National Research Council Canada | Conseil national de recherches Canada

NRC · CNRC

Departmental Performance Report

For the period ending
31 March 2005

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David L. Emerson
Minister of Industry

Canada

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Acronyms and Abbreviations

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3D	Three dimensional
AAFC	Agriculture and Agri-Food Canada
ACOA	Atlantic Canada Opportunities Agency
AMTC	Aerospace Manufacturing Technology Centre
AI	Atlantic Initiatives
AIP	Atlantic Investment Partnership
AIRS	Alliance Icing Research Study
ATC	Aluminium Technology Centre
CADC	Canadian Astronomy Data Centre
CARC	Canadian Agriculture Research Council
CBS	Canadian Biotechnology Strategy
CCHT	Canadian Centre for Housing Technology
CCMC	Canadian Construction Materials Centre
CCTI	Climate Change Technology and Innovation
CERION	Canadian European Research Initiative on Nanoelectronics
CERN	Centre for Nuclear and Particle Physics
CFI	Canadian Foundation for Innovation
CII	Confederation of Indian Industry
CIPM	Comité international des poids et mesures
CLS	Canadian Light Source
CNT	Carbon Nanotube
COTS	Commercial off-the-shelf
CPFC	Canadian Photonics Fabrication Centre
CRIAQ	Consortium pour la recherche et l'innovation en aérospatiale au Québec
CRTI	Chemical, Biological, Radiological, Nuclear Research Technology Initiative
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DRAO	Dominion Radio Astrophysical Observatory
DPR	Departmental Performance Report
EJOS	ENCompass for Journals onSite
EST	Expressed Sequence Tag
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GHI	Genomics and Health Initiative
GMOS	Gemini Multi-Object Spectrograph

GTERC	Gas Turbine Environmental Research Centre
HRB	Human Resources Branch
HRMSC	Human Resources Management Steering Committee
ICT	Information and Communications Technologies
INA	Innovation Network Advisor
IP	Intellectual Property
IPF	Industry Partnership Facility
IPSO	Intellectual Property Services Office
ISAC	Isotope Separator and Accelerator
ISI	Institute for Scientific Information
LHC	Large Hadron Collider
LRP	Long Range Plan
LTRC	Language Technologies Research Centre
MRA	Mutual Recognition Arrangement
MRI	Magnetic Resonance Imaging
MRRS	Management, Resources and Results Structure
NIC	NRC Information Centre
NINT	National Institute for Nanotechnology
NMR	Nuclear Magnetic Resonance
NRC	National Research Council Canada
NRC-ASPM	Administrative Services and Property Management
NRC-BRI	Biotechnology Research Institute
NRC-CHC	Canadian Hydraulics Centre
NRC-CISTI	Canada Institute for Scientific and Technical Information
NRC-CSTT	Centre for Surface Transportation Technology
NRC-HIA	Herzberg Institute of Astrophysics
NRC-IAR	Institute for Aerospace Research
NRC-IBD	Institute for Biodiagnostics
NRC-IBS	Institute for Biological Sciences
NRC-ICPET	Institute for Chemical Process and Environmental Technology
NRC-IFCI	Institute for Fuel Cell Innovation
NRC-IIT	Institute for Information Technology
NRC-IMB	Institute for Marine Biosciences
NRC-IMI	Industrial Materials Institute
NRC-IMS	Institute for Microstructural Sciences
NRC-IMSB	Information Management Services Branch
NRC-IMTI	Integrated Manufacturing Technologies Institute
NRC-INH	Institute for Nutrisciences and Health
NRC-INMS	Institute for National Measurement Standards

NRC-IOT	Institute for Ocean Technology
NRC-IRAP	Industrial Research Assistance Program
NRC-IRC	Institute for Research in Construction
NRC-PBI	Plant Biotechnology Institute
NRC-SIMS	Steacie Institute for Molecular Sciences
NSERC	Natural Sciences and Engineering Research Council
OAG	Office of the Auditor General Canada
OAP	Oceans Action Plan
OECD	Organization for Economic Cooperation and Development
ORIC	Okanagan Research and Innovation Centre
OSPRey	Online Submission and Peer Review
PAA	Program Activity Architecture
PDF	Post-doctoral Fellow
PERD	Panel for Energy Research and Development
PSMA	Public Service Modernization Act
PSP	Paralytic shellfish poisoning
R&D	Research and Development
RA	Research Associate
RPP	Report on Plans and Priorities
RTMW	Rapid Triage Management Workbench
S&T	Science and Technology
SARS	Severe Acute Respiratory Syndrome
SIM	Inter-American Metrology System
SME	Small and Medium-sized Enterprise
SOFC	Solid oxide fuel cell
STM	Scientific, Technical and Medical
SWNT	Single Wall Nanotubes
TBS	Treasury Board of Canada Secretariat
TPC	Technology Partnerships Canada
TRIUMF	Tri-University Meson Facility
U.K.	United Kingdom
UPEI	University of Prince Edward Island
U.S.	United States
VFCVP	Vancouver Fuel Cell Vehicle Program
WES	Women in Engineering and Science
YES	Youth Employment Strategy

Section I Overview

Section I: Overview

Minister's Message

A key priority of the Government of Canada is building an economy that will meet the challenges of the 21st century; an economy that is knowledge-based, technology-driven, and globally oriented. In support of this goal, the National Research Council Canada (NRC) and the 14 members of the Industry Portfolio encourage innovative basic and advanced research, promote the commercialization and the adoption of new technologies and support the diffusion of transformative ideas throughout our economy. We also work to forge new and improved relationships with international partners, including emerging markets, in science and specialized technical areas. Essential to this work is a framework of marketplace regulations and laws that encourages innovation and stable growth. Through our efforts, the Industry Portfolio is helping to build a world-leading economy driven by talent, ideas and initiative.

The organizational members of the Industry Portfolio are:

- Atlantic Canada Opportunities Agency [2]
- Business Development Bank of Canada [1]
- Economic Development Agency of Canada for Quebec Regions [2]
- Canadian Space Agency
- Canadian Tourism Commission [1]
- Competition Tribunal
- Copyright Board Canada
- Enterprise Cape Breton Corporation [1] [2]
- Industry Canada
- National Research Council Canada
- Natural Sciences and Engineering Research Council of Canada
- Social Sciences and Humanities Research Council of Canada
- Standards Council of Canada [1]
- Statistics Canada
- Western Economic Diversification Canada [2]

[1] Not required to submit a Departmental Performance Report.
[2] Not a Portfolio member for the purposes of the Main Estimates.

The Industry Portfolio is composed of NRC and 14 other federal departments, agencies, Crown corporations, and quasi-judicial bodies. These organizations collectively play a key role in advancing Canada's industrial and economic development as well as fostering progress in science and technology. Advancing these priorities improves the overall health of the Canadian economy, provides opportunities for all Canadians to participate in our economic development and prosperity, and contributes to the quality of life of all Canadians.

Many Industry Portfolio initiatives build upon our strategic investments in research and development and help to move publicly-funded scientific and technological advances into the marketplace. Other key activities and programs encourage business growth and help industrial sectors be more innovative. Collectively, Industry Portfolio initiatives — and more importantly the results of those initiatives — stimulate the necessary adaptive and transformative changes demanded by the global economy.

NRC's *Departmental Performance Report* for the period ending March 31, 2005 describes the achievements and results of NRC, including:

- The launch of three spin-off companies in 2004-2005, bringing the total of new companies created by NRC since 1995-1996 to 61 with approximately 500 full-time jobs and an estimated $375 million in cumulative private investment. NRC accounts for 47% of the total royalties of licensed technology from federal research organizations and for 75% of the new companies created from federal technology.
- NRC's contribution to Government of Canada priorities through its formal collaborative research agreements with public and private-sector partners at the international and national levels. In 2004-2005, NRC signed 395 new collaborative agreements worth a total of $128 million. Within Canada, NRC works side by side with other federal departments and agencies through its involvement in the Canadian Biotechnology Strategy; the Chemical, Biological, Radiological, Nuclear Research and Technology Initiative; Canadian Aerospace Partnership; Climate Change and the Environment; and the National Marine and Ocean Industry Roadmap projects.
- NRC performs world-class research that is relevant to Canadians. Research and development performed at NRC contributes to the improved the health of Canadians, building a cleaner, sustainable environment and creating a safer and more innovative society. In 2004-2005, NRC researchers published 1,287 articles in refereed journals including five research articles in the highly ranked journals *Nature* and *Science*.
- NRC nurtures technology-based clusters across Canada, helping to stimulate community-based innovation through the growth of new firms, the attraction of highly-qualified people and the attraction of direct foreign investment. In 2004-2005, NRC was successful in renewing its funding for its technology clustering activities in Atlantic Canada.

As a member of the Industry Portfolio, NRC has contributed to the industrial and economic development of our nation. The work and contributions of the department are part of the overall government effort to develop and foster opportunities that reflect Canada's economic and social character. Through these efforts, we are investing in our people, our enterprises, and our future — the result will be a stronger and more prosperous economy for all Canadians.

I am pleased to present NRC's *Departmental Performance Report* for 2004-2005.

David L. Emerson
Minister of Industry

Management Representation Statement

I submit for tabling in Parliament, the 2004-2005 Departmental Performance Report (DPR) for the National Research Council Canada.

This document has been prepared based on the reporting principles contained in the Treasury Board of Canada Secretariat's *Guide for the preparation of 2004-2005 Departmental Performance Reports*:

- It adheres to the specific reporting requirements;
- It uses an approved Business Lines structure;
- It presents consistent, comprehensive, balanced and accurate information;
- It provides a basis of accountability for the results pursued or achieved with the resources and authorities entrusted to it; and
- It reports finances based on approved numbers from the Estimates and the Public Accounts of Canada.

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Pierre Coulombe

President

Summary Information

The National Research Council (NRC) is Canada's largest science and technology (S&T) agency, a premier vehicle for innovation and a leading resource for science, research, and technology development. NRC is a national organization with over 4,000 talented and dedicated people in 19 research institutes, the NRC Industrial Research Assistance Program (NRC-IRAP), the NRC Canada Institute for Scientific and Technical Information (NRC-CISTI) and 2 technology centres. As an integral part of the Industry Portfolio and the Canadian and international S&T community, NRC plays a critical role in building an innovative and knowledge-based economy.

NRC creates value for Canada through:

- Advances in scientific knowledge
- National & international networks, linkages and partnerships
- Commercialization and technology transfer
- Research and Development (R&D) assistance to Canadian companies
- Creation of new companies and highly skilled jobs
- Developing new and improved technologies
- Community-based technology cluster and innovation initiatives
- Provision of scientific, technical & medical information
- Access to Industry Partnership Facilities (IPFs)
- Provision of standards, codes and measurement activities

NRC's research spans the gamut of scientific fields and its applications include, to name a few, better health advice and medical treatments; a better understanding of the environment and sustainable practices; and improved productivity in transportation, construction, manufacturing and information technologies. Ultimately, NRC's collaborative R&D, technology transfer and commercialization support services contribute to knowledge creation and help make the lives of Canadians healthier, more productive and more prosperous.

NRC's Vision 2006

NRC's Vision 2006 is about value-creation through science, technology and innovation. It is a source of pride and motivation for NRC employees and it guides their R&D activities. It is fully endorsed by NRC's Governing Council and is well grounded by NRC's mandate. NRC's 2004-2005 Departmental Performance Report (DPR) describes the organization's performance against its Vision 2006 performance management framework using those indicators that are pertinent to the year's performance.

NRC's Vision 2006

Recognized globally for research and innovation, NRC is a leader in the development of an innovative, knowledge-based economy for Canada through science and technology.

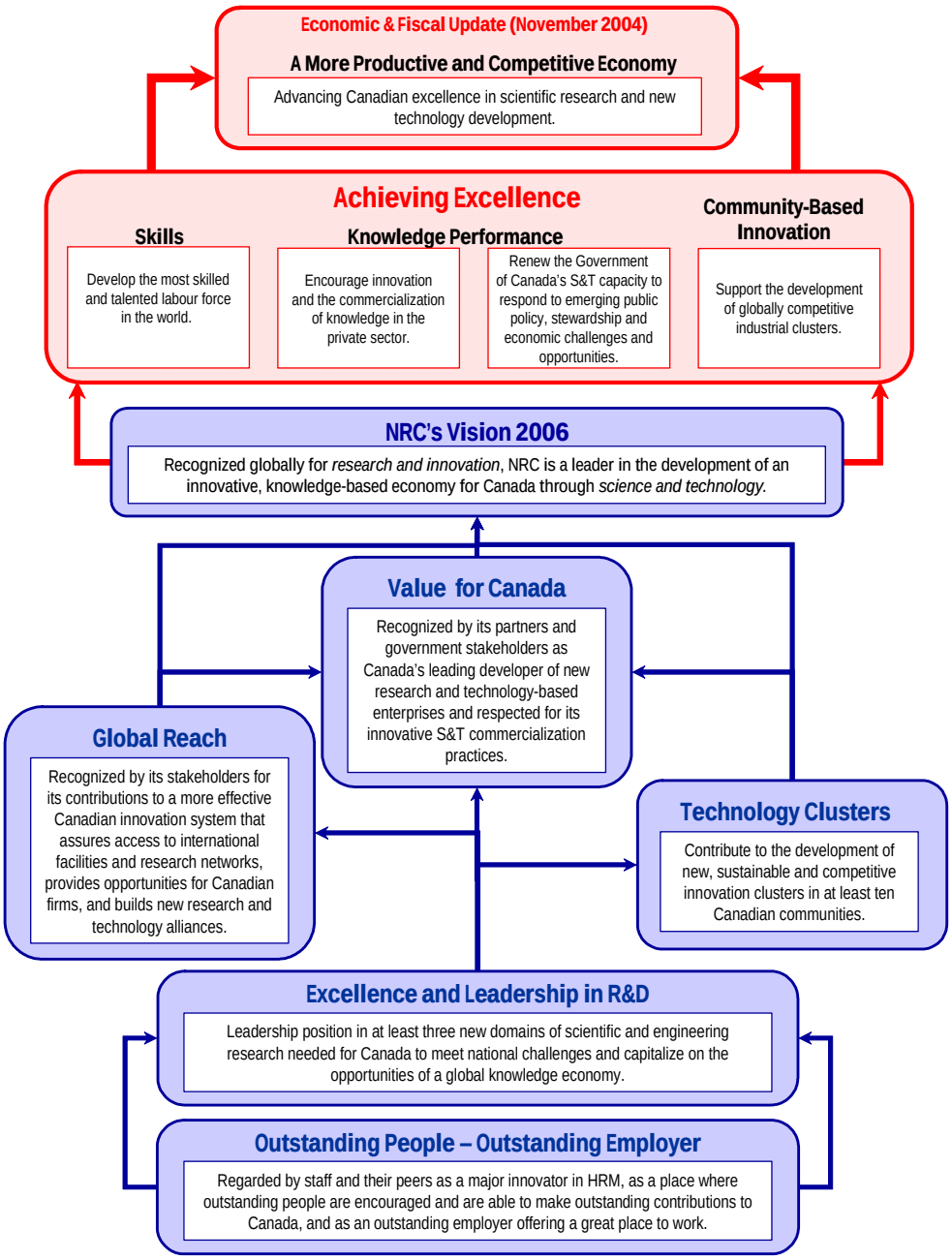
This Vision is founded on five strategic pillars:

- **VALUE FOR CANADA:** commitment to the creation of new technology-based enterprises, technology transfer and knowledge dissemination to industry;
- **GLOBAL REACH:** access to global research & information networks and science facilities, stimulation of enhanced international opportunities for Canadian firms and technologies;
- **TECHNOLOGY CLUSTERS:** development of the innovative capacity and socio-economic potential of Canada's communities;
- **EXCELLENCE AND LEADERSHIP IN R&D:** integration of public and private strengths to create new opportunities and meet national challenges for Canada; and
- **OUTSTANDING PEOPLE – OUTSTANDING EMPLOYER:** recognition as a leading research organization distinguished by the excellence and creativity of its employees.

More details about NRC's Vision 2006 can be found at http://www.nrc-cnrc.gc.ca/aboutUs/corporatereports/vision2006/index_e.html.

Figure 1-1 demonstrates how NRC's Vision 2006 contributes to objectives laid out by the Government of Canada in 2004-2005.

Figure 1-1 – How NRC's Vision 2006 aligns with the Government of Canada's policy objectives



NRC Transitional Period: Building a Roadmap for Future Sustainability

2005-2006 marks the last year in which NRC will be guided by its Vision 2006. In January 2005, NRC launched a strategic review of the organization referred to as the "Renewal Project". A key objective of the renewal exercise will be to review the value and continuing relevance of NRC's activities and to develop strategies for the

organization's future sustainability. The new strategy will be based on identification of opportunities consistent with NRC's current and potential capabilities. A key goal of the project is to develop a new vision and a corresponding corporate strategy. A new Vice-President was appointed in December 2004 to lead this initiative.

Following Treasury Board of Canada Secretariat's (TBS) directive, NRC is working towards modernizing its management practices. In 2004-2005, NRC developed a Program Activity Architecture (PAA) under the Management, Resources and Results Structure (MRRS). This is a shift in planning and performance reporting practices for NRC and will require a phased-in approach to full implementation. As a result, 2004-2005 was a transition year for NRC as it works to evolve its financial systems to better support its new PAA.

NRC Mandate

The *National Research Council Act* and the *Weights and Measures Act* set out the legislative framework that guides NRC.

Under these Acts, NRC is responsible for:

- undertaking, assisting or promoting scientific and industrial research in different fields of importance to Canada;
- investigating standards and methods of measurement;
- working on the standardization and certification of scientific and technical apparatus and instruments and materials used or usable by Canadian industry;
- operating and administering astronomical observatories established or maintained by the Government of Canada;
- administering NRC's R&D activities, including grants and contributions used to support a number of international activities;
- providing vital scientific and technological services to the research and industrial communities; and
- establishing, operating and maintaining a national science library and publishing, selling, and otherwise distributing scientific and technical information.

Please consult http://lois.justice.gc.ca/en/n-15/text.html for more details about NRC's legislative framework.

Summary of Resources

The following three tables provide a summary of NRC's performance in relationship to the organization's resources, priorities and commitments.

In order to provide consistency and reflect progress against NRC's 2004-2005 Report on Plans and Priorities (RPP), the basis for reporting in this document is according to NRC's strategic outcome and business line structure. At this time, NRC is only able to provide resource information by business line and not by strategic outcome. The organization is working towards evolving its financial systems and performance measurement strategies to accomplish this in the future.

Table 1-1: Total Financial Resources, 2004-2005 (millions of dollars)		
Planned	**Authorities**	**Actual**
724.1	772.9	712.4

Table 1-2: Total Human Resources, 2004-2005 (Full Time Equivalents)		
Planned	**Actual**	**Difference**
3,919	4,178	259

Table 1-3: A Crosswalk between NRC's Strategic Outcomes and Business Lines

	Strategic Outcomes				
Business Lines	Excellence and Leadership in R&D	Technology Clusters	Value for Canada	Global Reach	Outstanding People - Outstanding Employer
Research and Technology Innovation					
Research Institutes	√	√	√	√	√
Support for Innovation and the National Science and Technology Infrastructure					
Industrial Research Assistance Program		√	√	√	√
Scientific and Technical Information		√	√	√	√
Technology Centres	√		√	√	√
Program Management					
Corporate Branches		√	√	√	√
Executive Offices	√	√	√	√	√

Business Lines	**Type**	**Planned Spending (millions of dollars)**	**Actual Spending (millions of dollars)**	**Current Status** [1]
Research and Technology Innovation	On-going	449.5	420.8	Successfully met
Support for Innovation and the National Science and Technology Infrastructure	On-going	200.8	188.1	Successfully met
Program Management	On-going	73.8	103.5[2]	Successfully met

[1] The majority of performance expectations from the 2004-2005 RPP were met or are ongoing and therefore the current status for each business line is deemed "successfully met". Please see Table 1.4.

[2] Difference between planned and actual spending is largely due to transfer of utilities costs from the Research and Technology Innovation business line, collective bargaining increases, payments in lieu of taxes and internal adjustments to fund additional requirements.

Progress and Performance against RPP Commitments

Table 1-4 presents the commitments made in the NRC 2004-2005 RPP against the results achieved.

Table 1-4: Summary Table of Achievements versus Commitments

Legend: ■ Not met expectations; □ On-going; Δ Progress against expectations; ○ Successfully met expectations; ❋ Exceeded expectations

Strategic Outcome	Performance Expectations (from RPP)	Status	2004-2005 Key Results	Reported on Page
Value for Canada	• Create new technology-based companies	○	• NRC launched 3 new companies in 2004-2005	23
	• Transfer NRC technologies to Canadian companies through licensing agreements and collaborative research	○	• In 2004-2005, NRC signed 105 new licensing agreements and 395 new formal collaborative research agreements.	25
	• Improvement of intellectual property management systems	Δ	• NRC implemented the first stage of its initiative to improve intellectual property management and commercialization practices	27
	• Implementation of NRC-IRAP strategic plan with the emphasis on the needs of medium-sized businesses and on helping more businesses grow from small to medium size	○	• In 2004-2005, NRC-IRAP management took a comprehensive look at program delivery, specifically with regard to streamlining delivery and increasing accountability.	27
	• Ensure Canadians have ready access to scientific, technical and medical information to support research and innovation	□	• NRC-CISTI maintains, publishes, and provides access to scientific, technical, and medical (STM) information critical to the global knowledge base and Canada's innovation system.	29
	• Publication of objective-based codes and guides to support the construction industry and promote innovation in this sector	Δ	• NRC will publish new editions of the National Building Code, National Fire Code, and National Plumbing Code in September 2005.	31

Table 1-4: Summary Table of Achievements versus Commitments (continued)

Legend: ■ Not met expectations; □ On-going; Δ Progress against expectations; ○ Successfully met expectations; ❋ Exceeded expectations

Strategic Outcome	Performance Expectations (from RPP)	Status	2004-2005 Key Results	Reported on Page
Global Reach	• Development and enhancement of strategic bi-lateral alliances with key innovation partners in Europe, Asia, Latin America and the U.S.	○	• NRC signed 109 new formal collaborative research agreements with international partners worth $16.5 million.	35
	• Enhanced innovation capacity of Canadian small and medium-sized enterprises (SMEs) through international ventures and partnerships	□	• NRC-IRAP undertook technology missions with over 75 SMEs to 16 countries on three continents	36
	• Harmonize international measurements standards to support international trade	○	• The Institute for National Measurement Standards (NRC-INMS) participated in planning or implementing numerous international measurement comparisons.	37
	• ISO/IEC 17025 accreditation for NRC-INMS	○	• Approval from NRC-INMS' Regional Metrology Organization has been received.	37
	• Continued implementation of astronomy and astrophysics Long Range Plan	Δ	• A mid-term review of the Long Range Plan acknowledged the significant progress on those areas of the Plan within NRC-HIA's responsibilities.	38
	• Canadian participation in leading-edge international science activities and development of large-scale S&T infrastructure of importance for the Canadian scientific and engineering community	□	• NRC provides varying degrees of stewardship over Canada's investments in large-scale S&T infrastructure of critical importance to the research community. NRC operates two Canadian large-scale research facilities	39
	• Prepare case of funding of new five year plan for Tri-University Meson Facility (TRIUMF)	○	• Renewed funding for TRIUMF was announced in the February 2005 budget at the level of $222 million over the next five years.	41 & 92 (Table 3-10)

Table 1-4: Summary Table of Achievements versus Commitments (continued)

Legend: ■ Not met expectations; □ On-going; Δ Progress against expectations; ○ Successfully met expectations; ❋ Exceeded expectations

Strategic Outcome	Performance Expectations (from RPP)	Status	2004-2005 Key Results	Reported on Page
Technology Clusters	• Continue activities to build technology clusters across Canada	□	• NRC nurtures the growth of cluster initiatives in many regions across Canada in addition to those areas where new, cluster-specific funding has been received.	45
	• Complete a formative evaluation of NRC's Atlantic technology clusters initiatives	❋	• NRC used the evidence provided in the evaluation to make a case to the Government of Canada for renewed funding for the Atlantic Initiative.	44
	• Prepare case to government for continued funding of the Atlantic Cluster Program	○	• NRC received $110 million over five years for the second phase of its technology-based clusters in Atlantic Canada.	44
	• Complete and open IPF in Halifax, Winnipeg and continue building new R&D and IPFs in Charlottetown, Montreal, Ottawa, Regina, and Edmonton	Δ	• The Institute for Marine Biosciences (NRC-IMB) IPF opened in Halifax, September 2004. • The Institute for Biodiagnostics (NRC-IBD) IPF in Winnipeg delayed opening to August 2005. • Continued building new IPF facilities in other cities.	51
	• Increase the IPF occupancy and graduation rates for Canadian start-ups	○	• Increased occupancy rate from 86% in 2003-2004 to 89% in 2004-2005. • Fourteen tenants graduated from NRC IPFs in 2004-2005, a 27% increase over last year.	51
	• An integrated national network of industrial partnership facilities offering incubation services for high tech start-up enterprises	□	• NRC's IPFs are connected internally through a network of managers and business development officers. • A national network meeting was held in Halifax in June 2004 which focused on regional entrepreneurship and how IPFs can better fit within NRC's Commercialization Strategy.	51

Table 1-4: Summary Table of Achievements versus Commitments (continued)

Legend: ■ Not met expectations; □ On-going; Δ Progress against expectations; ○ Successfully met expectations; ❋ Exceeded expectations

Strategic Outcome	Performance Expectations (from RPP)	Status	2004-2005 Key Results	Reported on Page
Excellence and Leadership in R&D	• Increase horizontal R&D programs particularly in emerging areas of S&T	□	• NRC has continued to emphasize multidisciplinary R&D initiatives within NRC in the areas of nanotechnology; life sciences, genomics and health; and hydrogen and fuel cells. • NRC has worked with other leading research institutions in Canada and internationally through its involvement in the Canadian Biotechnology Strategy; the Chemical, Biological, Radiological, Nuclear Research and Technology Initiative; Climate Change and the Environment; and the National Marine and Ocean Industry Roadmap.	53 57
	• Renewal of Genomics and Health Initiative funding	○	• NRC led the development of an inter-departmental Treasury Board Submission seeking renewal of federal genomics R&D funding at current levels for the next three-five year time frame. In March 2005, funding was approved through to 2007-2008.	55
	• Build Canada's technology capacity, improve its R&D performance and support the needs of Canadian industry in emerging R&D	□	• NRC conducts research in the areas of life sciences; information and communication technologies; physical sciences and engineering; manufacturing; and discovery-based.	61

Table 1-4: Summary Table of Achievements versus Commitments (continued)

Legend: ■ Not met expectations; □ On-going; Δ Progress against expectations; ○ Successfully met expectations; ❋ Exceeded expectations

Strategic Outcome	Performance Expectations (from RPP)	Status	2004-2005 Key Results	Reported on Page
Outstanding People-Outstanding Employer	• Recruit and retain outstanding people	□	• Recruitment of new researchers under the New Horizons-New Opportunities Program • 70 employees received significant external awards	68 70 & 118 (Appendix A)
	• Develop leadership at all levels	Δ	• Designed and implemented an Integrated Orientation and Leadership Development process • Continued to reposition NRC's Leadership Management Development Program	69
	• Build cross functional and cross cultural capability	Δ	• Organized NRC's Leadership Forum on the theme of *Leadership in Cross-Functional and Cross-Cultural Initiatives.* • New director-level position oversees Sustainable Technologies Initiative and Inter-departmental Relations at NRC	69 58
	• Modernization of NRC's recruiting and hiring practices	Δ	• Began the implementation of the Modernization of Hiring activities.	69

NRC's Overall Performance for 2004-2005

Performance Context

This section explains the conditions under which NRC manages itself on a day-to-day basis and highlights the operating environment and context that affected NRC's performance in 2004-2005.

How NRC Plans and Reports

NRC's planning process includes the NRC Vision 2006, a five-year vision document, and an annual Report on Plans and Priorities (RPP). Vision 2006 outlines five strategic pillars and related corporate goals, strategies and desired outcomes. Vision 2006 provides the planning context for the 2004-2005 RPP, the strategic plans of the operating units, and the performance measurement framework approved by NRC Governing Council in June 2003. The performance measurement framework, with the 28 associated performance indicators, is used to report NRC's performance for 2004-2005 for the five strategic pillars of Vision 2006[3]. The performance indicators are highlighted throughout the DPR.

R&D normally takes several years before projects achieve results or are ready for industrial application. Each year the progress on most projects is incremental in nature. Many of the results described in this report could be attributed to investments and research activity from two, five or even ten years ago. After several years, it becomes a complex and expensive undertaking to trace all of the impacts and assess a reasonable attribution to NRC. The challenges in measuring results from R&D organizations, on an annual basis, have been noted by the OAG of Canada[4], the United States' General Accounting Office[5], the Organization for Economic Cooperation and Development (OECD), and public and private sector R&D organizations.

In response to these challenges, NRC has developed and implemented performance measurement strategies since 1995-1996. Aligned with Vision 2006 goals, each NRC institute, program and branch prepares a yearly planning outlook and a performance report. The performance reports and the performance indicators are submitted and used in producing NRC's DPR, Annual Report and Report to Council.

NRC's Operating Environment

National S&T Infrastructure - NRC delivers a national S&T program with laboratories, centres and facilities in communities across Canada (http://www.nrc-cnrc.gc.ca/contactIBP_e.html).

[3] For details about the Vision, please visit http://www.nrc-cnrc.gc.ca/aboutUs/corporatereports/vision2006/index_e.html
[4] Office of the Auditor General of Canada. Chapter 22: Attributes of Well-Managed Research Organizations, November, 1999.
[5] United States General Accounting Office, Measuring Performance: Challenges in Evaluating Research and Development (GAO/T-RCED-97-130), April 1997.

Ownership, Management and Maintenance of Capital Assets - In charge of its own highly technical and complex operations, NRC manages 175 buildings totaling approximately 517,406 square metres of space.

Funding - NRC is funded through government appropriations. In the course of providing technical services to companies and other organizations, it recovers some of its costs for the purpose of reinvesting in the operation and maintenance of equipment and facilities.

Internal Changes
NRC's new President, Dr. Pierre Coulombe, joined NRC in February 2005, just as NRC was beginning its renewal process.

NRC's Commercialization Branch, created in April 2004, to explore strategic collaborative initiatives with partners and develop pilot projects to demonstrate NRC's enhanced capabilities for commercialization was restructured in March 2005 into two offices: the Business Portfolio Office and the Intellectual Property Services Office (IPSO). The Business Portfolio Office focuses on core technology transfer, intellectual property (IP) management and commercialization, IP portfolio management, licensing, and new venture creation and maintenance in support of cross-council commercialization activities. The IPSO is responsible for intellectual property protection, maintenance of NRC patent portfolio and license administration. These two new offices now report directly to the Vice-President of Technology and Industry Support.

Economic Context
The overall economic picture in 2004 was more favourable than in the previous year. Free from any major sectoral or regional losses in output or investment, the Canadian economy recorded a 2.8% increase in real gross domestic product (GDP) in 2004[6]. The growth trend continued into 2005 with GDP growth of 0.2% in January or 2.0% annualized[7]. Growth was fuelled by the increased demand for oil and gas. Increased personal disposable income (3.9% in 2004) together with falling prices for imports due to a stronger dollar both contributed to a 3.5% increase in consumer spending[8]. The acceleration of the housing market added to the increase in GDP. Corporate profits rose a healthy 18%[9]. Fixed investment in machinery and equipment increased by 9.4% to deal with capital utilization rates above the 10-year average. Labour productivity however remained unchanged from 2003[10].

The appreciation of the Canadian dollar again played a role in slowing down economic growth although much of the impact was felt towards the end of the year. The exchange rate rose 5.6¢ U.S. from its January 2004 value[11], after a 7¢ increase the year before[12].

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[6] http://www.dfait-maeci.gc.ca/eet/pdf/SOT-2005-English.pdf, Sixth Annual Report on Canada's State of Trade, Trade Update (April 2005)
[7] http://strategis.ic.gc.ca/epic/internet/ineas-aes.nsf/en/h_ra01898e.html, Monthly Economic Indicators (April 2005)
[8] http://www.statcan.ca/Daily/English/050427/d050427a.htm, The Daily (27 April 2005)
[9] ibid
[10] http://strategis.ic.gc.ca/epic/internet/ineas-aes.nsf/en/h_ra01898e.html, Monthly Economic Indicators (March 2005)
[11] http://www.dfait-maeci.gc.ca/eet/pdf/SOT-2005-English.pdf, Sixth Annual Report on Canada's State of Trade, Trade Update (April 2005)

The health of the manufacturing sector is affected by fluctuations in the value of the Canadian dollar. In addition, the single largest R&D spender, the communications equipment sector, has not as yet fully recovered, keeping its R&D outlays at a level 52.5% lower than four years ago.[13] Likewise, the aerospace and computer system design industries' R&D spending has levelled off over the past four years. Since industry investment in research and development falls with decreased financial performance, the demand for NRC services (e.g., expert advice and contract research) is impacted.

Venture capital investment rose 6% to $1.8 billion representing the first increase since 2000[14]. The amount of venture capital available, together with the direct investment available to Canadian firms, affects NRC commercialization efforts (e.g., spin-off companies and licenses).

2003-2004 Audit by the Office of the Auditor General
The Office of the Auditor General of Canada (OAG) conducted a Value for Money audit of NRC in 2003-2004. During 2004-2005, NRC made progress on implementing many of the OAG's recommendations through the following key initiatives:

- NRC Council Task Force on Governance;
- NRC Renewal Initiative;
- NRC Integrated Corporate Planning & Performance Management Solution;
- Enterprise Risk Management Framework; and
- NRC Research Management Self-Assessment Tool.

Table 3-14 in this document provides an overview of the OAG recommendations and NRC's progress in addressing them.

Alignment with Canada's Performance

NRC has a long history of making valuable scientific discoveries that contribute to the well-being of Canadians, Canadian industry and others worldwide. NRC's Vision 2006 supports two main Government of Canada priorities as outlined below.

Sustainable Economy – an innovative and knowledge-based economy: The Government of Canada continues with its commitment to maintaining a strong Canadian economy where Canadians can enjoy a high quality of life[15]. Productive efforts in science and technology, education and commercialization are the cornerstones to achieving this objective. Through its focus on excellence and leadership in research and development, technology cluster growth, added value for Canada through knowledge transfer, and the development of outstanding people through education and training, NRC supports a sustainable economy in Canada.

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[12] http://www.statcan.ca/english/ads/11-010-XPB/pdf/apr05.pdf, Canadian Economic Observer, Canada's Economic Growth in Review (April 2005)
[13] http://www.statcan.ca/english/freepub/88-001-XIE/88-001-XIE2005004.pdf, Science Statistics, Industrial Research and Development 2001-2005 (June 2005)
[14] http://www.statcan.ca/Daily/English/050427/d050427a.htm, The Daily (27 April 2005)
[15] http://www.fin.gc.ca/budget05/speech/speeche.htm, The Budget Speech (February 2005), The Honourable Ralph Goodale, Minister of Finance..

Canada's Place in the World – a prosperous global economy that benefits Canadians and the world: Canada seeks to play a major role in alleviating the economic, health, environmental and security challenges facing the world. Through its research in genomics and health, sustainable technologies, and the environment, as well as its focus on global reach and international research collaborations and assistance, NRC contributes to the development of a prosperous economy that benefits Canadians and the world.

Section II Performance by Strategic Outcome

Section II: Performance by Strategic Outcome

Value for Canada

Strategic Outcome

Commitment to new technology-based enterprises, technology transfer and knowledge dissemination to industry.

By 2006, NRC will be recognized by its partners and government stakeholders as Canada's leading developer of new research and technology-based enterprises and respected for its innovative S&T commercialization practices.

Expected Results:

Intermediate Outcomes

- Ensure Canadians have ready access to scientific, technical and medical information to support research and innovation.
- Improved building, construction and urban infrastructure codes system in Canada.
- New technology-based companies providing highly-qualified jobs to Canadians and stimulating new foreign investment in Canada.
- Enhanced innovation capacity of companies and socio-economic growth through the diffusion of NRC technologies.
- Integrated national and international network of scientific, technical and medical information resources readily available to Canadians.

Immediate Outcomes

- Improvement of Intellectual Property Management systems.
- Increase the Industry Partnership Facilities (IPFs) occupancy and graduation rates for Canadian start-ups.
- Transfer NRC technologies to Canadian companies through licensing agreements and collaborative research.

Plans, priorities and commitments

- Create new technology-based companies.
- Implementation of NRC-IRAP strategic plan with the emphasis on the needs of medium-sized businesses and on helping more businesses grow from small to medium size.
- Publication of objective-based codes and guides to support the construction industry and promote innovation in this sector.

Program resources and results linkages*

- NRC's 19 research institutes – see Appendix B for full list
- NRC Industrial Research Assistance Program
- NRC Canada Institute for Scientific and Technical Information
- NRC Technology Centres

Performance Indicators:

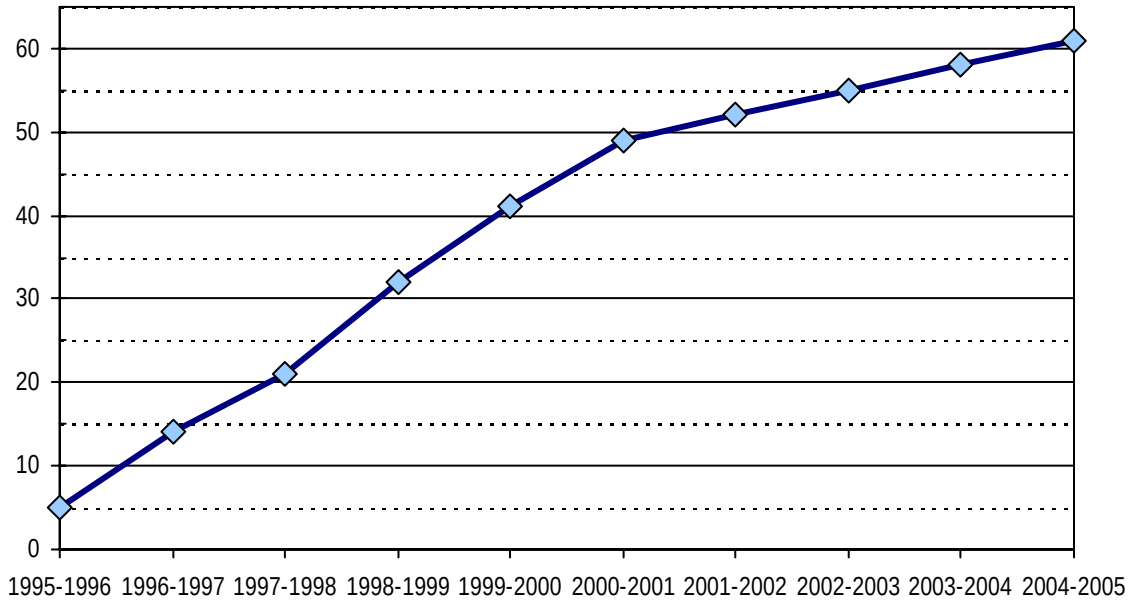
- Technology transfer
- Knowledge dissemination
- Highly qualified personnel to Canada
- Client success
- Spin-offs/Spin-ins
- Economic, social and environmental impact

** At this time NRC is only able to provide resource information by business line and not by strategic outcome. The organization is working towards evolving NRC's financial systems and performance measurement strategies to accomplish this in the future.*

Creating Value: Growing the Firms for the 21st Century Economy

When NRC develops a technology with particularly strong market potential and where there is no Canadian receptor capacity identified, entirely new companies are created to commercialize the technology. These new companies create innovative products and services for the global marketplace and new jobs for Canadians. A turn around in market conditions and the moderate growth in venture capital investments from 2003[16] fuelled success in NRC's existing companies and supported NRC in launching three new companies. This brings the total of new companies created by NRC since 1995-1996 to 61 with approximately 500 full-time jobs and an estimated $375 million in cumulative private investment, an increase of 20% from last year[17] (see Figure 2-1). In 2004, overall investment from all sources into NRC new companies was up significantly to $57 million, almost three times the level of 2003 ($19 million), although still only slightly more than one-half of 2002 levels ($105 million).

Figure 2-1: NRC Spin-Off Companies - Cumulative Number (1995-2004)



Source: NRC Performance Information Database, 2005.

[16] Macdonald & Associates Limited, *Overview of Venture Capital in Canada 2004*, February 9th 2005.

[17] Adventus Research Inc., *Economic Impact of National Research Council Canada Spin-Off Companies 2005 Survey*, February 28th 2005.

For example, XYZ RGB Inc., has four employees since graduating from NRC's Institute for Information Technology's (NRC-IIT) IPF in November 2004. NRC-IIT's three dimensional (3D) laser scanner system was short listed for consideration by the Academy of Motion Picture Arts and Sciences Scientific and Technical Awards Committee at the 77th Academy Awards. The revolutionary 3D system is booked for many other television and motion picture projects including the next big budget project for *Lord of the Rings'* Director, Peter Jackson, a remake of *King Kong*, that promises to again influence the industry with eye-catching innovations based on the NRC technology.

Industrial Impact of NRC 3D Scanning Technology

"The influence of this system is already being felt throughout the major motion picture industry. It is hard to imagine any significant computer graphics based film in the future not being affected by the benchmark the NRC scanner technology and our work has set."

Helmut Kungl
President, XYZ RGB

Companies created in 2004-2005:

- *Cyrium Technologies* of Ottawa was established by a former NRC employee, Dr. Simon Fafard, to commercialize a revolutionary technology which exploits the unique properties of semiconductor nanostructures and to develop disruptive photonic products using semiconductor nanotechnology innovations. The company is co-located in one of NRC's IPFs and has turned to NRC's Institute for Microstructural Sciences' (NRC-IMS) Canadian Photonics Fabrication Centre (CPFC) to accelerate the fabrication of its prototypes. (http://www.cyriumtechnologies.com/)

NRC-IMS Commercialization Success

Targeted assistance from NRC's toolkit of people, programs and technologies is helping former NRC researcher, Dr. Simon Fafard, CEO of Cyrium Technologies, along the innovation road. Research on quantum dots and the assistance of the Canadian Photonics Fabrication Centre will allow Cyrium Technologies to produce quantum dot wafers for more efficient solar cells. Quantum dots can collect energy from a greater portion of the light spectrum and are more efficient at transforming solar energy into electrical energy. Europe's largest manufacturer of solar cells would like to use Cyrium's technology in space applications to significantly reduce the expense of satellite operations. NRC has significantly contributed to the formation of this new company.

NRC Institute for Microstructural Sciences

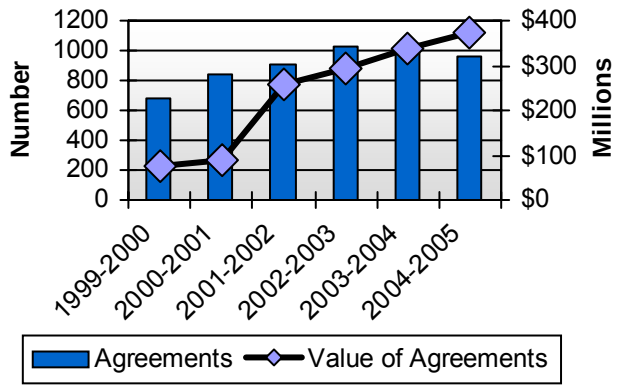
- *Accufusion Inc*. is incubating in London at NRC's Integrated Manufacturing Technologies Institute (NRC- IMTI) and was formed to provide products and services utilizing NRC's laser consolidation technology. Laser consolidation promises cost savings, waste reduction and improved productivity to the manufacturing sector. The company has three employees. (http://www.accufusion.com/)

- *Medtrode Inc.* is located in London and was formed to develop NRC-IMTI's technology that enables diagnosing and treating neuronal disorders by intracranial Magnetic Resonance Imaging (MRI) and neuromodulation. (http://www.medtrode.com/)

Enhanced Innovation Capacity of Firms

In 2004-2005, NRC signed 395 new formal collaborative research agreements with partners worth a total of $128 million. Although the total number of active collaborative agreements during the fiscal year fell slightly to 963, the total value over the lifetime of these agreements grew to $372 million (see Figure 2-2). This is a 10% increase over last year's value. The number and value of collaborative agreements are leading indicators that foreshadow increased research activity.

Figure 2-2: Canadian Collaboration (2000-2004)

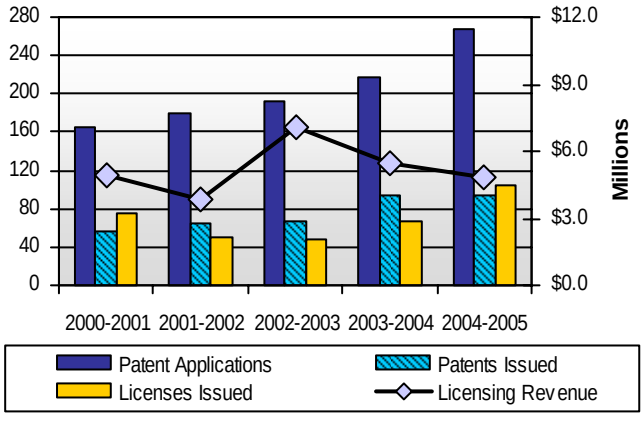


Source: NRC Performance Information Database, 2005.

The management of IP makes an important contribution to the innovative capacity of firms. A new patent is a key step in the continuum from discovery to innovation. In 2004-2005, NRC applied for 267 new patents, and secured 95 patents from applications made in previous years. Forty-one percent of these were issued in the United States (an Organization for Economic Cooperation and Development (OECD) recognized measure of competitiveness).

Licence agreements show a direct flow of innovation into business application. NRC entered into 105 new licence agreements in 2004-2005 (an increase of 57% over last year). The substantial increase in licence agreements was due to NRC-HIA licensing 52 copies of its software suite for performing accurate photometry of stars and astronomical images. By negotiating a licence agreement to use NRC technology, the industrial partner endorses the merit of NRC research. IP licensing revenue for 2004-2005 was $4.8 million, a 13% decrease from last year, but greater than the average of $3.3 million over the last ten years (see Figure 2-3).

Figure 2-3: NRC IP Portfolio (2000-2004)



Source: NRC Performance Information Database, 2005.

Just over $2.7 million of IP revenue in 2004-2005 is attributable directly to the Meningitis-C Vaccine. This is a 29% decrease from last year due to a drop in royalties received from Baxter Healthcare as a result of the sales of the vaccine not meeting original expectations. $634,000 of the total licensing revenue, mostly as a result of both hardware and software development, was attributed to NRC-IIT and $418,000 was attributed to the Institute for National Measurement Standards (NRC-INMS) for their Quantum Hall resistance technology.

NRC compares favourably with Canadian universities on indicators such as licensing revenue and spin-off companies (http://www.tbs-sct.gc.ca/rma/dpr/03-04/NRC-CNRC/NRC-CNRCd3401_e.asp#_Value_for_canada) as well as Canadian federal science-based departments and agencies. In 2002-2003, the most recent year for which information is available, the intellectual property management trends in the federal government show NRC accounting for 47% of the total royalties of licensed technology from federal research organizations and for 75% of the new companies created from federal technology (http://www.fptt-pftt.gc.ca/pdf/annual_report03-04_e.pdf).

Examples of NRC technology licensed to industry in 2004-2005 include:

- *Porous titanium implants:* NRC's Industrial Materials Institute (NRC-IMI) licensed a new materials technology to Stryker Orthopaedics (http://www.stryker.com/) which will result in the production of better implants. The new technology will simplify surgical operations and increase the long-term comfort of hip-joint replacement patients.
- *Quantum Hall resistance technology:* NRC-INMS licensed its technology for quantum Hall effect electrical resistance standard to the Ontario company, Measurements International Inc. (http://www.mintl.com/). The company has recently received orders from China's Air and Space laboratory and the U.S. Navy Standards laboratory. This represents a strong vote of confidence for the viability of this technology to provide an electrical resistance standard at the highest level.
- *Compressed-air-foam technology:* NRC's Institute for Research in Construction (NRC-IRC) expanded the market potential of its compressed-air-foam technology to the fire protection of power transformers. This technology has been licensed to FireFlex Systems Inc. (http://www.fireflex.com/).

NRC Receives Two FPTT Team Awards

In 2004, NRC received two awards from FPTT. A team from NRC, the Department of Justice and Capital Laser Inc. received an award for the successful development, transfer and commercialization of laser micro-processing technology used to produce miniaturized electronics, biomedical devices and precision components. Another team received an award for the successful development and commercialization of an enhanced leak noise correlation technology for detecting and locating leaks in pressurized pipes that was transferred to NRC spin-off company Echologics Engineering Inc.

2004 FPTT Technology Transfer Awards
http://www.fptt-pftt.gc.ca/success/awards2004/main_e.shtml

Implementing NRC's Intellectual Property Management and Commercialization Initiative

In 2004-2005, NRC implemented the first stage of its initiative to improve intellectual property management and commercialization practices. Specific accomplishments included:

- Integrating IP management strategies into institute operating plans;
- Establishing processes with five institutes to better screen disclosures and improve management decision-making;
- Conducting IP portfolio assessments at selected institutes to focus on high-value IP;
- Piloting royalty audits by third parties to ensure compliance with licensing agreements;
- Performing market research on 20 potential technology opportunities; and
- Launching the on-line technology database of available IP with over 40 technologies (http://infoex.nrc-cnrc.gc.ca/pls/otd/otd_patch.initial_page).
- Selecting an NRC enterprise-wide IP database software with procurement and roll-out in 2005-2006.

Supporting Small and Medium-Sized Enterprises

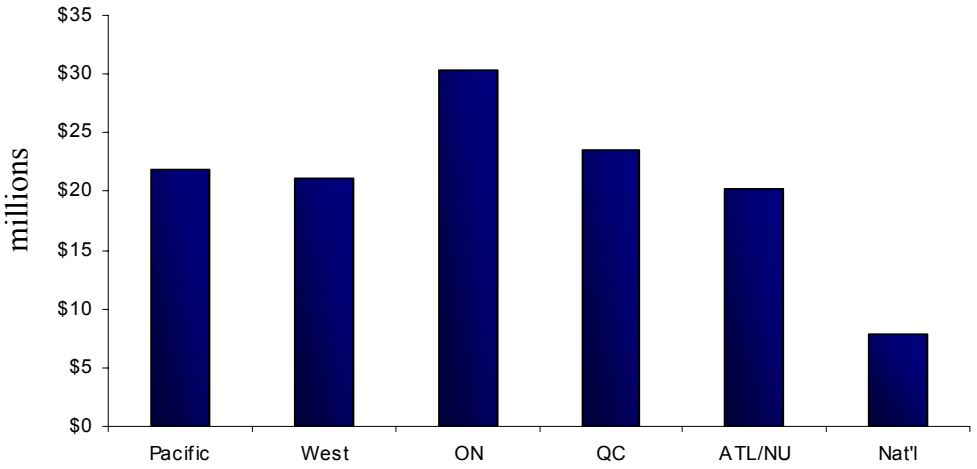
NRC-IRAP provides Canadian small and medium-sized enterprises (SMEs) with value-added technological and business advice, financial assistance and a range of other innovation assistance. NRC-IRAP helps SMEs realize their full potential, turning knowledge and innovation into strategic opportunities, jobs and prosperity for all Canadians. In 2004-2005, NRC-IRAP management took a comprehensive look at program delivery, specifically with regard to streamlining delivery and increasing accountability. Consequently, significant adjustments were made to NRC-IRAP's business processes. Although this exercise has contributed to some decrease in the number of clients and projects in 2004-2005, the benefits resulting from changes made to business processes are expected to become apparent in 2005-2006 and beyond.

NRC-IRAP's activities in 2004-2005 included:

- NRC-IRAP's total expenditures by region are presented in Figure 2-4 and amounted to $127 million.
- NRC-IRAP delivered programs for other government departments, bringing its total level of activity to $145 million. With these resources, NRC-IRAP provided 10,773 SMEs with customized information, advice and referrals to expertise to assist them in increasing their innovation capabilities.
- The Program's total financial contributions to increase the innovation capacity of firms were $80.3 million, including: $14.9 million in Technology Partnerships Canada (TPC) funding on behalf of Industry Canada and $4.85 million in the Youth Initiatives Program on behalf of Human Resources and Skills Development. The contributions were provided by Industrial Technology Advisors (ITAs) to 2,361 clients; of whom 692 were new clients.
- Overall 2,620 innovation capacity building projects received NRC-IRAP financial support. This represents a 40% decrease in the number of projects funded since 2000 and reflects NRC-IRAP's continued strategy to fund fewer but on average

larger projects with the goal of helping more businesses grow from small to medium size.

Figure 2-4: NRC-IRAP SME Innovation / Capacity Building Regional Portfolio (2004-2005 Total Expenditures by Region)



Source: NRC Industrial Research Assistance Program Performance Report 2004-2005.

For more information on the regional performance and NRC-IRAP clients' successes, refer to the following website: http://irap-pari.nrc-cnrc.gc.ca/english/success_e.html.

The IRAP-TPC program is funded equally up to a total annual investment of $30 million by NRC-IRAP and TPC to provide pre-commercialization assistance to SMEs in the development of new and significantly improved technological products, processes or services for market. In 2004-2005, 40 new IRAP-TPC projects received funding approval, bringing the total number of projects funded since the launch of the program in 1998 to 420. A total of $15 million was invested in new and on-going innovation projects through IRAP-TPC. The total amount invested in IRAP-TPC projects, since 1998, is $157 million. These funds were leveraged further by $353 million from other sources.

> "The VMM (Vansco Modular Multiplexed System) will put us in a very strong position to win over a good chunk of what will be a new market for us. To get a product like this going is a major investment, and without IRAP, we just couldn't have made it happen."
>
> **Ed Van Humbeck**
> **President**
> **Vansco Electronics Ltd**

The initiative provides repayable contributions to SMEs, with the Government of Canada sharing both the risk and the rewards of high technology development. In 2004-2005, $5.6 million in contributions were repaid, by 115 firms that received IRAP-TPC funding, bringing the total amount of recovered payments since 1999-2000 to $13.9 million.

In 2004-2005, total contributions to NRC-IRAP Network Member organizations amounted to $18.2 million to address gaps in the national, regional, and community innovation system. NRC-IRAP's Innovation Network Advisors (INAs) help SMEs to define their business-related innovation needs and provide access to new and innovative resources within the network. In addition, NRC-IRAP's Technology Visits and Innovation Insights Programs help improve the productivity and competitiveness of Canadian SMEs and provide participants a chance to see, hear and learn how successful companies meet manufacturing challenges. In 2004-2005, there were 2,420 participants and over 120 host companies that opened their doors to share knowledge and expertise.

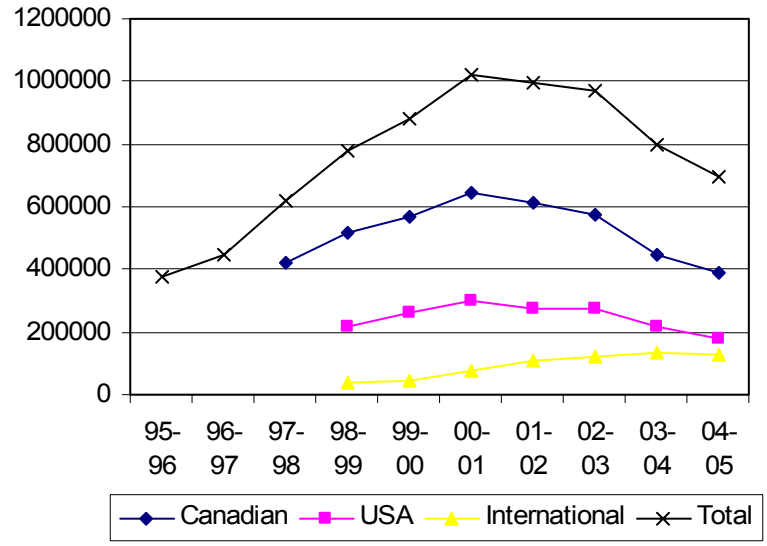
Improved Dissemination of Knowledge; a Key Contributor to Innovation - NRC Canada Institute for Scientific and Technical Information (NRC-CISTI)

NRC-CISTI maintains, publishes, and provides access to scientific, technical, and medical (STM) information critical to the global knowledge base and Canada's innovation system. To fulfill its mandate, NRC-CISTI maintains and grows the nation's STM information resources, provides access to these resources through state-of-the-art document delivery and current awareness services, provides specialized information products to serve SMEs, and publishes and disseminates the results of Canadian and international research. NRC-CISTI plays a crucial role in providing information services to NRC researchers and supporting NRC's regional technology cluster activities.

NRC-CISTI's total income amounted to $24 million (a 5% decline from last year) and expenditures were $47.4 million resulting in 51% of expenditures being covered by income. NRC-CISTI has a collection of STM information that is one of the largest in the world and in 2004-2005 it maintained its collection at levels similar to those of the previous year with 48,521 scientific journals, of which 8,697 are active subscriptions. The collection also included 727,331 monograph titles and a large collection of technical reports. NRC-CISTI also had licensed access to 4,716 electronic journals, a 7.6% increase from last year, and provided access to 16,203 web based resources, an increase of 10%.

Document delivery, one of NRC-CISTI's main information distribution channels, is a major success and provides significant revenue to support CISTI's activities. However, as the field of electronic information dissemination evolves, a wide variety of alternate sources for STM information are available

Figure 2-5: NRC-CISTI Document Delivery



to NRC-CISTI's clients. This has resulted in a decline in the demand for document delivery, a trend that is experienced by document delivery providers around the world. Figure 2-5 shows the decline, starting in 2000-2001, in document delivery orders, particularly from Canada and U.S. The number of documents ordered fell by almost 18% in 2003-2004 and a further 13% in 2004-2005 (from 797,827 in 2003-2004 to 697,024). To address the fluctuations in demand for document delivery, NRC-CISTI is committed to managing costs, introducing process efficiencies, and adjusting staffing levels in concert with the volume of business. CISTI has also developed a new business model that foresees a national STM "infostructure" that is based on partnerships and alliances. This infostructure will assure universal, seamless, and permanent access to the world's STM information for Canadians.

Information on NRC-CISTI's service standards can be found in Table 3-8. Client feedback indicates a high level of satisfaction with CISTI's document delivery services. For articles available in CISTI's collection, CISTI processes 90% of the orders received within 24 hours. For CISTI's global service, which extends to information sources around the world, clients can be 99% certain that they will receive the article that they are seeking. Studies have shown that CISTI outperforms other libraries in terms of turnaround time, fill rate, and cost.

In 2004-2005, NRC-CISTI launched its Secure Desktop Delivery method, enabling electronic delivery of documents directly to end-users' desktops from virtually all of the collection. NRC-CISTI is the first organization in the world to implement EJOS (ENCompass for Journals onSite) software, which enables rapid searching and retrieval of millions of full-text journal articles loaded on NRC-CISTI's technical infrastructure. The goal is to extend the reach of this technology and add new content through collaborations with Canadian academic and federal government partners.

As Canada's largest publisher of scientific and technical journals, the NRC Research Press holds an international leadership position in electronic publishing. The on-line versions of NRC Research Press journals are available free to Canadian readers. In 2004-2005, use of the Press' electronic journals increased dramatically as a result of indexing by the internet search engine Google. Almost 1,000,000 articles were downloaded, representing an increase of 138% over last year's 420,000. NRC Research Press received 3,603 research papers from authors in Canada and around the world. Following the process of peer review, 2,162 were published.

"Enterprise Buyers Speak Out – Annual Production Satisfaction Scorecard" (Volume 1, May 27, 2005)

Based on a survey of 600 information buyers in the corporate and government sectors conducted by Outsell Inc., NRC-CISTI is ranked top overall for document delivery. The survey documents user satisfaction with document delivery vendors. NRC-CISTI outranked all other key vendors, such as the British Library Document Centre and Infotrieve Document Delivery. http://cisti-icist.nrc-cnrc.gc.ca/media/press/outsell_e.html

Outsell Inc.

The NRC Research Press publishes 15 peer-reviewed journals (available in both print and electronic format), monographs, and conference proceedings. NRC Research Press highlights included:

- The launching of a flexible, powerful, and convenient web based manuscript submission and peer review system, known as OSPRey (Online Submission and Peer Review). The system was co-developed by NRC-CISTI and Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO).
- The NRC Research Press' Canadian Journal of Fisheries and Aquatic Sciences ranks as the most highly cited fisheries journal in the world according to the Institute for Scientific Information (ISI) Science Citation Index.

The NRC-CISTI Strategic Plan 2005-2010 was launched in the spring 2005. Based on extensive consultations with over 180 stakeholders including NRC-CISTI staff. The Plan outlines how NRC-CISTI will respond to its challenges and work with partners to ensure that the infrastructure and expertise is in place for Canadians to derive value from STM information to drive their research, innovation, and commercialization activities.

Supporting Canadian Industry through Codes, Standards and New Technologies

Construction Codes and Standards

Codes, standards, and guides are critical tools for consolidating knowledge, reducing transaction costs, and facilitating the introduction of new products and processes to the construction sector (http://irc.nrc-cnrc.gc.ca/codes/home_E.shtml). Approximately 13,000 code documents were sold in 2004-2005, generating $1 million in revenue, a decrease of six percent from last year as sales diminished with the impending release of new editions of the National Building Code, National Fire Code, and National Plumbing Code to be published in September 2005. The new editions will also include extensive code-specific training materials which will be provided to the provinces and territories for delivery to stakeholders. With the release of the new codes, NRC-IRC expects revenues of $5.2 million in 2005-2006 and will be planning for the next code cycle.

NRC-IRC's Canadian Construction Materials Centre (CCMC) created 6 new scope and evaluation plans and 10 new evaluation protocols for evaluating the performance of innovative products in 2004-2005 (http://irc.nrc-cnrc.gc.ca/ccmc/home_e.shtml). NRC-IRC-CCMC plays an important role in the construction sector by promoting diffusion of innovative products to manufacturers and users of innovative construction products, the provincial and municipal building regulatory community, as well as designers and architects. CCMC also evaluated 21 products classed as innovative (first type to market or with no consensus standard), and 68 products classified as routine (those with a consensus standard).

Surface Transportation Technology

NRC's Centre for Surface Transportation Technology (NRC-CSTT) is a self-supporting business unit within NRC which provides surface transportation development and testing

services for the rail and road transport industries, defence departments and a wide range of vehicle and equipment manufacturers.

Some projects NRC-CSTT worked on during 2004-2005 include:

- NRC-CSTT completed a project for the Ministry of Transportation of Ontario to determine which of the tractor semi-trailer configurations currently on public roads should be retained under new regulations. The result of this project will gradually re-shape the fleet of heavy trucks in service, and reduce the deterioration rate of Ontario roads at considerable savings to the Province and the public.
- NRC-CSTT performed a project for Transport Canada to evaluate the roll stability of heavy tanker trucks in the Canadian fleet. Transport Canada's goal is to introduce a minimum "rollover threshold" standard for vehicles carrying dangerous goods. Transport Canada is proceeding to draft new regulations based on NRC-CSTT's work. The result will be a technically-solid regulatory base that increases transportation safety and environmental benefits throughout Canada.
- NRC-CSTT performed a project for General Dynamics Canada, to develop a prototype installation of communications electronics for the Canadian Army's new "Tactical Server Vehicle." The vehicle is conventional, but adapted to make significantly greater use of a new approach to military hardware — the use of commercial off-the-shelf (COTS) equipment, sufficiently ruggedized to serve in a military environment. The custom developed power management system uses NRC-CSTT's proprietary intellectual property to run the vehicle's on-board equipment as well as the vehicle itself, without risk of depleting the battery and losing the capacity to start the engine and escape enemy fire. The project is an important contribution to the Army's new direction to increase the use of COTS equipment and thus accelerate the introduction of new electronics technology and reduce costs for mobile combat and peacekeeping operations.

Hydraulics Technologies for Coastal Engineering, Cold Regions and the Environment

NRC's Canadian Hydraulics Centre (NRC-CHC) is a self-supporting business unit, and one of North America's largest hydraulic engineering laboratories with expertise and experience in physical and numerical modeling, and analysis services. NRC-CHC works to solve a wide range of hydraulic engineering problems.

Some projects NRC-CHC worked on during 2004-2005 include:

- NRC-CHC continues to provide physical modeling services to Canadian and international consulting firms and assists them in the performance evaluation and design optimization of coastal and offshore structures. NRC-CHC undertook several studies in 2004-2005 which included beach stabilization schemes, design of new marina and port facilities, and optimization of moored ship response.
- NRC-CHC provided Hydrodynamic and Sediment Transport Modelling Services to conduct an Environmental Impact Assessment of the Petitcodiac River Causeway in New Brunswick. This high profile project, led by AMEC Earth & Environmental Limited, Fredericton, for the New Brunswick Department of

Supply and Services investigated the environmental effects of various modification options to the causeway. A particular issue being looked at is related to fish passage.

- NRC-CHC is working with Transport Canada to put the Arctic Ice Regime Shipping System on a scientific basis, to implement a regulatory standard intended to minimize the risk of pollution in the Arctic due to damage of vessels by ice. NRC-CHC has proposed a system that can be used to characterize the ice regime and to assess the potential risks of navigation for different classes of vessels.

Global Reach

Strategic Outcome

Access to global research and information networks and science facilities; Stimulation of enhanced international opportunities for Canadian firms and technologies.

By 2006, NRC will be recognized by its stakeholders for its contributions to a more effective Canadian innovation system that assures access to international facilities and research networks, provides opportunities for Canadian firms and builds new research and technology alliances.

Expected Results:

Intermediate Outcomes

- Harmonize international measurements standards to support international trade.
- Raise the profile of Canada as an S&T country, through new relationships and access and disseminate the knowledge from abroad to Canadians.
- Enhanced innovation capacity of Canadians SMEs through international ventures and partnerships.

Immediate Outcomes

- Development and enhancement of strategic bi-lateral alliances with key innovation partners in Europe, Asia, Latin America and the U.S.
- Canadian participation in leading-edge international science activities and development of large-scale S&T infrastructure of importance for the Canadian scientific and engineering community.

Plans, priorities and commitments

- ISO/IEC 17025 accreditation for NRC-INMS.
- Prepare case of funding of new five year plan for Tri-University Meson Facility (TRIUMF).
- Continued implementation of astronomy and astrophysics Long Range Plan (LRP).

Program resources and results linkages*

- NRC's 19 research institutes – see Appendix B for full list
- NRC Industrial Research Assistance Program
- NRC Canada Institute for Scientific and Technical Information
- NRC Technology Centres

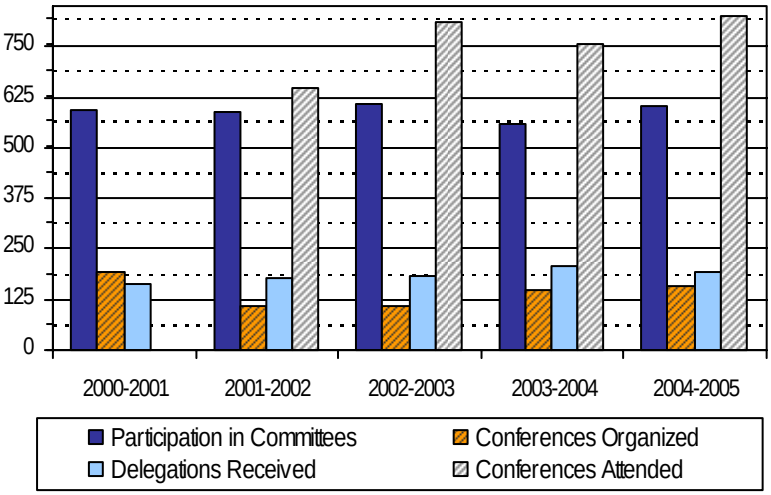
Performance Indicators:

- Number and value of international collaborative agreements
- International advisory board/committee participation
- International technology missions and impacts
- Joint authorship publications with international partners
- Foreign investment

** At this time NRC is only able to provide resource information by business line and not by strategic outcome. The organization is working towards evolving NRC's financial systems and performance measurement strategies to accomplish this in the future.*

NRC has a long-standing international reputation as a Canadian scientific authority in areas of measurement standards, astronomy, biology, chemistry, transportation, construction, manufacturing, aerospace, engineering and physics. Participation on international committees, representation at international conferences, and organization of international conferences are indicators of NRC's role as an integrator and facilitator of international research (see Figure 2-6). This year, NRC employees participated in the work of 603 international committees and attended 823 international conferences (up close to 10% from last year). NRC also organized 160 international conferences and workshops, a small increase from last year. In addition, 194 official foreign delegations were received at NRC in 2004-2005.

Figure 2-6: NRC International Reach (2000-2004)

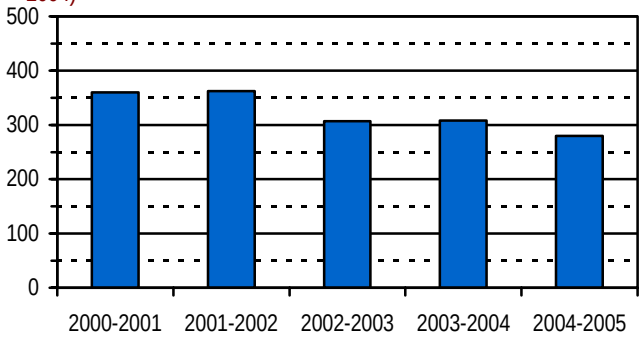


Source: NRC Performance Information Database, 2005.

Development and Enhancement of Strategic Bi-lateral Alliances with Key Innovation Partners in Europe, Asia, Latin American and the U.S.

In 2004-2005, NRC signed 109 new formal collaborative research agreements with international partners worth $16.5 million. The total number of active international collaborative agreements is similar to last year's number (see Figure 2-7), with a total value over the lifetime of the agreements of $139.7 million, a 3% decrease from last year. NRC's partners invest 2.14 dollars for every dollar NRC invests.

Figure 2-7: NRC International Collaborations (2000-2004)



Source: NRC Performance Information Database, 2005.

Examples of major S&T alliances include:

- NRC-IMS is responsible for the creation of the Canadian European Research Initiative on Nanoelectronics (CERION) that brings together seventeen European and eight Canadian nodes, actively working in Nanotechnology enabled research.

For 2004-2005, CERION completed its second mandate and efforts are underway to find a champion on the European side to facilitate a third mandate within the European Funding Network. NRC-IMS also participates in an international collaboration on Quantum information through the U.S. Department of Defence Advanced Research Projects Agency that is applying quantum bits to absolutely secure communications technology.

- NRC's Institute for Chemical Process and Environmental Technology (NRC-ICPET) joined forces with the University of Petroleum in Beijing to work on an Athabaska Oil Sands project. Chinese petroleum has a similar chemical structure to the Canadian oil sands. The renewed Memorandum of Understanding is in its second year, ensuring that this collaboration will extend for an additional two years, leading to technical and scientific knowledge and exchange of highly skilled staff. In addition, access to large scale super critical fluid extractors will enable Canada to perform its research at the pilot level. Coupled with a parallel agreement with Syncrude Canada, this collaboration is critical for the future development of oil sands in Canada.
- NRC's Institute for Biodiagnostics (NRC-IBD) participated in NRC-IRAP's technology missions to the United Kingdom (U.K.) and as a consequence a Scottish medical devices company has located in Canada. In total, six British companies initiated relationships with Canadian entities as a result of the mission. Other institutes within the NRC biotechnology group such as NRC's Institute for Marine Biosciences (NRC-IMB) have also formed alliances with researchers in Germany to study the pharmaceutical properties of Hyperforin. Hyperforin is found in St. John's Wort and preliminary research has shown that it is effective as an antidepressant.

Extending the Boundaries of Fuel Cell Innovation

NRC-IFCI is working to overcome the technical challenges to accelerate the market readiness of fuel cell and hydrogen technologies. It has developed an advanced solid oxide fuel cell that employs novel materials and a new anode to create a lower-cost system that yields higher efficiencies at reducing operating temperatures. This advancement brings the prospect of clean energy for Canadians that much closer. The potential of this research has been recognized internationally with $350,000 in funding from two of Japan's most prestigious science organizations – NEDO and the Institute of Applied Energy.

NRC Institute for Fuel Cell Innovation

Supporting Canadian SMEs

NRC-IRAP is well positioned to assist small- and medium-sized enterprises (SMEs) by tapping into international research consortia, programs, sources of technology, and technical intelligence. In 2004-2005, NRC-IRAP undertook technology missions with over 75 SMEs to 16 countries on three continents (Asia, Europe and North America). Participating SMEs identified possible new technology opportunities and partners and explored opportunities to collaborate through a series of formal presentations and one-on-one meetings. Examples of success achieved include the signing of a letter of intent between a Canadian and a Beijing firm for the deployment of a Mobile Services Delivery Platform. NRC-IRAP continued its participation in the Enhanced Relationship Initiative

with the U.S., a partnership of eight federal departments and agencies that provides an integrated approach to managing and advancing Canada's advocacy, trade, business development, science and technology, and investment interests in the U.S.

NRC-IRAP signed an agreement with the Confederation of Indian Industry (CII) in support of Canada's objective of strengthening S&T and trade ties with India. For the next three years, NRC-IRAP and CII will collaborate on a reciprocal basis to further objectives of supporting SME growth, technology transfer and development.

NRC-IRAP currently maintains nine strategic international partnerships in Asia. Partnerships with the Shanghai Science and Technology Commission of China and the Guangdong Science and Technology Commission were established in 2004-2005. These partnerships assist NRC-IRAP clients in exploring the potential for joint projects, financing and technology licensing ventures to develop market-focused technologies and products.

Harmonization of International Measurement Standards

The Quest for the Ultimate Measurement

NRC-INMS is part of a small group of scientists worldwide that are working to advance the field of super-accurate measurement by developing new methods with which time is measured and frequency of light is controlled. The research performed together with groups from the U.S., UK, Germany and France has been published in the prestigious journal *Nature*. Pushing the frontier in measurement and the physics of ions impacts our understanding of phenomena and opens the doors to significant advances in astronomy and telecom technologies as well as chemical and biotechnology processes.

NRC Institute for National Measurement Standards

With international trade agreements now demanding demonstrated equivalence between the measurement standards and accreditation systems of buyer and seller nations, metrology[18] has become vital to the regulation of trade and to resolving trade disputes. As Canada's National Metrology Institute, NRC-INMS provides most of the mandated measurement standards related activities at NRC. In 2004-2005, NRC-INMS received approval from its Regional Metrology Organization for ISO/IEC 17025 accreditation (official accreditation certificate is forthcoming).

NRC-INMS participated in planning or implementing numerous international measurement comparisons through its memberships with many international organizations. This work is vital to Canadian industry involved in the export of products to countries with which trade agreements have been reached, as well as the customers of products that are imported from these countries. The result is a uniform global metrology

[18] Metrology is based on the concept of traceability, which allows the calibration of a standard or measurement apparatus to be traced step-by-step to a reference standard, http://canadagazette.gc.ca/partI/2005/20050423/html/regle1-e.html

system that facilitates increased competitiveness of Canadian industry in the global marketplace.

As a result of NRC-INMS' international memberships, it participated in the following projects in 2004-2005:

- The planning or implementation of 29 comparisons in pursuit of the Comité International des poids et Mesures (CIPM) Mutual Recognition Arrangement (MRA).
- The planning or implementation of 9 comparisons under the auspices of the Inter-American Metrology System (SIM), which comprises 34 nations of North, Central and South America, as well as the Caribbean nations.
- 75 major comparisons involving the Institute's Time Dissemination program.
- 48 other major international comparisons not falling under the MRA or SIM.

In addition to NRC-INMS's work, several other NRC Institutes participated in the harmonization of international measurement standards.

- NRC's Herzberg Institute of Astrophysics (NRC-HIA) is participating with Industry Canada to optimize the shared used of the radio spectrum by radio astronomers and industry under the International Telecommunications Union. The work involves the implementation of allocations in the 71 to 275 GHz band and the interference problems that ultra-wideband devices create for radio astronomy.
- NRC-IIT participates on nine international standards committees, ranging from co-chairing the Global Grid Forum Certificate Authority Operations Working Group to advisory committees on learning, privacy testing and the mobile web.
- Members of NRC-IMS participate with the American National Standards Institute and the International Standards Organization on the standardization of methods to determine environmental noise and its impact. The work is critical for the standard assessment of noise pollution from airport operations and city traffic.
- NRC-ICPET participated in an international round robin of testing to develop internationally accepted standards for calibrating surface analysis instruments.

Continued Implementation of Astronomy and Astrophysics Long Range Plan

A mid-term review of the Long Range Plan (LRP) conducted by the Canadian Astronomical Society in 2004 evaluated progress since the LRP had been issued and made recommendations on the continuation of several international projects in which Canada must have a role to maintain our high international ranking in astronomy. The review acknowledged the significant progress on those areas of the LRP within NRC-HIA's responsibilities, including, for example:

- *Canadian Large Adaptive Reflector for the Square Kilometre Array (C-LAR, SKA):* the prototype adaptive panel was demonstrated at the International SKA meeting in Penticton and work continues on the focal plane array that will be needed to meet the SKA specifications.

- *Gemini:* Detailed proposals for the next generation of instruments and facility upgrades were prepared in collaboration with other international groups associated with the Gemini Observatory.
- *NRC-HIA's Canadian Astronomy Data Centre:* The Centre successfully met the extraordinary demands of servicing the users of the Canada-France-Hawaii Telescope Legacy Survey.

Access to International Research Facilities

NRC provides varying degrees of stewardship over Canada's investments in large-scale S&T infrastructure of critical importance to the research community, as well as, ensures Canada's reciprocal participation in leading-edge international science activities around the world. In Canada, NRC is a key player in initiating, planning, and developing such facilities. NRC operates two Canadian large-scale research facilities.

Canadian Neutron Beam Centre

NRC's Steacie Institute for Molecular Sciences (NRC-SIMS) operates the Canadian Neutron Beam Centre based at the National Research Universal reactor at Chalk River labs. Unique in Canada, this facility enables neutron beams to be applied to research on materials of all kinds, such as, steel, biological tissue, minerals, superconductors and cement. Under NRC management, 10% of the available neutron instrument time is used by NRC staff scientists, approximately 10% is used by industrial researchers, 40% by students and professors from over 20 Canadian universities, and the remaining 40% is used in collaborative projects with institutions in countries across the developed and developing worlds. The laboratory provides a broad national benefit in attracting, training and retaining HQP, generating knowledge of materials affecting energy, health, transport and engineering sectors, as well as connecting Canadian researchers to the international network of neutron laboratories. In 2004-2005, 52 professors and students, from 12 Canadian universities coast to coast, used the lab in their research projects. In the same year, scientists from Australia, Austria, Belgium, France, India, Japan, South Korea, the United Arab Emirates, the United Kingdom, and the United States, used the lab in their research. Over the past 3-year period, the facility has engaged 108 scientists, from 29 Canadian institutions, and researchers from 114 institutions in 14 foreign countries. Additional information can be found at http://neutron.nrc-cnrc.gc.ca.

Herzberg Institute of Astrophysics (NRC-HIA)

Astronomy is a science conducted in an open international context and NRC-HIA is Canada's primary interface to the international astronomy community. NRC-HIA's contributions to three major international facilities provide Canadian researchers with access to forefront research opportunities in optical and sub-mm spectral windows, thus forming a central pillar of Canadian astronomy's high distinction for citations. In 2004-2005, the Canadian Astronomy Data Centre (CADC) delivered archival data from the archives of the three major international telescope facilities to 405 distinct professional astronomers. It serviced 3,943 individual requests, up 44% from 2003-2004, and delivered 24,572 gigabytes of data to users (2.7 times as much data as in 2003-2004). A total of 179 refereed publications that used CADC services have been identified for the years 1996–2004 based on the presence of an acknowledgement in the publication. An

analysis done in 2004 showed that those papers acknowledging CADC service had a citation rate 1.5 times higher than the average Astronomical Journal paper of their year.

Prime Focus on the Universe

Whether keeping an eye on asteroids that may threaten the Earth or watching dim ancient asteroids circle the sun, MegaPrime, the world's largest digital camera has now been released for scientific use on the Canada-France-Hawaii Telescope. MegaPrime is a collaboration between several institutes in France and NRC-HIA. The new camera has the ability to observe large areas of the sky and the large number of pixels means that the images are obtained at very high resolution that can reveal the detailed structure of faint, distant galaxies. Canadian astronomers have a world-leading tool to further their original research and an opportunity to have a major impact in resolving fundamental questions about the nature of the universe. The images are carefully archived by the Canadian Astronomy Data Centre of NRC-HIA and will provide a lasting legacy for the entire world to exploit.

NRC Herzberg Institute of Astrophysics

Other Canadian large-scale research facilities NRC is involved with include:

TRIUMF (Tri-University Meson Facility)

The Tri-University Meson Facility (TRIUMF), located on the campus of The University of British Columbia, is Canada's national laboratory for particle and nuclear physics research and the related sciences of materials science, life science and medical therapy. TRIUMF is operated by a consortium of Canadian universities, under a contribution from NRC. For additional information on TRIUMF, refer to http://www.triumf.info/.

2004-2005 was the last year of TRIUMF's five year contribution agreement (2000-2005). It was a very successful year at the facility in terms of scientific accomplishments and economic impact. The federal government investment in TRIUMF and ISAC (Isotope Separator and Accelerator) over the last five years has paid off. Among the outcomes for the year were:

- Completion of the ISAC-II building, on time and on budget, which will house the second phase of ISAC. Construction costs for the building were fully funded by the Province of British Columbia.
- Construction of the first accelerator components for ISAC-II. ISAC-II is now and will continue to be for the foreseeable future, a unique ISOL facility in the world. As an indication of how successful ISAC is, facilities building on the ISAC success are planned for the U.S. and currently being constructed at GSI in Germany.
- Completed experiments in nuclear physics, nuclear astrophysics, particle physics, structure of matter, condensed matter, life sciences and medical therapies.
- Final delivery and commissioning of 52 specially designed, high precision magnets, manufactured by Alstom of Tracy, Quebec, along with nine pulse forming network and power supply units to CERN as part of Canada's contribution to the world's highest energy accelerator, the Large Hadron Collider (LHC).

- Infrastructure support for the construction of the ATLAS detector at CERN (Centre for Nuclear and Particle Physics) for the LHC on behalf of the Natural Sciences and Engineering Research Council (NSERC) supported Canadian university researchers. During the 2004-2005 fiscal year, construction of the Hadronic End Caps was completed and they were shipped to CERN for installation in the detector.
- TRIUMF continued to fulfill its infrastructure role for the whole of the Canadian subatomic physics community, providing the support required for Canadian scientists to participate in experiments and programs in Canada, Europe, the U.S. and Japan.
- A laboratory for advanced detector design was established at TRIUMF with a Canada Foundation for Innovation (CFI) grant awarded to The University of British Columbia and the University of Montreal.
- TRIUMF's overall, highly regarded international scientific and technical status and reputation continues to be confirmed by the Advisory Committee on TRIUMF reports on TRIUMF. This confirmation was further reinforced by the findings of the international Peer Review Committee, which met during 2003-2004.
- TRIUMF assisted their major technology transfer partner, MDS Nordion Inc. in the construction of a new TR30 cyclotron, resulting in substantially increased sales for MDS Nordion Inc and an increase in royalty revenue earned by TRIUMF.

A calculation of direct primary impact of TRIUMF on the Canadian economy indicates that in 2003-2004, the last year the calculation was made, the $40 million TRIUMF budget generated an economic impact over $109.7 million (excluding any form of multiplier). TRIUMF completed and submitted its next five-year plan for the period 2005-2010. Renewed funding for TRIUMF was announced in the February 2005 budget at the level of $222 million over the next five years.

Canadian Light Source (CLS)

CLS, Canada's synchrotron, is a third generation 2.9 GeV synchrotron, owned and operated by the University of Saskatchewan. As one of Canada's largest scientific projects, the CLS is an intense source of electromagnetic radiation where beams of synchrotron light (ten million times brighter than the sun) will help scientists understand the nature and structure of molecules and materials.

The construction of the CLS was completed on time and under budget in December 2003 at a cost of $174 million. First "light" was also achieved in December 2003. The synchrotron was commissioned in the first quarter of 2004. The capital funding for this national facility derived from CFI and 14 different funding partners including NRC. NRC is a part of a large interdisciplinary user community involved in the commissioning of seven experimental beamlines. The opening ceremony took place in October 2004 and was attended by several hundred dignitaries. Additional information can be found at http://www.lightsource.ca/.

Stimulation of New Foreign Investments in Canada

In 2004-2005, according to the NRC - 2005 Economic Impact Survey, overall investment in NRC spin-off companies was up significantly. Nationally, overall annual investment reported was up approximately 196% in 2004-2005 from 2003-2004 levels.
Examples of new foreign investments for 2004-2005 include:

- NRC-IBD's spin-off company Novadaq (http://www.novadaq.com/index.php) attracted $ 6 million (U.S.) in investment from a consortium of American investors represented by the firm Miami Venture Capital. Novadaq™ Technologies develops and markets medical devices that facilitate improved diagnosis and treatment in a variety of medical disciplines including cardiac surgery and ophthalmology.
- A number of companies incubating at the Plant Biotechnology Institute's (NRC-PBI) IPF were successful in capturing international investment to support their activities. In 2004-2005 this was estimated at $800,000 (U.S.).
- Zelos Therapeutics (http://www.zelostherapeutics.com/) is a spin-off of NRC's Institute for Biological Sciences (NRC-IBS) and attracted $11.7 million in venture capital, part of which came from the U.S. venture capital firm Seaflower. Zelos is advancing its novel therapeutics to treat a number of diseases including osteoporosis and psoriasis.
- SiGe Semiconductor (http://www.sige.com/) is an Ottawa-based spin-off company from NRC-IMS with over 100 employees world-wide. It attracted $20 million in venture capital in 2004-2005 part of which came from the Prism Venture Partners of Massachusetts. SiGe is a semiconductor company working on next generation integrated circuit design.

Technology Clusters

Strategic Outcome
Development of the innovative capacity and socio-economic potential of Canada's communities.

By 2006, NRC will contribute to the development of new, sustainable and competitive innovation clusters in at least ten Canadian communities.

Expected Results:

Intermediate Outcomes

- An integrated national network of industrial partnership facilities offering incubation services for high tech start-up enterprises.

Immediate Outcomes

- New, sustainable and competitive technology clusters in at least ten Canadian communities.

Plans, priorities and commitments

- Continue activities to build technology clusters across Canada.
- Complete a formative evaluation of NRC's Atlantic technology clusters initiatives.
- Complete and open Industrial Partnership Facilities (IPF) in Halifax, Winnipeg and continue building new R&D and IPF facilities in Charlottetown, Montreal, Ottawa, Regina, and Edmonton.
- Increase the IPF occupancy and graduation rates for Canadian start-ups
- Prepare case to government for continued funding of the Atlantic Cluster Program.

Program resources and results linkages*

- NRC's 19 research institutes – see Appendix B for full list
- NRC Industrial Research Assistance Program
- NRC Canada Institute for Scientific and Technical Information

Performance Indicators:

- Community participation
- Incubating firms and co-locating firms
- Investment to the cluster
- Venture capital to the cluster
- New companies to the cluster

** At this time NRC is only able to provide resource information by business line and not by strategic outcome. The organization is working towards evolving NRC's financial systems and performance measurement strategies to accomplish this in the future.*

Building technology clusters is recognized as integral to achieving the Government's innovation objectives. Clusters develop around emerging groups of innovative knowledge-based firms, supported by strong research institutions and a concentration of capital and business expertise. Clusters require a science and technology anchor, usually a government research institution or a university, able to work with local companies, transfer technology and spin off new enterprises. NRC has played that role in many technology clusters focusing on diverse areas of science and engineering. These include the mature clusters in biopharmaceuticals in Montreal, Information and Communications Technologies (ICT) in Ottawa and plant biotechnology in Saskatoon. Table 2-1 provides a summary of cluster-specific funding received by NRC since 2000 to implement its national Technology Cluster Strategy.

In 2003-2004, NRC began a formative evaluation of its Atlantic Initiatives (AI). NRC received $110 million to implement these initiatives over the five year period 2000-2001 to 2004-2005. This allocation was given to NRC as part of the $700 million Atlantic

Investment Partnership (AIP) announced in 2000. The purpose of the funding was to build new partnerships to strengthen the capacity of Atlantic Canada by fostering the growth of knowledge-based technology clusters. Through AI, NRC invested in national facilities, public and private partnerships, and expertise and services (including technology development, business advisory services and technology transfer expertise) to help close the gap in Atlantic Canada's innovation infrastructure and to foster the growth of companies. The NRC initiatives targeted a number of emerging research and technology fields that were identified by local partners during consultations with NRC.

The final evaluation report was completed in October 2004. The report summary can be found at: http://www.nrc-cnrc.gc.ca/aboutUs/audit-atlantic_e.html. NRC used the evidence provided in the evaluation to make a case to the Government of Canada for renewed funding for AI. NRC was successful in this endeavour and the February 2005 federal budget documents included a commitment of "$110 million over five years for the second phase of the NRC's technology-based clusters in Atlantic Canada" noting that "in this second phase, NRC's efforts will increasingly focus on identifying and meeting the innovation needs of local businesses".

Table 2-1: Allocation of new resources for NRC Technology Clusters

2000-2001 to 2004-2005

Location	Focus	Resources
St. John's (Newfoundland)	Ocean technology	$ 15.3 million
Halifax (Nova Scotia)	Life sciences	$ 18.6 million
Fredericton, Moncton and Saint John (New Brunswick)	E-business, e-learning, e-health	$ 27.7 million*
Cape Breton (Nova Scotia)	Wireless technologies	$ 6.3 million
Atlantic Canada	Coordination, administration, special studies, innovation assistance, S&T knowledge/information dissemination (includes NRC-IRAP and NRC-CISTI)	$ 42.1 million

2002-2003 to 2006-2007

Location	Focus	Resources
Saguenay-Lac-Saint-Jean (Quebec)	Aluminium technologies	$ 27 million**
Ottawa (Ontario)	Photonic	$ 30 million
Winnipeg (Manitoba)	Medical device technologies	$ 10 million
Saskatoon (Saskatchewan)	Plant nutraceuticals	$ 10 million
Edmonton (Alberta)	Nanotechnology	$ 60 million
Vancouver (British Columbia)	Fuel cells	$ 20 million
Ottawa (Ontario)	Coordination, administration, special studies, innovation assistance	$ 17 million

Table 2-1: Allocation of new resources for NRC Technology Clusters (continued)

2003-2004 to 2007-2008

Location	Focus	Resources
Victoria/Penticton (British Columbia)	Astronomy	$ 20 million***
Charlottetown (Prince Edward Island)	Bioresources	$ 20 million
Regina (Saskatchewan)	Sustainable urban infrastructure	$ 10 million

2005-2006 to 2009-2010

Location	Focus	Resources
Atlantic Provinces	Ocean technology, Life sciences, E-business, e-learning, e-health, (includes NRC-CISTI, NRC-IRAP, and National Secretariat)	$ 110 million

* An additional $12 million was received from an agreement with the New Brunswick Regional Economic Development Agency.

** An additional $5 million was received in 2001-2002.

*** This is in addition to $36 million received in 2002-2003.

Helping to Build Technology Clusters across Canada

NRC nurtures the growth of cluster initiatives in many regions across Canada in addition to those areas where new, cluster-specific funding has been received. The majority of NRC's recently launched cluster activities are still in early development or birth stage, focused on establishing facilities and attracting human resources, networks of public and private sector partners and R&D support. Below are descriptions of cluster activities and impacts for the Canadian clusters to which many of NRC's Institutes contribute.

Across the country

NRC-CISTI and NRC-IRAP are integral parts to NRC fostering development of community-based technology clusters. In various clusters, NRC-CISTI established NRC Information Centres (NIC), co-located at the respective Institute. NICs provide scientific, technical, medical and business-related information and analysis services to NRC researchers and companies located onsite, and external clients in the region. Similarly, NRC-IRAP supports technology cluster development opportunities through the provision of innovation support and infrastructure to Canadian SMEs.

St. John's (Newfoundland) – Ocean Technologies

During 2004-2005, NRC's Institute for Ocean Technology (NRC-IOT) continued to focus its resources on the fostering of the St. John's ocean technology cluster by providing research results, technical expertise and access to facilities. The AI evaluation indicated that NRC-IOT effectively accelerated development of and added credibility to the cluster. The Ocean Technology Enterprise Centre, NRC-IOT's IPF, graduated two companies funded through the Young Entrepreneurs Program and opened its doors to 10 others through both this and its Co-Location Program.

NRC-sponsored Oceans Advance, a multi-stakeholder technology cluster initiative, hosted the Oceans Technology Speakers series, as well as other forums throughout 2004-2005. Community marketing was further strengthened through a partnership with several stakeholders including the City of St. John's, which aims to increase awareness of St. John's and Newfoundland on the international markets. NRC-IOT also collaborated with several local industry associations, federal and provincial government departments and academic institutions on many projects to increase knowledge of business innovation needs and provide advice and services to young companies.

Helping Young Entrepreneurs

The Young Entrepreneurs Program has just concluded its second year of operation and the first two companies to enter the program have recently graduated. One of these, Madrock Marine Solutions, is now engaged in certification testing of its patented lifeboat release mechanism. The device has already received approval from Transport Canada.

NRC-IOT Performance Report

Cape Breton (Nova Scotia) – Wireless Technologies

Partnership projects with Cape Breton University continued in 2004-2005. The Wireless Systems cluster in the area benefited from the NRC-IIT hosted cluster initiative meetings with key stakeholders as well as discussions with private sector contacts regarding investment attraction. The Institute worked with the Cape Breton County Economic Development Authority, the Nova Scotia Department of Economic Development and Enterprise Cape Breton Corporation to develop an innovative solution, known as "Project Boomerang", to the HQP challenge in Cape Breton with the idea that the solution could be utilized across the four Atlantic Provinces to help attract talent to the region. The project involves an extensive web based marketing campaign to attract high quality personnel and companies to Cape Breton. Efforts are also being made to respond to the findings of the Atlantic Initiatives evaluation as they relate to the long-term outlook of the Cape Breton wireless technologies cluster.

Halifax (Nova Scotia) – Life Sciences

The activities of two NRC Institutes (NRC-IBD and NRC-IMB) contribute to the growth of the life sciences cluster in Halifax. In 2004-2005, NRC-IBD (Atlantic) continued to work with NRC-IRAP, NRC-CISTI, and academic and clinical researchers to begin commercializing brain repair technologies. The Institute also hosted the NRC-IRAP Medical Devices meeting on the commercialization of brain research in Halifax. NRC-IBD (Atlantic) participates as an active member of the Nova Scotia Life Sciences Development Association as well as the Executive, Research and Commercialization Committees at the Brain Repair Centre.

Together with the Izaak Walton Killam Health Centre and Dalhousie University, NRC-IBD (Atlantic) is working to build an MR Microimaging Centre that will be used for imaging animal models of human disease and for imaging fish. It will be primarily used for preclinical studies.

NRC-IMB is helping to develop the life sciences cluster in the region through its internationally recognized research and technology base, its work with stakeholders to leverage funding, and its ability to stimulate new business formation. The all-day "Partner's Forum", organized by the Institute in 2004, brought together 25 stakeholders to establish an engagement plan that included implementation by NRC-IMB of path-finding services for SME clients, and a needs assessment of the life sciences industry. Through the combined efforts of NRC-IMB, NRC-CISTI, and NRC-IRAP, the "Partners for Success" open house attracted more than 120 community leaders, partners and scientists.

Charlottetown (Prince Edward Island) – Nutrisciences and Health

In 2004-2005, NRC-IMB's satellite, the Institute for Nutrisciences and Health (NRC-INH), began its research program after a strategic recruitment effort to assemble a staff of 25 individuals. Over the past year the Institute continued to strengthen linkages with the biosciences community: NRC-INH's research officers are cross-appointed to the University of Prince Edward Island (UPEI); the Institute's governance model has representation from academia, government and the private sector; and the Institute is represented on the board of the newly-formed PEI BioAlliance. In 2004-2005, NRC-INH scientists conducted more than 30 speaking engagements and tours. A recently signed partnership with Agriculture and Agri-Food Canada (AAFC) will lead to joint research teams drawn from government, UPEI and the private sector. NRC-INH's building will open in early 2006 on the UPEI campus. The new structure will provide state-of-the-art research laboratories for UPEI and NRC researchers as well as an IPF facility.

Fredericton, Moncton, and Saint John (New Brunswick) – E-Business, E-health, E-learning

The AI evaluation found that NRC-IIT successfully completed its objectives set out in Phase I of clustering in the Atlantic Provinces which were to build stakeholder participation and coherence. During 2004-2005, NRC-IIT started the transition to build a research nucleus to further sustain cluster growth. Participation in cluster strategies and initiatives in 2004-2005 included membership on a University of New Brunswick led Research Collaboration Group and participation in Atlantic Canada Opportunities Agency (ACOA) meetings aimed at aligning resources to support business and academic research in the province.

In 2004-2005, NRC-IIT staff sat on 20 provincial, regional and university boards and committees including the Premier's Roundtable on eNB and Innovation, Enterprise Fredericton Community of Innovation Board and the University of New Brunswick's Research Advisory Board. The Institute also spearheaded the creation of research communities nationally and regionally in research areas where coordination was lacking such as Human-Computer Interaction and Privacy-Security-Trust.

Saguenay-Lac-Saint-Jean (Quebec) – Aluminium and Materials Technologies

NRC-IMI continued to contribute to the growth of the aluminium and materials technologies cluster in Quebec through two initiatives in 2004-2005: the Aluminium

Technology Centre (NRC-ATC) in Chicoutimi and the Centre for Innovation in Industrial Materials, a joint-project with the Corporation d'innovation Montérégie. The latter is well aligned with the economic development plan of its host region, the Montreal metropolitan area. Both centres have been involved in forging collaborations with the local community and participating in and organizing a number of projects and Special Interest Groups.

Montreal (Quebec)–Biopharmaceuticals

In 2004-2005, NRC's Biotechnology Research Institute (NRC-BRI) was involved in developing a strategy, in partnership with key industrial and academic organizations to capture the regional and national biopharma R&D investments and become successful in developing and delivering biopharmaceuticals to the market. In addition, NRC-BRI is involved in setting up Montreal's Integrated Biomanufacturing Technology Site which will help to complete the technology chain that is required to develop and manufacture biopharmaceuticals. The key partners are DSM Biologics and Laborium BioPharma for biomanufacturing and McGill University and John Abbot College for the training of biomanufacturing specialists. NRC-BRI also took a lead role in organizing and hosting several international conferences, workshops and seminars. This year saw the 10th edition of Crossroad of Biotechnology, a symposium that brought together over 300 businesses to network and share the latest information about the biomanufacturing industry.

Montreal (Quebec) and Ottawa (Ontario) – Aerospace Manufacturing

Both components of the Aerospace Initiative are now complete (the Institute for Aerospace Research's Aerospace Manufacturing Technology Centre (NRC-AMTC) and the Gas Turbine Environmental Research Centre (NRC-GTERC)). In 2004-2005 two Open Houses, with over 120 visitors attending each event, were organized to solidify awareness of NRC-AMTC capabilities in the academic and industrial community. The extensive and complex commissioning phase of NRC-GTERC continued in 2004-2005.

NRC's Institute for Aerospace Research (NRC-IAR) continues to be an active member of several aerospace associations including the Association of Quebec Aerospace Industries and the Consortium pour la recherché et l'innovation en Aérospatial du Quebec (CRIAQ) with which they have also developed four projects. Ties to academia are particularly strong as three NRC-AMTC scientists serve as adjunct professors at local universities and have developed graduate level courses to promote aerospace manufacturing as a field of graduate work.

Ottawa (Ontario) – Photonics

NRC-IMS's opening of the Canadian Photonics Fabrication Centre (NRC-CPFC) in 2004-2005 was well attended by officials from NRC's partner organizations,

NRC-CPFC Opens its Doors

"The Government of Canada recognizes the importance of investing in the commercialization of new technologies, such as photonics…with the opening of NRC-CPFC, Canada's innovative, small and medium-sized firms will have a world-class photonics research and development resource here in the National Capital Region."

David McGuinty,
MP for Ottawa South

Carleton University and the provincial government. Institute staff defined, inspected and purchased the Centre's suite of instruments as well as built relationships with key partners that accelerated the qualification of its facilities. In 2004-05, the first partial year of operations, $450,000 of business was secured by the Centre. As well, NRC-IMS continued to support the photonics community through consultations with industry stakeholders and membership on the Boards of several photonics organizations.

Gatineau (Quebec) – Language Technologies

As a result of sustained efforts by NRC-IIT, an R&D Collaboration and Language Technologies Research Centre (LTRC) was established in the Outaouais area of Quebec. The opening of the LTRC building on the campus of the University of Quebec is planned for January 2006. NRC-IIT also continued to be active on the management committee and subcommittees of the Technology Roadmap for the Canadian Language Industry.

Winnipeg (Manitoba) – Medical Devices Technologies

NRC-IBD continued to work to develop the medical devices cluster in Winnipeg with the view of creating a "BioMed City" near its facility. NRC-IBD staff continued to participate in several committees and advisory groups in the fields of economic development and medical science in 2004-2005. The Institute's commercialization and incubation efforts will be further strengthened when its IPF will relocate to NRC's Centre for the Commercialization of Biomedical Technology in August of 2005. NRC-IBD is also growing a satellite cluster in Alberta through a new collaborative research agreement with the Cross Cancer Institute in Edmonton.

Regina (Saskatchewan) – Sustainable Urban Infrastructure

NRC-IRC's Centre for Sustainable Infrastructure Research (NRC-IRC-CSIR) staff hosted visitors from a variety of public and private organizations in 2004-2005 including the Universities of Regina and Saskatchewan and the City of Harbin, China. In addition, the Institute also participated in two projects and several presentations and worked closely with its partners to increase the availability of project funding for technology-based companies in Regina. NRC-IRC-CSIR continued to work towards meetings its staffing needs.

Saskatoon (Saskatchewan) – Plant Biotechnology

NRC-PBI continued to build the plant biotechnology cluster through linkages with all players in the innovation chain. Highlights from the past year include the completion of a number of studies in conjunction with the University of Saskatchewan Masters of Business Administration program and Bioriginal Inc. on plant made pharmaceuticals; consultations with Bio-products Canada on building Canada's bio-products industry; working with Saskatchewan Forestry Centre to develop a research thrust in agro-forestry; and serving

NRC Supports Clusters in Saskatchewan

Since its inception in 1983, NRC-PBI has been critical to the success of the bio-economy cluster in Saskatchewan and instrumental in the development and commercialization of innovative technologies.

Dr. Ashley O'Sullivan
President & CEO Ag-west Bio Inc.

on the Canadian Agriculture Research Council (CARC) and Saskatchewan Innovation Council.

Edmonton (Alberta) – Nanotechnology

Management and staff at the National Institute for Nanotechnology (NINT) were active in supporting community stakeholders and developing joint initiatives to enhance the embryonic regional nanotechnology cluster in 2004-2005. These linkages and efforts included representation on the Steering Committee of nanoMEMS Edmonton and chairing and co-sponsoring the International Conference ICMENS 2004 in Banff and the MANCEF's COMS2004 Conference in Edmonton and several other workshops and committees in the cluster. NINT, and its partners, the University of Alberta, Western Economic Diversification Canada and Alberta Innovation and Science, have collaborated to create the NINT Innovation Centre. This 2,700 m^2 IPF will be housed in the NINT building and will offer leaseable laboratory and office space. Completion of the IPF is anticipated in July 2006.

Vancouver (British Columbia) – Fuel Cells

With the hydrogen and fuel cell sector still in its early developmental stages, NRC's Institute for Fuel Cell Innovation (NRC-IFCI) continued to nurture the cluster's growth through collaborative research projects, access to infrastructure and provision of expertise and other services.

In 2004-2005, NRC-IFCI facilitated partnerships and industry collaborations through investor visits and consortia building. As part of this effort, the Institute established the Sensor Consortium, bringing together 20 sensor suppliers and six key Canadian fuel cell companies to develop requirements and testing protocols for sensors in fuel cell systems. In addition, NRC-IFCI participated in the creation of a British Columbia (B.C.) Innovation Hub which will further integrate its activities with the province's top post-secondary institutions. NRC-IFCI also participated in the development of B.C.'s new Fuel Cell Strategy and played an important role in its implementation by leading the Hydrogen Highway Fuel Quality Working Group.

Penticton (British Columbia) - Astronomy

The plan for the establishment of the Okanagan Research and Innovation Centre (ORIC) in Penticton, is now complete. ORIC is intended to be a new, independent entity, closely related to NRC-HIA's Dominion Radio Astrophysical Observatory (DRAO). NRC-HIA will set up ORIC in 2005-2006 as a not-for-profit organization focused on technology transfer and support for companies in the cluster. NRC-HIA has also begun setting up partnerships with key stakeholders. During the year, the Institute served as a steward for the Okanagan Partnership and as President for the Okanagan Science and Technology Council. To lay the foundations for education and training within the cluster, NRC-HIA is renegotiating a 2003 Memorandum of Understanding with Industry Canada, Okanagan College and the University of British Columbia to further radio engineering research in the Okanagan region.

Strategy for Industry Partnership Facilities

NRC stimulates the creation of new firms, jobs, exports, and investment growth within regions through its incubation facilities, a vital component in fostering technology clusters. Incubating companies receive added value from access to NRC expertise and facilities. NRC's IPFs are connected internally through a network of managers and business development officers. A national network meeting was held in Halifax in June 2004 which focused on regional entrepreneurship and how IPFs can better fit within NRC's commercialization efforts.

Incubating companies and the IPF occupancy rate are important leading indicators of new company creation, attraction of venture capital and future investment in the cluster. In 2004-2005, NRC had 109 incubating firms, a decrease of 5% over last year. Successful firms eventually graduate from IPFs and create jobs and wealth within their communities. Fourteen tenants graduated from NRC IPFs in 2004-2005, a 27% increase over last year. The success of NRC's IPFs is also illustrated by demand. A total of 25,397 square metres of common and usable space was available to firms and this space was, on average, 89% occupied (see Table 2-2). In the past year, a new IPF opened at NRC-IMB in Halifax. In 2005-2006, an expanded facility will open at NRC-IBD and a new facility will open in Charlottetown at NRC-INH.

Table 2-2: NRC's Industry Partnership Facilities – Current and Planned

Location	Total Area (m^2)	Status	Completion Date	% occupied
Institute for Ocean Technology (St John's, Newfoundland)	457	in operation	2003-2004	94%
Institute for Marine Biosciences (Halifax, Nova Scotia)	691[1]	in operation	2004-2005	41%
Institute for Information Technology (Fredericton, New Brunswick)	1,000	in operation	2002-2003	78%
Biotechnology Research Institute (Montreal, Quebec)	9,800	in operation	1997-1998	100%
Industrial Materials Institute (Boucherville, Quebec)	2,180	in operation	2003-2004	50%
NRC Industry Partnership Facility, M-50 (Ottawa, Ontario), (shared facility with several Institutes)	1,581	in operation	1998-1999	99%
NRC Industry Partnership Facility, M-23A (Ottawa, Ontario), (shared facility with several Institutes)	297	in operation	2004-2005	14%[2]
100 Sussex Industry Partnership Facility (Ottawa, Ontario), (shared facility with several Institutes)	509[3]	in operation	2003-2004	95%
Institute for Biodiagnostics (Winnipeg, Manitoba)	477 4,645	in operation construction	1995-1996 2005-2006	90% -
Plant Biotechnology Institute (Saskatoon, Saskatchewan)	7,314	in operation	2002-2003	97%
Institute for Fuel Cell Innovation (Vancouver, British Columbia)	600	in operation	1999-2000	67%

Table 2-2: NRC's Industry Partnership Facilities – Current and Planned (continued)				
Location	**Total Area (m^2)**	**Status**	**Completion Date**	**% occupied**
Herzberg Institute of Astrophysics (British Columbia) Penticton Facility Victoria Facility	 114 125	 in operation in operation	 2001-2002 2001-2002	 18% 0%
NINT Innovation Centre (Edmonton, Alberta)	2,700	construction	2006-2007	-
Institute for Nutrisciences and Health (Charlottetown, Prince Edward Island)	600	design stage	2005-2006	-
Institute for Chemical Process and Environmental Technology (Ottawa, Ontario)	112[4]	in operation	1992-1993	90%
Integrated Manufacturing Technologies Institute (London, Ontario)	140	in operation	2003-2004	100%
Total	**33,342**			

[1] Space reported in 2003-2004 incorrectly included common space.
[2] Low occupancy is due to this facility being new.
[3] Space reported in 2003-2004 was incorrect.
[4] Previous year's number included 380m^2 for a proposed incubator facility.

Excellence and Leadership in R&D

Strategic Outcome
Integration of public and private strengths to create opportunities and meet national challenges for Canada.

By 2006, NRC will assume a leadership position in at least three new vital domains of scientific and engineering research needed for Canada to meet national challenges and capitalize on the opportunities of a global knowledge economy.

Expected Results:

Intermediate Outcomes

- Leadership position in at least three new domains of research of importance to Canada.
- Develop knowledge of key importance for health, safety, sustainable development and economic development.

Immediate Outcomes

- Increase horizontal R&D programs particularly in emerging areas of S&T.
- Build Canada's technology capacity, improve its R&D performance and support the needs of Canadian industry in emerging R&D areas.

Plans, priorities and commitments

- Renewal of Genomics and Health Initiative funding.
- Develop and enhance research programs in nanotechnology, nutrisciences and health, oceans technologies and alternative energy technologies.

Program resources and results linkages*

- NRC's 19 research institutes – see Appendix B for full list
- NRC Industrial Research Assistance Program
- NRC Canada Institute for Scientific and Technical Information
- NRC Technology Centres

Performance Indicators:

- Publications in refereed journals/proceedings & technical reports
- Citations comparison
- External grants
- Leadership and contribution to federal horizontal initiatives
- Multi-researcher networks and centres of excellence

** At this time NRC is only able to provide resource information by business line and not by strategic outcome. The organization is working towards evolving NRC's financial systems and performance measurement strategies to accomplish this in the future.*

Canada faces major challenges in areas such as industrial competitiveness and productivity; sustainable development and the environment; health care; and security. As a dynamic, national R&D organization, NRC helps address these challenges by conducting strategically focused collaborative research in emerging fields of science and engineering. Through these collaborations with industry, academia and government NRC builds the technology capacity that Canada will need to succeed in the years ahead.

Leadership in Emerging Research through Increased Horizontal and Multidisciplinary R&D

Research leadership is at the core of NRC's mission and mandate. The coming years will see the emergence of totally new technologies resulting from research that cuts across traditional disciplines in biology, physics, chemistry, information technology, materials science and manufacturing. Over the past year, NRC has continued to emphasize multidisciplinary R&D initiatives within NRC and with other leading research

institutions in Canada and internationally. Key areas of focus for horizontal initiatives at NRC in 2004-2005 are outlined below.

Nanotechnology

Through the establishment of a major interdisciplinary institute with a national focus, Canada is now developing a centre of excellence in nanotechnology that will provide both employment and training opportunities for a new generation of scientists and engineers. NINT was established in 2001 as a partnership between NRC and the University of Alberta, and is jointly funded by the Government of Canada, the Government of Alberta and the University of Alberta. The Institute will focus on key niches relevant to Canada – applications in ICT, life sciences, energy and advanced materials. For more information on NINT see http://nint-innt.nrc-cnrc.gc.ca/home/index_e.html.

NINT produced 43 publications in refereed journals and peer reviewed conference proceedings in 2004-2005. Examples of the impact of research from NINT in 2004-2005 include:

- The next generation of microscopes may image finer details thanks to a recent invention at NINT. Researchers reported a method to construct extremely sharp probes for microscopes. The team can fabricate, under full-control, and with a high yield, long narrow probes so sharp, their tips consist of only one atom.
- NINT researchers reported a breakthrough in the development of molecular transistors - making a single molecule act like a transistor, and switching it on/off with a single electron. Such a device, with a switch using perhaps one million fewer electrons than current devices, and a size which is orders of magnitude smaller than present commercial electronics, promises faster, smaller, cheaper, and more power-efficient electronics and computers for future generations. This molecular scale transistor invention, leading potentially to higher performance computing, is a particularly important innovation because it is created on silicon, not on some unusual or exotic surface. Silicon is the basis for the world's existing computer chips, a manufacturing infrastructure worth trillions of dollars.

Life Sciences, Genomics and Health Research

NRC's Genomics and Health Initiative (NRC-GHI) was launched in 1999 in order to bring the benefits of rapid advances in the genome sciences and health research to a variety of Canadian industrial sectors and regions. NRC-GHI complements major research efforts underway throughout the federal government. Through this initiative, NRC has established infrastructure facilities as well as developing expertise in key areas of genomics and health research.

NRC-GHI is NRC's largest internal horizontal research initiative and in 2004-2005 involved eight NRC institutes working in partnership with each other, as well as with partners in other government departments, universities, industry and organizations such as Genome Canada and the Canadian Institutes for Health Research. At the end of March 2005, NRC-GHI completed the final year of its second phase. A significant proposal review process, including seeking external expert opinion, was undertaken over the

course of 2004-2005 and five new program areas for Phase 3 were approved to begin in April 2005. NRC will undertake an evaluation of NRC-GHI in 2005-2006 and report on the findings and recommendations in next year's DPR. More information on NRC-GHI can be found at: http://ghi-igs.nrc-cnrc.gc.ca/home_e.html.

A major accomplishment for NRC-GHI in 2004-2005 was the renewal of federal intramural genomics R&D funding. NRC led the development of an inter-departmental Treasury Board Submission seeking renewal of federal genomics R&D funding at current levels for the next three-year time frame. In March 2005, $19.9 million per year for three years, was approved for the Genomics R&D Initiative.

The coordination of federal genomics R&D programs was strengthened through the establishment of a new NRC-led inter-departmental Assistant Deputy Minister coordinating committee in 2004-2005. The committee ensures that common management principles associated with R&D management are implemented and horizontal collaborations are pursued wherever relevant and possible.

2004-2005 saw increased visibility of NRC-GHI at a variety of external conferences, such as BioNorth and the Federal Horizontal S&T Conference. Throughout 2004-2005, NRC-GHI personnel were involved in 32 national committees and 21 external multi-disciplinary research networks/programs/centres of excellence. In addition, NRC-GHI organized or sponsored 25 external conferences.

The eight NRC-GHI programs produced the following research outcomes over the past year:

- 263 publications in refereed journals and peer reviewed conference proceedings; and
- 35 patent applications, 10 patents issued, 10 license agreements.

Examples of the impact of research from selected NRC-GHI program include:

- The Genomics of Aquaculture Program produced a draft sequence of *Aeromonas salmonicida*, a pathogen that infects salmonid fish. This is the first completely-Canadian large whole genome sequencing project to be undertaken. The genome sequence provides valuable information to NRC and other researchers who are interested in virulence and other genes of this economically important pathogen. This work will be used to develop vaccines to protect fish and assist the aquaculture industry. The full genome sequence will be a key tool in identifying targets for further vaccine testing.
- Researchers in the Systems Biology of Brain Cell Interactions Program made a ground-breaking discovery that dynamic DNA methylation plays a crucial role in the creation of neurons from 'undecided' stem cells. DNA methylation is the process by which the genome, in the more than 200 cell types in the human body, can be customized to ensure that each cell type (e.g., nerve or muscle or liver) can carry out its specialized function. Until now, the significance and extent of this process has been underestimated. Stimulation of this process in the injured brain will help improve functional recovery and lessen disability.

- A joint effort of the Enhancing Crop Performance and Value Through Genomics Program led to the development of more than 200,000 Expressed Sequence Tags (ESTs) that are obtained from canola seeds. The development and characterization of ESTs is one of the initial steps required to isolate genes that may be used to produce novel crop varieties.

Details on other life sciences research taking place at NRC can be found in the Research that Benefits Canadians section later in this document.

Fuel Cells and Hydrogen

Information on the NRC Fuel Cell and Hydrogen Program can be found at www.nrc-cnrc.gc.ca/randd/areas/fuelcells_e.html.

2004-2005 was the first full year of the second phase of NRC's Fuel Cell and Hydrogen Program and saw the solicitation of project proposals which were externally peer reviewed. Project selections were made by a committee, with both internal and external representation, in February 2005.

Federal government programs on the hydrogen economy are funded through a multiplicity of government departments including NRC, NRCan and Department of National Defence. Participating organizations are linked through an interdepartmental Hydrogen and Fuel Cell Committee. NRC was a founding member of the committee and continues to make significant contributions. In 2004-2005, NRC representatives initiated and chaired a Strategy Development Workshop for the Eastern Canadian Hydrogen and Fuel Cell community, bringing together more than 100 representatives.

Research outcomes from the Fuel Cell and Hydrogen Program in 2004-2005 include:

- 27 publications in referred journals and conference proceedings;
- 8 active collaborations with universities and other organizations; and
- 5 patent applications filed.

Examples of research impacts for the year:

- The completion of NRC-IFCI's Hydrogen Technology Environmental Chamber is underway. The chamber was fitted to perform tests on two devices: a PEM fuel cell back-up system and an unmanned aircraft. NRC-IFCI is continuing operational tuning through July 2005 and has plans for remote control and monitoring by October 2005.
- In support of the $8.2 million Vancouver Fuel Cell Vehicle Program (VFCVP), NRC-IFCI made infrastructure upgrades to its facilities and is providing trained technicians to assist Ford's mechanics. Since the launch of the VFCVP, NRC-IFCI and Ford-trained technicians have already performed crucial maintenance and repair to the fuel cell and fuel system of the cars.

> "The contributions of NRC, both financial and in-kind, have been extremely valuable to the VFCVP by providing necessary maintenance facility, fuelling station and technical support."
>
> **Bruce Rothwell, Manager of the VFCVP**

- In partnership with NRCan, BOC Canada and General Hydrogen, NRC-IFCI began dispensing hydrogen to four vehicles in the Vancouver Fuel Cell Vehicle Program in March 2005. Working with equipment supplier and system integrator, BOC Canada, and other partners, NRC-IFCI is responsible for facilities' integration, safety review, data communications and data and alarm management. In addition, NRC-IFCI is interim operator for the station while NRCan seeks a permanent operator. All parties involved expect to be operational at full pressure (350-bar) by June 2005 and anticipate additional load from other hydrogen-fuelled devices. This station is the second fuelling station operational in the Vancouver area and one of only eight in Canada. It is the first station to address multi-stakeholder expectations for fuel quality, product liability and general liability. It has also been instrumental in identifying areas requiring codes and standards development plus familiarizing authorities responsible for hydrogen technologies.

Contributing to Federal Strategies through Leading-Edge Research

NRC researchers contributed to the following federal strategies and horizontal initiatives in 2004-2005 through its collaborations with federal partners.

Youth Employment Strategy (YES)

NRC-IRAP manages two youth programs under the Government of Canada's YES: the Internship Program with Innovative Small and Medium-sized Enterprises and the Collaborative Research Internship Program. These NRC-IRAP programs, supported by Human Resources and Skills Development Canada, enable Canadian SMEs to hire highly qualified graduates with specific skills and expertise that can be used to advance their innovative projects. More information on YES can be found at http://irap-pari.nrc-cnrc.gc.ca/youthinitiatives_e.html. In 2004-2005, NRC-IRAP provided 475 graduates with the opportunity to work in 391 SMEs across Canada.

Canadian Biotechnology Strategy (CBS)

NRC through its GHI program is the lead department of the Genomics R&D Initiative component of the Canadian Biotechnology Strategy. The objective of the program is to build the capacity inside government laboratories to do a new type of biotechnology research, one that will strengthen the regulatory system and bring the benefits of revolutionary advances in research and technology to a variety of Canadian industrial sectors and regions. A summary of NRC's contribution to CBS can be found under the earlier heading Leadership in Emerging Research through Increased Horizontal and Multidisciplinary R&D.

Chemical, Biological, Radiological, Nuclear Research and Technology Initiative (CRTI)

CRTI brings together many government departments to address issues of counter terrorism and national security. More information about the initiative can be found at www.crti.drdc-rddc.gc.ca.

Examples of projects that NRC researchers worked on over the past year are described below.

- NRC-IMB was the chosen federal agency to provide leadership to the CRTI-funded program "Rapid Triage Management Workbench (RTMW)". This program concluded in January 2005. An NRC-IMB researcher managed the program that developed a software system designed to manage the communication of medical information during a chemical, biological, radiological or nuclear event. The RTMW system can be used at any location that has an Internet connection or stand-alone capabilities in the event of an Internet failure. There is considerable interest by emergency responders in implementing this software.
- Under CRTI, NRC-SIMS researchers were involved in developing novel nano-material architectures for capture and pre-concentration of pathogens for national security purposes. The technology will be used in low-cost portable devices capable of real-time detection and identification of pathogens.
- NRC-IMS contributed to advancing the research frontier in the design of effective chemical sensors for first responders involved in national security or other types of crisis situations as a result of CRTI funding. Advanced organic chemistry and soft lithography were combined to produce molecular imprinted arrays of chemically and spatially resolved functional groups on substrates to be used as molecular recognition devices.

Climate Change and the Environment

NRC is currently developing a horizontal program on sustainable technologies that would bring together its research efforts aimed at energy, the environment, and climate change. A new director-level position for the NRC Sustainable Technologies Initiative was created in July 2004.

It is likely that long term sustainability will, in part, result from the application of emerging technologies, such as biotechnology and nanotechnology, and enabling technologies, such as information technology and advanced manufacturing processes, to energy production and manufacturing. These are areas where NRC has considerable competencies, and is already working with its partners.

NRC's activities fall into three areas: (1) advanced technologies for energy efficient and environmentally friendly industrial processes and materials, (2) advanced technologies for sustainable cities, and (3) next generation technologies for energy and the environment. Summaries of research in each of these areas are included below.

Advanced technologies for energy efficient and environmentally friendly industrial processes and materials

- In the Aerospace sector, NRC contributed to sustainable development and climate change as well as to the development of environmentally friendly materials and manufacturing processes. NRC-GTERC facility and associated laboratories will support the development and use of dry low emission combustors (NOx and CO) by Canadian manufacturers of large industrial gas turbines and develop

methodologies to facilitate measurement and reporting of greenhouse gas emissions.

- Building on NRC's expertise in nano-polymers, two NRC institutes are studying their use in high voltage applications. These materials may offer better thermal properties and resistance to partial discharges, as well as withstanding higher operating stresses than conventional insulating materials. The outcome could be smaller-sized and more reliable high voltage apparatus such as power transformers and generators.

Advanced technologies for sustainable cities

- NRC-IRC worked with federal partners (Natural Resources Canada, Canada Mortgage and Housing Corporation and Public Works and Government Services Canada) on the development and implementation of strategic plans for two federal programs aimed at Buildings and Communities, namely Panel for Energy Research and Development (PERD) and Climate Change Technology and Innovation (CCTI). NRC-IRC researchers also provided Canadian technical expertise and research competence to the International Energy Agency's Implementing Agreements on Energy Conservation for Buildings and Community Systems.
- Leaks in water pipes are an enormous cost for municipalities. NRC-IRC successfully developed an enhanced leak noise correlation technology, called LeakfinderRT, for detecting and locating leaks in municipal water distribution pipes. Exclusive licensing rights of the technology were granted to Echologics Engineering Inc. of Toronto, an NRC spin-in company, to commercialize and further develop the system. The LeakFinderRT system is currently in use by several municipalities in Canada, the U.S., and China with reports of significantly increased accuracy in leak detection and reduced leakage levels. Echologics exceeded its first year revenue target and the NRC/Echologics team won an FPTT award for technology transfer.
- NRC-BRI has one of the largest research groups on environmental biotechnology in Canada. This group has developed a novel bioprocess for the treatment groundwater contaminated with methyl-tert-butyl-ether (MtBE - a fuel oxygenate). This process can be implemented on site, at a large scale.

Next generation technologies for energy and the environment

- Bioproducts - NRC is involved in efforts to diversify oilseeds, like canola, to produce new types of oils that can be used in a number of industrial applications, including lubricants, bioplastics, and biodiesel fuels. Increased performance and market diversity of crops will provide Canadian farmers with wider crop choices to enhance their income. NRC-PBI is involved in a co-operative effort with AAFC to develop plants with bio-fuel applications.
- Carbon Nanotubes, Gas Hydrates, and Biozeolites – NRC-SIMS established a formal collaborative agreement with the University of Sherbrooke to develop an industrial scale process for the production of Single Wall Nanotubes (SWNTs) for composite materials. A multidisciplinary team of chemists and engineers succeeded in producing 1kg/day, a production rate that is ten times the best

competitor's rate, and expects to exceed this amount when the process is fully optimized. NRC is also evaluating the absorption properties of SWNTs for hydrogen storage.

National Marine and Ocean Industry Roadmap

The Government of Canada announced its intention to develop the Oceans Action Plan (OAP) in the 2004 *Speech from the Throne.* Of the $73 million, over two years, approved to implement the OAP, NRC-IRAP was to be allocated $13.6 million for Ocean Science and Technology responsibilities including:

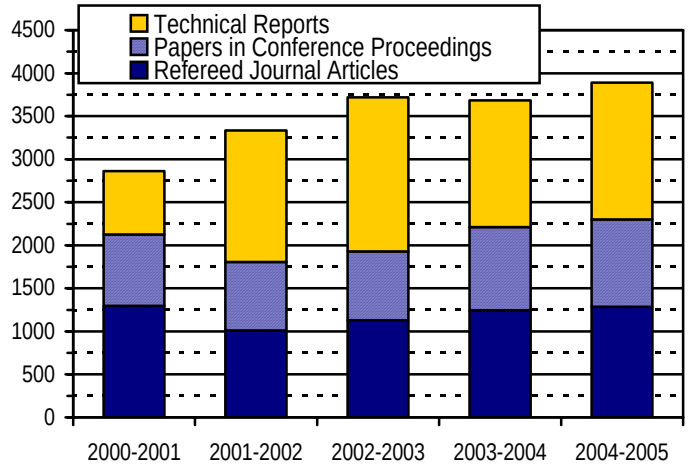
- a 'network of networks' agreement;
- a ocean technology solution fund; and
- support for Placentia Bay, Newfoundland's demonstration project.

Funding announced in Budget 2005 for the OAP was significantly lower than anticipated and only $200,000 was allocated to NRC-IRAP. As a result NRC-IRAP's involvement in the project was substantially reduced. Funds received will be directed to support an Oceans Network consortium. This consortium will enable collaboration among technology innovators across government, industry, academia, coastal communities and regional organizations. In 2004-2005, NRC participated as a major player in the development of the OAP with a particularly strong presence on the Science and Technology Working Group.

Excellence in R&D and Innovation

Scientific papers in leading peer-reviewed publications and conference proceedings are internationally acknowledged measures of research quality and relevance. They are also a key tool for dissemination of knowledge and the eventual creation of value for Canada in the long-term. NRC has consistently produced over a thousand peer-reviewed publications each year over the last five years. In 2004-2005, researchers published 1,287 articles in refereed journals (a 4% increase over last year) including five research articles in the highly ranked journals *Nature* and *Science*. NRC researchers also published 1,013 papers for peer-reviewed conferences, an increase of 5% from last year, and produced 1,590 technical reports (see Figure 2-8).

Figure 2-8: NRC Publications (2000-2004)



Source: NRC Performance Information Database, 2005.

National leadership in R&D and innovation is demonstrated by the participation of NRC research institutes on 542 national committees (a similar number to last year) and by the 300 conferences and workshops organized by institutes in 2004-2005 (55% increase over

last year). This increase is due to NRC-IFCI hosting over 70 conferences and workshops on behalf of Fuel Cells Canada and NRC-IRAP, as well as NRC-IRC hosting over 50 sessions in preparation for the launch of the new 2005 National Building Codes. The recognition of NRC's research excellence is exemplified by the participation on 68 research networks, the holding of 180 positions on the editorial boards of scientific journals, and the 412 adjunct professorships in Canadian universities (13% increase over last year). NRC's research excellence is also evident in the number of successfully funded research grant proposals to external granting agencies, where NRC researchers were investigators, and the Institutes' involvement in multi-researcher networks and centres of excellence. In 2004-2005, 259 research grants were successfully funded with NRC researchers being associated with a total of $49 million (an 87% increase over last year).

Research that Benefits Canadians

Included below are examples of the benefits to Canadians and Canadian industry resulting from selected NRC research projects conducted in 2004-2005.

Life Sciences

Francisella tularensis is one of the most infective bacteria known to exist in North America. The most deadly strains of *Francisella* naturally exist only in Canada and the U.S. mainly as pathogens in rodents and rabbits. NRC-IBS has taken aim at this pathogen through its participation in a large-scale international research collaboration. The research at NRC-IBS led to the invention of a novel vaccine additive that, when mixed with bacterial proteins and injected into the host, fools the immune system into thinking it has encountered a live vaccine, and as a result the body produces T cells. This is important as *Francisella* is an intracellular pathogen and therefore T cells rather than antibodies are needed to eliminate it. While this resident pathogen has yet to threaten the human population in large numbers, it has recently gained considerable attention due to concerns that it might be used as a bioterrorist weapon.

In the past year NRC-IMB scientists made a critical discovery related to shellfish poisoning. Paralytic shellfish poisoning (PSP) is a persistent problem on both coasts of North America. PSP is produced by naturally occurring algae that bloom seasonally in the water column during red tides, are consumed by filter-feeding shellfish and these in turn act as vectors of the toxins to humans. PSP causes economic losses due to the closure of shellfish harvesting grounds and the need for costly monitoring of toxins in shellfish to safeguard public health. There is currently no antidote for PSP and all cases require immediate medical attention. The NRC-IMB work is an important step towards identifying a cure for shellfish poisons.

In determining the benefits of naturally occurring compounds or bioactives, to human and animal health, NRC-INH scientists focus on three core areas: neurological disorders; obesity-related disorders; and infection and immunity. The majority of researchers at NRC-INH have been on site less than eight months, but have nonetheless contributed to the formation of international linkages through their memberships in international scientific organizations and their representation at international symposia.

Severe acute respiratory syndrome (SARS) is a global health threat that has been contained largely due to effective quarantine measures. There are no SARS-specific drugs currently available, making the prospect of the re-emergence of this disease a frightening one. Drugs targeted against this virus are therefore needed to tackle potential future outbreaks of the disease. PLPro (papain-like protease) is a key protein of the SARS virus that is essential for its replication. Researchers at NRC-BRI, drawing upon their vast experience with the papain-like enzymes, performed an in-depth characterization of the structure and function of this enzyme. NRC-BRI scientists created a computer model of the three-dimensional structure of this protein that provides a detailed molecular understanding of how it functions as well as suggested novel biological functions. This new knowledge impacts the value of SARS PLPro as a therapeutic target and provides a framework for new design strategies for antiviral drug development.

A group of NRC-IBD researchers are part of a national research team that will study the transmission of SARS using a mathematical model in an effort to help public health professionals design policies to achieve the eradication of the disease. The goal of the project is to use mathematical and statistical modelling as a quick and cost-effective tool for evaluating proposed SARS control strategies prior to their implementation. The collaboration involves investigating mathematical, statistical, and computational models of several other types of disease (influenza, childhood diseases, and HIV/AIDS), in particular, their pathogenesis and how this influences, and is influenced by, the epidemiology.

NRC-PBI continued their work with AAFC and collaborator Genome Canada, on a project to investigate seed development and composition. This collaboration optimizes research discovery by utilizing the complimentary facilities and expertise of the two federal research agencies. Further diversification of canola and its relatives is desirable, however, diversification of crops through conventional breeding can be slow and increasingly difficult to attain. This project aims to better understand the genetic basis for the accumulation of these valuable products. Results of NRC-PBI's research include identifying more than 10,000 new genes involved in regulating these types of traits; the development and characterization of 60,000 ESTs; and the development of improved profiling methods to understand the role of the hormone signalling networks that control seed development.

Information and Communication Technologies

Nouse (short for "nose as mouse") technology was developed more than three years ago at NRC-IIT. The technology prototype is recognized as the first to use the nose as a principle feature for facial tracking, a process that involves hooking up a webcam to a computer equipped with tracking software. In 2004, Nouse technology became the focus of

Nouse: Scientific Impact with Huge Social Potential

"Just like its predecessor, the mouse back in the 1960s, the Nouse was created to make computer operations easier for everyone."

Discovery Channel

a huge wave of global media attention. The research captured broad public interest from regions as far off as China, Russia and South Africa. The BBC (British Broadcasting Corporation), CNN (Cable News Network), the Discovery Channel, Maclean's Magazine, Reuters, and a host of other international media outlets all reported the story.

After reporting the first evidence of photoluminescence in single-walled carbon nanotubes (CNTs), NRC-IMS researchers also discovered that single walled nanotubes remain luminescent to temperatures as high as 425 °C, limited only by the black body radiation background. In addition, the NRC-IMS team discovered a transition affecting the bandgap as a function of the environment of the CNT. This work is important as CNT find their way as practical optoelectronic circuit elements or components in telecom applications in rugged conditions of the environment. This research has application in the ICT, environment and medical industries.

Physical Sciences and Engineering

Aerospace

NRC-IAR continued to provide international leadership through its efforts related to the study of icing on aircraft operation. The Institute was involved in a major research project, the Second Alliance Icing Research Study (AIRS II), involving five research aircraft and 27 separate agencies from four countries. As part of the study, a variety of remote sensing systems probed the clouds that the research aircraft flew through. The research resulted in a critical data set that will be used to develop technologies to permit the remote sensing of icing conditions around airports, improve forecasting of icing conditions and help to develop an increased understanding of aircraft performance effects under those flight regimes.

Ocean Technologies

Researchers at NRC-IOT continued their multi-year investigation of how bergy bits (smaller than icebergs but as large as a house) affect ships and structures at sea. In 2004-2005, the Institute increased the scope of the project to include predictions of damage to a vessel using its numerical simulations of ship/bergy bit collisions. As well, a new pressure sensor was used successfully in a series of novel ice-crushing experiments. The results of this research are expected to be of considerable benefit to NRC-IOT's industrial partners in the study as bergy bits are often difficult to detect by conventional radar.

Construction

NRC-IRC researchers have been contributing their expertise to help constructions associations, roofing industry manufacturers, insurance companies and building owners better prepare themselves for the destructive forces of hurricanes. Roofs are constantly exposed to environmental conditions and as such, they are typically one of the first parts of a building envelope to suffer damage during a hurricane. After 10 years of dedicated research at NRC-IRC in the area of dynamic evaluation of roofing systems, a new CSA standard was published in 2004-2005 (Standard Test Method for the Dynamic Wind Uplift Resistance of Mechanically Attached Membrane Roofing Systems- CSA A123.21-04). This standard will allow researchers to characterize new roofing products by assessing their physical and chemical limitations in a laboratory setting.

Manufacturing

NRC-IMTI and partners developed a device that is set to revolutionize treatment of neurological disorders. The small multi-channel recording and stimulating device may hold the future to improving the lives of people with neurological disorders such as Parkinson's Disease, Tourette's Syndrome, depression, epilepsy and eating disorders. NRC-IMTI's expertise in miniaturization and laser micro-fabrication processes makes it a valuable partner in this collaborative effort. Research on the design, development and fabrication of the multi-channel microelectrode prototype stems from the unique microprocessing capabilities available at NRC-IMTI. The development of this neurosurgical device is expected to aid in the advancement of a procedure called Deep Brain Stimulation which has recently emerged as one of the recommended treatments for advanced cases of movement disorders associated with neurological diseases. A joint collaboration between NRC-IMTI, the Lawson Health Research Institute, and Medtrode Inc. will enable further testing and development of the neurosurgical electrode and associated electronics. The ultimate goal is to simplify the procedure and reduce operating room time by shifting the majority of the treatment to an outpatient setting.

Successful Technology Transfer

"London is already known all over the world for its contributions to neurosurgery, imaging and surgical robotics. As a Londoner, I am proud to be able to invest in this development and help transfer this technology from research to the marketplace"

Dr. S. Assaf
Founder, Medtrode Inc.

During the past year, NRC-ICPET initiated its strategic plan by focusing research activities and implementing the foundation for better organizational integration. This has led to a significant reorganization of activities and personnel. As committed in its strategic plan, NRC-ICPET continued to be a key player in NRC's National Fuel Cell program, leading key activities in collaboration with other Institutes in solid oxide and proton exchange membrane fuel cells.

The pressure to develop cleaner, more efficient single sources of heat and electrical energy is the driving force behind the development of SOFCs (solid oxide fuel cells). However, if SOFCs are to become commercially viable, production costs must be lowered and the reliability and durability of these systems must be improved. NRC-ICPET researchers collaborated with the Imperial College in the U.K on a project to tackle these challenges. The work involved developing novel oxides, related to the mineral perovskite, and synthesizing these materials using soft chemical approaches and an unconventional production method – microwaves. The project demonstrated an effective combination of fundamental and applied scientific capabilities targeted to producing solid oxide fuel cells that are reliable, durable and less expensive to manufacture and operate.

Building on their expertise in ultrasonic lasers, researchers at NRC-IMI, in partnership with Environment Canada, developed an innovative technology to measure the thickness of oil spills. Oil spills can lead to ecological catastrophes and although environmental

authorities have access to a number of tools available to them, an analysis of the discharge is needed to find the best solution. The technology developed at NRC-IMI uses three lasers installed on an aircraft. By combining ultrasound with lasers the technology allows for detection of anomalies even if they are undetectable by the human eye. This more precise way of measuring the thickness of the layers of oil covering the surface enables a more effective analysis of a disaster.

Discovery-based Research

Astronomy and Astrophysics

Using instrumentation and innovative techniques developed at NRC-HIA, an international team of scientists discovered that the beginnings of our Universe are more complex than ever imagined. The Gemini Deep Deep Survey used a unique capability of the GMOS (Gemini Multi-Object Spectrograph) Instrument on the Gemini Telescope to survey a large number of galaxies. The study found that massive galaxies had already formed up to 11 billion years ago, shortly after The Big Bang. These findings challenge the previous model of hierarchical galaxy formation which held that massive galaxies are relatively recent assemblies of smaller galaxies. The Gemini Deep Deep Survey is an example of the integration of science and technology and clearly demonstrates the ability of NRC-HIA to translate scientific goals into concrete results. This study showcased Canadian expertise in astronomy and instrumentation on the world stage.

> "The Gemini Deep Deep Survey would not have happened without HIA's involvement. First, they built a spectacular instrument in GMOS, and then incorporated the fantastic "Nod and Shuffle" technique in the instrument and telescope system. This type of collaboration between the universities and HIA is a great strength of Canadian astronomy."
>
> **Dr. R. Abraham**
> **University of Toronto**

Molecular Sciences

In 2004-2005, NRC-SIMS began a process that will lead to the development of a new strategic plan. This started with an international peer review panel that evaluated the Institute's quality, impact and use of resources. The panel provided key findings and recommendations and identified potential future opportunities for the Institute. More information on the peer review can be found at http://www.nrc-cnrc.gc.ca/aboutUs/audit_sims_e.html.

In 2004-2005, NRC-SIMS researchers obtained, for the first time, an image of a single molecular orbital wave function using intense laser pulses. Hailed as a key breakthrough in 2004-2005, this finding was published in *Nature*[19] and highlighted in several international publications. Creating a 3D picture of an electron orbital is the first step towards creating images of how chemical bonds are broken and formed during reactions. This has major implications as it will allow direct validation of and will provide new insights into the fundamental theories upon which our chemical and pharmaceutical industries are built.

[19] Nature, Dec 16 2004; 432 (7019) : 867-871

Measurement

NRC-INMS scientists designed and developed a simpler, faster calibration system in response to requests from the electrical power industry. Normally three different calibration systems would be required to provide on-site/in-situ calibration services. The new system is contained in one compact and "portable" unit, and is based on highly accurate current-comparator-based voltage and current sensors, and two high accuracy 18-bit sampling systems. The new system provides the electrical power industry with a simplified, more efficient on-site calibration service.

Outstanding People-Outstanding Employer

Strategic Outcome
Recognition as a select research and innovation organization widely regarded as a great place to work; distinction for excellence and creativity.

By 2006, NRC will be regarded by staff and their peers as a major innovator in human resource management, as a place where outstanding people are encouraged are able to make outstanding contributions to Canada, and as an outstanding employer offering a great place to work.

Expected Results:

Intermediate Outcomes

- Recruit outstanding people.
- Develop leadership at all levels.
- Build cross functional and cross cultural capability.

Immediate Outcomes

- Align compensation and reward practices.
- More effective management of horizontal initiatives.

Plans, priorities and commitments

- Modernization of NRC's recruiting and hiring practices.
- Revitalized leadership and management development programs.
- Modernization of pension reform.

Program resources and results linkages*

- NRC's 19 research institutes – see Appendix B for full list
- NRC Industrial Research Assistance Program
- NRC Canada Institute for Scientific and Technical Information
- NRC Technology Centres
- NRC Corporate Branches

Performance Indicators:

- Number of top quality recruits
- External awards
- Investment in facilities
- Training as a percentage of salary
- Diversity (designated group representation of employees)
- Bilingualism (bilingual positions filled by qualified bilingual staff)
- Workplace safety (compensation cases)

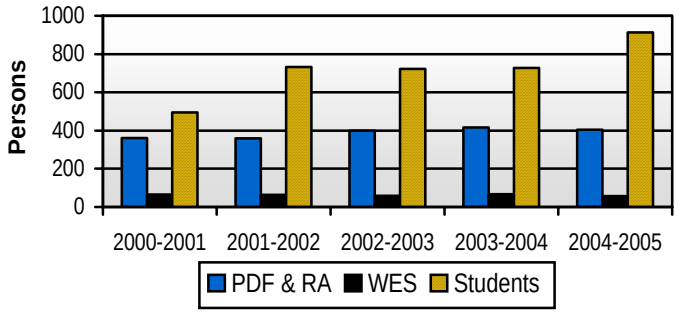
** At this time NRC is only able to provide resource information by business line and not by strategic outcome. The organization is working towards evolving NRC's financial systems and performance measurement strategies to accomplish this in the future.*

Recruitment and Retention of Highly Qualified Personnel

The development of highly qualified personnel is a priority for supporting an innovative and knowledge-based economy. NRC directly contributes to the development of highly qualified personnel through the training of students and recent graduates.

NRC recruited 561 employees bringing the total number of NRC staff to 4,145[20]. Over 1,300 students, Post-doctoral Fellows (PDFs), and Research Associates (RAs) work on research teams at NRC Institutes each year, thereby gaining valuable experience and training that is complementary to university and college courses. In 2004-2005, 442 graduate students, 471 summer and co-op students, 253 Natural Sciences and Engineering Research Council Visiting Post-doctoral Fellows and 152 RAs worked at NRC (see Figure 2-9).

Figure 2-9: NRC Training Programs (2000-2004)



Source: NRC Performance Information Database, 2005.

Women in Engineering and Science Program

Started in 1991, the Women in Engineering and Science (WES) Program's goal was to encourage talented female students to pursue professional careers in engineering, science and mathematics. The program provided placements for women pursuing undergraduate studies in these areas, matching promising students with world-class researchers and facilities. In 2004-2005, 57 women participated in this program at NRC Institutes across Canada. As an overall review of recruitment programs, a study was recently undertaken of the WES Program. This study, along with annual exit interviews and the on-going tracking of participants' career progression showed that the program had not provided participants with any further incentive to pursue a career in science or engineering. As a result, the decision was made to discontinue this program.

New Horizons - New Opportunities Program

In October 2002, NRC launched the New Horizons, New Opportunities initiative that aimed to recruit 50 outstanding researchers within the next five years. The initiative was set up to both target outstanding young scientists and engineers with the potential to become world leaders in their field, as well as renowned established researchers. Through this initiative, NRC helped to ensure Canada has enough highly qualified people with the skills for a more competitive, knowledge-based economy.

Over the course of the Program eight people were recruited. In 2004-2005, Patrick Côté was appointed to NRC-HIA and will primarily be working on analysis of Hubble Space Telescope data. NRC-IBS was successful in recruiting Dr. Christine Szymanski into a continuing position under the New Horizons – New Opportunities Program. Dr. Szymanski has outstanding credentials in the glycobiology of host-pathogen interactions and is a tremendous asset to NRC-IBS in pursuing its strategic directions. Due to budgetary constraints and the success of the Research Associates Program in recruiting

[20] As of 31 March 2005.

similar candidates, 2004-2005 will be the last year for New Horizons, New Opportunities initiative.

Progress on implementing the Human Resources Management Plan

The NRC Human Resources Management Plan aims to ensure that NRC realizes the goals of its Vision 2006 and Employment Philosophy. In 2004-2005, the Plan was approved and Human Resources Branch (HRB) was called upon to support and help implement it within its existing resource base.

The Human Resources Management Plan focuses on the following five broad themes: recruiting and retaining highly qualified people; developing leadership at all levels; building cross-functional, cross-cultural capabilities; aligning competitive compensation and reward practices; and performance management.

Some highlights of progress on implementing the plan in 2004-2005 include the following:

- NRC developed a plan to address the Public Service Modernization Act (PSMA). Although the majority of the PSMA does not apply to NRC, the organization is being proactive in developing an action plan that supports key principles of the Act. The NRC plan includes:
  - communicating with NRC managers and staff on elements of the PSMA that impact NRC;
  - updating relevant policies to comply with the new statutory requirements (i.e., developing a new process for negotiating essential services agreements, and enabling human rights, policy and group grievances); and
  - supporting the new PSMA principles through training (e.g., on principles of co-development and consultation on workplace issues).
- Continued to reposition NRC's Leadership Management Development Program
  - developed the selection processes and standards for the Accelerated Leadership Development Process and Executive Challenge
- Designed and implemented an Integrated Orientation and Leadership Development process
- Developed a roadmap for the orientation of new DGs
- Organized NRC's Leadership Forum in October 2004. The theme of the forum was *Leadership in Cross-Functional and Cross-Cultural Initiatives.* The event was attended by 165 NRC managers and helped to increase awareness of the nature of leadership in cross-functional/cross-cultural initiatives.
- Coordinated NRC's management category Merit Review Process
- Began the implementation of the Modernization of Hiring activities:
  - applied project management principles to the hiring process
  - collated and validated evaluation tools used during the interview process

Rewarding Professional Development and Productivity

NRC recognizes the outstanding work of a number of its employees through internal awards programs, including the NRC Outstanding Achievement Awards. In 2004-2005,

143 employees received an NRC Outstanding Achievement Award (either as part of a team or as an individual) and 249 employees received institute-level awards. In 2004-2005, Dr. Harold Jennings was named NRC Distinguished Research Scientist. This designation has only been bestowed on two other individuals: Dr. Gerhard Herzberg and Dr. Keith Ingold.

Formal recognition by peers in Canada and around the world is a primary indicator of having the best research and innovation talent for Canada. In 2004-2005, over 70 employees received significant external awards. See Appendix A for a list of notable awards and achievements.

Some of the prestigious recognitions include:

- André Charbonneau and Gabriel Mateescu of NRC's Information Management Services Branch (NRC-IMSB) received a 2004 CANARIE IWAY (Information Highway) award in the category of New Technology Development.
- Christian Couturier, DG of NRC-IIT, received the 2004 Industry Person of the Year Award at the Knowledge Industry Recognition and Achievement Awards gala in New Brunswick. Mr. Couturier was honoured for providing leadership and direction to the information technology sector in the province.
- Dr. Jerzy Dobrowolski, of NRC-IMS, was appointed a Member of the Order of Canada for his contributions to the field of science and in particular for his work in developing the holographic technique applied to Canadian paper currency, which safeguards it against forgery and counterfeiting. Membership to the Order of Canada recognizes a lifetime of distinguished service in or to a particular community, group or field of activity and is restricted to 136 new individuals each year.
- Ronald Gould of NRC-IAR received the Roméo Vachon Award. The award was introduced in 1969 by the Canadian Aeronautics and Space Institute in memory of one of Canada's outstanding bush pilots. It is presented for outstanding display of initiative, ingenuity and practical skills in the solution of a particular challenging problem or series of problems in aeronautics and space activities in Canada.
- Dr. Harold Jennings (NRC-IBS) was honoured with several awards for his work in developing the NeisVAc-C vaccine, which protects both infants and adults against meningococcal meningitis. He received an Honorary Doctorate of Science degree from Carlton University and was awarded the 2004 SCI Kalev Pugi Award from the Society of Chemical Industry for achievement in research and development.

NRC-IMSB Receives CANARIE IWAY Award

Two researchers from NRC-IMSB received a CANARIE IWAY 2004 Award for their development of SpectroGrid, a software application that allows researchers in remote locations to access spectroscopy research instruments. The CANARIE Awards were developed by CANARIE Inc., Canada's advanced Internet development organization, to recognize excellent contributions by Canadians to the development of our information society.

NRC-IMSB Performance Report

- Dr. Mary Williams, Director General of NRC-IOT, received an honorary Doctor of Science degree from Queens University. She was one of seven recipients of honorary doctorate degrees, including former Prime Minister Jean Chrétien.

Leading-edge Research Facilities and Equipment

The development and maintenance of leading-edge research facilities and equipment is fundamental to attracting the best research talent and to provide services to Canadian companies. NRC has made enormous efforts to keep its facilities and equipment up-to-date and to maintain the government's infrastructure investment (see Table 3-9 – Details on Project Spending). In 2004-2005, a total of $67.3 million was invested in major new equipment and facilities. The majority of NRC's laboratories and facilities are available to Canadian industry and academia through research collaborations and through fee-for-service arrangements. NRC provided fee-for-service based services to over 1,348 clients this past year.

An Outstanding Place to Work

NRC is committed to providing a work environment that enhances the creativity of employees. Beyond recruitment, developing and maintaining leading-edge research facilities, equipment, and practices, NRC institutes, programs, and branches are engaged in a number of activities promoting an outstanding work environment. Some of these are summarized below.

Human Resources Management Steering Committee (HRMSC)

Established in 2001, the HRMSC, chaired by a VP Research with representation from Directors General and Directors, allows for dialogue with senior executives regarding the human resource management challenges NRC faces as an organization and the strategies for dealing with them. In 2004-2005, HRB coordinated and supported bi-monthly HRMSC meetings. Some of the human resources issues discussed were:

- NRC Recruitment Strategy
- Workforce Adjustment Policy
- Alternate Work Arrangement Policy
- Employment Philosophy/Survey
- Leadership Forum
- Employment Equity and Official Languages
- Public Service Modernization Act
- Leadership Management Development Program
- NRC Renewal

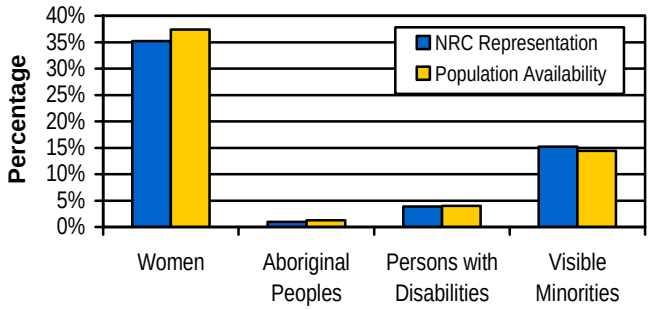
Bilingualism

NRC is committed to the official languages policy and is supporting the development of its employees through language training programs. As of March 2005, 86% of employees in positions classified as bilingual were qualified as bilingual. For supervisory positions, 74% of managers in bilingual positions were qualified. HRB implemented a Maintenance of Second Language Skills Campaign that includes a language buddy system.

Employment Equity

NRC's employment philosophy promotes employment equity. Through its recruitment efforts it is ensuring that its workforce is representative of the diversity within the Canadian population. As of March 2005, NRC's overall workforce was slightly under the national average with regard to women and aboriginals when compared to population availability estimates[21] and at or above the national average with regard to visible minorities and persons with disabilities (see Figure 2-10). NRC launched the Persons with Disabilities Recruitment Program in 2002 to help address under representation in this area. In 2004-2005, 13 individuals were hired under this mandate.

Figure 2-10: Representation at NRC and Population Availability of Designated Groups (2004-2005)



Source: NRC Human Resources.

Occupational Safety and Health Statistics

NRC manages the responsibility for occupational safety and health through the Occupational Safety and Health Committees across institutes, programs, and branches with the support of NRC's Administrative Services and Property Management (NRC-ASPM). In 2004-2005, NRC-ASPM refined the way injury information is captured. Injuries are classified as either minor (those that may require medical attention but no time off excluding the day of the injury, and no job/work modifications) or disabling (those that require medical attention and more than two days of leave, and job/work modification). NRC recorded 101 minor injuries and 17 disabling injuries in 2004-2005. In previous years, the seriousness of the injury was not distinguished and therefore it is difficult to compare the 2004-2005 statistics with number of injuries in other years. Compensation in 2004-2005 was $240,000, similar to the level in 2003-2004.

NRC-ASPM worked to improve air and water quality at NRC buildings, increase safety for material handling lifts and continued with inspections of health and safety related systems and critical equipment in the National Capital Region.

Artist in Residence for Research Program

In April 2001, NRC launched its Artist-in-Residence for Research Program in collaboration with the Canada Council for the Arts. The Program, designed as a two-year pilot, strived to encourage collaborations between art and science and the use of S&T in the arts. The research grants were awarded to established artists to work at NRC's

[21] Availability estimates for women, Aboriginal peoples and members of visible minorities are based on the 2001 Census of Canada. Availability estimates for persons with disabilities are based on the 2001 Participation and Activity Limitation Survey (PALS). Numbers have been tailored to NRC and endorsed by the Canadian Human Rights Commission.

research institutes. In November 2004, due to budgetary restraints imposed on both Councils, the program was cancelled. The four artists already selected under the program will complete their residencies at NRC-IIT, NRC-IFCI, NRC-IMTI and NRC-IRC.

Investment in Training

NRC is dedicated to providing extensive learning, personal growth and career enhancement opportunities to its employees. Through internal and external training, conferences and education opportunities, NRC invests in the future of its employees. In 2004-2005, NRC invested $4.7 million in training. This amount represents 1.7% of salary expenditures.

Management Initiatives

In addition to a work environment that enhances the creativity of employees, NRC strives to continue to improve the management of the organization. Highlights of some of the management initiatives that were underway in 2004-2005 are summarized below.

Energy Conservation and Reduction of Greenhouse Gas Emissions

NRC-ASPM completed lighting upgrades in Buildings M-35, U-96 and U-88 by installing energy efficient electronic ballasts and T-8 lamps. An energy performance contract is being implemented at NRC-IMB to reduce energy consumption, greenhouse gases and utilities costs. NRC and NRCan have installed a fuel cell test facility at the Canadian Centre for Housing Technology (CCHT) in Ottawa. Prototype Solid Oxide Fuel Cells and Photovoltaic cells have been installed at CCHT in Ottawa and the Institute for Fuel Cell Innovation in Vancouver for testing purposes. In 2004-2005, the Federal House In Order Program awarded NRC $796,000 to install energy saving systems at the NINT in Edmonton. Low flow fume hoods, radiant panel heating/cooling and water reduction technologies have been incorporated in the design.

Federal Science eLibrary

As part of its strategy to develop Canada's scientific infostructure, NRC-CISTI continued to play a lead role in supporting the *Federal Science eLibrary* initiative. The Strategic Alliance of Federal Science and Technology Libraries initiated the *eLibrary* proposal that would provide seamless desktop access to the world's published research information for all federal government employees working in science, engineering, medical, and technology disciplines.

In October 2003, the Federal S&T ADM Committee (Assistant Deputy Ministers of the Science and Technology departments and agencies) accepted the *eLibrary* concept as outlined in a study funded by the Chief Scientist Office, Health Canada, and approved the preparation of a submission to seek funding. NRC-CISTI took the lead in 2004 in preparing a business case for consideration by S&T government departments for a joint request for funding to Treasury Board. NRC-CISTI will continue to work with the Strategic Alliance to identify funding opportunities within the government to launch this important initiative that will support federal scientists and promote linkages across the government's S&T enterprise.

Performance Management

Performance management was identified as an areas for improvement in the 2003-2004 OAG audit of NRC. Information on NRC's progress in this area can be found in Table 3-14.

Section 3 Supplementary Information

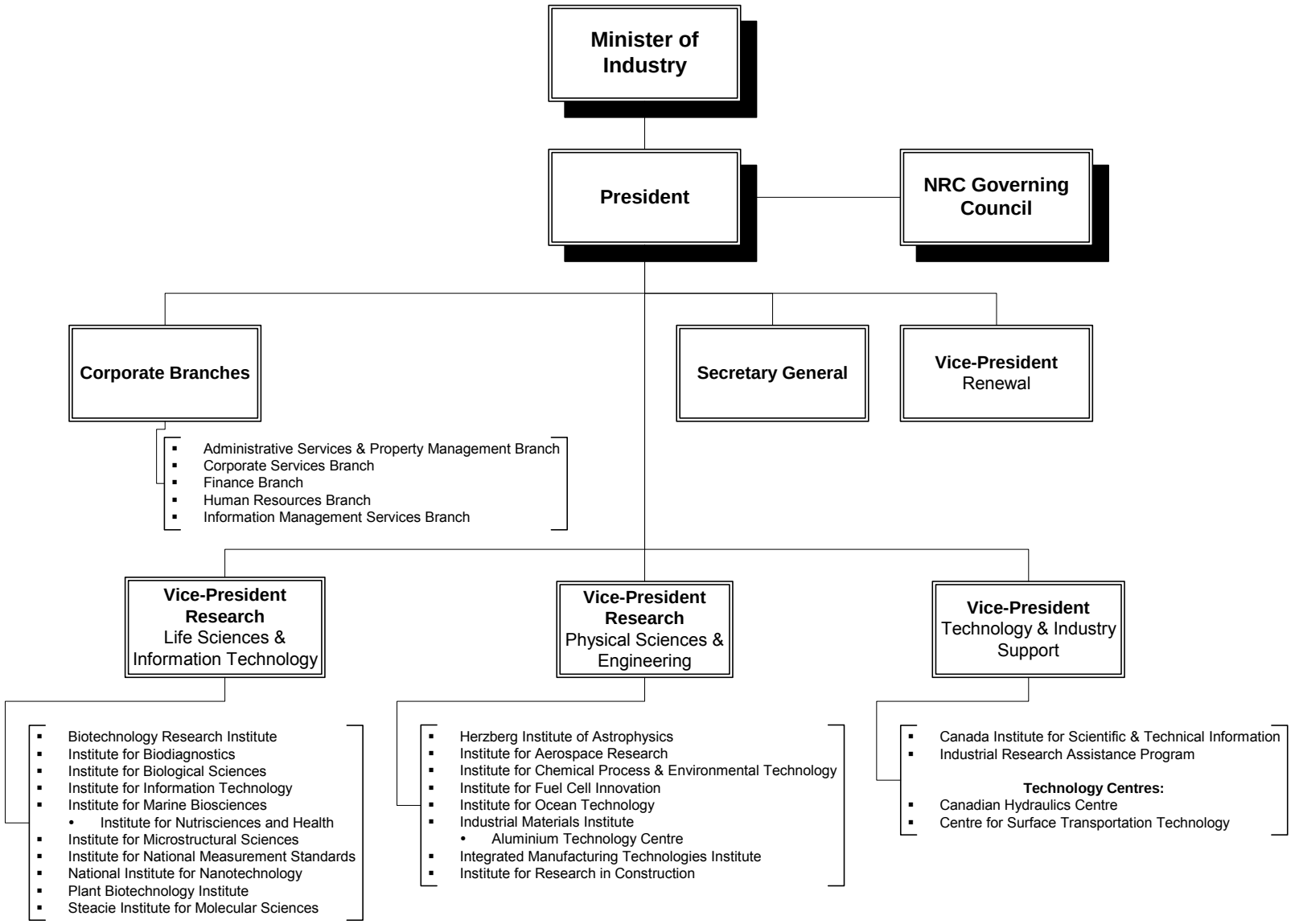
Section III: Supplementary Information

Organizational Information

Organizational Chart

NRC reports directly to the Parliament of Canada through the Minister of Industry. NRC works in partnership with the members of the Industry Portfolio to leverage complementary resources and exploit synergies in areas such as growth of small and medium-sized firms, innovation of firms through S&T and economic growth of Canadian communities. The NRC Governing Council provides strategic direction and advice to the President and reviews organizational performance. The President is the leader, responsible for fulfilling corporate strategies and delivering results. Three Vice-Presidents (Life Sciences and Information Technology, Physical Sciences and Engineering, Technology and Industry Support) are responsible for a portfolio of research institutes, programs, and centres. A Vice-President for NRC Renewal (two-year mandate) has also been appointed recently. Figure 3-1, provides an overview of NRC's organization.

Figure 3-1: NRC's Organizational Chart



Description of NRC

NRC is the Government of Canada's largest S&T agency, a premier vehicle for innovation and a leading resource for science, research, and technology development. NRC is a national organization with approximately 4,100 employees and 1,200 guest workers. In addition, it is an integral part of the Industry Portfolio and the Canadian and international S&T community. NRC is divided into three business lines, which provide a balance between conducting R&D, offering technical and innovation support services to industry and the public, and supporting the organization with corporate services.

Description of Business Lines

Business Line 1 – Research and Technology Innovation

Objectives

1) Achieve sustained knowledge-based economic and social growth in Canada through R&D and innovation in key areas.
2) Provide efficient, client-focused services that enhance NRC's effectiveness as an integrated, S&T organization.

Description

The business line includes the research programs, technology development initiatives and the management of national science and engineering facilities. These efforts all focus on key technological and industrial areas of Canada's economy where NRC has specific roles and recognized competencies, and where it has the ability to have an impact. The Vice-President, Research (Life Sciences and Information Technologies) and the Vice-President, Research (Physical Sciences and Engineering) share managerial responsibility and are accountable for this business line.

Associated Institutes

Vice-President, Research (Life Sciences and Information Technologies)

- **Biotechnology** – Biotechnology Research Institute, Institute for Biodiagnostics, Institute for Biological Sciences, Institute for Marine Biosciences, Plant Biotechnology Institute and Institute for Nutrisciences and Health
- **Information and Communications Technologies** – Institute for Microstructural Sciences and Institute for Information Technology (including e-Business Centre)
- **Measurement Standards** – Institute for National Measurement Standards
- **Molecular Science** – Steacie Institute for Molecular Sciences
- **Nanotechnology** – National Institute for Nanotechnology

Vice-President, Research (Physical Sciences and Engineering)

- **Aerospace Technologies** – Institute for Aerospace Research (including Aerospace Manufacturing Technology Centre)
- **Astronomy and Astrophysics** – Herzberg Institute of Astrophysics
- **Construction** – Institute for Research in Construction
- **Manufacturing Technologies** – Institute for Chemical Process and Environmental Technologies, Institute for Fuel Cell Innovation, Industrial Materials Institute (including Aluminum Technology Centre) and Integrated Manufacturing Technologies Institute
- **Ocean Engineering and Marine Industries** – Institute for Ocean Technology

Business Line 2 – Support for Innovation and the National Science and Technology Infrastructure

Objectives

1) Improve the innovative capability of Canadian firms.
2) Stimulate wealth creation for Canada through technological and financial assistance, information and access to other relevant resources.
3) Provide efficient, client focused services that enhance NRC's effectiveness as an integrated, S&T organization.

Description

Includes the dissemination of scientific, technical and medical information, the provision of innovation assistance and engineering and technology-based facilities, contribution to the commercialization process, intellectual property management, new company creation and strategic partnerships for Canadian SMEs, NRC institutes, the public and other government research organizations. The Vice-President, Technology and Industry Support is the sole manager responsible for this business line.

Associated programs and centres

- **Innovation Assistance to Firms** – Industrial Research Assistance Program
- **Scientific, Medical and Technical Information** – Canada Institute for Scientific and Technical Information
- **Technology Centres** – Canadian Hydraulics Centre and Centre for Surface Transportation Technology

Business Line 3 – Program Management

Objective

To provide efficient, client-focused services, which enhance NRC's effectiveness as an integrated, dynamic science and technology organization.

Description

The business line provides policy, program advice and executive support for the coordination and direction of NRC's operations and its governing Council. It also supports and enables effective and efficient management of NRC's resources through its specialization in finance, information management, human resources, administrative services and property management and corporate services. The President of NRC is the sole manager responsible for this business line.

Associated Corporate Branches

- **Administrative Services and Property Management**
- **Corporate Services**
- **Finance Branch**
- **Human Resources Branch**
- **Information Management Services Branch**

Management and Corporate Information

Senior Management and Corporate Information

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NRC Legislation

The establishment, duties, and powers of NRC are set out in the *National Research Council Act,* R.S.C. 1985, c. N-15.

NRC has responsibilities and duties relating to the calibration and certification of standards of measurement under the *Weights and Measures Act*, R.S.C. 1985, c. W-6.

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Table 3-1: Comparison of Planned to Actual Spending, incl. FTE (millions of dollars)						
			2004-2005			
Business Lines	2002-03 Actual	2003-04 Actual	Main Estimates	Planned Spending	Total Authorities	Actual
Research and Technology Innovation	440.5[1]	425.7	428.0	449.5	478.5	**420.8**
Support for Innovation and the National Science and Technology Infrastructure	179.5	184.0	194.8	200.8	213.3	**188.1**
Program Management	98.1[2]	95.6	72.6	73.8	81.1	**103.5**
Total	**718.1**	**705.3**	**695.4**	**724.1**	**772.9**	**712.4**

Total	**718.1**	**705.3**	**695.4**	**724.1**	**772.9**	**712.4**
Less: Spending of Revenues Pursuant to section 5(1)(e) of the NRC Act	(91.3)	(61.4)	(75.1)	(75.1)	(101.9)	(59.4)
Plus: Cost of Services received without charge*	16.6	20.3	19.4	19.4	19.4	21.1
Net Cost of Department	**643.4**	**664.2**	**639.7**	**668.4**	**690.4**	**674.1**

Full Time Equivalents (FTE)	**3,890**	**4,140**	**3,919**	**3,919**	**3,919**	**4,178**

Notes

* Services received without charge usually include accommodation provided by PWGSC, the employer's share of employees' insurance premiums, and expenditures paid by TBS (excluding revolving funds). Workers' Compensation coverage provided by Social Development Canada, and services received from the Department of Justice Canada (see Table 3-4).

1. Amount shown differs from Public Accounts. $550,871 Grant for International Affiliations was recorded against the incorrect Business Line. The correct Business Line is "Program Management", which is reflected in the Performance Report.
2. Amount shown differs from Public Accounts. $12,000,000 Contribution to TRIUMF was recorded against the incorrect Business Line. The correct Business Line is "Research and Technology Innovation" which is reflected in the Performance Report.

Table 3-2: Use of Resources by Business Line (millions of dollars)						
	2004-2005					
Business Lines	**Operating[1]**	**Capital**	**Grants and Contributions**	**Total: Gross Budgetary Expenditures**	**Statutory Items[2]**	**Total**
Research and Technology Innovation						
Main Estimates	285.1	58.6	45.9	389.6	38.4	428.0
Planned spending	*296.0*	*69.2*	*45.9*	*411.1*	*38.4*	*449.5*
Total authorities	315.8	60.8	45.9	422.5	56.0	478.5
Actual Spending	**280.1**	**60.3**	**50.8**	**391.2**	**29.6**	**420.8**
Support for Innovation and the National Science and Technology Infrastructure						
Main Estimates	76.8	-	87.6	164.4	30.4	194.8
Planned spending	*77.8*	*-*	*92.6*	*170.4*	*30.4*	*200.8*
Total authorities	86.5	-	91.2	177.7	35.6	213.3
Actual Spending	**80.1**	**0.7**	**83.6**	**164.4**	**23.7**	**188.1**
Program Management						
Main Estimates	58.9	6.4	1.0	66.3	6.3	72.6
Planned spending	*59.6*	*7.0*	*1.0*	*67.5*	*6.3*	*73.8*
Total authorities	63.3	6.5	1.0	70.8	10.3	81.1
Actual Spending	**89.8**	**6.3**	**1.3**	**97.4**	**6.1**	**103.5**
Total						
Main Estimates	420.8	65.1	134.4	620.3	75.1	695.4
Planned spending	*433.5*	*76.1*	*139.4*	*649.0*	*75.1*	*724.1*
Total authorities	465.6	67.3	138.1	671.0	101.9	772.9
Actual Spending	**450.1**	**67.3**	**135.6**	**653.0**	**59.4**	**712.4**

Notes

(1) Operating includes contributions to employee benefit plans.

(2) Spending of revenues pursuant to the NRC Act.

Numbers exclude the spending of proceeds from the disposal of surplus Crown assets.

Due to rounding, figures may not add to totals shown.

Table 3-3: Voted and Statutory Items (millions of dollars)					
		2004-2005			
Vote or Statutory Item	Truncated Vote or Statutory Wording	Main Estimates	Planned Spending	Total Authorities	Actual
	National Research Council Program				
65	Operating expenditures	373.5	386.2	411.2	**395.6**
70	Capital expenditures	65.1	76.1	67.3	**67.3**
75	Grants and contributions	134.4	139.4	138.1	**135.6**
(S)	Spending of revenues pursuant to the National Research Council Act	75.1	75.1	101.9	**59.4**
(S)	Contributions to employee benefit plans	47.3	47.3	54.4	**54.5**
	Total	**695.4**	**724.1**	**772.9**	**712.4**

Notes

Figures above exclude the spending of proceeds from the disposal of surplus Crown assets.

Total Authorities are Main and Supplementary Estimates plus other authorities.

Due to rounding, figures may not add to totals shown.

Table 3-4: Net Cost of Agency (millions of dollars)		
		2004-2005
Total Actual Spending		**712.4**
Plus: Services Received without Charge		
	Contributions covering employers' share of employees' insurance premiums and expenditures paid by TBS (excluding revolving funds)	19.3
	Salary and associated expenditures of legal services provided by Justice Canada	0.9
	Worker's compensation coverage provided by Social Development Canada	0.3
	Accommodation provided by Public Works and Government Services Canada	0.2
	Payroll Services provided by Public Works and Government Services Canada	0.2
	Audit services provided by the Office of the Auditor General	0.2
Less: Spending of Revenues Pursuant to section 5(1)(e) of the NRC Act		(59.4)
2004-2005 Net Cost of Agency		**674.1**

Table 3-5: Sources of Respendable Revenues by Business Line (millions of dollars)

Business Lines	Actual 2002-03	Actual 2003-04	2004-2005 Main Estimates	2004-2005 Planned Revenue	2004-2005 Total Authorities	2004-2005 Actual
Research and Technology Innovation						
Fee for Service	28.3	32.7	26.6	26.6	26.6	27.9
Rentals	2.1	2.2	2.1	2.1	2.1	2.5
Royalties	6.5	5.3	7.3	7.3	7.3	4.9
Publications	2.3	1.0	1.7	1.7	1.7	1.8
Other	0.5	1.0	0.7	0.7	0.7	0.3
Support for Innovation and the National Science and Technology Infrastructure						
Fee for Service	5.7	6.7	5.0	5.0	5.0	6.1
Royalties	0.1	-	0.1	0.1	0.1	0.1
Publications	26.2	23.4	25.1	25.1	25.1	22.4
Other	-	0.1	0.2	0.2	0.2	0.1
Program Management						
Fee for Service	1.6	2.0	1.2	1.2	1.2	2.2
Rentals	1.0	0.4	0.1	0.1	0.1	0.4
Other	3.5	4.7	5.0	5.0	5.0	6.5
Total Respendable Revenues	77.8	79.5	75.1	75.1	75.1	75.2

Notes

In accordance with section 5.1 (e) of the National Research Council Act, NRC is authorized to spend its operating revenues and therefore does not net-vote.

Total Authorities are Main and Supplementary Estimates plus other authorities.

Due to rounding, figures may not add to totals shown.

Refer to Table 3-6 for statutory payments.

Table 3-6: Statutory Payments

Spending of Revenues Pursuant to the NRC Act (millions of dollars)

Business Lines	Actual 2002-03	Actual 2003-04	2004-2005 Main Estimates	2004-2005 Planned Spending	2004-2005 Total Authorities	2004-2005 Actual
Research and Technology Innovation	53.7	31.4	38.4	38.4	56.0	**29.6**
Support for Innovation and the National Science and Technology Infrastructure	32.6	24.9	30.4	30.4	35.6	**23.7**
Program Management	5.0	5.1	6.3	6.3	10.3	**6.1**
Total Statutory Payments	**91.3**	**61.4**	**75.1**	**75.1**	**101.9**	**59.4**

Notes

Total Authorities are Main and Supplementary Estimates plus other authorities. The total of **$101.9M** for **2004-2005** includes an amount of **$26.7M** carried forward from previous years.

Due to rounding, figures may not add to totals shown.

Table 3-7: Resource Requirements by Branch/Sector Level (millions of dollars)				
	2004-2005 Business Lines			
Organization	Research and Technology Innovation	Support for Innovation and the National Science and Technology Infrastructure	Program Management	Total
Research Institutes				
Main Estimates	428.0			428.0
Planned Spending	449.5			449.5
Total Authorities	478.5			478.5
Actual Spending	**420.8**			**420.8**
Industrial Research Assistance Program				
Main Estimates		145.7		145.7
Planned Spending		151.4		151.4
Total Authorities		157.0		157.0
Actual Spending		**133.9**		**133.9**
Scientific and Technical Information				
Main Estimates		44.0		44.0
Planned Spending		44.3		44.3
Total Authorities		44.6		44.6
Actual Spending		**48.9**		**48.9**
Technology Centres				
Main Estimates		5.1		5.1
Planned Spending		5.1		5.1
Total Authorities		11.7		11.7
Actual Spending		**5.3**		**5.3**
Corporate Branches				
Main Estimates			60.9	60.9
Planned Spending			61.9	61.9
Total Authorities			68.8	68.8
Actual Spending			**89.4**	**89.4**
Executive Support				
Main Estimates			11.7	11.7
Planned Spending			11.9	11.9
Total Authorities			12.3	12.3
Actual Spending			**14.1**	**14.1**
TOTAL				
Main Estimates	428.0	194.8	72.6	695.4
Planned Spending	449.5	200.8	73.8	724.1
Total Authorities	478.5	213.3	81.1	772.9
Actual Spending	**420.8**	**188.1**	**103.5**	**712.4**

Notes

Figures above exclude the spending of proceeds from the disposal of surplus Crown assets.

Total Authorities are Main and Supplementary Estimates plus other authorities.

Due to rounding, figures may not add to totals shown.

Table 3-8: Policy on Service Standards for External Fees

In November 2004, Treasury Board ministers approved the *Policy on Service Standards for External Fees*. The Policy requires departments to report on the establishment of service standards for all external fees charged on a non-contractual basis. Although the Policy requires departmental reporting by the 2005-2006 DPR, NRC is able to provide the following information in its 2004-2005 DPR for NRC-CISTI document delivery.

NRC-CISTI Document Delivery Service Standards

Service Level	External Fee[1]			Service Standard	2004-2005 Performance Result	Stakeholder Consultation
	Canada (in CDN $)	US & Mexico (in US $)	Outside North America (in US $)			
Direct – ordered electronically and delivered by Ariel or fax	$12	$12	$12	Process ordered within 24 hours	90% of the time	Not available
Direct - ordered and/or delivered non-electronically	$18	$18	$33			
Direct - ordered electronically and delivered by Secure Desktop Delivery	$12	$12	$12			
Global – copies and loans	$20	$20	$20	Receive article they are seeking	99% of the time	Not available
Urgent	$15*	$15*	$15*	Receive a response to orders within 2 hours	99% of the time	Not available

[1] Effective 1 April 2005.

* surcharge

Table 3-9: Details on Project Spending (millions of dollars)							
				2004-2005			
Business Lines	Current Estimated Total Cost	Actual 2002-03	Actual 2003-04	Total Main Estimates	Total Planned Spending	Total Authorities	Actual
Research and Technology Innovation							
Advanced Aerospace Manufacturing Technology Centre, Project Close-out Phase, (S-EPA)	34.1	9.8	12.1	6.1	6.0	6.1	**4.9**
Aluminum Technology Centre, Project Close-out Phase, (S-EPA)	34.4	14.5	7.4	5.0	8.9	5.0	**5.0**
Construction of the Canadian Photonics Fabrication Centre, Project Close-out Phase, (S-EPA)	19.0	6.4	7.6	0.5	3.3	1.1	**2.2**
Construction of an Industrial Partnership Facility adjacent to NRC-IBD, Project Close-out Phase, (S-EPA)	8.5	0.0	0.9	6.1	6.1	6.7	**6.7**
Move of the National Research Council's Innovation Centre, Project Implementation Phase, (S-EPA)	20.0	0.0	1.0	0.0	8.6	0.8	**3.1**
Construction of Industry Partnership Facility at IMB, Project Close-out Phase, (DA)	7.2	2.2	3.4	0.8	1.6	1.1	**0.9**

Table 3-10: Details on Transfer Payments Programs (Grants, Contributions and other Transfer Payments)

1) Name of Transfer Payment Program: Industrial Research Assistance Program (NRC-IRAP)

2) Start Date: 1962-1963	**3) End Date:** on-going	**4) Total Funding for the period of 1993-94 to 2003-2004:** $896,352,577

5) Description of the Transfer Payment Program:

The Industrial Research Assistance Program (NRC-IRAP) is the National Research Council's (NRC) innovation and technology assistance program in support of Canadian small and medium sized enterprises (SMEs).

IRAP and its predecessors have been helping Canadian firms innovate in order to improve their competitive technological performance for close to 60 years. Over that time, the Program has broadened its strategic purpose from a limited focus on technology transfer to its current strategic objective of increasing innovative capabilities of Canadian SMEs. Today IRAP provides comprehensive innovation assistance to technology-based SMEs in almost every industrial sector of importance to Canada's current and future economic development.

6) Objective(s), expected result(s) and outcomes:

Strategic Objectives
- To increase the innovation capacity of Canadian SMEs
- To become the national enabler of technological innovation for Canadian SMEs

Immediate Outcomes
- Enhanced linkages
- Increased skills, knowledge and competencies
- Improved management practices
- Increased and enhanced SMEs innovation services and support

Intermediate Outcomes
- Increased innovation capacity of Canadian SMEs
- Improved financial performance of Canadian SMEs
- Enhanced the Canadian innovation infrastructure

Ultimate Outcomes
- Stimulate wealth creation for Canada through technological innovation

7) Achieved results or progress made:

Strategic Objective: To increase the innovation capacity of Canadian SMEs (6.1)

i. Enhanced linkages

Brought together the key players in the Canadian Innovation System:

- IRAP works closely with NRC's 19 research institutes and 2 technology centers, Canadian Manufacturer's Association, almost 140 of Canada's leading public and private research and technology based organizations; Federal Partners In Technology Transfer (FPTT) involving 16 federal government departments and agencies, linkages with S&T organizations in Europe and South East Asia.

Created or maintained regional linkages:

- Promotes economic development in specific regions of Canada by collaborating with Atlantic Canada Opportunities Agency (ACOA), Développment économique Canada, pour les regions du Quebec (DEC) and Western Economic Diversification Canada (WED).

Assisted SMEs in connecting with international programs, sources of technology and technical intelligence:

- Increased Technology Missions from ten in 2001-2002 to twenty five involving over 75 SMEs and 16 countries on three continents.
- Of the above, IRAP participated in a new U.S.A. federal technology initiative – namely four

Enhanced Relationship Missions (ERI) technology missions to the United States.

ii. Increased skills, knowledge & competencies

Enabled the hiring of recent university and college graduates with specific skills and expertise that can be used to advance innovative projects:

- Youth Employment Initiatives: 588 positions (475 new graduates) provided the opportunity to work with SMEs across Canada. ($4.85M)

Increased professional capacity in the area of technology transfer and commercialization:

- Federal Partners in Technology Transfer (FPTT) increased awareness among Canadian firms of federally developed technologies available for transfer & commercialization.

iii. Improved management practices

Encouraged and facilitated the sharing of manufacturing best practices and processes:

- Through business to business visits: Technology Visits Program (TVP) and Innovation Insights (ii). 122 hosts met with 2,400 participants from SMEs. Trade mission to China in which 23 manufacturing SMEs participated. 17 SMEs participated in a benchmarking exercise against top German high-tech companies.
- Used management consultant advisory services to look at client proposed business and market positioning on new projects – especially larger ones.

iv. Increased and enhanced SMEs innovation services and support. Assisted SMEs to increase their innovation capabilities by providing technical advice, referrals to expertise and other innovation services:

- 255 field delivery staff, together with SBDAs, provide customized services to 10,773 firms across Canada.

Funded innovation through contributions to 2,361 clients and 2,691 projects:

- $65.41M IRAP contributions made to SMEs and Youth Initiatives.
- $18.20M to organizations providing technical and research assistance to Canadian Industry.
- $14.93 conditionally repayable contributions through IRAP-TPC pre-commercialization assistance program designed to help SMEs develop new and improved technological products, processes or services. Of 116 funded IRAP-TPC projects 40 were newly approved. Investment in this portfolio is close to $157M and 420 approved projects.

Strategic Objective: To become the national enabler of technological innovation for Canadian SMEs (6.2)

i. Increased innovation capacity of Canadian SMEs

Contributed to increasing the capacity of SMEs to undertake highly innovative technology-based R&D projects:

- Funded the hiring of highly qualified and skilled engineers and scientists as well as internships for recent university and college graduates.
- Contributed to organizations providing technical and research assistance to Canadian SMEs as well as housing IRAP staff within universities and research facilities to facilitate linkages.
- Contributed funding through IRAP TPC for pre-commercialization assistance to SMEs.

ii. Improved financial performance of Canadian SMEs

This criterion is to be evaluated through a full Program Evaluation.

iii. Enhance the Canadian innovation infrastructure

Connecting SMEs with the technical and business advice needed:

- Contributed $18.20M to organizations, maintaining linkages with more than 200 of Canada's

leading public and private research and technology-based organizations.

- Created forums to share information and create synergies between regional player such as Plant BioTechnologies Association and Atlantic Swine Research Partnerships.
- Maintained linkages with Canada's universities, colleges, government laboratories, technological innovations organizations and the private sector. Examples include the University of Calgary Sun Centre of Excellence in Genomics Research and the selection of Kasterstener Publications of Red Deer, Alberta to provide a three-dimensional digital model of the human male anatomy for use in the centre's virtual reality cave.

Facilitates coordination among cluster players:

- Worked with local stakeholders across Canada to increase support for SMEs involved in either or both NRC lead cluster or other clusters, strengthen the innovation infrastructure, reinforce existing innovation agenda and facilitate coordination among cluster players.

millions of dollars

	8) Actual Spending 2002-03	**9) Actual Spending 2003-04**	**10) Planned Spending 2004-05**	**11) Total Authorities 2004-05**	**12) Actual Spending 2004-05**	**13) Variance(s) between 10 and 12**
Support for Innovation and the National Science and Technology Infrastructure						
Grants	-					
Contributions	94.6	82.0	92.6	91.3	**83.6**	9.0
Total Other Transfer Payments	-					
15) Total Technology and Industry Support	**94.6**	**82.0**	**92.6**	**91.3**	**83.6**	**9.0**
16) Total NRC-IRAP	**94.6**	**82.0**	**92.6**	**91.3**	**83.6**	**9.0**

17) Comments on Variances: Planned Spending as noted in Report on Plans & Priorities is a forecast based on assumption that Budget will be available. In fact the budget available ($85.8 million) was $6.84M (7.39%) less than required to execute the Plan fully thus the $ 9 million variance between planned ($92.6 million) and actual spending ($83.6 million).

The variance of $2.2 million between Final Budget Allocation ($85.8 million) and Actual Spending ($83.6 million) is explained by the characteristics of IRAP business such as:

i. Research and development has a high degree of uncertainty
ii. Subject to changes in overall economic activity in the region and country
iii. Changing SME priorities

18) Significant Evaluation Findings:

IRAP has helped to increase the innovation and financial performance of Canadian SMEs:

- Approximately 12,364 IRAP funded projects culminated in 39,186 new/ significantly improved products/ services or processes over 1996-2001—approximately 3.2 innovations per IRAP funded project;
- Approximately $11.3B actual sales revenues are linked to IRAP-assisted innovations--$4.2B attributable to IRAP over 1996-2001 and equivalent to 11 times IRAP's total contributions to client

projects during this period;

- Approximately $37.6B forecasted future sales revenues are linked to IRAP-assisted innovations—$14B attributable to IRAP during the remainder of clients' innovation life cycles; and
- Approximately 32,600 actual additional jobs are linked to IRAP-assisted innovations—12,025 jobs attributable to IRAP over 1996-2001 and equivalent to $32,000 of IRAP contributions per job created during this period.[22]

IRAP has also provided value and wealth creation for Canada:

- Approximately 37% of IRAP client innovations are considered 'World Firsts', 66% 'Firsts in Canada', and 96% 'Firsts in the Firm;
- IRAP contributions to client projects are associated with total investments for all phases of the clients' innovation projects equivalent to approximately 12.5 times IRAP's contributions[23]--firms' own equity make up almost 50% of these investments;
- Estimates from the evaluation's socio-economic analysis study, indicate that IRAP provides the public with value for money--IRAP contributions provide a return to the federal government in the form of present and future corporate income taxes valued at approximately 11 times the value of IRAP's contributions[24]; and
- IRAP is recognized by clients as the top government technology support program and the top external source of information (outside of firms' supply chain and publicly available information).

URL to 2001-2002 evaluation report: http://www.nrc-cnrc.gc.ca/aboutUs/audit_irap_e.html

1) Name of Transfer Payment Program: Tri-University Meson Facility (TRIUMF)

2) Start Date: 1976	**3) End Date:** 31 March 2010	**4) Total Funding for the period of 1994-95 to 2003-2004:** $685,800,000

5) Description of the Transfer Payment Program:

TRIUMF, Canada's national facility for research in sub-atomic physics, is located on the campus of the University of British Columbia in Vancouver. It has been operated since 1968 by a consortium of four Western universities – the University of Alberta, Simon Fraser University, the University of Victoria, and the University of British Columbia – under a joint venture agreement.

A fifth university, Carleton, joined the consortium on April 1, 2000. Five additional universities (Regina, Manitoba, Toronto, Queen's, and Montreal) are associate members.

TRIUMF houses a particle accelerator that produces beams of mesons and other particles for fundamental research in nuclear and particle physics used by Canadian and foreign researchers. This research lays the foundation for new technologies in the physical and life sciences, and the facility is a contributor to advanced materials research in Canada.

TRIUMF functions as a national laboratory and as Canada's gateway to international subatomic physics. It is Canada's contribution to the worldwide network of high-energy physics facilities located in every major country in the industrialized world.

6) Objective(s), expected result(s) and outcomes:

- Maintain the TRIUMF laboratory as a national facility for sub-atomic physics, and provide support for an on-going experimental program at TRIUMF, including the auxiliary programs in materials

[22] Data on number of innovations have been extrapolated to IRAP project population of 14,564; data on sales revenues and jobs are based on survey of 684 IRAP clients extrapolated to IRAP client population of 9,158; average client innovation cycle estimated at 10 years; attribution to IRAP is based on 37% incrementality of IRAP funding; total IRAP contributions to client projects for 1996-2001 was $386 million.

[23] Data on additional investments have been extrapolated to IRAP project population of 14,564 and include investments for all phases of clients' projects that may not have been assisted by IRAP.

[24] Data on return to government is based on economic modeling of 26 individual IRAP client cases, including modeling of client actual annual revenues, expected future revenues over remainder of innovation life cycle, fixed and variable costs, profits, machinery/equipment depreciation, 33% corporate income tax rate, 6% social discount rate and 38.4% corporate income tax attribution to IRAP.

science, life sciences, and medical therapy;

- Construct and operate an expanded Isotope Separation and Acceleration facility (ISAC-II) to provide for an innovative research program in nuclear physics, nuclear astrophysics, materials science and life sciences;
- Act as Canada's main connection with the European Centre for Nuclear Research (CERN), and supply components which will form Canada's contribution to the Large Hadron Collider (LHC) and the A Toroidal LHC Apparatus (ATLAS) detector, at CERN in Geneva, Switzerland, in order that Canadian scientists can become involved in research programs at the forefront of particle physics;
- Provide infrastructure support to the Canadian sub-atomic physics research community; and
- Maximize the economic benefits of the federal Government's investment in TRIUMF to Canadian companies through pro-active technology transfer activities, contracts and procurement policies.

7) Achieved results or progress made: The federal government investment in TRIUMF and ISAC (Isotope Separator and Accelerator) over the last five years has paid off. Among the outcomes for 2004-2005 were:

- Completion of the ISAC-II building, on time and on budget, which will house the second phase of ISAC. Construction costs for the building were fully funded by the Province of British Columbia.
- Construction of the first accelerator components for ISAC-II. ISAC-II is now and will continue to be for the foreseeable future, a unique ISOL facility in the world. As an indication of how successful ISAC is, facilities building on the ISAC success are planned for the U.S. and currently being constructed at GSI in Germany.
- Completed experiments in nuclear physics, nuclear astrophysics, particle physics, structure of matter, condensed matter, life sciences and medical therapies.
- Final delivery and commissioning of 52 specially designed, high precision magnets, manufactured by Alstom of Tracy, Quebec, along with nine pulse forming network and power supply units to CERN as part of Canada's contribution to the world's highest energy accelerator, the Large Hadron Collider (LHC).
- Infrastructure support for the construction of the ATLAS detector at CERN (Centre for Nuclear and Particle Physics) for the LHC on behalf of the Natural Sciences and Engineering Research Council (NSERC) supported Canadian university researchers. During the 2004-2005 fiscal year, construction of the Hadronic End Caps was completed and they were shipped to CERN for installation in the detector.
- TRIUMF continued to fulfill its infrastructure role for the whole of the Canadian subatomic physics community, providing the support required for Canadian scientists to participate in experiments and programs in Canada, Europe, the U.S. and Japan.
- A laboratory for advanced detector design was established at TRIUMF with a Canadian Foundation for Innovation (CFI) grant awarded to The University of British Columbia and L'Université de Montreal.
- TRIUMF assisted their major technology transfer partner, MDS Nordion Inc. in the construction of a new TR30 cyclotron, resulting in substantially increased sales for MDS Nordion Inc and an increase in royalty revenue earned by TRIUMF.

TRIUMF's overall, highly regarded international scientific and technical was further reinforced by the findings of a international Peer Review Committee, which met during 2003-2004. A calculation of direct primary impact of TRIUMF on the Canadian economy indicates that in 2003-2004, the last year the calculation was made, the $40 million TRIUMF budget generated an economic impact over $109.7 million (excluding any form of multiplier).

millions of dollars						
	8) Actual Spending 2002-03	**9) Actual Spending 2003-04**	**10) Planned Spending 2004-05**	**11) Total Authorities 2004-05**	**12) Actual Spending 2004-05**	**13) Variance(s) between 10 and 12**
Research and Technology Innovation						
Grants						
Contributions	41.0	40.0	40.0	40.0	40.0	-
Total Other Transfer Payments						
15) Total Research and Development	**41.0**	**40.0**	**40.0**	**40.0**	**40.0**	**-**
16) Total TRIUMF	**41.0**	**40.0**	**40.0**	**40.0**	**40.0**	**-**

17) Comments on Variances: no variance

18) Significant Evaluation Findings:

The Review Committee endorses without reservation the proposed five-year scientific research program with its well-defined priorities. The Committee considers the proposed research program to be of the highest quality.

The Committee commends the process by which the Five-Year Plan was developed, in particular, the continued and major involvement of the Canadian science community.

TRIUMF has undergone a major reorientation over the last decade from a hadron facility primarily for medium-energy nuclear physics to a laboratory with a two-fold research mission: i) an internal program based on the 500 MeV cyclotron, primarily the ISAC facility, to provide intense beams of short-lived nuclei for nuclear astrophysics and physics of nuclei far from stability; plus important programs in molecular, materials, and life sciences; ii) an external program directed towards the major opportunities in particle physics expected from future facilities, in particular the LHC at CERN. In addition, TRIUMF has developed a vigorous and successful technology transfer, educational and public awareness program.

In the Committee's opinion, the laboratory has successfully mastered the many critical issues underlying its difficult transition and is now well positioned to assume its dual role in the internal and the external programs.

Technical developments, in particular the successful construction of ISAC, as well as programmatic structures are now well aligned to allow major contributions to the respective areas of research. The proposed Five-Year Plan effectively translates the general goals of the science into a detailed and well-planned program.

The Committee believes that, based on these developments, TRIUMF provides new and important opportunities in its traditional role of supporting Canadian university research and increasingly attracts

scientists from the international community.

The leadership, technical, and management structure in place at the laboratory are well suited to successfully carrying out the five-year program.

The Committee considers the requested funding support appropriate and necessary. Any reduction would unavoidably result in the loss of important science for TRIUMF and the Canadian scientific community at large.

URL to 2003-2004 peer review report: http://www.nrc-cnrc.gc.ca/aboutUs/audit_e.html

1) Name of Transfer Payment Program: Canada-France-Hawaii Telescope (CFHT), James Clerk Maxwell Telescope (JCMT), Gemini Telescopes

2) Start Date: 1978 (CFHT)	**3) End Date:** December 2012 (National Science Foundation of the US in support of the Gemini Telescopes)	**4) Total Funding for the period of 1994-95 to 2003-2004:** $98,456,485

5) Description of the Transfer Payment Program: NRC, in partnership with other international bodies, provides financial contributions that support the management and operations of these telescopes and their related facilities, and participates in the oversight and direction of the facilities and research.

Astrophysics research and development requires large, costly and very precise telescopes and related instruments situated in areas that will provide ideal viewing conditions. It is beyond the capacity of individual firms or even countries to support the costs of developing and maintaining the facilities required for astrophysics research, thus it is necessary for public sector organizations, through international partnerships, to support this R&D.

6) Objective(s), expected result(s) and outcomes:

Objectives:

- Increase Canada's access to and beneficial sharing of world-class facilities and expertise in astrophysics;
- Increase scientific collaboration among Canada and partner countries;
- increase training opportunities for Canadian scientists and researchers;
- Increase opportunities for Canadian researchers and firms to develop instrumentation; and
- Increase knowledge and understanding of the universe by the observation and study of the heavenly bodies.

Immediate Outcomes:

- Access to forefront facilities and technology is provided to Canadian astronomers.
- Facilities are made available to qualified students so they can advance their training.
- New technologies are developed as part of developing new concepts for new telescopes and instruments.
- Timely publication of results is facilitated.
- Telescope data is effectively used.

Intermediate Outcomes:

- As a member of G8 and OECD, Canada plays a prominent role in international, scientific endeavors.
- Scientific benefit of telescopes to the Canadian and worldwide community is maximized.
- Canadian industry has increased opportunities to participate in advanced scientific projects, and increased opportunities to benefit.
- New technology is transferred to industry

Ultimate Outcomes:

- Knowledge about the universe and the objects within is acquired.
- Canada's position among the world's leaders in astronomy is enhanced and sustained.

7) Achieved results or progress made: Focusing on the outcomes associated with the Long Range Plan for Canadian Astronomy, in 2004-2005 NRC-HIA achieved the following:

- The Canadian Astronomy Data Centre delivered archival data from the Canada-France-Hawaii Telescope, the James Clerk Maxwell Telescope and the Gemini Telescopes to 405 distinct professional astronomers. 3943 individual requests were serviced, up 44% from last fiscal year.
- Contacts at the NRC-HIA visitor centre the "Centre of the Universe" are conservatively estimated to have been 23,600 in 2004-2005 of which 10,900 were children. The CU is very popular and has the potential to foster the next generation of scientists and engineers.
- 30 university students received advanced training in 2004-2005 at NRC-HIA.
- Detailed proposals for the next generation of instruments and facility upgrades were prepared in collaboration with other international groups associated with the Gemini observatory.
- Canadian companies benefited from contracting and sub-contracting opportunities for various projects related to the Atacama Large Millimetre Array project in Chile.
- DAOPHOT software developed by NRC-HIA is the industry standard for photometric analysis of images from telescopes and 52 researchers worldwide licensed the software during 2004-2005 bringing the total to 337 active licenses.
- Several companies and universities directly benefited from the technical advice and services provided NRC-HIA.
- A study of Canadian science released in February 2005 by the Institute for Scientific Information shows that Canadian astronomy ranks #1 in the world. Canadian papers have the highest average citations per paper over the past 10 years compared to 62 other nations tracked by ISI in the field of astronomy.

These achievements clearly demonstrate the strength of Canadian astronomy, one pillar of which is the suite of offshore facilities managed by NRC-HIA.

millions of dollars

	8) Actual Spending 2002-03	**9) Actual Spending 2003-04**	**10) Planned Spending 2004-05**	**11) Total Authorities 2004-05**	**12) Actual Spending 2004-05**	**13) Variance(s) between 10 and 12**
Research and Technology Innovation						
Grants	-	-	-	-	-	-
Contributions	10.4	10.1	5.5	5.5	10.8	(5.2)
Total Other Transfer Payments	-	-	-	-	-	-
15) Total Research and Development	10.4	10.1	5.5	5.5	10.8	(5.2)
16) Total CFHT, JCMT & Gemini Telescopes	**10.4**	**10.1**	**5.5**	**5.5**	**10.8**	**(5.2)**

17) Comments on Variances: The difference between 2004-2005 planned and actual spending is accounted for by adjusted planning to meet Canada's international telescope commitments.
18) Significant Evaluation Findings: No information currently available.

Table 3-11: Statement of Financial Position (un-audited)

NATIONAL RESEARCH COUNCIL OF CANADA
Statement of Financial Position (un-audited)
as at March 31, 2005
(in thousands of dollars)

	Current Year		Prior Year	
ASSETS				
Financial Assets				
Accounts receivable - non-tax revenue **(Schedule 1)**	23,478		14,170	
Less: allowance for doubtful accounts	3,224		722	
		20,254		13,448
Investment - H.L. Holmes Fund **(Schedule 2)**		4,039		3,988
Accountable advances to employees		19		62
Other advances and taxes on purchases		3,732		1,516
Total financial assets		**28,044**		**19,014**
Non-Financial Assets				
Prepaid expenses **(Schedule 3)**		9,639		9,185
Inventories held for consumption		3,168		3,212
Capital assets **(Schedule 4)**	1,077,535		1,023,988	
Less: accumulated amortization	583,414		547,251	
		494,121		476,737
Total non-financial assets		**506,928**		**489,134**
Total assets		**534,972**		**508,148**
LIABILITIES AND GOVERNMENT OF CANADA EQUITY				
Liabilities				
Accounts payable and accrued liabilities **(Schedule 5)**		112,073		92,583
Allowances for employee benefits		34,410		33,616
Deferred revenue **(Schedule 6)**		29,604		29,866
Other liabilities **(Schedule 7)**		16		12
Total liabilities		**176,103**		**156,077**
Net Liabilities				
Government Equity, beginning of year		352,071		314,260
Add: net cash provided by Government		613,937		626,459
Deduct: net operating deficit		628,315		609,188
Government Equity, end of year		**337,693**		**331,531**
Add: services without charge		21,176		20,540
Net Liabilities		**358,869**		**352,071**
Total Liabilities and Government Equity		**534,972**		**508,148**

The accompanying notes and schedules form an integral part of these statements.

Table 3-12: Statement of Operations (un-audited)

NATIONAL RESEARCH COUNCIL OF CANADA
Statement of Operations (un-audited)
for the year ended March 31, 2005
(in thousands of dollars)

	Current Year	Prior Year
Revenues (Schedule 8)		
Sales of goods and services	83,222	74,963
Revenue from joint research projects and cost sharing agreements	19,168	21,864
Other revenue	1,355	10,594
Total revenue	**103,745**	**107,421**
Expenses (Schedule 9)		
Transfer payments	134,317	132,980
Program Expenses		
Personnel operating expenses **(Note 8)**	354,966	354,222
Operating and maintenance expenses **(Note 8)**	192,345	180,742
Amortization expenses on capital assets **(Schedule 4)**	46,260	47,501
Loss on disposal of physical assets	285	362
Loss or gain on foreign exchange revaluations at year-end	(119)	(114)
Interest on overdue suppliers accounts	1	-
Bad debts	3,384	114
Losses on write-offs and write-downs	621	802
Total program expenses	597,743	583,629
Total expenses	**732,060**	**716,609**
Net cost of operations	**(628,315)**	**(609,188)**

The accompanying notes and schedules form an integral part of these statements.

Table 3-13: Statement of Cash Flow (un-audited)

NATIONAL RESEARCH COUNCIL OF CANADA
Statement of Cash Flow (un-audited)
for the year ended March 31, 2005
(in thousands of dollars)

	Current Year	Prior Year
OPERATING ACTIVITIES		
Net cost of operations	**628,315**	**609,188**
Non-cash items included in net cost of operations		
Post capitalization revenue	1,213	10,066
Amortization of capital assets	(46,260)	(47,501)
Bad debt expense	(3,384)	(114)
Loss on disposal of physical assets	(285)	(362)
Loss or gain on foreign exchange revaluations at year-end	119	114
Loss on write-offs and write-downs	(599)	(802)
Services provided without charge by other Government departments	(21,176)	(20,540)
Statement of financial position adjustments		
Variation in accounts receivable	10,071	(2,550)
Variation in advances & taxes on purchase	2,173	(19,008)
Variation in prepaid expenses	454	(1,629)
Variation in investments	51	276
Variation in inventories	(44)	(389)
Variation in accounts payable and accrued liabilities	(19,490)	20,535
Variation in allowances for employee vacation and compensatory benefits	(794)	(5,224)
Variation in deferred revenues	262	(2,031)
Variation in other liabilities	(4)	(8)
Cash used in operating activities	**550,622**	**540,021**
Investing activities		
Net Changes in Capital assets	**63,315**	**86,438**
Net cash provided by Government	**613,937**	**626,459**

The accompanying notes and schedules form an integral part of these statements.

Schedule 1

NATIONAL RESEARCH COUNCIL OF CANADA
Receivables – Net of Allowances (un-audited)
as at March 31, 2005
(in thousands of dollars)

		Current Year			Prior Year		
	FRA Code	Other Govt. Depts.	External Parties	Total	Other Govt. Depts.	External Parties	Total
Accounts receivable	11221		20,594	20,594		12,141	12,141
Accrued receivables	11225		1,572	1,572		1,465	1,465
Refund of program expenses	11231		35	35		10	10
Other receivables	11242	1,277		1,277	554		554
Sub-total		**1,277**	**22,201**	**23,478**	**554**	**13,616**	**14,170**
Less: allowance for doubtful accounts	11229	-	3,224	3,224	-	722	722
Total accounts receivable - net		**1,277**	**18,977**	**20,254**	**554**	**12,894**	**13,448**

Schedule 2

NATIONAL RESEARCH COUNCIL OF CANADA
Investment – H.L. Holmes Fund (un-audited)
at March 31, 2005
(in thousands of dollars)

This account was established pursuant to paragraph 5(1)(f) of the National Research Council Act to record the residue of the estate of the late H.L. Holmes. Up to two thirds of the funds yearly net income from the fund is used to finance the H.L. Holmes award on an annual basis. The award provides the opportunity to post-doctoral students to study at world famous graduate schools or research institutes under outstanding research persons.

	FRA Code	Current Year	Prior Year
Investment at beginning of period, April 1st	13399	3,988	3,711
Net income during year	13399	51	277
Investment at end of period, March 31st		**4,039**	**3,988**

Schedule 3

NATIONAL RESEARCH COUNCIL OF CANADA
Prepaid Expenses (un-audited)
at March 31, 2005
(in thousands of dollars)

	FRA Code	Current Year	Prior Year
Subscriptions (journals, magazines, libraries, etc.)	14110	9,075	8,613
Memberships (professional and scientific associations, credit bureaus, etc.)	14110	106	388
EDP services	14110	146	20
Repair – EDP equipment	14110	195	82
EDP software license	14110	104	82
Tuition fees	14110	13	-
Total		**9,639**	**9,185**

Schedule 4

NATIONAL RESEARCH COUNCIL OF CANADA
Fixed Assets (un-audited)
2004-2005
(in thousands of dollars)

Fixed Assets (1)	GL Code	FRA Code	Deprec. Rate (2)	Opening Balance April 1 2004	Additions During Year	Deletions During Year Disposals/write-offs	Other Transactions (6)	Closing Balance March 31 2005
Land	15000	16111	n/a	10,912	-	-	-	10,912
Buildings	15050	16112	4%	351,001	135	-	6,110	357,246
Facilities **(3)**	15060	16112	4%	1,035	5	-	1,378	2,418
Works and infrastructure	15100	16113	4%	19,454	-	-	-	19,454
Machinery and equipment	15150	16121	10%	429,118	36,022	7,158	(2,281)	455,701
Informatics equipment	15200	16122	20%	87,056	5,575	3,491	19	89,159
Informatics software **(4)**	15250	16123	20%	3,251	1,009	133	139	4,266
Aircrafts	15300	16132	10%	9,599	812	-	-	10,411
Motor vehicles	15350	16133	20%	2,723	159	88	28	2,822
Buildings under construction	15800	16311	n/a	103,282	16,589	-	(4,132)	115,739
Works in progress	15850	16312	n/a	1,943	138	-	(234)	1,847
In-house software	16300	16315	n/a	3,915	2,722	-	10	6,647
Other	15870	16319	n/a	700	720	-	(507)	913
Total				**1,023,989**	**63,886**	**10,870**	**530**	**1,077,535**

Amortization Schedule
2004-2005

Fixed Assets	GL Code	FRA Code	Deprec. Rate (2)	Accumulated Depreciation April 1 2004 (5)	Amortization for the Year	Deletions During Year Disposals/write -offs	Other Transactions (6)	Accumulated Depreciation March 31 2005
Buildings	15400	16212	4%	180,255	13,999	-	-	194,254
Facilities	15410	16212	4%	14	41	-	1,378	1,433
Works and infrastructure	15450	16213	4%	10,039	694	-	-	10,733
Machinery and equipment	15500	16221	10%	271,907	25,089	6,613	(1,261)	289,122
Informatics equipment	15550	16222	20%	72,166	5,269	3,484	(13)	73,938
Informatics software	15600	16223	20%	2,077	789	55	29	2,840
Aircrafts	15650	16232	10%	8,776	119	-	-	8,895
Motor vehicles	15700	16233	20%	2,017	260	78	-	2,199
Total				**547,251**	**46,260**	**10,230**	**133**	**583,414**

Notes

1) Capital assets do not include any intangibles, works of art and historical treasures that have cultural, aesthetic or historical value or any similar assets located in museums.

2) The straight-line method of depreciation is used.

3) The fixed assets in this category include facilities and production equipment having a nominal value of one dollar. There are 44 items consisting, for the most part, of testing facilities, laboratories and specialized equipment. At statement date, these assets had not yet been appraised.

4) Informatics software was capitalized only from April 1, 2001 in accordance with Treasury Board Secretariat policies.

5) The accumulated depreciation opening balance includes all the adjustments made during the year for the post-capitalization of assets.

6) Other transaction include transfer from assets under construction and post capitalization transactions.

Schedule 5

NATIONAL RESEARCH COUNCIL OF CANADA
Accounts Payable and Accrued Liabilities (un-audited)
at March 31, 2005
(in thousands of dollars)

	FRA Codes	Current Year	Prior Year
Accounts payable at year-end	21111	90,517	68,531
Accrues salaries and wages	21112	6,464	5,203
Withholding tax	21128	15	1
Other payables to other government departments	21132	12,606	16,371
Goods and services tax (including HST) payable to CRA	21134	1,170	335
Provincial sales tax, excluding HST	21151	238	112
Contractors' holdbacks	21153	1,063	2,030
Total		**112,073**	**92,583**

Schedule 6

NATIONAL RESEARCH COUNCIL OF CANADA
Deferred Revenue (un-audited)
at March 31, 2005
(in thousands of dollars)

	FRA Codes	Current Year	Prior Year
Deferred revenues	21510	9,580	9,356
Deferred revenues – specified purpose accounts	23451	20,024	20,510
Total		**29,604**	**29,866**

Schedule 7

NATIONAL RESEARCH COUNCIL OF CANADA
Other Liabilities (un-audited)
at March 31, 2005
(in thousands of dollars)

	FRA Codes	Current Year	Prior Year
General suspense accounts	21611	16	4
Garnisheed salaries	21613	-	8
Total		**16**	**12**

Schedule 8

NATIONAL RESEARCH COUNCIL OF CANADA
Non-Tax Revenue (un-audited)
for the year ended March 31, 2005
(in thousands of dollars)

	FRA Codes	Current Year	Prior Year
Sales of goods and services			
Rights and privileges	42311, 42321	5,030	5,327
Lease and use of property	42312, 42322	2,925	2,529
Services of non-regulatory nature & other fees and charges	42314, 42319, 42324	63,813	57,335
Sales of goods and information products	42315, 42325	11,454	9,772
Sub-total		**83,222**	**74,963**
Gains on disposal of non-capital assets to outside parties	42412	-	-
Interest on overdue accounts receivable	42541	1	22
Interest H.L. Holmes Fund	42624	51	276
Crown assets disposal	42719	89	160
Donations & bequests	42725	1	70
Revenue from joint project and cost sharing agreements	42734	19,168	21,864
Post capitalization revenue	42771	1,213	10,066
Total		**103,745**	**107,421**

Schedule 9

NATIONAL RESEARCH COUNCIL OF CANADA
Expenses (un-audited)
for the year ended March 31, 2005
(in thousands of dollars)

	FRA Codes	Current Year	Prior Year
Transfer payments			
Other transfers to individuals	51119	304	340
Industrial development payments	51152	128,529	126,879
Other transfers to international organizations	51169	5,484	5,761
Sub-total		**134,317**	**132,980**
Personnel operating expenses			
Salaries and wages **(Note 8)**	51311	300,514	301,631
Employer contribution costs	51312	54,452	52,591
Sub-total		**354,966**	**354,222**
Operating and maintenance expenses (Note 8)	51321	**192,345**	**180,742**
Amortization expenses on capital assets (Schedule 4)			
Buildings and facilities	51412	14,040	12,897
Works and infrastructure	51413	695	647
Machinery and equipment	51421	25,089	24,772
Informatics equipment	51422	5,269	6,650
Informatics purchased and developed software	51423	789	1,790
Aircraft	51432	119	497
Motor vehicles	51433	259	248
		46,260	**47,501**
Loss on disposal of physical assets	51511	**285**	**362**
Loss/Gain on foreign exchange revaluations at year end	51712	**(119)**	**(114)**
Interest on overdue suppliers accounts	51726	**1**	**-**
Bad debts	51732	**3,384**	**114**
Loss on write-offs and write-downs	51733	**621**	**802**
Total		**732,060**	**716,609**

Schedule 10

NATIONAL RESEARCH COUNCIL OF CANADA
Source and Disposition of Authorities (Appropriations)
for the Year Ended March 31, 2005
(in thousands of dollars)

Source of Funding	Authorities available for use in the CY	Authorities used in the CY	Lapsed	Authorities available for use in subsequent years	Authorities used in the PY
Operating expenditures	411,185	395,620	15,565	-	386,550
Capital expenditures	67,292	67,291	1	-	71,310
Grants and contributions	138,132	135,633	2,499	-	133,456
Spending of revenues pursuant to paragraph 5(1)(e) of the National Research Council Act	101,875	59,421		42,454	61,411
Contributions to employee benefit plans	54,452	54,452	-	-	52,591
Spending of proceeds from the disposal of surplus Crown assets	232	221		11	167
Program Total (Budgetary)	**773,168**	**712,638**	**18,065**	**42,465**	**705,485**

NATIONAL RESEARCH COUNCIL OF CANADA
Source and Disposition of Authorities (Appropriations)
By Business Line
for the Year Ended March 31, 2005
(in thousands of dollars)

Business Lines	Authorities available for use in the CY	Authorities used in the CY	Lapsed	Authorities available for use in the subsequent years	Authorities used in the PY
Research and technology innovation	480,531	420,934	32,406	27,191	425,885
Support for innovation and the national science and technology infrastructure	207,499	188,146	9,735	9,618	184,011
Program management	85,138	103,558	(24,076)	5,656	95,589
Program Total (Budgetary)	**773,168**	**712,638**	**18,065**	**42,465**	**705,485**

Schedule 11

NATIONAL RESEARCH COUNCIL OF CANADA
Reconciliation of Net Results to Appropriations Used (un-audited)
for the year ended March 31, 2005
(in thousands of dollars)

	Current Year	Prior Year
Net results (Deficit)	**628,315**	**609,188**
Adjustments for items not affecting appropriations		
Less: Amortization of capital assets	(46,260)	(47,501)
Services without charges by other Government departments	(21,176)	(20,540)
Trust fund	(18,660)	(20,984)
Vacation pay	(792)	(5,224)
Bad debt write-offs	(3,384)	(114)
Loss or gain on foreign exchange	119	114
Net loss on disposal of assets	(285)	(362)
Loss on write-off and write-down of assets	(356)	(143)
Expenditures related to Justice Canada	(482)	(484)
Expenditures not affecting appropriation	(274)	(294)
Interest H.L. Holmes fund	-	(3)
Inventory adjustments	-	(392)
Sub-total	**(91,550)**	**(95,927)**
Add: Revenue	103,745	107,421
Reallocation of capital asset expenditures	19,766	52,674
Prepayments	454	(1,629)
Adjustment of previous years accounts payable – PAYE	5,493	1,321
Adjustment of prior years expenditures	907	792
Year-end adjustment for outstanding invoices (expenditures)	2,337	(818)
Sub-total	**132,702**	**159,761**
Adjustments for items affecting appropriations		
Add: Capital acquisitions	43,215	32,460
Inventory purchased	(44)	3
Sub-total	**43,171**	**32,463**
Total appropriations used	**712,638**	**705,485**

1. Authority and Objectives

The National Research Council of Canada exists under the National Research Council Act of 1966-67 and is a departmental corporation named in Schedule 2 of the Financial Administration Act. The objectives of the Council are to create, acquire and promote the application of scientific and engineering knowledge to meet Canadian needs for economic, regional and social development and to promote and provide for the use of scientific and technical information by the people and Government of Canada to meet Canadian needs for economic, regional and social development.

2. Sources of Funding

The **National Research Council** is primarily **financed by** the Government of Canada through **Parliamentary appropriations** and **statutory authority**. The latter gives the Council authority to spend revenues earned through collaborative research agreements and from fees-for-service-work, sales of publications, rentals of laboratory space, and license fees.

3. Significant Accounting Policies

a) These financial statements have been prepared on an **accrual basis of accounting** in accordance with Treasury Board Accounting Standards. These standards are based on generally accepted accounting principles in Canada. The primary source of the accounting principles is from the recommendations of the Public Sector Accounting Board of the Canadian Institute of Chartered Accountants supplemented by the recommendations of the Accounting Standards Board of the Canadian Institute of Chartered Accountants for situations not covered by the Public Sector Accounting Board. Readers of these statements are cautioned that the introduction of accrual accounting at the departmental level is evolutionary. Not all assets, liabilities and expenses applicable to the department are recorded at the departmental level at this time. As such, the financial statements are not necessarily complete. The accompanying notes provide additional detail and should be read with care. All such assets, liabilities and expenses are recorded at a government-wide level in the financial statements of the Government of Canada.

b) Appropriations provided to the department do not parallel financial reporting according to generally accepted accounting principles. They are based in large part on cash flow requirements. Consequently, items recognized in the statement of operations and the statement of financial position is not necessarily the same as those provided through appropriations from Parliament. **Schedule 10** to these financial statements provides information regarding the source and disposition of these authorities. **Schedule 11** provides a high-level reconciliation between the two bases of reporting.

c) All departments including agencies and departmental corporations operate within the Consolidated Revenue Fund (CRF). The Receiver General for Canada administers the CRF. All cash receipts are deposited to the CRF and all cash disbursements made by the Council are paid from the CRF. Net cash provided by the government is the difference between all cash receipts and all cash disbursements including transactions between other departments.

d) Revenue and expense transactions and any related asset and liability accounts between sub-activities within the Council have been eliminated.

e) **Revenues** are accounted for in the period in which the underlying transaction or event occurred that gave rise to the revenues. Revenues that have been received but not yet earned are disclosed in Schedule 6 – Deferred Revenue.

f) **Expenses** are recorded when the underlying transaction or expense occurred subject to the following:

- **Grants** are recognized in the year in which payment is due or in which the recipient has met the eligibility criteria.
- **Contributions** are recognized in the year in which the recipient has met the eligibility criteria.
- **Employee termination benefits** are expensed as paid. The department does not record any estimated accruals. Accruals for these benefits are recognized in the consolidated financial statements of the Government of Canada.
- **Vacation pay and overtime** are expensed in the year that the entitlement occurs.
- **Contributions to superannuation plans** are recognized in the period that the contributions are made. The department does not record actuarial surpluses nor deficiencies; these are recognized in the consolidated financial statements of the Government of Canada.
- **Environmental liabilities** are not recognized in the departmental books of accounts but are recognized in the consolidated financial statements of the Government of Canada.

g) **Receivables** are stated at amounts expected to be ultimately realized. A provision is made for receivables where recovery is considered uncertain.

h) **Inventories** are valued as follows:

- **Not for re-sale -** Inventories not for re-sale comprise spare parts and supplies that are held for future program delivery. Such inventories are valued using the moving-weighted-average method. Inventoried items no longer having service potential are valued at the lower of cost or net realizable value.
- **For re-sale -** Costs relating to inventories for resale are expensed when acquired and therefore no cost of sales is recognized.

i) **Intangible assets**, such as patents, are not capitalized but expensed when paid All other **capital assets and leasehold improvements** having an initial cost of $5,000 or more are recorded at their acquisition cost in accordance with the Public Sector Accounting Board Recommendations. The capitalization of software and leasehold improvements was done on a prospective basis from April 1, 2001. Capital assets do not include any intangibles, works of art and historical treasures that have cultural, aesthetic or historical value nor any similar assets located in museums. Depreciable capital assets are amortized using the straight-line method based on their estimated useful life as follows:

Asset Class	Amortization Period
Buildings and facilities	25 years
Works and infrastructure	25 years
Machinery and equipment	10 years
Informatics hardware	5 years
Informatics software	5 years
Vehicles	5 years
Aircraft	10 years

j) **Equity investments** are not recognized as assets but as revenue upon the sale of the equity in accordance with the Receiver General of Canada and the Treasury Board Secretariat directives.

k) **Transactions in foreign currency** are translated into Canadian dollar equivalents using the rates of exchange in effect at the time of the transactions. Assets and liabilities denominated in foreign currencies at year-end are translated using the applicable exchange rates in effect on March 31st.

4. Changes in Accounting Policies

In fiscal year 2004-2005, the services without charge provided by Other Government Departments are included in the financial statements. We have also modified the results for fiscal year 2003-2004 to reflect the change in the accounting policy.

5. Measurement Uncertainty

The preparation of financial statements requires management to make estimates and assumptions that affect the reported amounts of assets, liabilities, revenues and expenses reported in the financial statements. At the time of preparation of these statements, management believes the estimates and assumptions to be reasonable. The most significant item where estimates are used is amortization of assets.

6. Contractual Commitments

Commitments are comprised of contractual and other long-term obligations due and payable in subsequent years. As at March 31, 2005, the NRC had the following outstanding commitments:

Fiscal Year	Grants, Contributions & Construction (in millions)
2005-2006	$72
2006-2007	$62
2007-2008	$62
2008-2009	$58
2009-2010	$54

Significant commitments for the five-year period included in the above are:

James Clerk Maxwell Telescope:	$ 5
Gemini Twin Telescope Project:	$ 29
Tri-University Meson Facility:	$ 223
Canada-France-Hawaii Telescope Corporation:	$ 20

7. Contingent Liabilities

A contingent liability is a potential liability which may become a liability when one or more future events occur or fail to occur. Contingent liabilities are not recognized on the Council's financial statement as a liability until the amount of the liability is firmly established. As at March 31, there were eleven legal actions pending for which no liability is recognized. Also a contingent liability has been reported to Treasury Board regarding 2 contaminated sites. The total contigent liabilities are estimated at $1.5M.

8. Related Party Transactions

The Council is related in terms of common ownership to all other Government of Canada department, agencies and Crown Corporation. The Council enters into transactions with these entities in the normal course of business and on normal trade terms applicable to all individuals and enterprises except that certain services are provided without charge.

During the year, the Council received services without charge, which are recorded at fair value in the financial statements as follows

(Thousands of dollars)	Current Year	Prior Year
Accommodations provided by Public Works and Government Services Canada	$158	$158
Salary and associated costs of legal services provided by Justice Canada	$944	$934
Employee compensation payments provided by Human Resources Development Canada	$336	$329
Audit services provided by the Office of the Auditor General	$245	$0
Payroll services provided by Public Works and Government Services Canada	$160	$165
Contributions covering employer's share of insurance premiums and costs paid by the Treasury Board	$19,333	$18,954
TOTAL SERVICES PROVIDED WITHOUT CHARGE	**$21,176**	**$20,540**

Table 3-14: Response to Parliamentary Committees, Audits and Evaluations for 2004–2005

Response to Parliamentary Committees

NRC did not participate in any Parliamentary Committees in 2004-2005 that required a response.

Response to the Auditor General

The Office of the Auditor General of Canada (OAG) conducted an audit of NRC in 2003-2004. The objectives of the audit, tabled in March 2004, were to assess NRC's systems and practices for setting strategic direction for its scientific research activities and to determine whether NRC managed activities to maximize results. The audit also assessed whether NRC measured and appropriately reported the results and impacts of its efforts. Below is a summary of NRC's actions in 2004-2005 in response to the OAG's recommendations. NRC has also developed an Action Plan for the period 2005-2007 to continue.

OAG Recommendations	NRC Progress
Corporate Governance • Define role of NRC Governing Council to meet responsibilities under the *NRC Act* • Put in place governance mechanisms to implement NRC Governing Council role • Review corporate senior management structure to ensure appropriate accountability	• ***June 2004 - NRC Council Task Force on Governance*** • ***July 2004—New Members of NRC's Senior Executive Committee***-- Director General of Finance and Director General of Human Resources • ***October 2004-- Report on Proposed Council Structure*** • ***February 2005*** *--Implementation Plan for new Council Governance Model*
Setting Corporate Strategic Direction • Develop a corporate business plan • Develop a priority-setting mechanism • Conduct comprehensive review of research areas	• ***2004-2005--- NRC Executive Committees***-- Budget Advisory Committee, Strategies & Priorities Committee, Committee on Planning, Risk & Performance Management • ***January 2005—onward-- NRC's Renewal Initiative***-- Senior Executive Committee of NRC initiated a renewal process to: undertake a comprehensive review of the value and continuing relevance of NRC activities; renew NRC's vision; and develop an enabling corporate strategic plan in 2005-2006 • ***January 2005 –onward--NRC Integrated Corporate Planning & Performance Management Solution***-- NRC is undertaking development of an integrated process (strategic/business planning, human resources, risk & performance management, capital assets, finance) to support senior management priority-setting and decision-making • ***March-April 2005—NRC Allocation Process for Funding Renewal of Atlantic Initiatives*** — process will form the basis for allocation of resources for future renewal of NRC cluster initiatives.

	• ***March 2005 –onward-- NRC's Corporate Risk Profile and Risk Assessment Pilots*** -- NRC undertook risk management pilot projects at the corporate and Institute levels. The projects entailed using a common risk management approach that related to strategic planning processes. The organizational risk profile has been developed and is in the process of being finalized by NRC senior executives. NRC has also assessed the risk management pilots with Institutes and is examining recommendations for future implementation.
Research Management at Institute Level • Improve priority-setting framework • Clearly document key project decisions	• ***January 2005 – onward--NRC Research Management Self-Assessment Tool (RMSA)*** -- NRC is developing this tool to help Institutes/Programs regularly assess, improve and build upon their research management practices
Human Resources Management • Set strategic direction for human resources management, with clear goals and measurable objectives in partnership with senior management • Develop comprehensive human resources management action plan to implement strategic direction	• ***January 2004—HRM Representation at Senior Executive Committee*** • ***May 2004-- Human Resources Management Plan***—a three-year plan to address NRC's key human resources challenges: Recruitment, Leadership at all Levels, Building Cross-functional/Cross Cultural Strength, Aligning Compensation/Rewards and Performance Management • ***January 2005 –onward--NRC Integrated Corporate Planning & Performance Management Solution*** –the project is examining processes to integrate human resources planning with corporate strategic/business planning
Performance Measurement and Reporting • Establish resourced plan for implementing new performance management framework • Establish performance indicators and targets for expected results and link costs to results	• ***January 2005 –onward--NRC Integrated Corporate Planning & Performance Management Solution***—this solution will address NRC's planning and performance management gaps (linking planning and performance to resources at corporate and Institute/Program/Branch levels); establish an electronic system for ongoing collection and updating of performance data; facilitate NRC-wide planning and performance management (support decision-making); and facilitate internal and external reporting needs (e.g., NRC Performance Report)
External Audits	
External Audits • No external audits completed in 2004-2005	

Internal Audits and Evaluations

Internal Audits

- No internal audits completed in 2004-2005.

Internal Evaluations

- Peer Review of the Steacie Institute for Molecular Sciences (October 2004), http://www.nrc-cnrc.gc.ca/aboutUs/audit_sims_e.html
- Formative Evaluation of the Atlantic Initiatives (October 2004), http://www.nrc-cnrc.gc.ca/aboutUs/audit-atlantic_e.html

Table 3-15: Horizontal Initiatives

NRC is the lead on the Genomics R&D Initiative component of the Canadian Biotechnology Strategy. Performance information on the Initiative can be found on the Canadian Biotechnology Strategy page of TBS' Horizontal Initiatives database at: http://www.tbs-sct.gc.ca/rma/eppi-ibdrp/hrdb-rhbd/cbs-scb/2004-2005_e.asp.

Table 3-16: Travel Policies

NRC follows Treasury Board Secretariat's Travel policies and parameters. NRC does not have any Special Travel Authorities.

Appendix A: Awards and Achievements

- Attia, H. NRC-IAR
  Elected Corresponding Member of the College International pour la Recherche en Productique
- Baillie, S. NRC-IAR
  NATO/RTO Panel Excellence Award
- Bird, J. NRC-IAR
  Achievement Award from the Technology Cooperation Program
- Buriak, J. NINT
  Women in Science, Engineering and Technology Fellow, Royal Scientific Societies of Canada and Japan
- Charbonneau A., Mateescu G. NRC-IMSB
  2004 CANARIE IWAY award for New Technology Development
- Couturier, C. NRC-IIT
  Top 50 CEOs in Atlantic Canada - Atlantic Business Magazine
- Couturier, C. NRC-IIT
  Industry Person of the Year - Knowledge Industry Recognition and Achievement Awards
- Davidson, W. NRC-CS
  Elected to the Board of the Canadian Light Source Inc.
- Dinkel, C., Fung, D., Ul Islam, M., Nikumb, S., Reshef, H., Langlois, S. NRC-IMTI
  Federal Partners in Technology Transfer Award
- Dobrowlski, G. NRC-IMS
  Member of the Order of Canada
- El-Hakim, S. NRC-IIT
  Fellow of the International Society for Optical Engineering (SPIE)
- Gould, R. NRC-IAR
  Roméo Vachon Award for 2004, Canadian Aeronautics and Space Institute
- Hawari, J NRC-BRI
  Excellence in Review Award, Environmental Science & Technology of the American Chemical Society
- Holdcroft, S, Navessin, T., Wang, Q., Datong, S., Eikerling, M., Liu, S. NRC-IFCI
  Top 25 Hottest Research Publications, Elsevier Science
- Hunaidi, O., Wang, A. NRC-IRC
  Federal Partners in Technology Transfer Award
- Ivanov, M. NRC-SIMS
  Invited Professor Max Planck Institute for Quantum Optics, Germany
- Ivanov, M. NRC-SIMS
  F. Bessel Award, Humboldt Foundation
- Jennings, H. NRC-IBS
  Doctor of Science (honoris causa), Carleton University
- Jiang, W. NRC-ICPET
  Award from the Community Modeling and Analysis System Organization
- Kartha, K. NRC-PBI
  Gold Medal for Outstanding Service from the Professional Institute of the Public Service of Canada
- Liu, H. C. NRC-IMS

Fellow of the American Physical Society

- Liu, P. NRC-IOT
  Research Award from the Hong Kong K. C. Wong Education Foundation
- MacKensie R. NRC-IBS
  2004 Ottawa Life Sciences Achievement Award
- MacKenzie, R. NRC-IBS
  Applied Research Award, Ottawa Life Sciences Council
- Narang, S. NRC-IBS
  Member of Scientific Advisory Board Nichoals Piramal Ltd., Mumbai, India
- Quilliam, M. NRC-IMB
  Harvey W. Wiley Award from AOAC International
- Rachuk, T. NRC-IRAP
  2004 Premier's Award of Excellence (Bronze) for his contribution to the Alberta Environmentally Sustainable Agriculture Program
- Rahbari, R. NRC-IFCI
  2004 F.W. (Casey) Baldwin Award from the Canadian Aeronautics and Space Institute
- Robertson, A. NRC- INMS
  Godlove Award for outstanding contribution to the Field of Color from the Inter-Society Color Council
- Simpson, D., NRC-IAR
  Achievement Award from The Technology Cooperation Program
- Sneddon, D. NRC-IRAP
  Champion Award, Kingston Technology Council
- Song, X. NRC-IBD
  Auxilliary Fellowship from the Alzheimer Society of Canada
- Stolow, A. NRC-SIMS
  Professeur Invite École Normale Supérieur, Paris, France
- Weibe, P. NRC-IBD
  Federal Partners in Technology Transfer Award
- Williams, M. NRC-IOT
  Honorary Doctor of Science from Queens University
- Xue, L. NRC-IMTI
  The Technical Cooperation Program (TTCP) Award from the Non-atomic Military Research Development (NAMRAD) International
- Zimcik, D. NRC-IAR
  Fellow of the Canadian Aeronautics and Space Institute

Appendix B: NRC's Institutes, Program, Branches and Centres

Aerospace

Institute for Aerospace Research (NRC-IAR) – Ottawa, Ontario and Montreal, Quebec

Mission:
Maintain and develop the core competencies and the knowledge base critical for the needs of the Canadian aerospace community. NRC-IAR fosters innovation in the design, manufacture, performance, use and safety of aerospace vehicles, and supports the development, commercialization, and implementation of leading-edge technologies through world-class facilities and by networking nationally and internationally.

Core Business:
NRC-IAR maintains expertise in and operates national facilities for: aerodynamics testing, structures and materials research, aeroacoustic research, flight testing, airborne simulation and sensing, aeroproplusion research, icing research, materials processing, advanced manufacturing, non-destructive testing, diagnostic testing, and many other related areas.

2004-2005 Total Expenditures: $37,400,000
Director General: Stewart Baillie *(acting)*
General Inquiries: (613) 952-7214 http://iar-ira.nrc-cnrc.gc.ca

Astrophysics

Herzberg Institute of Astrophysics (NRC-HIA) – Victoria and Penticton, British Columbia

Mission:
Execute NRC's mandate to "operate and administer any astronomical observatories established or maintained by the Government of Canada". NRC-HIA is committed to excellence in astrophysical research through the provision of first-class facilities and services to Canadian researchers and the direct participation of its staff in research.

Core Business:
NRC-HIA operates telescopes in Victoria and Penticton, actively manages Canadian interests in the James Clerk Maxwell Telescope, the Canada France Hawaii Telescope and the Gemini Observatory. NRC-HIA has earned an international reputation for its astrophysical research, as well as for its development of advanced scientific instrumentation (optical design, antenna design, and sub-millimetre instrumentation); innovative technologies (multi-object spectroscopy, and phase monitoring for radio

interferometry); and data management, mining and manipulation technologies (data processing, and signal processing).

2004-2005 Total Expenditures: $29,400,000
Director General: Gregory Fahlman
General Inquiries: (250) 363-0045 http://hia-iha.nrc-cnrc.gc.ca

Biotechnology Group

Biotechnology Research Institute (NRC-BRI) – Montreal, Quebec

Mission:
Promote, assist, and perform leading-edge R&D in biochemical engineering and molecular level biology, closely linked to the needs of industries in the pharmaceutical and natural resources sectors.

Core Business:
NRC-BRI's research program has three sectors: health, environment and bioprocess platform. Its health sector is active in the development of new strategies for the treatment of cancer and infectious diseases, such as research at the molecular level, the use of receptors and signal transduction, and the use of proteases and protease regulation. The environmental sector's work is centred on prevention and pollution control, including technology and process development; identification and behaviour of pollutants; monitoring and ecotoxicological risk evaluation; green technologies and sustainable development; production of non-pollutant products; and exploration of ways to re-use organic wastes and turn them into value-added products. The internationally recognized bioprocess platform sector is engaged in the identification and integrated development of new bioprocesses: optimization of bioprocesses; scale up of fermentation processes to industrial levels; recovery and purification of biotechnology products; and production of research materials and training of industrial personnel. NRC-BRI is a founding member of the Montreal Centre for Excellence in Brownfields Rehabilitation, an industry-government partnership for decontamination and rehabilitation of sites.

2004-2005 Total Expenditures: $30,300,000
Director General: Michel Desrochers
General Inquiries: (514) 496-6100 http://irb-bri.cnrc-nrc.gc.ca

Institute for Biodiagnostics (NRC-IBD) – Winnipeg, Manitoba

Mission:
Foster socio-economic growth through the development and use of new instrumental technologies for the non-invasive diagnosis of diseases.

Core Business:
NRC-IBD's research focuses on non-invasive medical diagnostic technology in: biosystems (non-invasive investigation techniques such as magnetic resonance and infrared spectroscopy used primarily for cancer, stroke and heart disease research); informatics (analyze and monitor complex biomedical data and bring resulting software to the market); magnetic resonance technology (develop magnetic resonance techniques and instruments to diagnose human disease and create protocols for the said techniques to solve medical and biological problems); and spectroscopy (develop infrared imaging methods to pursue similar goals as magnetic resonance technology). NRC-IBD also operates a prototyping facility and has two satellite location in Calgary (Alberta) and Halifax (Nova Scotia).

2004-2005 Total Expenditures: $18,300,000
Director General: Ian Smith
General Inquiries: (204) 984-4890 http://www.ibd.nrc-cnrc.gc.ca

Institute for Biological Sciences (NRC-IBS) – Ottawa, Ontario

Mission:
Conduct innovative research in neurobiology and immunochemistry of importance to the health and pharmaceutical sectors.

Core Business:
NRC-IBS encompasses two major research programs. The Neurobiology program develops applications related to therapies for neurodegenerative disorders through its six research groups, Cerebrovascular Research, Experimental Stroke, Neurogenomics, Neurogenesis and Brain Repair, Molecular Signalling, and Receptors and Ion Channels. The Immunochemistry program conducts molecular-level research, through a multidisciplinary team, that leads to the development of novel vaccines and immunotherapeutics. These are pursued through the Bioanalysis, Carbohydrate-Protein Systems, Vaccine Design, Infection and Immunity, Immunobiology, Molecular Pathogenesis and Pathogen Genomics Research groups.

2004-2005 Total Expenditures: $18,300,000
Director General: Gabrielle Adams
General Inquiries: (613) 993-5812 http://ibs-isb.nrc-cnrc.gc.ca

Institute for Marine Biosciences (NRC-IMB) – Halifax, Nova Scotia

Mission:
Serve Canada and the local community by developing and applying new knowledge in key areas of marine biosciences and biotechnology.

Core Business:
NRC-IMB's research targets aquaculture (fish and shellfish health, nutrition, and husbandry), natural toxins (analytical methods, toxin detection kits, and certified reference materials); and advanced technology development (genomics, bioinformatics, proteomics, advanced mass spectrometry). NRC-IMB houses the most automated DNA sequencing facility east of British Columbia, and has an advanced mass spectroscopy research facility and analytical chemistry capabilities considered amongst the strongest in North America. NRC-IMB is also home to CBR, a distributed collaborative computing environment dedicated to providing Canadian researchers with convenient, effective access to biotechnology-related databases and bioinformatics software tools.

2004-2005 Total Expenditures: $18,400,000 *(includes total expenditures for NRC-INH)*
Director General: Joan Kean-Howie
General Inquiries: (902) 426-8332 http://imb-ibm.nrc-cnrc.gc.ca

Institute for Nutrisciences and Health (NRC-INH) – Charlottetown, Prince Edward Island

Mission:
Serve Canada and local communities through excellence in research by developing and applying nutritional advances and discoveries to optimize health.

Core Business:
Research at NRC-INH will focus on how naturally-occurring compounds can benefit human and animal health. More specifically, NRC-INH scientists will study the impact of nutraceuticals and bioactives on neurologic-, obesity-related disorders; and infection and immunity. They will be involved in the identification and characterization of compounds with nutritional and health benefits as well as the targeted exploration of the genetic basis of differences in nutritional and health effects.

2004-2005 Total Expenditures: *included in Total Expenditures for NRC-IMB*
Director General: Joan Kean-Howie
General Inquiries: (902) 426-8332 http://inh-isns.nrc-cnrc.gc.ca

Plant Biotechnology Institute (NRC-PBI) – Saskatoon, Saskatchewan

Mission:
Perform, assist, and promote strategic discovery research and innovation in plant biotechnology in partnership with key stakeholders, to improve and diversify Canadian industry and strengthen Canada's competitive position in the global knowledge-based economy.

Core Business:
NRC-PBI is a major research centre for plant biotechnology in Canada, with expertise in transformation, promoters, gene expression, genomics, metabolic pathways, DNA sequencing, and biochemistry. The Institute's research is organized in three domains: strategic technologies, crop metabolic modification, and crop performance. NRC-PBI expertise includes brassica technology, cereal and legume biotechnology, gene expression, growth regulation, promoter technology, and seed oil modification.

2004-2005 Total Expenditures: $14,600,000
Director General: Kutty Kartha
General Inquiries: (306) 975-5568 http://pbi-ibp.nrc-cnrc.gc.ca

Construction

Institute for Research in Construction (NRC-IRC) – Ottawa, Ontario

Mission:
Develop and maintain the core competencies and the knowledge base critical to the needs of the Canadian construction industry; support the development, commercialization, and implementation of leading technologies; and foster the provision of a safe and sustainable built environment through the development of codes and standards.

Core Business:
NRC-IRC has three business lines: construction research, product evaluation, and development of construction codes and guides. The construction research program includes indoor environment (acoustics, thermal comfort, lighting use, and air quality); building envelope and structure (optimization of envelope performance and structural safety of buildings); urban infrastructure rehabilitation (improve the design, construction, operation, and maintenance of buried and surface structures); and fire risk management (assess risks and costs of fire safety options for buildings, economical and effective methods of fire resistance, detection, and suppression). Product evaluations are conducted by a national evaluation service that determines the suitability of innovative construction products and technologies. The Canadian Codes Centre (CCC) supports the development of the National Building Code and other national codes on which construction regulation across Canada is based.

2004-2005 Total Expenditures: $22,300,000
Director General: Bob Bowen
General Inquiries: (613) 993-2607 http://irc.nrc-cnrc.gc.ca

Information and Communications Technology Group

Institute for Information Technology (NRC-IIT) – Ottawa, Ontario and Fredericton, New Brunswick, Cape Breton, Nova Scotia.

Mission:
Create and commercialize new software and systems technology, strengthen software engineering practices in the private sector, and communicate, educate, and consult to help Canada prosper in the information age and knowledge economy.

Core Business:
NRC-IIT is a multi-site organization with facilities in Ontario, New Brunswick and Nova Scotia that are dedicated to research areas in interactive information (new communications models to help acquire and distribute knowledge and to find, organize, summarize, and navigate through information); software engineering (devise tools and techniques to help Canadian software companies); integrated reasoning (automate and improve aspects of corporate decision-making); network computing (research in highly connected computing and communications); visual information technology (lead innovation in 3D imaging, 3D information management for various applications); and e-business (e-commerce, e-health, e-learning, and e-government).

2004-2005 Total Expenditures: $19,200,000
Director General: Christian Couturier
General Inquiries: (506) 444-0393 http://iit-iti.nrc-cnrc.gc.ca

Institute for Microstructural Sciences (NRC-IMS) – Ottawa, Ontario

Mission:
Provide leadership, in collaboration with Canadian industry and universities, in the development of the strategic base for information technology; that is, in the development of enabling technologies related to future hardware requirements for information processing, transmission acquisition, and display.

Core Business:
NRC-IMS core competencies include: photonic device design and fabrication; semiconductor process development (organic and inorganic); thin film technology; nanotechnology; and acoustics. NRC-IMS will also house the NRC-CPFC whose primary goal is to support growth of the Canadian photonics sector by offering access to fabrication services to develop leading-edge devices.

2004-2005 Total Expenditures: $21,500,000
Director General: Marie D'Iorio
General Inquiries: (613) 993-4583 http://ims-ism.nrc-cnrc.gc.ca

Manufacturing Technologies Group

Institute for Chemical Process and Environmental Technology (NRC-ICPET) – Ottawa, Ontario

Mission:
Develop chemical process technologies and value-added materials to help Canadian industries improve the commercial viability and the efficiency of their processing operations, while improving their environmental performance and sustainability.

Core Business:
NRC-ICPET's core research capabilities are process technologies (interfacial technology, advanced diagnostics, separation technology, combustion research, and electrochemistry); functional materials (polymeric materials, energy materials, nanostructured materials, and materials characterization); and modeling and design (air quality modeling, computational fluid dynamics, environmental management, simulation, and visualization).

2004-2005 Total Expenditures: $9,300,000
Director General: Don Singleton
General Inquiries: (613) 993-3692 http://icpet-itpce.nrc-cnrc.gc.ca

Institute for Fuel Cell Innovation (NRC-IFCI) – Vancouver, British Columbia

Mission:
As the lead institute for the NRC Fuel Cell and Hydrogen Program, NRC-IFCI mobilizes fuel cell expertise and research strength from a network of six NRC institutes. The Institute also works in partnership with industry, university, and government stakeholders to build fuel cell technology clusters across Canada and support the innovation needs of Canadian fuel cell technology companies.

Core Business:
NRC-IFCI's core research program has four components: polymer electrolyte membrane fuel cells (design of membrane electrode assemblies, device and unit cell design, fuel cell catalysis, and characterization); solid oxide fuel cells (develop next generation cells and stacks that permit direct oxidation of practical hydrocarbon fuels containing sulfur and other impurities); system integration, testing, and evaluation (develop testing and evaluation protocols and contribute expertise and infrastructure to companies that have their own testing and evaluation requirements); and materials wear (rolling contact abrasion, erosion corrosion, sliding abrasion, and failure analysis).

2004-2005 Total Expenditures: $13,600,000
Director General: Maja Veljkovic
General Inquiries: (604) 221-3099 http://ifci-iipac.nrc-cnrc.gc.ca

Industrial Materials Institute (NRC-IMI) – Boucherville and Ville Saguenay, Quebec

Mission:
Promote the growth and competitiveness of Canadian industry through R&D activities related to materials processing technologies.

Core Business:
NRC-IMI conducts R&D efforts involving different materials such as metals (strip casting, electroplating, powder formulation and forming, die casting, semi-solid die-casting, and surface technology); polymers (polymer foams and films, injection and blow moulding, and electroplating); and ceramics (composition and forming processes of ceramics, and thermal spraying of ceramic coating). NRC-IMI has a virtual processing laboratory and is currently constructing the NRC Aluminium Technology Centre (ATC) that will support the development and implementation of a second and third aluminium transformation industry in Canada.

2004-2005 Total Expenditures: $26,000,000
Director General: Blaise Champagne
General Inquiries: (450) 641-5291 http://www.imi.nrc-cnrc.gc.ca

Integrated Manufacturing Technologies Institute (NRC-IMTI) – London, Ontario

Mission:
Be a leader in the R&D of integrated technologies for the manufacture of products and equipment.

Core Business:
NRC-IMTI's core competencies are in two areas: systems simulation and control (concurrent engineering, distributed manufacturing, medical device manufacturing, and modeling and visualisation); and production technologies (materials addition, precision fabrication, and shape transfer processes). NRC-IMTI houses the Virtual Environment Technologies centre that is dedicated to fostering the adoption of advanced visualization technologies by Canadian industries.

2004-2005 Total Expenditures: $9,600,000
Director General: Georges Salloum
General Inquiries: (519) 430-7092 http://imti-itfi.nrc-cnrc.gc.ca

Measurement

Institute for National Measurement Standards (NRC-INMS) – Ottawa, Ontario

Mission:
As Canada's NMI, the Institute provides the technical and infrastructural foundation for the national measurement system and thereby strengthens Canada's innovation and competitiveness, supports international trade, and advances social well-being of Canadians.

Core Business:
NRC-INMS conducts frontier metrology research to improve the accuracy with which measurements are made of fundamental quantities such as length, time, electric current, temperature, luminous intensity, and mass. The Institute's research is organized in three sections: electromagnetic and temperature standards, chemical and mechanical standards, and radiation standards and optics. In addition, NRC-INMS is Canada's official time keeper. Metrologists of the Frequency and Time group ensure that Canada's Atomic Clock is always precise and in conjunction with other atomic clocks around the world. NRC-INMS delivers Calibration Laboratory Assessment Services, in partnership with the Standards Council of Canada, to provide quality system and technical assessment services and certification of specific measurement capabilities of calibration laboratories.

2004-2005 Total Expenditures: $15,100,000
Director General: James McLaren
General Inquiries: (613) 998-7018 http://inms-ienm.nrc-cnrc.gc.ca

Molecular Sciences

Steacie Institute for Molecular Sciences (NRC-SIMS) – Ottawa and Chalk River, Ontario

Mission:
Provide leadership in collaboration with the Canadian and international scientific communities in the development of a knowledge base in molecular sciences and to ensure that it has a positive impact on Canada by being pro-active in its dissemination to our partners.

Core Business:
NRC-SIMS undertakes fundamental interdisciplinary research in molecular sciences (nanoscience, bioscience, and optical science) that have the potential to generate and transform the technologies of the future. NRC-SIMS has expertise in chemical synthesis, material characterization, understands the chemistry of biological processes, predicting materials properties, and use of femtosecond (10^{-15}s) lasers for optics and communications research and its research programs are functional materials, molecular

spectroscopy, neutron program for materials, femtosecond science, chemical biology, molecular interfaces, organimetallic and cluster chemistry, and theory and computation. NRC-SIMS administers the Canadian Neutron Beam Laboratory in Chalk River (Ontario) through the Neutron Program for Material Research.

2004-2005 Total Expenditures: $14,000,000
Director General: Danial Wayner
General Inquiries: (613) 991-5419 http://steacie.nrc-cnrc.gc.ca

Nanotechnology

National Institute for Nanotechnology (NINT) – Edmonton, Alberta

Mission:
Conduct molecular and nanoscale technology R&D and commercialization focusing on the following major sectors: nanobiotechnology, energy and materials, information and communication technology, and nanoengineering.

Core Business:
NINT is an integrated multidisciplinary research organization, which performs research at the nanoscale (10^{-9}m) in physics, chemistry, engineering, biology, informatics, pharmacy, and medicine. The first four research groups have been identified as nanoscale devices, materials, and interfacial chemistry, supramolecular nanoscale assembly and theory and modeling. NRC and the University of Alberta jointly operate the Institute.

2004-2005 Total Expenditures: $7,800,000
Director General: Nils Petersen
General Inquiries: (780) 492-8888 http://nint-innt.nrc-cnrc.gc.ca

Ocean Engineering and Marine Industries

Institute for Ocean Technology (NRC-IOT), formerly Institute for Marine Dynamics (NRC-IMD) – St. John's Newfoundland

Mission:
Conduct ocean engineering research through modeling ocean environments, predicting and improving the performance of marine systems, and developing innovative technologies that bring benefits to the Canadian marine industry.

Core Business:
NRC-IOT offers a unique set of knowledge, experience, skill sets, and facilities to Canada in the areas of offshore engineering and ship technology. The offshore

engineering research works to predict the offshore system performance in marine and ice environments. The ship technology research focuses on the prediction of forces on marine structures (ships, sailboats, submarines, remotely operated vehicles, and autonomous underwater vehicles) to ensure safety, manoeuvrability, and adequate powering.

2004-2005 Total Expenditures: $9,600,000
Director General: Mary Williams
General Inquiries: (709) 772-2469 http://imd-idm.nrc-cnrc.gc.ca

Support for Innovation and the National Science and Technology Infrastructure

Canada Institute for Scientific and Technical Information (NRC-CISTI) – Ottawa, Ontario with offices across Canada

Mission:
Support the research and innovation communities by managing and disseminating high-value scientific, technical, and medical information products and related services.

Core Business:
NRC-CISTI is one of the world's major sources for information in all areas of science, technology, engineering, and medicine. NRC-CISTI maintains Canada's scientific, technical, and medical information resources, provides access to these resources through state-of-the-art document delivery and current awareness services, and publishes and disseminates the results of Canadian and international research. NRC-CISTI is home to the NRC Research Press, Canada's largest scientific publisher.

2004-2005 Total Expenditures: $44,900,000
Director General: Bernard Dumouchel
General Inquiries: 1-800-668-1222 http://cisti-icist.nrc-cnrc.gc.ca

Industrial Research Assistance Program (NRC-IRAP) – Ottawa, Ontario with offices across Canada

Mission:
Stimulate innovation in SMEs.

Core Business:
NRC-IRAP is the Government of Canada's premier innovation and technology assistance program in support of Canadian SMEs. The Program delivers a client-centred mix of services and activities designed to help SMEs excel in the knowledge-based economy. Its extensive networks link entrepreneurs with local, national, and international sources of knowledge, technology, and financial resources. The Program also provides pre-

commercialization assistance and risk-sharing contributions for early-stage R&D. Its objectives are to increase the innovative capabilities of Canadian SMEs and to become the national enabler of technological innovation for Canadian SMEs.

2004-2005 Total Expenditures: $ 127,000,000
Director General: Tony Rahilly *(acting)*
General Inquiries: 1-877-994-4727 http://irap-pari.nrc-cnrc.gc.ca

Technology Centres

Canadian Hydraulics Centre (NRC-CHC) – Ottawa, Ontario

Core Business:
NRC-CHC is Canada's largest hydraulics and coastal engineering laboratory. It operates on a cost-recovery basis, providing physical and numerical modeling and analysis services in the hydraulics fields, with a specialization in coastal engineering, environmental hydraulics, and cold-region technology.

2004-2005 Total Expenditures: $1,300,000
Director: Etienne Mansard
General Inquiries: (613) 993-9381 http://chc.nrc-cnrc.gc.ca

Centre for Surface Transportation Technology (NRC-CSTT) – Ottawa, Ontario and Vancouver, British Columbia

Core Business:
NRC-CSTT operates on a cost-recovery basis, providing a unique expertise and facilities to improve the productivity, competitiveness, reliability, and safety of rail and road transportation equipment and systems. The Centre's expertise is in vehicular engineering R&D, computer modeling and analysis, field testing, climatic simulation, and vehicle performance.

2004-2005 Total Expenditures: $3,300,000
Director: John Coleman
General Inquiries: (613) 998-9639 http://cstt-ctts.nrc-cnrc.gc.ca

Corporate Branches

Administrative Services and Property Management Branch (NRC-ASPM)
Director General: Subhash Vohra
General Inquiries: (613) 993-2440 subash.vohra@nrc-cnrc.gc.ca

Corporate Services Branch (NRC-CS)
Director General: Don Di Salle
General Inquiries: (613) 993-0361 don.di_salle@nrc-cnrc.gc.ca

Finance Branch (NRC-FB)
Director General: Daniel Gosselin
General Inquiries: (613) 990-7471 daniel.gosselin@nrc-cnrc.gc.ca

Human Resources Branch (NRC-HRB)
Director General: Mary McLaren
General Inquiries: (613) 993-9391 mary.mclaren@nrc-cnrc.gc.ca

Information Management Services Branch (NRC-IMSB)
Director General: Andy Savary
General Inquiries: (613) 991-3773 andy.savary@nrc-cnrc.gc.ca