Radioactive Material Transport Security

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Background

- Focus has been on Safety
- The rising threat of terrorism and sabotage is now recognized and transport has been recognized as a vulnerable part of the nuclear and radioactive material supply chain.
Dangerous Goods Transport Security

- Radioactive material is one of nine classes of dangerous goods regulated in transport (both safety and security).
- Radioactive material security must be compatible with the security approaches of the consignor, carrier, port authority, consignee, etc.
- Many other dangerous goods pose equally serious potential consequences:
  - Infectious substances
  - Bulk quantities of poisonous materials
  - Explosives
- Dangerous goods transport security is now being implemented worldwide.
All Nine Classes of Dangerous Goods Require Appropriate Security During Transport

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>Explosives</td>
</tr>
<tr>
<td>Class 2</td>
<td>Gases</td>
</tr>
<tr>
<td>Class 3</td>
<td>Flammable liquids</td>
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<tr>
<td>Class 4</td>
<td>Flammable solids</td>
</tr>
<tr>
<td>Class 5</td>
<td>Oxidizing substances and organic peroxides</td>
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<tr>
<td>Class 6</td>
<td>Toxic and infectious substances</td>
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<tr>
<td>Class 7</td>
<td>Radioactive material</td>
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<tr>
<td>Class 8</td>
<td>Corrosives</td>
</tr>
<tr>
<td>Class 9</td>
<td>Miscellaneous dangerous goods</td>
</tr>
</tbody>
</table>
Dangerous Goods Transport Security
International Roles and Responsibilities

- International Atomic Energy Agency – radioactive material guidance
- UN Committee of Experts on the Transport of Dangerous Goods – recommendations for all classes (relies on the IAEA for class 7 recommendations)
- Modal organizations regulations
  - International Civil Aviation Organization
  - International Maritime Organization
- Universal Postal Union regulations
- Regional organizations regulations
The International Regulation of the Transport of all Dangerous Goods

- IAEA (Vienna)
  - Regulations for the Safe Transport of Radioactive Material (Class 7)
- ICAO
- IMO
- UN Committee of Experts (Geneva)
- UPU
- ECE
- Recommendations for the Transport of Dangerous Goods (All classes)
  - South American MERCOSUR/MERCOSUL
  - Regional/European Road, Rail and Inland Waterway Transport Agreements
- National Regulations
Actions

• New guidance for the security in transport of nuclear and other radioactive material
• Training on guidance for security in transport of radioactive material
• Assessment procedure on security of transport of radioactive material
What are the Possible Consequences of Malicious Use of Radioactive Material?

- Acute radiation sickness or fatality
- Radiation doses to the public and emergency workers with subsequent increase in latent cancer fatality
- Contamination
  - Loss of function (area or facility)
  - Economic disruption
- Social disruption
- Psychological effects
The Transport Security Guide Considers:

- Reference doses and other parameters
- Potential Radiological consequences to determine thresholds
- Categorization methodology
- Identification of security groups
cont’d

• Use of DBT
• Specific recommendations for Physical Protection measures
• The three dimensional aspect of security (security level, where and when)
• “Denial of shipment”
Purpose and Scope

• A uniform and consistent approach
• Guidelines apply to all radioactive material
• Should provide states with guidance in implementing or enhancing a state security system to protect radioactive material
Planning basis for setting thresholds requires specifying:

- **Type of event** (dispersion – e.g., “dirty bomb” or other dispersal device, exposure device, etc.)
- **Effect of concern**, scenario, and parameters
  - Radiation dose criteria
  - Area involved (1 km², 500 acres, other)
  - Exposure pathways and parameters (time in area, distance to source, etc.)
  - Modeling approach (location-specific, theoretical, etc.)
- **Defines the activity of each radionuclide** that could cause such an event
Dispersion Consequence Evaluation

- A simple planar model was used to examine potential dispersion consequences ("magic" model)
- Chosen parameters
  - 1 km²
  - 1,000 mSv lifetime dose (ICRP 82)
  - IAEA TECDOC-955 dose conversion factors for long term dose from deposition
Transportation Security Consequence Evaluation

\[ A = \frac{D \times Area}{CF_4 \times RF} \left[ \frac{1}{(OF \times SF)} + \left(1 - OF \right) \right] \times \frac{1TBq}{10^9 kBq} \]

A = activity (TBq)
D = ICRP lifetime dose value (1000 mSv)
CF_4 = long term dose conversion factor for deposition
Area = surface area covered (10^6 m^2)
OF = occupancy factor (0.6)
SF = shielding factor (0.16)
RF = release factor (0.1)
Multiple Considerations in Setting a Transport Security Threshold

1. Current UN Model Regulation threshold
   - 3,000 $A_1$ or 3,000 $A_2$
   - Uses well established Q-system and A-values

2. Code of Conduct categories

3. Dispersion consequence calculations
   - IAEA meetings concluded
     - 3,000 $A_2$ except for radionuclides included in the Code of Conduct
     - 10 D (Category 2) for radionuclides included in the Code of Conduct
## Example Radioactivity Thresholds

<table>
<thead>
<tr>
<th>Radionuclide</th>
<th>Threshold (TBq)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Am-241</td>
<td>0.6</td>
</tr>
<tr>
<td>Cf-252</td>
<td>0.2</td>
</tr>
<tr>
<td>Cs-137</td>
<td>1</td>
</tr>
<tr>
<td>Hg-203</td>
<td>3,000*</td>
</tr>
<tr>
<td>I-131</td>
<td>2,100*</td>
</tr>
<tr>
<td>Mo-99</td>
<td>1,800*</td>
</tr>
<tr>
<td>Pu-238</td>
<td>0.6</td>
</tr>
<tr>
<td>$U_{\text{nat}}$</td>
<td>Unlimited*</td>
</tr>
</tbody>
</table>

* Limited by 3,000 $A_2$
Security Levels

- Some materials only need Prudent Management Practices.
- The threshold can be used to define materials requiring "basic" and "enhanced" security measures.
For small quantities of radioactive material transported as excepted packages, LSA-1 material or SCO-1, no specific security measures are proposed beyond the safety regulations and prudent management practices already implemented by consignors and carriers;

For any package with contents exceeding the excepted package quantity and material other than LSA-1 and SCO-1, (but with quantities lower than 10D or 3000 A²) a basic security level is proposed that includes some specific security measures; and

For radioactive material packaged in significant quantities, such that it is deemed to be ‘high consequence’ dangerous goods (above 10D or 3000A²), both the basic security measures and additional higher-level (i.e. enhanced) security measures should be applied.
Considerations in Setting Transport Security Measures

• Consistency with the Model Regulations
  • Two security levels (basic and enhanced)
  • Minimizes additional costs and complexity
  • Minimizes likelihood of denial of shipments

• Thresholds based on consequence evaluation and consistency with the Code of Conduct
  • 10D for radionuclides included in the Code of Conduct
  • Other radionuclides captured at the 3,000 $A_2$ level
Basic Transport Security Measures

• General security provisions
  • Competent Authority, at its discretion, should provide Threat information to operators
  • Operators should consider Security Requirements commensurate with their responsibilities
  • Transfers limited to appropriately identified carriers/consignees
  • Use of appropriate security measures at in-transit storage sites
  • Procedures to initiate inquiry for overdue shipments and, if lost or stolen, to initiate efforts to locate and recover
Basic Transport Security Measures (continued)

- Security locks
  - Secure and closed conveyances or sealed packages >500 kg secured to the vehicle
  - State should consider need for additional measures for open vehicles
- Security awareness
- Security awareness training of personnel
  - Content of security awareness training
  - Verification of training
  - Record retention
- Personnel identity verification
  - Carrier personnel should carry positive identification
- Security verification of conveyances
- Security inspections of conveyances
Basic Transport Security Measures (continued)

- Written instructions with required security measures
- Security related information exchange by operators
- Trustworthiness verification (“…may be subject to…commensurate with their responsibilities”)
Enhanced Security Measures

- Apply to packages exceeding thresholds
- Competent Authority should identify carriers and consignors
- All operators should develop, implement and periodically review a security plan
  - Allocation of responsibilities
  - Records of packages/materials transported
  - Review of operations and assessment of vulnerability
  - Identification of measures used to reduce security risks
  - Procedures for reporting and dealing with threats, breaches, and incidents
  - Evaluating, testing and review/update of security plan
  - Measures to ensure information security
  - Measures to limit distribution of sensitive information
  - Measures to monitor the shipment
Enhanced Security Measures (continued)

- State should assign responsibility for security plans
- Security plan may be incorporated into other plans
- Operators should ensure appropriate response plans
- Advance notification
  - Consignor should notify consignee of planned shipment, mode, and expected delivery time
  - Consignee should confirm receipt/non-receipt
  - Consignor should notify receiving/transit States (if required)
Enhanced Security Measures (continued)

• Tracking devices
  • When appropriate, transport telemetry or other tracking methods or devices should be used
    • Ranging from bar code to more sophisticated near real-time tracking systems
  • Carrier should provide ability to communicate from conveyance
• Additional provisions for road, rail, and inland waterway
  • Carriers should ensure operational readiness of devices, equipment, etc.
  • Continuous attendance or secure parking of road conveyance
Additional Security Measures

- States should consider enhancing measures based on a DBT, prevailing threat or nature of the material, inter alia:
  - Additional training
  - Carrier licensing, approval of their security plans, and auditing
  - Use of automated real-time tracking
  - Use of guards
  - Evaluation of potential for sabotage
  - Transfer of security responsibilities during shipment
  - Review of security plans, holding exercises, etc
Minimizing the Impact of Radioactive Transport Security Compliance

- Consistency with other dangerous goods security requirements
- Consistent application
  - National regulations and interpretations that set up unique requirements have caused some carriers to opt out of carrying radioactive material
  - "Context sensitive" (i.e., flexible) application of requirements, for example to air transport
- As requirements are put into place, Competent Authorities and carriers should share experience
  - Consistent interpretation of requirements
  - Application experience and ideas for improvement
The Challenge is in the Future

- IAEA Guide “Security of Radioactive Material during Transport” has been circulated to Member states for comments
  - Specific comments will help improve the draft and minimize operational impacts
  - When finalized, it should provide a consistent approach for national and international transport security requirements