EXECUTIVE SUMMARY

NORTH AMERICAN TECHNOLOGY AND INDUSTRIAL BASE ORGANIZATION (NATIBO)

On 30 May, 2001, the United States Department of Defense (DoD) and the Department of National Defence (DND) of Canada entered into a Memorandum of Understanding (MOU) whereby the two departments established an official channel to more efficiently pursue their efforts to improve the defense posture of the North American technology and industrial base. Although the North American Technology and Industrial Base Organization (NATIBO, formerly NADIBO) has existed since 1987, the MOU formalized the organization whose mission is to promote a cost effective, healthy technology and industrial base that is responsive to the national and economic security needs of the United States and Canada.

The objectives of the MOU are to:

- effectively leverage dollars/resources and reduce redundant efforts through bilateral cooperation on studies and projects relating to the defense technology and industrial base of the US and Canada;
- achieve rapid technology insertion and commercialization of emerging technologies that can be used in the manufacture and repair of defense materiel; and
- permit a wide variety of work to be accomplished on a single project, from paper studies and initial research to technology insertion efforts.

These objectives are met through the identification and analysis of key technology and industrial sectors critical to defense, the assessment of the viability of these sectors, the identification of issues and barriers related to the sectors' viability and the development of strategies to enhance and sustain the health of these sectors and their marketplaces.

The NATIBO spearheaded an effort to address the challenges of advancing and maintaining technological superiority in light of reduced government research and development funding. The criteria used for selecting technologies to study through this program are:

- the technology is in an area of high interest;
- the technology has potential for broad military and commercial applications;
- development and/or production exists in both the US and Canada; and
- there is a good window of opportunity for investment and application in the candidate technology.

DEFENSE TECHNOLOGY OPPORTUNITIES FOR FIRST RESPONDERS

Background

In July 2002, Congressman Curt Weldon from Pennsylvania invited representatives from the DoD to talk with him about DoD's developed technologies that were, or could be, made available for civilian first responders, specifically, fire fighters. The intent behind this initiative was to facilitate technology transfer from DoD to industry for commercial production so as to make them available to first responders.

As a result of the meeting, the Deputy Under Secretary of Defense (Advanced Systems and Concepts) Office of Technology Transitions (OTT) requested the Defense laboratories identify technologies that could be transformed into usable products and made available for first responders within 12-18 months. In phase I, the laboratories identified nineteen technologies/products that were at different stages of development/commercialization. Some were at the technology/prototype stage and some had been transferred to a commercial company where products using the technologies were available commercially. At the end of phase I, five technologies were retained as being most mature and useful to the civilian first responders' community. Those five technologies are the subjects of Phase II, which constitute this study.

Current

For this study, the US and Canadian governments assessed the potential for technology transfer of five technologies, which were developed to meet military requirements, to civilian first responders (emergency response teams, police, firefighters, etc). For each of the five technologies identified, the study determined:

- if the technology was already commercialized in North America;
- if competing technology existed and at what stage of development it was (i.e. research, development, commercialization);
- if industrial capability for production was available;
- if barriers existed to the transfer or manufacture of the technology;
- if there was a viable first responders market, or other existing market(s), for the technology; and
- recommendations on ways the US and Canadian Governments could further assist in making the technology available to the first responders.

The current Technology Transfer for First Responders Initiative has multiple parts:

- Phase I has identified and assessed the technologies available. This phase resulted in the down selection of the five technologies to be studied in Phase II.

- Phase II, which resulted in this report, was a Technology and Industrial Base Study to identify the North American manufacturing capabilities, competing technologies, and the barriers and facilitators to the transfer or manufacture of the five technologies down selected in Phase I.
- Phase III, not yet started, will use the recommendations of the Phase II Report to develop a Transition Plan that will include qualification and nonrecurring engineering costs, an outline of who needs to be involved and steps to be taken.

Phase I was completed in late 2003, but it recommended an ongoing identification process within the two Departments to ensure that new technologies are made available to the first responders. Phase I resulted in an initial listing of nineteen technologies. An assessment of the maturity and commercial interest in those technologies was carried out and five technologies were finally identified to pursue in Phase II.

The technologies identified were:

- Effervescent Liquid Fine Mist Apparatus for Extinguishing Fire (ELFMA) – a self contained fire extinguisher that uses chemical reaction to produce a bubbly two-phase (effervescent) flow through a convergent-divergent nozzle. The spray contains non-toxic gas bubbles that provide energy to atomize the water in the nozzle. The resulting fine mist increases suppressant surface area, oxygen displacement and heat dissipation. The system consumes less water than traditional sprinkler systems (thereby minimizing water damage) and is environmentally friendly.

- Joint Firefighter Integrated Response Ensemble (JFIRE) – a first-generation firefighter personal protective suit that provides firefighters with NBC protection while engaged in fighting fires. Previously, firefighters had to remain outside a contaminated building or area and were therefore restricted to containing the fire. Now they can enter the area and attack the fire. To work in a non-firefighting mode in a nuclear, biological or chemical contaminated environment, the firefighter can breathe ambient air through a CW mask that is filtered by a C2 canister. If a firefighter has to enter atmospheres where filtered air is not tenable, they can switch to supplied breathing air to fight fire or perform rescues. This suit is already thoroughly tested and fielded worldwide with military firefighters.

- Panoramic Night Vision Goggles (PNV) – night vision goggles with a wide field of vision to improve situational awareness. Normal goggles have a field of vision in the range of 40 degrees. These goggles have a 100-degree field of vision. Designed originally for pilots, they would also be useful to first responders.

- Remote Casualty Location Assessment Device (RCLAD) – is a developmental casualty location tool focused toward the search and rescue mission. Using various technologies, including Micro Impulse Radar or Ultra-Wide Band Radar, it locates casualties buried in rubble by remotely sensing heartbeat and breathing. It is intended to be low cost, portable and able to detect minute motion at close range though 10 feet of rubble. This technology was developed because existing heat sensor technology had a very limited range and could not medically assess a casualty, and passive listening devices require all quiet conditions – meaning the stop of all local rescue work.

- Threat Containment Unit – a small (about the size of a refrigerator), lightweight, inexpensive mobile bomb containment and disposal unit intended for one time use. Developed because existing technologies were too large or fixed, thus requiring the suspected package to be moved in unsafe and open conditions to the bomb disposal unit. This new container is small enough to enter buildings and still contain an explosion in a relatively confined space.

Phase II, which resulted in this report, is intended to identify production capabilities, barriers (limited requirement, the technology/item not producible, need not identified, institutional problems, etc.) and the facilitators (what can be done to encourage a production source) to transfer and/or manufacture the five technologies identified.

The methodology for Phase II included data collection from various sources including questionnaires, phone conversations with company representatives and government laboratory personnel, site visits and Internet sites.

For Phase III, the DoD has established a Technology Transfer Center of Excellence for First Responders at the University of Pittsburgh's Institute for Entrepreneurial Excellence, building on their small business development capabilities. This effort is funded at $500K in year 1 and $1.5M in year 2, with anticipated funding matching the level of effort in future years. This new Center will work with DND, DoD and civilian first responders in the two countries based on the NATIBO Report results as well as the results of the joint study matching first responders needs and identifying common areas for focus. If no manufacturing capability currently exists for these technologies, the Center will work with companies/new startups to establish a manufacturing capability.

Findings and Recommendations

ELFMA

Due to the simplicity of the design and the material involved in the manufacture of the ELFMA nozzle and fire extinguisher, there are numerous potential manufacturers (more than those that have been identified in this study) for this

equipment. There are also numerous manufacturers currently producing nozzles, sprinkler systems and fire extinguishers, which is reflective of a highly competitive market. This situation is a barrier to new competitors that have not yet established a client base, whereas the current manufacturers have no incentive to produce ELFMA nozzles or fire extinguishers because of their established positions in their respective markets. In addition, the cost of introducing a new fire extinguisher in the market is time consuming (24 to 36 months) and costly (more than US$ 100K) due to testing and certification requirements.

The base ELFMA patent (United States Patent # 5,520,331), which covers the nozzle, has already been licensed to International Aero (IA) for fire suppression throughout the US. This license covers the patent's use in the aerospace industry, the ground transportation industry, the marine industry, the offshore oil industry, and for buildings and other fixed structures. IA is currently concentrating on the aerospace industry, as it is the company's primary market, but they are willing to work with other companies for applications in other markets.

However, the patent for the ELFMA fire extinguisher has not yet been licensed. This patent would be relevant to companies wanting to manufacture fire extinguishers for the first responders market. At a minimum, the companies identified in the sections on the potential "fire extinguisher manufacturers" should be encouraged to pursue that route.

Since the technology involved in ELFMA is within reach of several companies and there are important potential applications for first responders, further licensing agreements should be encouraged to allow companies to manufacture ELFMA nozzles, sprinkler systems and fire extinguishers for the first responders' community.

Another ELFMA application that has not yet been considered and that has potential for further development is to adapt the ELFMA nozzle for forest fire fighting. The first step could be to demonstrate feasibility in a laboratory environment with larger apparatus and water throughput. The laboratory could then develop a prototype kit and have it installed on a test range firefighting vehicle currently part of the US Army inventory. If successful, the vehicle could then be used in a high-risk area for operational testing.

Further development of ELFMA must include consideration of unit cost to make it affordable and widely available to the local/municipal first responders' community.

JFIRE

Due to the lack of a civilian accepted standard (NIOSH) for a CB mask, civilian first responders cannot use the JFIRE mask which uses both a CB canister and a Self Contained Breathing Apparatus (SCBA). This situation limits the marketing

of a commercial off-the-shelf (COTS) ensemble for use by both civilian and military first responders.

Many textile manufacturers are bringing their newest textile or component to AFRL Tyndall AFB for subject matter expertise and opinion. While this approach provides some value to the manufacturers, it appears to hold little influence on the developmental direction of the next generation JFIRE.

In the Potential Canadian Manufacturers – JFIRE section, four Canadian companies (Stedfast, Bacou-Dalloz, AirBoss and VRS) were identified as having all complementary components (i.e. textile, garment, boots, gloves, mask) that could either contribute to the Full Spectrum Threat Fire Response Ensemble (FSTFRE) solution or present a different, but complete, solution to the next generation JFIRE requirement. Taken independently, each company could also be aligned with US partners. This also applies to US companies producing complementary components.

From a joint US-Canada military perspective, the next generation JFIRE (possibly the FSTFRE) is where future efforts should be concentrated. Individual suit components were discussed at length to capture the current state of the technology and encourage synergies among the listed companies. Nevertheless, it is recognized that the next iteration of these individual suit components should not be stove-piped independently, but specifically developed with an integration emphasis for the next generation JFIRE. Currently available solutions should not necessarily drive or constrain development (for instance, the bunker suit and Joint Services Lightweight Integrated Suit Technology (JSLIST) could be integrated into a single garment instead of two separate ones).

The Air Force, which has the largest firefighter contingent among the US Services, should accelerate development and finalization of their capability development document, highlighting current JFIRE deficiencies. This document is key to early budgetary identification, development and acquisition funding for all US DoD firefighter ensembles.

There is a need to set a standard for civilian use of CB masks. This would permit civilian first responders, and firefighters in particular, to use the JFIRE. Any future development of the JFIRE CB mask/SCBA should also be acceptable to the civilian first responders' community. This would ensure a COTS solution for both military and civilian personnel, thus reducing unit cost.

Efforts should be better coordinated within the US military and between the US and Canadian militaries in respect to developing a common structural firefighter/CB ensemble requirement. This would also contribute to reducing the unit cost for all potential users, whether they are civilian or military.

PNVG

PNVGs are at an advanced stage of technology development and the USAF does not hold proprietary rights. The night vision industry in North America is sufficiently large to support the needs of the militaries and the first responders.

The technology currently used in PNVG is an image intensifier tube, commonly called an I^2 tube. The manufacturers of these tubes are the key players in the industry as the tubes are the critical components of the PNVG. Any other company wanting to manufacture the PNVG would have to get I^2 tubes from these manufacturers or develop their own. This last strategy would be difficult for the new companies wanting to enter the market because of the investment and specialized skills that are required.

Another type of technology used for night vision is thermal imaging sensors, but the images are not as clear as the images in equipment using I^2 tube technology. The future trend for this kind of device is to combine both technologies into one system. This will give the end user the best of both worlds. The images will be clearer with the I^2 tube, but if there is fog or smoke, the user will be able to switch to the thermal imaging sensor, since night vision equipment using an I^2 tube cannot see through these impediments.

The biggest hurdle to commercializing the PNVG to the first responders' community remains its high cost.

The Department of Homeland Security (DHS) and Public Safety and Emergency Preparedness Canada (PSEPC) should consider acquiring a quantity of PNVGs that could be held in different key locations throughout North America. They could be stored in these locations and made readily available for use by first responders. Adequate training in using these devices should also be delivered to the first responders' community. Larger municipalities may be able to afford their own devices, but for the smaller communities, a regional pool would provide a capability they cannot afford.

Defense departments could also help drive down the cost of production of these systems by a "design to cost" development program for DoD and DND first responders needs. The resulting products could then be procured at an affordable price by other first responder agencies throughout North America.

RCLAD

Time Domain is the only company making RCLAD. RCLAD uses time modulated ultra wideband (TM-UWB) radar technology to detect live victims in rubble up to 23 inches thick. Time Domain is primarily a research company with limited manufacturing capability.

Since no other manufacturer makes live victim location devices of this nature, the companies most capable of making RCLAD-type devices are ground penetrating radar (GPR) manufacturers and through-the-wall surveillance (TWS) manufacturers.

The RCLAD system is being developed by Time Domain Corporation and all the intellectual property associated with the device belongs, or will belong, to the company. Existing Time Domain technology has been made widely available for licensing and it is likely the company will choose that approach to the RCLAD technology or, alternatively, use contract manufacturing.

A similar technology, Micro Impulse Radar (MIR), from Lawrence Livermore National Laboratory (LLNL) may also become available through other UWB Radar companies. It is possible that two or more private-sector sources of similar technology will be available within two to three years if the technology is proven to be technically viable and the cost structure is acceptable.

The commercialization of RCLAD will depend on the technical capabilities of the device, its unit cost and the availability of competing technologies.

One option to help transfer this technology quickly to first responders – assuming that the cost and technical targets are achieved – would be for the DHS to directly acquire some of the devices concurrently with, or prior to, DoD acquisition. These devices could then be made widely available under a grant program to first responders for further testing and evaluation. Direct acquisition by the DHS concurrently with DoD would likely lower the per-unit acquisition cost.

PSEPC could undertake a similar approach. PSEPC is currently setting up several Heavy Urban Search and Rescue (HUSAR) teams across Canada. As part of this endeavor, they are creating a list of standard equipment for these HUSAR teams. It is recommended that they add RCLAD to their list.

TCU

The TCU, designed and patented by the Naval Surface Warfare Center Carderock Division (NSWCCD), is a box-shaped steel shell with an inner liner of rigid polyurethane foam. The bomb or suspect explosive device is placed inside and is tightly packed with additional foam. If a bomb is detonated in the TCU, the foam pulverizes and the liner deforms into an ovoid or cylindroid shape while slowly venting pressure. The NSWCCD TCU is designed for a one-time use. It is small, lightweight and inexpensive.

The deployed units were made in US DoD facilities because the Federal Aviation Administration (FAA) has not licensed the NSWCCD TCU for commercial production. As the FAA is not expected to broaden the NSWCCD TCU usage beyond the airports within its mandate, no license is available.

Nevertheless, there are already several North American companies making products similar to the NSWCCD TCU. The TCUs designed by these companies vary; they can be mobile or fixed and designed for both multiple or single uses. Some are even capable of CB containment.

No further action is recommended on the NSWCCD TCU as there are comparable products already commercially available.

Airport first responders should also consider the acquisition of other technologies suitable to handle threats other than just explosives (i.e. CB).

These technologies should also be considered for urban bomb containment and disposal in crowded outdoor environments and in subways, train stations, large stores and office buildings.