Radiological assessment and protection of first responders during a radiation emergency in EPC III and EPC IV

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First responders

A first responder is any first emergency worker to respond at the scene of an emergency.

An emergency worker is any person having a specified role as a worker in an emergency and who might be exposed while taking actions in response to the emergency.

Emergency workers may include those employed by registrants and licensees as well as personnel from response services, such as police officers, firefighters, medical personnel, rescue brigades and control teams for hazardous materials.
Exposure of emergency workers

- In an emergency exposure situation, the relevant requirements for occupational exposure in planned exposure situations shall be applied for emergency workers, in accordance with a graded approach.

- Response organizations and employers shall ensure that no emergency worker is subject to an exposure in an emergency in excess of 50 mSv other than those whose perform exceptional tasks.

- Assigned exceptional tasks have to be adequate to a skills and experience of emergency worker.
# Emergency Preparedness Categories

<table>
<thead>
<tr>
<th>Hazard and Emergency Planning Areas (EPA)</th>
<th>EPC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On-site:</strong> Severe deterministic effects</td>
<td>I</td>
</tr>
<tr>
<td><strong>Off-site:</strong> Severe deterministic effects. Warranting precautionary and urgent protective actions</td>
<td></td>
</tr>
<tr>
<td><strong>On-site:</strong> Severe deterministic effects</td>
<td>II</td>
</tr>
<tr>
<td><strong>Off-site:</strong> Warranting urgent and other protective actions</td>
<td></td>
</tr>
<tr>
<td><strong>On-site:</strong> Severe deterministic effects</td>
<td>III</td>
</tr>
<tr>
<td><strong>Off-site:</strong> No urgent protective actions are warranting</td>
<td></td>
</tr>
<tr>
<td><strong>Unpredictable location in the country:</strong> Severe deterministic effects</td>
<td>IV</td>
</tr>
<tr>
<td><strong>Continuation of EPA of EPC I facility in neighboring country:</strong> Warranting urgent and other protective actions</td>
<td>V</td>
</tr>
</tbody>
</table>

Radiological assessment and protection of first responders
Radiation protection of first responders

Exercising response to radiation emergency
Radiation protection of first responders

Delay with support from Radiological Assessor/Team in action

be ready to face with reality!
Conditions at scene

✓ Fist responder at scene has no
  ▪ adequate information about radiation conditions.
  ▪ adequate Individual protection devices.
  ▪ adequate support from Radiological Assessor/Team.

✓ First responder has only his skills and knowledge for self protection.

✓ First responder has the primary responsibility for protection from risks at scene
Source emergencies in which first responders will be involved

<table>
<thead>
<tr>
<th>EPC</th>
<th>Situation</th>
<th>What</th>
<th>Where</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>Loss of control over source in EPC III</td>
<td>☢</td>
<td>☢</td>
</tr>
<tr>
<td>IV</td>
<td>Physical loss of controlled source in EPC III or IV</td>
<td>☢</td>
<td>☢</td>
</tr>
<tr>
<td>IV</td>
<td>Orphan or stolen source</td>
<td>☢</td>
<td>☢</td>
</tr>
<tr>
<td>IV</td>
<td>Malicious act</td>
<td>☢</td>
<td>☢</td>
</tr>
</tbody>
</table>
Categorization of radionuclide sources

<table>
<thead>
<tr>
<th>Activity</th>
<th>Danger to the person</th>
<th>Cat.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A/D &gt; 1000$</td>
<td>Extremely dangerous</td>
<td>1</td>
</tr>
<tr>
<td>$10 &lt; A/D &lt; 1000$</td>
<td>Very dangerous</td>
<td>2</td>
</tr>
<tr>
<td>$1 &lt; A/D &lt; 10$</td>
<td>Dangerous</td>
<td>3</td>
</tr>
<tr>
<td>$0.01 &lt; A/D &lt; 1$</td>
<td>Unlikely to be dangerous</td>
<td>4</td>
</tr>
<tr>
<td>$A/D &lt; 0.01$</td>
<td>Most unlikely to be dangerous</td>
<td>5</td>
</tr>
</tbody>
</table>
Indication of dangerous sources

Yellow Ionizing Radiation Symbol for any source

ISO 361:1975
Basic ionizing radiation symbol

Red Ionizing Radiation Symbol for dangerous sources in category 1, 2 or 3

ISO 21482:2007
Ionizing Radiation Warning - Supplementary Symbol
Radiation factors to be considered for first responders in EPC III and IV

- **Whole body external exposure** from sealed source, ground deposition and surfaces;
- **External exposure of open skin and lense of eye** from strong beta-emitters on surfaces;
- **Contact exposure of skin** from strong beta-emitters fixed on/in the clothes;
- **Internal exposure** due to intake of radionuclides from fire/explosion or via dirty palms or inhalation.
Criteria of worker’s protection from risks of external exposure

- Ambient dose rate, Sv/h
- Duration of exposure, hours

Haematopoietic ARS: 99% lethality
Haematopoietic ARS: 1% lethality

Radiological assessment and protection of first responders
Radiation Protection: Rules of Thumb

- **Protection with time:**
  Shorter time of contact with the source - the lower dose

- **Protection with distance**
  Longer distance to the source – the lower dose

- **Protection with shield**
  More protective layers to the source – the lower dose
Individual protection of first responders

✓ Inform first responders of the radiological hazards present and safe working rules
  - external dose - time, distance, shielding
  - surface contamination - personal protective equipment
  - airborne contamination - respiratory protection
  - ingestion - don’t put your hands in your mouth
  - inhalation - stay up wind
  - skin contamination - wear gloves, don’t touch face
  - contamination spread - set up contamination control zones, monitor people in and out.
  - second devices/other non-radiological hazards - be alert for your own safety.
Not normally a concern only burns to skin or severe effects from inadvertent ingestion

Only from direct contact with contamination from leaking container

Unlikely from secondary contamination
  - For example, from a contaminated person

Severe health effects not possible from contamination resulting from smoke

Dangerous levels of contamination removed by:
  - Washing hands and face
  - Removing outer clothing

Can be done by the public at home – if it can not be performed promptly at the site
Self-protection against Internal exposure

Radiation instrumentation can not see dangerous smoke or contamination

Be self-protected!

Avoid within 100 m
Summary

- Designation of the first responders in advance;
- Training of first responders on how to perform their specified duties under emergency conditions and how to protect themselves;
- Managing, controlling and recording the doses;
- Provision of appropriate specialized protective equipment and monitoring equipment;
- Medical follow-up;
- Obtaining informed consent to perform duties.
Thank you for your attention!