Large Tank Fire

Thailand
December 1999
Thailand Background

- Oil refinery rated at 220,000 bbls/day
- Originally built 1962
- Located 130 kilometers from Bangkok
- Site occupies 150 hectares
  - Refinery process occupies SW portion of site
  - Tank farms occupy NE and NW portions
  - Admin, shops and stores occupy center of site
Thailand Background

- **Within the diked area- 9 gasoline tanks**
  - tank #3004- 12 million liters capacity (1970)
  - tanks #3005- 12 million liters capacity- 2.2 million liters at time of loss
  - tank #3006- 12 million liters capacity- 12.2 million liters at time of loss
  - tank #3022- empty at time but normally 2 million liters (scaffolding was erected)
  - tank #3003- 3 million liter capacity-1.8 million liters at time of loss
Thailand-Events

- December 2 (All times are local)
  - 2053 hrs- In line blending into tank #3005 begins
  - 2144 hrs- Pump feeding tank #3005 trips and is reset at 2153 hrs.
  - 2145 hrs- Tank #3004 filling is completed by ‘C’ shift team. Gauge level of 1254 cm.
Thailand-Events

- 2200 hrs- shift change
- 2236 hrs- high level alarms rings in offsite control room. This was apparently not heard
- 2255 hrs- High-high audible alarm also rings. This too was reportedly not heard.
- 2322 hrs- two operators are dispatched to investigate why tank #3005 was not filling.
- 2325 hrs- explosion & subsequent fire
December 4

- afternoon-fire is finally extinguished. Fire had rekindled twice during extinguishment due to loss of foam supplies. Foam was flown in from Singapore.
**Thailand - Cause**

- Over-topping of storage tank #3004 due to operator error (overfill of 203,000 liters)
  - During the inline blending operation a valve was incorrectly opened which filled tank #3004 instead of tank #3005.
- Due to the blast damage it has been suggested that the vapors were ignited in the vicinity of the fire station.
Thailand- Lesson Learned

- Location of fire station & administration buildings should be moved.
- Alarm system should be revised and possible automatic trips added
- Operating procedures should be revised/reviewed
Thailand- Fire Damages

- 7 staff/contractors were killed
- Fire damage was largely confined to 5 of the 9 tanks within the dike (#3004, 3005, 3006, 3003 & 3022)-all destroyed, along with 41 million liters of gasoline
- Two other tanks within the dike were less seriously damaged (#3058 & 3036)
- Fire damage to piperack traversing the diked area
Blast damage was more widespread:
- Walls of several tanks facing the blast were rippled (tanks T113 to T126)
- Main office/administration building
- Warehouses #1 & #2
- Fire station & six fire trucks parked inside

No damage to process units however site was shutdown in a controlled manner
Flammable Liquids Filling Operation

Quebec, Canada
February 2001
Site occupied for the ‘bulk breaking’ of many industrial chemicals and packaging into smaller consumer sized packages.

- Automotive liquids
- Wood preservatives
- Fuels
- Household solvents

Small amount of blending also carried out.

Site composed of many interconnected buildings.
Filling Operation - Background

**Building 4**

- Grade floor area of 32,340 square feet
- 28 feet in height
- Sprinklered
- The building is constructed with:
  - Roof: Insulated steel deck on open-web steel joists supported by non-fire-proofed steel columns.
  - Walls: Insulated metal sandwich panel
  - Floor: Concrete on grade
**Filling Operation- Background**

**Filling area**
- Stand alone structure within building 4.
- Measured 84 feet by 26 feet and rises to a height of 10 feet. Located a minimum of 25 feet from any of building 4’s exterior walls.
- Constructed with 8 inch C.B. walls and a poured in place concrete roof which formed a mezzanine.
- Many openings are provided in the walls for access to personnel as well as product entry and exit.
- Sprinklered
Filling Operation- Background

- 7 filling lines- all electro-mechanical.
  - Material obtained directly from tankage or from blending area (located in another building)
  - Each filling line with an 80 US gallon maximum reservoir size
  - All machinery grounded
- Explosion proof electrical fixtures through-out.
- Forced mechanical ventilation.
- Ground straps located at several points.
- All process piping was steel.
Filling Operation- Events

- **Friday 3:00 p.m.- New shift starts.**
  - 2 employees responsible for cleaning line 4 prior to filling of new product
  - Previous material filled at line 4 was lacquer thinner (mixture of toluene, MEK & acetone- class IB flammable liquid)
  - Piping is drained into a 55 US gallon metal drum
  - 4 other employees in filling area tending to the operating lines (1, 3 & 5)
Filling Operation - Events

❖ Just prior to 4:10 p.m.
  - Contents of the drum ignite, the two employees receive facial burns
  - Remaining 4 employees start to fight fire with fire extinguishers

❖ 4:10 p.m.
  - Plant wide page to emergency response team
  - Fire department called
  - Additional employees start to fight fire with extinguishers
  - Fire starts to involve lines 3 & 5
Filling Operation - Events

~4:15 p.m.
- Fire within the filling area cannot be controlled, all staff leave and all doors are closed
- Only 4 staff remain in the building to fight fire via package exits
- It is discovered that the fire has exited filling area near an air inlet duct
- Ventilation system is shut down

~4:23 p.m.- Plant staff using a single 1½” hose report having fire outside filling area under control
Filling Operation - Events

- Approximately 4:25 p.m.: Fire department arrives and stations itself west of Bldg 4.
- 4:30 p.m.: All employees now out of building.
- 4:48 p.m.: Fire department enters building.
- 5:05 p.m.: Fire department requests that sprinkler system be shut down.
- After 5:45 p.m.: Electrical power is restored to the site, and one employee spends the night as a precautionary measure.
2 employees receive minor injuries

Fire fighting

- Eleven of 18 sprinkler heads within the filling area fused and operated.
- Five sprinkler heads outside the filling area and below the bottle nets also fused and operated.
- Ten, 20A-10BC and five, 10A-5BC fire extinguishers were used.
- 3400 US gallons of foam/water were treated on-site.
Building 4.
- No structural damage to the building

Filling area.
- Severe heat damage to filling lines 3 & 4
- Severe heat damage to the ventilation system
- Heat damage to all electrical equipment
- Moderate to light smoke and water damage to filling lines 1, 2, 5, 6 & 7
- Moderate smoke damage to the entire area
Filling Operation - Outcome

- Mezzanine above filling area.
  - Severe heat damage to bottle nets and associated conveyor system
  - Water damage to production equipment
  - Light smoke damage to production equipment

- Labeling area
  - Heat damage to entire area

- Packaging & storage areas
  - Light to moderate smoke damage
Filling Operation - Cause

- Static charge from the splashing of lacquer thinner into a 45 gallon metal drum.
  - Less than 10 gallons of lacquer thinner within the collecting drum
  - Less than 130 US gallons of various flammable liquids were involved in total (includes other filling lines)
Filling Operation - Lessons Learned

- Reinforce use of safe grounding & bonding procedures.
- Install fire rated dampers on filling room ventilation system.
Filling Operation - Damages

- All values in Canadian dollars (2001)
- Site value $33,456,000
- Loss amounts
  - $252,114 Equipment
  - $183,445 Inventory
  - $67,897 Labor
  - $76,372 Cleaning etc.
- Total loss $580,000 (rounded)
- No loss of profits (made-up at another site)