Another Vapor Cloud Explosion, what is the lesson that is Screaming at Us?

15 Dead in Texas Refinery Blast

Blast at Texas Oil Refinery Kills 15, Injures More Than 100

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BP operation in Texas City, Texas is BP's largest refinery and the third largest refinery in the U.S. An explosion rocked the oil refinery Wednesday, March 23, 2005, at about 1:30 pm and sparked approximately four fires in the unit and set at least 15 cars on fire. About 433,000 barrels of crude oil are processed a day at the plant, producing 3 percent of the U.S. supply. Other than the "isomerization" unit affected by the blast, the rest of the refinery was running normally. Most of the smoke that was visible for over an hour was coming from the vehicle fires which were left burning until all of the process area fires were controlled, mostly small to medium size fires in the unit. Windows rattled more than five miles away.

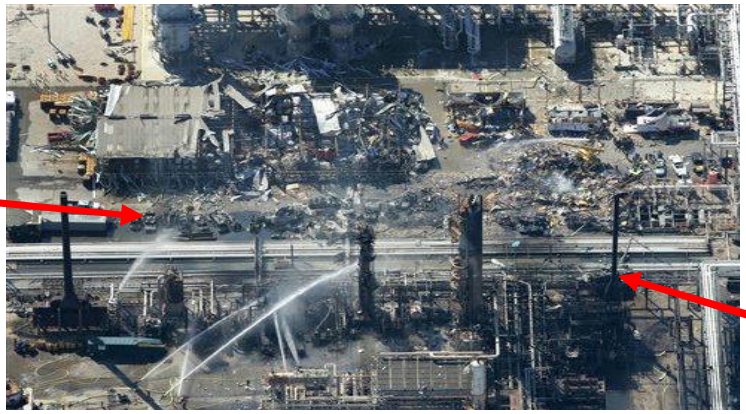
The product release came from an isomerization unit with an estimated capacity of 25,000 B/D. The isomerization unit is used to change low octane rated straight chained Naphtha type material in Isomer's chains thus upping the octane level to a good quality gasoline additive.

The unit was just coming up from a turnaround. There was a sizable release of liquids from the elevated stack of a blow down drum. With process liquids coming from process relief valves on one of the distillation towers. The release was spotted by several operators who spread the word about the problem on the radio, and then ordered for every one to start shutting down everything. The released liquid started to pool under the stack and showed a visible vapor cloud. The ignition source appears to be a truck that was started by a contractor at the edge of the cloud.

Those who died were all contractors, all of whom were in meetings held in temporary office buildings or trailers. These trailers were in the car parking lot of a large metal building used to store catalyst next to the isom unit. The catalyst warehouse was across a wide pipe rack at ground elevation. This is a major pipe-way between the refinery units and the tank farm.

Catalyst Storage Warehouse

Line of Parked Cars.



Temporary office Trailers

Edge of Isomerization Unit where the release Came from and drifted Up and to the Left.

Damaged Temporary Offices Top Yellow Box

Totally Destroyed Temporary Offices Bottom Yellow Box

Burnt Cars Green Box

We can learn from this Loss.

The temporary offices where the deaths accrued were modular trailer house type structures containing offices. This meant that the floor of the building was about 2 to 3 feet above the ground. This open space is necessary for the wheels and tires that are mounted on the frame of the trailer. The temporary offices were spaced far enough from the process not to be in an electrical classified or hazardous area. However because of several unrelated items the trailers were down wind from the release point. The edge of the vapor cloud did getting under a few of the temporary trailers, unfortunately these were the occupied trailers. Now appears that all of the fatalities were in offices that were **reduced to splinters when the vapors under them exploded upward through the offices**. See below.

Blow down Drum

Some of the other trailer offices just feet away were damaged by the over pressure waves braking in the windows and doors in then pushing up on the roof, but these were **not totally destroyed** like the ones where the vapors got underneath them before the ignition. The wreckage on the ground in the picture, came from the adjacent trailers that were destroyed. See below.

The fire damage in the unit was not that severe. The fires lasted less than an hour. Note the sheet metal debris.

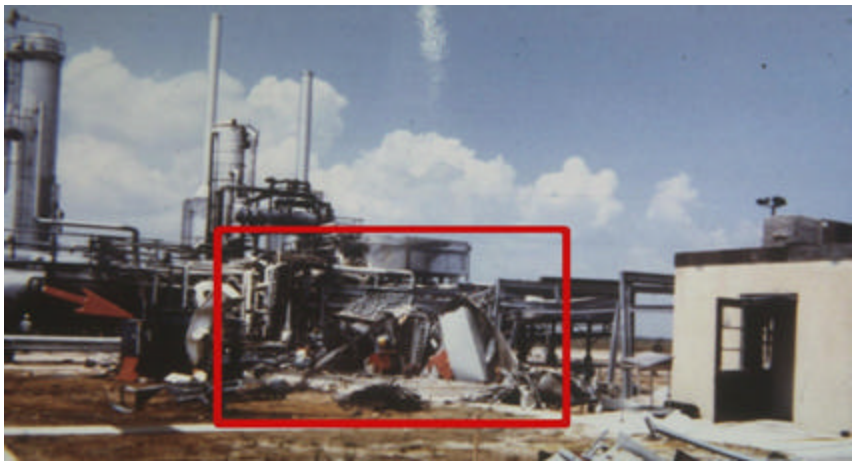
This is not the only time that major blast damage and resulting overpressure damage has occurred **at the edge of a vapor cloud where the vapors were trapped under a structure**.

Below is a railroad box car, which was at the edge of a butadiene vapor cloud in a Houston rail road switching yard. The containment between the ground and the bottom of the car caused enough confinement for the vapors to explode upward through the floor and out through the roof. The walls were not destroyed because they were ¼ inch thick metal.

The explosion under these empty truck transport tankers caused one to completely flip over and the next one, which was only ½ over the vapor cloud, to flip up in the air and lean on the next trailer. The third trailer, which was almost completely outside the vapor cloud, was only dented in on the front of the tanker but the truck was totally destroyed. The vapor cloud was from a gasoline tank overfill.

In another gasoline tank overfill, the pickup below had the front ½ over an explosive overpressure but the back portion was not. The front ½ of the truck is missing the fenders, hood, and cab. Note you can see through the frame to the pipes on the other side. The rear of the pickup bed is only burned by the ensuing fire and not distorted by an overpressure. The truck was flipped over on to the pipe rack by the explosion under the front of it.

Below is what is left of a small motor control center (was in the red box) after a propane vapor cloud covered this area with enough depth to get in the MCC through the air conditioning air inlet. The floor of the MCC was all that is left in place after the racks were moved out during the investigation. Note the control room on the right, no vapors entered the building because the air intake was on the roof, even though it was much deeper in the vapor cloud.



The Hydrocarbon processing industry should step-up their assessments regarding pressurization of structures inside and around process units. The industry has pressurized occupied buildings because of the electrical classification and personal protection, but not to prevent these buildings for becoming epic centers of explosive overpressures.

It can be seen by these examples vapor clouds can produce massive overpressures, from being only partial contained in enclosures that have only two sides, top and bottom, even when all four sides are open. Also these vapor cloud outer edges both Vertical and Horizontal are much more likely to be mixed with air and more likely to cause explosive overpressures when contained. There were hundreds of rail road cars in the incident at the Houston rail yard that were well inside the vapor cloud had no damage from overpressures. The vapors just burned away with a flash fire because they were to rich and there was not enough containment. All of these examples suffered from an **explosion in them or under them** causing extreme damage to everything in the vicinity.

Many of the **vapor cloud computer models** are using congestion as a trigger for higher overpressures, but they are not analyzing the losses to determine if it was an enclosures, and not just congestion.

The Lesson screaming at us is:

We **can not** change the process units congestion but we **can** install pressurization systems on enclosures with an elevated fresh air intake, or remove operator shacks or sheds inside and at the perimeter of operating units.

A facility can survive a Large Vapor Cloud Release and the Resulting Fires if these pockets of explosions are Eliminated or Minimized and the ensuing Fires are quickly Controlled by personal that have had Concentrated Fire Brigade Training on BLEVE prevention.