



# Operating Experience Summary

Office of Environment, Safety and Health

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## ***PRELIMINARY FINDINGS ON FATAL EXPLOSION AT TEXAS REFINERY***

*Operating Experience Summary* [2005-11](#) described the March 23, 2005, explosions at the BP America Refinery in Texas City, Texas that claimed the lives of 15 workers and injured 170 others. The explosions and fires occurred during an infrequent startup of an isomerization (ISOM) unit used to convert low-octane blending feeds into higher-octane components for unleaded gasoline. During startup, a cloud of hydrocarbon vapor was accidentally released from a fractionating column and ignited. All of the fatalities occurred in temporary trailers used by contract workers supporting turnaround work. These trailers were placed too close to process units that handle highly hazardous materials. The U.S. Chemical Safety Board (CSB) issued preliminary findings on October 27, 2005, and the Occupational Safety and Health Administration (OSHA) announced fines of more than \$21 million on September 22, 2005.

The accident occurred when operators started up a tower called a raffinate splitter. The tower and associated piping were over-filled and over-pressurized. This resulted in hydrocarbons flowing from the tower into a blowdown drum, which was vented to atmosphere through a tall stack. The blowdown drum filled completely with flammable liquid, and a geyser erupted out of the stack. A large flammable vapor cloud developed at ground level and drifted underneath the trailers housing the contract workers. Figure 1 shows firefighters spraying water on damaged refinery equipment located to the right of the temporary trailers.

Figure 2 shows the extensive damage to the trailers, some of which were as close as 121 feet from the release. A total of 43 trailers were damaged by the blast pressure wave, and 13 of them were totally destroyed.



*Figure 1. Damaged refinery equipment*

An exact source of ignition has not been determined; however, investigators have identified the following four potential ignition sources:

- a diesel truck that was parked near one of the contractor trailers;
- a furnace that was operating at the time of the release;
- an electrical switchgear building near the ISOM unit that could have produced an electrical spark; and
- a diesel pickup truck that was parked 25 feet from the blowdown drum and stack.

The BP accident resulted in the largest and most complex investigation ever undertaken by the CSB. The Board expects to issue its final report on the accident, including root cause determination and new safety recommendations, in late 2006. The following six key safety issues were identified in the preliminary findings.





*Figure 2. Aerial view showing some of the destroyed temporary trailers (inside red box)*

**Key Safety Issue Number 1** – Occupied trailers were placed in an unsafe location near process equipment handling hazardous materials. This is important because all the fatalities occurred in these trailers.

**Key Safety Issue Number 2** – The ISOM unit never should have been started up because of existing malfunctions associated with the tower level indicator, level alarm, and a control valve. These known problems were never repaired before startup and contributed to the release.

**Key Safety Issue Number 3** – The raffinate splitter tower had a history of abnormal startups. Operating with levels above the range of the indicator (i.e., not knowing how high the level really was) became the norm during previous startups.

**Key Safety Issue Number 4** – On the day of the accident, an unsafe blowdown drum vented highly flammable material to atmosphere. The 1950s-era drum had never been upgraded to connect to a flare, which would have safely combusted flammable vapors.

**Key Safety Issue Number 5** – Between 1995 and the time of the accident, there were four other serious releases of flammable material from the blowdown drum and stack. No effective investigations were conducted nor were changes made to prevent recurrence of these releases.

**Key Safety Issue Number 6** – In 1992, OSHA cited a similar blowdown drum and stack at the refinery as being unsafe because flammable material was vented to the atmosphere, but the citation was dropped, and the drum was not connected to a flare—a missed opportunity.

The CSB issued recommendations to the BP Global Executive Board of Directors, the American Petroleum Institute (API), and the National Petroleum and Refiners Association (NPRA). These recommendations are included in the text box on the next page.

Many of the CSB findings point to management culture issues at BP. Investigators also questioned the effectiveness of programs associated with mechanical integrity, hazards analysis, change control, and incident investigations. Other issues of concern in the March 23 accident include the following.

**Fatigue** – On the day of the incident, some of the BP operators had worked 30 straight, 12-hour days, and some had a 2-hour commute time.

**Downsizing of Supervision and Training** – There were no supervisors with appropriate experience overseeing the startup on the day of the incident. BP Texas City went from 38 trainers in 1998 to just 9 in 2005.

**Workload** – A single control-board operator was responsible for running the controls of three different complex process units, including the startup of the ISOM unit.

**Obsolete Equipment** – The blowdown drum and stack were 50-year-old technology, and they were rebuilt in the 1990s according to the original design, which was known to be antiquated and unsafe.

OSHA conducted an investigation of the refinery accident and, as a result, cited BP with numerous

## CHEMICAL SAFETY BOARD URGENT RECOMMENDATIONS

### BP Global Executive Board of Directors

Commission an independent panel to assess and report on the effectiveness of BP North America's corporate oversight of safety management systems at its refineries and its corporate safety culture, including the degree to which:

- process safety is effectively incorporated into management decision making at all levels;
- employees at all levels are empowered to promote improved process safety;
- process safety programs receive adequate resources and are appropriately positioned within organizational structures; and
- corporate officials exercise appropriate leadership.

Examine and recommend improvements on the following:

- near-miss reporting and investigation programs;
- mechanical integrity programs;
- hazard analysis programs; and
- siting policies for occupied structures near hazardous operating units.

### American Petroleum Institute

Issue a new Recommended Practice to ensure the safe placement of occupied trailers and similar temporary structures. Ensure that the new practice:

- establishes minimum safe distances for trailers and similar temporary structures away from hazardous areas of process plants;
- protects occupants from accident hazards (i.e., heat, blast overpressure, and projectiles); and
- evaluates the siting of trailers under a separate methodology from permanent structures because trailers are more susceptible to damage, are more readily relocated, and likely do not need to be placed near hazardous areas.

### National Petroleum and Refiners Association

- Issue a safety alert to your membership to ensure the safe placement of occupied trailers away from hazardous areas.

safety violations totaling \$21,361,500 in penalties. OSHA inspectors identified 12 willful safety and health violations. Willful violations are those committed with the intentional disregard of, or plain indifference to, the requirements of OSHA regulations. Inspectors also identified 22 serious safety and health violations. A serious violation is one in which there is a substantial probability that death or serious physical harm could result and the employer knew or should have known of the hazard.

Many of these violations are not direct causal factors of the accident; however, the sheer number of citations indicates that problems with process safety existed throughout the site. The following are examples of the cited violations:

- failure to install intrinsically safe electrical equipment in hazardous locations;
- failure to correct deficiencies in equipment that are outside acceptable limits for the pressure-relief header subsystem, liquid knockout subsystem, blowdown drum stack, blowdown snuffing stream, blowdown vessel, quench system, raffinate tower sightglass, and 69 pieces of equipment tied into the pressure relief system in the ISOM unit;
- failure to adequately evaluate the safety and health impact of a catastrophic blast on temporary trailers located near the ISOM unit;
- failure to ensure that the emergency shutdown procedure for ISOM unit included specific information for emergency shutdown of the raffinate splitter;
- failure to ensure operators followed startup procedure and the procedure was not written;
- failure to ensure refresher training at least every 3 years (operators did not understand parameters concerning blowdown and raffinate tower);
- failure to inform each affected contractor prior to startup of the raffinate splitter; and
- numerous source vessels relieved to atmosphere through the blowdown stack, which was not in a safe location and which was in poor condition.





Despite the fact that DOE does not operate refineries, the six key safety issues identified by CSB have relevance to DOE facility operations, particularly in the use of trailers and temporary structures. It is important to consider area hazards when siting trailers and to ensure that adequate safety setback is provided for the protection of workers. In many cases, trailers are located for reasons of convenience (e.g., ready access to work areas) rather than for reasons of safety. In the BP accident, the trailers did not need to be located as close as they were to the process areas for the workers to perform their jobs. BP's policy did not consider danger to the occupants when staging trailers for short periods of time. Unfortunately, none of the fatalities would have occurred if the trailers had been safely located.

*The BP refinery accident underscores the importance of fostering a first-class safety culture that does not promote risk taking and that is founded in sound decisionmaking and accountability at all levels of management.*

*In addition, noncompliance with worker safety and health standards can lead to serious injuries and catastrophic accidents. It is important to have an aggressive program to find and abate worker safety hazards quickly. Under [10 CFR 851](#), Worker Safety and Health Program, published on February 9, 2006, civil fines and enforcement actions associated with worker safety will soon be a concern for DOE contractors. The Department's worker protection program requirements are currently established in [DOE Order 440.1A](#), Worker Protection Management for DOE Federal and Contractor Employees, and are enforceable through contract actions.*

**KEYWORDS:** *Explosion, fire, fatality, injury, refinery, hazardous, procedures, trailers, conduct of operations, CSB, OSHA, fines, process safety*

**ISM CORE FUNCTIONS:** *Analyze the Hazards, Develop and Implement Hazard Controls, Perform Work within Controls*

