RISK ASSESSMENT RELATED TO DETECTING AND IDENTIFYING CHEMICAL AGENTS: A CANADIAN FORCES APPROACH

Major Jean-François Legault, MCIC, PEng.
Directorate of Nuclear, Biological and Chemical Defence
National Defence Headquarters
MGen G. R. Pearkes Building
101 Colonel By Drive
Ottawa, ON
K1A 0K2
legault.jjf@forces.gc.ca

Abstract:
Since September 11th, 2001, the threat of chemical agents is now more unfortunately a "hot" topic of discussion among numerous federal/provincial/municipal agencies. Combined with this is the use of Toxic Industrial Chemicals or 'TICs' where chemical plants or storage facilities may be destroyed, resulting in massive contamination. The Canadian Forces (CF) have quickly recognized the situation and must consider the impact on the modern battlefield or urban area of a wider range of hazardous chemical compounds, which include classic chemical warfare agents as well as TICs. As a result, they have undertaken a $76 M project aimed at detecting and identifying those chemical hazards. More specifically, the project is scheduled to deliver the following capabilities by 2005-6:

- *An area detection and identification system;*
- *A local detection and identification system; and*
- *A personal detection system.*

Using this project, this paper will present the process by which risk is identified and assessed by the CF. Recognizing that risk is defined by the probability times the impact, both aspects will be discussed in terms of the CF project management system. The following measures designed to identify and mitigate risks will also be discussed:

- *Resources;*
- *Changes in Technology;*
- *Technology Challenges;*
- *International Co-operation and Scientific Support; and*
- *Cost Reduction Measures.*

1. Aim

The aim of this paper is to present a Canadian Forces (CF) risk assessment related to detecting and identifying chemical agents. The latter are defined as a chemical substance intended for use in military operations to kill, seriously injure, or incapacitate humans or animal through its physiological effects. Combined with those agents are other chemicals not covered under this definition and which are defined as "Toxic Industrial Chemicals" or TICs.

2. Background

2.1 Capability Deficiency

The Government of Canada has recognized since 1915 that an attack by chemical warfare agents can produce high casualties and have a devastating psychological impact on military personnel. Even the threat of a hazardous chemical attack would have an important negative impact on the CF ability to achieve its operational objectives because of the enormous resources needed to mount an effective defence. The CF currently lacks an operationally viable hazardous chemical detection, identification and sampling system to alert military commanders and personnel within the Area, Local and Personal battlespace of the presence of a hazardous chemical. The chemical warfare agent sensors now in service have a limited use and they are generally employed to verify the presence or absence of a chemical agent once an attack or chemical event has taken place.

2.2 Chemical Agent Sensor Project

As a result of the above capability deficiency, the CF have undertaken a major initiative, the Chemical Agent Sensor Project, to address this shortfall. The intent is to provide a capability to detect, identify and sample hazardous chemical compounds (chemical agents and TICs). The Chemical Agent Sensor project intends to:

a. Acquire sufficient hazardous chemical compounds detection, identification and sampling functionality to equip the Main Contingent Force and to ensure that the CF can simultaneously respond to an emergency in Canada involving the use or threat of the use of a hazardous chemical compounds at the Area, Local and Personal Capability level. This objective is summarized in Table 1.

Capability Requirements	Functions	Tasks
Area (Outside the target area)	Detect and identify hazardous chemical compounds	Wide area surveillance before the chemical incident Wide area monitoring after the incident
Local (Within the target area)	Detect, identify and sample hazardous chemical compounds	Surveillance before the chemical incident Monitoring area contamination, collective protection and decontamination process Reconnaissance and survey Sample collection
Personal	Detect hazardous chemical compound	Monitoring

Table 1 - Summary of Capability Requirements

b. Acquire sufficient systems to provide for essential individual and collective training throughout the CF;

c. Acquire the Integrated Logistics Systems (ILS) capability needed to support all systems throughout the first two years of their in-service life; and

d. Ensure that the systems acquired can be linked or integrated into the future Command Control and Information Systems now being defined and developed by the CF Command System.

2.3 Project Plan

There are several potential military off the shelf (MOTS) or commercial-off the shelf (COTS) solutions that could meet the requirements of the CF. Although solutions exist, they do so at different maturity levels and the current state of technology is developing rapidly due to global demands for new solutions. This means that other, more advanced solutions might be available in 18-24 months time. The Department of National Defence (DND) intends to follow a normal procurement approach, where by the project team will use the data acquired from foreign trial reports, test and evaluation results and buy and try. This should reduce the risk and provide the best possible product to satisfy the operational requirement within the time constraints and the performance objectives of the Nuclear, Biological and Chemical (NBC) Defence Program. Consequently, to procure solutions commercially available as early as possible without increasing overall project risk level, the intent is to implement the project by phases, as each solution is defined and available. It is anticipated that three phases will be required to procure the complete solution, which include the acquisition of the Local detection and sampling system in Phase 1, the Personal detection system in Phase 2 and the Area detection system in Phase 3.

3. Current Project Risk Assessment

This section provides the results of the current project risk assessment, including the estimated effect on project costs, and risk management strategies proposed.

3.1 External and Internal Risk Factors

The external risk factors are discussed in greater detail at Annex A.

The internal risk factors are discussed at Annex B.

3.1.1 Changes in government priorities

This topic is discussed at Annex A.

3.1.2 Externally imposed schedule

The impact on the project of an externally imposed schedule or of time delays resulting from such things as relatively minor changes in technology; requirements of participating

departments; available windows of opportunity with international partners; seasonal considerations; the need for regulatory approvals; or other similar factors.

No externally imposed schedule risks are identified at this time. The likelihood of new externally imposed schedule risks is assessed as low. Should new risks arise the impact could be high, as it would affect both performance and cost criteria. It would also impact priority for deliverables. Adjusting the definition phase would be the first step in mitigating any schedule risk. It also might be possible to combine two phases of the project so that a greater number of deliverables are included in a single procurement.

3.1.3 Private sector capability

Civilian industry manufactures a variety of chemical sensors to monitor industrial pollution, chemical leaks and aspects of the industrial process. In addition, a number of highly skilled firms produce military off the shelf chemical agent sensors/monitors for the military market. As this project has been directed to deliver a capability in five years (2004-09) the project team has identified several contenders to meet the CF requirement for each capability. There are, however, differing levels of maturity in these products. To recognize this fact the project will do a phased acquisition thus permitting lagging technology to evolve or final testing/type classification to be completed. The likelihood of industry not fulfilling the CF's requirements in the 2004-09 timeframe of the project is assessed as low due to the current global demand for this technology. This is deemed a low risk project because of these factors.

3.1.4 Sponsoring department cost estimate expertise

The experience of the sponsoring department in managing and developing cost estimates for a project of a particular magnitude or type or its ability to assign sufficient in-house expertise.

The risk of this factor is assessed as low. DND has extensive experience in procuring and in the life cycle maintenance cost of chemical and biological sensor systems. The project team will build on this experience through a "buy and try" program and formal submissions from industry.

3.1.5 Project size and complexity

This is not considered a large or complex project. The risks associated with the project are mitigated by the fact that there are five or six separate COTS/MOTS deliverables that will be phased in throughout the life of the project. The risks are further mitigated because there is a dedicated project management office responsible for delivering all aspects of the project.

3.1.6 Availability of data upon which to base risk assessment

The availability of feasibility studies, test or user trial programs, pre-production appraisals, similar production items, reliable construction estimates, or other similar data upon which to base a risk assessment.

The risk is assessed as low. The project will not introduce any unproven technologies. DND has extensive experience with in-service chemical agent sensors and other devices with similar technologies. The project team has developed a project definition plan that includes a data collection program.

3.1.7 Unproven technology

The need for research, development and testing of unproved technology or assemblies of products within the scope of the project deliverables.

The risk is assessed as low. There are no unproven or developmental technologies associated with this project. All but the area detection capability is in production, completing final pre-production testing or in-service within North Atlantic Treaty Organisation (NATO).

3.1.8 Number of critical work locations

The number of locations involved in completing the work critical to the end product.

The risk is assessed as low. The number of work location in terms of prime contractors and sub-component suppliers could potentially be quite high because of the number of deliverables involved in this project. The Requests for Proposal will be structure to ensure that one prime contractor is responsible for the delivery of each major capability. In this way the prime contractors would be responsible for the performance of their sub-contractors.

3.1.9 Hazards

Inherent hazards of a biological, chemical, environmental, radiological, explosive, toxic or other similar nature.

The risk is assessed as low. There are no biological, chemical, explosive hazards associated with any of these systems. Some sensors, which use Ion Mobile Spectrometry contain a small radiological source. The procedure for certifying and controlling the hazards associated with this type of devise is well established within DND. Trial and evaluations of the various detectors using live chemical agents will only be conducted at DND facilities that are authorized to perform this type of experimental work.

3.1.10 Resources or activities provided by other participants

Whether the continuity or availability of a portion of project funding or other project activity is contingent upon the ability of other participants, especially non-federal government participants, to meet their obligations when and as defined in the project agreements.

There are no interdependencies with outside agencies or other government departments associated with this project. Alternative source delivery possibly using an offshore scientific institute will be considered only if required.

3.1.11 Joint or shared funding

The impact of potential contingent or residual liabilities arising from participation in joint or shared funded projects including liabilities caused by withdrawal from the project by one or more participants.

This project will be funded entirely by DND.

3.2 Risk Summary

The risks associated with this project are assessed as low overall because:

- All but one of the CF requirements can be met with MOTS/COTS solutions;
- The project office has assess to a wide variety of information sources upon which to base procurement decisions; and
- The project is supported by a dedicated project office; and
- Similar capabilities are being procured by the United-States and United Kingdom at this time.

4. Proposed Management Framework

This section provides the proposed management framework. {Project leaders must ensure that the proposed project management framework and allocation of project management resources are based on and tailored to the complexity and the assessed risk for the individual phases of the project. The project management framework is to show how risk, complexity and allocation of human resources will be managed and reduced to the degree feasible in each phase and throughout the life of the project.}

4.1 Management of Risk

Risk is managed in accordance with the DND guidelines.

4.1.1 Applying risk management to the project

A process for applying risk management, called “Apply Risk Management to the Project” is implemented. This includes starting, installing, and improving continuous risk management in the project.

4.1.2 Performing continuous risk management

Within DND, a set of processes has been identified and is used as continuous activities throughout the life cycle of a project. The project team will use the following activities to manage risk:

a. Identify Risk. Search for and locate risks before they become problems. Capture statements of risk and context;

b. Analyze Risk Information. Transform risk data into decision-making information. Risk analysis is performed to determine what is important to the project and to set priorities. Evaluate impact probability, and timeframe, classify risks, and prioritize risks;

c. Plan Risk Response. Translate risk information into decisions and mitigating actions (both present and future) and implement those actions. Produce mitigation plans for mitigating individual or groups of risks;

d. Track Risk Indicators and Actions. Monitor risk indicators and mitigation plans. Indicators and trends provide information to activate plans and contingencies. These are also reviewed periodically to measure progress and identify new risks. Acquire, compile and report data on the risk and mitigation plan;

e. Control Risk Response. Correct for deviations from the risk mitigation plans. Actions can lead to corrections in products or processes. Any action may lead to joint resolution. Changes to risks, risks that become problems, or faulty plans require adjustments in plans or actions. Analyze tracking data, decide on how to proceed, and execute decisions; and

f. Communicate Risk Information. Provide information and feedback internal and external to the project on the risk activities, current risks, and emerging risks. Communication occurs formally and informally and is a key process that links to all the other Manage Project Risk processes.

4.2 Management of Complexity

4.2.1 Approval Process

The project team then expects deliver the entire chemical sensor capability in three phases. This will be accomplished by seeking implementation in three phases as follows:

<u>First Phase – Proposed Deliverables:</u>

- Local detection and identification capability;
- Chemical sampling collection capability;
- Training and simulation unique to the Local system; and
- ILS unique to the Local detection capability,

Second Phase – Proposed Deliverables:

- Personal detection capability;
- Training and simulation capability unique to the Personal system; and
- ILS unique to the Personal detection capability;

Third Phase – Proposed Deliverables

- Area detection and identification capability
- Training and simulation unique to the area system;
- ILS unique to the area detection and identification capability.

4.2.2 Monitoring and Assessment

Project progress, quality and performance assessment is pursued at two levels:

a. Project Team Level. At the project level, the Project Director (PD) of the Chemical Agent Sensor project reports on progress and coordination matters during the weekly project production meeting. All items of concern are dealt with immediately or recorded for further staffing;

b. Senior Review Board (SRB) Level. At the SRB level, the PD and Project Manager (PM) will keep the SRB Core Members apprised of any significant event on a monthly basis, as well as giving regular briefings and updates to the full SRB on an as required basis, and at least annually.

4.2.3 External Audit

The DND Chief of Review Services (CRS) may conduct an independent review of the project at his discretion.

4.3 Risk Assessment and Mitigation

This is an initial risk assessment. Measures will be implemented throughout the life of the project to identify and mitigate risks. These measures are explained at Annexes A and B.

5. Conclusion

The risk associated with the procurement of the local and personal detection systems is assessed as low because only MOTS or COTS solutions are being considered. Furthermore, similar modern MOTS and COTS detection equipment is currently being procured or are in the final pre-production testing phase in the US, UK and elsewhere within NATO. The risk associated with the acquisition of an area detection system is assessed as medium because the proposed

solution is the Defence R&D Canada (DRCD) -Valcartier standoff detection system, which requires some engineering development in order to meet the CF requirement.

ANNEX A - EXTERNAL FACTORS

Risk Factor	Description	Mitigation	Second Level Mitigation	Risk
Government Policy	This project conforms to the 1994 White Paper on Defence and other policy guidance such as the Defence Plan 2001, which flow from government policy.	Adjust project according to Defence Planning Guidance. Increase or reduce project scope as appropriate.	Monitor Government defence priorities and announcements.	Low
Government Priorities	The Government has place a high priority in improving the CF NBC Defence capability in light of the 11 September 2001 attacks and the threat presented by international terrorism. It is unlikely that the Government will reduce the priority assigned to this activity during the planning period. ❁ This project supports the 1989 National Counter-Terrorism Plan and the Government decision to create an independent NBC Response Team.	Adjust project according to Defence Planning Guidance. ❁ The scope of this project was adjusted in part because of Government direction contained in the February 2001 Federal Budget.	Monitor Long Term Capital Program.	Low
NATO Policy and Force Goals	This project conforms to NATO doctrine and operational concepts. The risk that NATO doctrine and concepts will change during the planning period is assessed as low.	Monitor NATO policy and adjust project accordingly.	NATO Force Goals are reviewed and updated regularly.	Low
Funding	The risk associated with project funding is assessed as low at this time. Adequate funds have been allocated to meet the CF's minimum operational requirement in terms of acquiring sensing systems for the Main Contingency Force.	A reduction in funding would result in a decrease in capability delivery. The risk of that that funding might be reduced at any time must be recognized. This risk will be mitigated by preparing a number of equipment allocation solutions for	Options to reduce overall capability delivered would be presented to SRB for consideration.	Low

Risk Factor	Description	Mitigation	Second Level Mitigation	Risk
		consideration by SRB.		
Doctrine	The CF transition from a Cold War to an asymmetric threat NBC defence posture will take time to complete. As a result questions relating to the exact quality and quantity to be distributed to the Canada's naval, land, air and joint forces cannot be addressed at this time.	The definition phase is specifically designed to seek solutions to a large number of doctrinal issues.	The modelling and simulation now in progress will yield important information on designing future capabilities.	
Foreign Exchange Rate	As most of the next generation of advanced military hazardous chemical compound detectors are manufactured either in the US, the UK or off shore foreign exchange rates will have an impact on predicting the exact cost of the equipment and ILS support. This is an understood risk, which is assessed as Low.	Apply contingency funding as required in the event of a major change in foreign exchange rates.	Reduce the scope of the project in terms of capability delivered.	Low
Cost Reduction Measures	The project team does not expect that extensive buy and try, trial and evaluations and expensive studies will be required to prepare a "short list" of suitable options. Emphasis will be placed on obtaining technical and operational trial results from Canada's major allies in order to make informed decisions. The project team will also make use of loans from the US, UK. The most important costs reduction measure will result from modeling and simulation studies that have now been initiated. These studies will evaluate the effectiveness of various sensors against a number of operational scenarios. This work should result a rational and objective quantitative requirement. Finally, measures will be taken to reduce the life cycle management costs of this	Cost reduction measures will be examined throughout the life of the project.		Low

Risk Factor	Description	Mitigation	Second Level Mitigation	Risk
	program by the innovative use of Alternative Service Delivery and interoperability.			
Private Sector Capability (Canada)	For all but one deliverable the procurement strategy will be to seek MOTS and COTS solutions. ❁ Canadian companies manufacture a variety of commercial chemical sensing equipment to detect and monitor Toxic Industrial Chemicals and other hazardous materials. The possibility therefore exists that a Canadian company will form an alliance with a foreign supplier to provide part of this requirement.	This risk will be reassessed once a Procurement Review Committee has reviewed the project. ❁ This risk will be further mitigated because Canadian industry has a proven capability to provide the ongoing life-cycle support to in-service systems. The project team will conduct a logistics support analysis studies to determine the most cost-effective method to support this new capability.	This project will consider procurement solutions and strategies. A number of these reforms are designed to reduce risk.	Low
Private Sector Capability (Foreign)	Globally, there is an extensive foreign private sector capability to design, develop and deliver chemical agent sensors. There are a variety of modern detectors in-service throughout NATO and others being introduced into service. In addition, the heightened threat of a chemical agent attack has prompted substantial government and private sector R&D effort to meet future requirements. The project team has assessed that the CF will be able to meet its full operational requirement with proven MOTS items if this option is selected. The assessed risk is therefore	The project definition plan includes a detailed data collection plan to gather information on all contenders before the final option analysis in conducted. A series of trial and evaluations will be conducted employing DRDC scientific support to confirm the performance of all contenders.		Low

Risk Factor	Description	Mitigation	Second Level Mitigation	Risk
	low.			
Deliverables Requiring Unproven Technologies	There are no unproven technologies being considered as a solution to this requirement. The risk is assessed as low because all but one deliverable will be MOTS/COTS. The risk associated with the DRDC-Valcartier standoff system is assessed as medium. This risk will be reduced by a gated engineering development and strict project review.	The risks will be mitigated by a variety of methods. Only systems that have completed all scientific, technical and operational trial and evaluations will be considered. The DRDC-Valcartier system will undergo the full range of technical and pre-production trial and evaluation.	This factor will be reassessed once the project team has review the project procurement strategy.	Low
System Integration	It is recognized that systems integration command and control and information systems interface require careful study. This analysis will be undertaken during the definition phase of the project.	This risk is understood and will be mitigated a separate sub-project, which will handle the systems integration of all NBC sensors.	A separate study is in progress to identify the major integration issues and propose solutions.	Med
Changes in Technology	DRDC, Canadian Forces Liaison Officer, Canadian Defence Military Attaché, NATO Working Groups and industry will alert the project team regarding any major changes in technology. Because CF Chemical Agent Sensor project intends to deliver a capability in the 2004-09 period changes in technology would likely not have an impact on the final options selected for procurement. The project team has assessed that the technology associated with the area detection and identification system requires carefully analysis during project definition because no	The project team will receive regular updated from industry and DRDC on emerging technologies that should be considered.		Low

Risk Factor	Description	Mitigation	Second Level Mitigation	Risk
	single product is available which meets the CF's requirement. However, new products are being introduced on a regular basis because of the world wide demand. The technological risks associated with this project as assessed as low except for the area detection system which is assessed as medium.			
Technological Challenges	Introducing an area detection capability into the CF presents the most important technological challenge to the project.	To mitigate this risk the Project Team will seek the support of organizations such as the Space Optronics Section at DRDC-Valcartier in order to benefit from the Spectral Imaging Group's recent experience in the area of standoff detecting system technologies. In addition, DRDC will be requested to appoint an R&D establishment to assume the lead in coordinating the inputs from the other R&D laboratories. Technological risk will be further mitigated by the use of selected "buy and try" and technical and user evaluations.	A strict engineering review process will control the final engineering development of the DRDC-Valcartier system. Gates will be established to permit SRB to review the success of the development process.	Med
Technological	There are mature technologies to meet all but one of the CF's capability requirements using MOTS and COTS systems. The systems under	The project team will review all foreign trial and evaluation reports as part of	Extend the project definition phase to conduct further	Low

Risk Factor	Description	Mitigation	Second Level Mitigation	Risk
	considerations to meet all but one of the CF's requirements are already in-service with Canada's major allies or are in the final pre-production testing phase. ❁ The CF will benefit from the on going development work into passive standoff detection now in progress at DRDC Valcartier in meeting its area detection requirement. ❁ There is also a possibility that space based satellite imagery and airborne sensing systems whether mounted in manned or unmanned aerial platforms will become available during the planning period. These options present a very high technical, financial and schedule risk and have not been recommended for further study during definition.	the option analysis during project definition.	equipment validation as needed.	
Area Detection Technology	Area detection can be achieved through either standoff or remote sensors. The technological risk associated with remote detectors is low. The risk associated with third generation standoff detectors is assessed as medium because not device has actually been fielded.	The project team will complete the final engineering development of the DRDC-Valcartier standoff system while concurrently assessing and foreign contender that might be available to meet the CF's requirement.	Delay the introduction of an area detection system until a mature technology exists. ❁ Select a area system based on remote or point detectors.	Med
Local Detection Technology	Local detection is generally achieve by deploying a number of point detectors and link them to a warning device within the target area. This type	The project team will conduct a series of scientific, technical and user trials and	The US is currently procuring 270,000 Joint Chemical Agent	Low

Risk Factor	Description	Mitigation	Second Level Mitigation	Risk
	of technology is mature and in-service with the US, the UK and several other NATO nations.	evaluations before recommending a solution to the requirement.	Detectors (JCAD) some of which will be used to provide a local detection capability.	
Personal Detection Technology	A personal device is general a compact and lightweight point detector. Personal detection devices are now entering service with the US and UK forces. The risk assessed with this technology is assessed as low.	The project team will conduct a series of scientific, technical and user trials and evaluations before recommending a solution to the requirement	The US and the UK devices appear to both meet the CF requirement.	Low
Monitoring Technology	Chemical Agent Monitors have been in service with the CF since 1988. The technology is well understood and the risks are assessed as low.	The project team will conduct a series of scientific, technical and user trials and evaluations before recommending a solution to the requirement		Low
Sample Collection Technology	Two types of sample collection kits have been purchased and are under evaluation by DRDC-Suffield. The technology is well understood and the risks are assessed as low.	There are virtually no risks associated with sample collection kits.		Low
Simulation Technology	There is a requirement for training simulators for the local and personal detection system. The CF already has these types of simulators in service and as such the techno1ogy is well understood and the risk is assessed as low.	The project team has already initiated a training development program to review the overall NBC Defence training concept for use with the next generation of NBC systems. This working group will present its recommendations to SRB on a regular basis.	Conduct operational and user trails to validate the training concepts. Hold training and simulation workshops with industry to examine advanced training concepts.	Low

Risk Factor	Description	Mitigation	Second Level Mitigation	Risk
Quantitative Requirement	Determining the quantitative requirement will be a complex undertaking because of the need to adjust from the Cold War to the asymmetrical threat posture. The project team also anticipates pressure to increase the quantity of detectors held for training purposes.	The process of determining the quantitative requirement is already in progress and is estimated to take 18 months. This will be conducted through modeling and simulation using a variety of operational scenarios.	In the final analysis the quantitative requirement will be constrained by the funding allocated to the project and by SRB guidance.	Low
Project Scope	The scope of the project will be restricted to acquiring only the minimum operational capability for the CF. It is intended that this capability will be available for domestic and international operations. A proposed equipment distribution plan has been issued to stakeholders. This plan will be refined over the next two years by using the outcome of modelling and simulation and through discussions with stakeholders.	The modelling and simulation process that will be used in defining the scope of the project is already in progress and is estimated to take approximately 18 months. ❁ SRB will be requested to review and approve an overall equipment procurement strategy, which will ultimately define the scope of the project.	Should the scope of the project exceed the funding allocated, the project team will recommend creating separate capital projects to deal with the capability deficiencies.	Low
Risk Tolerance	The Risk Tolerance within DND and the CF is low which means that time and effort will be committed to risk reduction activities. This risk is understood and therefore it is assessed as Low	The project team will present a Risk Management Plan to SRB designed to mitigate project risk.	Extend the project definition phase in order to reduce unexpected risk factors.	Low
Project Assumption Testing	This project will introduce new techniques, tactics and procedures into the CF and as such a number of educated assumptions have been incorporated into the chemical defence construct..	A process to test assumptions is already in progress. All major assumptions will be confirmed by SRB.		Low

Risk Factor	Description	Mitigation	Second Level Mitigation	Risk
Costs	The risk that the cost of MOTS equipment will escalate dramatically over the period 2003-08 is assessed as Low. There is a reasonable possibility that because of large procurements in the US and the UK that the actual cost of individual items might decrease in cost. ❁ Should the CF select an option other than ground based area detection and identification sensing systems the associated risks would be very high.	There is a medium risk that the cost of an ambitious information system integration program could escalate the cost of the project. This risk is mitigated because a separate. ❁ The option analysis recommends that only ground based and unmanned aerial systems be considered for further study		Low
NATO NBC Doctrine **US NBC Doctrine** **NATO Force Goals**	The CF can expect that NATO and US doctrine and operational concepts regarding chemical agents detection will remain largely unchanged during the period 2003 -12. Generally, this doctrine is based on a multi-layered suite of chemical agent sensors, which are integrated to form an early warning network and linked to the command, control and information system. ❁ This project will assist Canada meet NATO Force Goals. The risk that NATO Force Goals will change during the planning period is assessed as nil.			Low
Threat	The CF can anticipate a gradual increase in the chemical threat over the planning period as new chemicals warfare agents are developed and militarized. The threat is also expected migrate to	Operational analysis using modeling and simulation will be used to define the impact of chemical agents events.	It will be possible to re-program all proposed systems to detect new chemical agents threats	Low

Risk Factor	Description	Mitigation	Second Level Mitigation	Risk
	new areas of the globe because of the gradual proliferation of Weapons of Mass Destruction. This is an understood risk.	Modeling and simulation will assist the project team to validate the threat in order to acquire the appropriate capability. Since these operational research techniques are well developed the threat is assessed as low.	as they are identified.	
Simulation Technology	There is a requirement for training simulators for the local and personal detection system. The CF already has these types of simulators in service and as such the techno1ogy is well understood and the risk is assessed as low.	The project team has already initiated a training development program to review the overall NBC training concept for use with the next generation of NBC systems.	Conduct operational and user trails to validate the training concepts. Hold training and simulation workshops with industry to examine advanced training concepts.	Low

ANNEX B – INTERNAL FACTORS

Risk Factor	Description	Mitigation	Second Level Mitigation	Risk
Schedule	The project staff has assessed that the majority of the technological risks are considered Low. Delay in meeting critical milestones will likely result in failing to secure, approval and technical, scientific and operational support in a timely fashion to complete the definition phase of the project.	The project definition plan can be modified so that meaningful work can continue under adverse circumstances. ❁ Close co-operations with all stakeholders will be used to mitigate scheduling delays.	The project team will schedule bi-annual meetings to update SRB on the progress of the project and to seek essential guidance.	Low
Scientific Support	The project requires the co-operation of the DRDC community to conduct technical and user trials using live chemical agents. This activity while critical to the success of the project might conflict with DRDC primary R&D role and lead to delays.	Scientific support is one of the most important events on the project's critical path. To mitigate this risk the project team will propose that a separate Service Level Agreement be signed with DRDC to support this project. If this approach is not successful the work will be conducted using Alternative Service Delivery, possibly offshore.	Obtain scientific support through alternative source delivery possibly offshore.	Low
Doctrine and	Chemical Agent Sensor project will introduce	Doctrine and training	The project office	Low

Risk Factor	Description	Mitigation	Second Level Mitigation	Risk
Training Development	several new capabilities into the CF. The delivery of capability includes developing the appropriate doctrine, training and Tactics, Techniques and Procedures (TTP). Developing these items will require an important level of effort.	development are acknowledged as important project deliverables.	structure has sufficient resources to address doctrinal and training issues starting immediately.	
Operational Support	The project will require the co-operation of the Army Trial and Evaluation Unit and the CF NBC Defence School to conduct user trials. These trials might conflict with the unit's primary role and lead to delays.	All trials will be formally tasked through the standard tasking procedures.		Low