MOSST, should ensure that those engaged in federal scientific activities are aware of new and ongoing expectations by the government of its science missions as identified in the 'Role' paper.*

Recommendation 2 : *Science-oriented departments, Treasury Board Secretariat and the Public Service Commission should apply the principles enunciated in the 'Role' paper to the various functions of personnel management (staffing, job assignment, performance appraisal, training and development, promotions and transfer of personnel) for all scientific occupational groups in order to align knowledge, skills and experience of government scientific personnel with federal science policy and program thrusts.*

Training and Development of Research Managers in the Public Service

Recommendation 3 : *The Treasury Board Secretariat, in conjunction with the science-oriented departments and the Public Service Commission, should consider establishing an interdepartmental committee on training and development (T&D) of science managers to identify the T&D needs of science departments, and to coordinate the effort required for effective action at departmental and central agency levels.*

Recommendation 4 : *For centrally established programs, the Public Service Commission should examine the feasibility of developing a series of course packages/modules for training and development of science managers at various levels of management, based on identified needs. Active participation of departmental science managers and training and development officers should be sought for developing these courses which would emphasize training and development needs of existing personnel through creating an awareness of contemporary R&D management skills and techniques.*

Recommendation 5 : *Departments in consultation with the PSC should identify those areas in the training programs which could be developed internally and those to be acquired from interdepartmental and external sources. This would also involve a comparison of sources for course content, fees, dislocation costs and course development charges.*

Recommendation 6 : *As part of its executive education program, the Public Service Commission should examine the feasibility of including in their courses on executive training content to familiarize managers with or without a scientific background, with the purpose and use of scientific activity in a government setting and its linkages with other sectors.*

Recommendation 7 : *Science-oriented departments should develop in conjunction with the March 1977 policy directive of the Treasury Board on "Identification of Training and Development Needs and the Evaluation of Results" sufficient information to integrate human resource planning systems within departments with training and development requirements of the various levels of science management.*

Recommendation 8 : *Departments should encourage both the science managers and the training and development (T&D) officers to become aware of available opportunities and to set up the desired program standards to develop appropriate T&D plans for each research establishment.*

Recommendation 9 : *Departments should encourage on-the-job training assignments for development of science managers, combined with an educational curriculum to improve skills in particular areas of management. Such career assignments can be developed through rotational positions within the laboratory setting, or outside it within the department, interdepartmentally or through exchanges with other sectors.*

Temporary Movement of Scientists Between Government Laboratories and Canadian Industry

Recommendation 10 : *Based on the approach followed by the Office of the Auditor General, the Public Service Commission in conjunction with the Treasury Board Secretariat, should examine the Interchange Canada program for the purpose of using this mechanism to establish a specific exchange program for R&D personnel with the objective of promoting technology transfer from government to industry at the laboratory level, as well as developing managers. Criteria for eligibility would be related to the needs of the individual, department and industry sector.*

Recommendation 11 : *The Treasury Board Secretariat, in conjunction with MOSST and science-oriented departments, should take steps to modify existing policies, relevant Personnel Management Manual (PMM) chapters, and related mechanisms to remove identified impediments to exchanging scientific personnel between government laboratories and industry in the following areas: leave of absence, pay and benefits, secondment, and personal services contracts in order to facilitate such exchanges and to improve their effectiveness in technology transfer and contracting-out, and their response to other government policies for R&D.*

Recommendation 12 : *The Treasury Board Secretariat, in conjunction with MOSST, the Public Service Commission and science-oriented departments, should develop a long range plan for the gradual increase of exchanges between the government laboratories and industry.*

Recommendation 13 : *In view of the limited nature of movement of scientific personnel between government and industry, the Public Service Commission and the Treasury Board Secretariat should publish and circulate a bulletin on available programs, mechanisms and criteria for exchanges between the two sectors, in industry as well as in federal departments.*

Renewable Term and Rotational Appointments

Recommendation 14 : *The laboratory director, being a line manager, is responsible for producing research results in support of the department's mission, and for managing the personnel and assets of his laboratory to this end. His performance is judged on*

the basis of his success in contributing to the mission; criteria such as relevance, timeliness and communicability of results (as well as their scientific quality) are applied. In order to ensure that this response to the departmental mission continues regular annual appraisals should be augmented by a major review of his performance and of the work of the laboratory at least every five years.

Recommendation 15 : *Further to the foregoing recommendation, rotational appointments should be considered for positions involving primarily coordination of R&D activities, for the purpose of training and development, at levels below the laboratory director and the director general.*

Recommendation 16 : *Departments and agencies should identify those positions in research establishments, and in research planning and coordination, which are appropriate for rotational appointments and develop the necessary criteria for defining the positions based on the nature of the S&T functions, organizational structure and nomenclature, and the size and geographic distribution of the research establishments.*

Recommendation 17 : *The Treasury Board Secretariat and the Public Service Commission should examine ways to facilitate the use of rotational appointments, by developing criteria necessary to select and appoint candidates, appraise their performance, and return the incumbents to line functions so as to benefit both the individuals and the organizations.*

Recommendation 18 : *The Treasury Board Secretariat and the Public Service Commission, in conjunction with MOSST, should examine the possible impact of any new government personnel policy proposals (e.g. Senior Manager classification) on movement of federal scientific personnel within a department.*

APPENDIX III

WORKING PAPER

PROVISION OF SCIENTIFIC & TECHNICAL SERVICES

BY

FEDERAL LABORATORIES TO INDUSTRY

BACKGROUND

In December 1978, MOSST approached several science departments and agencies to review the progress made in the implementation of the April 1978 Cabinet decision on "Enhancement of Technology Transfer from Government Laboratories to Industry". The intent was to identify the actions taken by the departments on the initiatives as well as to obtain comments on any difficulties departments may have met in technology transfer and suggestions for modifications or additions to the initiatives which might improve this transfer to industry. A need for the closer examination of scientific and technical services provided by the federal research establishments to industry was suggested, in particular, for the use of unique federal S&T facilities and expertise by industry. There was considerable consensus among the departments that adequate recognition and support should be given to federal laboratories for the specialized scientific services which they provide to industry on a cost-recovery or shared cost basis.

INTRODUCTION

The work done on behalf of industry under departmental programs falls into two categories: the services that are provided because of collective choice, and those that are

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provided on the basis of payment for the use of services.[1] The focus of this paper is on the latter where services of public importance are rendered by the government to individuals at their specific request. Since the services are rendered at the option of identifiable individuals, the cost of these services is generally borne by them. The nature and extent of the services provided, however, varies from department to department depending on factors such as the mandate of R&D establishment, ongoing programs, and the availability of both expertise and facilities for outside use.

PURPOSE

The purpose of this paper is to describe the special circumstances and conditions under which scientific services to industry and other customers are provided by federal research establishments. This is done by examining the practice of some of the federal departments and agencies in this area: the conditions under which S&T activities on behalf of companies are undertaken, the nature of the work performed, the type of customers, industry's view of the usefulness of federal laboratories, and the impediments to such practice.

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1 Treasury Board, Guide on Financial Administration for Departments and Agencies of the Government of Canada

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Federal contracting-out policy asserts that as a general principle, the government's mission-oriented S&T requirements must be contracted out to the private sector, but at the same time, among other criteria for carrying out R&D work in-house, it recognizes the useful role of federal laboratories and their scientific personnel in this area. Exceptions to contracting-out of research to industry may therefore be provided:[2]

> "where the conduct of science and technology is necessary to the effective support and operation of in-house facilities which provide federal testing and research services that are agreed, after appropriate consultation, to be necessary to Canadian industry."

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[2] Treasury Board, Policy and Guidelines on Contracting-Out the Government's requirements in Science and Technology, p. 5.

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SPECIAL CIRCUMSTANCES

In general, scientific and technical services are provided to industry by federal research establishments in either one, or a combination of, the following three situations:

- In support of government's contracting-out research and development activities in order to meet departmental program requirements and needs. This may involve the use of federal equipment and expertise.
- To assist industry in solving its scientific-technical problems as requested either by an individual company or on a sectoral basis through the use of unique facilities and/or specialized personnel not available in the private sector.
- To familiarize industry with the relevant R&D programs, expertise and facilities having potential use for industry, which are available in federal laboratories.

Most of the services provided to the private sector on a contractual basis have been carried out to meet either of the first two situations. Under these two sets of circumstances, the service performed is generally of a "routine" or "non-routine" nature. For the routine work, related to testing and analysis performed for outside organizations for which available standard procedures have been prepared, an approved fee has been set by the department or by an Order-in Council. Non-

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routine work, on the other hand, deals with services performed for which no exact price can be quoted until the work is completed because of its magnitude, complexity or unpredictability. Generally, this type of work is of a definite duration and has a unique objective. For non-routine work, research/development contracts are used in which both parties agree on their specific contributions to the project.

For familiarizing industry with R&D skills and programs of federal laboratories, the traditional method for communicating information to industry has been through the dissemination of published material. Little effort has been made to transfer such know-how by obtaining scientific personnel from industry groups to work on the initial stages of a research project within the government laboratories.

In the following section, examples of this practice by selected departments are described to illustrate policies and procedures pertaining to both "routine" and "non-routine" types of services to industry. Examples of this practice within Energy, Mines and Resources, Department of Communications, and the National Research Council illustrate conditions for carrying out routine testing and analysis services in their establishments. The use of R&D contracts by the National Defence and AECL, on the other hand, shows a project approach to the provision of services

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in order to meet a specific departmental priority program.

EMR - Canada Centre for Mineral and Energy Technology (CANMET)

The Canada Centre for Mineral and Energy Technology (CANMET) is a part of the Department of Energy, Mines and Resources, charged with the responsibility for carrying out EMR's Mineral and Energy Resources Programs. This program aims at ensuring the effective use of Canada's mineral and energy resources by determining the country's natural resource potential, improving resource technology, formulating and implementing policy, and providing governments, industry and the public with information related to mineral and energy resources.

Employing 700 scientists, engineers, technicians and support staff, CANMET is Canada's largest research organization serving the mineral and energy sectors. Because of its unique facilities and specialized personnel, CANMET often renders certain types of scientific services such as performing test analyses, investigations and research and development, and some advisory services at the request of outside organizations.

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The Centre accepts these outside assignments only when the following special circumstances apply:

a) when this work cannot be provided by commercial laboratories or by other organizations or individuals;

b) when an offer to perform the work will not interfere with CANMET fulfilling its own research program; or

c) when the work may benefit the Government of Canada or general public.

Among the unique CANMET facilities which are frequently used by outside organizations, are a pilot scale boiler, a flame research furnace, a rolling mill and a Cam Plastometer. The boiler and flame research furnace are used by industry to study burning characteristics and relative efficiency of various types of fuels. The rolling mill and the Cam Plastometer are used for simulating instrumentation and for testing strength of metals. The present replacement cost of this equipment is estimated to be around $1.5 m.

In 1978, the Centre provided scientific and technical services to seventy companies. A majority of them were small and medium sized companies and the services provided were essentially of testing and analysis type, more than 90% of the jobs done were under $400. Major contracts were

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entered, however, with bigger organizations such as Imperial Oil Co. and Ontario Hydro. The total revenue earned in 1978 through CANMET services to industry was estimated at $800,000.

In order to carry out scientific activities on behalf of industry the Centre has, over the years, developed administrative and financial procedures in accordance with the Treasury Board's directives on financial administration. Any authorization for performance of outside work requires the following basic information:

a) project description

b) cost

(i) estimated total cost

(ii) estimated time to complete

(iii) cost sharing agreements with EMR (if any)

(iv) expenditures by type to be covered by a special deposit account

(v) amount required from customer to establish a special account

c) personnel requirements

d) relationship of the project to departmental goals and objectives

e) effect of project on existing departmental programs.

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CANMET has been authorized 19 unfunded man-years for the provision of services to outside organizations. The cost structure of fees for routine work is essentially based on full cost-recovery basis. In addition to the number of working hours spent, the fees also cover relevant divisional, branch and departmental overhead costs plus the depreciation on capital. Whenever non-routine work is undertaken, the job is carried out on a shared cost basis. CANMET makes its contribution in kind (expertise and facilities) whereas the customer's contribution is in terms of incremental costs. These costs generally cover the salaries of the unfunded man-year personnel, materials, special attachment or equipment needed for the experiment.

NRC - National Aeronautical Establishment (NAE)

Research establishments of the National Research Council have over the years evolved individual policies based on their specific expertise and facilities for providing cost based services to their particular clientele. The general criteria for charging for these operations are stated in the

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* If additional unfunded man-years are needed, a request for man-years without dollars is included in the main estimates for the coming year.

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Council's Standard Operating Policies and Procedures. In the case of NRC's National Aeronautical Establishment which has within its laboratories, facilities and expertise specialising in aerodynamics and materials, the services to outside organizations or a private individual are provided only when:

- the service is not available in the private sector;
- the service is unique and would be expensive to duplicate anywhere else in the country; and
- the service provided is relevant to an internal research program.

The National Aeronautical Establishment has a number of wind tunnels (18 in all) which are used not only by the aviation industry, but by many other industries interested in the effects of wind on their products, particularly the construction and automobile industry. The 30 foot low-speed wind tunnel is one of the largest of the new generation of its kind and when completed in the early seventies was estimated to have cost $7,000,000.

This tunnel has been in constant demand. More than seventy-five percent of its utilization is for testing purposes, the remainder of the time is required to support internal research programs. In 1978, more than 50 companies

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made use of the tunnel earning annual revenue of approximately $1,500,000. Since 1962, NAE has received for services rendered to outside organizations more than $12 million in fees.

Where a research project is undertaken at the request of an individual company, it is NAE's policy to charge that company for the service provided, and the research results are treated as confidential for an agreed period. Only cases where a project is undertaken for the benefit of a whole sector, or for industry in general, is the cost assumed by the Establishment, and results are then made freely available to interested parties.

The fee structure should be competitive with the comparable use of facilities and expertise outside Canada. A distinction between Canadian and foreign users in charges for services is made; for example, the foreign companies must pay for the amortization costs of the capital facilities, unlike their Canadian counterparts.

Revenue generated through these services is collected centrally by NRC as a separate employer. At the discretion of the Vice-President (Laboratories), some of the reveneue is returned to the establishment involved, some is kept for reallocation, and a portion is used to reduce the appropriation required from Parliament. NAE is allowed to hold on to up to 25% of revenues for incremental costs. As a separate

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employer, NRC has obtained special authorization from Parliament to carry over up to $2 million collected as revenues for services to enable it to provide specialized services to outside organizations.

DOC - David Florida Laboratory and High-Reliability Laboratory

The two laboratories of the Department of Communications are extensively involved in providing services to the Canadian space and electronics industry. Conditions for providing services to outside clients in the case of these two laboratories are not significantly different from other departments and agencies. The work is carried out in-house only if it cannot be performed in the private sector. However, unlike other government facilities, the David Florida Laboratory's mission has been recently expanded to include support to the government's objective to develop and demonstrate Canadian capability to act as a prime contractor for the supply of complete satellites for both domestic and export markets. In this, the David Florida Laboratory is expected to provide both government agencies and industry the use of its facilities for the integration of spacecraft.

For testing the spacecraft components and assembly of space subsystems, the Florida lab has a unique vibration and vacuum testing facility, the largest of its kind and most

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complete in the country. The replacement cost of the present equipment is estimated to be around $7,000,000. The lab facilities are predominantly used by high technology companies, both big and small. Like NRC's Wind Tunnel, most of the utilization of this facility is for testing purposes for outside customers, only 10 percent of the equipment utilization time is available for internal research purposes. Last year, the laboratory earned $700,000 in revenues for providing services to outside organizations.

In the case of the High Reliability Laboratory which specializes in the development and application of techniques for assessing the reliability of electronic subsystems and components, particularly the semiconductor devices, the laboratory seeks to support the high priority projects of both DOC and Canadian industries in the space sector. Its facilities comprise a wide range of electron microscopes, laser equipment and general testing equipment. The value of the laboratory's facilities to industry is its ability to provide both equipment and competent expertise with a back-up knowledge in solving individual industry problems. Researchers from both the industry and government sectors welcome the opportunity to benefit from the interaction and to discover a wider range of the techniques developed in the laboratory setting.

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DND - Defence Research Establishments (DRE)

Use of DND facilities by industry is encouraged when considered practical. Generally, two types of situations exist. In the first case, DND may wish to have a contractor on the site to do a job. For example, in the development of laser technology in the sixties, DND invited personnel from Bristol Aerospace Company to work on the initial stages of prototype development in their laboratories at Valcartier. In the second case, a contractor may wish to use DND resources for personal projects.

DNDP 55 sets out the policy and procedures governing the provision of services to non-defence agencies. DND considers its resources as an important reservoir of skills and capabilities which can be drawn to contribute to the economic development of Canada.

According to DND regulations, the diversion of departmental resources, skills and specialities, to other than departmental tasks should be provided only when prompted by necessity; or in the national interest. Assistance is only given where a civil capability clearly requires augmentation.

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In general, the following relevant criteria are applied prior to providing such a service outside DND establishments.

a) The service must be in the public interest and consistent with the purposes of government policy;

b) The service must not compete with or duplicate similar on-going activities of the civil sector to the detriment of these civilian activities; and

c) The service should not be on a continuing basis since the department should encourage the civil sector to be independent of such support.

The provision of these services are subject to a written agreement completed in advance; the terms of the agreement should not exceed one year.

DND's research establishments' experiences with developmental contracts for technology transfer have been very productive in terms of enabling firms to produce new products based on departmental innovations. As in the case of DRE Valcartier and Bristol Aerospace's cooperation in the design and development of the various Black Brant rockets and the rocket fuel, the use of government facilities and interaction with scientific and technical personnel in the initial stages of the project proved beneficial in achieving a better understanding of DND specifications and design before eventual product development.

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AECL - Chalk River Nuclear Laboratories (CRNL)

Over the past 15 years, AECL has employed R&D contracts with industry in order to transfer technology for improved operation and easier maintenance of nuclear plants. To provide product development under contract to CRNL, AECL invites the manufacturing company to attach its staff to the nuclear laboratories. The expertise necessary is generally not available within the industrial company itself. The purpose of such personnel secondments is to enable the industrial company to build up its technological expertise in a specific field. Staff are attached for one or two years and are part of AECL's research program. The number of staff varies considerably from year to year but is generally around 25.

Discussion

In summation, the foregoing examination of the current practice of S&T services to industry by federal laboratories indicates three types of situations:

a) When the outside organization wants to use federal facilities and expertise for the organization's objectives (e.g. testing and analysis services)

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b) When the services of an outside organization are needed to improve or contribute to the on-going work in a federal laboratory (eg. hiring or secondment of industry personnel); and

c) When both the outside organization and a government department or agency can mutually benefit from a joint performance of scientific activities in federal laboratories (eg. in support of a 'chosen instrument' or developing 'prime contractor' capability in a particular industry sector).

The practice of various science-based departments and agencies indicates that there are three major conditions under which S&T activity may be performed in a federal laboratory for industry.

(1) Lack of availability of the service in the private sector

The services by the federal laboratories to industry are provided only when they are not in competition with the private sector, and are not easily available elsewhere in Canada. These services are located in the public sector mainly because industry, in the past, has not found it profitable to venture into this area.

Private companies, particularly small rapidly growing high technology companies, have been reluctant to invest in capital equipment and facilities for two reasons: their low capital equity and a slow rate of return on capital investment.

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For a quicker rate of return on testing equipment, these companies must have a higher continuous volume of testing. At the same time, equipment maintenance necessitates both the capacity and the financial commitments to employ knowledgeable and experienced staff to handle such equipment.

Public sector management of these facilities is considered positively by many smaller companies because government establishments provide effectively both continuity and a base of back-up knowledge. These would not normally be available if the facilities were run by private companies. Also, government facilities appear to avoid any conflict of interest vis-a-vis other companies. The testing and evaluation services, for example, should be operated by an entity which is independent of the commercial interests in a particular industry sector. For export purposes, the data obtained from government laboratories by private companies is considered 'authoritative' and 'neutral' for use in contract negotiations.

(2) Support of Intramural Research Program

The services provided to industry should have relevance to the in-house research program. The federal scientific personnel liaising with industry should accomplish two tasks at the same time. They should apply the techniques being

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developed within the government laboratories to solve industry problems; and at the same time, through this contact, they should come to know more about industry's own scientific endeavours and problems. This process has been described as beneficial to federal scientists in improving the state of the art and keeping their skills and public facilities updated. In the case of DND and AECL, use of industry personnel during the early stages of a research project with government scientists in government laboratories helped to facilitate the easy transfer of research designs to industry.

In the early seventies, DOC's Communication Research Centre (CRC) made extensive use of industry personnel to support a DOC program for developing a Communication Technology Satellite. CRC took the research initiative and development risks in-house while a policy of using industry where necessary to transfer full capacity to the industrial sector was promulgated by DOC. As a result, at one stage CRC had approximately 125 people working on the new satellite program and of these, only about 25 were government employees.

(3) Benefit to the Government of Canada and the Canadian public

The above DOC-ISIS Satellite program can also be cited as an example of a program where joint government-industry effort was

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explicitly aimed at supporting a government priority. The government has in recent years identified other areas (in addition to space) as being of special priority e.g. energy, oceans, food etc. Government policies on regional development and industrial goals may further define circumstances under which scientific services may have to be provided to outside organizations if they can not be easily performed by industry. Support may also be provided to government's "chosen instrument" or "prime contractor" in its effort to develop a stronger industrial capability in a particular sector.

INDUSTRY VIEW OF FEDERAL LABORATORIES

In 1974 the Science Council, in order to obtain the views of the private sector on their experiences in the use of government laboratories, conducted a survey of Canadian manufacturing firms with R&D units.[3] These were the firms which most likely would have interacted with various government R&D establishments. Of the 179 respondents to the Science Council questionnaire, 40% stated the single most important reason for contacting a government research establisment was

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3 Arthur J. Cordell, James Gilmour, The Role and Function of Government Laboratories and the Transfer of Technology to the Manufacturing Sector, Science Council of Canada, Background Study No. 31, pages 279-346.

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"high quality of expertise and availability of special expertise". This was followed by special facilities available in the government R&D establishments. See Table I:

Table I - Most Important Reason for Contacting a Particular Government R&D Establishment

Reason	Percentage of firms
1. High quality of expertise, availability of special expertise	40
2. Special facilities of the establishment	30
3. Interest, motivation of the staff of the laboratories	7
4. Cheaper or more convenient than other sources	5
5. Last resort, no other sources available	4
6. Variety of expertise	4
7. Dependable	4
8. Reputation of the establishment	4
9. Quality of service, dependable delivery, efficiency	1
10. Terms of license from CPDL or contract	1

Source: Arthur J. Cordell, James Gilmour, The Role and Function of Government Laboratories and the Transfer of Technology to the Manufacturing Sector, Science Council of Canada, Background Study No. 35, p. 305

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Such views coincided with the actual interactions of these firms with the government establishments. Table II, showing the most frequent purpose of these companies' interactions with government laboratories, points to testing, quality control services, and the use of special facilities, among the top three purposes for government-industry interaction, within government R&D establishments.

Table II - Most Frequent Purpose of Interactions

Purpose	Percentage of firms
1. General, printed information, e.g., publications, data, maps	24
2. Services, e.g., quality, assurance, testing, calibration	22
3. Use of the special facilities of the laboratory	18
	40%
4. Assistance with technical problems encountered in research	13
5. Assistance with theoretical problems encountered in research	7
6. Assistance with problems encountered in research	6
7. Advice on general technological trends, market trends	4
8. Suggestions for new R&D opportunities, new product ideas	4
9. License for product invented by the laboratory	1
10. Advice on new application of one of the firm's products	1

Source: Cordell and Gilmour, op. cit., p. 301

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The Science Council's report summed up industry's views on the subject by stating that it appeared that "the expertise and the facilities of government R&D establishments are their major attraction to the manufacturing industry, approximately two-thirds of the firms indicated these as the most important reasons for contacting a government establishment". (See Table 1). However, among its broader conclusions, the survey showed that of 179 firms with R&D units of their own, less than half claimed to be aware of the activities of government R&D establishments in their fields of interest, and that industry, in general, was not well informed about the roles, functions and structure of government R&D.[4]

CONCLUSIONS

Contracting-out can make a major contribution to successful technology transfer, but, as this examination shows, under special circumstances it may also be desirable that some government laboratory work be carried out under contract for non-government entities. Industrial companies may decide to place a contract with a government laboratory to avoid developing an in-house capacity for something needed

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4 Cordell and Gilmour, op. cit., p. 289

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only once or to make use of special facilities and expertise. In addition, the industry may obtain an access to a particular government laboratory's current technology and ideas. In many cases, both contracting-in and contracting-out have simultaneously taken place on the same projects. The precedents for joint projects exist mainly in those cases where government procurement or production is a basis for the industry and is therefore invited to work with federal scientific personnel. Contracting-in, more often than not, could complement the contracting-out of research as a means of technology transfer.

A great deal of reluctance at the departmental level in this area stems from a lack of clarity about the role of government laboratories in providing scientific services to help solve industry's individual or collective scientific and technical problems. There is a need for a clearer definition of terms and criteria under which provision of scientific and technical services is feasible in federal laboratories, and its relationship to other federal policies e.g. contracting-out, technology transfer, industrial development etc. Based on the overview provided by this paper, and the government's April 1978 decision on technology transfer, a department could evolve an effective role for its laboratories in industrial R&D.

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Any emphasis on more contracted work by government scientific establishments may require additional resources to carry out the increased work load. Although most of the funding for such services is generated from revenues earned as fees for services performed, such an activity would require advance planning and non-salary resource allocations plus unfunded man-years to cover incremental demands and costs. Guidelines from the Treasury Board Secretariat on financial and administrative matters would be helpful in situations as identified in this paper to science-based departments in enabling them to respond to the government objectives aimed at the enhancement of government-industry cooperation in scientific and technical areas. This would be particularly useful on issues such as personal services contract, incremental costs, loan of S&T equipment, S&T personnel exchange program, and utilization by laboratories of revenues earned through provision of scientific and technical services to industry. Any flexibility provided to departments and their research establishments in management of these issues could considerably help them in further opening their laboratories, their expertise and facilities, for use by industry. Prospective 'chosen

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instruments' or 'prime contractors' in a priority industry area could be allowed the use of government laboratories in the early stages of those R&D projects which have some potential for technology transfer.

Finally, one of the major criticisms by industry of federal laboratories has been that industry has not been adequately informed about the federal capabilities which might be useful to industry. As shown earlier through the findings of the Science Council study, half of the sample of 179 Canadian firms** with R&D units of their own were unaware of the particular federal scientific establishments related to their industry. Although part of the reason for poor government-industry interaction in this area may lie with industry itself,*** industry critics maintain that the major cause for this poor rapport has been the reluctance of government laboratories to share any information except through publications. To bridge this gap, federal laboratories should inform their counterparts in industry of the available services and opportunities for working together on various

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** According to the Statistics Canada there are more than 35,000 manufacturing companies in the manufacturing industry alone.

*** The Science Council study found that a clear majority of the industrial laboratories had no interest in research, either basic or applied, because most of them were primarily interested in the development of either new products or adaptation of existing products. Cordell & Gilmour, op. cit. p. 283.

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problems. Wherever such an effort is now made, it is usually done on an ad hoc basis and limited to selected companies and with a great deal of concern that any increase in the provision of such services will require the diversion of financial and human resources.

MOSST, because of its past experience, could develop a "Directory of Federal Scientific and Technical Services" on a pilot scale on a government-wide basis, identifying specialized capabilities and services, skills and facilities in relevant federal laboratories for use by industry, together with the necessary criteria and procedures for obtaining these services.

NRC'S STATEMENT

ON

LABORATORY ROLE IN INDUSTRIAL R/D

INTRODUCTION

The role of NRC within the overall Canadian research and development effort has been unique, and throughout NRC's long history this role has evolved continuously in response to new needs or opportunities. As an independent research agency with its own governing council, NRC was encouraged to develop a strong Canadian R&D capability and high quality scientific expertise available to governments, to the private sector and to Canadian citizens. By the mid-sixties NRC had developed a highly competent group of laboratories and multi-disciplinary research capability. With the aid of NRC support, university laboratories had developed strength in most scientific disciplines to the point where it was no longer necessary for Canadian students to seek high quality scientific training outside Canada. Also, NRC had made substantial progress in promoting and assisting research in industry.

Compared to the near-colonial status of the forties, Canadian science and technology had reached a degree of maturity and of R&D capability where they could henceforth contribute effectively to our national development. During the past decade NRC policies have been directed toward greater and more effective use of this national research potential. In order to adapt to static or declining budgets and to improve the effectiveness of Canadian research, continuing efforts have been made to consolidate research programs and to promote closer research collaboration amongst industry, university and government.

In 1974, with the decision to separate the University Grants and Scholarships Program from NRC and to set up a new granting Council, NRC took the opportunity to review and redefine its role, centering its activities primarily around its existing laboratory and extramural programs. Within its Engineering and Natural Sciences Program, four sub-objectives were defined which reflect not only its future role, but to a large degree, also formally express NRC's historical development and evolution in Canadian science and engineering. Two sub-objectives relate to NRC's basic and exploratory research program and its research program on long-term problems of national concern. Two other sub-objectives reflect NRC's activities in support of

industry:

- the application and use of engineering and the natural sciences to assist industry in Canada with the development of new and improved processes, methods, products, systems, techniques and services.
- to develop and maintain national standards and criteria based on the natural sciences and engineering.

In recent years the Council has given priority to policies and programs for advancing and assisting industrial R&D in Canada. A number of earlier initiatives have now developed into highly effective programs, both in terms of cost-effectiveness and their endorsement by the industrial sector. Also, in keeping with the government's contracting out policy, NRC has developed effective mechanisms (i.e. PILP and major projects such as the Remote Manipulator System) to further promote contracts to industry from NRC. Efforts are now being made to integrate and reinforce these separate programs into a total strategy of NRC support to industry in Canada.

OBJECTIVES AND GENERAL POLICIES RELATED TO INDUSTRY

Over the years a number of objectives and general policies have evolved which govern NRC's industrial R&D activities and concern those laboratories and programs which have a role to play in these activities.

1. *To assist Canadian industry with the formation and development of its own research capabilities.*

   In 1962, NRC started the Industrial Research Assistance Program. Three policies have evolved in dealing with this objective and program:

   (i) It is NRC *policy* to provide the infrastructure support necessary to manage IRAP both technically and administratively.

   (ii) It is NRC *policy* to assist IRAP by providing laboratory personnel who evaluate and monitor scientific and technical aspects of IRAP proposals and assist companies directly when the necessary expertise and facilities are available in the NRC laboratories.

   (iii) It is NRC *policy* to assist new enterprises to develop their research capabilities in areas of NRC laboratory expertise by inviting company staff to work in the NRC laboratories.

(iv) In keeping with the government's contracting-out policy, it is NRC *policy*, whenever possible and appropriate, to contract-out R/D to industry.

2. *To assist Canadian industry with the exploitation of its own research capabilities.*

IRAP has been expanded to include this objective and it is NRC *policy* to provide infrastructure support and laboratory assistance as outlined in policies 1(i), 1(ii) and 1(iv) above.

3. *To make known and accessible to Canadian industry, for its use, the resources (staff expertise, facilities and equipment, and information banks) existing in NRC.*

Three policies have evolved in dealing with this objective:

(i) It is NRC *policy* to develop personal contacts and close technical interactions between NRC scientists and engineers and those in industry. One mechanism to achieve this end is by encouraging visits of NRC personnel to industry and visits of industry staff to NRC laboratories that are of interest to them; another is through industrial seminars.

(ii) An additional direct means of putting NRC resources at the disposal of industry is through the operations of CISTI. It is NRC *policy* to assist CISTI in its information role by providing the laboratories' publications and public reports, and by providing direct assistance on enquiries referred by CISTI to the laboratories.

(iii) It is NRC *policy* to provide and/or manage national R&D facilities as a service to industry, governments and universities.

Several other policies relating to NRC's industrially-oriented research are listed below (and apply in general to all laboratory activities under these various industrial objectives):

(i) Where a research project is undertaken at the request of an individual company it is NRC *policy* to charge that company for the service provided and the research results are treated as confidential for an agreed period.

(ii) Where a research project is undertaken for the benefit of an industrial sector or for industry in general it is NRC *policy* that the cost is assumed by NRC and the results are then made freely available to those interested.

(iii) Relevant to both situations, it is NRC *policy* to assist in the transfer to industry of the particular expertise which may exist in the laboratory by encouraging the individual companies or industry associations to participate directly in a given project and where possible to make their staff available to work in the NRC laboratories (and vice versa).

(iv) It is NRC *policy* to collect centrally any revenue from these industrial activities. At the discretion of the Vice-President (Laboratory Operations) some of the revenue is returned to the Division involved, some is kept for reallocation and a portion is used to reduce the appropriation required from Parliament.

4. *To encourage Canadian industry to gain familiarity with and make use of the results of research conducted in NRC for further industrial exploitation.*

Over the years a considerable number of now large companies, as well as divisions of companies, were formed around a nucleus of research results obtained from NRC laboratories. Several policies have evolved in response to this overall objective:

(i) It is NRC *policy* to encourage and stimulate industrial innovation by (a) effective methods of technology transfer to industry and (b) technical and financial assistance to industry. In 1974, one part of this process was formalized into the Program for Industry/Laboratory Projects (PILP). Also there are other direct contracts (non-PILP) for R/D and prototype developments.

(ii) It is NRC *policy* to provide infrastructure support for the financial and technical administration and promotion of the PILP program.

(iii) It is NRC *policy* to encourage and reward good performance of its staff in all aspects of technology transfer and assistance to industry by appropriate salary and career advancement.

5. *To assist industry in developing new capability in selected industrial sectors.*

Activities relating to this objective have been going on at NRC for many years and it has become NRC *policy* to conduct or support promising research projects aimed directly at helping to develop industrial capability. Since significant projects of this type usually require relatively high rates of funding over long periods of time, only a small number of high priority projects in areas of national industrial concern can be carried out at any one time. In keeping with the government's contracting-out policy, it is NRC *policy*, whenever possible and appropriate, to contract-out R/D to industry.

6. *To develop and maintain primary standards and to assist with standards and test and calibration services relating to industry.*

NRC laboratory activities related to this objective have evolved over the many years that NRC has served as a national reference center for standards of measurements and performance standards. Several of the laboratories' activities in standards are in response to specific responsibilities assigned to NRC through the "Weights and Measures" Act. It is NRC *policy* to conduct research in the field of primary physical standards, to provide services and expertise in support of national and international standards activities, including training of non-NRC staff and membership on various standards writing bodies and to provide testing and technical services that are either inappropriate to industry (such as standards, specifications and codes) or are too large and costly for either single companies or associations of companies, to develop on their own.

7. *To assist those Canadian companies (usually the smaller ones) which are unable to organize and maintain research and/or engineering facilities, with problems requiring research knowledge and/or facilities for their solutions.*

There are two general policies which deal with this objective:

(i) Within its scientific and technical information program, NRC provides a Technical Information Service (TIS) for small and medium sized companies. In responding to their needs and problems,

TIS calls on CISTI, the NRC laboratories, the Dept. of Industry, Trade and Commerce and the various provincial research organizations. It is NRC *policy* to assist the TIS program by providing technical advice in areas of the laboratories' expertise and, on occasion, by conducting research projects where new information is required.

(ii) Partly related to objective 2 and partly related to this objective, it is NRC *policy* to assist small units through personal contacts by providing technical advice and by conducting research in selected areas that are appropriate to the laboratories.

8. *To assist in the development of well-trained scientists and engineers for employment in industry.*

It is NRC *policy* (i) to provide training for scientists and engineers currently in industry in areas of NRC expertise by inviting them to work within the laboratories; and (ii) to provide well-trained scientists and engineers for its own laboratories who potentially are candidates for employment in industry (e.g. the Research Associate Program is one mechanism for training future industrial staff).

9. *To assist in the development within government of an awareness that R&D in industry is of vital importance to the country, hence the need for as high a level as possible of various types of support for this activity.*

It is NRC *policy* to advocate and promote as strongly and objectively as possible appropriate government measures for encouraging and supporting research in industry. It is important to put particular stress on the need for longer term strategies, from five to ten years, since it is periods of this duration that are required for the achievement of significant results.

10 *To integrate the above set of industrial support activities into an overall and clearly articulated government industrial support strategy of which NRC activity is necessarily only one important component namely R&D and industrial innovation.*

APPENDIX V

DEPARTMENT OF ENVIRONMENT'S POLICY DIRECTIVE ON TECHNOLOGY TRANSFER

TRANSFER OF TECHNOLOGY

1. PURPOSE

1.1 The purpose of this Directive is to describe the Department's requirements with regards to the transfer of technology developed in Departmental laboratories to industry.

2. BACKGROUND

2.1 Cabinet, recognizing that Departmental laboratories represent an important Canadian source of technological knowledge and developments potentially useful to Canadian industry, has agreed that the transfer of such technology to industry should be an objective of all Departmental laboratories.

The Cabinet decision is directed at improving the transfer of technology from the Department, whether the technology is primarily developed for industrial purposes or not. The intent is not to bias research and development work in the Department away from the mission which may be to support regulatory activities or other internal Departmental purposes. Rather it is to identify research that is of possible interest to industry, and with suitable planning, to get such technology and knowledge that may emanate from this research to industry.

3. DEFINITION

3.1 Transfer of Technology - It is a transfer deemed to take place whenever technical knowledge, particular techniques or a device developed in Departmental laboratories is taken up and transferred to the user. Technical transfer

TRANSFERT DE CONNAISSANCES TECHNIQUES

1. OBJET

1.1 L'objet de la présente directive est de décrire les règles régissant la communication à l'industrie de connaissances techniques acquises dans les laboratoires du Ministère.

2. ETAT DE LA QUESTION

2.1 Estimant que les laboratoires des ministères représentent une importante source de connaissances et de réalisations techniques pouvant être utiles à l'industrie du Canada, le Conseil des ministres a convenu que tous les laboratoires de l'Etat doivent se fixer comme objectif de communiquer ces connaissances techniques à l'industrie.

La décision du Conseil vise à améliorer le transfert de connaissances techniques en provenance des ministères, que la technologie soit d'abord ou non destinée à des fins industrielles. On ne tente pas de faire dévier les travaux de recherche et de développement des ministères de leur mission qui peut être de contribuer aux activités de réglementation ou aux autres objectifs internes. Ils s'agit plutôt de définir la recherche qui peut intéresser l'industrie et, grâce à une planification convenable, de communiquer à cette dernière les connaissances techniques qui peuvent découler de cette recherche.

3. DEFINITION

Transfert de connaissances techniques - Il y a transfert chaque fois que l'on communique aux usagers des connaissances techniques, des techniques particulières ou une réalisation provenant de laboratoires du Ministère. Les trans-

refers to both hard technology (e.g. material devices and designs of such devices) and soft technology (e.g. inventive ideas and the know how needed for the implementation of such ideas).

4. POLICY

4.1 The Department will adhere to the requirements outlined in Cabinet Document 140-78RD.

5. PROCEDURES

5.1 The person in charge of each Departmental laboratory will:

(i) ensure, where it is possible, (e.g. the information produced is not solely for use within Departmental laboratories, classified, etc.) that technology developed in that laboratory is made available to industry;

(ii) decide on the best method(s) of making industry aware of the technology which has been developed in that laboratory; and

(iii) ensure that if a contract or agreement is necessary to transfer the technology, this is completed prior to the transfer, and through the appropriate section of the Department of Supply and Services.

ferts dits techniques ont trait à la technologie dure (comme les équipements et leurs plans) et à la technologie douce (c'est-à-dire les idées originales et les connaissances nécessaires à la mise en application de ces idées).

4. POLITIQUE

4.1 Le Ministère se conformera aux exigences énoncées dans le document nº 140-78RD du Conseil des ministres.

5. PROCEDURES

5.1 La personne responsable de chaque laboratoire du Ministère agira comme suit:

(i) elle assurera, dans la mesure du possible (c'est-à-dire quand l'information produite n'est pas uniquement destinée aux laboratoires du Ministère, n'est pas réservée, etc.), que les connaissances techniques acquises dans son laboratoire sont mises à la disposition de l'industrie;

(ii) elle choisira la meilleure méthode pour communiquer à l'industrie les connaissances techniques qui ont été acquises dans son laboratoire; et

(iii) advenant la nécessité d'établir un contrat ou un accord pour permettre la communication des connaissances techniques, elle assurera que cette mesure est bien respectée avant que ne s'effectue le transfert, et que l'on suive la filière appropriée du ministère des Approvisionnements et Services.

6. RESPONSIBILITIES

6.1 Assistant Deputy Ministers are responsible for taking the necessary action to ensure that this Directive, which becomes effective December 1, 1978, is adhered to.

7. RECORDS

7.1 The person in charge of each Departmental laboratory will ensure that a record by fiscal year, containing the pertinent details of each transfer of hard technology is maintained. This record, which is to be made available to Departmental officials upon request, is to be kept updated.

6. RESPONSABILITES

6.1 Il incombe aux sous-ministres adjoints de prendre les mesures nécessaires pour assurer que l'on respecte cette directive, qui entre en vigueur le 1er décembre, 1978.

7. DOSSIERS

7.1 La personne responsable de chaque laboratoire du Ministère s'occupera de la tenue d'un dossier pour chaque année financière, où seront inscrits les renseignements pertinents relatifs à chaque transfert de connaissances sur les techniques dures. Ce dossier, que les hauts fonctionnaires du Ministère pourront consulter sur demande, devra être tenu à jour.

APPENDIX VI

EXAMPLES OF TECHNOLOGY TRANSFER PROJECTS FROM THE DEPARTMENT OF ENVIRONMENT

1. Sidescan imagery equipment developed by DOE is now being adapted to special applications for NORCO Ltd.

2. Unmanned submersible vehicle now being manufactured by a Port Moody B.C. firm.

3. Ion selective electrodes used in analysis and developed from DOE research now manufactured in USA, UK and France.

4. Gamma ray spectrometry technique for measuring snow water equivalent of the snowpack is in the course of being transferred.

5. Glacial melt model developed by DOE now being used by B.C. Hydro.

6. Erosion protection system using patented concrete blocks now under study by DOE on a cost recovery basis for a private body.

7. Oil spill recovery techniques from ice covered rivers now incorporated into standard procedures.

8. Technique for metal alkryl analysis has been adopted by two chemical producers.

9. Improved method for determination of adenosine tri-phosphate (ATP) now used by Dearborn who pass it on to their clients in turn.

10. The Canada Land Data System and methodologies for ecological land classification are regularly used by the provinces.

11. Six air quality models developed in DOE are now available for interactive use.

12. Acoustic laser technique for nitric acid detection developed by Ultra Lasertech with DOE assistance.

13. Atmospheric mercury detector developed by Barringer Research with DOE assistance.

14. Assisted in development of standard methodology for air pollution measurement through participation in Canadian Standards Association.

15. Atmospheric modelling technology was transferred to Ontario Hydro for use in their studies of both wind-induced cable damage and regional sulphur and ozone transfer.

16. Two private companies acquired contracts to provide weather services with the help of staff loans and training from AES.

17. Private industry employs over 20 technicians trained in weather observing techniques and standard observing codes.

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18. A radio transmitter developed by DOE to telemeter the status of large animal traps has been modified for space applications.

19. Foliage as a resin extender has been proven feasible technically. (COPI)

20. Spruce foliage as adhesive extender in wafer and particle board is in the testing phase. (COPI)

21. Kraft liquin board adhesives are now under developoment by a private company. (COPI)

22. VHRF Band receiver was developed but market prospects appear to be limited. (COPI)

23. Environmental monitoring systems (MEMS) shown to be feasible and discussions with MOT are underway. (COPI)

24. A lumber slicer is now in testing phase and looks very promising. (COPI)

25. A time lapse camera developed for observing seasonal hydrologic changes in remote areas has attracted the attention of the private sector.

26. Technology for the removal of phosphorous from municipal waste water was developed at Burlington and is now in common use in Southern Ontario.

27. Technique for the removal of radium from uranium processing effluents is now at pilot scale test at Elliot Lake.

28. A special biological sewage treatment plant was developed for highly variable loads and is now used by Hemlock Valley Recreation Ltd.

29. The continued use of nonyl phenol as a pest control agent in forests was made possible through the efforts of DOE researchers.

30. The technique for calibrating single engine aircraft engaged in delivering certain pest control agents is now in use in Newfoundland.

31. A private contractor was trained by DOE to use techniques developed by DOE for measuring the impact of spray operations on small mammals, birds and aquatic mechanisms.

32. A seed germination box was invented by DOE and is currently under consideration for full scale production by a private company. (COPI)

33. A refined prototype planting head for injection planting is being developed by a private company. (COPI)

34. Computer programs dealing with forestry problems are used by B.C. and University of Alberta.

35. The Aerial Ignition Device developed by DOE is now being produced by a B.C. manufacturer.

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36. Forestry and silviculture guidelines are based on DOE research.

37. The Fire Weather Index System developed in DOE is in common use across Canada.

38. Fatty acid pesticides now manufactured in Canada.

39. Control of ambrosia beetles by water-misting of leg decks is now common practice by private industry.

40. A seed sorting system for tree seeds is now coming into use in B.C. and shows signs of catching on.

41. Forest inventory sampling methodology using aerial photography now in use by private industry.

42. Road construction guidelines are in common use by private industry.

43. Methods of producing and field planting of seedlings grown in paper pots now widely used in Ontario.

44. A tree planting machine now is in commercial production.

45. A site preparation tool called the CFS V-Blade is now in commercial production.

46. A mechanical cone harvester is in the final stages of development.

47. Modified harvest cutting as an alternative to clear cutting is now used by several private enterprises in Ontario.

48. Peat utilization is now under trial at two pulp and paper mills.

49. A long list of discoveries concerning diseases of trees, planting technique, control of pests have been assimilated into practice by the provincial agencies and by industry.