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Trailer siting issues: BP Texas City

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Abstract

On 23 March, 2005, a series of explosions and fires occurred at the BP Texas City refinery during the startup of an isomerization (ISOM) process unit. Fifteen workers were killed and about 180 others were injured. All of the fatalities were contract workers; the deaths and most of the serious injuries occurred in and around temporary office trailers that had been sited near a blowdown drum and stack open to the atmosphere as part of ongoing turnaround activities in an adjacent unit. Due to problems that developed during the ISOM startup, flammable hydrocarbon liquid overfilled the blowdown drum and stack which resulted in a geyser-like release out the top into the atmosphere. The flammable hydrocarbons fell to the ground releasing vapors that were likely ignited from a nearby idling diesel pickup truck.

A total of 44 trailers were damaged by the blast pressure wave that propagated through the refinery when the vapor cloud exploded. Thirteen trailers were totally destroyed and workers were injured in trailers as far as 479 ft away from the release. The focus of this paper will be on trailer siting issues, including:

- Need for work/office trailers within process units
- Adequacy of risk analysis methods in API RP 752
- Minimum safe distance requirements

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1. Introduction

On Wednesday, 23 March, 2005 at 1:20 p.m., a series of explosions and fires occurred at the BP Texas City oil refinery during the startup of an isomerization (ISOM) process unit. Fifteen workers were killed and about 180 others were injured. This accident was one of the most catastrophic workplace disasters in the past two decades.

The BP Texas City oil refinery is the third largest oil refinery in the U.S. with 29 process units capable of producing 2.5% of the nation's annual gasoline supply, or 10 million gallons a day. The isomerization (ISOM) process unit, where the incident occurred, was one of several that had been shut down for maintenance. During the subsequent startup of a section of the ISOM unit, liquid hydrocarbons were pumped into a distillation tower for over 3 h without any of the liquid being removed and sent to storage. Consequently, undetected by the operations crew, the distillation tower was overfilled and the liquid hydrocarbons overflowed into the vertical piping off the top of the tower.

The build-up of liquid hydrocarbons in the overhead piping produced sufficient hydrostatic pressure when combined with the distillation tower's normal operating pressure to open three emergency relief valves used to protect the tower from high pressure. Liquid hydrocarbons then flowed from the discharge of safety relief valves through a collection header pipe into a disposal blowdown drum with an attached stack that discharged 113 ft off the ground into the atmosphere. The drum and stack rapidly overfilled with hydrocarbon liquid resulting in a geyser-like release out the top of the stack. As the liquid hydrocarbons fell to the ground, some of the liquid evaporated to produce a flammable vapor cloud. The explosions and fires occurred

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when the flammable vapor cloud was ignited most probably by a nearby idling diesel truck.

A total of 44 trailers were damaged by the blast pressure wave that propagated through the refinery when the vapor cloud exploded. Thirteen trailers were totally destroyed. All of the fatalities were contract workers; all of the deaths and many of the serious injuries occurred in and around temporary trailers that had been sited near the ISOM unit to support a turnaround in an adjacent refinery unit. The fifteen fatalities occurred in or near two trailers that were located 121–136 ft from the blowdown drum. Occupants were injured in trailers as far away as 479 ft from the drum. The roof of one trailer collapsed and its walls were heavily damaged 579 ft from the drum. Damage was noted in trailers almost 1000 ft away.

Following the tragic accident in March 2005, BP developed a new corporate trailer siting policy that provides exclusion zones for areas where explosions are possible. The BP policy states that all occupied trailers should be located outside of vulnerable areas even if this means a location outside the site boundary. A large number of Texas City personnel were relocated to a permanent building away from the refinery [1].

1.1. CSB urgent recommendation to the American Petroleum Institute

On 25 October, 2005, the CSB issued an urgent recommendation [2] to the American Petroleum Institute (API) to develop new industry guidance "to ensure the safe placement of occupied trailers and similar temporary structures away from hazardous areas of process plants." The Board's urgent safety recommendation called on the industry to establish minimum safe distances for trailers away from hazardous process areas. The CSB noted that, for reasons of convenience, trailers are often placed close to refinery units during maintenance activities. Unlike permanent structures such as control rooms, trailers can easily be relocated to safer positions.

On 30 June, 2006, CSB released trailer blast damage information [3] to API and the public. The information was released to help expedite the development of new guidance that is based on the best available science and provides adequate protection for industry workers. The information also underscores just how vulnerable trailers are to serious blast damage. Modest explosion overpressures that would cause no significant harm to a modern blast-resistant refinery control room can devastate a trailer. CSB believes that siting trailers where there is a possibility of explosion poses an unacceptable risk to occupants.

The remainder of this paper will explore the need for office/work trailers in process units; the adequacy of risk analysis in existing consensus standards, such as API RP 752; what minimum safe distance requirements should be followed for siting trailers subject to explosion risks in process plants.

2. Siting of temporary mobile buildings at processing facilities

Today, when it comes to deciding where temporary office trailers are placed at chemical, petrochemical and hydrocarbon processing facilities, the often quoted real estate phrase: "Location, Location, Location" seems to apply. The Center for Chemical Process Safety (CCPS) noted this trend in a subchapter entitled "Temporary Buildings and Office Trailers" in a recently issued book [4]:

> *Temporary, nonpermanent structures may be used at processing facilities. The most common are mobile office trailers used during construction or periodic major unit overhaul or turnaround.* ***A common practice is that these temporary offices are located near processing areas for convenience*** *[emphasis supplied] and are not removed on completion of the job; thus, they transition from temporary to semi-permanent.*

However, while acknowledging today's trailer siting practices, the CCPS book is also careful to point out the materials used in the construction of the mobile office trailers are below the standards typically used for permanent processing facility structures and advises that trailer installations be included in facility siting studies.

2.1. Trailer siting at the BP Texas City refinery

The mobile office trailers at the BP Texas City refinery were placed in the open area near the ISOM blowdown stack because the contractor personnel working in them were involved in turnaround work at an adjacent unit across the road. The open area between the Naphtha Desulfurization Unit (NDU) and the ISOM unit, north of the Catalyst warehouse where the fifteen people died in the March 2005 explosion had been viewed as an appropriate location to site trailers for years. In fact, utilities that had been installed in that area when temporary office trailers were previously sited at that location in 2002 where again used to hook up the trailers used in the 2005 turnaround.

2.2. Previous trailer siting incidents

However, the BP Texas City refinery is not the only process safety related incident where fatalities and/or injuries have occurred to employees and contractors in mobile office trailers as a result of an explosion or fire. On 16 October, 1995, an explosion and fire occurred at the Pennzoil refinery in Rouseville, Pennsylvania, which resulted in deaths, injuries, public evacuation, and significant plant damage. Temporary work trailers occupied by contractor employees were located close to storage tanks which exploded allowing the subsequent fire to quickly engulf the trailers resulting in the three deaths. OSHA and EPA jointly investigated this incident. In its investigation report [5], EPA recommended that the company use PHA techniques to evaluate the hazards of siting equipment and work areas. OSHA cited the employer for not conducting any process hazard analysis.

On 21 January, 1997, an explosion and fire occurred at the Tosco Avon refinery in Martinez, California, when a section of effluent piping ruptured in a hydrocracker unit releasing flammable gases which instantly ignited. A Tosco operator was killed and 8 Tosco and 38 contractor personnel were injured. Some of the injured were inside or near contractor trailers that

had been sited less than 100 ft from the hydrocracker unit reactors for maintenance turnaround projects. None of these trailers were designed to withstand explosion and fire. EPA, California OSHA and the California Bay Area Air Quality Management District (BAAQMD) jointly investigated this incident. In its investigation report [6], EPA made a number of recommendations concerning improvements to the Hydrocracker PHA, but did not address the issue of facility siting.

3. Evaluation of facility siting

3.1. U.S. regulatory requirements

In the United States, employers are subject to the requirements of the Occupational Safety and Health Act of 1970. Section 5 of this Act places a specific duty on employers to comply with standards promulgated by the Occupational Safety and Health Administration (OSHA) as well as a general duty to eliminate hazards generally recognized as posing serious physical harm or death to employees by feasible abatement methods. This is known as the "general duty clause." For employers with facilities that process "highly hazardous chemicals", OSHA has promulgated a process safety management (PSM) standard, codified at 29 CFR 1910.119. The purpose of this standard is to implement appropriate management systems for preventing catastrophic releases of highly hazardous chemicals.

3.1.1. OSHA process safety management standard

One of the management elements that must be addressed in complying with the PSM standard is to conduct a process hazard analysis (PHA). According to OSHA, the PHA is a "thorough, orderly systematic approach for identifying, evaluating, and controlling the hazards of processes involving highly hazardous chemicals" [7]. Subparagraph (e) (3) (v) of 29 CFR 1910.119 requires that facility siting be specifically addressed as one element of the PHA. The inclusion of this requirement was due to testimony provided by participants at the public hearing on the proposed requirements of the PSM standard who believed that "facility siting should always be addressed during process hazard analyses" [8]. Although OSHA agreed with the public hearing participants and added facility siting as a PHA element, the agency has provided very little guidance to the regulated community on how to consider facility siting within the context of a PHA.

For example, the term "facility siting" is not defined in the PSM standard. The discussion on process hazard analysis in appendix C of the PSM standard, entitled "Compliance Guidelines and Recommendations" does not address facility siting, but it does refer the reader to the CCPS book, *Guidelines for Hazard Evaluation Procedures* [9]. The CCPS book refers to siting in the following areas:

- In Chapter 6.3, Relative Ranking, the book explains that relative ranking is often used to compare process siting or design alternatives and the subchapter goes to explain various relative ranking indices, including the *Dow Fire and Explosion Index*.
- In Chapter 6.4, Preliminary Hazard Analysis, the book explains that preliminary hazard analysis is customarily performed during a process plant's conceptual design or siting phases or during early development to determine if any hazards exist.
- In Appendix B—Supplemental Questions for Hazard Evaluation, there is a series of questions pertaining to "unit siting and layout." These questions can obviously be used with the Checklist, What If, or What If/Checklist hazard evaluation methods described in the text. Although trailers are not discussed in any of the individual questions, one question does inquire about the hazards a unit poses to workers in control rooms, adjacent units, or nearby office or shop areas.

OSHA also has not issued any interpretation letters explaining what is meant by the term "facility siting" or what methods are acceptable for incorporating it into a PHA. As facility siting was added to the PHA requirements of the PSM standard by OSHA near the end of the rulemaking process, the agency likely did not have sufficient time to assess how it would be accommodated in the hazard evaluation methodologies listed in the standard based on limited published information on how to do siting assessments. A number of these techniques, as described in the CCPS book, cannot be used without some modification to address facility siting concerns.

So, the limited guidance available to the regulated community concerning how to incorporate facility siting into a PHA comes primarily from two sources:

(1) Two paragraphs in separate appendices of OSHA's instruction to its compliance officers on how to do program quality verification inspections at PSM-covered facilities
(2) Citations issued by OSHA for failure to properly consider facility siting in PHA studies.

3.1.2. OSHA PSM compliance directive

The PSM standard compliance directive, OSHA Instruction CPL 2-2.45A [10], issued in September 1992 and revised in September 1994 defines facility siting as follows in appendix B, entitled "Clarifications and Interpretations of the PSM Standard":

> *(e)(3)(v) Facility siting*
> ***What does "facility siting" mean?***
> *With respect to existing plants, "siting" does not refer to the site of the plant in relation to the surrounding community. It refers, rather, to the location of various components within the establishment* [10,page B-20]

In appendix A of the compliance directive, entitled "PSM Audit Guidelines", OSHA advises its compliance officers to do the following when evaluating facility siting in PHAs:

> *Review calculations, charts, and other documents that verify facility siting has been considered. For example, safe distances for locating control rooms may be based on studies of individual characteristics of equipment involved such as: types of construction of the room, types and quantities of*

materials, types of reactions and processes, operating pressures and temperatures, presence of ignition sources, fire protection facilities, capabilities to respond to explosions, drainage facilities, fresh air intakes, etc. [10,page A-14]

3.1.3. OSHA PSM citations

A review of 93 facility siting citations issued between 1992 and 2004 by Dreux [11] reveals that one of the four types of violations being issued under the facility siting standard is that the layout and spacing of buildings were too close to processes containing highly hazardous chemicals. In supporting these citations, OSHA relied heavily on five industry guidance documents:

(1) *Dow Fire and Explosion Index*
(2) Industrial Risk Insurer's *General Recommendations for Spacing*
(3) Factory Mutual's *Loss Prevention Data Sheet 7–44*
(4) NFPA 496, *Purged and Pressurized Enclosures for Electrical Equipment*
(5) API Recommended Practice 752, *Management of Hazards Associated With Locations of Process Plant Buildings*

However, the siting of temporary mobile trailers apparently was not one of the main issues being considered by OSHA when issuing these citations. According to Dreux, OSHA compliance officers seem to have focused on a variety of other occupied areas, such as: control rooms, administration buildings, maintenance buildings, lunchrooms, break rooms, work stations, and even parking lots. Of course, it is possible that some of the buildings cited by OSHA were temporary mobile trailers and the analysis did not pick up on this fact.

While it is true that OSHA's inspection database, which can be queried via the internet, will allow anyone to find out information about citations issued to various companies pertaining to facility siting, it will not provide details on what specific siting situation was cited. Thus in the absence of interpretations by OSHA, employer practice on what to incorporate into facility siting during PHA studies is primarily guided by information found in industry standards, process safety related books, and technical journal articles.

3.2. API Recommended Practice 752

As noted above, one industry standard used by the chemical, petrochemical and hydrocarbon processing industries for evaluating facility siting in a PHA is API Recommended Practice 752, *Management of Hazards Associated with Locations of Process Plant Buildings* [12]. As this guideline also served as a basis for the BP Texas City facility siting studies, we will examine some of its provisions further. This recommended practice uses a three-stage analysis process for identifying hazards and managing risks to building occupants from explosion hazards. The analysis becomes more complex as it progresses through the stages. Buildings screened out during one of the stages require no further evaluation, but those remaining must be evaluated. The standard also allows companies to develop specific criteria pertaining to occupancy levels, evaluation-case events, consequence modeling/analysis programs, and risk acceptance criteria [12, Section 2.4.1]. Consequently, the values chosen by each company for these criteria will affect how severely buildings will be screened for hazards during the analysis process.

However, API RP 752 does not address the basic question of whether the placement of temporary mobile structures, like trailers, in close proximity to process units handling high hazardous chemicals for matters of convenience outweigh the risk to occupants. Also, the API guidelines do not establish a minimum safe distance between various types of buildings and hazardous process units. The guidelines do note that occupancy is normally based on an annual average and provides suggestions that weekly occupancy rates vary from 200 to 400 person hours each week (the difference between 5 and 10 full-time employees being exposed to risk) and peak occupancy varies from 5 to 40 personnel. Yet by allowing this amount of latitude, companies applying API RP 752 using a high occupancy criterion could place employees at significant risk and still fall within the allowances of the guidelines. Also, using an annual average as a basis for occupancy is not appropriate for trailers that will only be occupied for several months during a unit turnaround.

Most of the data used by API to assess vulnerability of building occupants during building collapse is based on earthquakes, bombs and windstorm damaged buildings. As vapor cloud explosions tend to generate low overpressures with long durations (i.e., relatively high impulses) [13], the mechanism by which they induce building collapse does not necessarily match the data being used in API RP 752 to assess vulnerability. This data is heavily weighted on the response of conventional buildings, not trailers, which are not typically constructed to the same standards. Also, the data fails to adequately take into account serious injuries to occupants from flying projectiles, which are typically combinations of window glass and failed building components.

3.3. BP Texas City facility siting practices

The BP Texas City refinery decided to conduct its facility siting studies separate from its PSM-covered process unit PHAs. This approach is permitted under OSHA's PHA standard because 29 CFR 1910.119(e) (2) allows employers to use "one or more methodologies" to analyze the hazards of a process. The first refinery-wide siting analysis was conducted at the Texas City refinery in 1995. OSHA required all facility PHAs to be completed by May 26, 1997 and while OSHA required employers to document the priority order of PHAs based on a number of factors, employers were allowed wide latitude in completing these studies due to the performance nature of the PSM standard. Although OSHA also requires that PHAs be revalidated every 5 years; Texas City's refinery-wide siting analysis was not updated until 2002.Trailers were evaluated in the refinery-wide siting analysis along with all other buildings, including control rooms. In order to address the siting of buildings introduced into the refinery between the PHA studies, such as temporary

mobile office trailers used in unit turnarounds, the refinery also required all new structures to be evaluated under its management of chance procedure, which also required that a PHA be conducted.

3.3.1. Amoco Facility Siting Screening Workbook

As the Texas City refinery was owned and operated by Amoco Corporation at the time the initial refinery-wide siting analysis was conducted, the refinery utilized the Amoco Petroleum Products Sector (PPS) Refining Facility Siting Screening Workbook [14] as its methodology for conducting the siting analysis. Amoco's corporate refining process safety group developed the workbook, which generally follows API RP 752, but contains some important differences explained below. The workbook sets forth a methodology for assessing risks involved in the location of buildings with respect to process units and discusses potential remedial measures to reduce these risks using the same three stage concept as the API guidelines. After the BP-Amoco merger in 1999, the Texas City refinery continued to use the Amoco workbook for the 2002 plant-wide facility siting PHA revalidation even though BP Oil Company had been using a different risk-benefit approach for facility siting in its petroleum refineries since the mid-1990s [15].

The Amoco workbook used a less conservative correlation for vulnerability to occupants than API RP 752. The workbook shows lower vulnerabilities at comparable pressures than API. For example, API states that a 1.0 psi peak side-on pressure applied to a wooden building will result in a 10% vulnerability to the occupants whereas Amoco states that a 5.0 psi reflected pressure (approximately equivalent to a 2.5 psi peak side-on pressure) will produce the same vulnerability. The differences in vulnerabilities between the Amoco workbook and the API guidelines lessen as the vulnerability increases. The overpressure experienced at the two trailers closest to the blowdown drum has been estimated to be between 2.5 and 2.8 psi peak side-on pressure. This overpressure resulted in the destruction of both trailers with 50% and 100% vulnerability to the occupants. The occupants were subjected to structural debris hazards and several occupants were either thrown with and/or buried in the debris.

The building identification step of the analysis consists of initially identifying those buildings that can be screened out from further analysis. Buildings can be exempted from further analysis based on their location, construction or occupancy. The workbook notes that minimum damage will result if a building is located "far enough" away from a vapor cloud explosion and provides minimum distances between buildings and processing units. The workbook states that trailers can be located a distance of 350 ft from the center of the nearest concentration of congested equipment in the closest unit. This was generally interpreted at the refinery to mean that trailers could be located within 350 ft of the unit's battery limits. Steel frame buildings with sheet metal siding could be located within 450 ft and concrete, masonry, brick, or cinder block buildings could be located within 700 ft. The workbook notes that the minimum distance for trailers was some what less than for other types of buildings because "data from actual events indicate that trailers tend to roll in response to a vapor cloud explosion, and walls and roof do not collapse on occupants, resulting in fewer serious injuries/fatalities."

3.3.2. Amoco Facility Siting Reference Manual

The basis for the safe distance used in the Amoco workbook was documented in the Amoco PPS-Refining *Facility Siting Reference Manual* [16]. A typical volume of congested equipment was calculated to be 200 mscf, using the average from five Amoco U.S. refineries. Then using this typical congested equipment volume, the distances that resulted in a 10% occupant vulnerability for various building types were calculated. These distances were then listed in the Amoco workbook. These distances placed trailers at an increased risk from vapor cloud explosions due to the following factors:

- As explained previously, Amoco's occupant vulnerability correlation was not conservative
- The average calculated for the typical volume of congested equipment was influenced by Amoco's smaller refineries. The average unit size was smaller in three of the five refineries used to compute the average. Larger volumes of congested equipment produce higher blast overpressures
- Trailers at the Texas City refinery were tied down to resist hurricanes and thus are not likely to roll in response to explosions. There was also no supporting evidence in the Amoco reference material to support the note in the workbook and the damage from the March 2005 explosion clearly showed that the trailers responded to the blast by means of structural deformation, not by sliding or rolling. API RP 752 also contradicts the note in the Amoco workbook by explaining that trailers are more fragile than other structures and thus they pose greater vulnerability to occupants if subjected to blast overpressure from vapor cloud explosions.

The workbook also set occupancy limits, which would exclude further screening. A building was excluded from further analysis if one individual occupied it for 20 h per week or less; or if all inhabitants occupied it less than 200 h per week. However, although the occupancies were listed on a weekly basis, the workbook instructed users to calculate occupancies on an annualized basis. For trailers only occupied for a couple of months during a unit turnaround, this approach diluted the actual risks to the occupants by weighting them (i.e., assuming zero risk for the months that the trailer was not being used) over a yearly average. Consequently, nearly all trailers at the refinery were excluded from further screening based on their annualized occupancy levels. The Amoco workbook also noted some factors to take into consideration when determining peak occupancy levels, including meetings and gatherings, but did not provide any guidance on what to do if the peak occupancy was exceeded. In the March 2005 explosion, there were a total of 22 BP and contractor workers inside a double-wide trailer located 120 ft from the blowdown drum. The normal occupancy of the trailer was 13. When this trailer was destroyed by the blast overpressure wave from vapor cloud explosion, 11 of the occupants were killed and the other 11 occupants were seriously injured. Res-

cuers spent many hours locating and extracting the occupants from the debris pile.

3.3.3. BP Texas City PSM management of change program

As the trailers involved in the 2005 explosion near the ISOM blowdown drum and stack were placed there after the 2002 facility-wide siting study was completed and the next revalidation was not due until 2007, facility siting was evaluated using the refinery's MOC procedure. The refinery used a What If/Checklist methodology for PHAs involving trailer siting. After a What-If hazard analysis, a trailer siting checklist needed to be completed. The checklist was the first step in the screening process in determining whether the building could be screened out based solely on its distance from the process unit as explained previously. One of the checklist questions asked if the trailer was to be located within 350 ft of a process unit. If the answer to this question was: "Yes", then further screening was required. This involved doing building siting analysis using the Amoco workbook. The MOC team conducting the PHA for the first trailer to be sited near the ISOM blowdown drum first did a What If analysis, using questions "brainstormed" by the MOC team, and then completed the checklist. As the trailer was closer than 350 ft from the unit, they correctly answered the question on the checklist and were directed to perform a building siting analysis. However, none of MOC team members had been trained in the use of the Amoco workbook and thus did not understand how to do the building siting analysis. So in lieu of doing an analysis, the MOC team attached a drawing showing the proposed interior configuration of the trailer and measured its location from the catalyst warehouse.

In addition, the workbook specifically instructed the users to consider clusters of buildings, such as turnaround trailers, as one building for the purposes of siting. Refinery personnel involved in siting trailers for the turnaround misinterpreted this requirement to mean that additional trailers could be placed in the same area after an MOC PHA had been completed on the first trailer. So although an MOC PHA was conducted in September 2004 for the first trailer sited near the ISOM blowdown drum, nine other trailers were sited between the ISOM and NDU in January and February of 2005 based on it. By covering all subsequent trailers under the same MOC, the occupancy load of the other trailers was never considered an increase to the risk.

Moreover, the MOC procedures clearly state that the proposed change–in this case the siting of the first trailer – cannot be initiated until all action items identified in the PHA have been resolved. Although two action items were still pending for the MOC at the time of the March explosion, this trailer was occupied by contractor personnel in November of the previous year. The MOC was never approved by the ISOM unit superintendent. After the March 2005 incident, the refinery discovered that a majority of the mobile office trailers were sited without applying the MOC process and thus no PHAs or siting assessments had been conducted. They also learned that if the MOC process was used to site a trailer or group of trailers, the building siting analysis portion of the PHA was either not done, or it was performed incorrectly.

4. Appropriate equivalent methodologies for facility siting

The OSHA PSM standard requires that a PHA utilize an appropriate methodology to determine and analyze the hazards of the process being analyzed. The standard lists six acceptable methodologies – Checklist, What-If, What-If Checklist, Hazard and Operability Study (HAZOP), Failure Mode and Effects Analysis (FMEA), and Fault Tree Analysis (FTA) – as well as allowing any "appropriate equivalent methodology" [29 CFR 1910.119(e)(2)(I)-(vii)]. Based on 12 years of past citation history, OSHA has also apparently recognized five industry guidance documents that can be used as a basis for conducting PHA facility siting studies. As we have discussed, the siting methodology outlined in API RP 752 when applied to trailers may not be conservative and thus may not minimize the risk to trailer occupants from potential vapor cloud explosions. We also observed that the company-specific criteria for occupancy and risk acceptance that BP Texas City used in its siting assessments for trailers placed occupants at an unacceptable risk from vapor cloud explosions.

On 21 September, 2005, OSHA issued 18 egregious willful violations to the BP Texas City refinery for failing to adequately evaluate safety and health impact of the catastrophic blast for 18 temporary trailers located near the ISOM unit citing PSM management of change requirements [29 CRR 1910.1910.119(l)(1)]. OSHA also issued a singe willful violation for failure to adequately address facility siting in the PHA for the ISOM unit shelter (old control room) that was structurally damaged in the March 2005 explosion [17]. In response to these citations, BP Products North American signed a comprehensive settlement agreement with OSHA and agreed to pay more than $21 million dollars in fines to the agency [18].

In this article we have identified some issues with API RP 752 and the facility siting methods used at the BP Texas City refinery before the explosion which leads us to question whether or not these practices actually met the definition of an "appropriate equivalent methodology." In its internal investigation of the March 2005 explosion, BP recognized the flaws inherent in the Amoco workbook and has adopted new policies for trailer siting at its facilities. Appendix 37 in the *Fatal Accident Investigation Report* [19] outlines the specifics of BP's new siting policy. Trailer siting is now based on exclusion zones for areas where explosions are possible. The new BP policy states that all occupied trailers should be located outside of vulnerable areas even if this means a location outside the site boundary. A large number of Texas City personnel were relocated to a permanent building away from the refinery after the explosion. As the entire investigation report has been made available by BP on its website, those interested in reviewing BP's new approach can easily do so. API has also convened a task force to revise API RP 752 to address the issues raised by the CSB in its urgent recommendation to that industry group. In June of 2007, API issued the first edition of Recommended Practice 753, *Management of Hazards Associated with Location of Process Plant Portable Buildings* [20].

5. Conclusion

In order to prevent further fatalities and serious injuries resulting from facility siting issues like those experienced by BP, Pennzoil and Tosco, we encourage all employers that still allow temporary mobile trailers to be sited close to process units to critically examine their own policies. During this examination, we urge you to ask yourself a question: Why put your employees at risk just to save a few steps?

6. Disclaimer

This paper has been prepared for general informational purposes only. This paper represents the individual views of the authors and all references, conclusions or other statements regarding CSB investigations are limited to information that is already in the public domain. Furthermore, this paper is not a product of the Board and its contents have not been reviewed, endorsed, or approved as an official CSB document. For specific and accurate information on completed investigations, please refer to the final published investigation report by going to the CSB website at www.csb.gov and clicking on the specific report desired under "Completed Investigations." To the extent this paper includes statements about the conclusions, findings, or recommendations of the Board, such statements come under the general prohibition in 42 U.S.C. §7412(r) (6) (G).

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