

# Vapor Cloud Explosion Research

EXPLOSION RESEARCH COOPERATIVE



The better we understand vapor cloud explosions, the more effectively we might protect ourselves from them. Ongoing Explosion Research Cooperative experiments, such as the propane deflagration shown at left, provide insights into blast loads from realistic plant geometries.

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## ACCOMPLISHMENTS

- Large scale vapor cloud explosion tests have been conducted over the past six years. Data collected from the tests has yielded improved flame speed estimates and blast predictions for both external and internal VCE. The tests have examined the effects of:
  - Equipment congestion
  - Confinement
  - Fuel reactivity
  - Plant geometry
- A software tool, VCEC (Vapor Cloud Explosion Contours), was developed for predicting blast loads from multiple-zone VCEs. The program allows users to plot blast contours and predict blast loads on specific targets.
- Numerical simulations have shown that some common blast shielding practices actually increase loads. (These findings have been experimentally verified in the BakerRisk shock tube).
- Analyses of VCE wave shapes and clearing effects have reduced the conservatism of blast predictions.

A Joint Industry Research Program  
by BakerRisk

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## CURRENT STUDIES:

**Classifying the Reactivity of Fuels and Mixtures (2004)** The objective of this study is to establish a more comprehensive fuel reactivity classification methodology for VCE predictions than the existing High, Medium, and Low categories, and to allow for a possible extension of the existing methodology to use a quantitative reactivity index rather than a general class.

**Vented Enclosure Explosions (2004)** Experiments will be conducted to obtain blast data for vented internal vapor cloud deflagrations in the presence of congestion and different room geometries. Explosion pressures inside and outside the congested volume will be measured. Using the obtained experimental data, a reactivity parameter multiplication factor will be developed for the NFPA68 guidelines to account for congestion and room geometry.

## PREVIOUS STUDIES:

**Shielding External Doors from Airblast (2003).** The reduction in blast load on an external door due to shielding was studied as a cost effective means to improve safety and reduce the need for heavy blast doors.

**Building Blast Loads from Vapor Cloud Explosions (2003).** A method was developed to predict loads on buildings for vapor cloud explosions that do not produce a shock wave. Current shock wave prediction methodologies commonly overestimate blast loads by not addressing the relatively slow rate of pressure rise frequently encountered with VCE scenarios.

**VCE Testing (2002)** The effect of fuel reactivity on deflagration to detonation transition was explored. Field experiments examined explosions of ethylene over a full range of fuel/air ratios.

**Effects of Jet Release and Jet Ignition on Vapor Cloud Explosions (2002)** Conditions for which jetting may have a significant impact on VCE severity were identified. Guidance was provided for estimating the impact of jetting on the VCE blast strength.

**VCE Fuel Reactivity Evaluation (2001)** A series of vapor cloud explosion tests were conducted to better understand and characterize fuels with laminar burning velocities between 54 cm/s and 80 cm/sec.

**VCE Aspect Ratio Evaluation (2001)** A series of VCE tests considering a 4:1 width-to-height aspect ratio were conducted.

**VCE Wave Shape (2001)** This study involved an extensive numerical modeling mapping to characterize blast wave shape (shock or pressure wave) and reflection factors from VCEs.

**Vapor Cloud Explosion (VCE) Blast Prediction (2000)** This study continued the development of a methodology for predicting VCE blast effects for use by safety and loss prevention professionals.

**Guidance for Applications of VCE Prediction Methodology (2000)** This study developed guidance for the application of the VCE blast prediction methodology, including ratings of confinement and congestion.

**VCE Prediction Methodology (1999)** This study continued the development of a VCE prediction methodology started in 1998.

**VCE Prediction Methodology Study (1998)** The objective was to develop a predictive model for vapor cloud explosions (VCEs) that take into account realistic plant geometries and conditions.



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For additional information on participating in the Explosion Research Cooperative, visit [www.BakerRisk.com](http://www.BakerRisk.com) or email us at [Co-op@BakerRisk.com](mailto:Co-op@BakerRisk.com)