CRTI - IRTC

PART I

DELIVERING CAPABILITIES

CRTI ANNUAL REPORT 2004–2005

Defence Research and Development Canada
Recherche et développement pour la défense Canada

Canada

The mission of CRTI is to strengthen Canada's preparedness, prevention and response to CBRN terrorist attack through science and technology.

Our vision is to be recognized as the Canadian authority in CBRN counterterrorism knowledge, expertise, and science and technology.

LETTER FROM THE CHAIR

As the Chemical, Biological, Radiological, and Nuclear (CBRN) Research and Technology Initiative (CRTI) enters the fourth year of its first five-year mandate, the program is resulting in field-ready products and technologies. Under the federal science and technology (S&T) leadership of CRTI, strategic investments in targeted risk areas have contributed to considerable gains in Canada's collective knowledge and capabilities to respond to a CBRN attack.

In 2004–2005, CRTI Research and Technology Development (RD) and Technology Acceleration (TA) projects have shown that collaborative efforts among federal government, academic, and industry partners can successfully leverage different areas of expertise toward a common goal. Technology acquisitions made this year will also improve the capabilities of federal laboratories in responding to a domestic CBRN incident. As more projects are completed and deliver additional capabilities, CRTI will reassess and address remaining gaps in our CBRN preparedness.

CRTI continued to build links between diverse communities. In 2004, United States representatives observed CRTI's second major exercise, Exercise Follow On, which brought us closer to achieving the goal of greater interoperability and integration of response plans and activities. In the future, CRTI intends to participate in a number of collaborative projects with the US under the auspices of the Canada–US Public Security Technical Program. CRTI also participated in significant community building with the United Kingdom, which has been formalized in a new Memorandum of Understanding for participation in radiological-nuclear counterterrorism scientific research. Established this year, the new Forensic Laboratory Cluster is expected to bridge gaps with laboratories dedicated to forensic science. As relationships with federal laboratories continue to solidify, CRTI anticipates that its focus will evolve to partnerships with first responders. The microbial sampling library and the decontamination work of the Chemical Laboratory Cluster are expected to develop new links with the S&T and first responder communities.

The threats that face Canada and its citizens are not future considerations—they are today's reality. In recent months and years we have seen the dramatic effects of terrorism in New York, Madrid, and London. The emergence of new diseases and the possibility of new pandemics further underscore the need for a broad and resilient approach to national safety and security. Published in April 2004, *Securing an Open Society: Canada's National Security Policy* contains several measures to improve Canada's security system in six key areas: intelligence, emergency planning and management, public health, transport security, border security, and international security. CRTI is now delivering on its mandate to provide outcomes that support the National Security Policy (NSP) and increase the security of Canadians through S&T innovation. Most significantly, CRTI has been able to examine the full spectrum of requirements for effective preparedness and response, from improved communications through to public confidence and psychosocial issues. Through scientific leadership, CRTI will continue to engage our partners and improve Canada's S&T infrastructure.

I am pleased to provide you a review of our successes through this third edition of the *CRTI Annual Report*. I would like to extend my thanks to all CRTI partners and staff whose efforts have sustained and advanced the objectives of this initiative.

Robert S. Walker
Chair CRTI Steering Committee,
Assistant Deputy Minister (Science and Technology), Department of National Defence,
Chief Executive Officer, Defence Research and Development Canada

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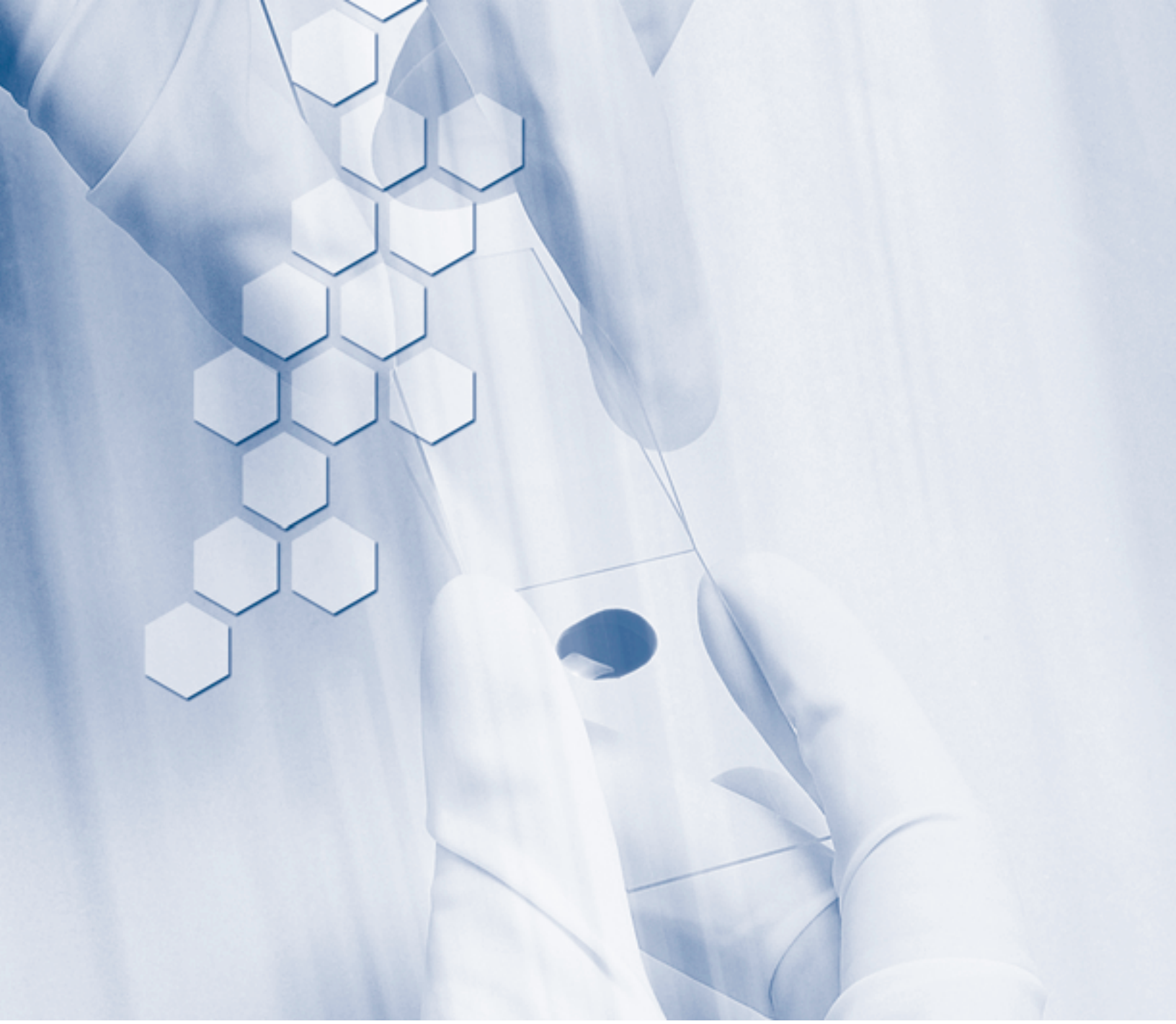

PART I DELIVERING CAPABILITIES

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1. INTRODUCTION

The Chemical, Biological, Radiological, and Nuclear (CBRN) Research and Technology Initiative (CRTI) is mandated to strengthen Canada's preparedness for, prevention of, and response to a CBRN terrorist attack through investments in science and technology (S&T). Since its launch in 2002, CRTI has issued four calls for proposals and has invested approximately $136 million of its $170 million 5-year budget in projects aimed at closing S&T gaps in knowledge and capabilities.

CRTI's success is rooted in its unique, cross-organizational model that continually provides new opportunities for knowledge sharing across organizations and disciplines. Comprised of 17 federal government departments and agencies, CRTI extends its reach to first responders, provincial governments, and academic, industrial and international partners. Work produced with the support of CRTI has gained national and international recognition within the S&T and security communities and has resulted in significant gains in Canada's CBRN response capabilities.

This annual report charts CRTI's progress and critical factors contributing to its success during its third fiscal year, 2004–2005. The structure and content of this report reflect the Results-based Management and Accountability Framework (RMAF), CRTI's blueprint for planning, measuring, evaluating, and reporting on the progress and results of the initiative throughout its life cycle. This report draws on the RMAF's measures and anticipated outputs to chart CRTI's activities during the last year. Corollary information, including financial data, is provided in appendices to this report.

1.1 Mandate and Key Activities

CRTI's mandate is to improve Canada's ability to respond to CBRN incidents by strengthening the coordination and collaboration of capacity, capabilities, and research and technology plans and strategies. It does this by

- creating clusters of federal laboratories as elements of a federal laboratory response network that will build S&T capacity to address high-risk terrorist attack scenarios;
- funding research and technology to build S&T capability in critical areas, particularly those identified in the scenarios that address biological and radiological attack;
- accelerating technology for the benefit of the first responder community and other operational authorities; and
- providing funds to those areas where national S&T capacity is deficient owing to obsolete equipment, dated facilities, and inadequate scientific teams.

CRTI manages six key activities:

1. *Creating laboratory clusters* and building an S&T response network for CBRN events.
2. *Building S&T capability* by funding research to build Canadian science capacity in targeted investment areas.
3. *Accelerating technology to first responders* by channelling funding into technology already under development, thereby facilitating timely adoption of new technologies by first responders.
4. *Funding national S&T capacity* by enhancing federal laboratory equipment and facilities.

5. *Building horizontal capability* by leveraging federal government expertise and non-traditional partners, thereby enhancing S&T capacity of Canada.
6. *Building CBRN S&T expertise and knowledge* in national and international CBRN communities.

Progress in each of the six key activities is described in Section 4.

1.2 CRTI Investment Priorities

Investment priorities are determined through analysis of the risk compared with capability and capacity, and the technology requirements and response gaps of first responders and the laboratory clusters. By the end of its third year, CRTI had created and funded 109 projects, 9 of which have been completed, in support of these priorities.

The table below indicates the mapping of the projects against the investment priorities. "Pan" projects that cover multiple hazard and target areas, or address broader response dimensions, are sorted by the primary and secondary capability to be provided by the project.

2. CRITICAL SUCCESS FACTORS

Three critical factors contributed to CRTI's success in 2004–2005:

- **International linkages:** CBRN threats are a global reality requiring collaborative and coordinated response frameworks. CRTI's international connections contributed to its ability to integrate and leverage its efforts in the context of global progress in S&T. Through its work with the Public Security Technical Program (PSTP) and other activities, CRTI continued to build stronger relationships with its United States (US) counterparts and contribute to improved preparedness. CRTI's community building efforts with the United Kingdom (UK) in 2004–2005 also expanded the reach of CRTI.
- **Linkages with the first responder community:** In its first two years, CRTI focused on the development of laboratory clusters and international partnerships to enhance federal CBRN preparedness and response. With the laboratory clusters firmly entrenched in 2004–2005, CRTI established closer linkages

	Number of Projects			
Investment Priority	**Biological**	**Chemical**	**RN**	**Total**
Cluster Management and Operations	4	1	2	7
Command, Control, Communications, Coordination and Information (C^4I) for CBRN Planning and Response	5	4	6	15
S&T for Training and Equipping First Responders	6	7	5	18
Prevention, Surveillance, and Alert	9	2	8	19
Immediate Consequence Management	15	11	10	36
Long-Term Consequence Management	7	5	5	17
Criminal Investigation Capabilities	3	2	3	8
S&T Dimensions of Risk Assessment	2	0	2	4
Public Confidence and Psychosocial Factors	2	2	2	6

with first responders through its Summer Symposium and other means to ensure that federal S&T remains aligned with the needs of this key community. Lessons learned from interactions with first responders directly inform CRTI decision making and ensure the continued relevance of the Initiative.

- **Exercises:** CRTI exercises provided unparalleled opportunities for CRTI partners to test their plans and capabilities and train participants in various aspects of CBRN response. These training opportunities enhanced cooperation and knowledge sharing between CRTI partner departments and first responder communities and were key in highlighting areas requiring further work and collaboration.

3. AUDIT RESULTS

3.1 Report of the Auditor General of Canada

In April 2005, the Auditor General of Canada released the second of two audit reports on the federal government's National Security Enhancement Initiative. One of the main objectives of the report was to determine whether the federal government's emergency preparedness programs, including CRTI, are adequately managed.

Overall, the results were very encouraging for CRTI. The report analyzed CRTI's mandate and reported the following findings:

- Of the $27.5 million in total funding allocated to acquiring technology in federal laboratories, CRTI committed 77 percent in the first two years to addressing the gaps identified in federal laboratory capacity.
- According to a Health Canada study of how member laboratories of the Biological Laboratory Cluster functioned during the September 2003 Severe Acute Respiratory Syndrome (SARS) crisis, the clustering of laboratories improves the response to an emergency. The study noted that more rapid analysis, and therefore more rapid prevention and mitigation measures, were possible because the cluster members involved in the incident were aware of the capacity and capabilities outside of their organizations that they could call on to assist during the incident.
- CRTI's Consolidated Risk Assessment, the tool through which CRTI identifies gaps in S&T, knowledge, and capabilities that ultimately guide the annual selection of projects, was found to be an acceptable assessment tool.

The report also identified a need for more integrated and coordinated emergency response strategies among federal agencies. Prior to the release of the report, CRTI had already begun a collaborative initiative with Public Safety and Emergency Preparedness Canada (PSEPC) to develop national CBRN equipment standards. Work in this and related areas is intended to strengthen CRTI's coordination with its partners.

3.2 CRTI Independent Financial Management Audit

CRTI is required by the Treasury Board of Canada Secretariat (TBS) to conduct independent financial management audits every two years. The first audit was conducted in July and August 2004 and covered CRTI's first two fiscal years, ending 31 March 2004. The audit was aimed at ensuring that

- CRTI funds are managed in accordance with the *Financial Administration Act* (FAA), TBS policies and guidelines, and departmental or other organizational resource management policies;
- information to support reporting, performance monitoring, and management decision making is both accurate and adequate; and
- the processes in place to support investment and distribution of CRTI funds, project procurement and monitoring, and CRTI financial oversight are effective and efficient.

The results of the review were favourable. CRTI has met all of the criteria against which it was measured, and the recommended actions for improvements have been completed or are underway. Key findings included the following:

- **Authorities:** The locations visited had established authorities that were appropriately delegated and clearly defined.
- **Contracting policies:** The locations visited had established contracting policies in accordance with TBS policy and departmental policies.
- **Matching funds:** It was recommended that
  - each location should determine a common definition and valuation methodology of in-kind contributions to improve the comparability of projects; and[1]
  - each location should establish a tracking system for in-kind contributions and they should be included in quarterly reporting.
- **FAA requirements and document retention:** FAA requirements were met and documents were retained.
- **Payments:** Based on the sample transactions, payments were accurate and made in a timely manner with a few exceptions, which have been addressed.
- **Records:** CRTI expenditures are recorded accurately and consistently.
- **Funds management and monitoring:** CRTI Secretariat Finance Officers track interdepartmental settlement transfers and adequately monitor suspense accounts used to flow funding to lead departments.
- **Reporting:** CRTI gathers information on CRTI-funded activities through quarterly reporting (for Technology Acceleration [TA] and Research and Technology Development [RD] projects only), contributions from third parties, a final completion report, and a project review committee presentation. These reports ensure that the CRTI Secretariat is informed of the progress of projects on an ongoing basis.

4. CRTI KEY ACTIVITIES 2004–2005

In its third year, CRTI began delivering the capabilities developed in its second year through its six key areas of activity.

4.1 Building Laboratory Clusters

Established in 2002–2003, CRTI's Biological, Chemical, and Radiological-Nuclear (RN) Laboratory Clusters are unique fora for dialogue and discussion in the federal S&T community, focusing on the joint needs of scientific labs and the operational community with respect to addressing CBRN terrorist attacks. Through each cluster, representatives from federal departments

[1] The Memorandum of Understanding (MOU), which enables the exchange of funds between CRTI and member departments, will be updated to include common definitions of in-kind contributions along with other required changes in 2006–2007.

and laboratories share their ideas, knowledge, experience, and resources, and discuss shared challenges and possible S&T solutions to issues. Such discussions benefit from the knowledge that each member brings to the collective and provides the opportunity for valuable synergies.[2]

In order to become more operationally focused and promote cross-cluster initiatives, CRTI established a fourth cluster in 2004–2005: the Forensic Laboratory Cluster. This cluster will be eligible for Technology Acquisition awards in April 2005, and is expected to play a key role in upcoming exercises.

4.1.1 Outputs

Implementing the Clusters

The Biological Laboratory Cluster reviewed its core membership and concluded that three key laboratories drive the cluster and will carry forward the cluster's activities: the Canadian Food Inspection Agency (CFIA), the Public Health Agency of Canada (PHAC), and Defence Research and Development Canada (DRDC). Organizational changes among members, including the creation of the PHAC, PSEPC, and the Canada Border Services Agency (CBSA) will require the development of new procedures. The cluster has prepared a first draft of an updated Cluster Implementation Plan and intends to finalize the document in 2005–2006. The cluster membership list will be updated as part of the Cluster Implementation Plan.

The Chemical Laboratory Cluster added provincial representation in 2004–2005: Ontario's Centre of Forensic Sciences first joined the Chemical Cluster as an affiliate member. The cluster also welcomed new membership from participating departments.

Formed in February 2005, the Forensic Laboratory Cluster held its first cluster meeting and established its objectives. A cluster workshop is planned for the fall of 2005, during which participants will map out a response to a CBRN mixed-threat scenario. The cluster intends to identify gaps and priorities for S&T support in 2005–2006.

While the RN Laboratory Cluster experienced no significant changes in membership, the cluster was joined by PSEPC in 2004–2005 and provinces possessing nuclear facilities joined as affiliate members. One laboratory in Ontario and one in British Columbia (BC) were also integrated into the cluster as affiliate members.

Supporting Operational Readiness

Cluster Exercises

Cluster exercises were held in 2004–2005 to test cluster plans, procedures, and equipment. These invaluable exercises highlighted participants' strengths and areas for improvement.

Hands-On Exercise Tests Knowledge of Forensic Sampling

In November 2004, the CRTI Biological and Chemical Laboratory Clusters held a training exercise at the Counter Terrorism Technology Centre (CTTC) located at DRDC Suffield. The objective of the exercise was to provide CRTI member departments with the opportunity to participate in an interdepartmental field activity to enhance their knowledge and improve their capabilities in taking forensic samples for evidentiary purposes. Thirty-five participants and observers came from the CFIA, Environment Canada, Health Canada, DRDC, the Royal Canadian Mounted Police (RCMP), Calgary Fire Department, CBSA and PSEPC.

[2] Cluster objectives and membership are provided in Annex C.

Following briefings by first responders and forensic experts, participants and observers were given a terrorist incident scenario and asked to gather and package samples, pass through the decontamination process, take notes, and prepare to present samples to laboratories for analysis. The participants were divided into three work groups according to their areas of expertise: human, environmental, and animal health.

This valuable training exercise brought together a wide range of representatives and organizations, and participants gained an appreciation of the strengths and limitations of their counterparts in conducting sampling work. Their work together in the field exercise established familiarity, respect, and confidence between the partner organizations—a solid basis for team building and networking. During the exercise, participants shared their knowledge about preparedness levels, protocols, and hazard assessment. They learned about the effective use of personal protective equipment (PPE), decontamination procedures, and evidence gathering techniques. The simulation also provided an opportunity to practise and discover areas for improvement before an emergency occurs, such as the need for communications training or supplemental equipment. Many of the participants recognized that there was a need to enhance their existing emergency contingencies based on the lessons learned during the fieldwork.

It was recommended that a follow-up exercise of similar size and scale be conducted and include many of the same participants. The participants also identified needs for more guidance on the roles and responsibilities of all levels of government in response to bioterrorism incidents and an improved understanding of interdepartmental mobilization mechanisms. Similar exercises were recommended to enhance cooperation and knowledge sharing between CRTI partner organizations and the first responder communities.

Expert Technical Teams Detect Radioactive Materials

In February 2005, expert technical teams from DRDC, the Director General Nuclear Safety (DGNS), Health Canada, Natural Resources Canada (NRCan), the Canadian Nuclear Safety Commission (CNSC), Atomic Energy of Canada Limited (AECL), and the RCMP participated in the second of a series of exercises at DRDC Suffield aimed at developing and testing response to radiological terrorism. More than 65 participants attended Exercise Follow On (EXFO), including three evaluators from a US Department of Energy (DOE) lab. This made EXFO the largest exercise using unsealed radiological sources ever held in Canada.

The exercise enabled various teams to respond as a unit to locate, identify, characterize and secure sources of radioactive materials. The teams used a specially equipped helicopter to detect radioactive sources from the air and estimate their locations on the ground. Ground teams then fanned out with support from a recently acquired Mobile Nuclear Laboratory. Later, irradiated *in vitro* blood samples were shipped to Ottawa for analysis at DRDC Ottawa and Health Canada. The National Support Centre in Ottawa (control centre under the *Federal Nuclear Emergency Plan* [FNEP]) received near real-time data from Suffield.

Conducted under strictly controlled conditions with thorough safety controls and procedures, EXFO marked the second time that the technical teams worked together, building upon lessons learned at the 2004 Exercise As Is. It successfully demonstrated a new command and control structure, new communications infrastructure, use of digital imaging, and integration of airborne and ground teams. It also identified improvements needed for future exercises, such as better documentation and improved integration with first responders and forensic investigators.

Smuggling Exercise Puts Radiological and Nuclear Labs to the Test

Canada became the tenth country to participate in an international exercise designed to evaluate and improve the techniques used by nuclear forensic laboratories following an invitation by the Nuclear Smuggling International Technical Working Group in 2004. As a first-time participant in a scenario simulating the apprehension of illegally trafficked nuclear material, Canada used the exercise to assess how well its radiological and nuclear laboratories work together, to evaluate their capacity to identify the source of confiscated nuclear materials, and to address any shortcomings in their response.

Coordinated by DRDC Ottawa, the response exercise involved nuclear forensic laboratories at DRDC Ottawa, the CNSC, Health Canada's Radiation Protection Bureau, the Royal Military College of Canada (RMC), the University of Alberta, and DRDC Atlantic. The RCMP non-nuclear forensic lab was also included to test the link between law enforcement responders and the nuclear laboratories.

In the scenario, the labs were told that a man had been stopped at the border between Luxembourg and Germany in possession of two small vials of highly enriched uranium oxide powder. They were then given a package that contained the vials as well as non-nuclear forensic evidence, such as fingerprints, pollen seeds, the plastic shopping bag holding the evidence, and a beer-stained coaster with a handwritten map on the back. They were expected to determine the nature and origin of the suspect material, and establish a reputation for their ability to do so in the process.

In keeping with the requirements of a nuclear analysis, the labs reported on their findings 24 hours, one week, and two months after receiving the material. Canada proved itself on par with the other nine participating countries in terms of its ability to identify the material and provide a reasonable interpretation of the data. At the same time, this first-ever exercise identified room for improvement in such areas as chain of custody issues, the speed with which labs issue their reports, and the need for protocols for handling radioactively contaminated forensic evidence. The labs are confident that participation in future inter-laboratory comparisons will address these performance concerns and ensure that individuals and organizations responsible for responding to a real nuclear incident are more than well prepared.

- Members of the Chemical Laboratory Cluster received chemical warfare analysis training at DRDC Suffield in October 2004. This is an annual three-day laboratory training course in which participants are trained in chemical warfare agent laboratory handling and analysis. Affiliate members joined core members as participants in 2004.
- Also in October 2004, the Chemical Laboratory Cluster participated in the Western Hemisphere Procurement Conference hosted by the Canadian Government Commercial Corporation in Vancouver, BC.
- In November 2004, the Chemistry Portfolio Manager led a mission of Canadian companies and researchers to Washington, DC, to attend the 4th Global Homeland Security Conference and Trade Show and to Vancouver to attend a Western Hemisphere Government Procurement Conference. In February 2005, the group attended the Ontario First Responders CBRN Preparedness Conference and Trade Show.
- To rapidly identify radiation-exposed individuals so that medical intervention could be targeted to those individuals needing the greatest attention in an emergency situation, the RN Laboratory Cluster developed a National Biological Dosimetry Response Plan (NBDRP). A Biology Dosimetry Response exercise was subsequently held at DRDC Ottawa in October 2004 to test the NBDRP protocols, establish analysis capacity, and test the cluster's ability to accurately predict exposure doses. The exercise highlighted areas of potential complications that led to modifications of the existing protocols and recommendations for further testing of the nascent NBDRP network.

- In November 2004, the RN Laboratory Cluster participated in two tabletop exercises as part of a conference with PSTP personnel. The two scenarios proved useful and highlighted areas for consideration, including border issues.
- Also in November 2004, the RN Laboratory Cluster co-sponsored a workshop held at the Lawrence Livermore National Laboratory (LLNL) in California on nuclear emergency preparedness and response. The three-day event was attended by more than 120 participants, among them world-renowned S&T experts and observers from Australia and the UK. On conclusion of the workshop, participants offered approximately 20 different ideas for collaborative projects.

Providing S&T Advice and Expertise

CRTI Secretariat and cluster members were invited to share their expertise with universities, federal departments and agencies, federal/provincial/territorial (FPT) committees, and international associations and governments in 2004–2005. They covered a range of topics, including knowledge management, risk assessment, the PSTP, and the characterization of radiological dispersal devices (RDDs). CRTI was invited to introduce the CRTI model to audiences in Riga, Latvia; Istanbul, Turkey; Manchester, UK; and Geneva, Switzerland. These activities enable CRTI members to increase the outreach of the initiative and participate in the ongoing national and international CBRN dialogue.

Developing Standards, Evaluations, and Certifications

CBRN Equipment Standards

Driven by requirements articulated by the first responder community, CRTI is collaborating with PSEPC to develop national CBRN equipment standards in Canada. The purpose of this initiative is to provide first responders and the operational community in Canada with direction and guidance to make informed decisions on CBRN equipment acquisitions, response procedures, and protection. The resulting standards will cover the spectrum of equipment, including PPE (respiration and clothing), detection, identification and quantification, and decontamination.

CRTI and PSEPC are currently developing a framework to guide work in this area in cooperation with all key stakeholders, including other federal government departments, provinces and territories, the US Department of Homeland Security (DHS), industry, standards development organizations, and first responders. CRTI and PSEPC will also provide support for the building of a testing and evaluation capability at the CTTC in Suffield, Alberta, for use by the first responder community, governments, and industry. This facility will reside at the CTTC and will be used to evaluate equipment against live CBRN agent materials.

Standard Operating Procedures for Chemicals of Interest

Periodic and formal reviews of chemicals of interest are conducted to identify potential threats and support a broadly based consciousness of global risk. The Chemical Laboratory Cluster intends to complete its collection and review of draft standard operating procedures (SOPs) for various chemicals of interest in 2005–2006.

Developing and Managing CBRN S&T Knowledge

The CRTI intranet portal, launched in June 2003, is continually updated to provide first responders and the S&T community with useful reference materials and CRTI project information. The intranet portal will continue to be expanded with materials of interest to members of the CBRN community.

Fully functioning, field-tested radiation detector

4.1.2 Alignment with Intermediate Outcomes

Through their organization of and participation in cluster exercises, cluster members support innovative cross-organizational collaborations and new means of testing products and procedures. Efforts to contribute to the development of national standards similarly ensure maximum benefits of innovative industrial products developed for the benefit of first responders. Participation by the CRTI Secretariat and Cluster members in CBRN conferences and other fora reflect CRTI's commitment to contributing to and expanding the knowledge base on CBRN countermeasures.

4.2 Building S&T Capability

RD projects must close existing gaps in capabilities and capacities of the S&T and operational communities in order to enable effective response to future CBRN incidents. CRTI builds S&T capability through collaboration with industry, government, and academia. RD projects require the involvement of at least two federal partners, and are completed within three to four years of funding approval. Typically, funding awards are in the $3 million to $10 million range.

4.2.1 Outputs

Completed Projects

Breakthrough Radiation Detector Reduces the Risk of Contamination to First Responders

The recent success of government and industry scientists in developing a "standoff" radiation detector able to detect radiation from a distance marks a breakthrough in contamination avoidance S&T that will be of great benefit to the health and safety of first responders. Unlike existing radiation detectors that require first responders to stand close to the hazard—where the risk of contamination through inhalation or ingestion is greatest—to directly detect the level of radiation, the new radiation detector uses indirect detection to safely measure radiation far away from the source. Scientists developed a field-ready model that enables first responders to detect a radiation field and identify areas of high and low radiation levels at a distance, reducing their exposure to the hazard. The team is looking to advance the model through a series of field trials scheduled to begin in June 2005 at Pacific Northwest National Laboratory, one of nine US DOE national multiprogram laboratories.

CRTI 0203RD: Standoff Detection of Radiation
Project Lead: DRDC Ottawa
Federal Partners: Health Canada, AECL
Industry Partner: Bubble Technology Industries

New Research Brings the Goal of a Fast-Acting, Chemical-based Radioactive Contamination Sensor Closer to Reality

A team of radiation detection experts has developed a sensor intended to instantly provide visible evidence of radioactive contamination. Still in the early stages of development, the Bubble Detector Film is designed to assist first responders entering an area suspected of contamination to automatically indicate the presence of low levels of radiation, especially alpha and beta emissions, freeing them up to carry out other essential tasks. The project team succeeded in developing an early-stage or laboratory model of the Bubble Detector Film. Still slightly bulky, the sensor device needs further development before it can be used in the field. In its final packaged form, the Bubble Detector Film is expected to be credit-card slim and made into a disposable strip with an adhesive backing that will stick to the pant leg or boot of a first responder. Before the Bubble Detector Film can be packaged for field use, however, the team must first shorten its reaction time. Because of its potential to identify radioactive material quickly and easily, the team is determined to continue pushing ahead.

CRTI 0204RD: Bubble Detector Film
Project Lead: DRDC Ottawa
Federal Partners: Health Canada, AECL
Industry Partners: Bubble Technology Industries

Polymer-based Biosensor Proves It Can Detect Genetic Material in Biological Warfare Agents

Researchers from the public and private sectors worked to prove that a biosensor using cationic, or positively charged polymers, could rapidly detect and identify biological agents that may be used as weapons by terrorists. The biosensor detects the genetic material in a disease-causing biological agent based on the recognition of nucleic acids, specifically deoxyribonucleic acid (DNA), without the use of the more traditional and time-consuming polymerase chain reaction (PCR) method. The project team succeeded in directly detecting the *Bacillus anthracis* bacterium on almost 300 copies of microbial DNA molecules in about 10 minutes. Given the biosensor's potential to save many lives by saving time—anthrax, for example, is highly treatable if detected early—work has already begun to move the biodector from the research lab to testing under real-world conditions. Once fitted into a low-cost, portable device, first responders will be able to quickly and easily detect and identify the presence of biological warfare agents on-site in minutes.

CRTI 02-0021RD: Direct Detection and Identification of Bioweapons Nucleic Acids Based on Cationic Polymers
Project Lead: National Research Council (NRC)—Industrial Materials Institute
Federal Partners: NRC—Steacie Institute for Molecular Sciences, Health Canada
Industry Partners: Centre hospitalier universitaire du Québec, Infectious Diseases Research Centre, Laval University, Infectio Diagnostic Inc.

Outputs of Projects in Progress

The following table provides highlights of the outputs achieved in ongoing R&D projects in 2004–2005.

RD Project Outputs 2004–2005

Project	Lead/Partners	Objective	Key Outputs
CRTI 0006RD: Rapid Induction of Innate and Specific Immunity of Mucosal Surfaces	• Health Canada • CFIA • Veterinary Infectious Disease Organization (VIDO), University of Saskatchewan • McMaster University	To develop novel formulations and procedures that provide short-term protection to the airways and intestines against various organisms that may be used in bioterrorism and to develop vaccines that can provide long-term immunity.	Recent laboratory work has provided valuable interactions of Cytosine-phosphate-Guamine (CpG) with cellular pathways.
CRTI 027RD: Biological Dosimetry and Markers of Nuclear and Radiological Exposures	• Health Canada—Radiation Protection Bureau • DRDC Suffield • DRDC Ottawa • McMaster University—Institute of Applied Radiation Sciences	To establish an NBDRP and develop rapid methods of radiation exposure assessment to increase throughput in large-scale events.	Novel cytogentic techniques, flow cytometry assays and biomarkers of radiation exposure were developed to improve biological dosimetry and long-term radiation risk assessments. An NBDRP was also created that increased CRTI's original capabilities from 4 scientists in 4 labs to more than 30 scientists in 18 labs across the country. Initial operational capabilities were tested and validated during CRTI exercises.
CRTI 0029RD: Protecting the First Responder Against CB Threats	• RMC • Health Canada • Department of National Defence (DND)—Directorate of Nuclear, Biological and Chemical Defence (DNBCD) • DRDC Suffield • RCMP • 3M Canada • DuPont Canada • Med-Eng Systems Inc.	To address the issues in individual protection faced by the first responder community in planning for and responding to a chemical or biological (CB) event.	Four publications on PPE requirements of first responders to chemical, biological, and radiological release scenarios were generated. Work is underway with the American standards development organizations, the National Institute for Occupational Safety and Health (NIOSH), the National Fire Protection Association (NFPA), and the advisory committees of two Canadian international standards organizations.

Project	Lead/Partners	Objective	Key Outputs
CRTI 0064RD: New Technologies for Surveillance of Biowarfare Agents and Identification of Engineered Virulence Genes	• Health Canada • University of British Columbia • DRDC Suffield	To rapidly identify engineered genes embedded in biowarfare strains in order to tailor therapy and develop surveillance strategies.	Researchers determined that the 2Dimensional Bacterial Genome Display (2DBGD) and Bacterial Comparative Genome Hybridization (BCGH) techniques can reproduce bacterial fingerprints from strains with varying percentages of Guanine + Cytosine (G+C). The techniques can also be used to identify genetic variations between closely related strains.
CRTI 0072RD: Nanodosimeters Based on Optically Stimulated Luminescence (OSL)	• DRDC Ottawa • Health Canada • University of Toronto • Bubble Technology Industries	To produce an OSL-based micro-osimeter that provides a detailed map of contamination patterns with integrated readout, analysis, communications, and Global Positioning System (GPS) electronics.	Work to redesign the prototype to integrate communications and GPS electronics was undertaken. Steps to optimize the operation of the Avalanche Photodiode (APD) were also initiated. The second generation minidosimeter prototype is nearing completion.
CRTI 0087RD: Therapeutic Antibodies for Ebola and Marburg Virus	• Health Canada • CFIA • Cangene Corporation • University of Alberta—Pharmaceutical Sciences	To develop monoclonal and polyclonal antibodies for unique diagnostics and therapeutics against Ebola and Marburg viruses and to develop recombinant monoclonal antibodies for a long-term solution.	Monoclonal antibodies against Ebola virus antigens were produced and characterized. The methodology to clone, express, and purify moderate amounts of non-glycosylated Ebola antigen was developed. Two potential monoclonal antibody candidates were identified for treatment against Ebola and Marburg viruses.
CRTI 0091RD: Development of Recombinant Monoclonal Antibodies for the Treatment and Detection of Bioterrorism Agents	• Health Canada • CFIA • University of Toronto • DRDC Suffield	To develop monoclonal antibody-based therapeutics and diagnostic reagents for biological agents and to identify candidate immunogens for vaccine development against them.	Polyclonal rabbit antisera to anthrax toxin components were produced and are being tested. Reagents have been developed and used, and diagnostic tests are being developed and evaluated. A monoclonal antibody to foot-and-mouth disease (FMD) viruses was shared with the CFIA for diagnostic development and testing.

Project	Lead/Partners	Objective	Key Outputs
CRTI 0120RD: Development of a Novel Molecular Imprinting Methodology for Sensing Applications	• NRC • DND—DNBCD • DRDC Suffield • Memorial University of Newfoundland	To enhance the capabilities of first responders to determine the presence of harmful agents in the environment.	A thin-film molecular imprinting methodology was developed to increase the density of recognition cavities in molecularly imprinted polymer devices and to enhance detection sensitivity. Researchers described a novel method for molecular imprinting involving self-assembled monolayers and microspectroscopic techniques for the characterization of the specificity of binding.
CRTI 0133RD: New Technologies for Rapid Assessment of Radioactive Contamination	• Health Canada • NRC • Trent University	To allow greater capability to screen samples and provide results quickly following an RN terrorist attack, thereby helping to mitigate the health, economic, and environmental impacts of such an event.	Rapid methods to measure plutonium and other actinides in biological samples were developed.
CRTI 0154RD: Rapid DNA-based Diagnostic Tests for Two Biological Agents	• DRDC Suffield • Health Canada • Université Laval—Infectious Diseases Research Centre • Infectio Diagnostic Inc.	To develop rapid molecular diagnostic assays for *Yersinia pestis* and *Francisella tularensis*. These assays will identify the agents in hours rather than days as is the current situation.	Developed rapid first generation assays for the identification of *F. tularensis* and *Y. pestis* that achieve very high specificity and sensitivity. Implemented partnerships and mechanisms to enable Canada to respond more readily to an attack using these bacteria.
CRTI 02-0024RD: Probabilistic Risk Assessment Tool for Radiological Dispersal Devices	• DRDC Ottawa • CNSC • PSEPC • University of Ontario Institute of Technology • Science Applications International Corporation (SAIC) Canada • CBSA • Canadian Security Intelligence Service (CSIS)	A probabilistic risk assessment for the construction and use of an RDD or "dirty bomb." The risk assessment will facilitate intelligence assessments, criminal or border surveillance, and identify gaps in radioactive materials security.	An interdepartmental position on the transport of radioactive material in Canada was developed. A strategy to more closely align Canada's domestic procedures with the expectations of the international community was also produced.

Project	Lead/Partners	Objective	Key Outputs
CRTI 02-0035RD: Canadian Network for Public Health Intelligence (CNPHI)	• Health Canada • CFIA • University of Guelph • TDV Global	A network to collect and process public health surveillance data, disseminate strategic intelligence related to the data, and coordinate response to biological threats, aimed at reducing human illness associated with infectious diseases.	The CNPHI framework was launched. Currently, there are over 1,000 registered users across Canada. An application for public health alerts was launched that will be used as a pan-Canadian, program-configurable notification resource. FluWatch, a multi-provincial application to streamline data collection and exchange on influenza and influenza-like illnesses, was launched as a pilot in the Atlantic region.
CRTI 02-0041RD: Real-Time Determination of the Area of Influence of CBRN Releases	• Health Canada • AECL • University of McGill • York University	A computer model that will provide real-time forecasts of the time, location, and amount of deposited CBRN material, enabling effective response to terrorist events involving an atmospheric release.	Modeling and simulation capabilities developed under this project and under CRTI 02-0093RD were used to support the federal response to the avian influenza outbreak in BC, as well as the accidental release of 10,000 kilograms (kg) of sulfur dioxide (SO_2) from a chemical plant in Montreal during the summer of 2004.
CRTI 02-0045RD: Forensic Optically Stimulated Luminescence	• DRDC Ottawa • CSIS • Bubble Technology Industries • RCMP	An OSL system to assist police and other officials in tracking radioactive sources and, after a CBRN event, accurately identifying locations where radioactive materials were stored.	Conceptual designs for an upgraded laboratory prototype were proposed and tested. The selected design uses light-emitting diode (LED) arrays for illumination and light guides above and below the sample. Selection of the various components for this design is nearing completion and construction is set to begin shortly.

Project	Lead/Partners	Objective	Key Outputs
CRTI 02-0066RD: Development of Simulation Programs to Prepare for and Manage Bioterrorism of Animal Diseases	• CFIA • Health Canada • Environment Canada • University of Guelph • Colorado State University • US Department of Agriculture—Animal and Plant Health Inspection	A computer simulation program and atmospheric dispersion model to predict the extent and direction of the spread of a biological agent.	Project members participated in the Tripartite Exercise on FMD and provided plume dispersion outputs to the CFIA. Application development has begun for two modules. Analysis is almost complete for one module, and is continuing for all other modules. Studies on avian influenza and dust transmission are underway.
CRTI 02-0067RD: Restoration of Facilities and Areas After a CBRN Attack	• Environment Canada • DRDC Ottawa • DRDC Suffield • Health Canada • SAIC Canada • Allen-Vanguard Corporation	New methods to decontaminate and restore buildings and areas after a CBRN attack.	After an extensive literature search, laboratory experiments are underway to test the efficacy of promising chemical, biological, and radiological restoration technologies. A series of tests were conducted to evaluate enhanced oxidation technologies for the destruction of toxic industrial chemicals.
CRTI 02-0069RD: Molecular Epidemiology of Biothreat Agents	• Health Canada • DRDC Suffield	Increased capacity of federal laboratories to subtype biothreat agents using molecular methods and develop new molecular methods for subtyping these organisms.	Molecular sub-typing methods for *B. anthracis, Y. pestis*, and *F. tularensis* were established.
CRTI 02-0080RD: Psychosocial Risk Assessment and Management (RAM) Tools to Enhance Response to CBRN Attacks and Threats in Canada	• Health Canada • CFIA • University of Ottawa • University of Waterloo	Tools to develop better understanding and mitigation of psychological impacts arising from stress and disruption associated with CBRN threats and attacks.	A literature search of best training practices and a national survey of public risk perception were completed. A psychosocial needs assessment and a web-based psychosocial risk assessment management tool were also developed.

Project	Lead/Partners	Objective	Key Outputs
CRTI 02-0093RD: Advanced Emergency Response System for CBRN Hazard Prediction and Assessment for the Urban Environment	• Environment Canada	A modeling system to forecast dispersion of CBRN materials (particularly in urban areas), predict contamination, and minimize the consequences of a CBRN attack.	Modeling and simulation capabilities developed under this project and under CRTI 02-0041RD were used to support the federal response to the avian influenza outbreak in BC, as well as the accidental release of 10,000 kg of SO_2 from a chemical plant in Montreal during the summer of 2004.

New Projects

A total of $14,686,347 was approved for funding of new RD projects in 2004–2005. CRTI anticipates the following outcomes:

- Novel nucleic acid biosensors that will enable first responders and health care workers to rapidly detect and identify pathogens. This project follows the successful proof-of-concept completed for CRTI 02-0021RD. (CRTI 03-0005RD: Sensor Technology for the Rapid Detection and Identification of Pathogens used as Bioweapons)
- A study that will address front line health care worker response, preparedness, and resilience for coping with disaster scenarios. This knowledge will be used to identify gaps and make recommendations for improved support mechanisms. (CRTI 03-0009RD: Caring About Health Care Workers as First Responders: Enhancing Capacity for Gender-based Support Mechanisms in Emergency Preparedness Planning)
- Research to address gaps in our knowledge of risk for both explosive and non-explosive dispersal of radioactive material. This information is essential to properly assess the risks associated with radiological terrorism. (CRTI 03-0018RD: Experimental Characterization of Risk for Radiological Dispersal Devices [RDDs])
- A validated serum-screening assay for *B. anthracis* (anthrax), defined domains on the protective antigen to identify people exposed to or infected with *B. anthracis*, an aerosol challenge model for anthrax, and novel vaccine leads for rapid immunization. (CRTI 03-0060RD: Protective Marker for Anthrax)

The RD projects approved in 2004–2005 are described in Part II of this report.

4.2.2 Alignment with Intermediate Outcomes

The successful completion of three RD projects in 2004–2005 has contributed to innovation in the Canadian S&T base in CBRN counterterrorism through the development of two new products and a proof of concept that will significantly enhance Canadian capabilities and facilitate emergency response. Knowledge generated as a result of these projects will inform the development of future CBRN products and technologies.

4.3 Accelerating Technology to First Responders

TA projects help to accelerate the commercialization of and transition to use by first responders and other operational authorities of technologies that address key capacity gaps. TA projects involve first responders, industry, and government and are usually completed within six months to two years of funding approval. These projects are typically funded to levels between $1 million and $10 million.

Introduced in 2004–2005, the new Technology Demonstration (TD) project category enables S&T partners to demonstrate the utility and impact of new technologies to first responders in an operational setting. TD projects afford a "leave-behind" opportunity to transfer knowledge, technology or capacity quickly to specific end-user communities. The advances in S&T resulting from the direct participation and interface with the end-user community are intended to improve the integration and interoperability of the collective response capacity. TD projects will typically span three to four years.

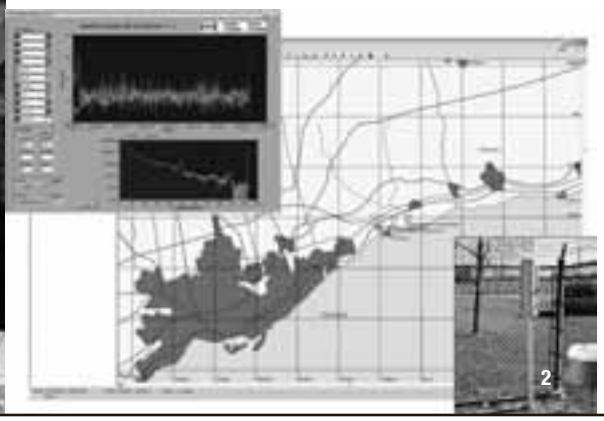
4.3.1 Outputs

Completed Projects

Biological Agent Detector Improved and Ready for First Responders

General Dynamics Canada pushed the evolution of its biological warfare agent detector, the Biological Agent Real-Time Sensor (BARTS), up the ladder to develop a smaller and more rugged version for use by first responders. Based on fluorescent particle detection—the process through which tiny particles of biological agents released in the air are detected by exposing them to light in the ultraviolet (UV) range so that they fluoresce or glow—the new BARTS model operates for about one and a half hours on nickel-metal hydride batteries and weighs less than 25 pounds, not quite small enough to operate as a hand-held device. The team will continue working to reduce the size, weight, and power requirements of the BARTS still further, but they have also developed a briefcase-sized BARTS model incorporating a continuous wave laser optical cell with an UV wavelength for immediate use. For the first time ever, a low-cost, portable device that can detect airborne biological agents, including pathogens and toxins, on site and in real time is now available to first responders.

CRTI 0011TA: Hand-Held Real-Time Biological Agent Detector
Project Lead: General Dynamics Canada
Federal Partner: DRDC Suffield
Industry Partner: National Optics Institute



1. First responders provide feedback

2. ARGOS links to Health Canada's radiation detection network

New Medical Triage Tool Improves Communication in Emergency Response

A team led by WorldReach Software Corporation recently developed a web-based communication system to enable first responders providing emergency medical services to casualties to manage a crisis situation from the scene of the emergency to the hospital. Designed with extensive input from first responders, the Rapid Triage Management Workbench (RTMW) is the first software tool of its kind featuring two major components: a portable component used in the field and a stationary central database accessible through the Internet, including wireless access. The bilingual software platform provides multiple users with simultaneous access to the central database to track casualties and status details. This enables first responders to maintain an organized flow of communication while improving a hospital's preparedness for the flow of casualties that may arrive. WorldReach has made the RTMW commercially available through its crisis management product suite, and with a view to continuous improvement, the team is looking for new funding to expand the RTMW's capabilities to make it still more useful to emergency planning teams.

CRTI 0060TA: Rapid Triage Management Workbench (RTMW)
Project Lead: NRC—Institute for Marine Biosciences
Industry Partners: WorldReach Corporation, Carleton University—Human Oriented Technology Lab, National Capital CBRN Health Planning Committee, University of Ottawa Heart Institute, Ottawa Hospital

Canada's National Nuclear Emergency Plan Strengthened with Customized Software System

Canada's FNEP was strengthened after the Radiation Protection Bureau of Health Canada worked with software developers to customize and implement the Accident Reporting and Guidance Operational System (ARGOS). Developed by the Prolog Development Center, in cooperation with the Danish Emergency Management Agency, the ARGOS is a decision support software system that improves Canada's ability to coordinate a timely and effective response to a nuclear or radiological emergency. With ARGOS, Health Canada and its FNEP partners can now rapidly coordinate an effective response to a radiological or nuclear emergency. Investing in the ARGOS also enabled Canada to join the ARGOS Consortium, a network of countries currently using any one of Prolog Development Center's software applications providing decision support and monitoring of nuclear emergencies.

CRTI 0080TA: Information Management and Decision Support System for Radiological-Nuclear Hazard Preparedness and Response
Project Lead: Health Canada—Radiation Protection Bureau
Federal Partners: Environment Canada, NRCan
Industry Partners: Prolog Development Center A/S (Denmark), Danish Emergency Management Agency

1. Testing a PEGylated version of GM-CSF

2. Side view of EOD 9 Helmet

New Drug Puts Cangene on the Trail of a Treatment for Radiation Exposure

Cangene Corporation sought to determine whether Leucotropin™—a recombinant human granulocyte-macrophage/colony stimulating factor (GM/CSF) protein developed to enhance the recovery of certain white blood cells in patients with Hodgkin's Disease and non-Hodgkin's lymphoma—could be used in the treatment of acute radiation overexposure. At the same time, the scientists at Cangene developed a more stable and longer-lasting form of human GM/CSF by modifying the protein with polyethylene glycol (PEG). They observed a small decrease in the time it took *Cynomolgus* monkeys exposed to radiation to recover from *neutropenia*, an abnormal decrease in white blood cells. They also discovered that the PEGylated GM/CSF remains in the bloodstream for a significantly longer time than non-PEGylated GM/CSF. This means that the PEGylated GM/CSF has a longer-acting medicinal effect, enabling patients to receive far fewer injections than they would need otherwise. Cangene is now planning a much larger study into PEGylated GM/CSF with help from the University of Maryland to develop the next version of Leucotropin.

CRTI 0085TA: Evaluation of GM/CSF for Acute Radiation Syndrome
Project Lead: Health Canada
Industry Partner: Cangene Corporation

New Helmet Provides Better Protection Against Bomb Blasts Using Chemical and Biological Agents

After two years of work, Med-Eng Systems Inc. has launched the Explosive Ordnance Disposal (EOD) 9 Helmet. Designed to improve on its predecessor, the SRS 5 Helmet, the new EOD 9 Helmet is more comfortable and provides better protection against standard explosives and explosively driven CB agents. The new helmet features a multi-purpose shell that accommodates two interchangeable visors. A complex curvature enables the CB visor to accommodate a wide range of face masks used with self-contained breathing apparatuses (SCBAs). The helmet also includes a remote control unit that enables the wearer to see and control the helmet's electronic functions, such as power supply, air ventilation, microphone, speaker volume, search lights, and so on. This increased electronic functionality, while a boon to first responders and the military, has created a need to ensure the helmet is compatible with electromagnetic influences. With the help of CRTI, Med-Eng is advancing the design of select system components to enable first responders to safely operate the helmet in environments sensitive to radio frequency. In the meantime, demand for the EOD 9 Helmet is so high that the company faces a backlog of orders from clients in Canada, the US, and abroad.

CRTI 0161TA: CBRN Blast Protective Helmet
Project Lead: Med-Eng Systems Inc.
Federal Partners: RCMP—Explosives Disposal and Technology Section, DRDC Suffield, RMC

New Company Takes Important First Step Toward Building Field-Ready Chemical and Biological Agent Sensor

Up-and-coming firm MEMS Precision Technology Inc. has built a real-time, portable sensor with the potential to detect airborne CB warfare agents and protect first responders and the military. Construction of the sensor was a major milestone on the road to producing a working model that first responders can use to detect toxic chemicals and dangerous micro-organisms in the field. The new sensor was developed using micro-electomechanical systems (MEMS), a technology that enables the construction of tiny and inexpensive devices that combine electrical and mechanical components. Designed to detect a CB warfare agent where and when it is released, the sensor warns first responders early enough for them to respond in an effective and timely way. By the project's end the team had moved development of an accurate, small, light, and energy-efficient sensor quite far along the road to a field-ready product. The next step is to test and evaluate the resonator sensors for stability and mass coating sensitivity before fine-tuning the design.

CRTI 0004TA: Development of Micro-electromechanical Systems (MEMS)–based Biological Agent Sensing Technology
Project Lead: DRDC Suffield
Industry Partner: MEMS Precision Technology Inc.

Outputs of Projects in Progress

The following table provides highlights of the outputs achieved in ongoing TA projects in 2004–2005.

TA Project Outputs 2004–2005

Project	Lead/Partners	Objective	Key Outputs
CRTI 0019TA: Real-time Confirmatory Bio-Detection and Identification	• DRDC Suffield • CFIA • Greenley & Associates • Dycor Technologies • Micralyne Inc.	To develop a breakthrough real-time biosensing technology.	It was determined that the existing technology is unsuitable for application in the context of a real- time biosensor. Among the many replacement technologies considered, evanescent-wave–based technologies showed promise as a possible future biosensor platform.

Project	Lead/Partners	Objective	Key Outputs
CRTI 0052TA: Rapid Carbon-14 Analysis by Accelerator Mass Spectrometry	• Health Canada • University of Toronto—IsoTrace Laboratory • Fisheries and Oceans Canada • High Voltage Engineering Europa BV, Netherlands	To develop and test equipment for the rapid, highly sensitive measurement of carbon-14 organic samples following the environmental dispersal of nuclear material.	IsoTrace intends to purchase a carbon dioxide (CO_2) gas ion source and an elemental analyzer with automated combustion unit and integrate it with the existing IsoTrace accelerator mass spectrometer. To facilitate this connection, tests of transfer line trap material were conducted and will be repeated with a modified design.
CRTI 0100TA: CB Plus Chamber	• DRDC Ottawa • DND—DNBCD • RMC • Greenley & Associates • Amtech International Ltd. • TNO Prins Maurits Laboratory (Netherlands) • Aberdeen Proving Grounds (Maryland, US)	To enable protective clothing and other first responder and military equipment to be tested for liquid, vapour, and aerosol hazards.	A chamber facility was installed at DRDC's facilities in Suffield. Standard operating procedures for the facility were completed, and systems integration and testing is underway. The design and construction of the test mannequin was also completed.
CRTI 0105TA: Mobile Real-Time Radiation Surveillance Network	• Health Canada • RCMP • NRCan • McFadden Technologies	To integrate existing radiation sensors, GPS, telecommunication, and signal detection technologies into a mobile radiation surveillance network for use in RCMP cruisers.	A second prototype was delivered and tested. Network migration to Health Canada began and a third, improved, prototype was delivered.
CRTI 0131TA: HI-6 Nerve Agent Antidote System	• DRDC • PSEPC • UGM Engineering Ltd.	To develop the essential components of a licensed, next-generation HI-6 nerve agent antidote system and establish a source of supply for the drug products in their final formulation.	Alternate synthesis routes for HI-6 have been evaluated. A method to convert the dichloride salt form of HI-6 to the dimethyl sulphonate form at a small-scale batch size has been identified. Partners for a revised international collaboration have been selected.

Project	Lead/Partners	Objective	Key Outputs
CRTI 0196TA: Rapid Detection Field Tests for Veterinary First Responders	• CFIA • Health Canada • NRC	To develop new, rapid, highly sensitive diagnostic tests for foreign animal diseases for use by veterinary first responders under field use conditions.	New assays for FMD, Nipah virus, classical swine fever, and avian influenza were developed. The matrix real-time PCR assay for avian influenza was validated in "real-life" field testing during an outbreak in BC in early 2004 and has since been transferred to four Avian Disease Network laboratories for their use.
CRTI 02-0007TA: Medical Countermeasures Against Ricin	• DRDC Suffield • Cangene Corporation • Twinstrand Therapeutics Inc.	Antibody-based countermeasures to ricin, one of the most toxic substances known.	Ricin toxoid and monoclonal antibodies to ricin were successfully produced. Laboratory work at DRDC Suffield demonstrated that polyvalent goat antibodies and monoclonal antibodies can neutralize 5 LD50 (lethal dose) of the toxin.
CRTI 02-0041TA: Deployable CBRN Monitoring Network	• Health Canada • Environment Canada • Bubble Technology Industries • Canadian Nuclear Safety Commission • General Dynamics Canada	To develop, integrate, and test a flexible CBRN detection and monitoring network that can be rapidly deployed and remotely operated.	The gamma monitor and hub have been completed. The chemical monitor has been procured and tested. The air monitor electronics have been tested and all components have been fitted into the enclosure. The gamma and bio monitors have been successfully operated through the central system software.
CRTI 02-0043TA: Accelerated Consequences Management Capabilities	• DRDC Suffield • Environment Canada • McMaster University • RCMP • Allen-Vanguard Corporation	Acceleration of development of a containment, mitigation, and decontamination system ("Blast Guard System") for CBRN agents.	Studies revealed that liquid and foam formulations were ineffective at decontaminating materials with porous surfaces, such as vinyl floors, ceiling tiles, and varnished wood. A novel method was developed to detect and quantify distilled mustard agent using liquid chromatography/mass spectrometry (LC/MS).

Project	Lead/Partners	Objective	Key Outputs
CRTI 02-0053TA: Simulation-based Decision Aid for the Optimization of Detection, Protection, and Decontamination Systems with Team Structures and Procedures	• DRDC Ottawa • DND—DNBCD • DRDC Suffield • Greenley & Associates • ITspatial USA • SAIC USA	A tool to allow visual simulations of an area of operations, allowing first responders to conduct trade-off and optimization analysis.	A simulation framework and entity models were developed to enhance ITspatial's command and control software, InterSCOPE. Hazard prediction and assessment capability (HPAC) was chosen as one dispersion model, and data were integrated into two- and three- dimensional views of Ottawa, which were recently enhanced.
CRTI 02-0057TA: Canadian Radiation Alert and Expert System for Critical Infrastructure Monitoring	• Health Canada • CBSA • SAIC Canada • Ontario Power Generation	An alert system that processes and evaluates isotopic and radiation field measurements with greater sensitivity and lower rates of false alarms.	Significant progress was achieved in developing the full spectral analysis capability of the system. All of the necessary programs were created to extract, evaluate, and fit the full spectral components with the real data. The new CRTI server was up and running, and the system was integrated with the ARGOS.
CRTI 02-0091TA: *Clostridium botulinum* Type A Genomic DNA Microarray	• Health Canada • Institute of Food Research (Norwich, UK) • Pasteur Institut Paris • University of Helsinki	A genomic DNA microarray aimed at rapidly detecting a potential biological weapon, botulinum neurotoxin, the most poisonous known substance.	A genomic DNA microarray of *Clostridium botulinum* type A strain Hall A was created and is showing potential for use as a forensic tool to type any isolate of *C. botulinum*. A DNA microarray of *C. botulinum* neurotoxin gene probes was also created. The microarray is being used to identify isolates of *C. botulinum*.
CRTI 02-0093TA: Advanced Polymer Research for Application to Personal Protective Equipment	• DRDC—Director Science and Technology Human Performance (DSTHP) • Université Laval • Airboss Defence—Acton International	CBRN-resistant polymers that can be adapted for use in protective clothing and equipment for first responders, and in other applications.	The team progressed to the fourth stage of the project in which PPE clothing will be made from promising polymer formulations and tested to determine how well they protect first responders against a wide range of chemical threats.

New Projects
A total of $11,583,350 was awarded for new TA projects in 2004–2005. CRTI anticipates the following outcomes:

- A field-ready directional gamma ray probe with sufficient sensitivity to detect radiation levels a few times higher to those present in a normal background. (CRTI 03-0017TA: Development of a Directional Gamma Ray Probe)
- An ultra-sensitive, low-cost nuclear detection web for the rapid and accurate detection of RN materials. (CRTI 03-0025TA: Defender Nuclear Detection Web)

TA projects approved in 2004–2005 are described in greater detail in Part II of this report.

A total of $2,915,007 was awarded for new TD projects in 2004–2005. The intended outcomes of these projects are as follows:

- Successful adaptation and deployment of an open-source Real-Time Outbreak Detection and Surveillance (RODS) system developed by the University of Pittsburgh as a technology demonstration. (CRTI 03-0013TD: Early CBRN Attack Detection by Computerized Medical Record Surveillance)
- Implementation of an operational radiological security system at the Ottawa International Airport that will provide a transferable model for the protection of other airports in the national aviation system. Particular emphasis will also be placed on the safety of both first responders and on airport staff in an actual or suspected radiological incident. (CRTI 03-0018TD Airport Radiological Counter Terrorism Sensor Network)
- An interconnected, Internet-based network enabling the secure collection, integration, analysis, and dissemination of key health related data and intelligence important for bioterrorism event detection and response. (CRTI 03-0019TD: Real-Time Biosurveillance and Response Readiness Using an Interconnected, Electronic, Information Infrastructure: A Region-Wide Technology Demonstration Project at the Winnipeg Regional Health Authority)
- Creation of a diagnostic core group that will develop, produce, and distribute tests for the detection of bioterrorist agents. (CRTI 03-0021TD: Assay Development and Production Team (ADAPT))
- Portable and rapidly deployable containment devices that would permit the safe handling of suspect materials, both at the collection and analysis phases of this process. (CRTI 03-0023TD: Portable and Collapsible Chemical/ Biological Isolators)

Technology Demonstration Day
In May 2004, a "Technology Demonstration Day" was held in Montebello, Quebec, for the Consequence Management Group (US/UK/ Australia/Canada). The day provided an opportunity to demonstrate the progress and results of CRTI projects in a hands-on environment. The projects demonstrated were:

- Med-Eng Systems' CBRN Blast Protective Helmet (CRTI 00161TA);
- Vanguard Response System's Blast Guard (CRTI 02-0043TA);
- McFadden Technologies' Mobile Real Time National Radiation Surveillance Network (CRTI 0105TA);
- Environment Canada's project on Restoration after a CBRN Attack (CRTI 02-0067RD);
- Health Canada's Information Management and Decision Support System – ARGOS (CRTI 0080TA);

- General Dynamics' Hand Held Real Time Biological Agent Detector (CRTI 0011TA); and
- Canadian Food Inspection Agency's Integrated Animal Disease Laboratory Network (CRTI 0196TA).

4.3.2 Alignment with Intermediate Outcomes

The capabilities delivered through completed TA projects are the results of unique collaborations and innovation among project partners. The development of new proofs of concept, prototypes, systems, and products has contributed to Canadian S&T performers' knowledge of CBRN countermeasures. The progress achieved in ongoing TA projects has further contributed to this knowledge base, and will deliver new capabilities to improve CBRN response upon their completion. New TD projects initiated in 2004–2005 are expected to transfer needed knowledge, technology, and capacity to first responders.

4.4 Building National S&T Capacity

CRTI supports the development of national S&T capacity through the acquisition of existing technology for use primarily by science-based departments and agencies.

Technology acquisitions are intended to establish or enhance the infrastructure and equipment of the laboratory clusters, and thereby address gaps in Canada's ability to respond to CBRN threats. These acquisitions should typically be made in the year in which they are funded and be "off-the-shelf" purchases of existing technology. Priority is given to those submissions that address the most critical gaps in capacity that are consistent with cluster objectives, roles, and responsibilities.[3]

4.4.1 Outputs

In 2004–2005, facilities were provided with funding to purchase acquisitions aimed at addressing identified gaps. In many cases, other organizations also gain access to the CRTI-funded acquisition, extending its reach and benefit. A total of $2.058 million was awarded for acquisitions in 2004–2005.

Technology Acquisition projects funded in 2003–2004 that were completed and began contributing to the federal laboratory response capacity in 2004–2005 are as follows:

- **Network Geographic Information System:** The CFIA purchased eight Hewlett-Packard ProLiant DL580 servers to supply geographical data to area and national emergency operation centres in real time, and the accompanying geographical information system (GIS) software and licence. The new GIS will enable the centres to better manage the outbreak of a highly contagious disease affecting Canada's food supply or livestock sector, as well as the spread of a deadly plant disease. (CRTI BIO017AP)
- **Public Health Map Generator:** Health Canada acquired the necessary technology to implement the Public Health Map Generator (PHMG) for the Canadian public health community in a secure environment. A web-based application, the PHMG enables local public health workers who do not have GIS capabilities to upload their case-level data and produce useful maps of the occurrence of diseases and

[3] A list of technology acquisitions approved in 2004–2005 is provided in Annex F.

other important information through a secure connection to the Health Canada application and spatial data holdings. (CRTI BIO018AP)

- **Upgrade of Hybridoma Facilities:** DRDC Suffield upgraded its hybridoma facilities through the acquisition of key equipment and the installation of an enhanced security surveillance system. Among the instruments acquired was a fluoresence-activated cell sorter (FACS), a state-of-the-art instrument that saves scientists a significant amount of time in screening hybridoma cell lines. The upgraded hybridoma facility at DRDC Suffield will enable DRDC scientists to develop new cell lines, produce and maintain stocks of selected monoclonal antibodies, and respond to requests for surge production of monoclonal antibodies in national emergencies. (CRTI BIO019AP)
- **Rapid Identification and Detection of Plant Pests and Pathogens:** The CFIA acquired valuable new tools that add to its capacity to rapidly detect plant pathogens that could pose a biological threat to Canada's food supply. Three portable Cepheid Smart Cycler PCR systems, a microarray reader, and a gene sequencer were purchased for the CFIA's Plant Health laboratories in Sidney, BC, Nepean, Ontario, and Charlottetown, Prince Edward Island. (CRTI BIO020AP)
- **Emergency Analytical Capacity for Pesticide Residues and Other Chemical Contaminants in Foods, Animal Feed, and Fertilizers:** The CFIA's laboratory in Calgary, Alberta added a high-performance liquid chromatograph/mass selective detection (HPLC/MSD) system to its arsenal of analytical instruments. The addition of this instrument expands the range of pesticide residues and other chemical contaminants the laboratory can analyze in emergency situations threatening the safety of Canada's food supply, and during routine monitoring programs. (CRTI CHEM016AP)
- **Saxitoxin and Other Marine Toxins:** The CFIA purchased a liquid chromatography/mass spectrometry/mass spectrometry (LC/MS/MS) instrument to enable staff at the CFIA's laboratory in Dartmouth, Nova Scotia to detect and identify saxitoxin, a powerful neurotoxin secreted by a type of blue-green bacteria. The instrument gives the Dartmouth laboratory the ability to defend against this type of bioterrorist attack. (CRTI CHEM018AP)
- **Decontamination Equipment:** Environment Canada's Environmental Technology Centre (ETC) designed and built a new decontamination facility for its field personnel. The self-contained unit consists of a six-metre trailer with heaters, air filters, generators, water, and a power supply that can be rapidly deployed to the scene of a chemical emergency in the Ottawa region. Environment Canada's regional offices also acquired small decontamination kits that will improve response capability and could be used to test other decontamination methods. (CRTI CHEM019AP)
- **Deployable Analytical Facilities to Support Expert Response to RN Incidents:** To enable response teams to respond rapidly to RN hazards, DRDC purchased four mobile nuclear laboratories fitted to the backs of Ford trucks. The self-contained labs can detect and analyze RDDs—also known as "dirty bombs"—and clandestine radiological sources, on land or in water. Located in Vancouver, BC; Whiteshell, Manitoba; Ottawa, Ontario; and Halifax, Nova Scotia; the mobile labs can be easily deployed or airlifted to an emergency site anywhere in Canada. (CRTI RN007AP)

1. Technician launches weather balloon

2. Meteorological monitoring equipment acquires weather data at incident site

Meteorological Systems Plot Plumes of Hazardous Substances

The Meteorological Service of Canada (MSC) purchased six new-generation, portable, upper air radiosonde monitoring systems for responding to potential terrorist incidents and other environmental disasters involving the release of hazardous substances into the atmosphere. The instruments have the potential to provide valuable data on the movement of clouds of deadly material, helping guide evacuations in terror emergencies. While the instruments would not necessarily detect the actual weapons material, they would measure air temperature, pressure, humidity, and wind speed in the area of the attack. The MSC could then plot a plume trajectory, showing where the material was headed.

The systems have been deployed to support efforts to halt the spread of avian influenza in BC. Radiosondes and weather balloons were also sent to ensure that equipment and operating personnel were protected.

4.4.2 Alignment with Intermediate Outcomes

The new mobile response vehicles, detection equipment, emergency systems and other products acquired in 2004–2005 represent significant technological enhancements to federal laboratory capabilities. The dual-use functions of some of the innovative equipment acquired will enable it to be tested under different conditions, thereby strengthening knowledge for its application as a CBRN countermeasure.

4.5 Building Horizontal Capability

"Building Horizontal Capability" refers to the ability of CRTI to encourage and nurture partnerships that leverage capability and capacity. As the field of CBRN counterterrorism is international and multidisciplinary, the need for strong partnerships to bridge geographical borders and complementary areas of expertise is critical.

4.5.1 Outputs

National and International Collaboration

CRTI expanded its reach through extensive collaborations with national and international partners in 2004–2005. With a view to further integrating CRTI efforts with those of its partners, CRTI has developed mechanisms that allow existing projects to submit applications for supplementary funding to allow expansion into such areas as international collaboration or development of national standards.

Launched in July 2003, the PSTP is aimed at enhancing capabilities in critical infrastructure protection (CIP) and border security through the collaborative delivery of S&T solutions with Canadian and US counterparts. In 2004–2005, a number of discussions were held and a framework for the program was initiated. CRTI also spearheaded the sign-off of a number of jointly funded projects for the PSTP CBRN/Explosive (CBRN/E) "mission area."

CRTI created and co-chaired a binational panel with the US DHS, which sponsored two international workshops. The first, held in April 2004 at Sandia National Laboratories, was a three-day, classified session focused on understanding RDD events that was attended by more than 70 Canadian and American S&T experts. In the second workshop, held in November 2004 at the LLNL, more than 120 Australian, Canadian, UK, and US first responder and S&T experts examined radiological response and consequence management. Together, these workshops resulted in over 20 proposals for binational collaboration. CRTI also participated in the Fourth Annual Global Security Conference in Washington, DC in November 2004.

The Leader of CRTI's Chemical Laboratory Cluster participated in preliminary meetings with the US Chemical and Biological Weapons Non-proliferation Program (CBWNP) to discuss cooperative research programs in counter-terrorism. The program monitors the global proliferation of CB weapons and develops strategies for stopping and reversing their spread.

CRTI also established significant new cooperation with the UK Nuclear Threat Reduction organizations and S&T Emergency Response Divisions. This effort resulted in the development and signing of an MOU in January 2005 to collaborate on radiological technologies and their applications in counterterrorism operations. A number of initiatives have already been pursued under this MOU.

CRTI was part of an outreach program with the provinces. A small investment in a provincial exercise in August 2003 helped to re-establish, in 2004, an FPT Coordinating Committee on RN emergency management that had not met since 1994. This FPT Committee has since developed a new governance structure, a consolidated schedule, and an action plan for training and exercises that has been approved by Canada's five provinces with nuclear facilities and the federal government. The action plan includes an expanded role in Top Officials (TOPOFF) III for the Technical Advisory Group that CRTI supports under Canada's FNEP. TOPOFF III is the third in a series of US-led exercises aimed at improving domestic and cross-border preparedness for potential terrorist attacks.

4.5.2 Alignment with Intermediate Outcomes

CRTI's strengthened partnerships with the US, as well as new relationships forged with other provincial, national, and UK partners enabled CRTI to share and receive new knowledge for CBRN countermeasures in 2004–2005.

4.6 Building CBRN Expertise and Knowledge

CRTI builds CBRN expertise and knowledge within the operational community and among national and international CBRN partners through symposia and workshops and other knowledge management activities and products.

4.6.1 Outputs

Symposia and Workshops

CRTI Summer Symposium

The second annual CRTI Summer Symposium was held in June 2004 in Gatineau, Quebec. Attended by approximately 250 participants, it provided an opportunity for CRTI and the broader CBRN community to learn about the progress of projects from the first two rounds of funding as well as future plans. The symposium allowed participants to share and exchange the knowledge created by CRTI partners and to learn about related allied work in CBRN.

Participants were provided with published abstracts of all CRTI projects funded in 2002 and 2003, and descriptions of projects were presented either orally or on posters by first responders and cluster leaders.

The First Responder Workshop and Technology Demonstration Day was attended by approximately 150 people. Among the highlights were scenario-based case studies and opportunities for first responders to learn about various CRTI products in a "hands-on" environment. Displays by first responder organizations and CRTI laboratory clusters demonstrated their capabilities to participants. Additional abstracts from researchers from allied CBRN communities were also provided, demonstrating the breadth and quality of the contribution they are making to national and international security.

Other symposia sponsored by CRTI in full or in part included the following events:

- **Sample Triage Workshop:** Held in Ottawa in October 2004, this workshop aimed to develop guidelines for safely handling and analyzing samples of suspect terrorist agents collected during forensic investigations of incidents involving CBRN materials. The workshop included more than 25 representatives from the science, intelligence, and first responder communities in Canada, the US, Australia, and the UK. A first draft of a protocol was prepared and is being used as the basis for further discussions and revision.
- **CRTI Canadian Culture Collection Initiative:** A significant initiative is currently underway to establish a national culture collection that boasts the same diversity, availability, access, quality control, and information technology available to Canada's main international partners. To this end, the CRTI Culture Collection Network hosted its first workshop in November 2004. Attended by about 25 participants, the workshop provided an opportunity for participants to gain and exchange information and discuss the feasibility of establishing a Canadian Culture Collection. Speakers included experts from the Netherlands, the UK, and Canada, who related their experiences in establishing culture collections.

4.6.2 Alignment with Intermediate Outcomes

Workshops and symposia provided CRTI with the opportunity to raise the profile of CRTI products and technologies and exchange knowledge with the first responder and S&T communities. In-person events enabled CRTI to develop new contacts and discover new expertise, further broadening the CRTI network and knowledge base. CRTI's second workshop for first responders and the S&T community proved a valuable venue for knowledge sharing of CBRN countermeasures.

5. OUTLOOK

During CRTI's fourth year, one of the key activities will be to build on its relationships with operational communities in a variety of ways, such as developing plans and projects for testing and evaluating equipment and supporting the development of standards for the benefit of first responders. Technology demonstrations and other fora will enable CRTI to channel collective knowledge and provide targeted guidance to operational communities. CRTI's newest laboratory cluster, the Forensic Laboratory Cluster, will also provide new opportunities to reach out to first responders.

In addition to working with Canadian first responders, CRTI intends to focus on international collaboration in 2005–2006, particularly with the US. Through the PSTP, CRTI will undertake collaborative projects aimed at enhancing Canada–US interoperability and integration. CRTI's domestic efforts to identify capabilities and responsibilities will be mirrored on the international stage through increased participation in international conferences, discussions, and events. The Biological Laboratory Cluster, for example, intends to participate in international symposia on environmental sampling and agroterrorism, and in a microbial forensic workshop to be held in conjunction with the American Society of Microbiology's upcoming

conference. The RN Laboratory Cluster also plans to further enhance its cooperation and collaboration with its allies, particularly with the US.

The CRTI laboratory clusters will continue to develop their capabilities and coordinate their efforts through projects and pan-cluster events. New exercises will enable CRTI to assess its impact and identify outstanding gaps in preparedness. In keeping with identified gaps, the Biological Laboratory Cluster will shift its attention to agroterrorism, as well as pandemic and avian influenza. The Chemical Laboratory Cluster plans to further inform itself of the respective capabilities of its members, develop standard methods of analysis, and document its activities. Extending its outreach to the provinces and first responders will be the focus of the RN Laboratory Cluster's activities.

CRTI was requested in 2004–2005 by the TBS to submit an application for renewal of its five-year mandate one year early. Initial consultations with TBS staff have produced an initial draft of the renewal submission. If the renewal is granted, it will be based on transition from capacity-based to capability-based response, exploitation of dual-use technology, and continuous review of the Consolidated Risk Assessment as a basis for assigning funding to priority areas. A balance will be sought between generating new ideas and targeting investment into gap areas to develop and maintain capability. It will be additionally critical to align CRTI proposed goals and activities with those of the PSTP, ensuring that the two programs mesh in the broad interests of national security.

CRTI's fourth year will mark its transition to a capability-based approach that focuses on how Canada might be threatened rather than on where, when, or by whom. This approach will enable CRTI to focus on the capabilities that are needed to deter and defend against possible threats. As more CRTI projects come to an end and deliver additional capabilities in 2005–2006, CRTI must seek new ways to maintain and leverage what it has already accomplished, sustain the momentum, and raise the profile of its successes. Canadian S&T capacity to respond to CBRN attacks has been significantly improved in the first three years of this key initiative—the challenge remains to ensure sustainability of these important gains.

LIST OF ACRONYMS AND INITIALISMS

2DBGD: 2Dimensional bacterial genome display

ADAPT: Assay Development and Production Team

ADM: Assistant Deputy Minister

AECL: Atomic Energy of Canada Limited

APD: avalanche photodiode

ARGOS: Accident Reporting and Guidance Operational System

BARTS: biological agent real-time sensor

BC: British Columbia

CB: chemical and biological

CBRN: chemical, biological, radiological, and nuclear

CBRN/E: chemical, biological, radiological, nuclear, and explosive

CBSA: Canada Border Services Agency

CBWNP: Chemical and Biological Weapons Non-proliferation Program

CFIA: Canadian Food Inspection Agency

CIP: critical infrastructure protection

CNPHI: Canadian Network for Public Health Intelligence

CNSC: Canadian Nuclear Safety Commission

CRTI: CBRN Research and Technology Initiative

CSIS: Canadian Security Intelligence Service

CTTC: Counter Terrorism Technology Centre

DGNS: Director General Nuclear Safety

DHS: Department of Homeland Security (US)

DNA: deoyribonucleic acid

DNBCD: Directorate of Nuclear, Biological and Chemical Defence

DND: Department of National Defence

DOE: Department of Energy (US)

DRDC: Defence Research and Development Canada

EOD: explosive ordnance disposal

EXFO: Exercise Follow On

FAA: *Financial Administration Act*

FFRAED: Federal First Responder Automated Emergency Dosimeter System

FMD: foot-and-mouth disease

FNEP: Federal Nuclear Emergency Plan

FPT: federal/provincial/territorial

FTIR: fourier transform infrared spectroscopy

GS/MS: gas chromatograph/mass spectrometry

GM-CSF: granulocyte-macrophage colony-stimulating factor

GPS: Global Positioning System

HPAC: hazard prediction and assessment capability

LC/MS: liquid chromatography/mass spectrometry

LED: light-emitting diode

LLNL: Lawrence Livermore National Laboratory

MEMS: micro-electromechanical systems

MOU: Memorandum of Understanding

MSC: Meteorological Service of Canada

NBC: nuclear, biological, and chemical

NBDRP: National Biological Dosimetry Response Plan

NFPA: National Fire Protection Association

NIOSH: National Institute for Occupational Safety and Health

NRC: National Research Council

NSP: National Security Policy

OSL: optically stimulated luminescence

PCR: polymerase chain reaction

PEG: polyethylene glycol

PHAC: Public Health Agency of Canada

PPE: personal protective equipment

PSEPC: Public Safety and Emergency Preparedness Canada

PSTP: Public Security Technical Program

RAM: risk assessment and management

RCMP: Royal Canadian Mounted Police

RD: Research and Technology Development

RAMP: rapid analyte measurement platform

RDD: radiological dispersal device

RMAF: Results-based Management and Accountability Framework

RMC: Royal Military College of Canada

RN: radiological-nuclear

RODS: real-time outbreak detection and surveillance

RTMW: Rapid Triage Management Workbench

SARS: Severe Acute Respiratory Syndrome

SCBA: self-contained breathing apparatuses

SOP: standard operating procedure

SPE: solid phase extraction

S&T: science and technology

TA: Technology Acceleration

TBS: Treasury Board of Canada Secretariat

TD: Technology Demonstration

TOPOFF: top officials

UK: United Kingdom

US: United States

VIDO: Veterinary Infectious Disease Organization

ANNEXES

ANNEX A: GOVERNANCE

CRTI is an interdepartmental collaboration initiative. All participants have been involved in identifying the needs to improve Canada's ability to respond to CBRN threats and to select those projects that best lend themselves to meet those needs. The participating departments and agencies are as follows:

- Agriculture and Agri-Food Canada*
- Atomic Energy of Canada Limited
- Canada Border Services Agency
- Canadian Food Inspection Agency*
- Canadian Nuclear Safety Commission*
- Canadian Security Intelligence Service*
- Department of National Defence/Defence Research and Development Canada*
- Environment Canada*
- Fisheries and Oceans Canada*
- Health Canada*
- National Research Council*
- Natural Resources Canada*
- Privy Council Office
- Royal Canadian Mounted Police*
- Public Safety and Emergency Preparedness Canada
- Transport Canada*
- Treasury Board of Canada Secretariat

*Signatories to the MOU.

CRTI is coordinated by an interdepartmental Steering Committee that is chaired by the Assistant Deputy Minister (ADM) for Science and Technology, DND. Representation from the participating departments is at the ADM level. A Secretariat of 10 people, located in DRDC, manages the Initiative on behalf of the Steering Committee.

In 2004-2005, the Secretariat included the following staff:

- Dr. Cam Boulet, Director
- Dr. Tom Cousins, Acting Director (January–March 2005)
- Ms. Helen Spencer, Biological Portfolio Manager
- Mr. Ted Sykes, Radiological/Nuclear Portfolio Manager
- Mr. Norman Yanofsky, Chemical Portfolio Manager
- Mr. Al Parisien, Forensic Portfolio Manager
- Mr. David Griffin, Financial Officer
- Mr. Mario Dubé, Acting Financial Officer (March–August 2004)
- Mr. Shaye Friesen, Senior Administrative Officer
- Mrs. Kirsten McDowell, Acting Senior Administrative Officer (June 2004–March 2005)
- Ms. Susan McIntyre, Knowledge Manager
- Mrs. Margaret Porter-Greene, Knowledge Management Officer
- Mrs. Dorothy Schryburt, Administrative Assistant
- Mrs. Elayne Hymovitch, Acting Administrative Assistant (April 2004–November 2004)

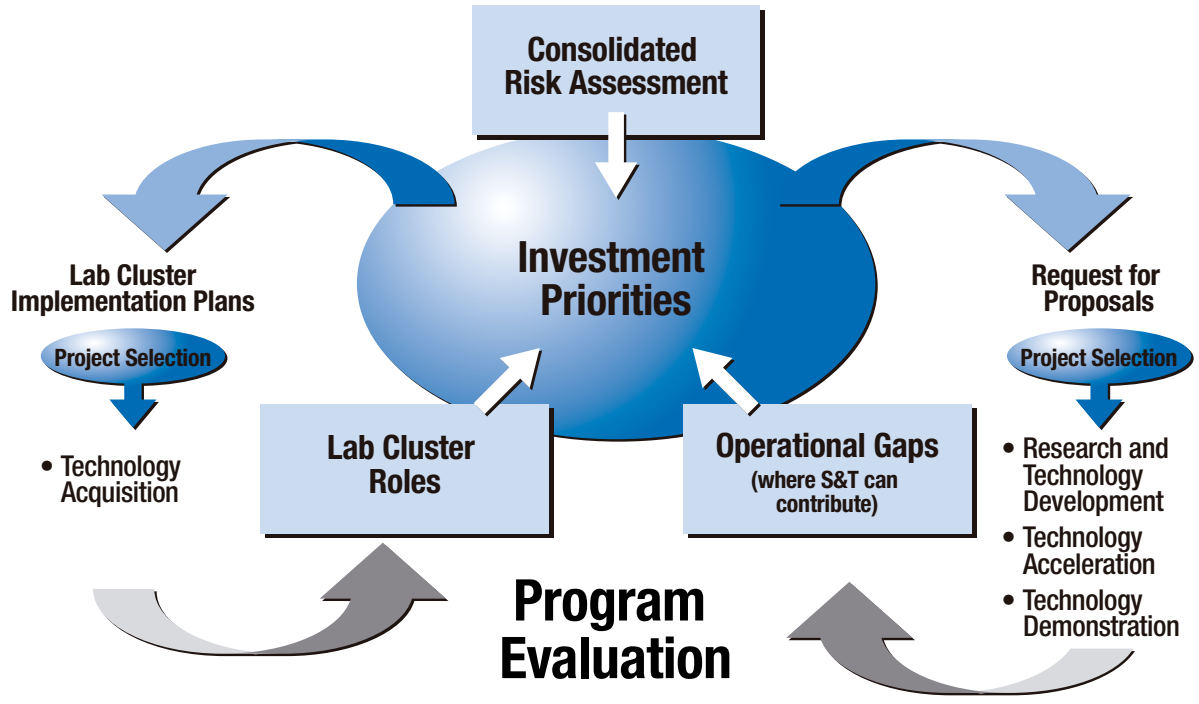
ANNEX B: PROPOSAL SELECTION PROCESS

The CRTI Framework, shown below, demonstrates the dynamic aspect of CRTI planning.

For Technology Acquisition projects, the laboratory clusters identify requirements through consensus and make submissions to a Project Review Committee, chaired by the Director of CRTI and made up of the laboratory cluster leaders, before going to the Steering Committee.

For projects in the RD, TA, and TD categories, a Proposal Selection Committee composed of experts in the fields of CBRN S&T, public security, and counterterrorism evaluates the project proposals. They are supported by a number of external reviewers who provide the necessary expertise, judgment, and knowledge needed to critically assess the proposals against identified selection criteria. After proposal synopses are screened and assessed, successful applicants are invited to submit a more detailed full proposal. The full proposals are evaluated using a structured language ladder. The Proposal Selection Committee makes recommendations for the balance of the portfolio and final selection to the Steering Committee. In all cases, the Steering Committee makes the final decisions.

CRTI Framework



The Proposal Selection Committee members are subject to a conflict of interest and non-disclosure agreement. The Committee for 2004–2005 included the following members:

- Dr. C. Boulet, Director, CRTI Secreteriat (Chair)
- Dr. T. Cousins, A/Director, CRTI Secretariat (Acting Chair)
- Dr. J. Cornett, Director, Radiation Protection Bureau, Health Canada and Leader, RN Laboratory Cluster
- Mr. D. Nelson, Program Manager, CBRN Forensics, RCMP and Leader, Forensics Laboratory Cluster
- Dr. M. Fingas, Chief, Emergencies Science and Technology, Environment Canada and Leader, Chemical Laboratory Cluster
- Dr. A. Fraser, Executive Director, Science Strategies, CFIA and Co-leader, Biological Laboratory Cluster
- Mr. T. Patraboy, Senior Scientist, PSEPC
- Dr. F. Plummer, Director, National Microbiology Laboratory, PHAC and Co-leader, Biological Laboratory Cluster
- Dr. C. Tucker, Special Advisor, Science and Technology Policy, PSEPC
- Dr. B. Davidson, Vice-President, Science and Technology, MDS SCIEX
- Dr. W. Johnson, Vice-President, Research and Development, Cangene Corporation
- Dr. F. Caron, Professor, Chemistry and Biochemistry, Laurentian University
- Dr. H. Durham, Professor, Montreal Neurological Institute, McGill University

ANNEX C: CLUSTER OBJECTIVES AND MEMBERSHIP

Cluster Roles

Laboratory clusters are groups of federal and other government laboratories composed of S&T experts and supporting equipment and facilities. They possess S&T capabilities and capacity, and have the necessary synergy to facilitate preparation, prevention, and response to CBRN terrorist attacks in Canada.

The four laboratory clusters address CBRN threats. The roles of each of the cluster teams are as follows:

- Managing the cluster;
- Supporting operational readiness, including training;
- Providing S&T advice and services in support of operations;
- Developing and maintaining standards, and performing evaluation and certification;
- Developing and managing pertinent S&T knowledge needed in operations; and
- Conducting research and development to grow and maintain the cluster's S&T capabilities.

Cluster membership is widely dispersed among participating departments and agencies. Categories of membership are as follows:

- **Member**—Labs that have a mandate or play an active role in the specific area of interest of the cluster.
- **Affiliate**—Labs that have the lead on cluster-related RD projects or provide specific expertise that is of interest to the cluster.

- **Partner**—Selected non-federal government labs (provincial, international, etc.) that work in the specific area of interest of the cluster.

Biological Laboratory Cluster

The Biological Laboratory Cluster has identified priority areas in which Canada needs to improve: surveillance, diagnostic and surge capacity, decontamination, disposal and treatment, and prevention. This assessment has been used in developing criteria for selection of Technology Acquisition projects for Canadian biological labs.

The cluster has identified gaps and examined mechanisms to fill those gaps. Four working groups have analyzed the status of Canada's preparedness regarding viral, bacterial, animal, and food and water concerns.

The Biological Laboratory Cluster Implementation Plan identifies 12 objectives:

1. Identifying links to first responders and the operational community;
2. Clarifying the roles and responsibilities of the cluster and its members;
3. Making decisions on Technology Acquisition projects;
4. Reviewing existing operational emergency plans and developing draft plan for integration of cluster work into the plans;
5. Prioritizing acquisition needs and closing 10 high-priority gaps through Technology Acquisition projects;
6. Establishing links to first responders and the operational community;
7. Developing common procedures for S&T response to an event;
8. Providing initial research and development (R&D) products to the operations community for evaluation;
9. Developing plans and actions to address, through working groups, the key gaps identified as vulnerabilities;
10. Participating in emergency planning exercises of laboratory roles;
11. Improving the integration of data and the development of a horizontal knowledge management system for information sharing and use by the cluster; and
12. Putting operational emergency response plans in place.

Chemical Laboratory Cluster

The objectives of the Chemical Laboratory Cluster are as follows:

1. Improving integration of data and information management systems for operational needs;
2. Improving analytical approaches to the detection of hoaxes;
3. Identifying lead laboratories for all chemicals on the priority substances list;
4. Addressing gaps in the lead lab capabilities for chemicals on the list;
5. Developing improved capabilities for field detection of chemicals on the list; and
6. Improving mobile analytical capabilities to provide direct support to responders.

The Chemical Laboratory Cluster Implementation Plan describes the following tasks for the cluster:

- Establish links to first responders and the operational community;
- Clarify the roles and responsibilities of the cluster and its members;

- Approve a plan for integrating labs into operational emergency plans;
- Complete two scenario-based exercises incorporating existing emergency plans;
- Develop common procedures for S&T response to events;
- Improve the integration of data and information management systems for operational needs;
- Provide initial RD products to the operational community for evaluation;
- Close a number of high-priority gaps through Technology Acquisition projects;
- Develop an analytical approach for the rapid detection of hoaxes;
- Develop a protocol for the identification and quantification of true unknown substances;
- Develop a long-term RD plan;
- Develop exposure markers;
- Develop a list of target chemicals and deal with the following tasks:
  - Assess capabilities of the cluster members vis-à-vis the target list,
  - Identify labs of primary interest, and
  - Evaluate, improve, and develop new kits for field detection of chemicals on the list;
- Assess and improve standard protocols for sample handling, transport, and testing of potentially highly hazardous materials; and
- Assess and improve mobile analytical capability to provide direct real-time support to first responders and the operational community.

RN Laboratory Cluster

The RN Laboratory Cluster Implementation Plan identifies the following objectives:

1. Developing a functional plan to establish links between the cluster, first responders, and the operational community;
2. Clarifying the roles and responsibilities of the cluster and its members;
3. Approving a plan for integrating labs into operational emergency plans;
4. Improving the integration and sharing of data within the cluster by developing, adopting, and implementing standard protocols;
5. Providing initial RD products to the operations community for evaluation;
6. Participating in emergency planning exercises that exercise the capabilities of the cluster laboratories;
7. Closing high-priority gaps in the areas of human and environmental measurement through Technology Acquisition projects;
8. Improving Canada's RN surveillance capabilities; and
9. Establishing a capability to notify and activate labs in the cluster on a 24/7 basis when an incident occurs.

Tasks to implement the objectives are as follows:

- Ensure cluster preparedness through the development, maintenance, and evolution of the Cluster Implementation Plan;
- Develop the roles and procedures by which the lab cluster interfaces with operational mandates during a CBRN event;
- Ensure appropriate working relationships between all stakeholders in the cluster, with particular emphasis on engaging first responders;
- Manage cross-cluster interactions;
- Provide and support CBRN standardized specific training that complement other efforts;

- Provide access to specialized training facilities for cluster members and first responders;
- Develop, conduct, and participate in exercises;
- Provide operational analysis in support of operational communities' capability investments (training, equipment, procedures, and organization);
- Provide S&T advice on equipment development and acquisition, especially for first responders;
- Provide tools and advice that support surveillance, monitoring, and trend analysis for early detection of CBRN events;
- Provide S&T dimension to communications and advice to the public;
- Support comprehensive CBRN risk assessment, by providing S&T expertise into the intelligence community's assessment;
- Provide rapid detection, identification, quantification, and isolation of agents and hazards;
- Provide advice on protection, treatment, containment, decontamination, transport, disposal, and remediation of contaminants and contaminated materials;
- Provide forecasting, monitoring, and advice on dispersion, fate, and effects of the agents and hazards;
- Support exposure and health monitoring;
- Provide expert support for forensic examination of crime scene samples, advice, and testimony including the investigation of incidents;
- Provide certification services and evaluation or validation of field and laboratory equipment;
- Develop and provide SOPs and protocols;
- Develop and provide standards and limits for occupational health and safety, response, remediation, and follow-up health monitoring;
- Maintain registry of training, equipment availability, comparability, interoperability, and testing to standards;
- Provide CBRN S&T knowledge management, including linkages and coordination, contact lists, reference libraries, information directories, digital maps, SOPs and protocols, and standards;
- Develop and provide information that supports the early identification and communication of potential and emerging threats in different targets;
- Provide technical assessment of the efficacy of emerging threats, ensure collaboration amongst S&T, civilian, and military intelligence communities, and identify appropriate mitigation measures;
- Develop and implement an appropriate information and knowledge management architecture to enable effective day-to-day working relationships among cluster members, between clusters, and with operational communities;
- Conduct research and development to close knowledge gaps in the cluster's ability to provide the roles described above; and
- Conduct research and development to address operational gaps in the nation's ability to prevent and respond to CBRN attacks.

Forensic Laboratory Cluster

The Forensic Laboratory Cluster will identify priority areas in which Canada needs to improve in 2005–2006. This assessment will be used to develop criteria for selection of Technology Acquisition projects for Canadian forensic labs.

The Forensic Laboratory Cluster Implementation Plan identifies 16 objectives:

1. Clarifying the roles and responsibilities of the cluster and its members;
2. Constructing a plan for integrating forensic expertise into operational and emergency plans;

3. Developing common procedures for the Forensic Laboratory Cluster response to an event;
4. Improving the integration of data and information management systems for operational needs between the first responder communities and the science-based laboratory members of CRTI;
5. Providing RD or TA products or both to the operations community for evaluation;
6. Participating in tabletop and operational field exercises of the cluster roles;
7. Identifying and closing high-priority gaps through Technology Acquisition projects;
8. Designing, developing, and delivering training for lab clusters on the identification, collection, and preservation of exhibit materials, analytical protocols necessary for criminal prosecutions, and on the presentation of scientific evidence in court;
9. Developing comprehensive partnerships with provincial forensic laboratories and forensic identification specialists;
10. Leading and coordinating pan-cluster collaborative work to establish sample triage protocols for the processing and analysis of "unknown" contaminant samples;
11. Participating in and consolidating CRTI knowledge development relative to CBRN-agent—material dissemination methods, including explosives;
12. Providing underlying S&T support specific to the needs of forensic identification technicians;
13. Establishing and maintaining direct links to operational communities such as provincial and local emergency management, police, fire, and emergency medical response organizations across Canada with a view to involving them in CRTI and its projects;
14. Contributing toward the development of a testing and evaluation capability based on S&T so that operational communities can make timely, informed, and science-based equipment acquisition decisions;
15. Establishing a repository for Canadian CBRN incident information; and
16. Representing the CRTI lab clusters in the development of the National Emergency Transportation System.

Cluster Membership

ORGANIZATION	BIOLOGICAL LABORATORY CLUSTER	CHEMICAL LABORATORY CLUSTER	RN LABORATORY CLUSTER	FORENSIC LABORATORY CLUSTER
Agriculture and Agri-Food Canada	M	M		
Agriculture and Agri-Food Canada—Land Resources Unit			M	
Atomic Energy of Canada Limited—Chalk River Laboratory			M	
Canada Border Services Agency				A
Canada Border Services Agency—Laboratory and Scientific Services Directorate	M	M	M	
Canadian Food Inspection Agency			M	

M = Member A = Affiliate P = Partner

Cluster Membership (continued)

ORGANIZATION	BIOLOGICAL LABORATORY CLUSTER	CHEMICAL LABORATORY CLUSTER	RN LABORATORY CLUSTER	FORENSIC LABORATORY CLUSTER
Canadian Food Inspection Agency—Animal Lab Network	M			
Canadian Food Inspection Agency—Food Microbiology Lab Network	M			
Canadian Food Inspection Agency—Laboratories Directorate		M		
Canadian Food Inspection Agency—Plant Lab Network	M			
Canadian Food Inspection System International Working Group	P			
Canadian Nuclear Safety Commission				M
Canadian Nuclear Safety Commission—Directorate of Nuclear Substance Regulation			M	
Canadian Public Health Laboratory Network	P			P
Canadian Security Intelligence Service	A		A	
Centre of Forensic Sciences (Ontario)				P
Defence Research and Development Canada—Counter Terrorism Technology Centre				M
Defence Research and Development Canada—Ottawa			M	M
Defence Research and Development Canada—Public Security Technical Program				M
Defence Research and Development Canada—Suffield	M	M		M
Department of National Defence—Directorate for Strategic Intelligence	A		A	
Emergency Protection Laboratory—Ontario			P	
Environment Canada	M			
Environment Canada—Canadian Meteorological Centre		M	M	
Environment Canada—Environmental Emergencies Section		M		
Federal/Provincial/Territorial Radiation Protection Committee			P	
Fisheries and Oceans Canada	A	M		
Fisheries and Oceans Canada—Atlantic Environmental Radioactivity Laboratory			M	
Health Canada—Bureau of Chemical Safety Laboratories		M		

M = Member A = Affiliate P = Partner

Cluster Membership (continued)

ORGANIZATION	BIOLOGICAL LABORATORY CLUSTER	CHEMICAL LABORATORY CLUSTER	RN LABORATORY CLUSTER	FORENSIC LABORATORY CLUSTER
Health Canada—Bureau of Environmental Health Sciences		M		
Health Canada—Emergency Preparedness and Response, Workplace Health and Public Safety Program				A
Health Canada—Food Directorate	M			
Health Canada—Food Directorate, Bureau of Microbial Hazards	M			
Health Canada—Health Products and Food Branch				A
Health Canada—Radiation Protection Bureau			M	
Institut national de santé publique du Québec				P
Laboratoire de sciences judiciaires et de médecine légale (Quebec)				P
National Research Council—Biotechnology Research Institute	A			
National Research Council—Fuel Cell Program			A	
National Research Council—Industrial Materials Institute		A		
National Research Council—Institute of Biological Sciences	M			
National Research Council—Institute of Biotechnology Research	M			
National Research Council—Institute for Chemical Processes and Environmental Protection		M		
National Research Council—Institute for Microstructural Sciences		A		
National Research Council—Institute for Research in Construction	A	A	A	
National Research Council—Integrated Manufacturing Technologies Institute	A	A	A	
National Research Council—Ionizing Radiation			M	
Natural Resources Canada—Canadian Explosives Research Laboratory				A
Natural Resources Canada—Canadian Forest Service	M			
Natural Resources Canada—CANMET Energy Technology Centre		M		
Natural Resources Canada—Earth Sciences Sector, Geological Survey of Canada		M		

M = Member A = Affiliate P = Partner

Cluster Membership (continued)

ORGANIZATION	BIOLOGICAL LABORATORY CLUSTER	CHEMICAL LABORATORY CLUSTER	RN LABORATORY CLUSTER	FORENSIC LABORATORY CLUSTER
Natural Resources Canada—Earth Sciences Sector, Geomatics Canada		M	M	
Natural Resources Canada—Emergency Mapping Service			M	
Natural Resources Canada—Radiation Geophysics Section, National Gamma Ray Spectrometry Program			M	
Networks for Centres of Excellence—Canadian Bacterial Disease Network	P			
Networks for Centres of Excellence—Canadian Network for Vaccines and Immunotherapeutics	P			
North American Plant Protection Organization	P			
Ontario Forensic Sciences Laboratory		A		
Ontario Provincial Police				P
Provincial Emergency Management Offices (Ontario, Quebec, BC, Nova Scotia, and New Brunswick)			A	
Public Health Agency of Canada—Centre for Emergency Preparedness and Response				M, A
Public Health Agency of Canada—Centre for Infectious Disease Prevention and Control	M			
Public Health Agency of Canada—Centre for Surveillance Coordination	M			
Public Health Agency of Canada—Laboratory for Foodborne Zoonoses	A			
Public Health Agency of Canada—Office of Laboratory Security	M			
Public Health Agency of Canada—National Microbiology Laboratory	M			M
Public Safety and Emergency Preparedness Canada	A			M, A
Public Safety and Emergency Preparedness Canada—Canadian Emergency Preparedness College				M
Radiation Protection Bureau—British Columbia			P	
Royal Canadian Mounted Police	A	M		

M = Member A = Affiliate P = Partner

Cluster Membership (continued)

ORGANIZATION	BIOLOGICAL LABORATORY CLUSTER	CHEMICAL LABORATORY CLUSTER	RN LABORATORY CLUSTER	FORENSIC LABORATORY CLUSTER
Royal Canadian Mounted Police—Canadian Police Research Centre				M
Royal Canadian Mounted Police—Explosive Disposal Unit, Forensic Identification Services, and Forensic Laboratory Services			A	
Royal Canadian Mounted Police—Explosives Disposal and Technology Section				M
Royal Canadian Mounted Police—Federal Investigation Section				M
Royal Canadian Mounted Police—Forensic Laboratory Services				M
Royal Military College of Canada		M		
Standards Group—Institute for National Measurement Standards			M	
Sûreté du Québec				P
Transport Canada		A		
United States Department of Agriculture—Animal and Plant Health Inspection Service	P			
United States Department of Agriculture—Animal Research Service	P			
United States Department of Energy			P	

M = Member A = Affiliate P = Partner

ANNEX D: PROJECT PARTNERS BY SECTOR

CRTI collaborated with a diversity of partners in 2004–2005.

Federal Government Partners

- Atomic Energy of Canada Limited
- Canada Border Services Agency
- Canadian Food Inspection Agency
- Canadian Nuclear Safety Commission
- Canadian Police Research Centre
- Canadian Security Intelligence Service
- Defence Research and Development Canada
- Department of National Defence
- Environment Canada
- Fisheries and Oceans Canada
- Health Canada
- Industry Canada
- National Research Council
- Natural Resources Canada
- Public Safety and Emergency Preparedness Canada
- Royal Canadian Mounted Police
- Transport Canada

Industry Partners

- 3M Canada
- Acton International (Airboss)
- AMITA Corporation
- Amtech Aeronautical Ltd.
- Bubble Technology Industries
- Cangene Corporation
- Carleton Quantitative Research
- DuPont Canada
- Dycor Technologies, Ltd.
- General Dynamics Canada
- Greenley & Associates
- IatroQuest
- IBM Canada Ltd.
- Infectio Diagnostic Inc.
- Innovative Micro Technology
- ITspatial Canada, Inc.
- JD Wilson & Associates
- JERA Consulting
- Kosteniuk Consulting
- McFadden Technologies
- MedEng Systems, Inc.
- MEMS Precision Technology Inc.
- Micralyne, Inc.
- Ontario Power Generation
- Science Applications International Corporation Canada
- Sciex
- TDV Global
- Twinstrand Therapeutics Inc.
- UGM Engineering Ltd.
- Allen-Vanguard Corporation (Nuclear, Biological, and Chemical [NBC] Team)
- Waterloo CFD Engineering Consulting, Inc.

Academic Partners

- Carleton University
- McGill University
- McMaster University

- Memorial University
- Queen's University
- Royal Military College of Canada
- Trent University
- University of Alberta
- University of British Columbia
- University of Guelph
- University of Laval
- University of Manitoba
- University of Ontario Institute of Technology
- University of Ottawa
- University of Saskatchewan
- University of Toronto
- University of Waterloo
- York University

Provincial Partners

- Ontario Ministry of Agriculture and Food
- Ottawa Hospital
- Ottawa Police Service

Foreign Partners

- Agriculture, Fisheries & Forestry (Australia)
- Carnegie Mellon University (US)
- Colorado State University (US)
- Danish Emergency Management Agency (Denmark)
- High Voltage Engineering Europa BV (Netherlands)
- Infectious Disease Research Center (US)
- Institute of Food Research (UK)
- ITspatial, LLC (US)
- Michigan State University (US)
- Pasteur Institute (France)
- Prolog Development Center (Denmark)
- Science Applications International Corporation (US)
- TNO Prins Maurits Laboratory (Netherlands)
- United Kingdom Ministry of Defence (UK)
- United States Department of Agriculture (US)
- University of Helsinki (Finland)

Other Partners

- Canadian First Responders
- Canadian Women's Health Network
- United States First Responders

ANNEX E: DISTRIBUTION OF FUNDS BY PROJECT

Distribution of Funds by Project

PROJECT	2002–2003	2003–2004	2004–2005	2005–2006	2006–2007	2007–2008	CRTI FUNDING
CRTI 01-0004TA	50,000						50,000
CRTI 01-0006RD	52,500	457,500	400,000	289,500			1,199,500
CRTI 01-0011TA	200,000	600,000					800,000
CRTI 01-0019TA	361,600	1,535,000	729,000				2,625,600
CRTI 01-0027RD	142,600	1,250,500	916,300	743,400	607,200		3,660,000
CRTI 01-0029RD	198,460	1,094,410	871,340	583,670	252,130		3,000,010
CRTI 01-0052TA	95,826	222,706	349,943	39,750			708,225
CRTI 01-0060TA		1,082,985	84,693				1,167,678
CRTI 01-0064RD	130,070	733,747	571,576	600,315	437,042		2,472,750
CRTI 01-0072RD	34,100	228,100	319,100	245,800			827,100
CRTI 01-0080TA	142,000	353,000					495,000
CRTI 01-0085TA	58,950	656,000	485,050				1,200,000
CRTI 01-0087RD	178,592	1,660,995	786,713				2,626,300
CRTI 01-0091RD	148,487	702,610	757,674	528,970	176,722		2,314,463
CRTI 01-0100TA		1,170,296	1,557,333				2,727,629
CRTI 01-0105TA	247,220	655,333	534,277	338,222			1,775,052
CRTI 01-0120RD	107,479	1,047,575	497,446				1,652,500
CRTI 01-0131TA	400,000	1,800,000	1,700,000	1,100,000			5,000,000
CRTI 01-0133RD	673,100	364,700	254,700	174,900			1,467,400
CRTI 01-0154RD	182,210	718,149	731,749	808,939	558,380		2,999,427
CRTI 01-0161TA	443,145	695,655	21,200				1,160,000
CRTI 01-0196TA	695,400	1,401,200	1,229,100	1,101,500			4,427,200
CRTI 01-0203RD	213,400	912,800	195,400				1,321,600
CRTI 01-0204RD	163,100	259,700	136,600				559,400
CRTI 02-0007TA		637,167	835,167	267,566			1,739,900
CRTI 02-0021RD		500,000	500,000				1,000,000
CRTI 02-0024RD		378,700	612,200	420,300			1,411,200

Distribution of Funds by Project (continued)

PROJECT	2002–2003	2003–2004	2004–2005	2005–2006	2006–2007	2007–2008	CRTI FUNDING
CRTI 02-0035RD		1,160,071	1,258,365	1,281,226			3,699,662
CRTI 02-0041RD		455,500	560,500	550,500	449,500		2,016,000
CRTI 02-0041TA		349,330	606,000	179,700			1,135,030
CRTI 02-0043TA		448,624	921,766	591,372			1,961,762
CRTI 02-0045RD		339,330	460,820	565,900			1,366,050
CRTI 02-0053TA		683,027	799,737				1,482,764
CRTI 02-0057TA		240,000	220,000	190,000			650,000
CRTI 02-0066RD		384,843	599,500	194,500	312,938		1,491,781
CRTI 02-0067RD		526,316	763,269	710,411			1,999,996
CRTI 02-0069RD		856,035	398,929	301,600	304,272		1,860,836
CRTI 02-0080RD		339,565	655,665	610,565	594,065		2,199,860
CRTI 02-0091TA		91,723	100,000	100,000	100,000		391,723
CRTI 02-0093RD		541,000	961,000	1,157,000	826,000		3,485,000
CRTI 02-0093TA		583,275	427,446	159,779			1,170,500
CRTI 03-0005RD			352,222	716,685	747,778	383,315	2,200,000
CRTI 03-0009RD			160,208	347,820	332,120	259,852	1,100,000
CRTI 03-0013TD			466,478	1,046,582	286,940		1,800,000
CRTI 03-0017TA			200,000	180,000			380,000
CRTI 03-0018RD			732,300	796,900	715,700	174,900	2,419,800
CRTI 03-0018TD			1,236,400	463,400	201,500		1,901,300
CRTI 03-0019TD			780,000	847,000	173,000		1,800,000
CRTI 03-0021TD			354,129	631,728	637,502	376,641	2,000,000
CRTI 03-0023TD			78,000	476,300			554,300
CRTI 03-0025TA			782,638	737,363			1,520,000
CRTI 03-0060RD			232,771	344,327	351,752	81,007	1,009,857

ANNEX F: TECHNOLOGY ACQUISITIONS SELECTED IN 2004–2005

The Technology Acquisition fund provides funds to those areas where the national S&T capacity is deficient owing to obsolete equipment, dated facilities and inadequate scientific teams. Projects are selected through gap analysis and cluster consensus.

CRTI Technology Acquisitions 2004–2005

Project Number	CRTI Funding ($000s)	Capability Description	Department/Facility
CRTI BIO021AP	552	Canadian Microbial Culture Collection	• Health Canada
CRTI BIO022AP	120	Acquisition of the Rapid Analyte Measurement Platform (RAMP) Detection Equipment as an Enhanced Capability for Rapid Identification of Bioterrorist Agents from Foods and Agricultural Products	• CFIA Lethbridge Laboratory
CRTI CHEM021AP	350	Construction of a Mobile Sample Reception Facility	• Environment Canada
CRTI CHEM023AP	114	Infrared Methods for Depth-Profiling Toxin-Exposed Solid Phase Materials	• DRDC Suffield
CRTI CHEM024AP	85	Enhanced Capability for Sample Clean-Up for the Analysis of Chemical Residues in Foods, Feeds, and Fertilizers	• CFIA
CRTI CHEM025AP	80	Refurbishment of Personal Portable Analytical Equipment	• Environment Canada
CRTI RN008AP	300	Federal First Responder Automated Emergency Dosimeter System	• Health Canada—National Dosimetry Services • RN Laboratory Cluster
CRTI RN009AP	133	Nuclear Mobile Laboratories	• DRDC Ottawa • Health Canada • Food and Agriculture Organization of the United Nations • AECL • NRCan
CRTI RN010AP	195	Prototype Robustness Package for the Fixed Point Surveillance System	• Health Canada • Environment Canada
CRTI RN011AP	130	Field Command Centre	• DRDC Ottawa

ANNEX G: FINANCIAL REPORT

CRTI Funding Model

CRTI Program Funding

$ MILLIONS	FIVE-YEAR SPAN
CRTI Secretariat	9.5
Technology Acquisition	27.5
Technology Acceleration	38.0
Research and Technology Development	95.0
Technology Demonstration	0.0
Totals	**170.0**

CRTI Funding Model (Framework)

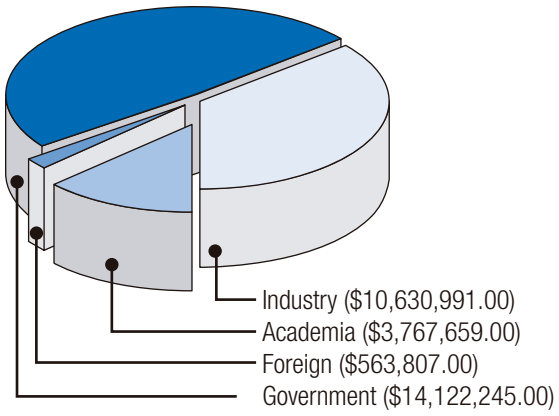
$ MILLIONS	2001–2002	2002–2003	2003–2004	2004–2005	2005–2006	2006–2007	2007–2008	TOTAL
CRTI Secretariat	0.1	1.8	1.9	1.9	1.9	1.9	0.0	9.5
Technology Acquisition	0.0	11.1	4.1	6.1	4.1	3.1	0.0	28.5
Technology Acceleration	0.0	10.0	7.0	10.0	7.0	6.0	0.0	40.0
Research and Technology Development	0.0	7.0	22.0	17.0	22.0	24.0	0.0	92.0
Technology Demonstration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	**0.1**	**29.9**	**35.0**	**35.0**	**35.0**	**35.0**	**0.0**	**170.0**

CRTI Financial Overview 2004–2005

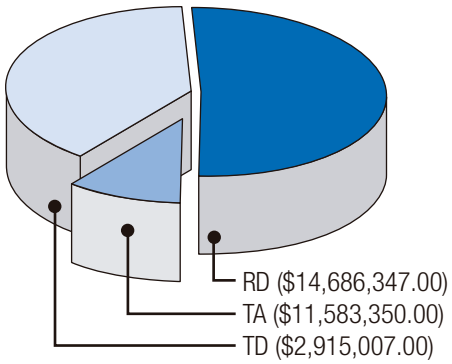
Distribution of Funds by Sector

YEAR	ACADEMIA	FOREIGN	GOVERNMENT	INDUSTRY	TOTAL
2002–2003	700,726	115,471	2,293,834	1,808,208	4,918,239
2003–2004	2,776,089	584,589	13,719,416	11,037,373	28,117,467
2004–2005	3,767,659	563,807	14,122,245	10,630,991	29,084,702
2005–2006	3,144,929	615,250	10,265,988	6,297,323	20,323,490
2006–2007	2,274,753	335,176	4,940,671	513,941	8,064,541
2007–2008	480,420	0	795,295	0	1,275,715

Distribution of Funds by Sector (2004–2005)



Distribution of Funds by Project Category (2004–2005)



Distribution of Funds by Project Category

YEAR	RD	TA	TD	TOTAL
2002–2003	2,224,098	2,694,141	0	4,918,239
2003–2004	14,912,146	13,205,321	0	28,117,467
2004–2005	14,686,347	11,583,350	2,915,007	29,184,704
2005–2006	11,973,228	4,985,252	3,465,010	20,423,490
2006–2007	6,665,599	100,000	1,298,942	8,064,541
2007–2008	899,074	0	376,641	1,275,715

CRTI Funding to Federal Government Partners 2004–2005

DEPARTMENT/AGENCY	FUNDING
Atomic Energy of Canada Limited	136,800
Canada Border Services Agency	50,600
Canadian Food Inspection Agency	2,227,089
Public Safety and Emergency Preparedness Canada	6,000
Department of National Defence	5,588,133
Environment Canada	1,179,483
Health Canada	4,017,344
National Research Council	886,096
Royal Canadian Mounted Police	30,700
Total	14,122,245