Integrated IT Technology for HazMat Incidents Decision Support

Symposium: Application of Informatics and Communication Technologies in Fire and Rescue Services

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Chemical Release: The Challenge

- What’s happening?
- Where is it coming from?
- How big is it?
- Where is it headed?
- How long will it last?
- What are the actual downwind concentrations?
- Where should we stage our resources?
- Whom should we notify?
- Whom should we warn?
- Which areas require evacuation?
- Can we shelter in place?
- What roads should be closed?
- How do we prioritize actions with limited resources?
- How can we share this information?
  - With the EOC & other responders
  - With the community

The right response to a chemical emergency.
SAFER Systems Overview

• 30+ Years of Emergency Response Information Management Solutions
• Software Developer
• Consulting Services
• Turn-key, Integrated Solutions
• Technical Support and Upgrades
• 600+ Installation Worldwide
SAFER Key Differentiators

• Geographic Information System (GIS)
• Real-time Meteorology
• Complex Terrain Wind Fields
• Real-Time Gas Sensor Data Integration
• Advanced Back Calculation Algorithm
• Combustion Analysis Model
SAFER Base System
Real-Time Weather Data Input

– Portable Met Station
– Fixed Met Stations
– Internet Weather
– Manual Input
What the wind corridor means...

Wind Direction

Stability Class drives width of corridor.

10 minutes down wind

5 minutes down wind
List of Receptors of Concern Potentially Affected
Plume Response
Toxic Release Emergency Response Decision Support Solution
Source Term Modeling Algorithms

- Plume Dispersion Algorithms
  - Gas release
  - Liquid release
  - Two-phase release
  - Pool evaporation model
  - Tank and Pipe releases
  - Stack / Jet Releases
LIQUID POOL FORMATION

Dispersion Dynamics

TANK

ENTRAINED AIR

FLASH

AEROSOL

VAPOR CLOUD

DROPLET COALESCENCE

EVAPORATION

LIQUID POOL FORMATION
One ton chlorine release over 2 hours with a “non real-time” static met data environment.
Same one ton chlorine release over 2 hours using “real-time” met data.
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Same one ton chlorine release over 2 hours using “real-time” met data
Total footprint from one ton chlorine release over 2 hours using actual real-time met data.
As compared to the static met data situation.
Complex Terrain?
Complex Terrain
What is the release rate?
Advanced Back Calculation (ABC)

based on real-time weather and concentration data
Rapid Deployment System

Wireless – GPS Enabled – ATEX - Multigas

Plume Measurement Technology

AreaRAE Steel

- PID 10.6eV Lamp (VOCs)
- LEL (combustible)
- O2
- 2x Electrochemical: NH3, Cl2, NO, NO2, CO, H2S, CLO2, HCN, PH3, SO2
Idle Mode with GPS Sensors, Downwind Corridor & Receptor List
Loss of Containment

Actual Event

Advanced Back Calculation

Weather Based Prediction to Identify Facilities at Risk

Release Rate calculated with ABC using real-time sensor and meteorological readings.

Plume Measurement vs. Modeling Alone

AreaRAE deployed in the downwind corridor

Impact assessment continuously updated.

GPS Satellite Positioning and Wireless Sensor Data Transmission

All data archived for incident debrief, post event analysis and after action reporting.

End of incident.

System stand down and prepared for next event.

LEL (High)

Toxic (Medium)

Odor (Low)

Toxicological Impact

SAFER Monitoring

Advanced Back Calculation

Plume Measurement vs. Modeling Alone
Combustion Analysis Model

Fire and Explosion Emergency Response Decision Support Solution
Overpressure Plot from Explosion Model
## Structural Damage Report from Explosion Model

**Release time:** 10/22/2002 10:50:37 AM

### Structural Damage Report

<table>
<thead>
<tr>
<th>Effects</th>
<th>Overpressure</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shattering of glass</td>
<td>30.0 (mbar)</td>
<td>1138.8 ft</td>
</tr>
<tr>
<td>Failure of wood siding panels</td>
<td>70.0 (mbar)</td>
<td>455.1 ft</td>
</tr>
<tr>
<td>Shattering of concrete wall</td>
<td>140.0 (mbar)</td>
<td>214.9 ft</td>
</tr>
<tr>
<td>Rupture of oil storage tank</td>
<td>200.0 (mbar)</td>
<td>147.3 ft</td>
</tr>
<tr>
<td>Snapping of utility poles</td>
<td>340.0 (mbar)</td>
<td>85.6 ft</td>
</tr>
<tr>
<td>Overturning of rail cars</td>
<td>480.0 (mbar)</td>
<td>64.0 ft</td>
</tr>
<tr>
<td>Failure of brick wall panel</td>
<td>550.0 (mbar)</td>
<td>57.7 ft</td>
</tr>
</tbody>
</table>
Products of Combustion
Thermal Radiation Plot from Tank Top Fire Model
Structural Damage Report from tank top fire model

**Structural Damage Report**

<table>
<thead>
<tr>
<th>Effects</th>
<th>Thermal radiation (W/m²)</th>
<th>Distance (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comfortable zone</td>
<td>1600.0</td>
<td>223.8</td>
</tr>
<tr>
<td>Causes pain within 20 seconds</td>
<td>4000.0</td>
<td>128.9</td>
</tr>
<tr>
<td>Second degree burns</td>
<td>9500.0</td>
<td>71.2</td>
</tr>
<tr>
<td>Melting of plastic tubing</td>
<td>12500.0</td>
<td>58.7</td>
</tr>
<tr>
<td>Damage to process equipment</td>
<td>37500.0</td>
<td>25.9</td>
</tr>
</tbody>
</table>
Combustion Analysis Model
Tank Top Fire
Products of Combustion

Case summary

Gas Composition (mass):
- N₂ 43.7 (%)  
- CO₂ 17.8 (%)  
- CO 16.1 (%)  
- H₂O 12.3 (%)  
- CH₄ 5.4 (%)  
- H₂ 4.8 (%)  
- NH₃ 0.02 (%)  

Gas rate:
- 40487.8 (kg/min)  
Soot rate:
- 5949.1 (kg/min)  
Release temperature:
- 617.0 (deg C)  
Air to Fuel ratio:
- 1.0 (Very Sooty)  

9.5 (km/h)  
NE (deg [from])  
22.0 (deg C)  
750 (W/m²)  
75.0 (%)
Beyond Emergency Response

- Fence-Line Monitoring
- Community Early Warning
- Investigation and Follow-Up / Claim Management
- Retrospective and Post-Event Analysis
- Incident Debrief
- Workforce Protection
- Incident Pre-Planning
- Training, Education and Drills
- Odor Complaints
- Emergency Response
- Maintenance Work and Shut-Downs
Thank You!

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