

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**

Thailand- Events

■ **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 (overflow 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 be 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**

Thailand- Explosion Damages

- **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

Filling Operation- Background

- ★ **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)**

Drum 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

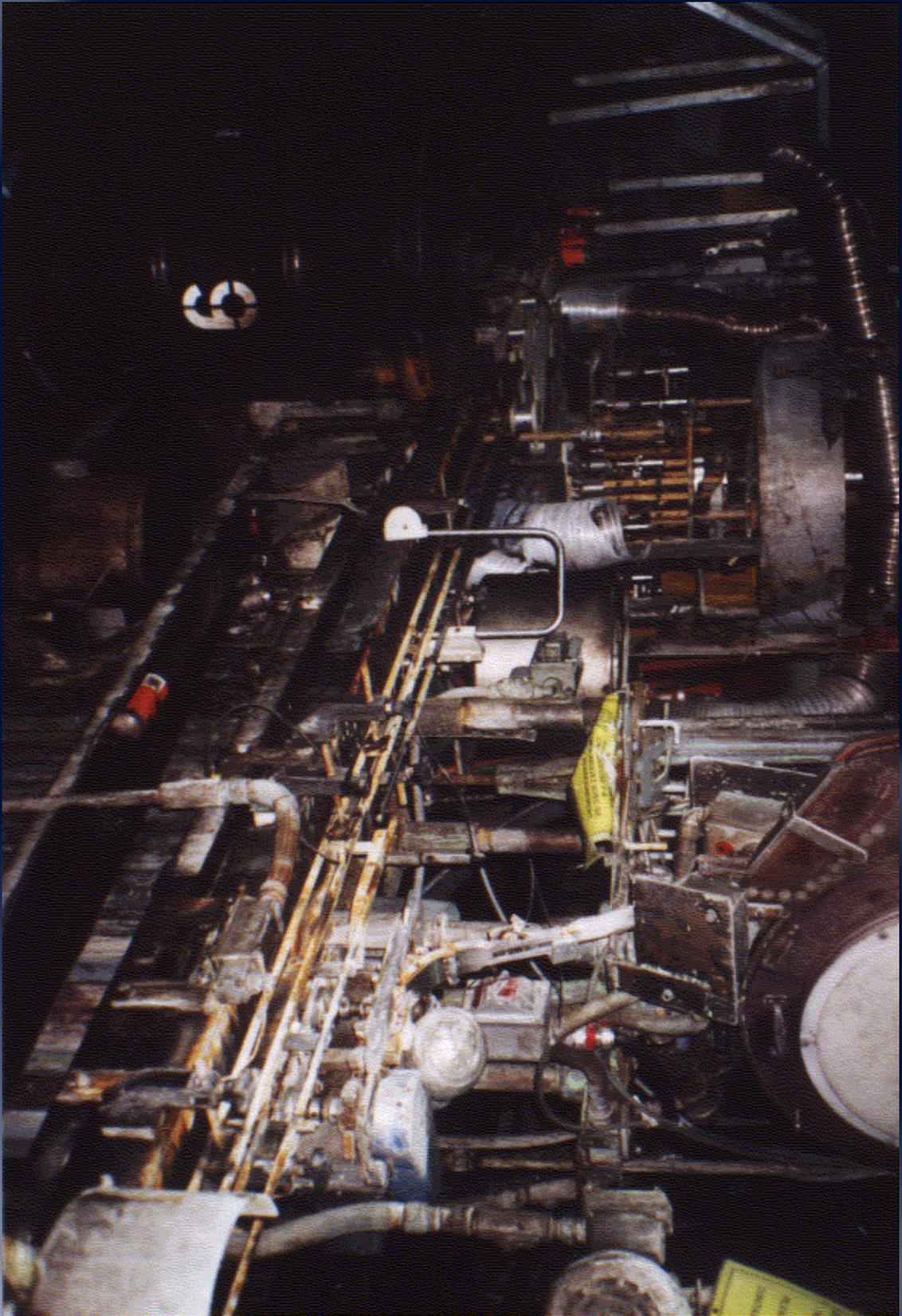
★ ~4:15 p.m.

- 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

Filtering Operation- Events

- ★ ~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.
- ★ >5:45 p.m.
 - Electrical power is restored to the site
 - One employee spends the night as a precautionary measure



Filling Operation- Outcome

- ★ **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.**

Filling Operation- Outcome

*** 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)