Occupied Building Impact Studies

an example

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Outline

Disclaimer
Scope of Dow Occupied Building Impact Studies
Estimating Different Types of Impacts
  • Toxic or Flammable Impacts
  • Fire Impacts
  • Overpressure Impacts
The Case for Risk-Based Studies
Hazard scenarios described in this presentation are for illustration purposes only.

While these hazard scenarios are intended to be realistic illustrations, any resemblance to actual plants or scenarios is strictly coincidental.
A multi-year program has supplemented Dow’s traditional Fire and Explosion Index evaluations. It was designed to study Dow Chemical manufacturing facilities across:

~ 41 countries in
~ 10 geographical regions
Different criteria were used for different types of impacts. These criteria were established in advance of the studies.

Risk-based elevation criteria were also established in advance of the studies.

Benchmarking efforts have found that peer companies used different approaches and different criteria for estimating impacts to people in occupied buildings. There is no recognized “right way” or “wrong way” to perform such studies. Dow believes its approach and criteria for these studies were consistent with peer companies.
**Toxic or Flammable Impacts**

**subject to flammable impact** – A building is subject to flammable impact if Dow Chemical Exposure Index (CEI) calculations indicate that a concentration equal to a lower flammable limit could reach it. Dispersion models may also be used to estimate flammable impact distances.

**subject to toxic impact** – A building is subject to toxic impact if CEI calculations indicate that a toxic concentration equal to or greater than AEGL-3 or ERPG-3 / EEPG-3 could reach it. Dispersion models may be used to estimate toxic impact distances.
Toxic or Flammable Impacts

define occupied and unoccupied buildings

(Dow used guidance from API RP 752)
Toxic or Flammable Impacts

determine if occupied buildings are subject to impacts
Toxic or Flammable Impacts

Recommendations for buildings subject to toxic or flammable impact

Shelter-in-place or evacuate

If shelter-in-place:

• Air intake systems capable of rapid shutdown, automatic detection may be needed.
• OD to shut down HVAC systems
• Two-way emergency communications equipment
• A way to find out wind direction
• Positive seals at exhaust fans and wall penetrations / openings
• A building integrity maintenance program

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**subject to fire impact** – A building is subject to fire impact if Dow Fire and Explosion Index (F&EI) calculations indicate any part of the building is within the radius of exposure. Other process hazard analysis tools or software may be used to estimate fire impact distances from pool or jet fires. In this case, a thermal radiation level of 6.3 kW/m² should be used.
determine if occupied buildings are subject to impacts
Toxic or Flammable Impacts

Recommendations for buildings subject to fire impact

Emergency plans for safe evacuation
subject to overpressure impact - A building is subject to overpressure impact if predicted blast loads could exceed heavy moderate damage (building damage level 2B) to a Dow type 0 building.

Dow type 0 is a generic building response model based upon permanent structures that are relatively susceptible to blast damage (such as typical wooden buildings).
Layers of Protection Analysis (LOPA) scenarios were used. Industry failure rate data used to estimate potential scenarios not evaluated in LOPA.

explosion models were available for

• vapor cloud explosion (VCE)
• vessel overpressure failure (expanding gas, included BLEVE scenarios)
• building explosion (flammable mix in process building, included dust explosion scenarios)
• condensed phase detonable material explosion
Overpressure Impacts

map congested volumes for VCE modeling

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Overpressure Impacts

determine origin points for dispersion models for VCE modeling
Overpressure Impacts

overlay dispersion models onto congested zones for VCE models
Overpressure Impacts

estimate blast loads at buildings and building damage levels

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Overpressure Impacts

Recommendations for all occupied buildings subject to overpressure impact:

- restrain windows
- restrain ceiling fixtures
- relocate ordinary portable buildings
- consider relocating heavy objects away from outer walls or attaching them to structural members

Operating discipline to alert people in impact zones anytime process hazard concerns are at a high level
Overpressure Impacts

Recommendations for some buildings subject to overpressure impact

Move portable buildings

Review if non-location-critical roles need to be located in these buildings

Consider building upgrades or replacements (blast hardening)
Dow’s VCE methodology considered infrequent events, such as large diameter failures (modeled as 250 mm [10 inch] opening size).

These models provided conservative blast load estimates.

- More buildings categorized as “subject to overpressure impact” (passive blast mitigation measures).

- The broad range of scenarios provided a more complete estimate of explosion impact risks at existing occupied buildings.

The frequency estimates for these scenarios allowed Dow to discern effective risk reduction measures and prioritize risk reduction efforts.
Questions ?