Defence Research and Development Canada

Recherche et développement pour la défense Canada

CRTI-IRTC

Science for a Secure Canada:
Building Capacity

Part I: Annual Report 2003-2004

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 response.

LETTER FROM ADM, SCIENCE AND TECHNOLOGY

As the Chemical, Biological, Radiological and Nuclear (CBRN) Research and Technology Initiative (CRTI) enters its third year, it is encouraging to take stock of the progress that has been made in 2003–2004. CRTI has proven to be an effective model for bringing together Canada's national security and science and technology (S&T) communities and applying our collective knowledge and capabilities toward common goals. In October 2003, the initiative was further enhanced when Transport Canada signed the Memorandum of Understanding (MOU) as a partner. CRTI continues to demonstrate that collaboration and partnerships among federal departments and agencies, academia, and industry produce tangible results that will help us to mitigate and address both current and future CBRN threats to our national security.

In 2003–2004, CRTI focused on achieving gains in Canada's CBRN response capabilities and in enhancing the expertise, knowledge, and capabilities of laboratories and operational authorities. An updated Consolidated Risk Assessment (CRA) has enabled us to focus funding decisions for new projects on those areas that pose immediate or high levels of risk, thereby maximizing returns on our investments. Future updates to the risk assessment will help ensure that CRTI addresses new or emerging risks and that it remains relevant to the needs of the day.

A Results-Based Management and Accountability Framework (RMAF) for CRTI, developed in the past fiscal year, provides specific objectives for each of CRTI's six main activity areas, as well as measurement criteria to help us assess how well we are doing. The RMAF will further enhance our ability to improve CRTI in the years to come.

The workshops and exercises in which the Laboratory Clusters participated, both in Canada and the United States (US), represent a significant step forward in advancing Canada's commitment to international security. Future planned exercises, such as those involving the Northern Command (NORTHCOM) and the Department of Homeland Security in the US, will further improve cross-border and inter-agency co-operation, coordination, and interoperability. These are key factors to improving our collective CBRN planning and response capabilities.

In the next year, CRTI will pursue S&T initiatives to equip and train first responders; enhance our ability to mitigate, contain, and decontaminate a CBRN event; and to find ways to better understand and mitigate the psychosocial aspects of CBRN terrorist threats. All of our efforts will be supported by continued work to test and validate a robust CBRN risk assessment.

I invite you to read this second edition of the *CRTI Annual Report*, which provides highlights of work carried out during 2003–2004 in support of our mission. I also would like to thank all partners and participants for their continued commitment and dedication to the CRTI program and its objectives.

John Leggat
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Assistant Deputy Minister (Science and Technology),
Department of National Defence,
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PART I: BUILDING CAPACITY

1. Introduction

The Chemical, Biological, Radiological and Nuclear (CBRN) Research and Technology Initiative (CRTI) is a $170 million, five-year program. Its mission is to strengthen Canada's preparedness for, prevention of and response to a CBRN terrorist attack through science and technology S&T. As an example of a horizontal emergency preparedness initiative, CRTI represents the collaborative and coordinated efforts of the federal S&T community and its partners in enhancing Canada's capability and capacity to respond to potential CBRN threats to public security.[1] Launched on May 10, 2002, the first year of CRTI saw the building of communities within the federal government, academia, industry, provincial governments, foreign, and other sectors. New partnerships and networks were forged between disparate organizations, contributing to a unique, cross-organizational model and providing new opportunities for sharing and cross-disciplinary exchange of knowledge. In 2003–2004, the collective outputs of these new communities resulted in measurable gains in Canada's CBRN response capabilities and in the expertise, knowledge, and capabilities of Canadian CBRN S&T performers.

This annual report charts CRTI's progress and critical factors contributing to its success during its second fiscal year, 2003–2004. Corollary information, including financial data, is provided in appendices to this report.

1.1 Mandate and Key Activities

The 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.

[1] The governance of CRTI is described in Annex A.

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 the 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 Results-Based Management and Accountability Framework

The Results-Based Management and Accountability Framework (RMAF), as required by the Treasury Board of Canada Secretariat, was completed in September 2003. The RMAF is the CRTI's blueprint for planning, measuring, evaluating and reporting on the progress and results of the initiative throughout its life cycle. It defines the strategic outcomes of CRTI and focuses attention on achieving results and measuring performance to continually improve the efficiency and effectiveness of the initiative.

The RMAF's Logic Model directs CRTI's progress in achieving its immediate, intermediate, and final outcomes. For each key activity, quantitative and qualitative measures are cited by which to gauge CRTI's outputs. The structure and content of this annual report reflects the RMAF and draws on its measures and anticipated outputs to chart CRTI's activities during the reporting period.

2. Critical Success Factors

Two critical success factors emerged in CRTI's second year of operation:

- Cluster management of technology acquisitions; and
- Project portfolio selection.

2.1 Cluster Management of Technology Acquisitions

Cluster management of technology acquisitions and activities proved key to building federal laboratory capability and capacity to respond to CBRN incidents. Proposed acquisitions were carefully evaluated to ensure their relevance to closing the most critical gaps in Cluster capability and capacity, and to ensure consistency with the Cluster's objectives, roles and responsibilities. The uniqueness of the S&T capability that would result from the investment was also examined in the course of evaluation. Cost-benefit analyses were conducted to assess benefits that would be accrued to the Cluster relative to the cost of the investment and contributions provided by partners. Capabilities and fulfillment of the acquisitions were tracked by each Cluster to facilitate information sharing. Many of the acquisitions demonstrated value by enhancing potential response in dual use situations. Selected acquisitions are described in Section 4.

2.2 Project Portfolio Selection

During 2003–2004 CRTI achieved a balanced project portfolio. The program model has ensured that CRTI has put in place the necessary partnership and leveraging mechanisms across the horizon of S&T performers. The CRTI

projects have been mapped against investment priorities to demonstrate how the program has achieved broad coverage. Projects spanning the entire planning and preparedness, prevention and response spectrum are now in place targeting the needs and requirements of the counter-terrorism community, from the first responder to the laboratory bench, to meet broad response outcomes. By striving for and establishing a balanced portfolio, CRTI made significant progress in closing gaps in technology, knowledge and capability through specific investments addressing critical S&T priority areas.

The table below maps projects selected in 2002–2003 and 2003–2004 against CRTI's investment priorities. Numbers reflect each of the priorities that a project addresses.

CRTI projects approved through the annual competitive project solicitation process contributed significantly to the building of expertise, knowledge, and capabilities among Canadian CBRN S&T performers. Rigorous application of evaluation criteria ensured that the projects that were accepted would greatly enhance Canada's ability to mitigate or prevent potential threats. This was accomplished through an innovative and unique process aimed at maximizing the benefits of partnerships and leveraging. This process is open to all sectors of the national innovation system. This competitive program model ensures the most relevant projects were selected and recommended for funding.[2]

Progress on projects selected in 2002–2003 is reported in Section 4. Projects selected in 2002–2003 are described in Part II of this annual report.

Projects by CRTI Investment Priorities

Technology Acceleration and Research & Technology Development

Investment Priority	Biological	Chemical	RN
Cluster Management and Operations	2	1	1
Command, Control, Communications, Coordination and Information (C^4I) for CBRN Planning and Response	4	4	4
S&T for Training and Equipping First Responders	6	7	4
Prevention, Surveillance, and Alert	6	2	5
Immediate Consequence Management	12	9	8
Long-Term Consequence Management	5	4	5
Criminal Investigation Capabilities	1		2
S&T Dimensions of Risk Assessment	2		1
Public Confidence and Psychosocial Factors	1	1	1

3. Consolidated Risk Assessment Update

In June 2003, the federal S&T community along with intelligence, law enforcement, and operational response communities updated the CBRN Consolidated Risk Assessment (CRA). The results of the CRA are invaluable in identifying the gaps in S&T, knowledge and capabilities, thus helping to shape CRTI's investment priorities and ultimately guide the types of projects funded through the annual Call for Proposals.

[2] The CRTI project selection process is described in Annex B.

The CRA identifies risks stemming from CBRN threats against a particular target. Representative scenarios are used to cover a range of CBRN terrorism events including:

- CBRN attacks against people in cities and enclosed spaces;
- CBRN terrorism against agricultural systems (plant and animal);
- CBRN terrorism using food, water, or consumer products to affect human populations; and
- CBRN terrorism as it may affect critical infrastructure.

The updated CRA identifies 14 scenarios that pose an immediate risk to mitigation capabilities and capacity, including exposure to industrial and other hazardous materials.

The CRA is updated annually as part of CRTI's annual business cycle. New or emerging risks are identified based upon information supplied by the scientific and intelligence communities and on actual events—such as recent outbreaks of Severe Acute Respiratory Syndrome (SARS) and Bovine Spongiform Encephalopathy (BSE or "mad cow disease")—that draw attention to those emergency preparedness and response capabilities that would be needed in the event of a terrorist attack.

The CRTI Secretariat led a two-day workshop with participants from 13 federal departments and agencies to develop the updated 2003 CRA. Annual updates of the CRA are expected to further focus project funding on those projects that address areas of greatest risk.

An abridged, unclassified version of the CRA is available from CRTI.

4. CRTI Key Activities 2003–2004

CRTI achieved notable gains in developing capabilities through its six key areas of activity in its second year.

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 attack. Through each Cluster, representatives from federal departments 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.[3]

4.1.1 Outputs

Implementing the Clusters

Cluster Implementation Plans guide the operations and key objectives of the Clusters, focusing on sharing expertise and filling capability gaps. All Clusters accomplished the majority of goals that they had set in this reporting period, including the following key activities:

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

- The Biological Cluster completed a tabletop preparedness exercise resulting in recommendations for emergency response.
- The Chemical Cluster completed a tabletop exercise and developed procedures in a technical response plan.
- The RN Cluster developed and participated in emergency planning exercises that tested and evaluated the capabilities of the participating laboratories.

All Clusters intend to evaluate their progress and update their plans in the next fiscal year to reflect evolving directions.

Overall, Cluster membership remained as established at inception, with some changes in individual participation through regular attrition. The stability of the networks established in 2002–2003 enabled the Clusters to progress past the initial phase in which participants became acquainted and familiar with each other's capabilities, and begin to follow through on meeting their respective objectives.

Supporting Operational Readiness

Cluster Exercises

Several Cluster exercises were held to assess Cluster readiness and the potential benefits of new technologies. Exercises were preceded by training sessions for participants, as well as required site preparation and equipment deployment. Cluster exercises and training highlighted each laboratory Cluster's strengths and areas for improvement in terms of their CBRN response capabilities.

Exercise As Is

In October 2003, radiological response teams located and identified sealed sources of radioactive material within a controlled-access and regulated outdoor area as part of the RN Cluster's major exercise of 2003–2004.

Sixty participants from Health Canada, Natural Resources Canada (NRCan), the Canadian Nuclear Safety Commission (CNSC), Defence Research and Development Canada (DRDC), and Atomic Energy of Canada Limited (AECL) participated in a scenario involving the detection of radioactive materials scattered throughout nine locations at the Chalk River Laboratories "loop" site in Chalk River, Ontario. Participants were informed that the sources included gamma, beta, and neutron emitters and were tasked with locating any distributed radiological contamination or sealed sources, identifying the isotope and activity of each source, and preparing the sources for transport off-site. Together, the air and ground teams found all 9 source locations, and correctly identified 15 of the 22 sources. Artificial time constraints imposed by the exercise precluded the teams' identification and disposal of the complete isotope set.

Field teams performing radiological survey

Overall, the exercise was a valuable learning opportunity and laid a strong foundation of technical expertise on which to build specialized RN Federal Field Teams to support a government scientific and technical response under the *Federal Nuclear Emergency Plan* (FNEP). Participants gained considerable insight and experience that will guide ongoing efforts to strengthen the federal RN response capability.

A Lessons Learned report was also produced. Areas for improvement included the need for improved field instrumentation and techniques to find and characterize beta- and neutron-emitting sources. Standard operating procedures (SOPs) for both ground and air survey teams are also needed, as is access to detailed maps for air survey teams and Global Positioning System (GPS) units for ground teams. To address these and other related issues, four working groups were established in the areas of aerial surveillance, command and communication, equipment, and field procedures.

Radiological air survey

- The Biological Cluster held its first preparedness exercise in May 2003 to familiarize members with their emergency management responsibilities and to suggest subject areas for the development of SOPs. This tabletop exercise featured an anthrax-based scenario and involved a large number of federal CRTI partners, including Health Canada, the Canadian Food Inspection Agency (CFIA), Agriculture and Agri-Food Canada (AAFC), DRDC, the Office of Critical Infrastructure Protection and Emergency Preparedness (OCIPEP),[4] the Royal Canadian Mounted Police (RCMP), and the Canadian Security Intelligence Service (CSIS).

  The exercise resulted in a list of targeted recommendations and the development of a national biological technical response plan. Planning for a larger, simulation-based Cluster field exercise is currently underway.

- Members of the Chemical Cluster received chemical warfare training at DRDC Suffield in October 2003. This is an annual three-day laboratory training course in which participants are trained in chemical warfare agent (CWA) laboratory handling and analysis.

- In January 2004, members of the RN Cluster formed part of a Canadian contingent with Department of National Defence (DND)/ Canadian Forces (CF) and Public Safety and Emergency Preparedness Canada (PSEPC) personnel that observed Unified Defense 04, a homeland defence and security test. This exercise was sponsored by the United States (US) Department of Homeland Security and the US Northern Command (NORTHCOM) and was held at various locations in Washington, D.C.

[4] OCIPEP was integrated into a new department, PSEPC, in December 2003.

Unified Defense 04 afforded Canada an opportunity to become familiar with the roles and operations of the co-sponsoring organizations and other groups, and to identify focus areas for future exercises. Specifically, Canada's participation in a NORTHCOM exercise planned for 2005 is being evaluated. The exercise also facilitated a discussion on ways that Canada and the US can jointly handle potential CBRN incidents.

- In March 2004, under the International Technical Working Group (ITWG), the RN Cluster conducted a laboratory exercise to test its ability to intercept the smuggling of nuclear material suitable for use in the manufacture of a nuclear weapon. In the scenario, authorities intercepted an individual carrying a plastic bag containing two small vials and a handmade drawing. An on-scene examination by a radiation protection specialist confirmed that the bag contained high-enriched uranium. The contents were then prepared for shipping prior to extensive forensic analysis.

This exercise contributed to the evaluation of the *Model Action Plan for Nuclear Forensics and Nuclear Attribution*,[5] and will help to develop internal and international lab accreditation standards, and contribute to work on sample handling and chain of custody (documented path of a sample) for evidentiary purposes. Participants included DRDC Ottawa, DRDC Atlantic, Health Canada, CNSC, Royal Military College (RMC), the Canada Border Services Agency (CBSA), the University of Alberta, and the RCMP Forensics Laboratory.

- The RN Cluster co-sponsored and organized, along with the US Department of Homeland Security, a three-day workshop in March 2004 at Sandia National Laboratory on the threat posed by Radiological Dispersion Devices (RDDs). Topics presented included the impact, mitigation, and consequence management issues surrounding RDDs.
- An executive steering committee was formed to plan the participation of the RN Cluster at an upcoming field exercise at the Counter Terrorism Technology Centre (CTTC) at DRDC Suffield in February 2005.

Providing S&T Advice and Expertise

Canada is recognized internationally for its expertise in S&T for CBRN protection and response. CRTI Secretariat and Cluster members are regularly invited to participate as spokespersons or advisors in CBRN symposia, media interviews, and other fora. In 2003–2004, CRTI Secretariat and Cluster members shared their expertise in a number of topic areas, including point of occurrence detection, anthrax spread within facilities, infectious diseases, SARS lessons learned, antidote storage, modelling, knowledge management, and chemical warfare. Such activities facilitate information sharing and provide ongoing opportunities for CRTI members to participate in and learn from the national and international CBRN dialogue. They also serve to introduce CRTI to a broader community and increase the outreach of the initiative.

[5] M.J. Kristo, et al., *Model Action Plan for Nuclear Forensics and Nuclear Attribution*. UCRL-RT-202675, March 26, 2004.

Developing Standards, Evaluations and Certifications
Standardization supports a consistent and coordinated approach to planning and response activities in order to achieve efficiencies and increase effectiveness. To this end, the Chemical Cluster drafted a Cluster-wide SOP on dealing with unknown samples and intends to collect and review other draft SOPs for various chemicals of interest.

Developing and Managing CBRN S&T Knowledge
In June 2003, CRTI launched its intranet portal, an online library containing thousands of referenced materials for members of the CBRN community. The portal also includes CRTI project information and various items generated by the Clusters.

The current lack of interoperability of laboratory reporting systems has been highlighted as an issue of interest to the federal S&T community. A confidential and rapid means of exchanging highly technical, analytical data and laboratory results in the event of a CBRN incident is required. The Chemical Cluster has assumed the leadership role in exploring potential solutions, and will share its findings with the other Clusters and the larger S&T community.

4.1.2 Alignment with Immediate Outcomes

The Laboratory Clusters enhanced federal capability and capacity to respond to CBRN incidents through their collective participation in exercises and through their early progress in developing laboratory standards to achieve efficiencies and increase effectiveness. Participation by CRTI Secretariat and Cluster members in CBRN symposia, interviews, and other fora, along with the launch of the CRTI intranet portal, similarly contributed to the focused expertise, knowledge, and capabilities of Canadian CBRN S&T performers.

4.2 Building S&T Capability

Research and technology development (R&D) 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. R&D projects require the involvement of at least two federal partners, and are typically 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

Outputs of Projects in Progress
Significant progress was made on many of the projects begun during the first year of CRTI. The following table provides highlights of the outputs achieved.

R&D Project Outputs 2003–2004

Project	Lead	Objective	Outputs
0006RD: Rapid Induction of Inmate and Specific Immunity of Mucosal Surfaces	Veterinary Infectious Disease Organization (VIDO), University of Saskatchewan Health Canada CFIA 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.	Genes from domestic species and rats were cloned to identify potential sequences that may induce immunity, and development began on rapid screening methods and tools.
027RD: Biological Dosimetry and Markers of Nuclear and Radiological Exposure	Health Canada, Radiation Protection Bureau DRDC Ottawa AECL McMaster University Credit Valley Hospital	To establish a National Biological Dosimetry Response Plan (NBDRP) and develop rapid methods of radiation exposure assessment to increase throughput in large-scale events.	NBDRP was established, facilitating the coordinated delivery of dosimetry services by a network of labs across Canada that are able to respond to a nuclear or radiological event. Assay preparation time was reduced from 72 to 48 hours and processing capacity was increased from 1 sample every two hours to 200 samples per day. Capacity for training of technicians increased from 4 to 18 in the four core labs, and an additional 18 technicians were trained in other labs across Canada.
0029RD: Protecting the First Responder Against CB Threats	RMC DRDC Programs DND RCMP Health Canada 3M Canada DuPont Canada Research Development and Engineering Command, US Army	To address the issues in individual protection faced by the first responder community in planning for and responding to a CB event.	Testing capability was established for personal protective equipment (PPE) clothing and respiratory equipment through acquisition of a respiratory protection test system. Extensive chamber testing on respirators and PPE clothing was conducted, and two papers were prepared: *Canadian Jurisdictions and Legislation on PPE,* and a working paper on PPE standards development.

Project	Lead	Objective	Outputs
0064RD: New Technologies for Surveillance of Biowarfare Agents and Identification of Engineered Virulence Genes	University of British Columbia Health Canada DRDC Suffield	To rapidly identify engineered genes embedded in biowarfare strains in order to tailor therapy and develop surveillance strategies.	Two-dimensional display conditions have been developed for *Yersinia pestis and Bacillus anthracis*. Work continues to optimize the procedures to improve image quality of the results. A review of a software system to collect and analyze the data has been completed.
0072RD: Nanodosimeters Based on Optically Stimulated Luminescence	DRDC Ottawa Health Canada University of Toronto Bubble Technologies Industries Inc.	To build a dosimeter that provides a detailed map of contamination patterns.	A second prototype of a nanosensor based on optically stimulated luminescence (OSL) was delivered.
0087RD: Therapeutic Antibodies for Ebola and Marburg Virus	Cangene Corporation Health Canada CFIA University of Alberta	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.	Two independent Ebola biased Fab antibody phage libraries were constructed.
0091RD: Development of Recombinant Monoclonal Antibodies for the Treatment and Detection of Bio-terrorism Agents	Health Canada, National Microbiology Laboratory DRDC Suffield CFIA	To develop monoclonal antibody-based therapeutics and diagnostic reagents for biological agents and to identify candidate immunogens for vaccine development against them.	Monoclonal antibody immunoreagents and preliminary diagnostic immunoassays to anthrax toxins and foot-and-mouth disease (FMD) virus (two of three strains) were developed where none previously existed. Canada now has unlimited ability to produce clones for diagnostic reagents for anthrax and FMD. A provisional patent has been filed for the anti-anthrax toxin monoclonal antibodies, and monographs on several antibodies have been developed.
0120RD: Development of a Novel Molecular Imprinting Methodology for Sensing Applications	National Research Council (NRC) DRDC Suffield DND Memorial University	To enhance the capabilities of first responders to determine the presence of harmful agents in the environment.	A novel molecular imprinting methodology was developed and presented at various national and international conferences. Multi-functional polymers were designed and synthesized, and thin films are being fabricated and tested.

Project	Lead	Objective	Outputs
0133RD: New Technologies for Rapid Assessment of Radioactive Contamination	Trent University Health Canada NRC MDS Sciex	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.	Methods for direct measurement of plutonium (Pu) and americium (Am) in urine have been developed and tested, and a paper has been published. New microwave technologies purchased allow for up to 20 samples to be prepared for analysis in approximately two hours, enabling 50 samples per day in each of three labs to be analyzed.
0154RD: Rapid DNA-Based Diagnostic Tests for Two Biological Agents	Université Laval, Infectious Diseases Research Centre DRDC Suffield Health Canada 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.	A specific and sensitive multiplex assay has been developed for *Yersinia pestis*. A molecular method to accurately discriminate between *Y. pestis* and *Y. Pseudotuberculosis* has been developed.
0203RD: Standoff Detection of Radiation	DRDC Ottawa AECL Bubble Technologies Industries Inc.	To enable detection of hazards or the characterization of hazard areas to take place prior to entry of personnel into contaminated areas.	Field trials were undertaken of a prototype standoff radiation detector for detecting alpha, beta, and gamma sources at considerable distances. This capability is believed to be unique in the world.
0204RD: Bubble Detector Film	DRDC Ottawa AECL Bubble Technologies Industries Inc.	To develop a sensitive, unpowered, real-time radiation exposure indicator designed specifically for alpha and beta radiation detection.	Proof of principle has been successfully demonstrated of a new radiation sensor, the Bubble Detector Film (BDF). Microencapsulation of the oil-soluble dye has been achieved, which will be used in the visual interface of the BDF. The complete BDF principle has been demonstrated, including all of the various chemical reactions.

New Projects

A total of $5,481,360 was approved for funding of new R&D projects in 2003–2004. The intended outcomes of these projects are as follows:

- Proof of novel concept for a nucleic acid biosensor that could enable on-site detection and identification of potential bioweapons, better capabilities for medical triage procedures, and efficient diagnosis of infectious diseases. (Project 02-0021RD: Direct Detection and Identification of Bioweapons' Nucleic Acids Based on Cationic Polymers)
- 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. (Project 02-0024RD: Probabilistic Risk Assessment Tool for Radiological Dispersal Devices)
- 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. (Project 02-0035RD: Canadian Network for Public Health Intelligence)
- 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. (Project 02-0041RD: Real-Time Determination of the Area of Influence of CBRN Releases)
- An optically stimulated luminescence (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. (Project 02-0045RD: Forensic Optically Stimulated Luminescence)
- A computer simulation program and atmospheric dispersion model to predict the extent and direction of the spread of a biological agent. (Project 02-0066RD: Development of Simulation Programs to Prepare for and Manage Bioterrorism of Animal Diseases)
- New methods to decontaminate and restore buildings and areas after a CBRN attack. (Project 02-0067RD: Restoration of Facilities and Areas After a CBRN Attack)
- Increased capacity of federal laboratories to subtype biothreat agents using molecular methods and develop new molecular methods for subtyping these organisms. (Project 02-0069RD: Molecular Epidemiology of Biothreat Agents)
- Tools to develop better understanding and mitigation of psychological impacts arising from stress and disruption associated with CBRN threats and attacks. (Project 02-0080RD: Psychosocial Risk Assessment and Management (RAM) Tools to Enhance Response to CBRN Attacks and Threats in Canada)
- A modelling system to forecast dispersion of CBRN materials (particularly in urban areas), predict contamination, and minimize the consequences of a CBRN attack. (Project 02-0093RD: Advanced Emergency Response System for CBRN Hazard Prediction and Assessment for the Urban Environment)

The R&D projects approved in 2003–2004 are described in Part II of this report.

4.2.2 Alignment with Immediate Outcomes

The progress achieved to date in ongoing R&D projects has enhanced federal laboratory capability and capacity to respond to CBRN incidents through the development of rapid screening methods and tools, new testing capabilities, and increased capacity for training. Participation in these projects has expanded the expertise and knowledge of Canadian CBRN S&T performers and, upon their completion, will ultimately contribute to their capabilities. The diversity and breadth of participants in the projects leverages existing CBRN knowledge to further build Canadian competencies in these areas.[6]

4.3 Accelerating Technology to First Responders

Technology Acceleration (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 typically completed within six months to two years of funding approval. These projects are usually funded to levels between $1 million and $10 million.

4.3.1 Outputs

Outputs of Projects in Progress
Significant progress was made on many of the projects begun during the first year of CRTI. The following table provides highlights of the outputs achieved.

TA Project Outputs 2003–2004

Project	Lead	Objective	Outputs
0004TA: Development of Micro-Electro-Mechanical Systems (MEMS)-Based Biological Agent Sensing Technology	MEMS Precision Technology, Inc. DRDC Suffield Health Canada NRC	To demonstrate, through proof of concept, a novel approach to the design and fabrication of MEMS resonating sensors.	Proof-of-concept was achieved for MEMS resonating sensors, which provided sensitivity to 10 to 15 grams for chemical or biological analytes. The project team successfully overcame mechanical obstacles in MEMS fabrication, and complete sensor chips were fabricated.
0011TA: Hand-Held Real-Time Biological Agent Detector	General Dynamics Canada DRDC Suffield	To accelerate the development of the world's first hand-held, real-time biodetector.	A prototype of the first battery-powered real-time biological detector was produced, allowing biological particles as small as 0.5 micrometers to be detected. The product was presented as the "4Warn Scout" at the Emergency Management Homeland Security Expo in Orlando Florida in November 2003.

[6] Project Partners for both R&D and Technology Acquisition projects are listed in Annex D.

Project	Lead	Objective	Outputs
0019TA: Real-time Confirmatory Biodetection and Identification	IatroQuest Corporation DRDC Suffield CFIA Dycor Technologies Ltd. Fluorosense Inc.	To develop a breakthrough real-time biosensing technology.	An optical and fluidic subsystem was successfully designed and constructed. Current efforts focus on developing an alternative sensing technology.
0052TA: Rapid Carbon-14 Analysis by Accelerator Mass Spectrometry	University of Toronto, IsoTrace Laboratory Health Canada Fisheries and Oceans High Voltage Engineering Europa B.V.	To develop and test equipment for the rapid, highly sensitive measurement of carbon-14 organic samples following the environmental dispersal of nuclear material.	System components have been selected to be purchased, assembled and tested during 2004–2005.
0060TA: Rapid Triage Management Workbench (RTMW)	AMITA Corporation (WorldReach Corporation) NRC National Capital CBRN Planning Team Ottawa Hospital Carleton University Ottawa Heart Institute	To manage the communication of medical information during a CBRN event.	Requirements specifications, a privacy impact assessment, and an architecture framework were completed for the RTMW, a computerized communication system.
0080TA: Information Management and Decision-Support System for Radiological-Nuclear Hazard Preparedness and Response	Health Canada, Radiation Protection Bureau Environment Canada NRCan	To implement an international emergency management system for monitoring, alerting, data gathering, analysis, decision support and information exchange tool to support emergency preparedness and response under the FNEP and improve coordination and interoperability among FNEP partners.	Work progressed on implementation of the ARGOS software application suite. Set-up and configuration of the network, server, and SQL software was completed and the base system was installed.
0085TA: Evaluation of GM-CSF for Acute Radiation Syndrome	Cangene Corporation Health Canada	To find ways to mitigate the effects of sublethal radiation exposure where some viable early stem cells remain.	Reaction conditions were developed for mPEG-GM-CSF synthesis (granulocyte-macrophage colony-stimulating factor), and monoPEGylated GM-CSF was purified. Experiments were conducted that show no loss of bioactivity in monoPEGylated GM-CSF when compared to nonPEGylated GM-CSF.

Project	Lead	Objective	Outputs
0100TA: CB Plus Chamber	DRDC Programs DND RMC Amtech Aeronautical Ltd. Greenley & Associates	To enable protective clothing and other first responder and military equipment to be tested for liquid, vapour, and aerosol hazards.	Specifications and requirements were completed for a human-form mannequin, and contracts were awarded for construction of a chemical and biological test and evaluation chamber (CB-Plus Chamber).
0105TA: Mobile Real-Time Radiation Surveillance Network	McFadden Technologies Health Canada RCMP NRCan	To integrate existing radiation sensors, GPS telecommunication, and signal detection technologies into a mobile radiation surveillance network for use in RCMP cruisers.	The RCMP demonstrated a prototype surveillance system. The first prototype was delivered and tested, a second prototype has been designed.
0131TA: HI-6 Nerve Agent Antidote System	DRDC Programs DND 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.	In 2003–2004, a baseline project plan neared completion, a patent application for the HI-6 2Cl to dimethanesulfonate (DMS) conversion process was submitted to the DRDC Business Development Office, and HI-6 alternate synthesis investigations were ongoing at two Canadian universities.
0161TA: CBRN Blast Protective Helmet	Med-Eng Systems Inc. RCMP DRDC Suffield RMC	To design, develop and evaluate a new CBRN blast protective helmet.	Chemical simulant testing on an early prototype. A tool was designed to press and form the composite material for the helmet visors, and the design for the remote control module was finalized. The design of the interior helmet liner was refined, and tooling of all plastic components continued. A reliability and performance test matrix was created for future testing.
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.	Field testing of new diagnostic tests for animal diseases was carried out during an outbreak of Avian Influenza in British Columbia in early 2004.

New Projects

A total of $3,661,504 was awarded to new TA projects in 2003–2004. The intended outcomes of these projects are as follows:

- Antibody-based countermeasures to ricin, one of the most toxic substances known. (Project 02-0007TA: Medical Countermeasures Against Ricin)
- Acceleration of development of a containment, mitigation, and decontamination system ("Blast Guard System") for CBRN agents. (Project 02-0043TA: Accelerated Consequences Management Capabilities)
- A tool to allow visual simulations of an area of operations, allowing first responders to conduct trade-off and optimization analysis. (Project 02-0053TA: Simulation-Based Decision Aid for the Optimization of Detection, Protection and Decontamination Systems with Team Structures and Procedures)
- An alert system that processes and evaluates isotopic and radiation field measurements with greater sensitivity and lower rates of false alarms. (Project 02-0057TA: Canadian Radiation Alert and Expert System for Critical Infrastructure Monitoring)
- A genomic deoxyribonucleic acid (DNA) microarray aimed at rapidly detecting a potential biological weapon, botulinum neurotoxin, the most poisonous known substance. (Project 02-0091TA: *Clostridium botulinum* Type A Genomic DNA Microarray)
- CBRN-resistant polymers that can be adapted for use in protective clothing and equipment for first responders, and in other applications. (Project 02-0093TA: Advanced Polymer Research for Application to Personal Protective Equipment)

TA projects approved in 2003–2004 are described in greater detail in Part II of this report.

Technology Demonstration Day

In February 2004, a "Technology Demonstration Day" was held in Ottawa, providing an opportunity to demonstrate the results of five selected CRTI projects to the Federal/Provincial/Territorial CBRN Working Group and also for this group to meet with representatives from the newly created PSEPC to discuss interoperability issues. The five CRTI projects were:

- Hand-Held Real-Time Biological Agent Detector (General Dynamics Canada) (Project 0011TA);
- Advanced Emergency Response System for CBRN Hazard Prediction and Assessment for the Urban Environment (Canadian Meteorological Centre) (Project 02-0093RD);
- Information Management and Decision-Support System for Radiological-Nuclear Hazard Preparedness and Response (Health Canada, Radiation Protection Bureau) (Project 0080TA);
- Mobile Real-Time Radiation Surveillance Network for the National Capital Region (McFadden Technologies) (Project 0105TA); and
- Rapid Triage Management Workbench (National Research Council) (Project 0060TA).

4.3.2 Alignment with Immediate Outcomes

Early achievements in ongoing TA projects focused on the development of specifications, requirements, configurations and prototypes. This early progress has contributed to the expertise and knowledge of Canadian S&T performers, and has laid the groundwork for increasing their capabilities upon completion of the projects. The capacity of performers is enhanced by leveraging partnerships as has been demonstrated in the diversity of partnerships.[7]

4.4 Building National S&T Capacity

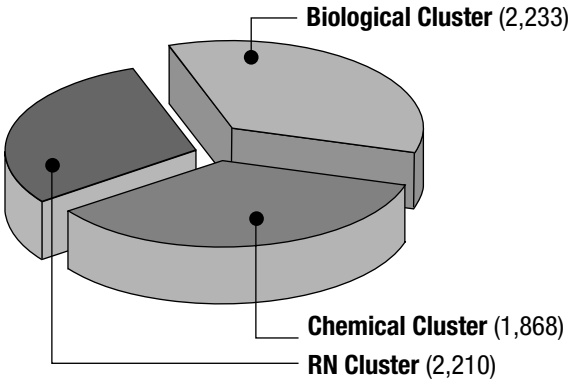
CRTI supports the development of national S&T capacity through the acquisition of existing technology. The focus of this activity is primarily science-based departments and agencies.

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.[8]

4.4.1 Outputs

In 2003–2004, 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 $6.3 million was awarded for acquisitions in 2003–2004.

Acquisitions by Cluster (2003-2004)



Technology acquisition projects funded in 2002–2003 that were completed and began contributing to the federal laboratory response capacity are as follows:

- **Analysis of Pesticide Residues:** A new detection system designed to detect pesticide residue and other chemical contaminants in food monitoring programs has enhanced the CFIA's Calgary Laboratory's capacity to analyze chemical contaminants that could potentially be used in a deliberate attack on the food supply. It is, for example, being used for the analysis of the banned drug chloramphenicol in honey and other foods, which is a serious human health hazard. (CHEM016AP)

[7] Annex E lists project funding for both R&D and TA projects.

[8] A list of technology acquisitions approved in 2003–2004 is provided in Annex F.

- **Rapid Diagnostic Tests for FMD, Hog Cholera and Avian Influenza:** Acquisition and testing of commercially-produced test kits for rapid diagnosis of FMD, hog cholera, and avian influenza by the National Centre for Foreign Animal Disease (NCFAD) will provide knowledge and validation of the capabilities of this equipment. This work is being performed with a view to empower first responders and local laboratories to provide diagnostic support to the NCFAD, and preclude the need to transport all diagnostic samples to the National Microbiology Laboratory in Winnipeg. (BIO016AP)
- **Public Health Map Generator:** This tool provides first responders with access to maps of interest on the Health Canada Internet site. As first responders will not have to rely on other agencies to produce maps, this will reduce the time to produce reports and increase the utility of spatial data. (BIO018AP)
- **Analysis of Saxitoxin and Other Marine Toxins:** New detection equipment purchased by the CFIA has been instrumental in the discovery of gymnodimine, a potent neurotoxin, in Canadian waters. It has also led to the discovery of previously unidentified toxins in Canadian waters, helping to protect Canadians from naturally occurring outbreaks. (CHEM018AP)
- **Equipment for Decontamination of Environment Canada Personnel and Others:** The purchase of new decontamination equipment has provided Environment Canada with improved capacity for on-site response to terrorist events involving toxic chemicals. (CHEM019AP)
- **On-Site Acquisition of Meteorological Data:** Surface and upper air monitoring systems, which could support CBRN and other environmental emergency response efforts, were purchased by Environment Canada for six Canadian cities. These systems have been used extensively, for example, to support forest firefighting efforts in British Columbia and for hurricane forecasting and research. (PAN001AP)

Members of investigation team being checked for contamination using P3 Portal Monitor at NATO exercise, May 2003

- **Upgrade of Hybridoma Facilities:** The Hybridoma Facility at DRDC Suffield was upgraded to enable DRDC Suffield to produce monoclonal antibodies from existing hybridomas and to develop new or additional hybridoma cell lines for biological threat agents where deficiencies exist. As a result of the upgrade, DRDC Suffield can develop new cell lines in response to deficiency gaps, produce and maintain stocks of selected monoclonal antibodies for use by the Canadian Forces (CF), the CTTC, and the Biological Cluster, and respond to requests for surge production of monoclonal antibodies in a national emergency. (BIO019AP)
- **Fixed Point Radiation Surveillance System:** Health Canada's Human Monitoring Laboratory's acquisition of a new Radiological Contamination in Lung Counter brings both improved performance and increased capacity for measuring many isotopes including pluto-

nium. Sensitivity for measuring plutonium has improved by a factor of four, and the purchase of additional P3 portal monitors will result in greater field processing capability. One of the new portal monitors was used at a North Atlantic Treaty Organization (NATO) CBRN exercise in May 2003 at DRDC Suffield. (RN003AP)

Mobile nuclear lab

Mobile Nuclear Laboratories

Potential threats from terrorism have created the need for response teams across the country with RN expertise that are able to respond rapidly, particularly for incidents involving RDDs or "dirty bombs." To improve the ability of response teams to provide timely response, the RN Cluster delivered four mobile nuclear laboratories to locations in British Columbia, Manitoba, Ontario and Nova Scotia. Each lab comprises a truck-mounted box equipped with a suite of state-of-the-art data acquisition, analysis, and communication equipment that will enable scientific teams to identify the nature and extent of radiological contamination at the site of an incident and thence predict the future dispersal pattern of contamination. These labs ensure timely provision of essential technical information to decision makers, regardless of where an incident takes place.

A Concept of Operations and SOPs for the mobile laboratories will be developed in 2004–2005.

Emergency Surface Weather Station

The Meteorological Service of Canada (MSC) regional centres acquired emergency weather observation equipment in 2002–2003 for emergency deployment. Since its acquisition, this equipment has been deployed to support a range of response efforts, validating its capabilities in a variety of real-time emergency response and disaster management situations, including the following:

- In support of the CFIA's response efforts to the outbreak of the avian flu virus, MSC Pacific and Yukon Region and the Canadian Meteorological Centre (CMC) deployed an emergency surface weather station and an emergency upper air station to the Lower Fraser Valley and provided special weather forecasts. Atmospheric modelling (fine scale and dispersion) and meteorological aspects of forensic investigation services were also provided to assess possible airborne pathways for contamination.
- The Pacific and Yukon Region also deployed the emergency response trailer to support fire-fighting efforts in British Columbia in September. Since the Kelowna upper air station was in the general area of both forest fires (one north of Kamloops and the other near Kelowna), extra soundings were necessary to satisfy the requirements of the fire weather forecasters. On short notice, the emergency response mobile upper air station was deployed to Cranbrook to provide upper air data for another major fire. A series of flights were launched and quality data was transmitted, including excellent wind data. Communications from the trailer worked flawlessly and all messages were confirmed received by the Mountain Weather Services Office in Kelowna.
- Also in September, trailers were deployed at Downsview, Ontario, Peterborough, Ontario and St. Hubert, Quebec to support prediction and research efforts during Hurricane Isabel. The systems provided upper air sounding data every three hours for two days. During Hurricane Juan, the Atlantic Region deployed its emergency upper air system to provide additional data to support forecast and research efforts.

The deployment of this specialized, dual-use equipment represents an optimal use of resources and a positive contribution to the capability to prepare, prevent and respond to CBRN terrorist events.

Pacific and Yukon Region emergency response trailer deployed to support BC fire fighting efforts, September 2003

Balloon released during a training course in Edmonton, Alberta

4.4.2 Alignment with Immediate Outcomes

The acquisition of new detection systems, test kits, decontamination equipment, air monitoring systems, and other tools in 2003–2004 improved the ability of federal laboratories to respond to CBRN incidents. The dual-use functions of some of the acquired equipment provided the opportunity to test the equipment in other types of emergencies, contributing to general preparedness.

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 multi-disciplinary, 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 recognizes that effective counterterrorism programs must address psychosocial factors and thus assist in instilling and maintaining public confidence. The challenge here is to establish links between the CBRN S&T community and the social sciences community. As a first step, CRTI held discussions with the Social Sciences and Humanities Research Council of Canada (SSHRC), the federal agency charged with supporting research and training in the social sciences and humanities. CRTI also held a series of workshops to introduce itself to the social sciences community and to encourage their participation in the program. CRTI subsequently received applications in 2003–2004 from the

social sciences community, and funding was approved for one social science project: Psychological Risk Assessment and Management Tools to Enhance Response to CBRN Attacks and Threats in Canada (described in detail in Part II of this report).

DRDC is leading the development of the Public Security Technical Program (PSTP) on behalf of Canada. The PSTP, a joint US–Canada program, was initiated in July 2003 with the aim of enhancing capabilities in Critical Infrastructure Protection (CIP) and border security via collaboratively delivering S&T solutions with US counterparts. An interdepartmental Program Management Board supports the Canadian portion of the program, while the Department of Homeland Security leads the US portion. The Deputies of the PSTP are Director General, R&D Programs, DRDC and Special Assistant for International Policy, Science & Technology, Department of Homeland Security. The principals are the Assistant Deputy Minister, Science & Technology, Department of National Defence and US–Canada Assistant Secretary, Science & Technology, Department of Homeland Security. The PSTP focuses on four major "mission areas": Chemical, Biological, Radiological and Nuclear/Explosive (CBRN/E); CIP; Disruption and Interdiction (DI); and Systems Integration Standards and Analysis (SISA). The CRTI Cluster Leaders are the principal delegates in the CBRN/E mission area, with the Director, CRTI and the Program Manager for Radiological, Nuclear and Explosives Countermeasures, US Department of Homeland Security as co-chairs.

Collaboration and co-operation also took place among federal departments and the provinces and territories. In 2003–2004, Transport Canada joined the CRTI federal partners in signing the Memorandum of Understanding (MOU) to participate in projects. The various exercises that took place in this period provided an opportunity for the Clusters to work with various federal departments and agencies. There has also been renewed activity in reaching out to provinces possessing nuclear facilities. A new governance structure, new Terms of Reference and a long-term work plan were developed by Health Canada's Radiation Protection Bureau and the RN Cluster for the Federal/Provincial/Territorial Nuclear Emergency Committee. This committee met in March 2004 and plans to have future semi-annual meetings.

Exercise Intrepid

In August 2003, CRTI supported an exercise organized by the New Brunswick Department of Public Safety, which was held at the Point Lepreau Nuclear Generating Station. Staff from Health Canada's Atlantic regional office and Radiation Protection Bureau, CNSC, and OCIPEP participated. "Exercise Intrepid 2003" tested the activation of FNEP in response to a simulated release of radioactivity from the generating station.

The exercise allowed municipalities and the province of New Brunswick to validate their emergency plans and procedures, and to demonstrate new capabilities, including the emergency evacuation of off-site populations. Health Canada's personnel practised their role as part of the National Support Structure, linking the New Brunswick Emergency Management Organization with the National Support Centre in Ottawa.

The exercise was preceded by a one-day training session for Health Canada staff in the Atlantic region to prepare them for their duties during the exercise. A Technical Assessment Phase Workshop, held as part of the exercise, provided a forum for federal and provincial representatives to discuss federal-provincial capabilities and arrangements for managing longer term consequences.

Exercise Intrepid improved relationships between provincial and federal response organizations, including regional offices and the National Support Centre. It increased awareness in New Brunswick and the Atlantic region of the federal resources available to support a nuclear emergency response and should contribute to a closer working relationship in the future.

4.5.2 Alignment with Immediate Outcomes

Relationships and partnerships built in 2003–2004 with the SSHRC, the PSTP, the provinces and territories, and other international partners enabled CRTI to expand its knowledge base and contribute to the focused expertise, knowledge and capabilities of Canadian CBRN S&T performers.

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

Protecting First Responders Against CBRN Threats

In May 2003, CRTI sponsored its first event specifically aimed at bringing together multidisciplinary teams from the CBRN S&T and first responder communities to build relationships and enhance communications between these groups. About 60 representatives from the first responder community participated in the workshop, including fire, police, emergency medical services, and hazardous materials (HAZMAT) teams. The workshop was organized in conjunction with Emergency Preparedness Week and featured a CRTI project aimed at developing new standards for protective equipment (Project 0029RD). Using a three-part bioterrorism scenario, the workshop provided first responders with an opportunity to learn about managing CBRN risks, and to identify S&T and knowledge gaps.

The workshop highlighted the importance of effective communications and knowledge exchange between the multidisciplinary teams that respond to a CBRN terrorism event. Among the findings resulting from the workshop was the need for

- better sources of information for preparation for, or response to, a CBRN event;
- better training and access to expertise on how to interpret readings from hand-held detectors and how to make decisions relating to personal protection, evacuation, and site remediation;
- clarification on the responsibilities of the different levels of government and different categories of first responders in responding to a CBRN event;
- knowledge of federal and provincial regulatory requirements for occupational protection of first responders; and
- knowledge of the capabilities and availability of protective equipment.

CRTI used lessons learned from this inaugural event to improve future workshops and build stronger links among first responders and the S&T community.

In May 2003, CRTI sponsored a forensics workshop presented by the RCMP Forensic Laboratory in Ottawa. Presentations were delivered on various attack scenarios and addressed issues including defining "the first responder," site processing, sampling, and procedures for packaging and transporting materials to a laboratory. Participants discussed laboratory procedures for service continuity, security, record keeping and note taking, examination and analysis, and results compilation and presentation. The participants agreed to pursue the topic and develop knowledge within the Clusters with respect to the presentation of evidence in court.

In June 2003, CRTI hosted its first Summer Symposium in Aylmer, Quebec. Under the theme of "Science for a Secure Canada," 105 participants shared their scientific and technological knowledge on CBRN preparedness in Canada. Presentations and posters were given by project

and technology acquisitions teams from the 2002 portfolio. Dr. Elizabeth George from the US Department of Homeland Security and Mr. John Bryden, Member of Parliament, were featured keynote speakers. An annual Pan-Cluster and individual Cluster meetings were hosted prior to the Symposium.

The CRTI Geospatial Information Systems (GIS) Community of Experts met twice during the year, in April and November 2003, to develop a community of practice that could contribute to CBRN preparedness and response. In a supplementary initiative, members created an inventory of GIS capabilities within the Biological Cluster using a Data Matrix.

CRTI, together with the National Microbiology Laboratory and the CFIA, organized a conference on the application of nucleic acid detection technologies in CBRN counterterrorism. Held in Winnipeg in November 2003, the workshop provided a forum by which US and Canadian scientists could share their experience in working with nucleic acid technologies, including recent experiences with outbreaks of SARS, avian influenza, and FMD. Participants also discussed methods of interpreting results and the advantages and disadvantages of the various tests used to detect potential bioterrorism organisms.

Technology Assessments and Special Studies
In July 2003 members of the RN Cluster observed a Field Program Atmospheric Dispersion Study, held in Oklahoma City. Sponsored by the US Department of Energy's National Nuclear Security Administration and the US Department of Defense, the study advanced knowledge on the movement of contaminants in and out of urban structures. The resulting data will also be used to refine computer models that simulate the atmospheric transport of contaminants in urban areas.

4.6.2 Alignment with Immediate Outcomes

Knowledge sharing and building events served to bridge diverse communities and focus divergent areas of expertise on similar outcomes. Linkages between operational and scientific communities are essential to ensuring that S&T solutions are targeted towards counterterrorism operational needs. CRTI's first workshop for first responders marked one of the CRTI's key contributions to focusing the expertise, knowledge and capabilities of Canadian CBRN S&T performers in 2003–2004. This workshop, along with others, provided a uniquely valuable forum for information sharing. Other fora provided occasions for new expertise and contacts to develop.

5. Outlook

Building on the strength of the communities and capabilities that have been developed during the first two years of CRTI, the focus of activity during year three will be on delivering these capabilities to CBRN S&T performers. Through its efforts, CRTI aims to contribute to increased innovation in the CBRN S&T community, resulting in new products, knowledge and technical support activities, including cross-organizational collaboration. The momentum that has been built is expected to enable CRTI to grow and strengthen its sphere of influence within the Canadian counterterrorism community.

In the next year, the introduction of a Technology Demonstration project category will create opportunities and venues for S&T partners to demonstrate first-hand the utility and impact of emerging technologies for first responders in an operational setting. Technology Demonstration projects require the participation of first responders or operators in the project

team and demonstration. They involve placing technology in an operational setting and generate a "leave behind" capability at the end of the project. This category of project will enable specific knowledge, technology, and capacity to be transferred quickly to end-user communities.

CRTI's work with national and international partners has highlighted the benefits that may accrue from bridging geographical borders and areas of mutual concern. CRTI's first steps in observing exercises in the US and participating in the establishment of PSTP were important foundations upon which the program will build greater knowledge and capacity in 2004–2005. Future planned exercises, meetings and workshops will continue to establish strong links with the US, the United Kingdom (UK), and Australia.

Greater collaboration with the provinces and territories, as well as with first responders, will be achieved through improved exercises and other collaborative activities planned for 2004–2005. Lessons learned during exercises of the past year, such as the "Exercise As Is" and the inaugural workshop with first responders, will enable CRTI to more effectively meet the needs of these groups and achieve CRTI objectives. Further meetings planned for the Federal/Provincial/Territorial Nuclear Emergency Committee will also help to strengthen coordination among those provinces possessing nuclear facilities. Investments will be made to further improve inter-agency cooperation, coordination, interoperability and decision making to enhance the collective capabilities of CBRN operational communities.

Developing S&T in support of equipping and training first responders will continue to be required of CRTI in 2004–2005, with emphasis on developing the S&T knowledge base to establish standards and protocols across all response dimensions. CRTI will also invest in the development of safe, realistic and affordable training capabilities, particularly those that exercise integrated and inter-agency roles.

Response capacity will be further enhanced through investments in activities aimed at increasing prevention, surveillance and alert capabilities, particularly through early detection and warning for wide area attacks and CBRN material interdiction. Improvements to point and area detection capabilities are also planned, which will enhance the capabilities of first responders to protect, mitigate and contain a CBRN event. CRTI aims to enhance police capabilities to conduct criminal investigations associated with CBRN events by developing rapid diagnostic techniques to identify CBRN agents.

In moving forward, the Clusters will evaluate their progress and update their respective Cluster Implementation Plans—the primary vehicle through which the Clusters define their key objectives and operational priorities. Joint activities, such as an upcoming exercise on forensic sampling to be held at DRDC Suffield by the Biological and Chemical Clusters, will leverage Cluster knowledge and resources. The RN Cluster is also planning several exercises, including a biological dosimetry response exercise at DRDC Ottawa in October 2004 and a Federal Field Team exercise at DRDC Suffield in February 2005.

As the many projects that were initiated in the first and second years of CRTI begin to produce tangible results, CRTI looks forward to expanding the gains achieved by the initiative to the CBRN S&T and response communities.[9]

[9] CRTI Financial Reports are provided in Annex G.

List of Acronyms and Initialisms

AAFC: Agriculture and Agri-Food Canada

AECL: Atomic Energy of Canada Limited

ADM: Assistant Deputy Minister

BDF: Bubble Detector Film

CB: Chemical and biological

CBRN: Chemical, Biological, Radiological and Nuclear

CBRN/E: Chemical, Biological, Radiological, Nuclear and Explosive

CBSA: Canada Border Services Agency

CF: Canadian Forces

CFIA: Canadian Food Inspection Agency

CIP: Critical Infrastructure Protection

CMC: Canadian Meteorological Centre

CNSC: Canadian Nuclear Safety Commission

CRA: Consolidated Risk Assessment

CRTI: CBRN Research and Technology Initiative

CSIS: Canadian Security Intelligence Service

CTTC: Counter Terrorism Technology Centre

CWA: Chemical Warfare Agent

DI: Disruption and Interdiction

DMS: dimethanesulfonate

DNA: deoxyribonucleic acid

DND: Department of National Defence

DRDC: Defence Research and Development Canada

FMD: Foot and Mouth Disease

FNEP: Federal Nuclear Emergency Plan

GIS: Geospatial Information Systems

GM-CSF: granulocyte-macrophage colony-stimulating factor

GPS: Global Positioning System

HAZMAT: hazardous materials

HPLC-MSD: High Performance Liquid Chromatograph – Mass Selective Detector

ITWG: International Technical Working Group

LC/MS/MS: Liquid Chromatograph Tandem Mass Spectrometer

MEMS: Micro-Electro-Mechanical Systems

MOU: Memorandum of Understanding

MSC: Meteorological Service of Canada

NATO: North Atlantic Treaty Organization

NBC: Nuclear, Biological and Chemical

NBDRP: National Biological Dosimetry Response Plan

NCFAD: National Centre for Foreign Animal Disease

NORTHCOM: Northern Command

NRC: National Research Council

NRCAN: Natural Resources Canada

OCIPEP: Office of Critical Infrastructure Protection and Emergency Preparedness

OSL: Optically Stimulated Luminescence

PPE: Personal protective equipment

PSEPC: Public Safety and Emergency Preparedness Canada

PSTP: Public Security Technical Program

RAM: Risk Assessment and Management

R&D: Research and Technology Development

RCMP: Royal Canadian Mounted Police

RDD: Radiological Dispersion Device

RMAF: Results-Based Management and Accountability Framework

RMC: Royal Military College

RN: Radiological-Nuclear

RTMW: Rapid Triage Management Workbench

S&T: Science and Technology

SARS: Severe Acute Respiratory Syndrome

SISA: Systems Integration Standards and Analysis

SOP: Standard Operating Procedure

SSHRC: Social Sciences and Humanities Research Council of Canada

TA: Technology Acceleration

UK: United Kingdom

US: United States

VIDO: Veterinary Infectious Disease Organization, University of Saskatchewan

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 Customs and Revenue Agency (Canada Border Services Agency)[10]
- Canada Food Inspection Agency*
- Canadian Nuclear Safety Commission*
- Canadian Security Intelligence Service*
- Department of Fisheries and Oceans*
- Department of National Defence/Defence Research and Development Canada*
- Department of National Defence/Office of Critical Infrastructure Protection and Emergency Preparedness* (Public Safety and Emergency Preparedness Canada)[11]
- Environment Canada*
- Health Canada*
- National Research Council*
- Natural Resources Canada*
- Privy Council Office
- Royal Canadian Mounted Police*
- Solicitor General of Canada* (Public Safety and Emergency Preparedness Canada)
- Transport Canada[12]
- Treasury Board of Canada Secretariat

CRTI is coordinated by an interdepartmental Steering Committee that is chaired by the Assistant Deputy Minister (ADM) for Science and Technology, Department of National Defence. Representation from the participating departments is at the ADM level. A Secretariat of eight people, located in Defence Research and Development Canada, manages the Initiative on behalf of the Steering Committee.

* Signatories to the MOU to participate in the R&D and TA projects.

[10] Canada Border Services Agency was created out of the Canada Customs and Revenue Agency on 12 December 2004.

[11] Public Safety and Emergency Preparedness Canada was created on 12 December 2003 to include the former Solicitor General of Canada and the Office of Critical Infrastructure Protection and Emergency Preparedness, and other entities within the public security portfolio.

[12] Signed the MOU on 9 October 2003.

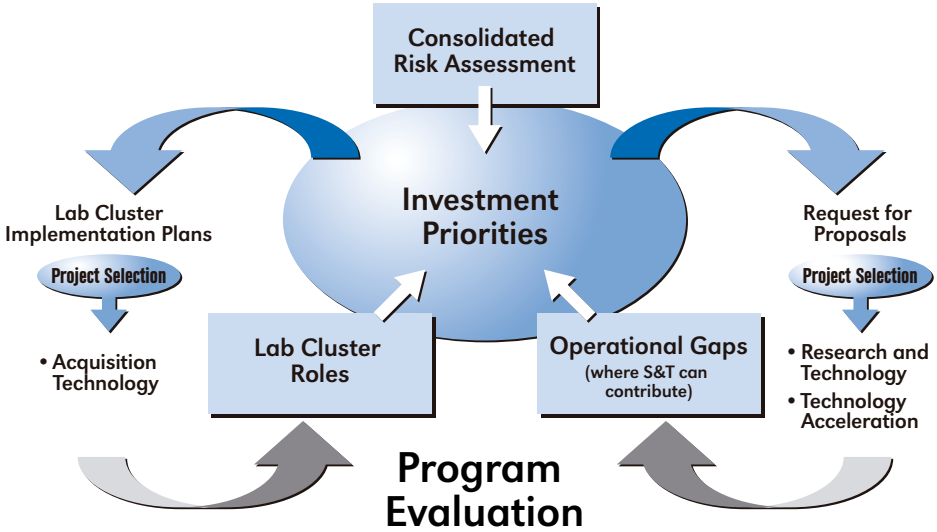
Annex B: Proposal Selection Process

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

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 R&D and TA 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 is composed of a cross-section of subject-matter experts supported by external reviewers. The Committee members are subject to a conflict of interest and non-disclosure agreement. The Committee for 2003–2004 included

- Dr. Cam Boulet, Director CRTI Secretariat (Chair);
- Dr. Jean Hollebone, Acting Science Director, Canadian Food Inspection Agency and Co-Leader, Biological Cluster;
- Dr. Frank Plummer, Director, National Microbiology Laboratory, Health Canada and Co-Leader, Biological Cluster;
- Dr. John Carey, Director General, National Water Research Laboratory, Environment Canada and Leader, Chemical Cluster;
- Dr. Jack Cornett, Director, Radiation Protection Bureau, Health Canada and Leader, Radiological-Nuclear Cluster;
- Mr. Tim Patraboy, Scientist, Solicitor General;
- Insp. Richard Shaddick, Solicitor General;
- Dr. John Arnold, Chief Scientist, Canadian Police Research Centre, National Research Council;
- Dr. Heather Durham, Professor, Montreal Neurological Institute, McGill University;
- Dr. Bill Davidson, Vice-President, Science and Technology, SCIEX;
- Dr. Wendy Johnson, Vice-President, Research and Development, Cangene Corporation; and
- Dr. Chris Tucker, Director, Research and Development, Office of Critical Infrastructure Protection and Emergency Preparedness.

Annex C: Cluster Objectives and Membership

Cluster Roles

Laboratory Clusters are groups of federal and other government laboratories composed of scientific and technical 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 three Laboratory Clusters address the 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 R&D 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 R&D 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 Implementation Plan identified 12 objectives:

- Identify links to first responders and the operational community.
- Clarify the roles and responsibilities of the Cluster and its members.
- Make decisions on first phase Technology Acquisition projects.
- Review existing operational emergency plans and develop draft plan for integration of Cluster work into the plans.
- Prioritize acquisition needs and close 10 high priority gaps through Acquisition Technology projects.
- Establish links to first responders and the operational community.
- Develop common procedures for S&T response to an event.
- Provide initial R&D products to the operations community for evaluation.
- Develop plans and actions to address, through working groups, four key gaps identified as vulnerabilities: surveillance, diagnostic methods, decontamination and disposal, treatment and prevention.
- Participate in emergency planning exercises of laboratory roles.
- Improve the integration of data and the development of a horizontal knowledge management system for information sharing and use by cluster.
- Put operational emergency response plans in place.

Membership of the Biological Laboratory Cluster

The Biological Laboratory Cluster consists of 18 core members from eight federal science-based departments and agencies representing approximately 75 federal laboratories. The Cluster also includes affiliate members and partners.

Lab Cluster Co-Chairs 2003–2004:
Dr. Frank Plummer, Health Canada—National Microbiology Laboratory

Dr. Jean Hollebone, Canadian Food Inspection Agency

Core Cluster Members:
- Agriculture and Agri-Food Canada
- Canada Customs and Revenue Agency—Lab and Scientific Services Directorate
- Canadian Food Inspection Agency—Animal Lab Network

- Canadian Food Inspection Agency—Food Microbiology Lab Network
- Canadian Food Inspection Agency—Plant Lab Network
- Defence Research and Development Canada—Suffield
- Environment Canada
- Health Canada—Centre for Infectious Disease Prevention and Control
- Health Canada—Centre for Surveillance Coordination
- Health Canada—Food Directorate
- Health Canada—Food Directorate—Bureau of Microbial Hazards
- Health Canada—National Microbiology Lab
- Health Canada—Office of Lab Security
- National Research Council—Institute of Biological Sciences
- National Research Council—Institute of Biotechnology Research
- Natural Resources Canada—Canadian Forest Service

Affiliate Members:

- Canadian Security Intelligence Service
- Department of Fisheries and Oceans
- Department of National Defence—Directorate for Strategic Intelligence
- Health Canada—Laboratory for Foodborne Zoonoses
- National Research Council—Biotechnology Research Institute
- National Research Council—Institute for Research in Construction
- National Research Council—Integrated Manufacturing Technology Institute
- Office of Critical Infrastructure Protection and Emergency Preparedness (Public Safety and Emergency Preparedness Canada)
- Royal Canadian Mounted Police

Partners:

- Canadian Food Inspection System International Working Group
- Canadian Public Health Laboratory Network
- Networks for Centres of Excellence—Canadian Bacterial Disease Network
- Networks for Centres of Excellence—Canadian Network for Vaccines and Immunotherapeutics
- North American Plant Protection Organization
- United States Department of Agriculture—Animal and Plant Health Inspection Service
- United States Department of Agriculture—Animal Research Service

Chemical Laboratory Cluster

The objectives of the Chemical Lab Cluster for the first two years of CRTI are as follows:

- Improving integration of data and information management systems for operational needs;
- Improving analytical approaches to the detection of hoaxes;
- Identifying lead laboratories for all chemicals on the priority substances list;
- Addressing gaps in the lead lab capabilities for chemicals on the list;
- Developing improved capabilities for field detection of chemicals on the list; and
- 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 R&D 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 R&D 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.

Membership of the Chemical Laboratory Cluster

Lab Cluster Chair 2003–2004:
Dr. John Carey, Environment Canada—National Water Research Laboratory

Mr. Alain Cassista, Royal Canadian Mounted Police (co-lead)

Core Cluster Members:
- Agriculture and Agri-Food Canada
- Canada Customs and Revenue Agency—Laboratory Scientific Services Directorate
- Canadian Food Inspection Agency—Laboratories Directorate
- Defence Research and Development Canada—Suffield
- Department of Fisheries and Oceans
- Environment Canada—Canadian Meteorological Centre
- Environment Canada—Environmental Emergencies Section
- Health Canada—Bureau of Chemical Safety Laboratories
- Health Canada—Bureau of Environmental Health Sciences
- National Research Council—Institute for Chemical Processes and Environmental Protection
- Natural Resources Canada—CANMET Energy Technology Centre

- Natural Resources Canada—Earth Sciences Sector—Geological Survey of Canada
- Natural Resources Canada—Earth Sciences Sector—Geomatics Canada
- Royal Canadian Mounted Police
- Royal Military College

Affiliate Members:

- National Research Council—Industrial Materials Institute
- National Research Council—Institute for Microstructural Sciences
- National Research Council—Institute for Research in Construction
- National Research Council—Integrated Manufacturing Technologies Institute
- Transport Canada

Radiological-Nuclear Laboratory Cluster

The RN Cluster Implementation Plan identifies the following objectives for the first two years of CRTI:

- Developing a functional plan to establish links among the Cluster, first responders and the operational community;
- Clarifying the roles and responsibilities of the Cluster and its members;
- Approving a plan for integrating labs into operational emergency plans;
- Improving the integration and sharing of data within the Cluster by developing, adopting and implementing standard protocols;
- Providing initial R&D products to the operations community for evaluation;
- Participating in emergency planning exercises that exercise the capabilities of the Cluster laboratories;
- Closing high-priority gaps in the areas of human and environmental measurement through Technology Acquisition projects;
- Improving Canada's RN surveillance capabilities; and
- 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 R&D to close knowledge gaps in the Cluster's ability to provide the roles described above; and
- Conduct R&D to address operational gaps in the nation's ability to prevent and respond to CBRN attacks.

Membership of the Radiological-Nuclear Laboratory Cluster

The RN Laboratory Cluster consists of 13 core members from 11 federal science-based departments and agencies. The Cluster also includes six affiliate members and four partners.

Lab Cluster Chair 2003–2004:
Dr. Jack Cornett, Health Canada—Radiation Protection Bureau

Core Cluster Members:

- Agriculture and Agri-Food Canada—Land Resources Unit
- Atomic Energy of Canada Limited—Chalk River Laboratory
- Canada Customs and Revenue Agency—Laboratory and Scientific Services Directorate
- Canadian Food Inspection Agency
- Canadian Nuclear Safety Commission—Directorate of Nuclear Substance Regulation
- Defence Research and Development Canada—Ottawa
- Department of Fisheries and Oceans—Atlantic Environmental Radioactivity Laboratory
- Environment Canada—Canadian Meteorology Centre
- Health Canada—Radiation Protection Bureau
- National Research Council—Ionizing Radiation
- Natural Resources Canada—Earth Sciences Sector—Geomatics Canada Mapping Services Branch
- Natural Resources Canada—Emergency Mapping Service
- Natural Resources Canada—Radiation Geophysics Section—National Gamma Ray Spectrometry Program

Affiliate Members:

- Canadian Security and Intelligence Service
- Department of National Defence—J2 Directorate for Strategic Intelligence
- National Research Council—Fuel Cell Program
- National Research Council—Institute for Research in Construction
- National Research Council—Integrated Manufacturing Technology Institute
- Royal Canadian Mounted Police—Explosive Disposal Unit, Forensic Identification Services, and Forensic Laboratory Services

Partners:

- Emergency Protection Laboratory—Ontario
- Federal, Provincial and Territorial Radiation Protection Committee
- Radiation Protection Bureau—British Columbia
- US Department of Energy

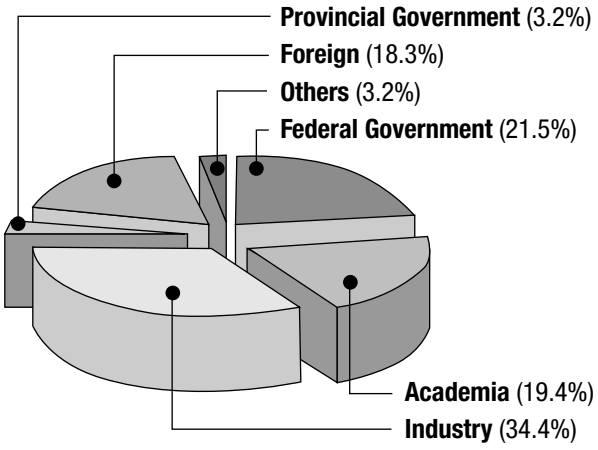
Annex D: Project Partners by Sector

CRTI collaborated with a diversity of partners in 2003–2004. The figure below illustrates a breakdown of the number of CRTI partners by sector.

CRTI Partners by Sector

Sector	Number of Partners	%
Federal Government	20	21.5
Academia	18	19.4
Industry	32	34.4
Provincial Government	3	3.2
Foreign	17	18.3
Others	3	3.2

CRTI Partners by Sector (2003–2004)



Federal Government Partners

- Atomic Energy of Canada Limited
- Canada Customs and Revenue Agency (Canadian 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 Fisheries and Oceans
- Department of National Defence
- Environment Canada
- Health Canada
- Industry Canada
- National Research Council
- Natural Resources Canada
- Office of Critical Infrastructure Protection and Emergency Preparedness (Public Safety and Emergency Preparedness Canada)
- Public Safety and Emergency Preparedness Canada
- Royal Canadian Mounted Police
- Solicitor General of Canada (Public Safety and Emergency Preparedness Canada)
- Transport Canada

Industry Partners

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

Academic Partners

- Carleton University
- McGill University
- McMaster University
- Memorial University
- Queens University
- Royal Military College
- 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 Centre (Denmark)
- Science Applications International Corporation (US)
- TNO Prinz Mauritz Laboratory (Netherlands)
- UK 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	Total
PROJECT CRTI-0006RD:	52,500	457,500	400,000	289,500	-	1,199,500
PROJECT CRTI-0064RD:	130,070	733,747	571,576	600,315	437,042	2,472,750
PROJECT CRTI-0087RD:	178,592	1,660,995	786,713	-	-	2,626,300
PROJECT CRTI-0091RD:	148,487	702,610	757,674	528,970	176,722	2,314,463
PROJECT CRTI-0133RD:	673,100	364,700	254,700	174,900	-	1,467,400
PROJECT CRTI-0154RD:	182,210	718,149	731,749	808,939	558,380	2,999,427
PROJECT CRTI-0196TA:	695,400	1,401,200	1,229,100	1,101,500	–	4,427,200
PROJECT CRTI-0011TA:	200,000	600,000	–	–	–	800,000
PROJECT CRTI-02-0091TA:	–	91,723	100,000	100,000	100,000	391,723
PROJECT CRTI-02-0041TA:	–	349,330	606,000	179,700	–	1,135,030
PROJECT CRTI-02-0035RD:	–	1,160,071	1,258,365	1,281,226	–	3,699,662
PROJECT CRTI-02-0021RD:	–	500,000	500,000	–	–	1,000,000
PROJECT CRTI-02-0066RD:	–	384,843	599,500	194,500	312,938	1,491,781
PROJECT CRTI-02-0069RD:	–	856,035	398,929	301,600	304,272	1,860,836
PROJECT CRTI-0029RD:	198,460	1,094,410	871,340	583,670	252,130	3,000,010
PROJECT CRTI-0120RD:	107,479	1,047,575	497,446	–	–	1,652,500
PROJECT CRTI-0004TA:	50,000	–	–	–	–	50,000
PROJECT CRTI-0019TA:	361,600	1,535,000	729,000	–	–	2,625,600
PROJECT CRTI-0060TA:	–	1,082,985	84,693	–	–	1,167,678
PROJECT CRTI-0131TA:	400,000	1,800,000	1,700,000	1,100,000	-	5,000,000
PROJECT CRTI-0100TA:	–	1,170,296	1,557,333	–	–	2,727,629
PROJECT CRTI-0161TA:	443,145	695,655	21,200	–	–	1,160,000
PROJECT CRTI-02-0043TA:	–	1,076,982	738,202	146,578	-	1,961,762
PROJECT CRTI-02-0053TA:	–	683,027	799,737	–	–	1,482,764
PROJECT CRTI-02-0007TA:	-	637,167	835,167	267,566	–	1,739,900
PROJECT CRTI-02-0093TA:	–	583,275	427,446	159,779	–	1,170,500
PROJECT CRTI-02-0067RD:	–	526,316	763,269	710,411	–	1,999,996
PROJECT CRTI-02-0080RD:	–	339,565	655,665	610,565	594,065	2,199,860
PROJECT CRTI-0027RD:	142,600	1,250,500	916,300	743,400	607,200	3,660,000
PROJECT CRTI-0072RD:	34,100	228,100	319,100	245,800	–	827,100
PROJECT CRTI-0203RD:	213,400	912,800	195,400	–	–	1,321,600
PROJECT CRTI-0204RD:	163,100	259,700	136,600	–	–	559,400
PROJECT CRTI-0052TA:	95,826	222,706	349,943	39,750	–	708,225
PROJECT CRTI-0080TA:	142,000	353,000	–	–	–	495,000
PROJECT CRTI-0085TA:	58,950	656,000	485,050	–	–	1,200,000
PROJECT CRTI-0105TA:	247,220	655,333	534,277	338,222	–	1,775,052
PROJECT CRTI-02-0057TA:	–	240,000	220,000	190,000	–	650,000
PROJECT CRTI-02-0041RD:	–	455,500	560,500	550,500	449,500	2,016,000
PROJECT CRTI-02-0093RD:	–	541,000	961,000	1,157,000	826,000	3,485,000
PROJECT CRTI-02-0045RD:	–	339,330	460,820	565,900	-	1,366,050
PROJECT CRTI-02-0024RD:	–	378,700	612,200	420,300	–	1,411,200

Annex F: Technology Acquisitions Selected in 2003–2004

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 2003–2004

Project Number	CRTI $ (000)s	Capability Description	Department/Facility
BIO014AP	241	Canada/US Counterterrorism R&D MOU – Aerosol Sampling Equipment Retention	DND, DRDC Suffield
BIO016AP	250	Penside and Rapid Diagnostic Tests for FMD, Hog Cholera and Avian Influenza	CFIA
BIO017AP	256	Network GIS	CFIA
BIO018AP	384	Public Health Map Generator	HC, Population and Public Health Branch
BIO019AP	685	Upgrade of Hybridoma Facilities	DND, DRDC Suffield
BIO020AP	365	Rapid Detection and ID of Plant Pests and Pathogens	CFIA
CHEM013AP	103	High Throughput, Multiplexed ID of Ricin and Other Bio-Toxins	DND, DRDC Suffield
CHEM014AP	60	Standard Atmospheres for CWA Detector Challenge and ID	DND, DRDC Suffield
CHEM015AP	220	Vehicle-Mounted Gas Chromatographs for Analysis of Target Chemicals in Air and Water	EC, Emergencies Science & Technology Division
CHEM016AP	275	High Performance Liquid Chromatograph – Mass Selective Detector (HPLC-MSD) for Analysis of Pesticide Residues	CFIA, Calgary Lab
CHEM017AP	35	Chemical Containment Laboratory Study	HC, Winnipeg Building
CHEM018AP	390	Liquid Chromatograph/Tandem/Mass Spectrometer (LC/MS/MS) for Analysis of Saxitoxin and Other Marine Toxins	CFIA, Dartmouth Lab
CHEM019AP	480	Equipment for Decontamination of EC Personnel and Others	EC, Emergencies Science & Technology Division
CHEM020AP	305	Coordinated Computer Management System to Facilitate Immediate Lab Cluster Reaction Capabilities	EC, National Lab for Environmental Testing, National Water Research Institute
RN001AP	630	Fixed Point Radiation Surveillance System for Canada	HC, Rad Protection Bureau
RN006AP	80	Networking Laboratory Results from a Certified National Radiological Laboratory	HC, Rad Protection Bureau
RN007AP	1,500	Deployable Analytic Facilities to Support Expert Response to RN Incidents	Multi-departmental – AECL CRL, DRDC Ottawa, NRC, CNSC, CCRA, HC, DFO

Annex G: Financial Report

CRTI Funding Model

CRTI Program Funding

$ Millions	5-year
CRTI Secretariat	9.5
Technology Acquisition	27.5
Technology Acceleration	38.0
Research and Technology Development	95.0
Totals	**170.0**

CRTI Funding Model (Framework)

$ Millions	2001–2002	2002–2003	2003–2004	2004–2005	2005–2006	2006–2007	Total
CRTI Secretariat	0.1	1.8	1.9	1.9	1.9	1.9	9.5
Technology Acquisition	0.0	11.1	6.1	4.1	3.1	3.1	27.5
Technology Acceleration	0.0	10.0	10.0	7.0	6.0	5.0	38.0
Research and Technology Development	0.0	7.0	17.0	22.0	24.0	25.0	95.0
Total	**0.1**	**29.9**	**35.0**	**35.0**	**35.0**	**35.0**	**170.0**

CRTI Financial Overview 2003–2004

Distribution of Funds by Sector

Data	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	13,737,124	11,648,023	28,745,825
2004-2005	3,059,489	517,807	12,012,081	8,036,617	23,625,994
2005-2006	1,823,271	535,975	7,718,763	3,312,582	13,390,591
2006-2007	1,160,036	335,176	2,996,662	126,375	4,618,249
2007-2008	-	-	-	-	-

Distribution of Funds by Project

Data	RD	TA	Grand Total
2002–2003	2,224,098	2,694,141	4,918,239
2003–2004	14,912,146	13,833,679	28,745,825
2004–2005	13,208,846	10,417,148	23,625,994
2005–2006	9,767,496	3,623,095	13,390,591
2006–2007	4,518,249	100,000	4,618,249
2007–2008	–	–	–

CRTI Funding to Federal Government Partners (2003–2004)

Dept. Name	Total
AECL	356,000
CCRA	25,000
CFIA	2,024,944
DNBCD	2,095
DND	4,914,827
EC	740,332
HC	3,663,331
NRC	1,305,440
RCMP	705,155
	13,737,124