Defence Research and Development Canada
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Workshop on chemical and biological test and evaluation

Requirements, testing and standardization

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Abstract

Discussions with first responders (FRs) and public security stakeholders have indicated a significant gap in test and evaluation information needed to assess operational suitability of chemical and biological defence (CBD) equipment that would enhance FR capability and confidence in their equipment. Currently, Canada has no mechanism through which to certify CBD equipment intended for use by first responders, no formalized testing and evaluation (T&E) capability for such equipment, and generally no associated performance or testing standards, aside from those for personal protective equipment. To enhance the capabilities of first responders, a coordinated CBD T&E initiative that combines capability requirements with standardized testing must be initiated. This workshop assembled key stakeholders within the FR community, standardization and certification specialists, and public security and CBD experts to 1) outline projected CBD response requirements and associated required equipment capabilities; 2) discuss current CBD T&E capabilities; and 3) identify relevant steps needed to improve CBD T&E capability within Canada. The workshop provided a forum whereby each stakeholder community presented their perspective through formal presentation or participation in a series of guided round table discussions. Areas that need to be addressed to improve both CBD T&E capability and FR capability included better access to technical resources, availability of operationally relevant technical information, and development and implementation of equipment performance and testing standards. Several recommendations were made, including creating an information repository for first responders and developing a suite of standards for CBD equipment.

Résumé

Des discussions avec les premiers intervenants (PI) et les intervenants en matière de sécurité publique ont révélé qu'il existait un écart important entre les renseignements d'essai et d'évaluation (E et E) nécessaires à l'estimation de la pertinence opérationnelle de l'équipement de défense chimique/biologique (CBD), lesquels renforceraient les moyens des PI et leur confiance en leur équipement. Actuellement, le Canada ne dispose d'aucun mécanisme ni pour certifier, ni pour formaliser la capacité d'E et E de cet équipement, tel que conçu pour utilisation par les PI; le Canada ne possède généralement pas non plus de normes de rendement ou d'essai qui s'y rapportent, outre celles qui s'appliquent à l'équipement personnel de sécurité. Afin de renforcer les moyens des premiers intervenants, il est essentiel de mettre sur pied une initiative coordonnée d'E et E en CBD qui allie exigences relatives aux capacités et essais normalisés. Cet atelier a regroupé des intervenants clés provenant de la collectivité des PI, des spécialistes de la normalisation et de la certification ainsi que des experts en sécurité publique et en CBD, afin 1) d'exposer les grandes lignes des exigences futures relatives à l'intervention en CBD ainsi que l'équipement requis connexe; 2) de discuter des capacités d'E et E CBD; et 3) d'identifier les différentes étapes pertinentes requises pour améliorer la capacité d'E et E CBD à l'intérieur du Canada. L'atelier a procuré une tribune permettant à chaque collectivité d'intervenants de présenter son point de vue par le biais d'un exposé didactique ou d'une participation à une série de tours de table guidés. Les domaines qui demandent à être pris en compte aux fins de l'amélioration tant de la capacité d'E et E CBD que de la capacité des PI comprenaient un

meilleur accès aux ressources techniques, la disponibilité d'une information technique pertinente au plan opérationnel et le développement et la mise en application de normes sur la performance et la mise à l'essai de l'équipement. Plusieurs recommandations ont été faites, dont celles de la création d'un dépôt central des sources d'information pour les PI et du développement d'une suite de normes pour l'équipement de CBD.

Executive summary

Workshop on chemical and biological test and evaluation *Requirements, testing, and standardization*

S.J. Rowsell, R.E. Fulton, S.H.C. Liang, D.E. Bader, and E.F.G. Dickson; DRDC Suffield TR 2012-163; Defence R&D Canada – Suffield; October 2012.

Introduction or background: Currently, Canada has no mechanism through which to certify chemical and biological defence (CBD) equipment intended for use by first responders, no formalized testing and evaluation (T&E) capability for such equipment, and generally no associated performance or testing standards, aside from those for personal protective equipment. As a result, first responders and other public security stakeholders cannot assess, or have confidence in, the operational suitability of their equipment. As a first step towards addressing these deficiencies, a two-day workshop, which assembled key stakeholders from the first responder community, standardization and certification specialists, and public security and CBD experts, was held 27–28 September 2011 in Kingston, ON.

Results: From the discussions, it became apparent that a statement of capability need is not always in place when equipment is procured and that some response capabilities (e.g. biological detection and identification) continue to be weak. First responders feel that they do not have adequate access to meaningful or trustworthy information when selecting equipment; they gather whatever information they can and attempt to assemble and translate it into something that is operationally meaningful. A lack of standards is an additional problem.

The issues involved are complex, but investment in CBD T&E capabilities and dissemination of results appeared to the participants to be critical to their resolution. Suggestions to this end included creating an information repository containing specifications and meaningful performance information for available CBD equipment, providing a network of CB experts to whom first responders can have access, developing operationally relevant standards, and supporting third party test and evaluation within government.

Significance: As many of the issues have parallels with respect to the development of requirements, performance standards, and testing and evaluation for military CBD equipment, advances in the civilian sphere might also be applicable to the resolution of defence problems.

Future plans: Following the workshop, DRDC planned to develop standard test procedures and to provide equipment selection tools for first responders. With the restructuring of the national defence program, activities in these areas will focus on support to the Canadian Forces.

Sommaire

Workshop on chemical and biological test and evaluation *Requirements, testing, and standardization*

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Contexte: Actuellement, le Canada ne dispose d'aucun mécanisme ni pour certifier, ni pour formaliser la capacité d'essai et d'évaluation (E et E) de cet équipement, tel que conçu pour utilisation par les PI; le Canada ne possède généralement pas non plus de normes de rendement ou d'essai qui s'y rapportent, outre celles qui s'appliquent à l'équipement personnel de sécurité. En conséquence, les premiers intervenants (PI) et d'autres intervenants en sécurité publique ne peuvent évaluer l'adéquation opérationnelle de leur équipement ni avoir confiance en celle-ci. Comme première étape visant à combler ces lacunes, un atelier de deux (2) jours, lequel a regroupé des intervenants clés provenant de la collectivité des PI, des spécialistes de la normalisation et de la certification ainsi que des experts en sécurité publique et en CBD, s'est tenu les 27 et 28 septembre 2011, à Kingston (Ontario).

Résultats: Les discussions ont mis au jour qu'un énoncé des besoins en capacité n'est pas toujours en place lorsque de l'équipement est procuré, et que certains moyens en matière d'intervention (p. ex., détection et identification biologiques) demeurent faibles. Les PI sont d'avis qu'ils ne disposent pas d'un accès adéquat à des sources d'information pertinentes ou fiables lorsqu'ils choisissent de l'équipement; ils recueillent l'information qu'ils peuvent et tentent de la colliger et de la convertir en quelque chose qui soit significatif au plan opérationnel. Le manque de normes constitue un problème supplémentaire.

Les enjeux en cause sont complexes, mais l'investissement dans les capacités d'E et E CBD et la diffusion des résultats sont apparus aux participants comme étant critiques à la résolution de ces problèmes. Les suggestions émises à ce titre comprenaient la création d'un dépôt central des sources d'information contenant des spécifications et des données significatives sur la performance de l'équipement de CBD disponible, fournissant un réseau d'experts en CBD auxquels les PI peuvent avoir accès, le développement de normes pertinentes au plan opérationnel et enfin le soutien aux essais menés par des tiers et à l'évaluation au sein du gouvernement.

Pertinence: Comme on peut mettre en parallèle plusieurs de ces enjeux avec le développement d'exigences, de normes de performance et de mises à l'essai/d'évaluations liés à l'équipement militaire en CBD, les progrès réalisés dans le domaine civil pourraient être applicables également à la résolution des problèmes en matière de défense.

Prospectives: Après la tenue de l'atelier, RDDC a planifié d'élaborer des méthodes d'essai normalisées et de procurer aux PI des outils de sélection de l'équipement. Étant donné la restructuration du programme de la Défense nationale, les activités dans ces domaines seront axées sur le soutien aux Forces canadiennes.

Table of contents

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1 Introduction

1.1 Workshop purpose

The purpose of this workshop was to bring together first responders (FRs), standards development organizations (SDOs), and chemical and biological defence (CBD) experts with the aim of presenting current chemical and biological test and evaluation (CB T&E) capabilities at Defence Research & Development Canada (DRDC) and the Defence & Security Research Institute (DSRI), identifying FR CB T&E needs, and discussing CB T&E standardization requirements. These workshop activities were intended to produce a foundation for design of a formal CB T&E capability within Canada, a forum to inform the stakeholder communities with regards to strategic planning, and a starting point for development of investment plans that aim to address critical capability gaps. It is anticipated that follow-on workshops or projects will be needed to address some of the specific issues identified during this workshop.

1.2 Background

Within the Public Security community there is a requirement for CBD T&E, although it is not currently well-defined due to the diverse and diffuse nature of the CBD membership within the community. The impetus behind this workshop was multi-faceted, as described below.

1.2.1 FR feedback

Involvement with the First Responder Training Program (FRTP) and informal discussions with the FR community and public security stakeholders have indicated a need for increased CB T&E awareness within this community as well as a need for T&E information for assessing operational suitability of CB response equipment. This awareness and information would assist in enhancing FR capability and confidence in their equipment. In addition, a Canadian Police Research Centre (CPRC) report (Parisien & Marchand, 2008), which presented discussions on creation of a Canadian Responder Equipment Advisory Board, stated that in addition to recognizing the need for T&E, FRs have a vested interest in participating in operational field testing. This report also indicated that FRs feel that they have not been sufficiently included in T&E. Furthermore, this same report also broached the subject of standards; FRs indicated that standards would benefit interoperability and safety, but there needs to be a governing body to enforce the standards.

1.2.2 Level of investment

In the 2001 Federal Budget, approximately $10M was allocated for Chemical, Biological, Radiological, & Nuclear (CBRN) equipment for FRs (Alison Kerry Environmental & Management Consulting, 2007). In addition, federal, provincial, and municipal organizations have also allocated resources to addressing the CBRN threat. With the amount of funding dedicated to this purpose, it would be prudent to ensure that FRs get what they think they are buying. For example, if a HazMat team spends upwards of $150,000 on detection devices, but those devices require substantial and complex sample preparation, then the procurement will be useless as the device will likely sit on the shelf and not be used (Hawley & Royall Jr., 2011).

1.2.3 Technological advancement

Since 9/11, significant technological advances have taken place with regards to CB response equipment. Some HazMat response vehicles contain equipment that previously was only available in a laboratory setting. It has been observed that the ability to sustain proficiency on this equipment among FR users as well as maintain technology watch has become increasingly difficult and time-consuming in such a complex environment (Hawley & Royall Jr., 2011). While there are many high tech instruments that a FR could choose from, there are questions on whether information generated by these instruments can be interpreted and appropriate responses undertaken (Hawley & Royall Jr., 2011). If FRs have information on how their equipment works and what the gaps are, then they would be more likely to interpret results correctly and perform a more accurate risk assessment when dealing with a CB event. For example, aspects such as limit of detection and cross-reactivity must be known in order for a FR to accurately assess a particular situation. This indicates the importance of conducting operationally relevant T&E. Not only does this information assist in the use of a piece of equipment, but it can aid in the selection of equipment for procurement.

1.2.4 Federal Action Plan

The *Chemical, Biological, Radiological, Nuclear, and Explosives Action Plan for Canada* (Government of Canada, 2011) indicated a need to produce a list of current FR assets and equipment, with subsequent steps to conduct capability-based planning to identify gaps. Part of this plan also included establishing or adopting recognized standards for tools, equipment, and technologies; however, it is unclear in the plan where the responsibility for this activity lies. Unfortunately, this action plan did not identify T&E as an activity in the development of Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) resiliency in Canada, although T&E would be required to facilitate these other activities.

1.2.5 CBRNE Recommended Equipment List (REL)

The CRTI project to create the CBRNE REL (CRTI 08-0105RD) aims to correlate equipment, technology, training, and standards in order to prioritize resource allocation and conduct risk assessments within the FR community. This, in turn, may assist the scientific community in identifying opportunities for technology development, testing, and evaluation (DRDC Centre for Security Science, 2011). With the REL as a tool available to Canadian FRs, there should likewise be tools available for them to test and evaluate the equipment on the list.

1.2.6 International efforts

The National Science and Technology Council in the US has developed *A National Strategy for CBRNE Standards* which includes six goals, including establishing CBRNE equipment T&E infrastructure and capabilities to support equipment performance standards (National Science and Technology Council, 2011). Within the European Union (EU), a network called CREATIF has been created to provide a communication platform among equipment users, decision makers, and testing organizations. This network is viewed as the first step to the creation of testing standards and certification of test facilities for CBRN detectors. To keep pace with our international colleagues, an examination of Canadian T&E capabilities, identification of T&E issues, and

definition of actions to move forward is required. In addition, creating parallel Canadian efforts could facilitate international marketing of Canadian CB response products.

1.3 Objectives

Currently, Canada has no mechanism through which to certify CB equipment, no formalized capability for CB T&E, and few associated performance or testing standards (with the exception of protective equipment).

To enhance the capabilities of FRs, a coordinated CB T&E initiative that combines capability requirements with standardized testing must be initiated. This workshop assembled key stakeholders within the FR community, standardization and certification specialists, and public security and CB defence experts to:

1. Outline projected CB response requirements and associated required equipment capabilities.

2. Discuss current CB T&E capabilities.

3. Identify relevant steps needed to improve CB T&E capability within Canada.

The workshop aimed to provide a forum whereby each stakeholder community could present their perspective, after which a series of guided round table discussions took place to develop answers to key questions.

1.4 Scope

It was the intention of this workshop to focus solely on T&E of chemical and biological response equipment. A similar approach could be taken when addressing other disciplines. Due to the multiple stakeholders that would be involved in CB T&E and standardization, the list of invitees included FRs, industry, federal government, and SDOs. It is acknowledged that the full range of stakeholders may not have been present within each of these groups; however, to maintain a manageable group size for the round table discussions some attendance limitations were imposed (see section 2.3).

2 Workshop organization

2.1 Workshop structure

The workshop took place over two days, with the first day focused on first responder capabilities and perspectives and the second day focused on industry perspectives and standards. Presentations were provided on the following topics:

- T&E and the Centre for Security Science;

- T&E and Standards Overview;

- T&E of Biological Detection Equipment;

- T&E of Biological Identification Equipment;
- T&E of Individual Protective Equipment;
- T&E of Chemical Detection Equipment;
- First Responder Perspective on CB Equipment;
- Industry's Solution to Personal Protective Equipment;
- Evolution of PCR Instrumentation and Equipment; and
- Standards Development.

Each day included presentations in the morning, followed by facilitated breakout sessions in the afternoon. The agenda is provided in Annex A and presentations are provided in Annex B.

2.2 Workshop location

The workshop was held 27-28 September 2011 at the Holiday Inn Kingston Waterfront Hotel, Kingston, Ontario.

2.3 Workshop attendees

Several stakeholder groups were invited to attend this workshop. Invitations were sent to:

- Members of the first responder community within the professional networks of the workshop organizers;
- CRTI Clusters; and
- Industry involved in development and/or distribution of CB response equipment in Canada.

In addition, individuals from various stakeholder backgrounds were identified and invited to speak at the workshop.

The workshop was successful in attracting participants (34 persons in total) from the municipal, provincial, and federal FR community, industry (marketing and R&D), as well as various federal government organizations. Many participants (32%) had been involved in the purchase of CB response equipment within the last year, while 14% and 11% had purchased this equipment within the last 1–3 and 3–5 years, respectively. The balance of participants had either never purchased this equipment or indicated that purchasing this equipment was not applicable to their organization.

The participant list is provided in Annex C.

3 Round table questions

Questions were provided during the breakout sessions to guide the discussions and obtain specific information. These questions were primarily geared towards what the FR community would like to see from government and industry to improve CB response capabilities. Several themes and topics were covered during these sessions; the rationale for each is provided below:

1. **Requirements and capabilities**: Knowledge of FR current and future requirements or statements of capability need assisted in setting the tone for the workshop. This information is not only used by the FR community in strategic planning, but also impacts how equipment is tested and characterized. With this knowledge, the test community can develop methods that generate data to allow evaluation of equipment under operationally relevant conditions.

2. **Role of government and other stakeholder groups**: A separate breakout session was conducted specifically for government representatives to get an indication of what the federal government views as its own responsibility. This session also gathered information on programs and funding mechanisms that are available for testing equipment.

3. **Knowledge gaps**: Prior to this workshop, it was felt that one of the major barriers to filling FR capability gaps was access to equipment performance information and interpretation of this information. This topic also addressed issues such as the adequacy of T&E on commercially available equipment, and Technology Readiness Levels (TRLs) of Commercial Off-The-Shelf (COTS) equipment.

4. **Standards**: The issue of standards in the realm of CBRN response is a recurring theme and, as such, it was felt that it should be addressed at this workshop. Issues relating to both performance and testing standards were discussed. Example issues are: the priority of equipment performance standards, the role of performance standards in equipment selection process, the need for full consensus standards or guidance documents, the availability of funding for third party testing, and testing lab accreditation.

5. **Industry issues**: Although the workshop was primarily focused on the FR community, it was felt that the perspective of industry was also important. It is viewed that T&E and standards can assist in overcoming some commercialization challenges and that the linkage between the FR community and industry should be better defined.

A listing of the specific questions posed follows.

3.1 Theme: requirements & capabilities

3.1.1 Topic: concept of operations or statement of capability need

1. Does your organization have a first responder concept of operations or a statement of capability need for CB response equipment?

2. How does your organization currently do their 'requirements development' for equipment? Is information sourced from sales people, the internet, colleagues, standards (e.g., NIOSH/CGSB), or subject matter experts? Please explain.

3. What approaches does your organization use to ensure that they are selecting the correct equipment for the task? Does your organization select equipment based on equipment technical specifications, recommendations from colleagues, recommendations from experts in the field, or do you develop your own requirements?

3.1.2 Topic: information for selection of equipment

1. Do you see yourself as an informed customer, developer/supplier, or government /science expert for CB response equipment?

2. What resources are available to first responders when selecting CB response equipment? For example, internet, word-of-mouth, seeking help from experts, other?

3. Is this information easily accessible? What improvements could be made in this area?

4. Have you ever consulted T&E data and information when purchasing, developing, or recommending equipment?

5. To what extent do you rely on information provided by sales people when selecting CB equipment?

6. How often do you have questions on various aspects of CB response equipment, but don't know who to ask?

7. What do you think about having a central repository with access to information and experts on various aspects of CB response? (e.g., website, magazine, newsletter). Explain your answer (be specific about what the best repository format might be).

8. From your perspective, what is the biggest barrier or difficulty, aside from funding, in purchasing or developing/marketing CB response equipment? Explain your answer.

9. Would a guidance document be useful when defining desired capability and then selecting equipment? (e.g., something that outlines issues to consider or provides a list of questions to ask a vendor or developer). Explain your answer.

3.2 Theme: satisfaction with equipment & procedures

3.2.1 Topic: level of satisfaction with current equipment & procedures

1. How satisfied are you with the current equipment and procedures that are available to the first responder? Explain your answer.

2. If you think your current equipment/procedures are inadequate, could you please compile a list of things that you are not happy with?

3. Within your current fielded CB equipment or procedures, which items or procedures would you like to have a better immediate understanding of with regards to performance? (What gives you the most grief right now?) Please describe the item/procedure and discuss why it should be addressed.

3.3 Theme: role of government (posed to government only group)

3.3.1 Topic: T&E and standards responsibility

1. What is the role of each of the stakeholder groups (FR, industry, government, and SDOs in T&E? Refer to overview slide[1]. Identify the lead organization for each role.

2. Are full consensus standards necessary or would guidance documents be sufficient? (Guidance documents would follow a similar process to a standard but are not produced by consensus. Alternatively, they may be produced by comparative testing studies that outline performance without having any serious requirements development component.). Explain.

3. What value do you see in standards vs. guidance documents for first responders? For industry or technology developers? As a government stakeholder?

4. What programs and funding mechanisms are available to test this equipment? Are there any non-fiscal barriers to accessing these funding mechanisms? Explain your answer.

3.4 Theme: knowledge gap

3.4.1 Topic: current T&E

1. Do you feel there is adequate T&E conducted on commercially available CB response equipment? Explain your answer.

2. Do you agree that all COTS devices are a Technology Readiness Level (TRL) of 8 or higher?[2] Explain your answer.

3. To the best of your knowledge, are COTS devices tested at each TRL? Explain your answer.

4. What TRL do you consider acceptable for FR fielded use?

[1] T&E Overview slide is provided in Annex D.
[2] TRL definition is provided in Annex E.

3.5 Theme: standards

3.5.1 Topic: performance standards

1. What priority/emphasis do you place on equipment performance standards? Explain your answer.

2. If you think that developing performance standards for CB response equipment is a priority, then provide more detail on what you would like to see.

3. What role do you see performance standards having in future equipment selection and procurement within the FR community? (e.g., Should standards push technology to develop to a particular standard or should they describe standard achievable performance characteristics? Should standards be voluntary vs. regulated?).

4. Are full consensus standards necessary or would guidance documents suffice? (Guidance documents would follow a similar process to a standard but are not produced by consensus. Alternatively, they may be produced by comparative testing studies that outline performance without having any serious requirements development component.).

5. What value do you see in standards vs. guidance documents etc. as something you will use in the development and marketing process? If the document is not a national standard, will you spend any money to test to ensure that your item complies or is on an approved list? Will you contribute money to get something of yours tested in a third party manner if it is part of an organized assessment that compares products?

6. What programs and funding mechanisms are available to test this equipment? Are there any non-fiscal barriers to accessing these funding mechanisms?

3.5.2 Topic: lab accreditation

Is accreditation of testing laboratories important to your community? Explain.

3.6 Theme: industry issues

3.6.1 Topic: commercialization challenges

1. Are there any challenges to commercializing new technologies? Explain.

2. What non-marketing mechanisms or programs do you use to commercialize technologies within Canada? Outside of Canada?

3. Are you aware of any viable technologies that have not been successfully commercialized? If yes, do you know the reason for this failure?

3.6.2 Topic: First Responder – industry linkage

1. Have you been involved with any linkages between first responders and industry? What were these linkages?

2. Do you think there are sufficient linkages between first responders and industry? If no, what kind of linkages would you like to see developed?

4 Round table discussion summary

Although the round table discussion questions were organized into themes and topics, the answers provided and information generated did not necessarily fit into these categories. Instead, the information generated from the discussions was grouped and organized, as presented in this section.

4.1 Requirements & capabilities

Participants indicated during discussions that a concept of operations or a statement of capability needs usually exists for FRs. When polled, most participants indicated that their requirements were known and that their current equipment is appropriate for their requirements. Although it was indicated through the poll that their equipment is suitable, other responses and the round table discussion indicated that this may not always be the case. For example, some FRs stated that they are generally not satisfied with their current equipment and procedures. Chemical response is adequate, but there is a shift towards Toxic Industrial Chemicals/Toxic Industrial Materials (TIC/TIM) capability rather than Chemical Warfare Agents (CWA). Biological response is still weak (e.g., in biological incidents they may just take the patient to the hospital and let medical personnel address the situation). Most FRs are happy with their Personal Protective Equipment (PPE), but the life cycle costs are becoming a liability. (Author's note: Better clarification on this issue might have been achieved had the question been targeted towards specific capabilities (e.g., biological detection and identification, or protection against CWA)).

Discussions did, however, reveal that the statement of capability need is not always formalized and is often driven by military requirements for a similar capability. Although linking their capability needs with the military enables access to additional information on equipment performance, it also generates difficulties for FRs, since the scope of threat is likely broader for FRs. Some FRs stated that often times a capability need is not developed until the situation is encountered in the field, indicating that FRs need to possess sufficient knowledge and breadth of capability to allow them to think reactively.

Although several capability gaps are known to exist, the round table groups indicated that they often are not filled for several reasons:

- there is a relatively small FR market (i.e. Industry does not develop technologies specifically for the FRs even though they are aware of the gaps.);
- support for equipment procurement is reactive and follows the nature of the most recent attack; 9/11 was over a decade ago;
- internal politics slow the process of procuring equipment; and

- there is a lack of knowledge on the technologies and the specifics of the capability required (e.g., biological detection and identification).

Some FR organizations have the equipment, but have difficulty maintaining/sustaining it, have insufficient training on it, or experience skill fade. A suggestion to avoid this was for organizations to include maintenance and sustainment as part of their procurement contracts.

In some FR organizations, members feel that they are already saturated with equipment, so are not looking to procure. In these cases, it was suggested that their equipment list could be revised and updated, and some follow-on testing could be conducted to help in further defining their existing capability. However, other FR organizations use multiple technologies along with intelligence to make a decision, so in these cases they are looking for complementary technologies.

When discussing the technology readiness levels for available equipment, the participating FRs assumed that all COTS devices are TRL 8 or higher, meaning that the equipment is fully developed and qualified through test and demonstration or that it has been proven through successful mission operations. The government representatives at the workshop were in disagreement with this. FRs and government feel that a TRL of 8 is acceptable for field use (TRL 7 is reasonable if other teams are using it), while industry wants TRL 9. Industry representatives indicated that to get PPE approved by the National Institute for Occupational Safety and Health (NIOSH), the TRL must be 8 or 9. If it is not developed to this TRL, NIOSH will not provide a certification number.

FRs indicated that funds for equipment procurement come from their own operating budgets and in some cases from the Joint Emergency Preparedness Program (JEPP)[3].

4.2 Information for equipment selection

4.2.1 Source

Most of the participants considered themselves informed customers; however, most of them also indicated that they didn't have the right information on CB response equipment. Currently, FRs employ several sources of information when selecting equipment to fill a capability gap:

- US Department of Homeland Security (DHS);
- CBRNe World magazine;
- vendors or sales people;
- reachback (e.g., Centre for Forensic Sciences, Canadian Border Services lab);
- buy and try (this is not the preferred approach as it is not scientific);
- show and tell from industry;
- organizational knowledge (e.g., within larger and more experienced operational units); and

[3] The JEPP, administered by Public Safety Canada (PSC), provides funding and support to emergency preparedness and critical infrastructure.

- subject matter experts (only when they can be identified).

Although there are multiple sources of information out there, FRs can suffer from information overload and admit that in some cases equipment selection is a shot in the dark.

One of the difficulties in equipment selection is the lack of standards. This suggests that current evaluations are based on any information scraped together from the above sources as well as purchasing cost.

4.2.2 Accessibility

Industry and government representatives indicated there is inadequate T&E on CB equipment, while FRs were unsure because they either don't know what information exists or they have concerns with the validity of the T&E performed by manufacturers. The main concern here was whether the testing done by manufacturers uses suitable test methods and is operationally relevant. In addition, FRs expressed that when information is accessible, it is not all in one place and is difficult to consolidate. Furthermore, FRs felt that there were security issues when gaining access to test information or sharing information on what kit they use might expose vulnerability.

Over half (54%) of the participants polled at the workshop indicated that there was insufficient T&E information validating CB response equipment. Thirty-six percent of participants indicated that they know what validation information would be useful, but they don't know where to find it; the remainder of the group was not sure what information to look for. Participants indicated that for CB response equipment, the most information is available for PPE, some is available for chemical detection and identification, and very little is available for biological detection and identification.

4.2.3 Value

There is some concern among FRs that some of the T&E information available is not peer-reviewed. In general, they place higher value on the information if it is from a trusted source. Higher value is also placed on test data that includes operational or field performance with end users in addition to lab performance, since it is more representative of actual use. Finally, test data provided to FRs does not have value unless they know what it means, indicating the need for translation of test data into useable, or operationally relevant, information.

4.2.4 T&E capability within Canadian Federal Government

Discussions amongst the federal government representatives at the workshop revealed test capabilities that were previously not apparent, but also indicated the need for additional test capabilities. For example, the Centre of Forensic Sciences lab is able to conduct some testing, but would prefer to see a facility dedicated to testing kit specifically for FRs. Canada Border Services Agency (CBSA) does some T&E in the explosives and narcotics area, but doesn't have the facilities to do CB testing. However, their experience in working with users and industry, as well as their approach to testing, may prove to be a useful resource for development of CB T&E capabilities. Industry indicated that there are very few labs in Canada that have the capability to perform CB T&E, with the exception of DRDC Suffield and Royal Military College of Canada (RMCC). Often times, industry looks outside Canada for this capability (e.g. to Defence Science & Technology Laboratory (Dstl), Porton Down, Netherlands Organization for Applied Scientific

Research (TNO), or US Edgewood Chemical Biological Center (ECBC)). Only a few companies in Canada would have the finances to do their own T&E in-house.

Since the workshop participants did not include the full spectrum of testing labs in Canada, there was a suggestion to develop an inventory of T&E capabilities across government.

4.3 Performance and operational standards

Round table discussions revealed that all participants place a high importance on standards, with the rationale varying by participant group (FR, industry, and testers). FR participants indicated that the adoption of standards would have a positive effect on safety of responders and the public, reliability of equipment, sustainability of capability, and interoperability. FRs stated that without standards, liability is an issue[4]. Currently, there is a lack of guidance and/or standards documents, with the exception of PPE. This has led to FRs adopting military requirements for a similar, but not identical, capability. With this approach, there is concern over greater liability since exposure guidelines are expected to be more stringent in a civilian environment compared to a military environment. Adoption of performance standards would facilitate equipment selection, enable procurement, help ensure appropriate capability, and protect against lowest bidder acquisitions. Standards would also assist in establishing an acceptable level of risk around use of equipment and facilitate interoperability. Purchasing would no longer be based on perceived benefit, but rather on actual performance against scientifically-based standards.

From an industry perspective, standards would provide a defined direction for equipment development and testing. Compliance with a given standard could be viewed as a promotional tool, where T&E investment yields valuable marketing information and may facilitate placement of a particular device on a certified equipment list (should this list exist). For industry, regulated standards would be acceptable over voluntary standards so long as they are not a barrier to development and innovation.

From a testing perspective, standards might help establish a long term investment in T&E capabilities; they would also provide direction on the development of standard test methods.

Development of standards would require significant involvement and investment by all stakeholders, as well as some kind of incentive to ensure participation from industry and academia. Due to the effort and length of time needed for standards development, it was noted that it might be more feasible to begin with the development of guidance documents that could evolve into standards. This would be particularly appropriate if there was insufficient information for the development of a standard in a given area. However, it was recognized that guidance documents could be more open to interpretation and may not provide the defined direction that FRs and industry are looking for. In addition, guidance documents might provide too much of a grey area with regards to equipment performance. Such documents are viewed as a less powerful tool and could be created by any of the stakeholders, independent of the others; standards, on the other hand, would have the buy-in from everyone.

While recognizing that standards are important, FRs also recognize that standards need to be developed and applied appropriately. For example, the community needs to ensure that a

[4] This is particularly true for the medics. For example, in the past FRs used the C4 mask, but this mask does not meet NIOSH standards. They are required to use a mask that meets NIOSH standards.

standard does not become a wish list of trendy equipment features. In addition, FRs would like to see standards that require vendors to provide performance data rather than a pass/fail designation. This way, the user knows exactly what they are getting and whether the equipment meets or exceeds their requirement or capability need. Also, each standard needs to be implemented such that its meaning and context is communicated to the end user community. Any standards that are generated should be regularly reviewed and improved to promote technology performance improvements.

The issue of geographical differences for standards requirements was also discussed. It may be easier to try and align with international standards if they exist. This would avoid duplication of effort and ease the burden for industry in trying to meet multiple standards. On the other hand, it is important to ensure that the standard fits the Canadian environment. For example, there is a relationship among FRs (a unionized group), the Canada Labour Code, and standards development. Unionized FRs would be required to work with standards that are written into, or are consistent with, the applicable provincial/territorial or federal labour codes.

Many participants were somewhat unsure as to who (i.e., which department) in government should be responsible for taking the lead in generating standards. Although not represented at this workshop, it was suggested that Industry Canada and Public Works and Government Services (PWGSC)'s Canadian Innovation Commercialization Program may have a role to play here. When government representatives were asked what the roles are and where the responsibilities lie with respect to standards development and implementation, the following were identified:

- FR role: create a statement of capability need, participate in operational T&E, and provide input to CBRN Research & Technology Initiative (CRTI) calls for proposals, which may help define priorities for standards development;
- Industry role: test equipment in the lab and possibly conduct certification;
- Government role: conduct lab and field testing, evaluate equipment, and establish government specific standards; and
- SDO role: manage standards development process.

There is a definite need to scope out what standards exist, which do not, and which are needed. Some known sources of relevant standards are North Atlantic Treaty Organization (NATO), ASCAUKUS CBR Memorandum of Understanding (MOU) test operating procedures, and industry standards; however, none of these are specific to the FR community and the CB response realm. The US Department of Homeland Security may be a more appropriate source of information on this topic; Canada should look to the US more to determine a suitable approach.

Some specific desired standards that were identified at the workshop are listed below:

- performance standards for the full spectrum of CB equipment, particularly detection equipment;
- capability standards for equipment and procedures required for CB response teams;
- a Canadian equivalent to the US NIOSH standard that allows use of C4 and C650 masks. The C4 mask is not NIOSH approved, but FRs are required to use NIOSH approved masks. FRs would prefer to use the C4 mask due to its proven performance with CWA;
- field protocols for use of equipment;

- suggested equipment list;
- testing standards;
- standard list of test conditions (e.g., environmental conditions, test agents, concentrations, etc.) that industry must state alongside performance information to provide additional guidance; and
- standard for selection of equipment appropriate for certain scenarios.

4.4 Testing standards and lab accreditation

It was clear that effort is required to identify what test criteria are needed and what test methods are the most appropriate. There was some discussion on the importance of matching the test approach and methods to the concept of use. The issue of standard test methods is a significant one since organizations have investments in their current procedures; a requirement to change to a new procedure may not be feasible from a capability or funding perspective. There was a suggestion to place standard test methods on a secure website so that the testing community could have access.[5]

All workshop participants indicated that accreditation (e.g., ISO 17025) is important for testing labs.

4.5 Suggestions for testing

During the discussions there were a number of suggestions made with regards to who conducts testing, the approaches that could be used for testing, and where T&E funds could come from. These are presented in this section.

4.5.1 Who conducts testing?

The FRs would like to see third party certification on equipment that meets a particular standard; however, they have no funding to support it. Industry indicated that for the military end user, third party performance reports are a requirement within an acquisition. This being said, the T&E capability for CB equipment is rare and primarily occurs in government labs where access is not always rapid. More third party testers exist in the US compared to Canada. Although third party testing is preferred, it can be expensive, causing reduced scope of testing and lower confidence. Furthermore, procurement of and testing with certain materials is restricted to authorized organizations.

Some participants would like to see an equipment certification system that is independent of both vendor and buyer. Industry expects independent government evaluation of their equipment. Alternatively, if industry were to test and certify their products, there could be a system in which the testing and certification process is audited.

[5] Authors' note: Within the ASCAUKUS CBR MOU, the Test, Evaluation, and Simulation Working Group (TESWG) is developing multi-national test procedures which are placed on a secure site. This site is currently only accessible to members of the Working Group.

4.5.2 How is testing conducted?

Prior to the outset of testing any equipment, objectives must be set regarding the test criteria. For example, is the device being validated against the manufacturer's claims or against accepted performance standards? This distinction could influence the testing approach and methodologies that are selected.

Round table discussions among the various groups indicated that there are several approaches that could be employed when conducting T&E on CB response equipment. Some of these have been undertaken while others are suggestions. These are listed as follows:

- ask the vendor to bring equipment to test at a test facility to see how well it works;
- borrow equipment from the manufacturer to test at a facility;
- place equipment in the field for 6 months to compare to existing equipment, allowing assessment from a user perspective, but not necessarily an evaluation of performance (which should have a set procedure to allow scientific comparison);
- tely on industry (which only works if there are performance and testing standards; data would be owned by industry and may not be accessible by the users);
- organize a national T&E demonstration and/or comparative study of equipment[6];
- conduct user trials to generate information that is operationally relevant to FRs;
- conduct T&E at the systems level; and
- rely on testing conducted in the US.

Additionally, users could include specific T&E criteria in RFP documents, so that vendors are required to meet and provide third party test data. A suggestion was made to include a user-accepted test and sign-off in RFPs, to weed out technologies that rank high technically, but low on user suitability. This could include a demonstration to train the user for the purpose of gathering user suitability information prior to purchase. Also, procurements could be structured such that vendors must provide a demonstration for testing prior to full procurement.

Depending on the approach selected, the funding mechanism and dissemination of results would vary.

4.5.3 Where do the funds come from?

In addition to discussions on who could do testing and where it could occur, there were also discussions related to funding testing activities. Testing for much of this equipment can be quite expensive, particularly if live agent is involved. There were a number of different funding mechanisms discussed, each with its own advantages and disadvantages.

CRTI has the ability to fund studies and projects. Studies would involve a small scale endeavour (e.g., testing a single device), whereas projects would be larger in scope (e.g., comparing performance of multiple devices). Although projects would generate more information, they take

[6] Authors' note: This would be similar to the Technology Readiness Assessment and Technology Readiness Evaluation process in the US, where the government puts out a Request for Proposal (RFP) with a minimum specification on equipment to be tested.

longer to get off the ground and are more complex to manage. In addition, it is more difficult to secure funding for projects due to the competitive process.

PWGSC Canadian Innovation Commercialization Program assists industry in commercializing their products. T&E could be a component of this, although at the current time it is not clear if this is a requirement.

Industry could pay for the T&E and provide the device(s) free of charge, but the results would only be releasable back to the vendor and not to other parties. Most would not pay to have their product tested against competitors' products.

The Canada-US Bilateral on Counterterrorism was discussed as an option; however, it was indicated that it may be difficult to identify a funding mechanism within this agreement for comparative studies.

Most participants indicated that T&E should be funded by government, particularly if testing to a standard or conducting comparative tests. Although discussions covered funding to conduct testing, there was no discussion of who should or could fund the development of standards.

4.6 Advice or feedback to industry

Many of the FR participants felt that there should be more interaction between the FR community and industry or technology developers. In some cases, industry puts equipment into the hands of the end user too late in the development process for any significant changes to be made to operational capability or design. Interaction should occur during the conceptual stages. More communication with FRs would familiarize developers on how FRs use their products. FRs are also interested in communicating directly with the developer rather than a supplier or distributor, so that they have access to the 'expert' with detailed information. When developers upgrade their products, they should include a consultative phase with the users to determine if any of the changes will have a negative impact (e.g., making it more difficult to use in the field or increasing the number of training hours required).

Manufacturers should provide information on the recertification and regular maintenance requirements in the initial stages of procurement. In addition, they should allow (where possible) the end user to perform maintenance, recalibration, and repairs themselves. For many FR organizations, these aspects can be cost prohibitive, preventing procurement of a particular device or causing the device to sit on the shelf because it requires maintenance that is too costly.

On the more specific and technical side, suggestions were provided to industry to:

- avoid equipment-specific support items that increase Operation & Maintenance (O&M) costs (e.g., avoid the requirement for equipment-specific batteries and select for generic batteries);
- provide the ability to analyze complex samples (e.g., ability to work with samples that are not pure);
- produce read-out screens that are better designed for outdoor use where ambient light is brighter;
- provide batteries that operate under cold conditions;

- afford the ability for the user to update libraries and avoid shipping the device back to the manufacturer (which places the device offline and impacts capability); and
- avoid costly visits from a service technician.

In general, FRs feel that there is currently no available equipment or technology that is fast enough, cheap enough, or reliable enough for CB detection and identification.

4.7 Barriers to developing and marketing

Other issues that arose during the round table discussions were related to developing and marketing CB response equipment, but they indirectly relate to T&E. These included unachievable requirements and regulatory barriers. In some cases, users develop requirements or statements of capability need that ask for too much. For example, with respiratory threats from industrial chemicals, there are three to five different lists of industrial threats. The NIOSH standard requires testing with ten specified and representative chemicals from these lists. This causes different masks to have different requirements, and for industry to supply multiple masks for different uses. This is a developmental barrier. Regulatory barriers include such things as the International Traffic in Arms Regulations (ITAR), which control the import and export of defence-related articles into and out of the US, and the Canadian Controlled Goods Regulations, which prevent controlled goods and technology from being accessed by unauthorized persons. Both of these sets of regulations provide challenges to development and marketing, but also to T&E; the regulations can impede access to test facilities and can prevent sharing of test data.

5 Common themes and recommendations

From the discussions during the round tables, there were several recurring themes that appeared in the summary presentations that were provided by each round table group at the end of each session. These are presented below, along with possible actions, feasibility, and some linkages to current activities, which were generated from information gathered following the workshop.

1. **Access to technical resources and lessons learned from other responders needs to be increased**. FRs want access to T&E information that is meaningful, as well as subject matter experts that can assist with their questions. This could be addressed through production of a central repository of information on equipment available and its performance (for COTS), lessons learned, and user feedback. This could be in the form of an electronic guidebook of available equipment. Vendors and manufacturers could send their information to this central repository so that it is accessible to the FRs and in a single location. Testing organizations could also submit information for this repository. Regardless of the source, the information should be translated so that it is operationally meaningful to FRs. If a repository is created, it should be layered to allow the user to dig down to a level of technical detail that they are comfortable with. FRs would also like to see equipment lists from CBRN operational units (e.g., National Response Team) so they can see what others have used or are using. Equipment-specific information should include aspects such as ruggedness, ease of use, O&M costs, and training burden. Additional options to improve access to information include a 24/7 CBRN hotline with access to chemical, biological, and radiological experts, presentations at conferences (e.g., CBRN Emergency Medical Services (EMS) Symposium or CBRNe Convergence Conference), and information sharing sessions during national or other exercises. This action is viewed as feasible and would likely be the

responsibility of a federal government department; however, some information could be a security issue if critical gaps are exposed.

2. **Capability gaps still exist (e.g., biological detection and identification)**. One way to address this would be to conduct technology roadmapping for identifying capability gaps. This could be done by each operational organization or at a higher level (e.g., by CRTI). Additionally, T&E that needs to be done now could be identified. This would include reviewing existing fielded equipment and testing it against its concept of use. For example, some fielded equipment has not been tested with operationally realistic samples with complex or mixed matrices. Information from operationally scoped T&E would assist in identifying capability gaps.

3. **Barriers to purchasing include the lack of knowledge (of technologies and the market) and the lack of performance standards**. In this case, it was suggested that T&E standards be embedded into procurements and guidance documents and that these standards be effectively communicated to the affected communities.

4. **Need for clear standards and/or guidance documents**. The action to address this is to develop standards for CB equipment performance and guidance documents for equipment selection. Standards should consider performance under operationally relevant conditions. Training standards should also be examined. FRs would like to see some kind of guidance document for use in the selection of CB response equipment; some feel that interactive modules and web-based information might be more useful. Such a guidance tool could also be used for writing an RFP.

5. **Need for a better network of experts, including identification of centres of expertise within government, as well as linkages with industry**. Many participants indicated that Canada needs a CBRNE governing body to achieve this; they would like to see a list of government contacts, but recognize that this would be difficult to keep current.

6. **Need for certified T&E facilities for third party T&E**. These facilities could work together to identify standard test methods and materials. They could also develop and implement standard test methods and lab certification processes. Testing needs to be re-worked so that operationally relevant performance data is generated.

7. **Need for funding more and better T&E**. Government departments and agencies need to develop a program and funding mechanism for third party CB T&E. Although some funding is available to purchase CB response equipment, the funding of T&E that would facilitate the purchase is not readily available. For example, provinces and territories are able to apply for funding from the JEPP. For equipment bought with JEPP funding, a performance assessment is required one year after the purchase to report on reliability and effectiveness, and to share information with other jurisdictions (Public Safety Canada, 2012). However, since JEPP funding is for a single fiscal year, this performance assessment may not occur to the extent that is needed. At the time of this writing, it is unclear as to the amount of JEPP funding that has been allocated to CBRNE equipment. In addition, the subject matter expertise and T&E capabilities available to these FRs to justify their equipment selection under this funding mechanism is likewise not apparent.

6 Next steps

At the outset of this activity, the workshop was aimed at identifying knowledge gaps that link capability needs and testing requirements, outlining stakeholder linkages for successful CB T&E, and developing a roadmap for implementation of improved CB T&E within Canada. As such, recommendations are outlined in the following sections.

6.1 Recommendations for T&E

1. Develop a T&E Strategy for the various types of equipment (e.g., chemical detection, biological identification, etc.). This would include outlining various phases of testing for COTS equipment, with each phase being progressively more rigorous and down-selecting the list of equipment eligible for each phase of testing by applying criteria related to capability needs.

2. Identify or develop and validate T&E methods and materials that are appropriate to the technologies on the market as well as to the anticipated operational use. Move towards standardizing these methods and materials.

3. Identify funding mechanisms to conduct T&E on specific pieces or types of CB response equipment.

4. Work towards certification of T&E facilities. This includes identifying a champion for this effort as well as a funding source.

6.2 Recommendations for standards

1. Develop standards[7] for the suite of CB response equipment required based on anticipated level of response for a given FR organization. This may be in the form of a guidance document for selection of equipment.

2. Develop standards for the performance of each type of equipment under various anticipated operating environments.

6.3 Recommendations for future workshops or activities

1. Develop a strawman for the information repository on CB response equipment and expertise.

2. Conduct technology and capability roadmapping for various types of response scenarios. This could identify and help prioritize efforts to provide the most value for effort.

3. Determine existing projects and initiatives that would benefit or could tie into CB T&E activities.

[7] In this case, the term ‘standards’ encompasses standard test materials, standard test procedures, and performance standards.

7 Participant feedback

Participant feedback was sought through real-time electronic polling as well as feedback forms. Real-time polling indicated that a significant majority of the participants found the workshop to be a useful exercise. Many felt that the results of this workshop could influence programs that would enable them to better perform in their jobs. In addition, many participants would attend a follow-up workshop in the future.

Participants enjoyed the opportunity to network among industry, research, and end users. Although the group size was smaller than most other workshops, it was generally felt that it was high quality. The two day duration was good, although some suggested three days.

Suggestions for future T&E workshops included:

- identification and description of T&E funding mechanisms;
- engage a broader spectrum of first responders, perhaps through the Association of Canadian CBRNE Technicians (ACCT);
- incorporate RN and E in CBRNE;
- cover T&E for specific disciplines (e.g., chemical, biological, radiological/nuclear, explosives or detection, protection, etc.);
- hold similar workshops on a regular (annual or biannual) basis;
- focus on framework and process for T&E program development; bring multiple T&E organizations together to develop a T&E process that is whole-of-government;
- develop structured guidance on T&E for FRs;
- develop specific standards;
- present T&E being performed in Canada by FRs or military; and
- prioritize suggestions from this workshop, then hold workshops on high priority areas.

Suggestions for future non-T&E workshops included:

- CBRN overview for Occupational Health and Safety (OHS) professionals, emerging physicians, nurses, etc.;
- Standards Council of Canada (SCC) standardization and lab accreditation;
- international standards with invited speakers;
- evidence collection with standardization focus;
- medical management;
- training standards for users of equipment;
- Technical workshops on respiratory protection, PPE[8], and CB detection;

[8] A workshop on respiratory protection and PPE has been proposed for the AIChE conference in Montreal in 2013.

- update on current CRTI projects and future focus projects;
- DRDC program updates and gaps;
- technology gaps, funded R&D, and Canadian R&D priorities (similar to US Department of Defense (DoD) Joint Program Manager for Protection (JPM-P) meetings);
- lessons learned during responses or exercises;
- Identification and development of mechanisms to link FRs and industry;
- capability based planning and risk assessment to inform procedures at the various levels of response (i.e., municipal, provincial, federal);
- structure of a CBRNe governing body (e.g., roles, responsibilities, training offered, reachback mechanisms, information sharing options, etc.);
- decontamination workshop (many FRs currently use water for decon);
- selection of equipment; and
- operational training.

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Annex A Agenda

Monday, 26 September 2011		
1930	Networking Social (no host) – DOX Restaurant and Lounge	

Tuesday, 27 September 2011 – First Responder & Capability Focus		
0800-0830	Registration	
0830-0845	Welcome & Introductions	
0845-0900	T&E and Centre for Security Science	Ted Sykes, CSS
0900-0930	T&E and Standards Overview	Susan Rowsell, DRDC Suffield
0930-0950	T&E of Biological Detection Equipment	Susan Rowsell, DRDC Suffield
0950-1010	T&E of Biological Identification Devices	Elaine Fulton, DRDC Suffield Doug Bader , DRDC Suffield
1010-1030	***Coffee***	
1030-1055	T&E of Individual Protective Equipment	Sep Liang, DRDC Suffield
		Eva Dickson, RMC
1055-1115	T&E of Chemical Detection	TBD
1115-1150	First Responder Equipment Selection Protocols	Chris May, Toronto Police
1150-1300	***Lunch (no host)***	
1300-1600	Round Table Discussions	
1445-1500	Coffee	
1600-1645	Summary Presentations	
1645-1700	Closing Remarks	
1930	Networking Social (no host) - DOX Restaurant and Lounge	

Wednesday, 28 September 2011 – Industry & Standards Focus		
0800-0830	Registration	
0830-0845	Welcome & Introductions	
0845-0900	Highlights from Day One	Susan Rowsell, DRDC Suffield
0900-0930	Industry's Solution to Personal Protection Equipment T&E Needs	Luc Dionne, Airboss-Defense
0930-0950	The Evolution of PCR Instrumentation and Reagents since 2001: A Canadian Perspective	Ryan Clermont, Clermark
0950-1015	***Coffee***	
1015-1100	Standards Development	Eva Dickson, RMC Dave Shanahan, CSA
1100-1145	Participant View Poll & Discussion	Susan Rowsell, DRDC Suffield
1145-1300	***Lunch (no host)***	
1300-1600	Round Table Discussions	
1445-1500	Coffee	
1600-1645	Summary Presentations	
1645-1655	Participant Feedback Poll	
1655-1700	Closing Remarks	

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Annex B Presentations

B.1 T&E and Standards Overview

Testing vs. Evaluation

- Testing = obtaining performance and operational data
- Evaluation = extracting information

Current Tests
Inspection
Previous Tests
M&S
Expert Opinion
DEMONSTRATION
Analysis

1

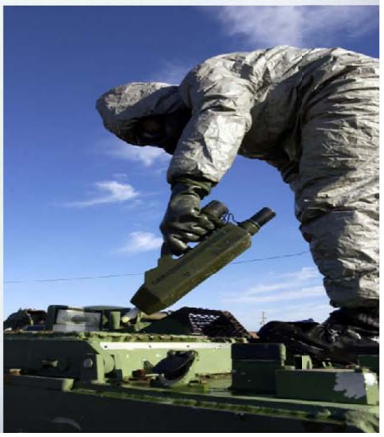
What is the purpose of T&E?

- Provide technical and/or operational information to decision makers
  - Overall performance, specific performance, suitability, technology impact, technical maturity
- Observe how a system reacts
- Attempt to break the system
- Generate data for system improvements

2

What are the benefits of T&E?

- Opportunity for verification and validation
- Better definition of capability
- Opportunity to assess at various stages of development (e.g., technology readiness)
- Opportunity to assess under simulated operational conditions with simulated and real agents
- Potential for certification to accepted universal standards



3

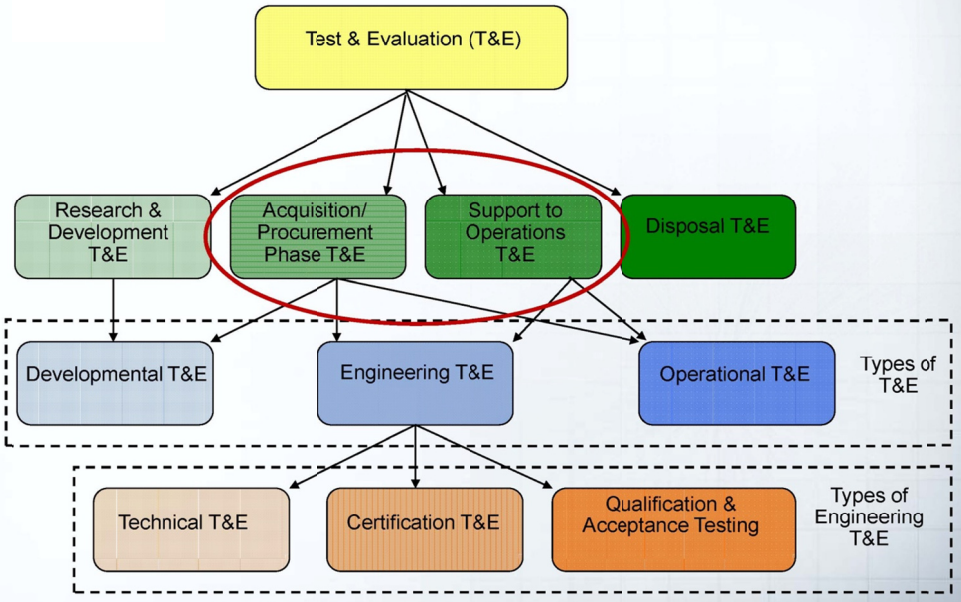
Technology Readiness Levels (TRLs)

TRL	Definition
1	Basic principles observed and reported.
2	Technology concept and/or application formulated.
3	Analytical and experimental critical function and/or characteristic proof-of-concept.
4	Component and/or breadboard validation in lab environment.
5	Component and/or breadboard validation in relevant environment.
6	System/subsystem model or prototype demonstration in a relevant environment.
7	System prototype demonstration in an operational environment.
8	Actual system completed and qualified through test and demonstration.
9	Actual system proven through successful mission operations.

Modified from "Department of Homeland Security Science and Technology Readiness Level Calculator" Final Report, 30 Sept 2009.

4

T&E Spectrum



5

Developmental T&E (DT&E)

- **Early** stages of acquisition
- Evaluate system components, prototypes, and technology-related risk areas
- Verify **technical** requirements
- Critical in helping mature engineering design
- Lower requirement with COTS solutions

6

Operational T&E (OT&E)

- **Later** in acquisition
- Field T&E with operational test scenarios/environments with typical users
- Evaluates operational effectiveness and suitability of a system
- Involves use of production or production-like systems
- Can be combined with DT&E

7

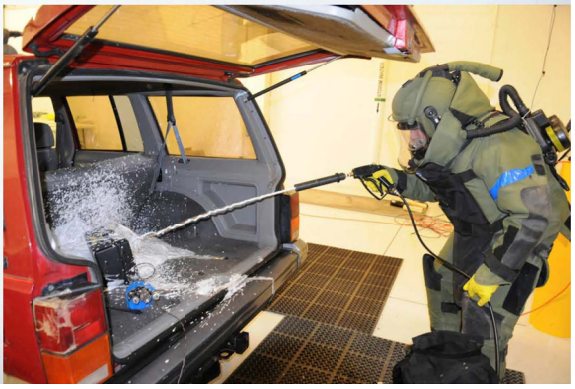
COTS Testing

- Define the concept of operations and compare it to commercial intended use
- Use commercially-generated or 3rd party-generated test data to evaluate performance
- Fill in any information gaps

8

Whole Systems T&E

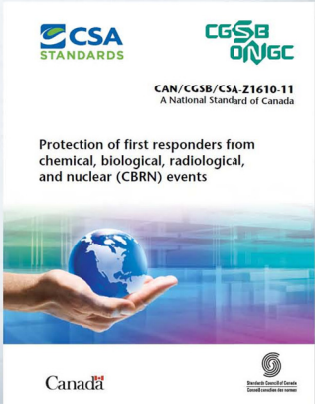
- Equipment is operated within a system
- Systems can introduce complexities
- Whole systems must be recognized during testing (especially with OT&E)
- Compatibility and interoperability



9

Standards

- Performance standards
  - Regulated, best-practice, specification-driven
- Testing standards
  - Recognized standard test methods that relate to performance standards
  - Standard testing materials



10

Standardization Initiatives

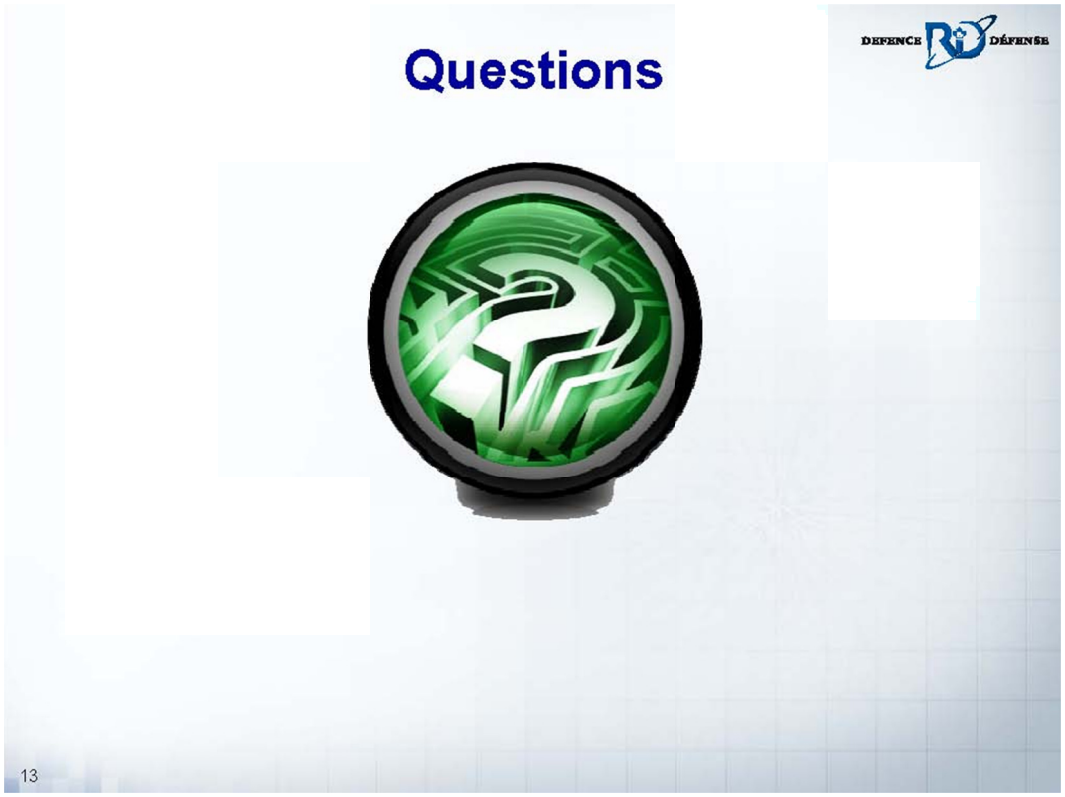
- SIBCRA
- Global Health Security Laboratory Network (Proficiency Exercises)
- Test, Evaluation, & Simulation Working Group
- ISO 17025

11

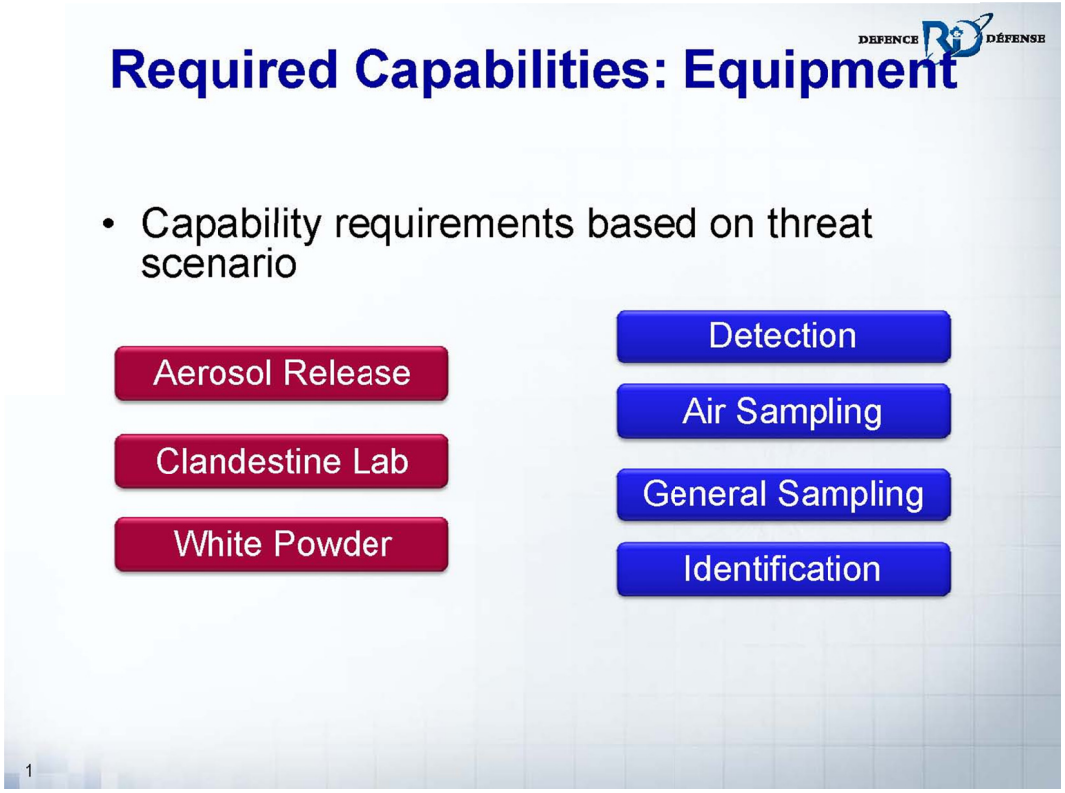
Where can T&E fail?

- Lack of test planning
- No consideration of operating environment
- Test procedures ≠ performance and suitability parameters
- No facilities available for the type of testing needed
- Insufficient time
- Representative threat systems not available for test support
- Unverified M&S used as a T&E methodology

12


Questions
DEFENCE R&D DÉFENSE
13

B.2 Capability Requirements for Response



Capability Requirements - Equipment

DEFENCE R&D DÉFENSE

- Detection
- Air Sampling
- General Sampling
- Identification

2

Capability Requirements - Equipment

DEFENCE R&D DÉFENSE

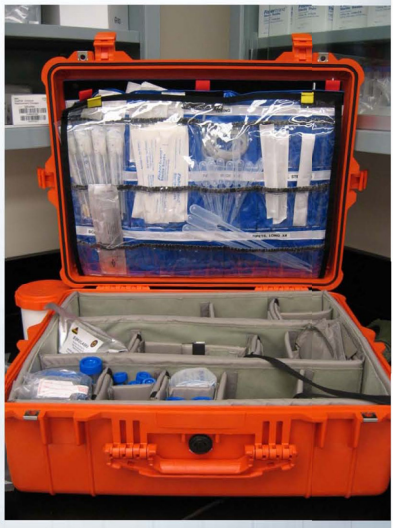
- Detection
- Air Sampling
- General Sampling
- Identification

3

Capability Requirements - Equipment

DEFENCE R&D DÉFENSE

- Detection
- Air Sampling
- General Sampling
- Identification



4

Capability Requirements - Equipment

DEFENCE R&D DÉFENSE

- Detection
- Air Sampling
- General Sampling
- Identification

5

B.3 T&E for Biodetectors

Biological Detectors

- Runs 24 x 7
- Low or no consumables
- Low false alarm rate
- Detect-to-treat vs. detect-to-warn
- Sampling
- (Identification)

7

Performance Testing: Biological Detection Equipment

- Challenge with simulants
- Define reference sampler system
- Test Facilities
- Operational testing/field use

8

Bioaerosol Challenge

- Simulants
  - Allows operationally relevant testing
  - Safe

9

Reference System

- Measure the challenge

10

Test Facilities: Chamber

DEFENCE R&D DÉFENSE

11

Test Facilities: Chamber

DEFENCE R&D DÉFENSE

12

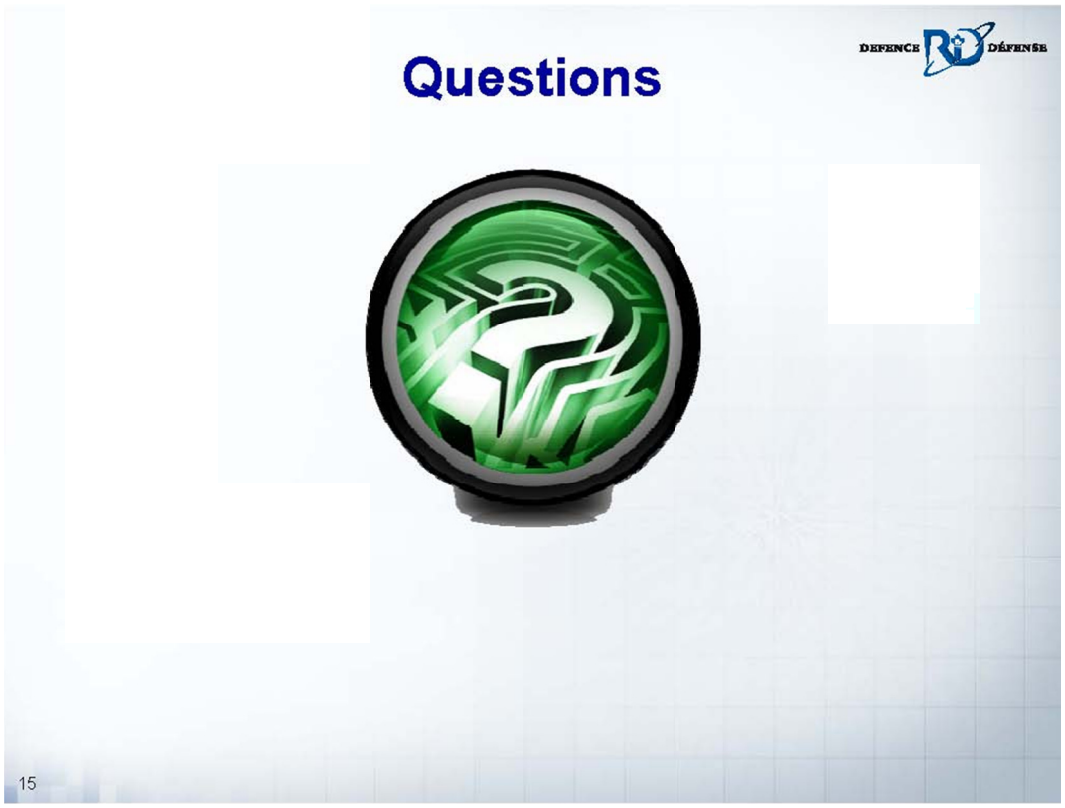
Test Facilities: Open Air

13

Performance Testing: Biological Detection Equipment

- Present and measure the challenge
  - Agent Containing Particles per Litre of Air (ACPLA)
  - Mass per unit volume of air
- Compare the detector output to reference
- Evaluate LOD, false alarm rate, and effect of interferents

14


Questions
DEFENCE R&D DÉFENSE
15

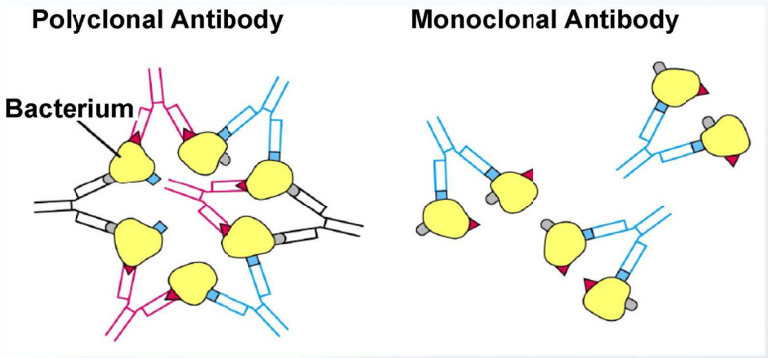
B.4 T&E for Biological Identification Devices

Immunological Bio-identification

- When used: deployed post alarm (biodetector), suspicious materials observation, or intelligence report
- Samples may be environmental (e.g. air, soil, water, powder, surface) or medical (e.g. blood, urine, sputum)
- Identification based on antigen-antibody interaction
- Consumables (antibodies, buffers, positive control antigens, etc.)
- High sensitivity / specificity
- Low rate of false positives and negatives
- Rapid response, easy to operate

2

Antigen-Antibody Interaction



3

Performance Testing: Immunological Bio-identification Equipment

How done:

- Challenge with killed agents or vaccines (BSL-2)
- Follow-up challenge with live agents (BSL-3)
- Reference agent panels: core threat, inclusivity and exclusivity; positive and negative controls
- Reference interference and matrix panels
- Support to operational testing: indoor or outdoor (killed agents or simulants)

4

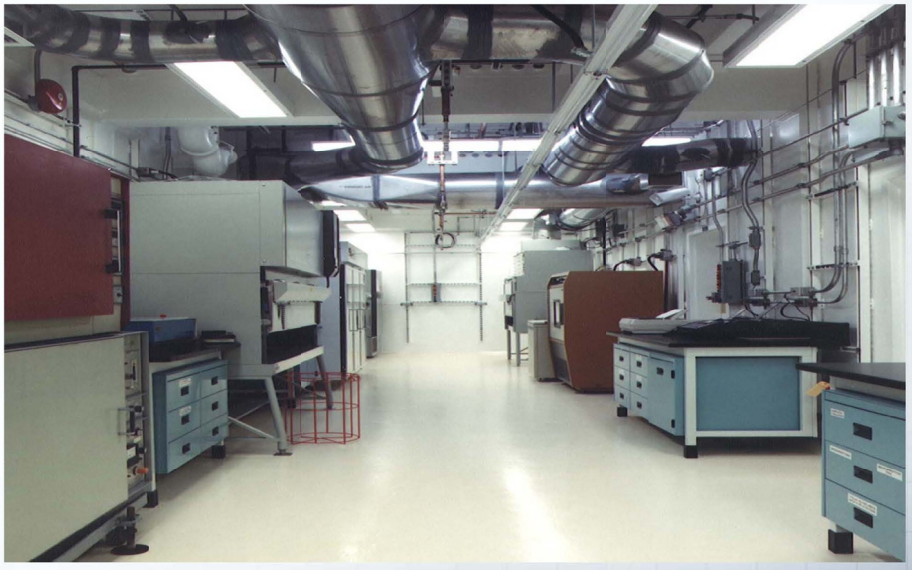
Performance Testing: Immunological Bio-identification Equipment (cont'd)

Types of Experiments:

- Present challenge and measure response
  - Signal (counts, optical density, fluorescence, etc.)
  - Signal to background (S/B) determination
  - Significance level (assay cut-off 2-3x bkgd; 2x sd dev bkgd; S/B = or > 1.2 (20% > bkgd)
- Equipment/assay output may be compared with gold standard assay output
- Demonstration of assay limit of detection (LOD) (cfu/mL, pfu/mL, protein/mL); specificity, reproducibility, interferents and matrix effects, stability (response to variations in temperature, reagent volumes, etc.)
- Test facilities: Indoor laboratory (BSL-2, BSL3)

5

Performance Testing Facilities: Indoor Laboratory (BSL3 Bacterial Suite)



6

T&E of Immunological Bio-identification Equipment: DRDC Suffield Examples

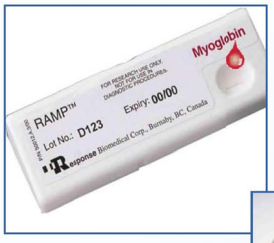
- Rapid Analyte Measurement Platform (RAMP)
- M1M Electrochemiluminescence (ECL) Platform

7

DEFENCE R&D DÉFENSE

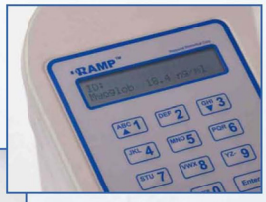
RAMP® – Response Biomedical Inc.

Add Sample



Insert Cartcridge

Read Result



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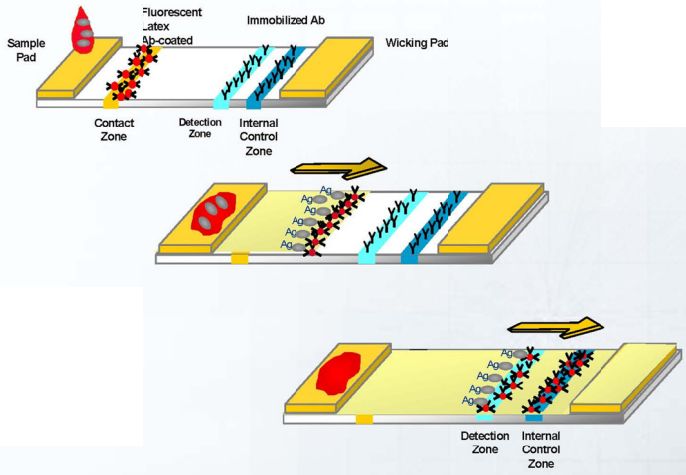
DEFENCE R&D DÉFENSE

RAMP® – Response Biomedical Inc.



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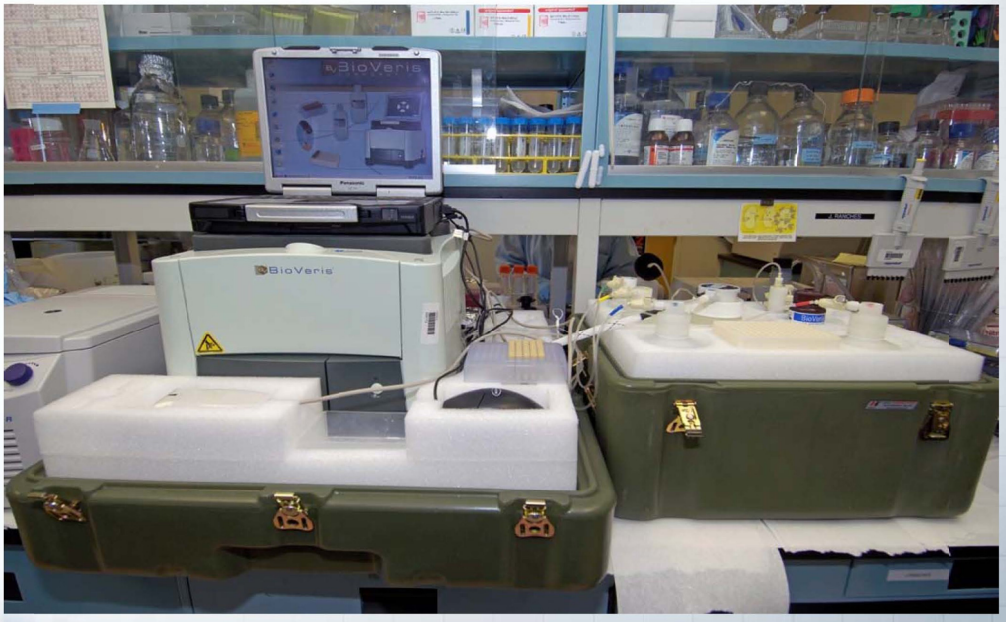
M1M ECL Analyzer – BioVeris Corp.



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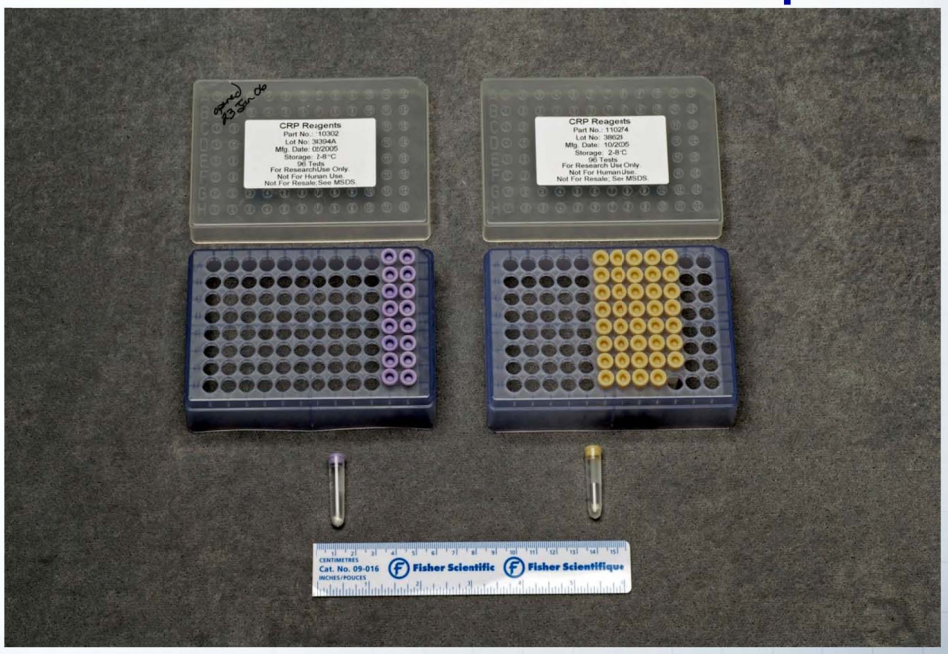
M1M ECL MINItubes – BioVeris Corp.



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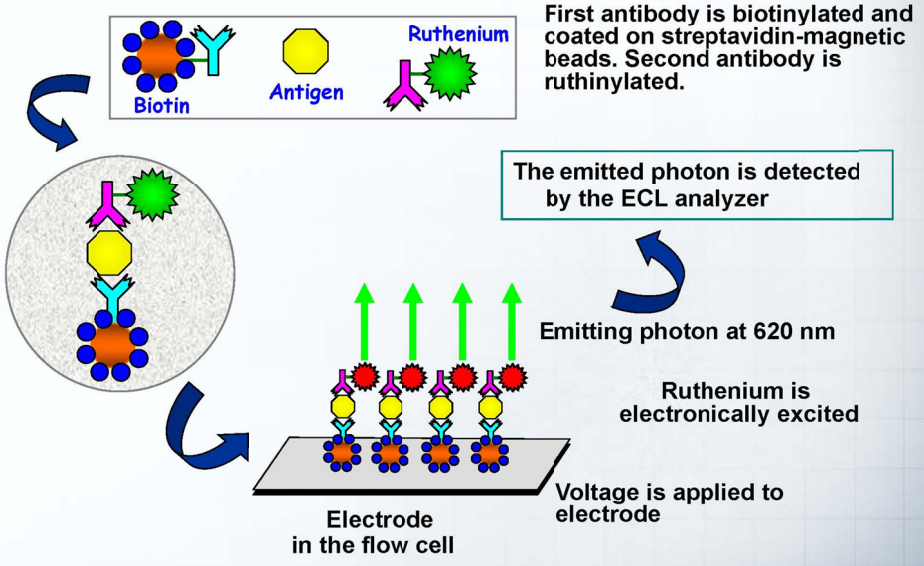
Electrochemiluminescence (ECL) Bio-identification System



12

Questions

13

DEFENCE DÉFENSE

Defence Research and Development Canada – Suffield Biotechnology Section, Bio-analysis Group

T&E of Genetic Bio-identification Equipment

CB T&E Workshop: Requirements, Testing, and Standardization
27-28 September 2011

Doug Bader

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

Canada

DEFENCE DÉFENSE

Genetic Bio-identification

- Deployed post alarm (biodetector), suspicious materials observation, or intelligence report
- Environmental samples (e.g. air, soil, water, powder, surface)
- Clinical (e.g. blood, urine, sputum)
- Low copy number detection
- High sensitivity/high specificity

- Real-time PCR technology (enzymatic amplification of threat-specific genetic sequences)
- PCR = device + reagents and other consumables
- Reagents/consumables (gene probes, primers, reaction buffer, controls, tubes, tips)

2

Performance Testing: Genetic Bio-identification Equipment

- Present challenge and measure response
  - Cp signal (fluorescence signal crosses above background)
  - Cp signal is inversely proportional to the amount of genetic analyte
- Performance parameters
  - Limit of Detection (LOD)
  - Assay linearity and dynamic range
  - Sensitivity (TP, i.e. absence of false negatives)
  - Specificity (TN, i.e. absence of false positives)
  - Amplification efficiency (100% = doubling every cycle)
  - Assay speed
  - Assay performance in the presence of interferents and different matrices
  - Reproducibility

3

Performance Testing: Genetic Bio-identification Equipment

- Challenge with killed agents or extracted genetic material (BSL1-2 labs)
- Challenge with live BSL2/3 agents (BSL2/3 labs)
- Challenge with biothreat, near-neighbour, and non-neighbour material (inclusivity and exclusivity).
- Challenge with environmental/clinical matrices and interferents to assess cross-reactivity, PCR inhibition/interference
- Support to operational performance testing
  - Indoor (lab/chamber environment)
  - Outdoor/field (use killed agents or simulants if required for testing)

4

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Genetic Bio-identification Equipment: DRDC Suffield Examples

- Smart Cycler (Cepheid)
- LC480 (Roche)
- FilmArray (Idaho Technologies)

5

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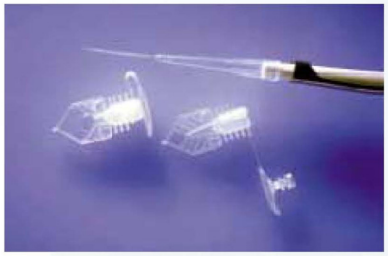
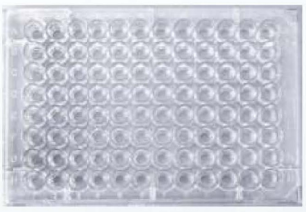
Smart Cycler®



- 16 independent reaction sites with expansion to 80 sites
- Runs off 12V battery or AC110/120
- Easily transported, operational flexibility
- Manual sample preparation/NA extraction
- Agent assays are not provided by the equipment manufacturer

6

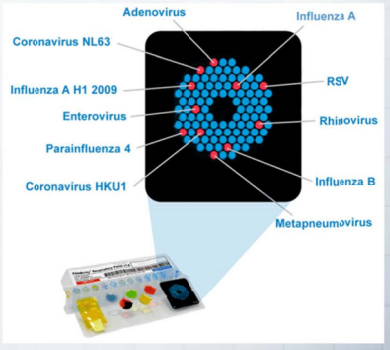
LC480



- Lab-based system
- High throughput capacity (up to 96 or 384 reactions possible per run)
- Manual sample preparation/NA extraction
- Agent assays are not provided by the equipment manufacturer

7

FilmArray™



- One sample per run; multi-agent ID; > 100 PCR reactions per run
- Fully integrated system (sample prep, NA extraction, PCR, analysis, reporting) in ~1 hr
- Assays are available from the equipment manufacturer

8

Questions

9

B.5 T&E of Individual Protective Equipment

Current Canadian CB Protection

DEFENCE R&D DÉFENSE

- C4 gas mask/C7A plastic canister developed for respiratory protection
  - bromobutyl rubber facepiece + polycarbonate lens system
  - impregnated carbon + HEPA
- Horizon One Protective Suits
  - Outer Layer: cloth, twist, nylon/cotton, 170 g/m^2
  - Inner Barrier Layer: cloth, filter, composite, laminated or bonded, with activated carbon
- CB Protective gloves, boots, hood

1

Certification of Gas Mask

DEFENCE R&D DÉFENSE

Military

- NATO NAAG standards
- AS/CA/UK/US army standards
- Individual country (e.g.,Canadian Department of National Defence) specifications

Industrial

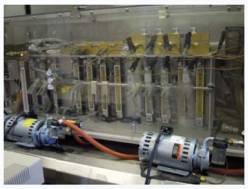
- NIOSH (National Institute for Occupational Safety & Health)
- CGSB (Canadian General Standards Board)

In most cases, **Military ≠ Industrial**

2

T&E on Gas Mask

- Material: swatch test
- Ballistic performance (Valcartier)
- Fit testing
- Breathing resistance
- Performance impregnated carbon
- Human factor (Toronto)
- Tensile strength...



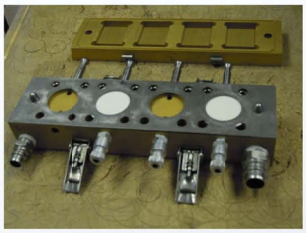


3

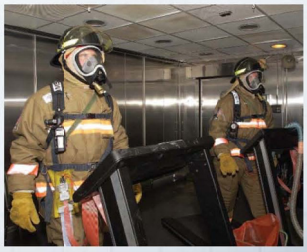
Certification of CB Protective Clothing

- **Military**
  - NATO standards
  - ABCA army standards
  - DND specifications
- **Industrial**
  - NIOSH
  - NFPA
  - CGSB
- **Military ≠ Industrial**

Component Level

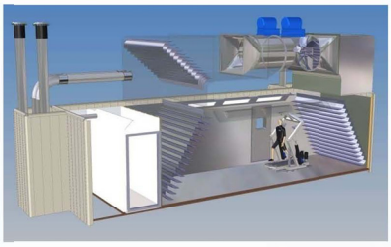


System Level



4

Suffield Wind Tunnel Exposure Chamber



Wind tunnel design
Fully automated process control
Environmental control
    air flow (0-7 m/s), temperature (5-50°C), humidity (10-90%)
Challenge dissemination capability (simulants) 5-500mg/m^3
    vapour, liquid droplets, aerosols (spores) 0.3 - 10µm
Full wash-down (decon) capacity
Articulated mannequin platform
    Life-size anthropometrically correct

5

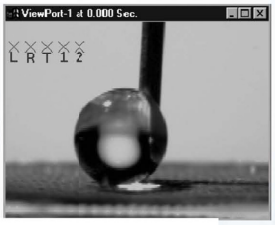
Suffield Wind Tunnel Exposure Chamber

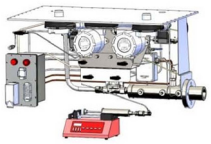
- Systems Test
  - passive samplers (converting to real-time)
  - Bioaerosol

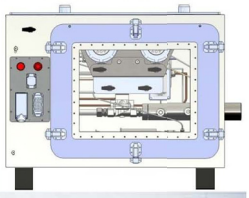
6

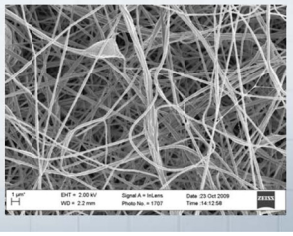
Support at DRDC Suffield

- Research and development effort:
  - how best to test novel materials?
- Develop test methodology and equipment at representative component level for vapour and aerosol challenges under dynamic conditions in evaluating percutaneous protection
- Better understanding of:
  - percutaneous toxicity of aerosols
  - the effects of aerosol challenge concentration and particle size on skin deposition









7

Conclusions: T&E Protective Ensemble

- Requirement for CB protection established for military. Most can be translated into first responders applications
- Testing capabilities set up at various DRDC Centres across Canada
- Test methodologies developed and established at DRDC and some translated into civilian application e.g., ASTM F 2588 - 07 Standard Test Method for Man-In-Simulant Test (MIST) for Protective Ensembles
- Testing performed at component and system levels
- CB protection standards set up for civilian e.g., CGSB-205.1 CSA Z1610-200X Protection of First Responders from Chemical, Biological, Radiological and Nuclear (CBRN) Events
- T&E activities supported by research and development activities at DRDC

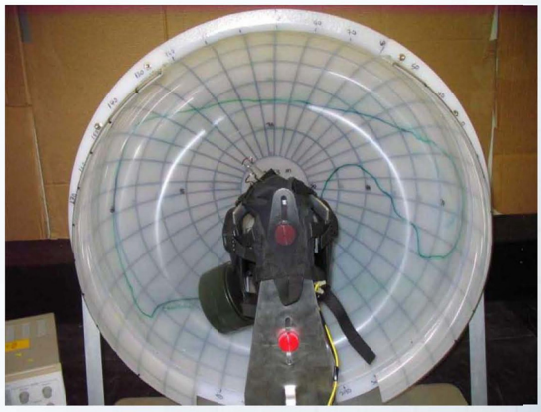
8

B.6 DSRI & RMCC CB T&E Capabilities

T&E on respirators

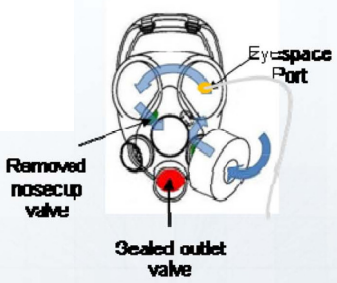
Respirator testing

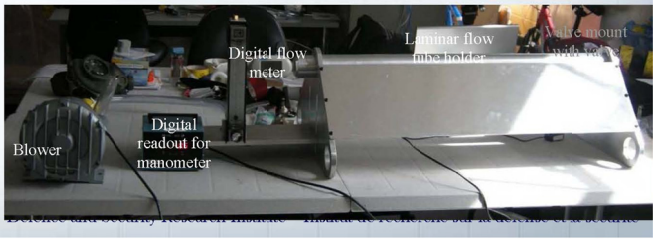
- Field of view
  - Obstruction of visual field due to eyepieces/visors, helmets, canisters, nosecup
  - Restriction of movement when wearing bulky gear such as bomb disposal
  - Relevant to NATO, NIOSH, NIJ, EN, CSA standards



Respirator testing

- Breathing resistance
  - Discomfort and loss of endurance due to breathing through valves and canisters
  - Relevant to NATO, NIOSH, CSA, EN standards





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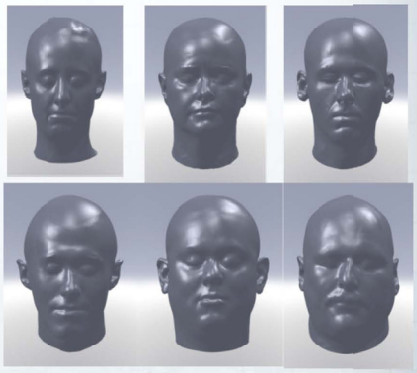
Respirator testing

- Performance under controlled breathing conditions
  - Design phase
  - Test seal, sizing and protection
  - Measuring dynamic flow resistance and protection simultaneously on multiple anthropometric headforms using realistic breathing patterns, motion



6

Respirator testing

- Performance under simulated workplace conditions
  - Design, qualification, selection phase
  - Test seal, sizing and protection
  - Test effect of integration with other equipment, weapons firing, other realistic activities
  - Relevant to NATO, CSA standards

Respirator testing

- Performance of canister
  - Design, qualification, selection phase
  - Test filtration (particulate removal) and TIC vapour removal capacity
  - Relevant to NATO, ISO, NIOSH, CSA standards

T&E on clothing/dermal protection

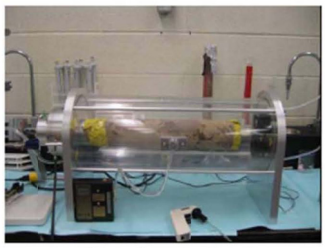
Clothing/system testing: vapour protection

- Performance under simulated workplace conditions
  - Design, qualification, selection phase
  - Test materials, seal, sizing and protection
  - Test effect of integration with other equipment, other realistic activities
  - Relevant to NATO, NFPA, NIJ, CSA standards

- Materials can be tested independently

Clothing/system testing: bioaerosol protection

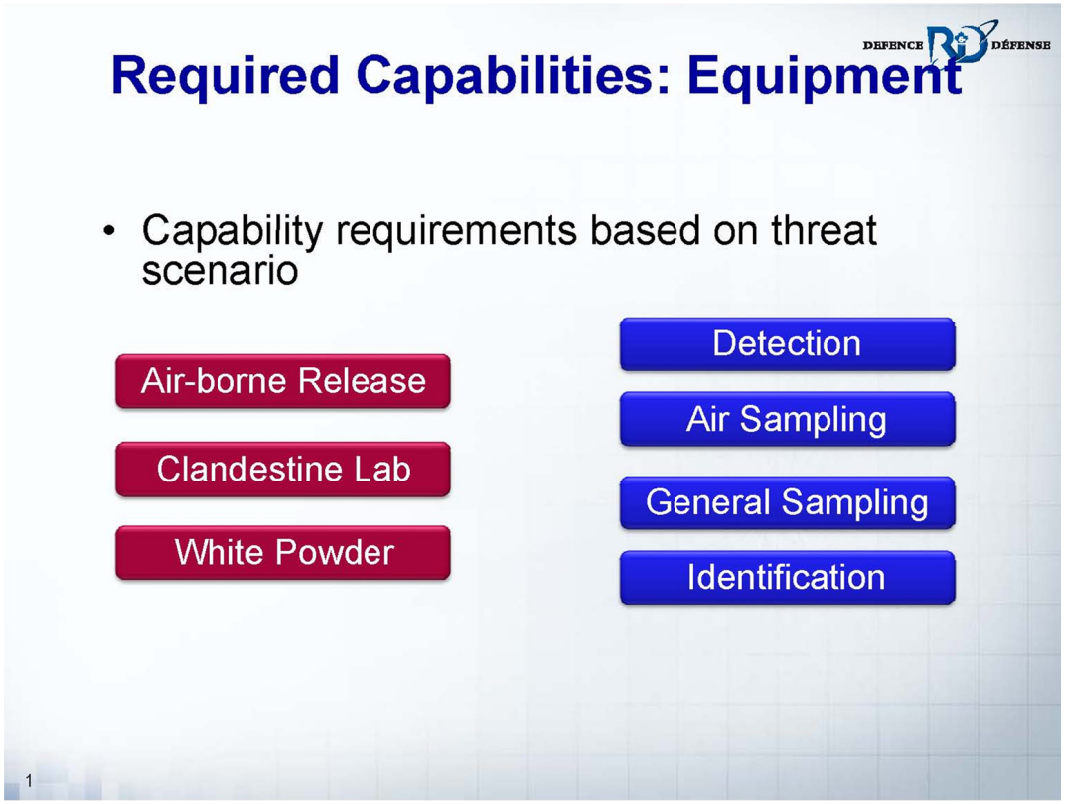
- Performance under simulated workplace conditions
  - Design, qualification, selection phase
  - Test materials, seal, sizing, protection, and decontamination procedures
  - Test effect of integration with other equipment, other realistic activities



Small bench-scale chamber

- Materials can be tested independently

B.7 T&E for Chemical Detectors



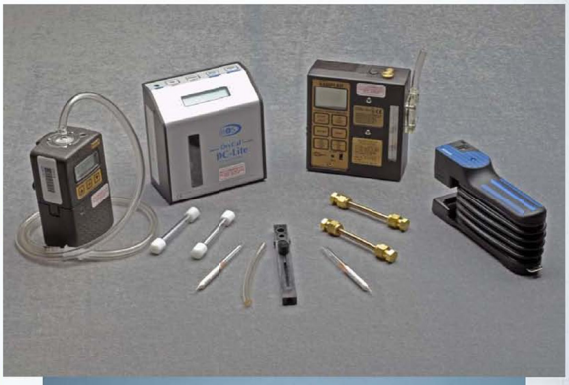
Capability Requirements - Equipment

- **Detection**
- Air Sampling
- General Sampling
- Identification

2

Capability Requirements - Equipment

- Detection
- **Air Sampling**
- General Sampling
- Identification

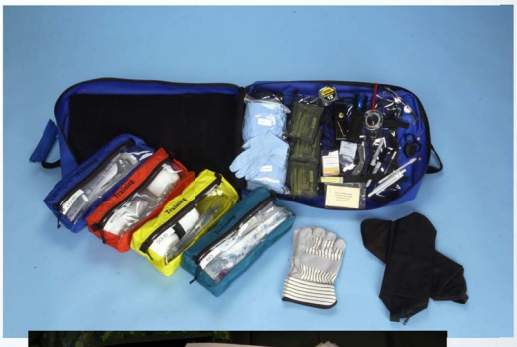


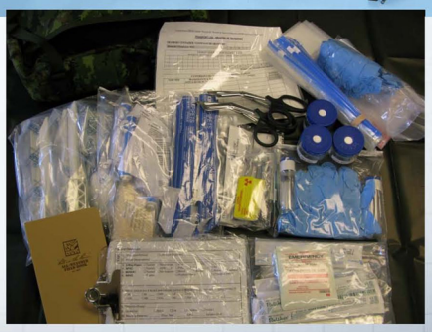
3

Capability Requirements - Equipment

DEFENCE R&D DÉFENSE

- Detection
- Air Sampling
- General Sampling
- Identification





4

Capability Requirements - Equipment

DEFENCE R&D DÉFENSE

- Detection
- Air Sampling
- General Sampling
- Identification

5

DEFENCE R&D DÉFENSE

Defence Research and Development Canada
Counter Terrorism Technology Centre (CTTC)

T&E of Chemical Detection Equipment

CRTI T&E Workshop
27-28 September 2011

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

Canada

Chemical Detectors

DEFENCE R&D DÉFENSE

- Chemical threats to detect
- Sensitivity requirements (IDLH vs. AEGL)
- Low false alarm rate
- Low or no false negatives
- Reduced size
- Wide environmental operating range
- Low or no consumables
- Chemical classification (possibly identification)

7

Performance Testing: Chemical Detection Equipment

- Challenge with:
  - CWAs (and/or simulants)
  - CWAs and interferents
  - TICs and TIMs
- Define reference system
- Test facilities
- Operational testing/field use

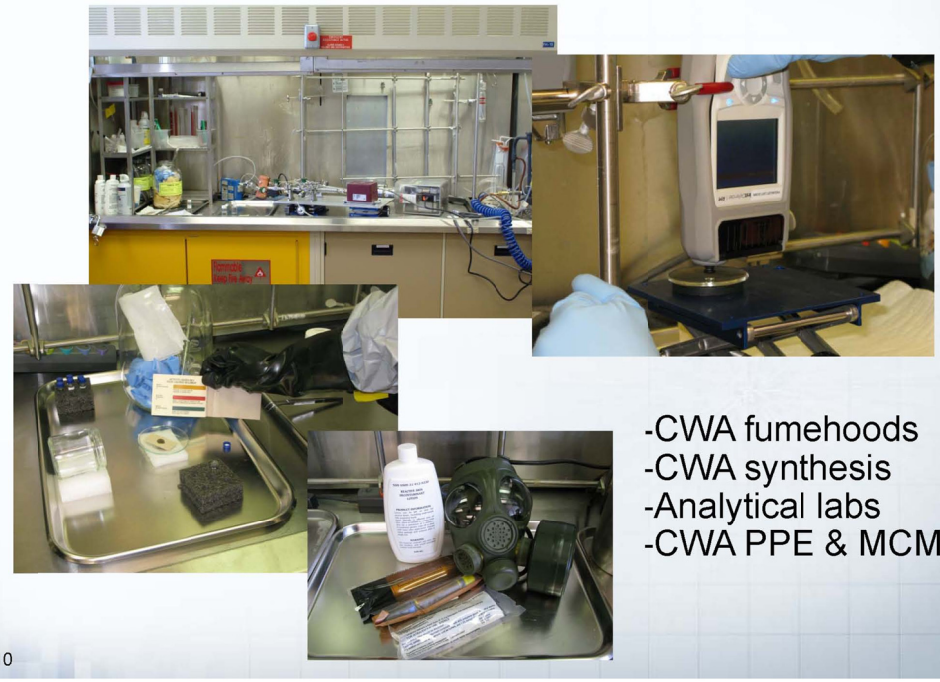
8

Reference Systems

- Measure the challenge (purity/conc'ns)
  - Chemical purity (GC-MS and ^{1}H NMR)
  - Vapor conc'n (air sampling/GC-MS)
  - Liquid and solid conc'n (weight or volume)

9

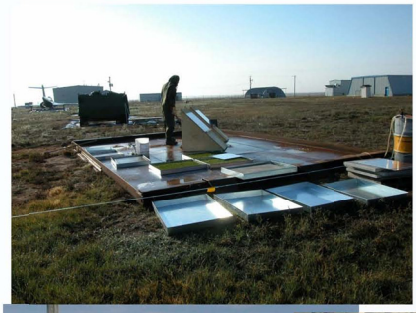
Test Facilities: Fumehoods



-CWA fumehoods
-CWA synthesis
-Analytical labs
-CWA PPE & MCMs

10

Test Facilities: Open Air



-limited CWA use
-operational tests
-qualitative results

11

Performance Testing: Chemical Detection Equipment

- Present and measure the challenge
  - Chemical purity determination
  - Vapour concentration (ppm_v or mg/m^3)
- Compare the detector output to reference
- Evaluate LOD, false alarm rate, and effect of interferents

12

Questions

13

B.8 First Responder Equipment Selection

Kingston T & E Workshop

September 2011

Toronto CBRNE Team

Sgt. Chris May

Toronto Police Service

Toronto CBRNE Team

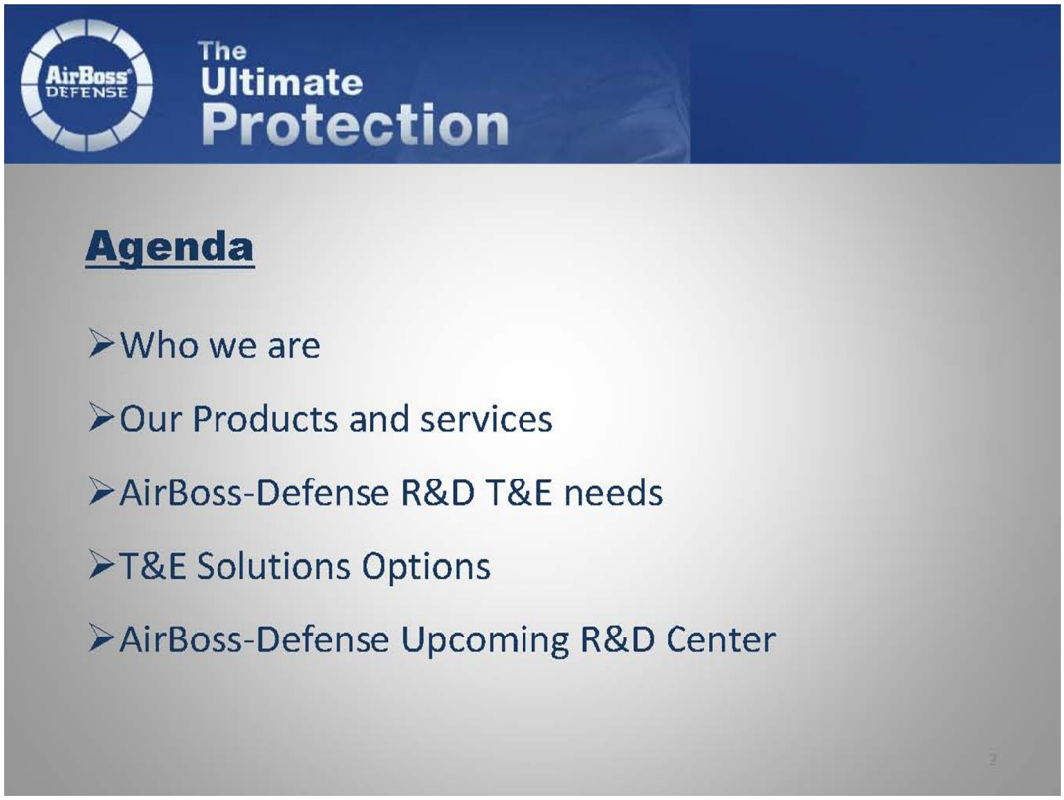
Current Technologies

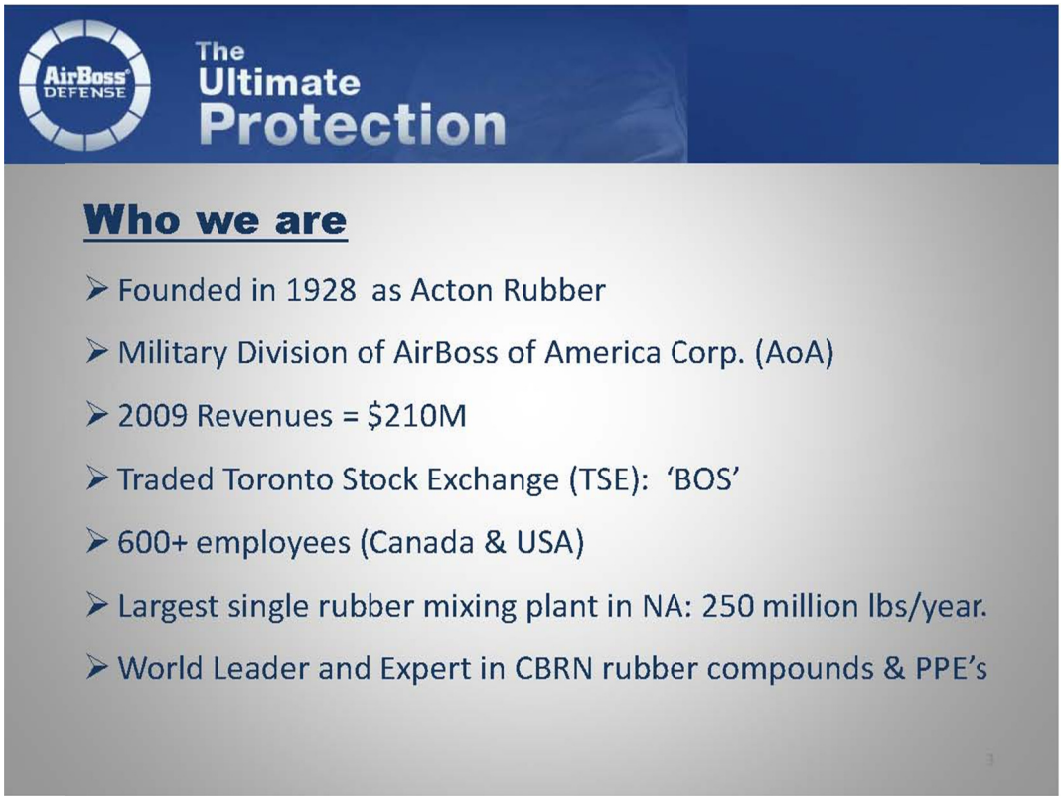
- Colourmetric tubes- e.g. Draegar Tubes
- 3-way paper
- NAVD
- Litmus papers
- IMS- e.g. CAM, LCD 3.3
- Flame Spectroscopy- e.g. AP4C
- FTIR- e.g. Hazmat ID
- Ramon IR- e.g. Responder IR
- PID
- Multi gas
- GCMS- e.g. Hapsite

Current Technologies

- 20/20 Protein test kit
- HHA e.g. Pro Strips
- FTIR e.g. Hazmat ID (protein warning)
- PCR- e.g. Razor

B.9 Industry T&E Solutions: Case Study – AirBoss Defense


AirBoss DEFENSE
The Ultimate Protection
Agenda
Who we are
Our Products and services
AirBoss-Defense R&D T&E needs
T&E Solutions Options
AirBoss-Defense Upcoming R&D Center


AirBoss DEFENSE
The Ultimate Protection
Who we are
Founded in 1928 as Acton Rubber
Military Division of AirBoss of America Corp. (AoA)
2009 Revenues = $210M
Traded Toronto Stock Exchange (TSE): 'BOS'
600+ employees (Canada & USA)
Largest single rubber mixing plant in NA: 250 million lbs/year.
World Leader and Expert in CBRN rubber compounds & PPE's

AirBoss DEFENSE

The Ultimate Protection

Our products

Canadian C4 Gas Mask

- Maybe not as cute as some competing products
- But it's light, it fits and it will save your life!




AirBoss DEFENSE

The Ultimate Protection

Our products

Molded AirBoss Lightweight OverBoot (MALO)

- Easy ON
- Easy OFF
- 24 hours NBC protection

The Ultimate Protection

Our products

AirBoss Molded Glove (AMG)

- The glove that fits
- The glove that feels
- 24 hours NBC Protection

JOINTLY DEVELOPPED BY AIRBOSS-DEFENSE
AND
DEFENSE RESEARCH & DEVELOPMENT CANADA - DRDC

6

The Ultimate Protection

Our products

Other Products

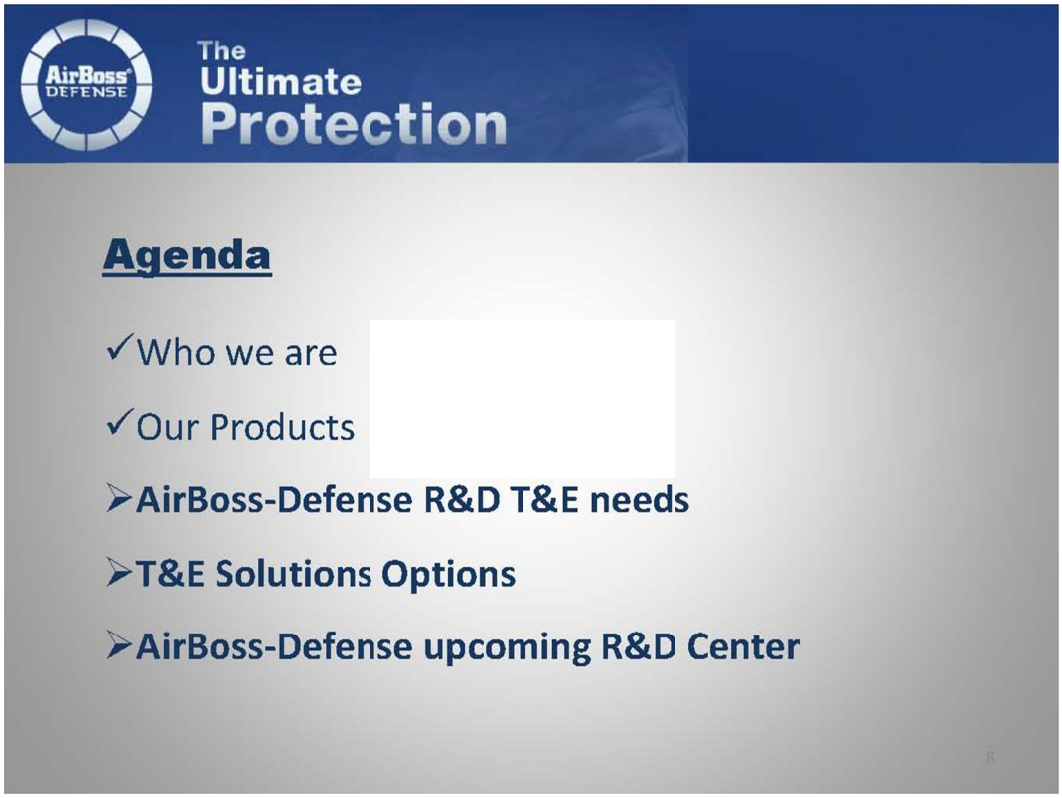
Fire Boot

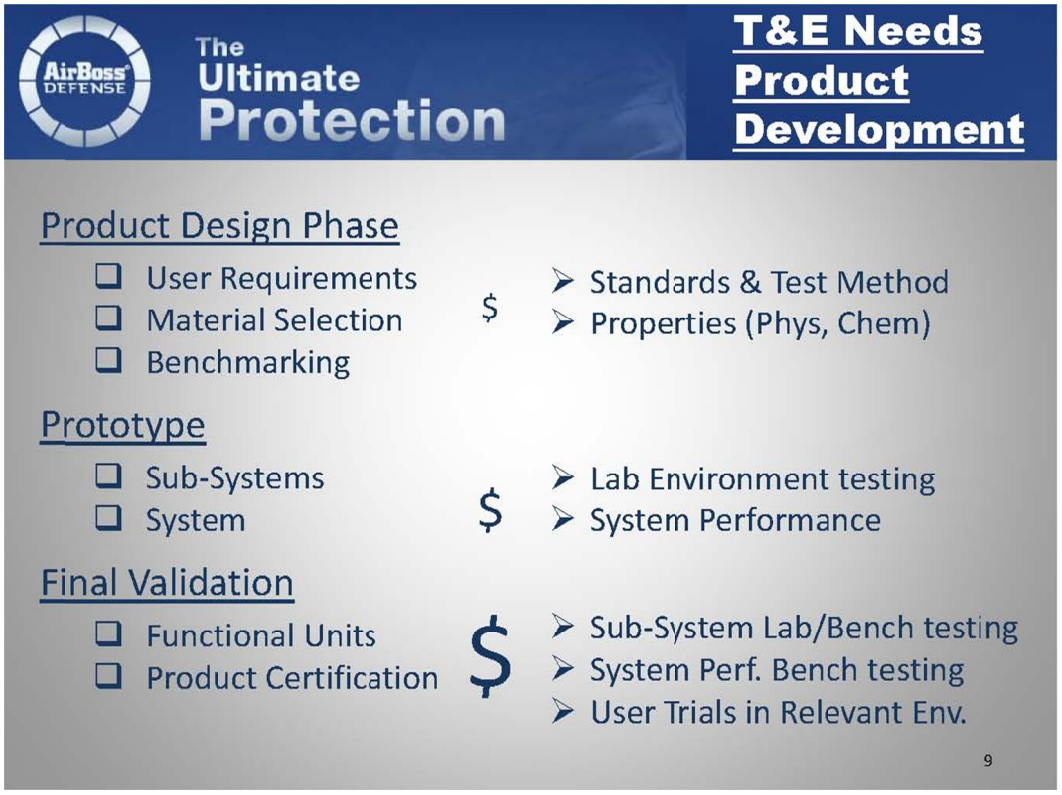
The only hand made
Fire boot in NA!

Extreme Cold Weather boot

Warm an Dry, Day and Night!

7


The Ultimate Protection
Agenda
✓Who we are
✓Our Products
➢AirBoss-Defense R&D T&E needs
➢T&E Solutions Options
➢AirBoss-Defense upcoming R&D Center


The Ultimate Protection
T&E Needs Product Development
Product Design Phase
User Requirements
Material Selection
Benchmarking
$
Standards & Test Method
Properties (Phys, Chem)
Prototype
Sub-Systems
System
$
Lab Environment testing
System Performance
Final Validation
Functional Units
Product Certification
$
Sub-System Lab/Bench testing
System Perf. Bench testing
User Trials in Relevant Env.
9

The Ultimate Protection

T&E Needs

Example:

Some NBC PPE Clothing Material Requirements	Standard & Test Method
CWA, Liquid/ Vapour Protection (VX/HD/TGD),	TOP 8-2-501 or ASTM F739
TIC, Protection	NFPA 1991, section 5.4.1
Thermal burden: - Vapor transmission - Thermal Resistance	 ISO 11092 ASTM F1291-10
Flame Resistance	ASTM D6413
POL Resistance	UK/SC 4985B

10

The Ultimate Protection

➢ Etre plus explicite sur des exemples de tests

T&E Solutions

AirBoss-Defense internal capability

- **Polymer/Material T & E**
  - Hardness, Tensile, Tear, Puncture, Viscosity, Brittleness, Flame Resistance etc Flex Fatigue etc.....
  - ISO Certified Laboratories
- **Chemical Performance T & E**
  - Typical Analytical Chemistry (FTIR, GC, ...)
  - TIC Lab (TOP 8-2-501)
  - Filter and Flat Carbon sheet Penetrometer *
- **Respirator System Testing**
  - Valve air flow Pressure drop
  - Digital Breathing Machine *
  - Component and Face seal leakage testing

* Projected in future AirBoss-Defense new labs

11

AirBoss DEFENSE

The Ultimate Protection

T&E Solutions

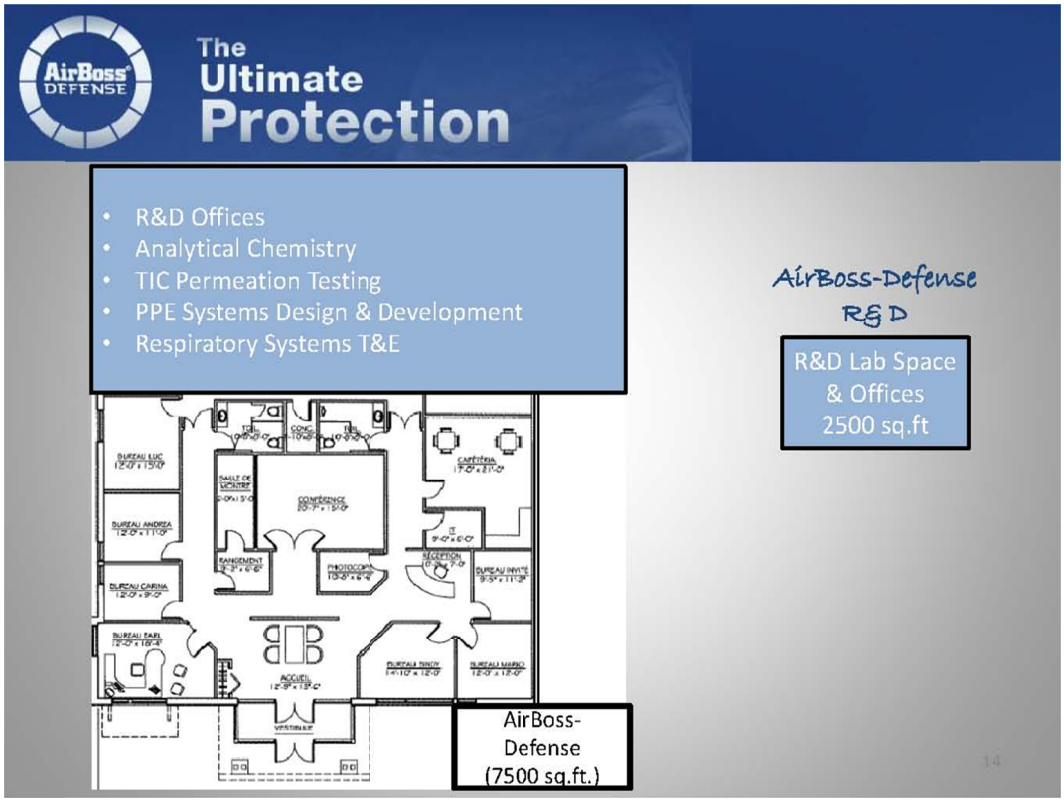
External Solution / Need	SATRA TECHNOLOGY CENTRE	CTTGroup	DRDC Suffield	proQares a TNO company	RMC CMR
Air permeation	✓	✓			
Drying rates	✓	✓			
Thermal Rating	✓	✓			
Flame Resistance	✓	✓			
Sweating hands	✓	✓			
Life cycle evaluation	✓				
Live Agent Testing: Polymers & Fabrics			✓	✓	
Product Certification / CE Marking	✓			✓	
Systems integration in MIST Chamber					✓
Respirator field of view				✓	✓
Respirator leak testing					✓
Respirator Breathing Resistance					✓

AirBoss DEFENSE

The Ultimate Protection

AirBoss-Defense – Bromont Industrial Park
7500 sq. ft – March 2012

13


AirBoss DEFENSE
The Ultimate Protection
• R&D Offices
• Analytical Chemistry
• TIC Permeation Testing
• PPE Systems Design & Development
• Respiratory Systems T&E
AirBoss-Defense R&D
R&D Lab Space & Offices 2500 sq.ft
AirBoss-Defense (7500 sq.ft.)
14

B.10 Evolution of PCR Instrumentation

PCR Evolution Since 2001

- Adaptable technology bringing PCR out of the lab and into the field
- Driven by the needs and requirements of First Responders
- Overview on three generations of technology

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The Early Years (Pre 2001)

"No one was selling a thermal cycler, so I decided to build one... And it had to be fast!"

"We used a hair dryer, a vacuum cleaner and a flowcytometer... It was big and loud!"

Carl Wittwer MD PhD

Clermark

The Early Years (Pre 2001)

Clermark

PCR Evolution Since 2001: 1st Generation

- High flexibility
- Skill intensive – requires highly trained technicians
- Requires lengthy sample prep time
- Employs AC power
- Relatively large in footprint

Clermark

PCR Evolution Since 2001: 1st Generation

- Examples: Cepheid SmartCycler

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PCR Evolution Since 2001: 1st Generation

- Examples: Roche Lightcycler

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PCR Evolution Since 2001: 1st Generation

- Examples: Idaho Technology R.A.P.I.D.

Noted deployments:

- CBSA
- PHAC

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PCR Evolution Since 2001: 2nd Generation

- Focus on portability and user friendliness
- Simplified sample prep methodology
- Shift towards pre-mixed reagents
- Introduction of reagent pouch technology
- Operational on battery power
- Much smaller size

Clermark

PCR Evolution Since 2001: 2nd Generation

- Examples: Smiths Bio-Seeq

Clermark

PCR Evolution Since 2001: 2nd Generation

- Examples: Idaho Technology RAZOR

Noted deployments:

- RCMP
- PHAC

Clermark

PCR Evolution Since 2001: 2nd Generation

- Examples: Idaho Technology RAZOR EX

Noted deployments:

- Canadian Forces VP BioSentry
- CF Special Forces
- PHAC
- RCMP
- OPP PERT

Clermark

PCR Evolution Since 2001: 3rd Generation

- Employing MicroArray technology
- Massive Multiplex technology
- Completely automated
- 102 PCR reactions in one run in an hour
- Simple user interface
- Integrated sample prep “in the bag”
- Flexible for bio incident response or clinical diagnostics

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PCR Evolution Since 2001: 3rd Generation

- Example: Idaho Technology FilmArray

Noted deployments:

- Classified Canadian Research Agency

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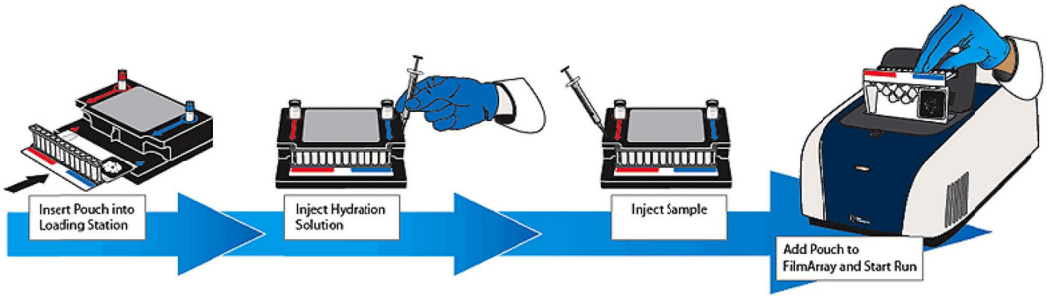
PCR Evolution Since 2001: 3rd Generation

Idaho Technology FilmArray – PCR Simplicity



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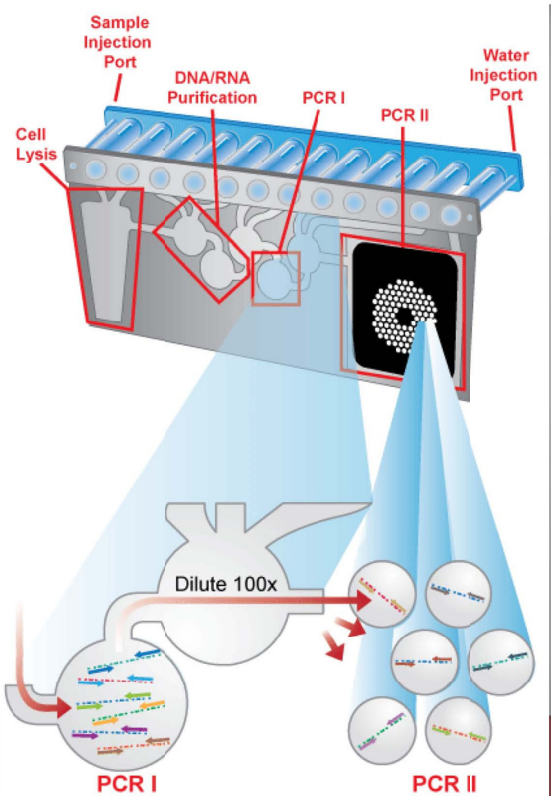
PCR Evolution Since 2001: 3rd Generation

Idaho Technology
FilmArray – PCR
Simplicity



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Operational Objectives Driving Development of PCR Technology

1. Time to Results
   - Reduction in sample prep time
   - Reaction to end analysis speed
2. Ease of Use
3. Portability & Ruggedness
4. Reagent Availability
5. Cost per Test

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Operational Objectives: Time to Results

- **Total time to results depends on both:**
  - Sample prep time (SPT)
  - Instrument run time (IRT)
  - Total time to results = SPT+RPT

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Operational Objectives: Time to Results

- **1st Generation** **1:45**
  - SPT 60 minutes + IRT 45 minutes = 1:45 time to results
- **2nd Generation** **0:55**
  - SPT 10 minutes + IRT 45 minutes = 0:55 time to results
- **3rd Generation** **0:55**
  - SPT 5 minutes + IRT 50 minutes = 0:55 time to results
- With advances in "reagent pouch technology", operators have been able to significantly reduce time to results to under an hour after arriving on the scene

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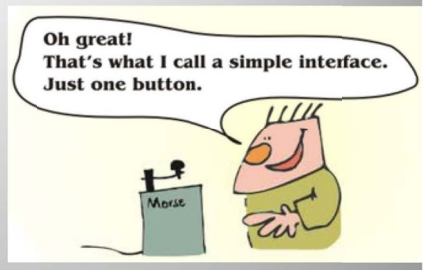
Operational Objectives: Ease of Use

- Ease of use has been a primary driver in the development of PCR instrumentation that meets the objectives of First Responders
- Recognizing that many FR's do not use specialized bio ID instrumentation on a weekly basis
- Requirement to simplify both a) sample prep protocols and b) instrument operation
- Focus on retaining accuracy and reliability of results while reducing operator error and false calls



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Operational Objectives: Ease of Use - Reagent Pouch Technology

- Advent of "reagent pouch technology" (2nd Generation) introduced the following:
  - No pipetting / detailed measuring / washing / centrifugation / agitation of sample
  - No glass capillary tubes for reduced breakage and contamination
  - Freeze dried reagents in pre-selected FR configurations loaded into the pouch
  - Kit based approach with all consumables in a box
  - Easy to follow instructions in a peel and stick format for PPE equipment
  - Instrument user interfaces designed for PPE equipment
  - Results in an hour on the instrument – no laptop required

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Operational Objectives: Ease of Use - Reagent Pouch Technology

Clermark

Operational Objectives: Portability & Ruggedness – 1st Generation

- Requirements moving instrumentation "out of the lab – and into the field"
- 1st Generation instruments were categorized as being large, heavy and requiring A/C direct power, but for the first time, PCR was field-ready
- The United State's JBAIDS program was driven by this principle and resulted in the R.A.P.I.D. instrument (*essentially a ruggedized LightCycler*) with wide scale deployment across military bases and installations worldwide

JBAIDS

Clermark

Operational Objectives: Portability & Ruggedness – 2nd Generation

- Development of 2nd Generation instrumentation was driven by the US military demanding a smaller / battery operated variant that did not require a laptop to interpret results
- Further advancement of 2nd Generation technology was jump started with a "wishlist" of requirements identified by the Canadian Forces including: MIL-STD 810 certified for shock / drop / vibration / altitude / dust

RAZOR EX

Clermark

Operational Objectives: Portability & Ruggedness – 3rd Generation

- 3rd Generation equipment has not made the leap to a ruggedized configuration; however it is expected to be introduced in the coming years (GEN4)

Clermark

Operational Objectives: Reagent Availability – 1st Generation

- Freeze dried reagent development has been driven in the past 10 years by:
  - CDC List of Category A/B/C Threats
  - NATO Threat List (Classified)
  - Input from US DOD (JBAIDS Program)
  - Input from Canadian Forces (VP BIO SENTRY program)
- Following 21 threat targets are available for 1st Generation instruments:

THREAT TARGETS		
B Anthracis 1/2/3	E. Coli 0157 1	Variola
F Tularensis 1/2	Salmonella 1	Ricin 1/2 (HP)
Y Pestis 1/2	Campylobacter 1	Av Infl H5 ST ½ (HP)
Brucella sp 1	C Botulinum A 1	Infuenza A 1 (HP)
Listeria Mono 1	Cryptosporidium 2	

Clermark

Operational Objectives: Reagent Availability – 2nd Generation

- Goal was to introduce a comprehensive threat library of reagents into a single pouch
- Development was spurred by the CF's VP BIO SENTRY program
- Resulted in the development of the CF Special pouch (classified) and the RAZOR 10 POUCH:

THREAT TARGETS			
B Anthracis	Coxiella	Ricin	Variola
Brucella sp	E Coli 0157	Salmonella	Y Pestis
C Botulinum	F Tularensis		

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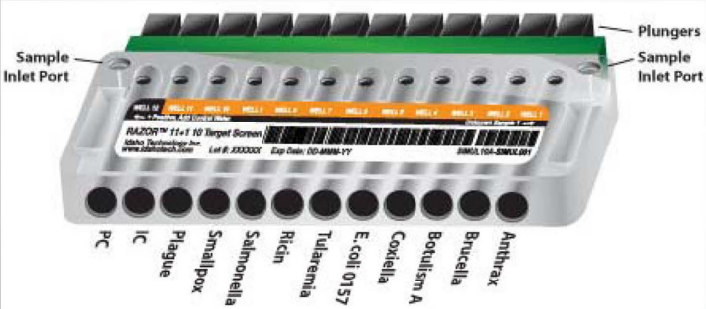
Operational Objectives: Reagent Availability – 2nd Generation RAZOR 10 Pouch



THREAT TARGETS			
B Anthracis	Coxiella	Ricin	Variola
Brucella sp	E Coli 0157	Salmonella	Y Pestis
C Botulinum	F Tularensis		

Clermark

Operational Objectives: Reagent Availability – 3rd Generation

- FilmArray pouch technology is an evolutionary leap with roots in the RAZOR 10 Target pouch technology
- Employs Massive Multiplex and Micro Array technology capable of 102 separate PCR reactions during a single run on a single pouch
- Resulted in the following configuration:
  - Viral Pathogens x 7 threats
  - Bacterial Pathogens x 7 threats
  - Toxin Gene Targets x 3 threats
- Note: multiple targets within each threat in triplicate for increased specificity and reliability

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Operational Objectives: Reagent Availability – 3rd Generation

- FilmArray Biothreat Panel includes:

Viral Pathogens	Bacterial Pathogens	Toxin Gene Targets
Ebola Zaire virus	*Bacillus anthracis* (pXO1, pXO2, chromosomal)	Ricin toxin gene from *Ricinus communis*
Marburg virus	*Yersinia pestis*	SEB gene from *Staphylococcus aureus*
Eastern Equine Encephalitis virus	*Francisella tularensis*	Botulinum toxin from *Clostridium botulinum*
Western Equine Encephalitis virus	*Brucella* (*melitensis*, species)	
Venezuelan Equine Encephalitis virus	*Burkholderia* species (*mallei*, *pseudomallei*)	
Variola major virus	*Coxiella burnetii*	
Orthopox virus	*Rickettsia* species (spotted fever group, typhus group)	

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Operational Objectives: Cost per Test

- Operating budgets of First Responder agencies are adversely affected by the cost of reagents compared to threats such as Chemical, Radiological and Nuclear detection
- Key is to reduce the cost per test, while retaining the key response tenets of speed, reliability and convenience

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Operational Objectives: Cost per Test

- RAZOR Pouch Technology has allowed more threat targets to be configured into a single run:
  - 12 reactions / 10 threats / 2 controls $20.00 / reaction
- FilmArray Pouch Technology has drastically reduced the cost per reaction of Bio ID responses by efficiently loading lower quantities (and more numerous) reagents into the BioThreat pouch panel:
  - 102 reactions / 17 threats (multiple in triplicate) / multiple controls $0.50 / reaction
- ***Note: price of instrumentation (2nd Generation and 3rd Generation) are approximately equivalent***

Clermark

Conclusions

- Operational requirements have been driven by:
  - **SPEED**
  - **SIMPLICITY**
  - **FLEXIBILITY**
  - **PRICE**
- Since 2001, Canadian First Responders have taken advantage of evolving technologies to better prepare against the threat of Bio-Terrorism
- As 3rd generation PCR technologies evolve, they will be transformed into operational instruments suited for the field with emphasis on ruggedness and portability

Clermark

Clermark Contact Information

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613-963-9974
http://www.idahotech.com
http://filmarray.com
http://www.clermark.com

Clermark

B.11 Equipment Standardization

Outline

- Introduction: Standards Development Organizations and processes
- Examples of recent standards
- CSA Z1610: Protection of first responders
  - What should a standard look like?
  - How can you participate?
  - Discussion of this standard as an example

Introduction

STANDARDS DEVELOPMENT PROCESS

CANADIAN STANDARDS ASSOCIATION

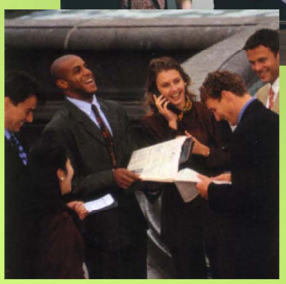
Independent. Not-for-profit.

- Standards touch us all, each day
- Leader in developing standards for more than 80 years
- Serving business, industry, consumers and government
- 9,000 members
- More than 2,600 published standards

15

CANADIAN STANDARDS ASSOCIATION

- Standards developed by: about 9,000 volunteers from all walks of life
- Consensus approach, so no one interest group dominates
- Referenced by governments and industry associations



CBRN PROTECTION GROUP
ROYAL MILITARY COLLEGE

Consensus Standards and Guidelines

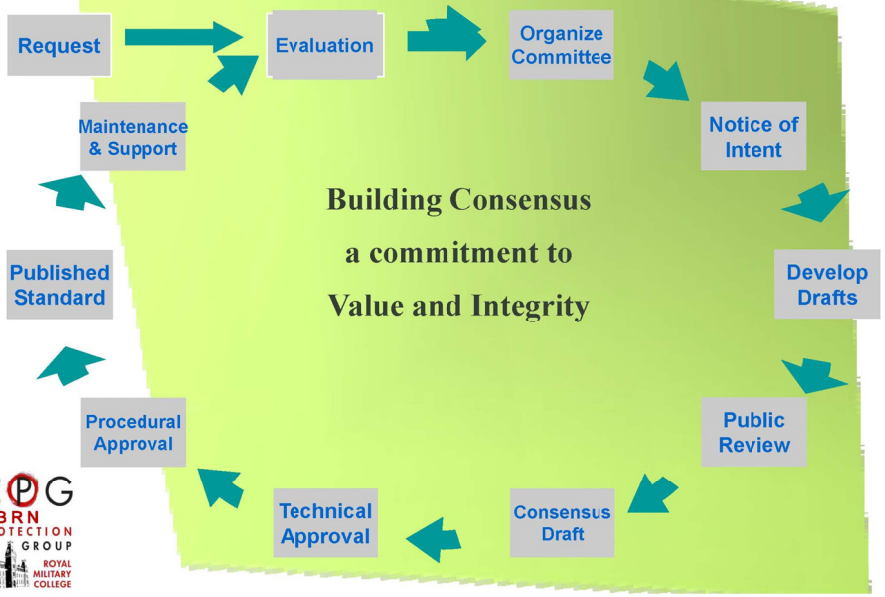
"Making standards work for People and Business"

Voluntary Consensus Standards

Motivation for compliance:

- **Due diligence**
- **Reduced liability**
- **Recognition by regulatory authorities (doing the "right things")**

Consensus Development Process

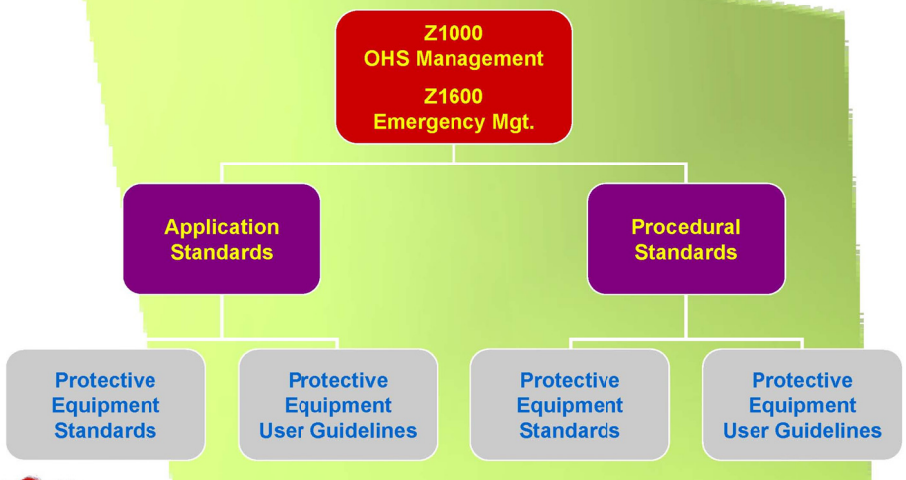


Our Principles

Strike a balance:

1. Principle of diversity
   - no one group dominates
2. Principle of consensus
   - satisfy the needs of those concerned about a particular topic

CSA Standards Structure



Recent CSA Standards

- **Z1000** OHS Management Systems
- **Z1600** Emergency Preparedness
- **Z1006** Work in Confined Spaces
- **Z611** Riot Helmets
- **Z617** Blunt Trauma Protection
- **Z94.4** Respirators
- **Z1610** PPE for First Responders to CBRN Events

Protection of first responders from chemical, biological, radiological, and nuclear (CBRN) events

CAN/CGSB/CSA-Z1610-11

Z1610 Development:

HOW DID IT ALL HAPPEN?

What does it take?

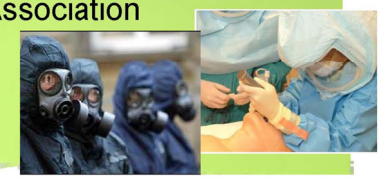
- Need
- Initiative
- Resources
- Standards development organization
- Willing committee participants

The start

- The need
- The initiative

Resources and SDO's

- Project CRTI 05-0016RD:
  - Development of a Canadian Standard for Protection of First Responders from Chemical, Biological, Radiological and Nuclear (CBRN) Events
- Project Lead:
  - Canadian General Standards Board (PWGSC - CGSB)
- Standards Development Partner:
  - Canadian Standards Association

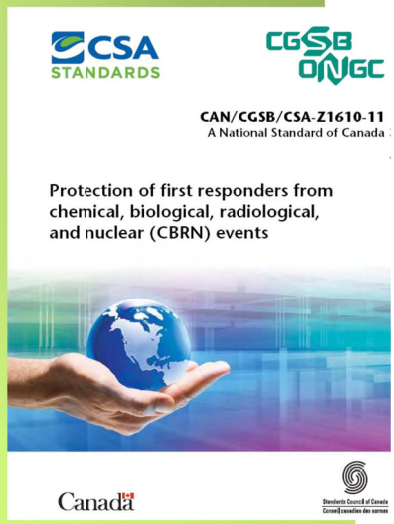


Participants: Committee members

- Federal Partners:
  - National Research Council
  - Public Safety Canada
  - Royal Canadian Mounted Police
  - Royal Military College of Canada
  - Transport Canada
- Industry/Other Partners (First Responders):
  - Canadian Association of Fire Chiefs
  - Canadian Council of Health Services Accreditation
  - Canadian Healthcare Association
  - Canadian Professional Police Association
  - Canadian Public Health Association
  - International Association of Fire Fighters (IAFF) Canadian Office
  - Paramedic Association of Canada
  - Various municipal responder groups
- Testing and specialist organizations

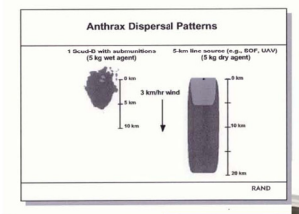
CBRN Equipment Standard:

WHAT SHOULD IT LOOK LIKE?



Scope

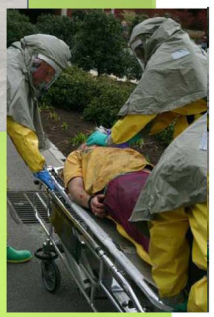
- Deliberate release of CBRN agent



– Including deliberate contagious event

Scope

- Targeted to fire, police, and medical first responders/receivers (prior to in-patient care)



CPG CBRN PROTECTION GROUP ROYAL MILITARY COLLEGE

Objective of such a standard

- Safety of the individual!
  - In this case, through the use of PPE
  - Safety is ensured by processes that include the use of particular items of equipment
  - Therefore the emphasis is not on specifying the equipment, but on providing guidance on how to select and use it
    - Required performance characteristics and associated test methods are then tightly tied to the concept of use

Objectives of Z1610

- Appropriate selection process
  - From qualified equipment
  - Taking into account
    - Nature of event
    - Nature of user
    - Protective performance and limitations
    - Human factors

Objectives of Z1610

- Appropriate procedures
  - Common concept of use
  - Limitations on use
  - Training and maintenance
  - Fitting/sizing

Content

- Required introductory material:
  - Legalities
  - Scope and applicability
  - Definitions
  - References

Content

- Concept of use
  - What for?
    - What is the function/use that's being served?
    - Type of event?
  - Who?
    - User group
  - When?
    - At what point in an event, and for how long?
  - Where?
  - How?
    - Assumptions & limitations on use

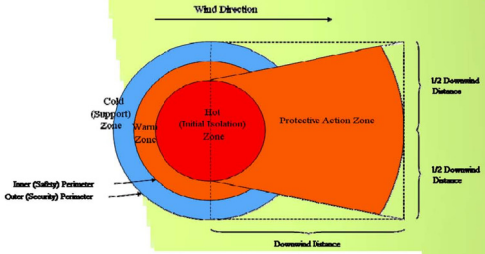
Introductory Material

Table 1
Phases of a CBRN event
(See Clause 4.3.1.)

Start of event		End of event
Phase 1: Response	Phase 2: Intervntion	Phase 3: Recovery
Notification		
Size up — detailed hazard assessment		
Identification as CBRN event (call-up standard)		
Indicators: (a) number of casualties; (b) where (target); (c) symptoms; and (d) evidence of suspicious/criminal intent	Identification of material and ability to quantify (possibly will not completely occur in Phase 2)	
Select PPE or alter response	Select specialist PPE	Select recovery PPE
Scene management and confinement — inner and outer perimeter	Zones detailed	Perimeters
Evacuation — rescue and extraction		
Casualty management on scene		
	Rapid intervention team (RIT)	
Emergency washdown (emergency decontamination [NFPA 472])		
Decontamination		
	Evidence — forensic	
Defensive mitigation (NFPA 472)	Offensive mitigation (NFPA 472)	

- A common framework describing event assessment and response parameters is included to support selection process in the initial response and intervention phases

Introductory Material



Elements of a CBRN Event

- Hazard Identification and Risk Assessment
- Responder roles and zones
- Release of CBRN material
- Contagious Outbreak Events

- Where will you be?
- What will you be doing?
- How long do you need PPE to protect for?

Tableau A.6
Rôles et activités des intervenants sur lesquels sont fondées les exigences relatives au port de l'EPI
(voir les articles 4.6, 5.2 et A.4.3 et le tableau 5.3)

	Zone				
Rôles et activités des intervenants	Chaude/ isolation	Tiède	Activités de protection	Aire de réception CBRN de l'hôpital (si elle se trouve dans la zone froide)	Périmètre (zone froide)
Contrôle des foules, établissement du périmètre, mise en quarantaine			M 1 et 2	M 1 et 2	M 1 et 2
Évacuation	E 1	E 1	E 1 et 2	—	M 1 et 2
Sauvetage, phase 1	E 1	—	—	—	—
Tri, traitement et transport (TTT), phase 1	—	—	—	M 1 et 2	M 1
Sauvetage des victimes et TTT, reconnaissance, EIR, extraction des intervenants en détresse	E 2	E 2	M 2	M 2	M 2
Intervention policière — techniciens en explosifs	E 2	—	—	—	—
Intervention policière — escouade d'intervention tactique	E 2	E 2	E 2	E 2	—
Collecte de preuves	M 2	M 2	M 2	M 2	

Selection

- If you have multiple potentially useful items of equipment:
  - What performance characteristics should they have to match the concept of use?
  - Derive the selection process based roughly on needs and capabilities
    - Iterative process that will include identifying gaps where there is a need but no capable equipment, or process is not robust

PPE configurations

- Complete protective systems
  - Limited protection (includes most currently available)
  - Recognised (mostly not yet available)

Unsuitable Limited protection Recognised

General descriptions and limitations only

Selection and Use

5 PPE Selection for CBRN Release Events

- Processes and information for selection during procurement, and on-scene, from recognised configurations
  - *Equipment Configuration Codes (RPD + DPE)*
  - *Recognised Configuration Descriptions (Systems)*
  - *Selection for a Release Event*

CGSB-205.1/CSA Z1610 – Protection of First Responders from Chemical, Biological, Radiological and Nuclear (CBRN) Events – Draft 8.6

Table 3 Recognised equipment configuration codes and explanations

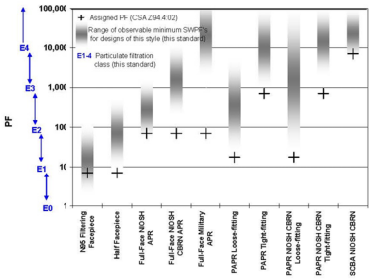
Configuration	Possible configuration components; almost all of these components require further qualification under this standard to meet configuration requirements, see Annex C	
	DPE	RPD
C1S or C1e	NFPA 1991	NIOSH CBRN SCBA or other SCBA e.g. NFPA 1981
C2S	Similar to 1994 Class 2	NIOSH CBRN SCBA
C2VP	Similar to 1994 Class 2	CDN CBRN APR
C2vP	Similar to 1994 Class 2	NATO equiv. CBRN APR
C2vp	Similar to 1994 Class 2	NIOSH CBRN APR
C2VP-PAPR	Similar to 1994 Class 2	CDN CBRN PAPR
C2vP-PAPR	Similar to 1994 Class 2	NIOSH CBRN APR with NATO equiv. APE
C2vp-PAPR	Similar to 1994 Class 2	NIOSH CBRN PAPR
CFS	NFPA 1971 Turnout Gear	NIOSH CBRN SCBA
CMS	Active Carbon; Similar to NATO AEP38	NIOSH CBRN SCBA

Selection and Use

6 PPE Selection for Contagious Outbreak Events

- Selection is for worst-case exposure using a predictive model (Annex F) that yields risk of infection levels, based on:
  - use of Category A bioagents
  - various types of response activities

Location	Expected Duration (hours)	No. Emitters	Probability of Infection				
			10%	1%	0.1%	0.01%	0.001%
			1 in 10	1 in 100	1 in 1000	1 in 10000	1 in 100000
Waiting room	1	20	E2	E3	E4	E4	E4
	8	20	E2	E3	E4	E4	E4
Emergency Treatment Tent	1	8	E3	E4	E4	E4	E4
	8	8	E3	E4	E4	E4	E4
Large Community Treatment Facility	1	100	E1	E2	E3	E4	E4
	8	100	E2	E3	E4	E4	E4



Recognised configurations

- For each configuration, components and entire PPE system must meet specific performance requirements for some or all of:
  - Respiratory protection
    - Particulate, Vapour, Liquid
  - Dermal protection
    - Liquid, Vapour, (Particulate), Pathogen
  - System performance
    - Protection, Human factors, Durability, Decontaminability

Selection process

- User group? Role?
  - Where located, what work rate, what tasks
- Type of event?
  - Release/contagious, type/amount of agent or unknown

Appropriate classes of PPE

Selection: Release Events

- Processes and information for selection during procurement, and on-scene, from recognized configurations

Selection of recognized PPE configurations for a
(See Clauses 5.10, 5.11, 8.2.1, B.5.1.1, B.6.1, B.6.2.2, B.7.1, B.8.1,

		PPE Class									
Hazard	Zone	C1S or C1s	C2S	C2VP	C2vP	C2 PAPR-VP	C2 PAPR-vP	CFS	CMS	CMVP	
Suspicious powder (1)	Hot zone	Y	Y	2, 3	2, 3	2, 4	2, 4	Y	Y	2, 3	
	Protective action/ warm zone	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Radiological hazard (13)	Hot zone	Y	Y	3	3	4	4	Y	Y	3	
	Protective action/ warm zone	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Biological agent (1)	Hot zone	Y	Y	3	3	4	4	Y	Y	3	
	Protective action/ warm zone	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Phase 1 — unknown hazard	Initial isolation zone or inner (safety) perimeter (5)	Y	N	N	N	N	N	N	N	N	
Phase 2 chemical — some knowledge of hazard but limited quantification	Hot zone	Y	N	N	N	N	N	N	N	N	
	Protective action/ warm zone	Y	7	7	6, 7	7	6, 7	7	8, 9	8, 9	

Partial selection table

Recognised configurations

	Respiratory Protection Type	
Dermal Protection Type	S	s
C1	C1S	C1s

All-hazard including unknown

Recognised configurations

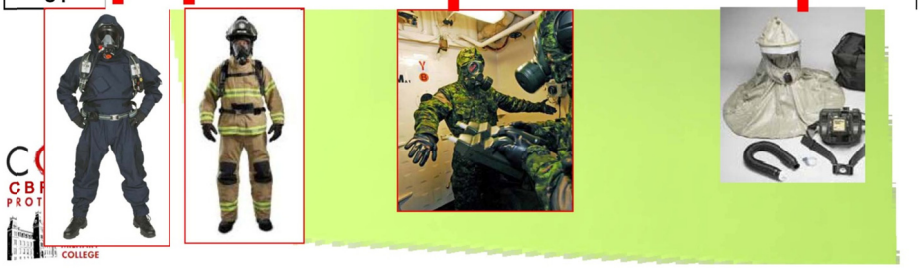
Particulate only (primarily B,R events)

	Respiratory Protection Type							
Dermal Protection Type	S	s	VP	vP	P	PAPR-VP	PAPR-vP	PAPR-P
C1								
C2								
CF								
CM								
C4	C4S	C4s			C4P			C4PAPR-P

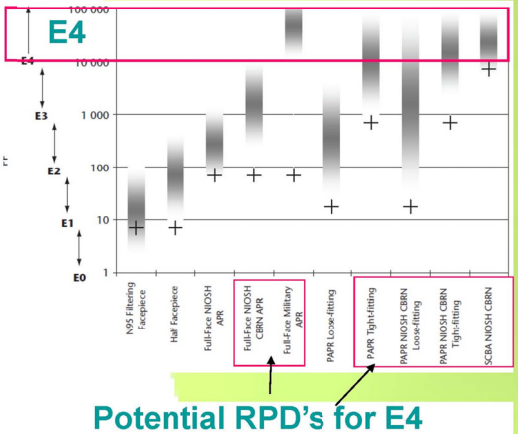
Recognised configurations

Lesser hazard e.g. outside hot zone (including C events)

	Respiratory Protection Type							
Dermal Protection Type	S	s	VP	vP	P	PAPR-VP	PAPR-vP	PAPR-P
C1								
C2	C2S		C2VP	C2vP		C2PAPR-VP	C2PAPR-vP	
CF	CFS							
CM	CMS		CMVP	CMvP		CMPAPR-VP	CMPAPR-vP	
C4								



Selection: Contagious Outbreaks



Potential RPD's for E4 protection

- Selection is for worst-case exposure using a predictive model that yields risk of infection levels, based on:
  - use of Category A bioagents
  - various types of response activities
  - Annex E provides model

Responsibilities

- **Manufacturer responsibilities**
  - Meet technical requirements for selected configurations (whole or part)
  - Labelling, packaging, shelf life, recall
- **Employer responsibilities**
  - Integration
    - Including additional technical requirements
  - Sizing
  - Training for use and on-scene selection
  - Life-cycle management

Annexes

Various annexes providing more detail and supporting information

Annex B: Hazards and Risk Assessment [informative]

- Potential characteristics of CBRN Terrorism release events and relevant ref information

Annex C. Acceptable equipment / standards and required evaluation methodologies [Normative]

- states requirements for various respirator styles, and entire protective systems worn with respirators

Annexes

Annex D. System integration and protective and user performance determination

- Addresses procedures and test methods for assuring equipment works as a system and in practice
- Sizing and Qualification for the individual
- Functionality
- Durability
- Simulated Workplace Protection Factor Requirements
- Respiratory/eye protection
- Thermal burden (heat stress)
- **Supplemental info in Annexes A, F-H**

Initial adoption of the standard

- **Voluntary standard**
- Currently would be considered “best practice”
- Employers:
  - Implement appropriate training, sizing, integration, modified limited response procedures for use of existing limited use configurations
  - Call up recognised configurations in procurement
    - Identify configuration types required tc fulfil response rcles
    - Require manufacturers to demonstrate compliance with technical specifications for recognised components
    - Perform integration/use exercise
    - Implement appropriate training, sizing, response procedures for recognised configurations

The way forward

- May be called up in legislation/regulation
- Development of PPE approval process
  - **New project CRTI 09-438TA**
    - Exploring approval options
    - Exercising the standard
    - Demonstration of integration/selection/testing exercise
      - Systems supplied by industry based on FR priorities
    - Sourcing/development of test methods
  - Recognised equipment list
- Other implementation activities
  - Training packages
  - Promotion

QUESTIONS?

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Kuang	Wenxing	Environment Canada
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Yanofsky	Norm	Centre for Security Science

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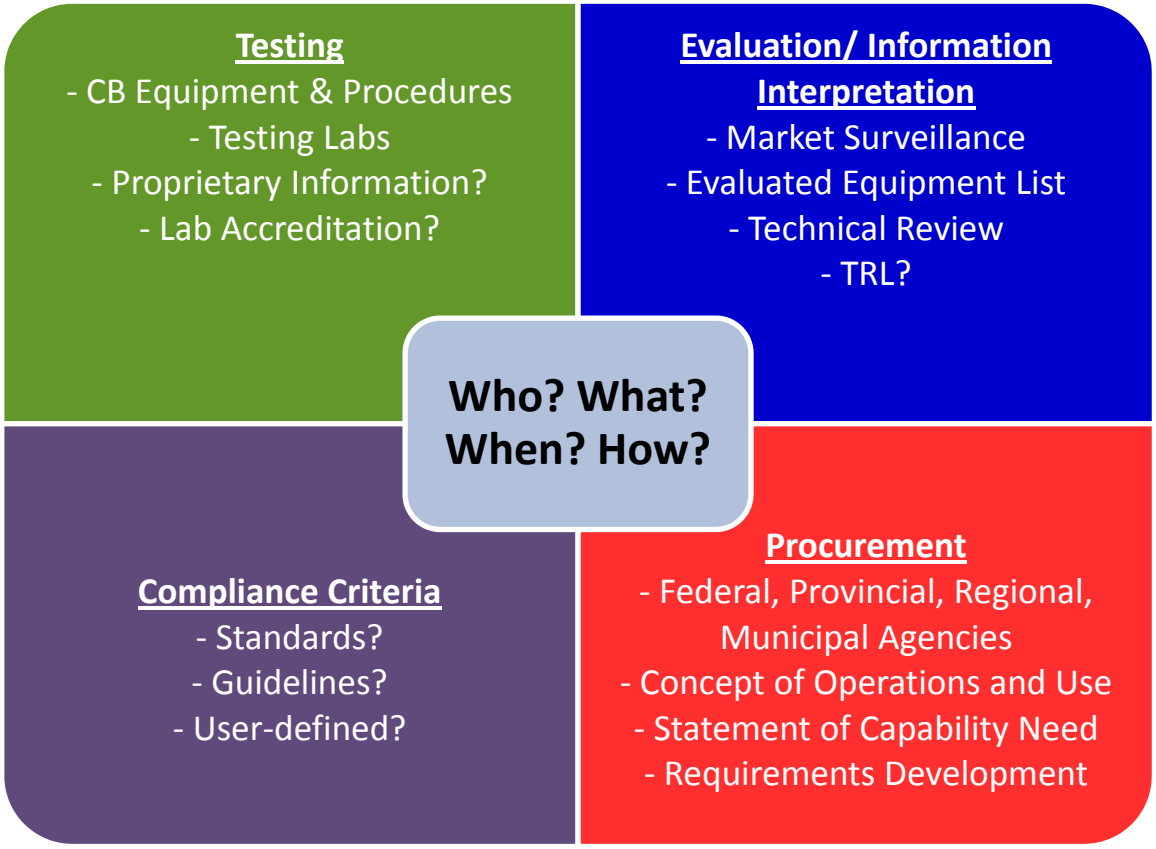
Annex D T&E Overview Slide



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Annex E Technology Readiness Levels

TRL	Definition
1	Basic principles observed and reported.
2	Technology concept and/or application formulated.
3	Analytical and experimental critical function and/or characteristic proof-of-concept.
4	Component and/or breadboard validation in lab environment.
5	Component and/or breadboard validation in relevant environment.
6	System/subsystem model or prototype demonstration in a relevant environment.
7	System prototype demonstration in an operational environment.
8	Actual system completed and qualified through test and demonstration.
9	Actual system proven through successful mission operations.

Modified from "Department of Homeland Security Science and Technology Readiness Level Calculator" Final Report, 30 Sept 2009.(Homeland Security Studies and Analysis Institute, 2009)

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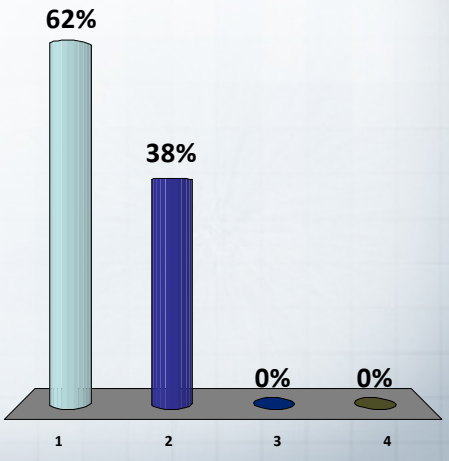
Annex F Participant Feedback Slides

How useful was the round table discussion?

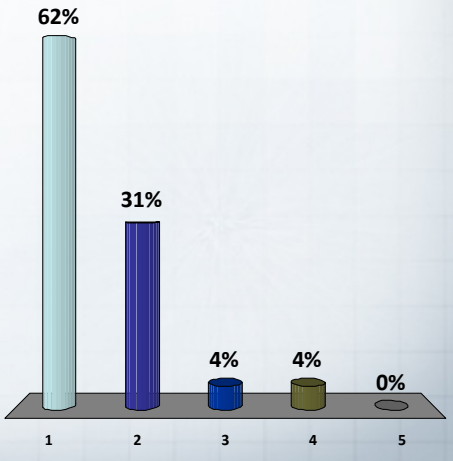
1. Very useful
2. Somewhat useful
3. Not useful
4. No opinion



15

Overall, how would you rate this session?

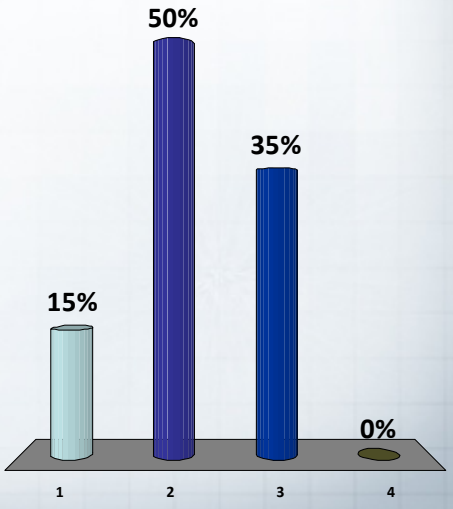
1. Excellent
2. Good
3. Fair
4. Poor
5. Very poor



16

How confident are you that this workshop will influence programs that enable you to better do your job?

1. Very confident
2. Somewhat confident
3. Not very confident
4. Not confident at all



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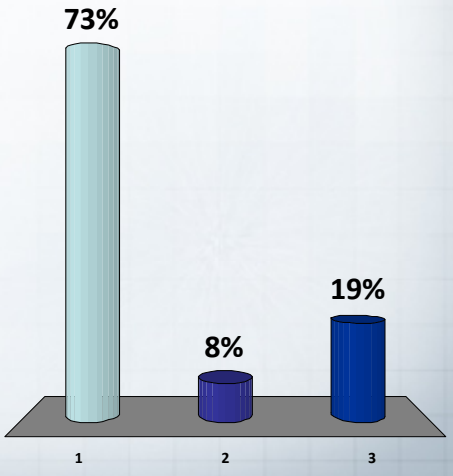
Would you attend another similar workshop offered on this topic?

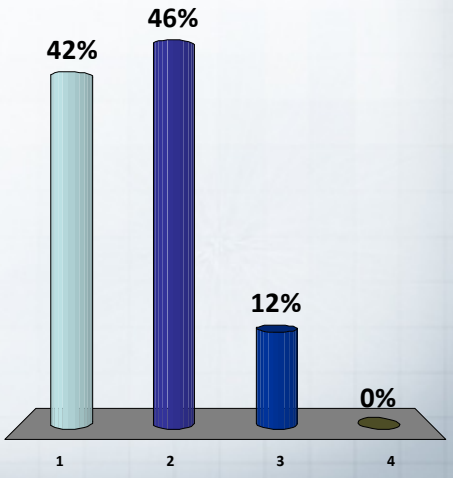
1. Yes
2. No
3. Maybe



18

How relevant was this session to you and your job?

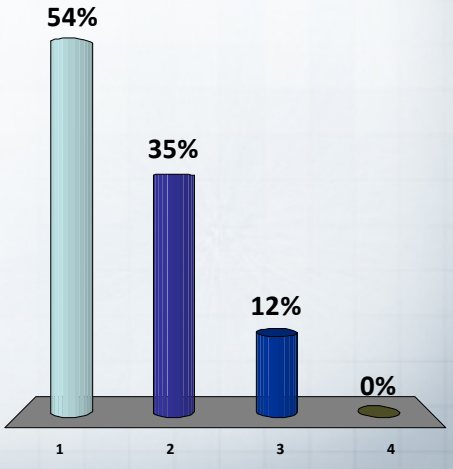
1. Very relevant
2. Somewhat relevant
3. Not very relevant
4. Not relevant at all



19

How satisfied were you with the venue?

1. Very satisfied
2. Somewhat satisfied
3. Not very satisfied
4. Not satisfied at all



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List of symbols/abbreviations/acronyms/initialisms

CB	Chemical and Biological
CBD	Chemical and Biological Defence
CBRN	Chemical, Biological, Radiological, and Nuclear
COTS	Commercial Off-The-Shelf
CRTI	Chemical, Biological, Radiological, and Nuclear Research & Technology Initiative
DND	Department of National Defence
DRDC	Defence Research & Development Canada
DRDKIM	Director Research and Development Knowledge and Information Management
DSRI	Defence & Security Research Institute
FR	First Responder
PCR	Polymerase Chain Reaction
PPE	Personal Protective Equipment
R&D	Research & Development
RMC	Royal Military College
SDO	Standards Development Organization
T&E	Test & Evaluation
TIC	Toxic Industrial Chemical
TIM	Toxic Industrial Material
TRL	Technology Readiness Level

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Discussions with first responders (FRs) and public security stakeholders have indicated a significant gap in test and evaluation information needed to assess operational suitability of chemical and biological defence (CBD) equipment that would enhance FR capability and confidence in their equipment. Currently, Canada has no mechanism through which to certify CBD equipment intended for use by first responders, no formalized testing and evaluation (T&E) capability for such equipment, and generally no associated performance or testing standards, aside from those for personal protective equipment. To enhance the capabilities of first responders, a coordinated CBD T&E initiative that combines capability requirements with standardized testing must be initiated. This workshop assembled key stakeholders within the FR community, standardization and certification specialists, and public security and CBD experts to 1) outline projected CBD response requirements and associated required equipment capabilities; 2) discuss current CBD T&E capabilities; and 3) identify relevant steps needed to improve CBD T&E capability within Canada. The workshop provided a forum whereby each stakeholder community presented their perspective through formal presentation or participation in a series of guided round table discussions. Areas that need to be addressed to improve both CBD T&E capability and FR capability included better access to technical resources, availability of operationally relevant technical information, and development and implementation of equipment performance and testing standards. Several recommendations were made, including creating an information repository for first responders and developing a suite of standards for CBD equipment.

Des discussions avec les premiers intervenants (PI) et les intervenants en matière de sécurité publique ont révélé qu'il existait un écart important entre les renseignements d'essai et d'évaluation (E et E) nécessaires à l'estimation de la pertinence opérationnelle de l'équipement de défense chimique/biologique (CBD), lesquels renforceraient les moyens des PI et leur confiance en leur équipement. Actuellement, le Canada ne dispose d'aucun mécanisme ni pour certifier, ni pour formaliser la capacité d'E et E de cet équipement, tel que conçu pour utilisation par les PI; le Canada ne possède généralement pas non plus de normes de rendement ou d'essai qui s'y rapportent, outre celles qui s'appliquent à l'équipement personnel de sécurité. Afin de renforcer les moyens des premiers intervenants, il est essentiel de mettre sur pied une initiative coordonnée d'E et E en CBD qui allie exigences relatives aux capacités et essais normalisés. Cet atelier a regroupé des intervenants clés provenant de la collectivité des PI, des spécialistes de la normalisation et de la certification ainsi que des experts en sécurité publique et en CBD, afin 1) d'exposer les grandes lignes des exigences futures relatives à l'intervention en CBD ainsi que l'équipement requis connexe; 2) de discuter des capacités d'E et E CBD; et 3) d'identifier les différentes étapes pertinentes requises pour améliorer la capacité d'E et E CBD à l'intérieur du Canada. L'atelier a procuré une tribune permettant à chaque collectivité d'intervenants de présenter son point de vue par le biais d'un exposé didactique ou d'une participation à une série de tours de table guidés. Les domaines qui demandent à être pris en compte aux fins de l'amélioration tant de la capacité d'E et E CBD que de la capacité des PI comprenaient un meilleur accès aux ressources techniques, la disponibilité d'une information technique pertinente au plan opérationnel et le développement et la mise en application de normes sur la performance et la mise à l'essai de l'équipement. Plusieurs recommandations ont été faites, dont celles de la création d'un dépôt central des sources d'information pour les PI et du développement d'une suite de normes pour l'équipement de CBD.

14. KEYWORDS, DESCRIPTORS or IDENTIFIERS (Tech

chemical defence; biological defence; first responder; testing and evaluation

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