BP Texas City 2005 Refinery Explosion (Ref: U.S. Chemical Safety and Hazard Investigation Board)

Summary

On March 23, 2005, explosions and fires at the BP Texas City Refinery killed 15 people and injured another 180, and resulted in financial losses exceeding $1.5 billion. The BP Texas City facility was the third-largest oil refinery in the United States. Amoco was the original owner of the refinery. BP merged with Amoco in 1999 and BP subsequently took over operation of the plant. The refinery was originally built in 1934. In 2005 the facility was a large, complex site with 30 process units, tankage, power generation and other infrastructure.

The incident occurred while a section of the refinery's isomerization (ISOM) unit was being restarted after a one-month maintenance turnaround. During the startup, operations personnel accidentally overfilled a raffinate splitter tower. The ISOM startup procedure required that a level control valve on the raffinate splitter tower is used to send liquid from the tower to storage. However, this valve was closed by an operator and the tower was filled for over three hours without any liquid being removed. This led to flooding of the tower and high pressure, which activated relief valves that discharged flammable liquid to the blowdown system.

The released volatile liquid evaporated as it fell to the ground and formed a flammable vapor cloud. The most likely source of ignition for the vapor cloud was backfire from an idling diesel pickup truck located about 25 feet from the blowdown drum. The 15 employees killed in the explosion were contractors working in and around temporary trailers. These trailers had been sited too close to a process unit handling highly hazardous material.

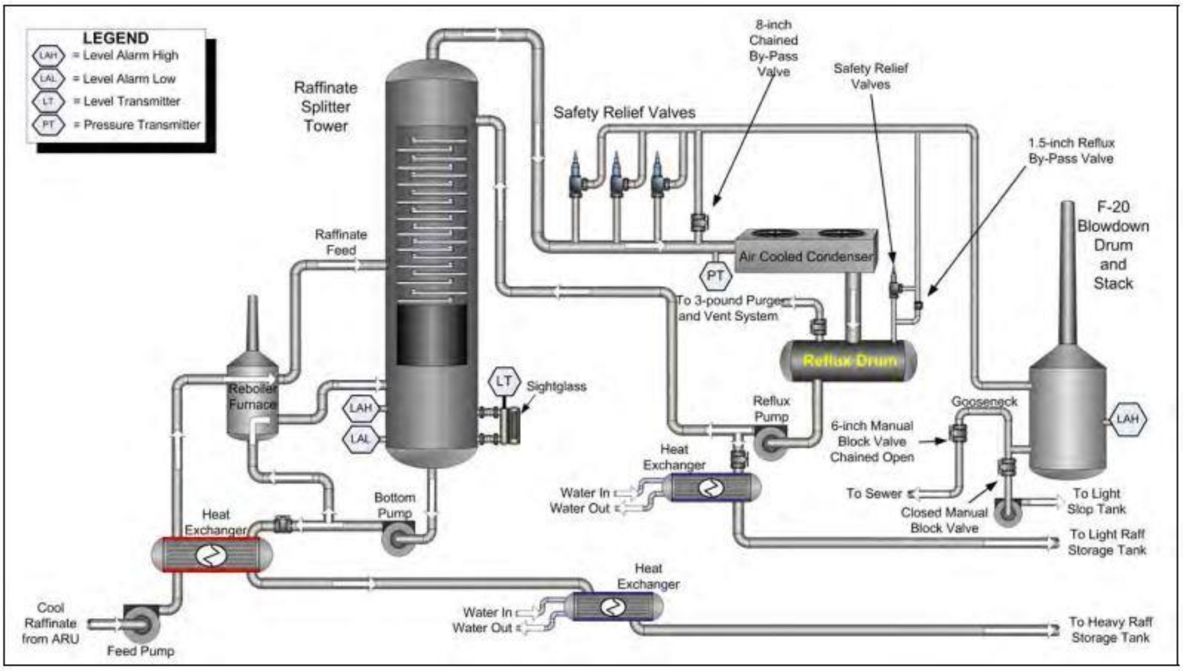

Figure 1. Raffinate section of the ISOM

1. Raffinate splitter as part of the ISOM Unit Process

The ISOM unit, installed at the refinery in the mid-1980s to provide higher octane components for unleaded gasoline, consists of four sections: an Ultrafiner, desulfurizer, a Penex reactor, a vapor recovery/liquid recycle unit, and a raffinate splitter. Isomerization is a refining process that alters the fundamental arrangement of atoms in the molecule without adding or removing anything from the original material. The raffinate splitter section took raffinate -- a non-aromatic, primarily straight-chain hydrocarbon mixture -- from the Aromatics Recovery Unit (ARU) and separated it into light and heavy components.

The **raffinate splitter tower** (Fig.1) was a vertical distillation column with an inside diameter of 3.8 m and height of 52 m with an approximate liquid-full volume of 586,100 liters. The tower was fitted with 70 distillation trays that separated the light from the heavy raffinate. Liquid raffinate feed was pumped into the raffinate splitter tower near the tower's midpoint. An automatic flow control valve adjusted the feed rate. The feed was pre-heated by a heat exchanger using heavy raffinate product. Heavy raffinate was pumped from the bottom of the raffinate splitter tower and circulated through the reboiler furnace, where it was heated and then returned below the bottom tray. Heavy raffinate product was also taken off as a side stream at the discharge of the circulation pump and sent to storage. The flow of this side stream was controlled by a level control valve that, when placed in "automatic," adjusted to maintain a constant level in the tower. The splitter tower was equipped with a level transmitter, which provided a reading of liquid level in the tower to the control room board operator. The splitter tower had two separate alarms that indicated liquid level; one was programmed to sound when the transmitter reading reached 72 percent (a height of 2.3 meters in the tower). The second, a redundant hardwired high-level switch, was designed to sound when the liquid level reached 2.4 m in the tower (approximately 78 percent on the transmitter).

Light raffinate vapors flowed overhead and down a 45-m long section of pipe before they were condensed and deposited into a **reflux drum**. Liquid from the reflux drum, called "reflux," was then pumped back up into the raffinate splitter tower. The reflux drum was operated as a "flooded" drum, which means that during normal steadystate operation, it was kept completely full.

To protect the raffinate splitter tower from overpressure, three parallel **safety relief valves** were located in the overhead vapor line 45 m below the top of the tower. The outlet of the relief valves was piped to a disposal header collection system that discharged into a blowdown drum fitted with a vent stack.

The **blowdown drum and stack** were designed to accept mixed liquid and/or vapor hydrocarbons from venting relief and blowdown valves during unit upsets or following a unit shutdown. In normal operation, light hydrocarbon vapors disengage from liquids, rise through a series of baffles, and disperse out the top of the stack into the atmosphere. Any liquids or heavy hydrocarbon vapors released into the drum either fall, or condense and then fall, to the bottom of the drum where they collect. Liquid would then be discharged from the base of the blowdown drum into the ISOM unit sewer system because a 6-inch NPS manual block valve was chained open.

The practice of discharging liquid to the sewer was unsafe; industry safety guidelines recommend against discharging flammable liquids that evaporate readily into a sewer. The blowdown system, installed in the refinery in the 1950s, had never been connected to a flare system to safely contain liquids and combust flammable vapors released from the process.

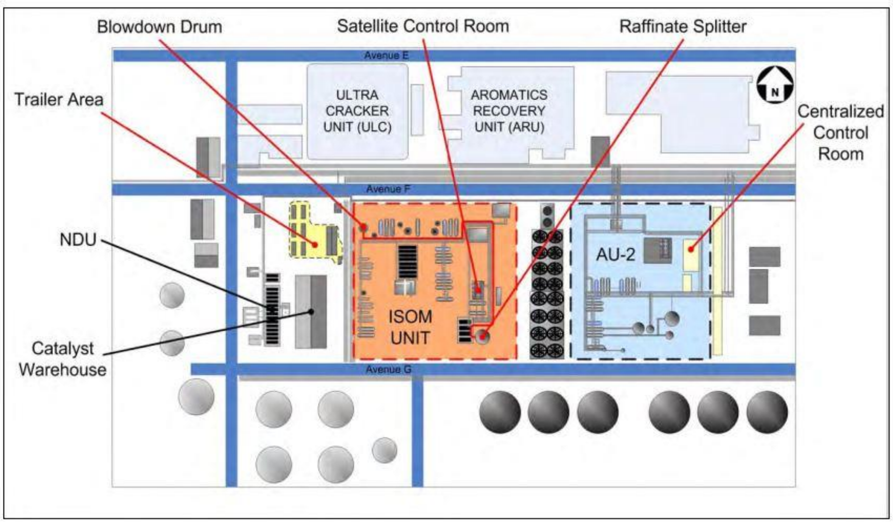

Figure 2. Layout of the refinery near the ISOM unit

2. The event

Several units were undergoing maintenance (called “turnaround” in the oil industry) at the site in February-March. Turnarounds greatly increased the number of contractor and BP personnel in the area. The raffinate splitter section of the ISOM unit was shut down on February 21, 2005, and the raffinate splitter tower was drained, purged, and steamed-out to remove hydrocarbons.

2.1 Preparation

On the morning of March 23, 2005, the raffinate splitter tower in the refinery’s ISOM unit (see Figure 2) was restarted after the turnaround[1]. BP Pre-Startup Safety Review (PSSR) procedure should have been used to ensure that complete and thorough technical checks were carried out and that all non-essential personnel were clear during the start-up operation. Once completed, the PSSR would be signed off by refinery operations and safety managers, authorising the start-up work. However, the process safety coordinator responsible for an area of the refinery that includes the ISOM was unfamiliar with the applicability of the PSSR, and therefore, no PSSR procedure was conducted.

Many other checks were also omitted due to the pressure to startup the facility. For example, on March 22, instrument technicians had begun checking the critical alarms when a supervisor told them that the unit was starting up and there was no time for additional checks. While some alarms were tested prior to startup, most were not. The supervisor, however, signed on the startup procedure that those checks had been completed. Other key safety preparations listed in the startup procedures were omitted or ineffectively carried out. BP guidelines state that unit startup requires a thorough review of startup procedures by operators and supervisors; however, this review was not performed. The procedure also called for adequate staffing for the startup and that any unsafe conditions be corrected. Both steps were signed off as being completed by a unit trainee at the direction of his supervisor.

2.2 Starting the startup

As mentioned above, the splitter tower had two separate level alarms. However, when the raffinate splitter tower was filled beyond the set points of both alarms to a level reading of 99 percent on the transmitter in the early morning on March 23, 2005, only one alarm was activated. The high level alarm was triggered at 3:09 a.m.. The redundant hardwired high-level alarm never sounded.

Filling the bottom of the tower until the level transmitter read 99 percent was not unusual, even though the startup procedure called for the level in the tower to be established at a 50 percent. Operations personnel explained that additional liquid level was needed in the tower because in past startups the level would typically drop significantly. To avoid losing the liquid contents of the tower and potentially damaging equipment, board operators typically operated the tower level well above 50 percent.

Once the raffinate section equipment was filled, the startup was put on hold and the splitter tower feed and bottoms pumps shut off. The circulation was shut down and the tower level control valve remained in the “closed” position for the next shift to resume the startup.

2.3 Shift change

Shortly before 5:00 a.m. on March 23, 2005, the Night Lead Operator left the refinery approximately an hour before his scheduled shift end time. He told his supervisor and the Night Board Operator that he was leaving,

[1] At the time of the incident most of the scheduled maintenance tasks had been completed on the raffinate splitter section, but the Penex reactor, in a separate section of the unit, was awaiting delivery of a gasket. When BP decided to start up the raffinate splitter section, three contractor crews were still working inside the battery limits of the ISOM unit: one crew was waiting to install the gasket on the Penex reactor, the second was removing some asbestos, and the third was painting equipment inside the unit. Employees from all three crews were injured as a result of the explosion and fire.

and briefly described the actions he had taken in the satellite control room. The following entry was added to the centralized control room logbook: “ISOM: Brought in some raff to unit, to pack raff with.”

When the Day Board Operator changed shifts in the central control room with the Night Board Operator shortly after 6:00 a.m., he received very little information on the state of the unit. The Day Board and Night Board Operators spoke to each other, but because the Night Board Operator was not the one who filled the tower, he provided few details about the night shift’s raffinate section startup activities other than what was written in the logbook.

The Day Board Operator read the logbook and interpreted the entry to mean that liquid was added only to the tower; the Day Board Operator, in post-incident testimony, said that he was unaware that the heat exchangers, the piping, and associated equipment had also been filled during the previous shift. The ISOM experienced Day Supervisor, Supervisor A, arrived for his shift at approximately 7:15 a.m., more than an hour late, and did not conduct shift turnover with any night shift personnel.

2.4 Raffinate tower startup

Prior to re-commencing the startup, a miscommunication occurred regarding how feed and product would be routed into and out of the unit. The Day Board Operator believed he was instructed not to send *heavy* raffinate product to storage and therefore closed the tower level control valve. However, the outside operators believed they were instructed not to send the *light* raffinate product to storage and manually changed the valve positions so that light raffinate would flow into the heavy raffinate product line. Moreover, no feed or product-routing instructions were entered into the startup procedure or the unit logbook. The miscommunication likely concerned whether the light or heavy raffinate tanks were full and unavailable to receive additional liquid from the tower.

The Day Board Operator, acting on what he believed were the unit’s verbal startup instructions and his understanding of the need to maintain a higher level in the tower to protect downstream equipment, closed the level control valve (which was used to send liquid from the tower to storage). However, the startup procedure required the level control valve to be placed in “automatic” and set at 50 percent to establish heavy raffinate flow to storage. The Day Board Operator said that, from his experience, when the splitter tower bottoms pumps were started and associated equipment filled, the tower level dropped. Operations personnel stated that if the level was maintained at only 50 percent, a drop in liquid level could result in losing heavy raffinate flow from the bottom of the tower, and that loss of flow from the tower bottom’s pump to the furnace would shut down the furnace and the startup process. The Day Board Operator observed a 97 percent level when he started circulation and thought that this level was normal; he said he did not recall observing a startup where the level was as low as 50 percent. At 10:10 a.m., 20,000 bpd of raffinate feed was being pumped into the tower and 4,100 bpd was erroneously indicated as leaving the tower through the level control valve. The Day Board Operator said he was aware that the level control valve was shut.

After examining control board data, CSB concluded that there was likely no flow out of the tower at this time.

2.5 Overfilling the tower

The tower instrumentation continued to show a liquid level less than 100 percent of the range of the transmitter. The level sight glass, used to visually verify the tower level, had been reported by operators as unreadable because of a buildup of dark residue; the sight glass had been nonfunctional for several years. Knowing the condition of the sight glass, the Day Board Operator did not ask the outside crew to visually confirm the level.

As the unit was being heated, the Day Supervisor, an experienced ISOM operator, left the plant at 10:47 a.m. due to a sudden family emergency. The second Day Supervisor was devoting most of his attention to the final stages of the ARU startup (see Fig. 2) that was also ongoing. He had very little ISOM experience and, therefore, did not get involved in the ISOM startup. No experienced supervisor or ISOM technical expert was assigned to the raffinate section startup after the Day Supervisor left, although BP’s safety procedures required such oversight.

The Day Board Operator continued the liquid flow to the splitter tower, but was unaware that the actual tower level continued to rise. At 9:55 a.m., two burners were lit in the raffinate furnace, which preheated the feed flowing into the splitter tower and served as a reboiler, heating the liquid in the tower bottom. At 11:16 a.m., operators lit two additional burners in the furnace. While the transmitter indicated that the tower level was at 93 percent (2.64 m) in the bottom 9 feet of the tower, the CSB determined from post-incident analysis that the actual level in the tower was 20m. The fuel to the furnace was increased at 11:50 a.m., at which time the actual tower level was 30 m, although the transmitter indicated that the level was 88 percent (2.6 m) and decreasing.

At 12:41 p.m., the tower's pressure rose to 33 pounds (psig) (228 kPa), due to the significant increase in the liquid level compressing the remaining nitrogen in the raffinate system. The operations crew believed the high pressure to be a result of the tower bottoms overheating, which was not unusual in previous startups. In response to the high pressure, the outside operations crew opened the 8-inch NPS chain-operated valve that vented directly to the blowdown drum, which reduced the pressure in the tower.

The startup procedure called for heating the raffinate splitter tower reboiler return flow to 135°C at no more than 10°C per hour to avoid excessive pressure in the tower. However, during this startup the temperature of the reboiler return to the tower rose as high as 153°C, and from 10 a.m. to 1 p.m. the temperature increased at a rate of 23°C per hour. In the previous five years, most of the 19 startups had deviated from written procedures. In the majority, the reboiler return was heated above 135°C and had temperature increase rates of over 38°C per hour; in five, the reboiler return was heated to over 143°C; and in six of these startups, temperatures increased at rates in excess of 66°C per hour.

The Day Board Operator and the Day Lead Operator agreed that the heat to the furnace should be reduced, and at 12:42 p.m. fuel gas flow was reduced to the furnace. At this time the raffinate splitter level transmitter displayed 80 percent (2.4 m) but the actual tower level was 43 m. From 10 a.m. to 1 p.m. the transmitter showed the tower level declining from 97 to 79 percent. The Day Board Operator thought the level indication was accurate, and believed it was normal to see the level drop as the tower heated up. At the time of the pressure upset, the Day Board Operator became concerned about the lack of heavy raffinate flow out of the tower, and discussed with the Day Lead Operator the need to remove heavy raffinate from the raffinate splitter tower. None of the ISOM operators knew the tower was overfilling. At 12:42 p.m., the Day Board Operator opened the splitter level control to 15 percent output, and over the next 15 minutes opened the valve five times until, at 1:02 p.m., it was 70 percent open. However, heavy raffinate flow had not actually begun until 12:59 p.m.

The heavy raffinate flow out of the tower matched the feed into the tower (20,500 bpd) at 1:02 p.m. and by 1:04 p.m. had increased to 27,500 bpd. Unknown to the operators, the level of liquid in the 52 m tower at this time was 48 m, but the level transmitter reading had continued to decrease and now read 78 percent (2.4 m). Although the total quantity of material in the tower had begun to decrease, heating the column contents caused the liquid level at the top of the column to continue increasing until it completely filled the column and spilled over into the overhead vapor line leading to the column relief valves and condenser.

All three relief valves opened at 13:14 and stayed open for over six minutes. Eventually, the amount of material and pressure in the tower overhead line decreased due to the flow through the valves, the raffinate splitter reflux flow, and the heavy raffinate rundown. This caused the pressure to drop and the safety relief valves to close after an estimated 51,900 gallons (196,500 liters) of flammable liquid flowed from the valves into the collection header and from there to the blowdown drum. The blowdown drum and stack was overfilled in less than five minutes after relief valves opened. As the blowdown drum and stack filled, some of the flammable liquid flowed into the ISOM unit process sewer system through the chained-open 6-inch NPS manual block valve. Fumes traveling under the refinery may have fueled one of what is believed to have been five explosions. The most likely ignition point was an idling diesel pickup truck.

Date	Time	Events
21-2		Raffinate splitter section of the ISOM unit is shut down; the 12-hour consecutive day shift schedule begins
10-3		A revised work order to replace leaking isolation valves is added to the list of turnaround work so that the level transmitter can be fixed
22-3		Supervisor A tells instrument technicians to stop checking the critical alarms because the unit is starting up and there is not enough time to complete the checks
23-3	2:15	The Night Lead Operator begins filling the tower with raffinate feed from the satellite control room
23-3	3:09	**The tower high level alarm sounds when the level in the tower reaches 2.3m in the tower**
23-3		**The redundant high level alarm switch does not sound when the tower level reaches 2.4m**
23-3		**The Night Lead Operator fills the tower, stopping when the transmitter reads 99%, which should have been 2.7m in the tower, but is actually 4m**
23-3	5:00	The Night Lead Operator leaves the refinery a little over an hour before his scheduled shift leave time
23-3	6:06	The Day Board Operator arrives at the refinery
23-3	6:23	The Night Board Operator leaves the refinery
23-3	7:15	Supervisor A arrives for his shift
23-3	9:27	Operators open 8-inch NPS chain valve to remove nitrogen; the pressure in the tower drops to near 0 psig/kPa
23-3		**A verbal miscommunication occurs between operations personnel regarding feed-routing instructions**
23-3	9:40	**The Day Board Operator opens the tower level control valve to 70% output for 3 minutes, then closes it**
23-3	9:51	Startup of the raffinate unit recommences and the tower begins receiving more feed from the ARU
23-3		The Day Board Operator observes a 97% transmitter reading (which should have been an 2.7 m, tower level) when he starts circulation
23-3	9:55	Two burners are lit in the raffinate furnace
23-3	10:47	**Supervisor A leaves the refinery due to a family emergency; no supervisor or technically trained personnel replaces him**
23-3	11:16	Two additional burners in the furnace are lit; the level transmitter reads 93%, which should have been a tower level of 2.6 m; but is actually 20 m
23-3	11:50	**Fuel to the furnace is increased; the actual tower level is 98 ft, but the transmitter reads 88% (2.6 m)**
23-3	12:41	The tower's pressure rises to 33 psig; operators reduce pressure by opening the 8-inch NPS chain valve
23-3	12:42	Fuel gas to the furnace is reduced; the actual tower level is 43 m, but transmitter reads 80% (2.4 m)
23-3	12:42	The Day Board Operator opens the tower level control valve to 15% output, then tries several times to increase output over the next 15 min.
23-3	12:59	Heavy raffinate flow out of the unit finally begins
23-3	13:02	Heavy raffinate flow out of the tower matches the flow of raffinate into the unit
23-3	13:04	The actual level in the tower is 158 ft (48 m) but transmitter reading has declined to 78% (7.9 ft; 2.4 m)
23-3	13:11	Supervisor A and Lead Operator talk; Supervisor suggests opening a bypass valve to relieve tower pressure
23-3	13:14	**Hydrocarbon flows out of the tower into overhead piping; tower pressure spikes to 63 psig; all three relief valves open**
23-3		The Board Operator begins troubleshooting the pressure spike; he notices the drum alarm had not sounded, so he resumes moves to reduce pressure believing there is a residual buildup of noncombustibles in the tower
23-3	13:15	Fuel gas to the furnace is reduced
23-3	13:16	The Board Operator fully opens the heavy raffinate level control valve
23-3	13:17	The overhead reflux pump is started by outside operators
23-3	13:19	The Day Lead Operator shuts off fuel gas to the furnace from the satellite control room
23-3	13:20	Vapor cloud ignites and explodes

3. Causes identified in the CSB investigation

The U.S. Chemical Safety and Hazard Investigation Board (CSB) investigated the accident. They summarized that the “Texas City disaster was caused by organizational and safety deficiencies at all levels of the BP Corporation. Warning signs of a possible disaster were present for several years, but company officials did not intervene effectively to prevent it”.

BP used inadequate methods to measure safety conditions at Texas City. For instance, improvement in personal injury rates at Texas City gave BP a misleading indicator of improving process safety performance. Safety campaigns, goals, and rewards focused on improving personal safety metrics and worker behaviors rather than on process safety and management safety systems. While compliance with many safety policies and procedures was deficient at all levels of the refinery, Texas City managers did not lead by example regarding safety.

The process safety management (PSM) program had serious deficiencies and a growing backlog of delayed or cancelled activities. Cost-cutting and failure to invest in the 1990s by Amoco and then BP left the Texas City refinery vulnerable to a catastrophe. BP targeted budget cuts of 25 percent in 1999 and another 25 percent in

2005, even though much of the refinery's infrastructure and process equipment were in disrepair. Also, operator training and staffing were downsized. The central training department staff had been reduced from 28 to eight, and simulators were unavailable for operators to practice handling abnormal situations, including infrequent and high hazard operations such as startups and unit upsets. Technical condition of the plant was poor. Blowdown drums and atmospheric stacks were not replaced, even though a series of incidents warned that this equipment was unsafe.

In the years prior to the incident, eight serious releases of flammable material from the ISOM blowdown stack had occurred, and most ISOM startups experienced high liquid levels in the splitter tower. Neither Amoco nor BP investigated these events. BP Texas City lacked a reporting and learning culture. Personnel were not encouraged to report safety problems and some feared retaliation for doing so. The lessons from incidents and near-misses, therefore, were generally not captured or acted upon. Further, potential safety effects of changes involving people, policies, or the organization were not assessed. Numerous surveys, studies, and audits identified deep-seated safety problems at Texas City, but no effective corrective actions were carried out. A "check the box" mentality was prevalent at Texas City, where personnel completed paperwork and checked off on safety policy and procedural requirements even when those requirements had not been met. Outdated and ineffective procedures did not address recurring operational problems during startup, leading operators to believe that procedures could be altered or did not have to be followed during the startup process.

The process unit was started despite previously reported malfunctions of the tower level indicator, level sight glass, and a pressure control valve. The indicator showed that the tower level was declining when it was actually overfilling. The redundant high-level alarm did not activate, and the tower was not equipped with any other level indications or automatic safety devices. Further, the control board display did not provide adequate information on the imbalance of flows in and out of the tower to alert the operators. Supervisors and operators poorly communicated critical information regarding the startup during the shift turnover. There was a lack of adequate supervisory oversight and lack of technically competent personnel during the startup, and the ISOM operators were likely fatigued from working 12-hour shifts for 29 or more consecutive days. Finally, the BP Board of Directors did not provide effective oversight of BP's safety culture and major accident prevention programs.

4. Historical developments

1950s	The ISOM blowdown system is installed in the southwest corner of the ISOM unit
1957	The blowdown system is moved approximately 200 ft to the northwest corner of the ISOM unit battery limits
1976	The HUF fractionator is installed into what is now the ISOM unit
1985	The HUF fractionator is converted into the raffinate splitter tower
1986	The raffinate splitter tower's capacity is increased
1987	The capacity of the splitter tower is increased again
1991-1992	The Amoco Refining Planning Department (ARPD) proposes a strategy to eliminate blowdown stacks that vent to the atmosphere. However, they do not include separate funding for flare/blowdown work in the 10-year capital plan because state and federal regulations are unlikely to require the change in the foreseeable future.
1992	OSHA cites a blowdown drum and stack as unsafe at the Texas City refinery and recommends it be reconfigured to a closed system with a flare. The citation was withdrawn in 1994 as part of a settlement agreement between OSHA.
1993	The Amoco Regulatory Cluster Project plans to eliminate all blowdown stacks and replace them with knockout drums; however, due to the project cost of $400 million, the project is not implemented.
1993	A HAZOP[2] is conducted on the ISOM unit; consequences of high level and high pressure in the splitter tower are not addressed, nor is the sizing of the blowdown drum for containment of liquid release.
1994	An Amoco staffing review concludes that the company will reap substantial cost savings if staffing is reduced.
12-Feb-94	The 115-ft DIH distillation tower in the ISOM unit is overfilled and results in a hydrocarbon vapor cloud release out of the relief valves that open to the blowdown drum and stack.
17.2.94	Leaking DIH relief valves result in a vapor release out of the ISOM blowdown stack; part of the unit is shut down.
27.2.94	The ISOM stabilizer tower emergency relief valves open five or six times over 4 hours, releasing a large vapor cloud near ground level; it is misreported in the event log as a smaller incident and no safety investigation is conducted.
8.5.95	The 8-inch chain vent valve of the raffinate splitter tower overhead piping is inadvertently left open for over 20 hours during a raffinate section startup, resulting in a significant vapor cloud release out of the blowdown stack.

[2] PHA = Process Hazard Analysis, HAZOP = Hazard and Operability Study, DIH = deisohexanizer, PSM = Process Safety Management, OSHA = Occupational Safety and Health Administration

1996	A staffing assessment of the Texas City refinery process units reveals that personnel are concerned that staffing is too minimal to handle unit upsets.
1997	The approximately 40-year-old ISOM blowdown drum and stack are completely replaced with similar but not identically sized equipment, yet a flare is not connected to it.
1997	BP Group's Getting Health, Safety and the Environment Right (GHSER) policy is established
1997	Behavioral safety programs begin to go into effect at the Texas City site
1998	The ISOM unit's HAZOP revalidation does not address previous incidents with catastrophic potential, as required by the PSM standard.
4.10.98	The ISOM blowdown stack catches fire during stormy weather, resulting in a unit upset; no investigation
31.12.98	BP merges with Amoco
1999	Texas City refinery is a separate business unit run by a director
1999	BP Group Management directs Texas City to cut costs 25%
16-Jan-99	During an ISOM unit shutdown, hydrocarbon liquid flows from the blowdown into the sewer system and hydrocarbons vapors release out of the sewer boxes, producing a significant vapor cloud.
2000	A series of incidents occur at BP's Grangemouth refinery in Scotland.
23-Jul-00	The ISOM blowdown stack catches fire, fueled by leaking pressure relief valves on the hydrogen driers; the fire continues over five 12-hour shifts before it is extinguished; no investigation is conducted
Oct-00	BP's in-house magazine publishes a document written by the Group Chief Executive who asserts that BP will learn the lessons from Grangemouth and other incidents.
2000	BP's Learning & Development department presses Texas City management for simulators to aid in training unit operators, but are unsuccessful in obtaining such technologies.
2001	The Texas City refinery joins four other facilities to become part of the BP South Houston complex, run by one site director who oversees each facility's Business Unit Leader.
2001	Presentation "Texas City Refinery Safety Challenge" is given to BP management; it predicts an employee death in the next 3-4 years.
2001	The PSM audit finds a substantial number of PHA action items still open well past their stated due dates, and a number of unit operating procedures that are not current.
May-01	BP Group issues a "Process Safety/Integrity Management" standard, which outlines the minimum requirements to prevent catastrophic incidents.
2002	BP engineers propose connecting the ISOM blowdown system to a flare, but a cheaper option is chosen
2002	The Texas City Refinery Retrospective Analysis: "capital spending has been reduced 84% from 1992 to 2000 - many budget cuts do not consider the specific maintenance needs of the refinery"
2002	A BP Group report on the Group Fatal Accident Investigation process finds that root causes are not being identified and corrective actions are not always practical or clear.
summer 2002	The refinery HSE department initiates the Clean Streams project with the goal of identifying and eliminating liquid streams routed to blowdown stacks; the ISOM unit is scheduled to be one of the first to undergo such changes.
Aug-02	The "Veba" study concludes that Texas City has serious deficiencies with mechanical integrity, inspections, and instrumentation, as well as a high likelihood for a major incident.
Apr-03	As the Clean Streams project budget increases from $6 to $89 million, its scope is altered and work plans for the ISOM unit are cancelled.
2003	The "Getting Maintenance and Reliability Right Gap Assessment" reveals that maintenance and mechanical integrity problems persist at the Texas City refinery.
2003	An internal inspection of the blowdown drum reveals that most vessel shed trays have collapsed in the bottom of the drum. The remaining trays that are still attached are considered dangerous to personnel, so the internal inspection is terminated and the drum is closed without recommending that the drum be taken out of service or repaired.
2003	The second ISOM unit HAZOP revalidation again does not address previous incidents with catastrophic potential.
2003	A process safety analysis action item requires a review of the ISOM unit's relief valves; the target completion date is March 31, 2005, seven days after the explosion; the study is never completed.
2003	A major modification of the blowdown drum occurred in 2003 when the quench capabilities of the drum fail due to corrosion and remained in disrepair until the time of the incident.
Aug-03	A development project is initiated at the request of BP Group Refining management because the refinery has not made a profit contribution proportionate to its capital consumption.
Sep-03	The 2003 GHSER audit determines that the Texas City refinery infrastructure and assets are in poor condition, and that both training and incident investigation activities are insufficient.
2003	The 1,000 Day Goals program is developed to measure site-specific performance; it focuses on personal safety and cost-cutting, rather than on process safety.
2004	A new behavior initiative is put in place, resulting in behavior safety training for nearly all BP Texas City employees.
2004	The PSM audit notes that many relief valves are missing engineering documentation, safeguards are not clearly defined, no official process for communicating lessons learned from previous incidents is in place, and unit managers and operators lack training.
Mar-04	The BP Internal Audit Group in London reports its GHSER audit findings of all business units; non-compliance of HSE rules, poor implementation of HSE management systems, lack of learning from previous incidents, and lack of leadership and monitoring are common deficiencies at he different sites.
Mar-04	The DIH tower pressure relief valves again lift after a short loss of electric power to the ISOM unit, resulting in a significant vapor cloud at or near ground level.

Apr-04	BP South Houston is dissolved and the Texas City refinery is once again a separate business unit run by a business unit leader who reports directly to the Regional Group VP of Refining.
Jun-04	The GHSER assessment grades Texas City as "poor" because accident investigations are not thoroughly analyzed for trends and preventative programs are not being developed.
May-04	The “Control of Work Review” reveals deficiencies in compliance with the Golden Rules of [personal] Safety.
Spring 2004	In response to the findings of the “Control of Work Review,” Texas City implements the “Compliance Delivery Process” and “Just Culture” programs that enforce adherence of site rules, promote individual accountability, and punish rule violations.
Jul-04	The BP Group Chief Executive for Refining and Marketing visits Texas City to review progress toward the 1,000 Day Goals; the site reports a "best ever" recordable injury frequency rate, but that the refinery needs to reduce its maintenance spending to improve profitability.
Aug-04	The Texas City Process Safety Manager gives a presentation to plant managers that identifies serious problems with process safety performance.
Aug-04	Pressure relief valves open in the Ultracracker unit, discharging liquid hydrocarbons out of the blowdown drum&stack.
Sep-04	Two employees are killed and another seriously injured when burned with hot water and steam during the opening of a pipe flange in the UU3 unit.
Sep-04	The Texas City Process Safety Manager tells the site director that Texas City received poor scores on PSM-related metrics, such as action item completion, and that incident investigations are not identifying the underlying root causes.
Sep-04	BP sites the double-wide trailer between the NDU and ISOM units to house contractor employees for turnaround work in the nearby Ultracracker unit
Oct-04	The Texas City site leader meets with the R&M Chief Executive and Senior Executive Team to discuss the 2004 incidents; management discusses how these incidents are the result of casual compliance and personal risk tolerance despite two of the three incidents being directly process-safety related.
2004	The 2004 PSM audit reveals poor PSM performance of the Texas City refinery, especially in mechanical integrity, training, process safety information, and management of change (MOC).
Nov-04	Plant leadership meets with all site supervisors for a "Safety Reality" presentation that declares that Texas City is not a safe place to work.
late2004	BP Group leadership gives the Texas City refinery business unit (BU) leader a 25% budget cut "challenge" for 2005; the BU leader asks for more funds due to the conditions of the refinery - less than half of the 25% cuts are restored.
late2004	The Telos survey is conducted to assess safety culture at the refinery and finds serious safety issues.
2004	The refinery-wide audit finds that only 25% of ISOM unit operators are given performance appraisals annually, and that no individual development plans are being developed for unit operators. Further, the budget allows for no training beyond initial new employee and OSHA-required refresher info.
Jan-05	Nine additional trailers are placed in the area between the NDU and ISOM units.
Jan-05	The Telos Report is issued with recommendations to improve the significantly deficient organizational and cultural conditions of the Texas City refinery.
Feb-05	The BP Group VP and the North American VP for Refining meet with refinery managers in Houston, where they are presented with information on the Telos report findings, the deteriorating conditions of the refinery, budget cuts, inadequate training, pressures of production overshadowing safety, and the 2004 fatality incidents.
2005	The 2005 Texas City HSSE Business Plan warns that refinery will likely "kill someone in the next 12-18 months."
Mar-05	The Texas City Process Safety Manager tells management that PSM action item closure is still a significant concern and this metric is finally added to the site's 1,000 Day Goals.
23.3.05	Explosion and fire at the Texas City refinery results in 15 fatalities and 180+ injuries