Canadian CBRN PPE Standards and Guidance
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The project objectives

• To provide guidance to first responders in the use and selection of protective equipment in order to enhance preparation for response to a CB incident
  - To drive the development of equipment guidelines and standards in this area for Canada
The approach

- R&D and guidance development in concert
  - Specialists and responders participate in program

- Determining what’s needed
  - Model scenarios
  - Understand responder roles, requirements and response procedures
  - Research toxicology of C,B,R agents
The approach

- Determining what’s possible
  - Model protective performance of clothing and respirators
  - Measure protection under realistic (workplace) conditions
  - Examine a variety of styles of protective equipment
  - Measure performance using a wide variety of appropriate agent simulants, toxic industrial chemicals
The approach

• Setting and meeting new requirements
  ✷ Develop standard assessment methods
  ✷ Set requirements
  ✷ Drive PPE standard development
  ✷ Assist industry in understanding, assessing and meeting new performance requirements
Standards development and guidance

- Systematic approach to advice based on all-hazards approach, operational requirements and reasonable maximum exposures
- Initial emphasis is on practical advice for managing the situation in combination with PPE selection
Scenario development and release modeling

• A variety of C, B, R scenarios have been developed and evaluated consistent with the Canadian environment
  ✷ Include indoor, outdoor release and contagious events
  ✷ Modeling of release events has been performed
Scenario development and release modeling

• Some basic initial assumptions:
  - Scenarios can be divided into those where a limited release volume is likely, and those where large volume release is possible
    - Use ERG 2004 small vs large release guidelines for chemicals to assist in defining perimeters
  - Vast overkill is unlikely
  - Agents are most likely to be chosen for lethality potential
FR working zones

- Based on ERG 2004 with some modifications

![Diagram showing FR working zones with support zone, initial isolation zone, and protective action zone. Wind direction is indicated.]
Roles and responsibilities in a CBRN event

Developed with assistance of FR working groups
<table>
<thead>
<tr>
<th>Service</th>
<th>Type of event</th>
<th>Duties: Rad</th>
<th>Duties: Chem</th>
<th>Duties: Bio</th>
<th>Location of ops</th>
<th>Work rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital first receivers - Decon Team</td>
<td>R, B, C indoor release or outdoor release</td>
<td>decon</td>
<td>decon</td>
<td>decon</td>
<td>outside hospital; hospital located in</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>cold zone; exposure to contaminated</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>casualties</td>
<td></td>
</tr>
<tr>
<td>Hospital first receivers</td>
<td>R, B, C, indoor release or outdoor release</td>
<td>treatment</td>
<td>treatment</td>
<td>treatment</td>
<td>inside hospital; hospital located in</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>cold zone</td>
<td></td>
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<td>Moderate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>protective action zone</td>
<td></td>
</tr>
<tr>
<td>Hospital first receivers</td>
<td>Bio, contagious</td>
<td></td>
<td></td>
<td></td>
<td>protective action zone</td>
<td>Moderate</td>
</tr>
<tr>
<td>EMS, general duty</td>
<td>R, B, C, indoor release</td>
<td>T, T &amp; T</td>
<td>T, T &amp; T</td>
<td>T, T &amp; T</td>
<td>cold zone perimeter of event</td>
<td>Moderate</td>
</tr>
<tr>
<td>EMS, specialists</td>
<td>R, B, C, indoor release</td>
<td>Rescue and</td>
<td>Rescue and</td>
<td>Rescue and</td>
<td>isolation, support</td>
<td>Heavy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T, T &amp; T</td>
<td>T, T &amp; T</td>
<td>T, T &amp; T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMS, general duty</td>
<td>R, B, C, outdoor release</td>
<td>T, T &amp; T</td>
<td>T, T &amp; T</td>
<td>T, T &amp; T</td>
<td>protective action zone</td>
<td>Moderate</td>
</tr>
<tr>
<td>EMS, specialists</td>
<td>R, B, C, outdoor release</td>
<td>treatment &amp;</td>
<td>treatment &amp;</td>
<td>treatment &amp;</td>
<td>isolation, support, protective action</td>
<td>Heavy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>rescue</td>
<td>rescue</td>
<td>rescue</td>
<td>zone</td>
<td></td>
</tr>
<tr>
<td>EMS, general duty</td>
<td>Bio, contagious</td>
<td></td>
<td></td>
<td></td>
<td>protective action zone</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

- also performed for police, fire
Guidance on PPE use during release event
Major issues identified

- **Recognize differences between Hazmat and CBRN terrorism events**

<table>
<thead>
<tr>
<th>Hazmat release event</th>
<th>CBRN terrorism event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Known substances, known amounts</td>
<td>Unknown substances, unknown amounts (all hazards approach)</td>
</tr>
<tr>
<td>Toxicity variable, usually low to moderate</td>
<td>Toxicity likely to be high</td>
</tr>
<tr>
<td>Primarily chemical, may include radiological</td>
<td>Biological agents, including infectious materials, included</td>
</tr>
<tr>
<td>Often outdoor release with relatively small area of effect</td>
<td>More likely to be either indoor release or covering very large outdoor area</td>
</tr>
<tr>
<td>Specific emergency plan in place</td>
<td>Planning must be generic</td>
</tr>
<tr>
<td>Not targeted</td>
<td>Targeted location and timing, may be weaponized for efficient delivery</td>
</tr>
<tr>
<td>Usually not criminal event</td>
<td>Criminal event</td>
</tr>
<tr>
<td>Event may last hours to days</td>
<td>Event may last hours to months</td>
</tr>
</tbody>
</table>

- **Initial approach to event must be all-hazards**
Major issues identified: approach to scene

- Approach to suspected unknown event from up to 3 km distance must include good respiratory protection for all responders
  - Protective action zone and support zone may contain concentrations well above IDLH
  - Support zone at sufficient distance
Major issues identified: characterization of event

- Important to recognize scale/nature of event as soon as possible in order to choose appropriate protective levels
  - Use appropriate indicators
  - Look for vehicles, reservoirs, ground-level air intakes which might indicate release of amounts larger than man-portable (200 kg)
  - Number of serious casualties relative to number exposed
  - Bio or rad dissemination devices
Decision tree for selection of PPE for CBRN events

Is this a potential CBRN event?
  No
  Yes
  Is this a contagious event?
    No
    Yes
    Is the quantity used known/likely to be more than 200L (liquid) or 100 kg (powder)?
      No
      Yes
      Is the agent used known to be in the form of a powder?
        No
        Yes
        Is the agent used known to be less than 200 L of a chemical?
          No
          Yes
          Unknown CBRN event; assumed to be small-scale; See Section 5.6
        None required
      Contagious
    Large-scale
  Small-scale powder
None required
Small-scale chemical liquid/vapour
Small-scale unknown
Setting protection requirements

- Model dispersion based on type, size of release
- Select various categories of worst-case agents, based on toxicity, ability to penetrate protective systems
- Establish acceptable exposure levels based on reasonable assumption of risk for single, acute exposure conditions
- Understand responder roles and locations
Guidance document

- Selection and use of personal protective equipment for the Canadian first responder to a CBRN terrorism event: Interim Guidance Document (Oct. 2005)
  - Found at http://www.rmc.ca/academic/chem/research/crti/projectreports_e.html
Table 2. Protection requirements for an unknown small-scale release event.

<table>
<thead>
<tr>
<th>Event</th>
<th>PPE class</th>
<th>Zone/Protection requirement</th>
<th>Suggested style</th>
<th>Relevant standards</th>
<th>Other comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown small-scale release</td>
<td>RPD</td>
<td>Initial isolation zone: NIOSH SCBA CBRN equivalent protection, SWPF of &gt; 20,000</td>
<td>SCBA</td>
<td>NIOSH CBRN approved SCBA</td>
<td>30 minute total time in isolation zone followed by immediate decontamination.</td>
</tr>
<tr>
<td></td>
<td>DPE</td>
<td>Initial isolation zone: NFPA 1991 (2005 edn) protection</td>
<td>Totally-encapsulating vapour tight (Level A) suit</td>
<td>NFPA 1991 (2005 edn)</td>
<td>Full skin decontamination should be implemented on exit to support zone after 30 minutes.</td>
</tr>
<tr>
<td></td>
<td>RPD</td>
<td>Support or protective action zone: SWPF of &gt; 10,000 and protection against 40,000 mg.min.m$^{-3}$ of chemicals of most concern</td>
<td>SCBA</td>
<td>NIOSH CBRN approved SCBA</td>
<td>Use for several hours makes ASR/APR/PAPR use more practical. No ASR/APR/PAPR have been demonstrated to have required capability.</td>
</tr>
<tr>
<td></td>
<td>DPE</td>
<td>Support or protective action zone: NFPA 1994 (2006 edn) class 2 equivalent protection; plus Class 2 shower test for decon role</td>
<td>Class 2 or similar</td>
<td>NFPA 1994 (2006 edn), or NFPA 1971 (2006 edn), CBRN option, for firefighter turnout gear</td>
<td></td>
</tr>
</tbody>
</table>
Major issues identified: respiratory protection

• CBRN-approved SCBA must be used in isolation zone until magnitude of event has been established
• If scale/nature of release can be estimated
  ✴ If large-scale chemical released, then APR cannot be used even in support/protective action zones
  ✴ If small-scale rad, bio incident, APR use is possible in support zone/protective action zones
  • APR use may be possible in isolation zone if event identified as rad/bio
Major issues identified: respiratory protection

- Chemicals of concern have been identified against which NIOSH CBRN-approved or military air purifying respirators may not provide sufficient protection
  - Canadian standard should include requirements for protection against these chemicals for small-scale events in support/protective action zones
  - Existing active carbon systems are being investigated for their performance
  - Modeling is being performed in order to assist in improved design
  - Plan to develop new APR cartridges
Major issues identified: respiratory protection

• Fitting of respirators and workplace protection factors have significant impact on ability of air-purifying respirators to provide adequate protection
  - Procedure for rapid on-site fit-testing for fundamental fit of respirator using condensation nuclei counters has been developed

• Appropriate individual fit-testing for high protection levels is a requirement
  - NIOSH CBRN APR requires laboratory PF of 2,000
  - However higher PFs should be achievable/desirable during individual fit-testing
Major issues identified: body protection

- Have provided input to *NFPA 1994 (2006 edn)* and *NFPA 1971 (2006 edn)* in order to bring standards requirements more closely in line with types of chemical hazards and updated toxicity estimates, using MIST assessments for certification
  - Focus on hazmat/fire requirements
  - Comfort/burden specifications have been improved
  - Still over-emphasis on “total” rather than “toxicologically relevant” protection
    - More information on dermally toxic chemicals needed
Major issues identified: body protection

- A number of garments for hazmat response and turnout gear for CBRN rescue are under development by industry and US government teams
  - are being evaluated against NFPA 1994 and 1971 (2006 edn) requirements
Major issues identified: body protection

- Garments certified against standard will not be available till 2006
- Garments are particularly focused on isolation zone and decon team requirements
- Canadian standard is planned to include more classes of clothing
  - To ensure match between functional requirements and minimal burden vs required protection for all categories
  - Need to understand performance and capabilities of air-permeable active carbon garments
Major issues identified: systems integration

- Systems should be certified with clothing and respirator worn together
- Integration between respirator, clothing, specialized helmets is critical
  - Current NIOSH approval procedures do not measure respiratory protection of system
The way ahead

- Continue to develop realistic performance evaluation methodologies for certification
- Continue to model and measure performance
- Work with CSA and CGSB to establish Canadian standards committee (summer 2006) for standards in 2008/9
- Work with industry to assist in development of appropriate systems to meet projected standards requirements (Canadian, NFPA 1994/1971)