
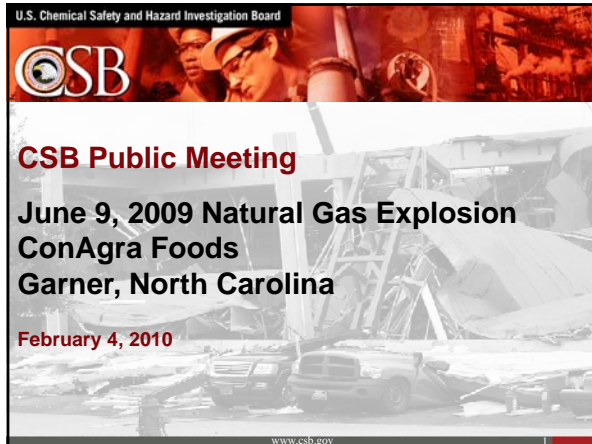


U.S. Chemical Safety and Hazard Investigation Board




CSB Public Meeting
June 9, 2009 Natural Gas Explosion
ConAgra Foods
Garner, North Carolina
February 4, 2010



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Presentation Outline

- Incident background
- Consequences
- Findings and causes
- Future work
- Recommendations


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Incident Summary

- Natural gas explosion
- 4 Fatalities
- 67 Injuries
- Extensive facility damage
- Ammonia release complicated search and rescue efforts
- Economic harm



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ConAgra Slim Jim Facility



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Air Purging

- Animation to be added....


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Incident Summary

- Gas purged directly into centrally located room
- 200 nearby workers not informed about the purging nor removed from the area



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Incident Summary



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Incident Summary

- Several people noted smell of gas
 - Most not seriously concerned
 - Knew indoor purging was occurring
 - Considered normal part of start-up process
- Contractor used sense of smell to detect gas

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Using Sense of Smell to Detect Gas

- Natural gas is odorless; identifiable smell is odorant called mercaptan
- Odor fade - new piping decreases odorant
- Odor fatigue - loss of sensitivity to a scent
- Large variation in detection and perception of odors
- Impossible to detect when Lower Explosive Limit (LEL) has been reached
 - LEL: Lowest percentage of a gas or vapor in air that can produce a fire or explosion in the presence of an ignition source
 - Determined using portable combustible gas detector

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Incident Summary

- Purging occurred intermittently for approximately 2 ½ hours
- Natural gas continued to build up within the vacuum pump room
- Gas found one of many ignition sources around 11:25am, causing the explosion

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Hazards Associated with Purging Indoors

- Gas does not easily disperse; may become trapped
 - Concentration of natural gas only needs to exceed 4% to create explosive atmosphere
- An explosion is more likely
- Blast wave can cause significant damage
- Falling debris, projectiles, and fire in an enclosed area is an imminent danger to nearby workers

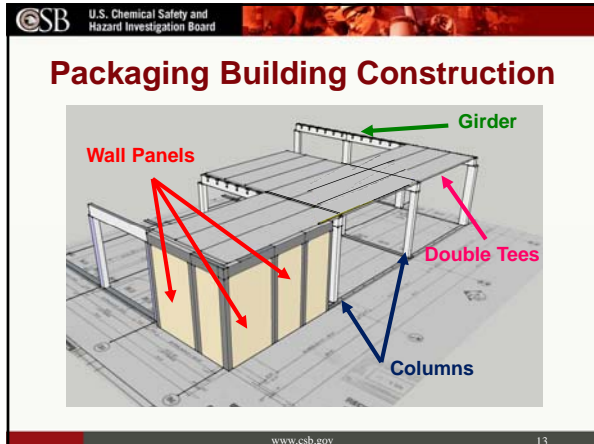
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Extent of Building Damage



Footage Courtesy of WDTN

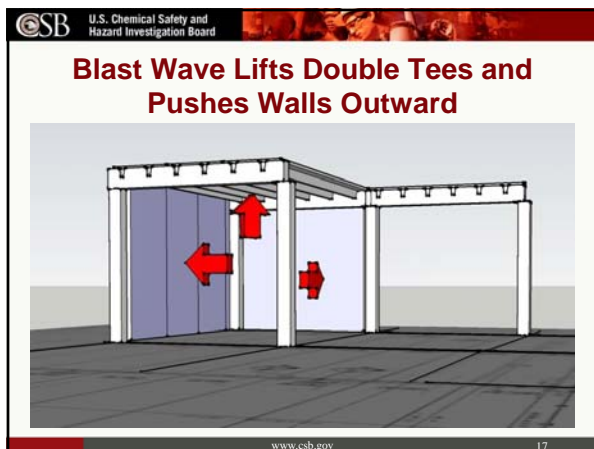


Precast Concrete Double Tee

- Packaging Area
 - Weigh 11 Tons
- Warehouse & Shipping Area
 - Weigh 13½ tons

<http://concretetech.com/project%20reports/images/astreetrect.jpg>

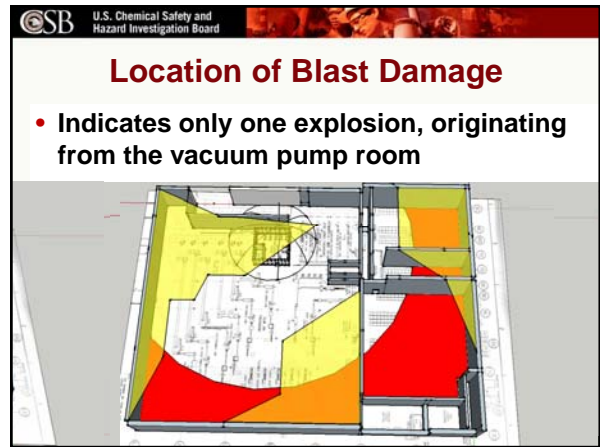
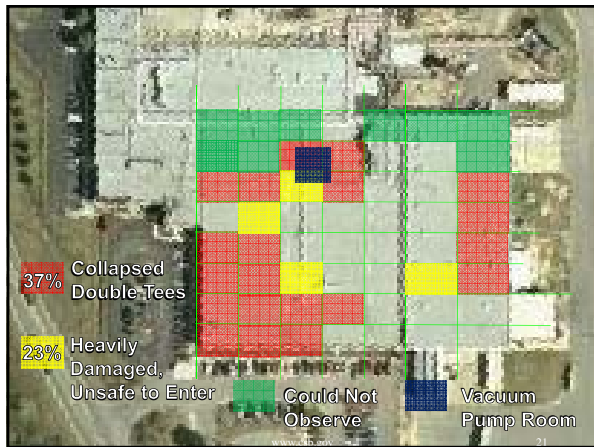
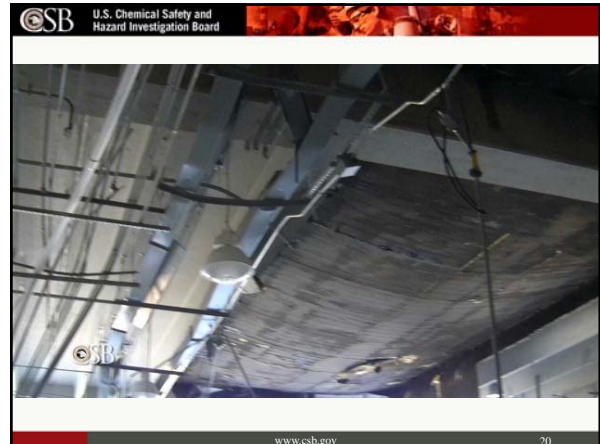
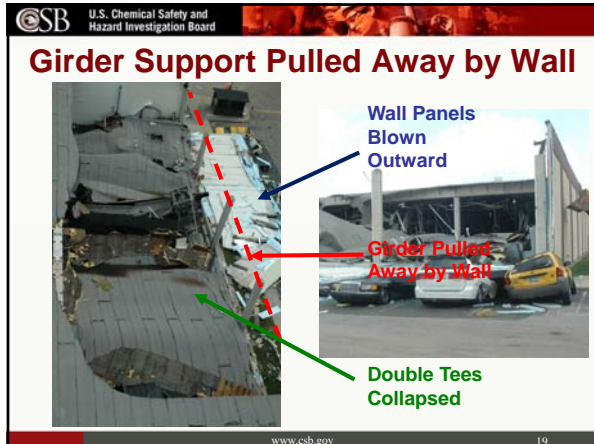
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Girder Support Pulled Away by Wall

- Double Tees have fallen separated from the girder
- Fallen Double Tees are supported by cables and warehouse shelving

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Ammonia Release

- Complicated search and rescue
- 62 protective suits used
- 600 man-hours of search and rescue operations, much using supplied air

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Next Steps in Investigation

- Complete a blast analysis to determine overpressures involved in the accident
- Enter vacuum pump room - when safe
- Examine and test piping, valves, and water heater igniter to determine whether they were functioning properly prior to explosion
- Analyze how the location of the water heater contributed to the building collapse

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Similar Incidents

- 1999 explosion at power plant in Dearborn, MI
 - 6 deaths, 38 injured, damages exceeded \$1 billion



Wisconsin Boiler Inspector's Association, www.communityhotline.com

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Similar Incidents

- 2008 explosion during construction of a Hilton Hotel in San Diego, CA -14 workers injured



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Similar Incidents


- 1997 explosion at a fitness center in Cary, NC
 - Severely burned 2 people and injured 4 others
- 2005 explosion at Triumph Foods in St. Joseph, MO
 - Killed 1 worker and injured 19 others
- 2005 school explosion in Porterville, CA
 - Burned 2 plumbers
- 2007 explosion at a hotel in Cheyenne, WY
 - Severely burned 2 plumbers

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Key Lessons from CSB Safety Bulletin on Safe Gas Purging

1. Directly vent to a safe location away from people and property
2. Purge indoors only in circumstances where purging is not practicable
3. Always use gas detectors to monitor the atmosphere during purging operations
4. Never rely on a single gas detector or as the only warning signal



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Safety Code Organizations

- Two prominent safety code organizations
 - National Fire Protection Association (NFPA)
 - International Code Council (ICC)
- Codes from these two organizations are adopted by state and local governments and followed by companies and individuals nationwide

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Codes and Standards

National Fuel Gas Code (NFPA 54/ANSI Z223.1), the International Fuel Gas Code and the North Carolina Fuel Gas Code on purging of gas piping:

“The open end of piping systems being purged shall not discharge into confined spaces or areas where there are sources of ignition unless precautions are taken to perform this operation in a safe manner by ventilation of the space, control of purging rate, and elimination of all hazardous conditions.”

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Gaps in Current Codes and Standards

NFPA and ICC codes:

- Do not require gases to be vented outdoors
- Do not define adequate ventilation or hazardous conditions
- Do not require evacuation of non-essential personnel
- Do not require use of combustible gas detectors

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Recent Change to North Carolina Fuel Gas Code

In September 2009, the North Carolina Building Code Council adopted the following provisions:

- **Require outdoor purging**
- **When outdoor purging is not possible:**
 - Evacuate nonessential personnel
 - Eliminate ignition sources
 - Use combustible gas detectors
 - Provide adequate ventilation to maintain gas concentration below 25% of the LEL
- **Provide training to personnel**
- **Prohibit reliance on sense of smell alone**

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Changes to ConAgra Purging Procedure

On July 8, 2009, ConAgra altered its procedures to:

- Direct venting of purged gases via a hose or piping to a safe location outdoors
- Eliminate ignition sources from the vicinity of the purged gas
- Continuously perform air monitoring using combustible gas detectors
- Evacuate all nonessential personnel from the vicinity

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Proposed Urgent Recommendation

NFPA, the American Gas Association (AGA) and the Chair of the NFPA 54/ANSI Z223.1 Committee

Enact a Tentative Interim Amendment as well as permanent changes to the National Fuel Gas Code (NFPA 54/ANSI Z223.1) to require that during the purging of fuel gas piping at industrial, commercial, and public facilities:

- **Purged fuel gases shall be directly vented to a safe location outdoors, away from personnel and ignition sources**

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Proposed Urgent Recommendation (cont.)

- If it is not possible to vent purged gases outdoors, purging gas to the inside of a building shall be allowed only upon approval by the authority having jurisdiction of a documented risk evaluation and hazard control plan.

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Proposed Urgent Recommendation (cont.)

- The evaluation and plan shall establish that indoor purging is necessary and that adequate safeguards are in place such as:
 - Evacuating nonessential personnel;
 - Providing adequate ventilation to maintain the gas concentration well below the LEL; and
 - Controlling or eliminating potential ignition sources

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Proposed Urgent Recommendation (cont.)

- Combustible gas detectors are used to continuously monitor the gas concentration at appropriate locations in the vicinity where purged gases are released
- Personnel are trained about the problems of odor fade and odor fatigue and warned against relying on odor alone for detecting releases of fuel gases

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Proposed Urgent Recommendation

International Code Council (ICC) and the Chair of the International Fuel Gas Code Committee:

Incorporate the revised gas purging provisions of the National Fuel Gas Code, consistent with CSB recommendation 2009-12-I-NC-UR1, into the International Fuel Gas Code

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