Fire Engineering®

Texas City Disaster
by Gregory Havel

Buildings are constructed for a specific purpose, with the strength to withstand their use and anticipated external stresses. Each building material and component has an ultimate strength, the maximum load that can be supported without failure, as does each of the connections that join the components. Buildings are designed for “normal” conditions of use and stresses. However, the stresses imposed by extreme forces such as hurricanes, tornadoes, massive earthquakes, bombs, and structural fire can break the connections and exceed the ultimate strength of the materials and components. Although bank vaults and bomb shelters are built to protect their contents under the most extreme conditions, simple economics prohibit such construction for most common buildings.

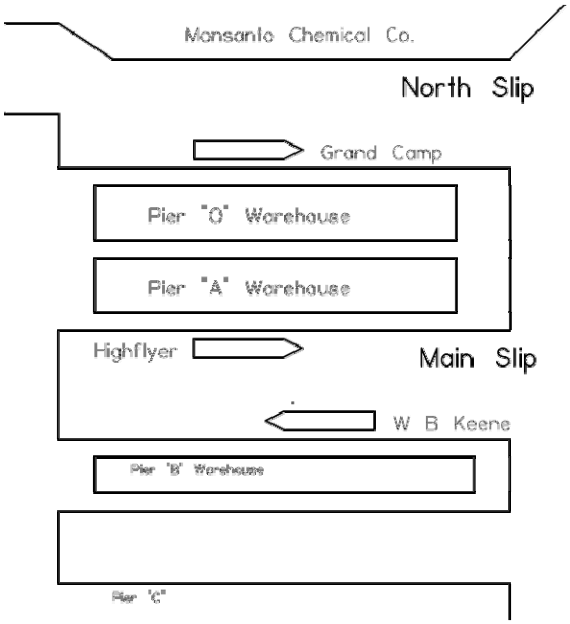
Fire departments respond to situations that are not normal for our communities and families. We usually plan for worst-case scenarios, to the extent that budgets and statutes allow, and use mutual-aid and automatic-aid agreements to augment our limited resources. Even so, a fire department can be overwhelmed by an incident that is far greater than the worst case used for planning.

An example of this type of incident occurred in Texas City, Texas, across the bay from Galveston, on April 16, 1947.

Texas City was a seaport and included a large industrial complex of warehouses, chemical plants, and refineries. During World War II, the port had been a shipping point for munitions and other products, and had been under military control.

Eighteen months after the war ended, the port was again under civilian control, and its operation was more relaxed than it had been during the war years. The military “No Smoking” signs were still in place but were often ignored. The Texas City Volunteer Fire Department had 28 men and four apparatus and a mutual-aid agreement with the nearby Republic Oil Refinery firefighters.

On April 16, three World War II Liberty ships (mass-produced transports) were in port (Photo 1, next page). The *Grandcamp* (launched as SS *Benjamin R. Curtis*) had been given to the government of France as war recovery aid and was being loaded with 2,300 tons of ammonium nitrate fertilizer in 100-pound paper bags, similar to those still used for Portland cement and flour. Additional cargo included sisal twine, peanuts, machinery, cotton, and small-arms ammunition.



The SS *High Flyer* was in the next berth; it had been loaded with1,000 tons of ammonium nitrate fertilizer and 2,000 tons of sulfur, both in 100-pound paper bags, and was undergoing repairs. Ship and dock crews did not seem to be aware of the combustible, reactive, and explosive properties of the cargo of either ship.

A fire was reported in the hold of the *Grandcamp* around 08:00 hours on April 16. One account states that a discarded cigarette was the ignition source, although this was never part of the official reports. The ship's captain ordered the hatches sealed and steam to be pumped into the hold to smother the fire, because he was concerned that water from fire streams would ruin the cargo. Smothering by steam was an accepted means of shipboard fire control. The fire department was dispatched at 08:10 hours. The steam pumped into the holds further heated the ammonium nitrate, which blew off the hatch covers at 08:30 hours, producing large volumes of orange and black smoke and flames and was attracting spectators (Photo 2, below). A tugboat and a fireboat from Galveston were requested, and firefighters began to apply hose streams into the hold. The water vaporized from the intense heat, with little effect. The ship exploded at 09:12 hours, before the tugboat and fireboat arrived.

The shock of the explosion scattered steel fragments from the ship's structure over several square miles; hurled one of the two-ton anchors more than 1.5 miles, collapsed or damaged most of the houses and other buildings in Texas City, and set many fires. It knocked people from their feet and shattered windows in Galveston, 10 miles away across the bay. The explosion was felt 150 miles away in Louisiana and registered on a seismograph in Denver. Chemical plants, refineries, and tank farms in the area were damaged by the shock wave and flying debris, and were set afire. The adjacent Monsanto and Union Carbide chemical plants were destroyed. Hundreds of people were killed instantly, including the ship's crew, stevedores, 28 members of the fire department, and spectators who had come to watch the fire. Thousands were injured or trapped in the debris of collapsed buildings. All of the fire department's apparatus were destroyed in this explosion.

Following the explosion, assistance began to arrive. Eventually, the U.S. Army, Navy, Coast Guard, Marine Corps Reserve, the Texas National Guard; and firefighters from

many communities as far away as Galveston and Houston assisted in firefighting, rescue, medical care, and recovery efforts.

In the surreal hours after the explosion, the survivors on the *High Flyer,* whose mooring lines had been severed in the explosion, fought fires and tried without success to move their ship out into the bay with the assistance of the tugboat. Because their ship was trapped by debris and burning, the crew eventually abandoned her, and she exploded even more violently than the *Grandcamp* at 01:10 hours on April 17, causing more damage, more fires, more deaths, and sinking the adjacent ship SS *Wilson B. Keene,* whose cargo was flour (Photo 3).

FIG. 12. Looking east showing destruction to Warehouse "B" and the S. S. WILSON B. KEENE which was astern of the S. S. HIGH FLYER.

The official death toll was 581, including 113 people of whom no trace was found. There were additional unreported deaths of travelers, undocumented laborers, and others, which could have numbered more than a hundred. Reports of people injured in the explosions, structural collapses, and fires vary from 3,500 to more than 5,000. The toll of death and injury was enormous, considering that Texas City's population was about 16,000. The last of the fires was extinguished a week later, and the last of the bodies was recovered from the debris in mid-May. Sixty-three unidentified bodies were buried in numbered graves in a memorial cemetery set aside by the city for that purpose.

Property losses were estimated at $100 million, plus $500 million in lost petroleum products. In today's dollars, that is more than $700 million, plus more than $3.5 billion in petroleum products.

Lawsuits included the first class-action suit (*Dalehite v United States,* 1953), filed under the Tort Claims Act of 1946, which allowed citizens to sue the federal government for negligence. The U.S. Supreme Court dismissed the case, stating that the government had not failed to protect its citizens, since the neglected safety-related duties were "discretionary" and not binding.

In the decades following the Texas City Disaster, legal precedents were established, consensus standards were developed, and new laws were passed. New standards were developed regarding the storage, handling, and shipping of ammonium nitrate and prohibiting its storage near known reactive materials like fuel oil and sulfur. Refineries in the Texas City area formed the Industrial Mutual Aid System (IMAS) as part of a plan to prevent future disasters. Other industrial areas nationwide followed suit. Today, there are several mutual-aid systems that span several states, use common procedures, and can provide almost unlimited resources.

NFPA 490, *Standard for Storage of Ammonium Nitrate,* was developed and adopted in 1963, based on reports from this disaster, research, and earlier proposals.

The Occupational Safety and Health Act (OSHA) of 1970 made safety-related duties the obligation of employers and required employees to comply with the safety rules established by their employers. The “Hazard Communication” and “Hazardous Waste Operations and Emergency Response” (HAZWOPER) standard, and many others regarding workplace safety were developed under this law. These two OSHA standards (www.osha.gov 29 CFR 1910.1200 and 1910.120) have parallel requirements in the Department of Transportation (www.dot.gov 49 CFR) and Environmental Protection Agency (www.epa.gov 40 CFR) regulations, so that all employees and workplaces are protected.

The 2008 edition of the *Emergency Response Guidebook,* produced jointly by the Departments of Transportation of the United States, , Canada, Mexico, and Argentina, provides information for the initial response to emergency incidents involving chemicals. It lists ammonium nitrate fertilizer under several UN numbers, most with Guide Number 140: Oxidizers. Sulfur is listed as UN 1350, with Guide Number 133: Flammable Solids.

The emphasis today is on knowledge of workplace hazards and hazardous materials; training employees to work safely with or near these hazards; developing and communicating procedures for handling hazardous materials; developing and exercising preincident plans for response to emergencies at specific locations and for specific materials; organizing incidents and emergency responses using the Incident Command System; and developingt and exercising large-scale emergency plans for community-wide disasters.

Today, Texas City is a growing industrial and port city with a population of 45,000, with the eighth-largest deep-water port in the United States. It is served by the Texas City Fire Department from three stations and 62 career personnel on three shifts. It provides fire protection; EMS; and special services, including water, high angle and confined-space rescue; and a hazmat team. The Industrial Mutual Aid System developed after the 1947 disaster has become a regional mutual-aid organization and response plan.

Although large-scale explosions and other incidents at shipping and industrial locations are still possible, as shown by the refinery explosion with 16 fatalities in Texas City in 2004, our knowledge of hazards, communications, planning, organization, and periodic exercise of plans should significantly reduce the impact of one of these incidents on our communities and emergency responders.

For additional information on the Texas City Disaster of 1947, search the Internet for “texas city disaster 1947” and “ammonium nitrate,” or visit these Web sites for reports and photos:

http://www.texascity-library.org/HistoryTCDisaster.pdf (3-page PDF).
http://www.local1259iaff.org/disaster.html
http://www.lib.utexas.edu/taro/uhsc/00039/hsc-00039.html Set of 21 snapshots; unknown photographer, during and after the incident (If the direct link does not work, visit http://www.lib.utexas.edu and follow the links provided).
http://www.texascity-library.org/TCDisasterExhibit/index.html Photos and articles before and after the incident.
http://supreme.justia.com/us/346/15/case.html: U.S. Supreme Court decision in *Dalehite v United States,* 1953.

http://www.usmm.org/libertyships.html Information on Liberty ships.
http://www.uscg.mil/hq/g-m/moa/boards/grandcamp.pdf The U.S. Coast Guard report on the incident. This 15-page document is worth reading completely.
http://www.local1259iaff.org/report.htm The joint report of the Fire Prevention and Engineering Bureau of Texasand the National Board of Fire Underwriters.

Photo credits:

Author: Photo 1

Joint report of the Fire Prevention and Engineering Bureau of Texas and the National Board of Fire Underwriters: Photo 2 and Photo 3 (Figures 10 and 12) (This document does not show copyright information.)

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