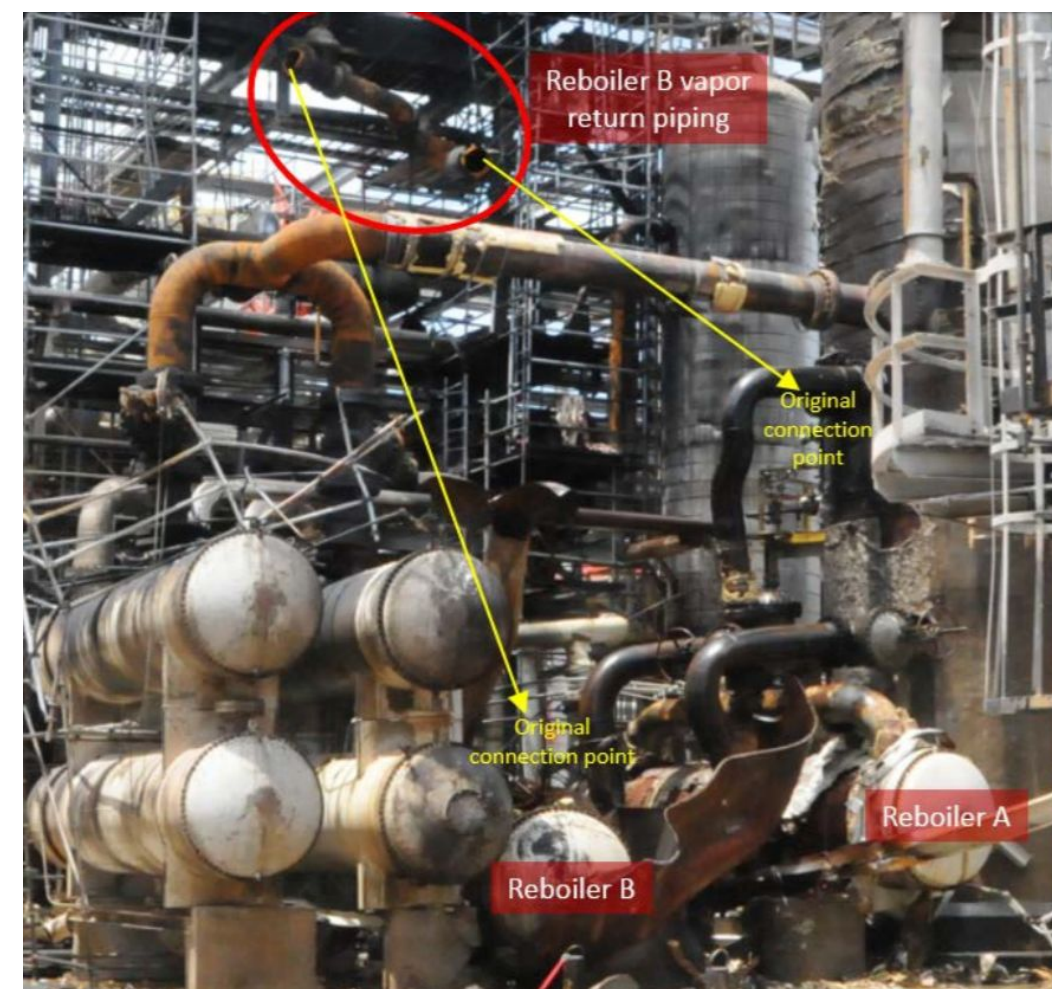


# Williams Olefins Plant Explosion

Group 213 | Pearce Bragaw, Mathias Heider, Seth Parker, Jonny Schott, Tucker Smith

## Background & Motivation

- The Williams Olefins Plant in Geismar, Louisiana regularly produces ethylene and propylene.
- On June 13th, 2013 at 8:33 AM, one of the two propylene reboilers exploded due to a propane leak and pressure buildup.
- At the time, there were 110 employees and 800 contractors present
- At the time, the plant produced 675,000 lbs of ethylene and 40,000 lbs of propylene per year
- Two workers were killed and 114 were injured



## Incident Investigation

**Initiating cause:** propane buildup in the decommissioned reboiler

**Deviation:** Worker opened the valve which caused hot water to flow into the reboiler, heating up the propane

**Loss Event:** explosion of the reboiler

**Impacts:** 2 deaths, 114 injuries, chemical release into the air



$$m_{TNT} = \frac{\eta m \Delta H_c}{E_{TNT}}$$

- $m_{TNT}$  = equivalent mass of TNT (kg)
- $n$  = experimental correction factor (assumed as 0.1 with no dimensions)
- $m$  = mass of material exploding (kg)
- $\Delta H_c$  = heat of combustion of material
- $E_{TNT}$  = energy of the explosion of TNT (4,686 J/kg)

**$m_{TNT}$  calculated to be 75.37 kg**

$$Z_e = \frac{r}{m_{TNT}^{1/3}}$$

- $Z_e$  is the scaled distance
- $r$  = radius of shock wave (3218.69 m)

**$Z_e$  calculated to be 42.71**

$$P_o = P_s P$$

- $P_o$  is the scaled overpressure of the explosion
- $P_s = .1$
- $P = 14.7$

**$P_o$  is calculated to be 1.47 psi**

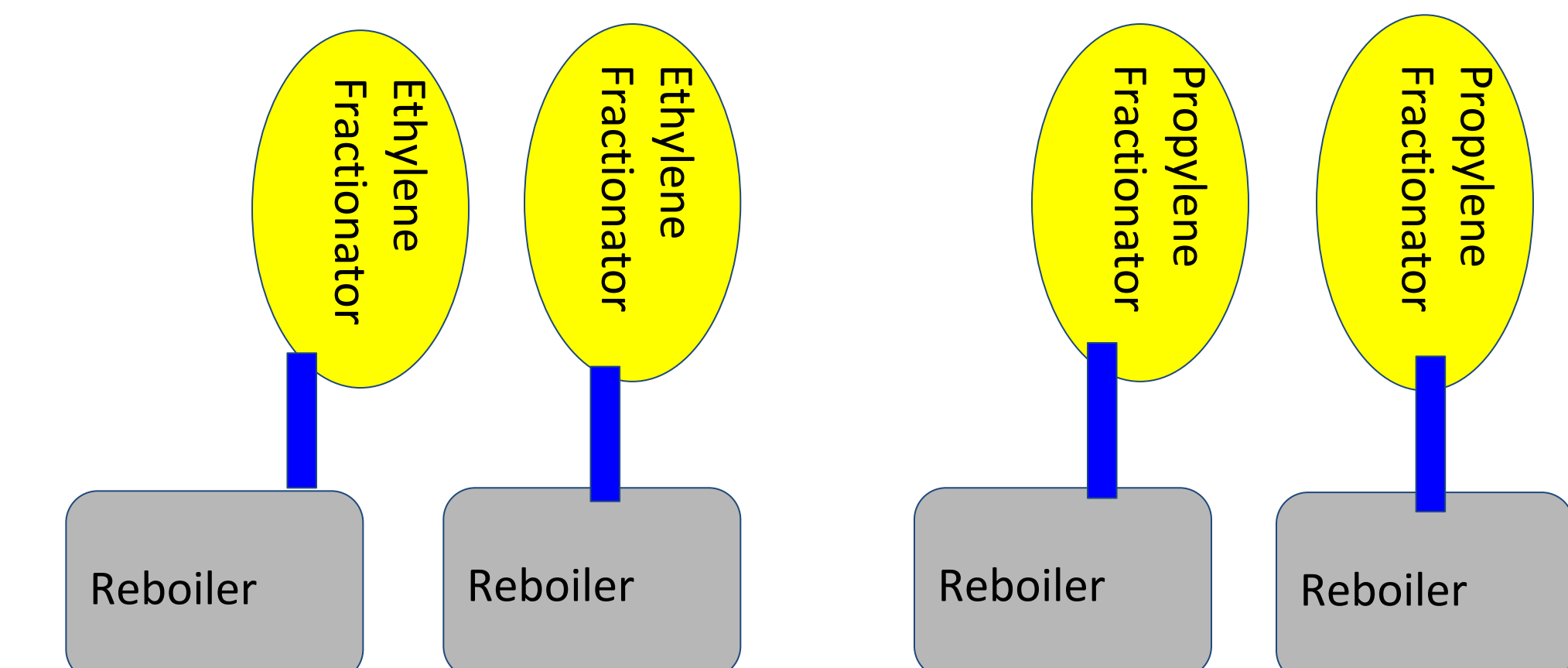
This scaled overpressure causes harmful noise, glass to break, and steel to warp. This happened in the explosion.

## Long-Term Impacts

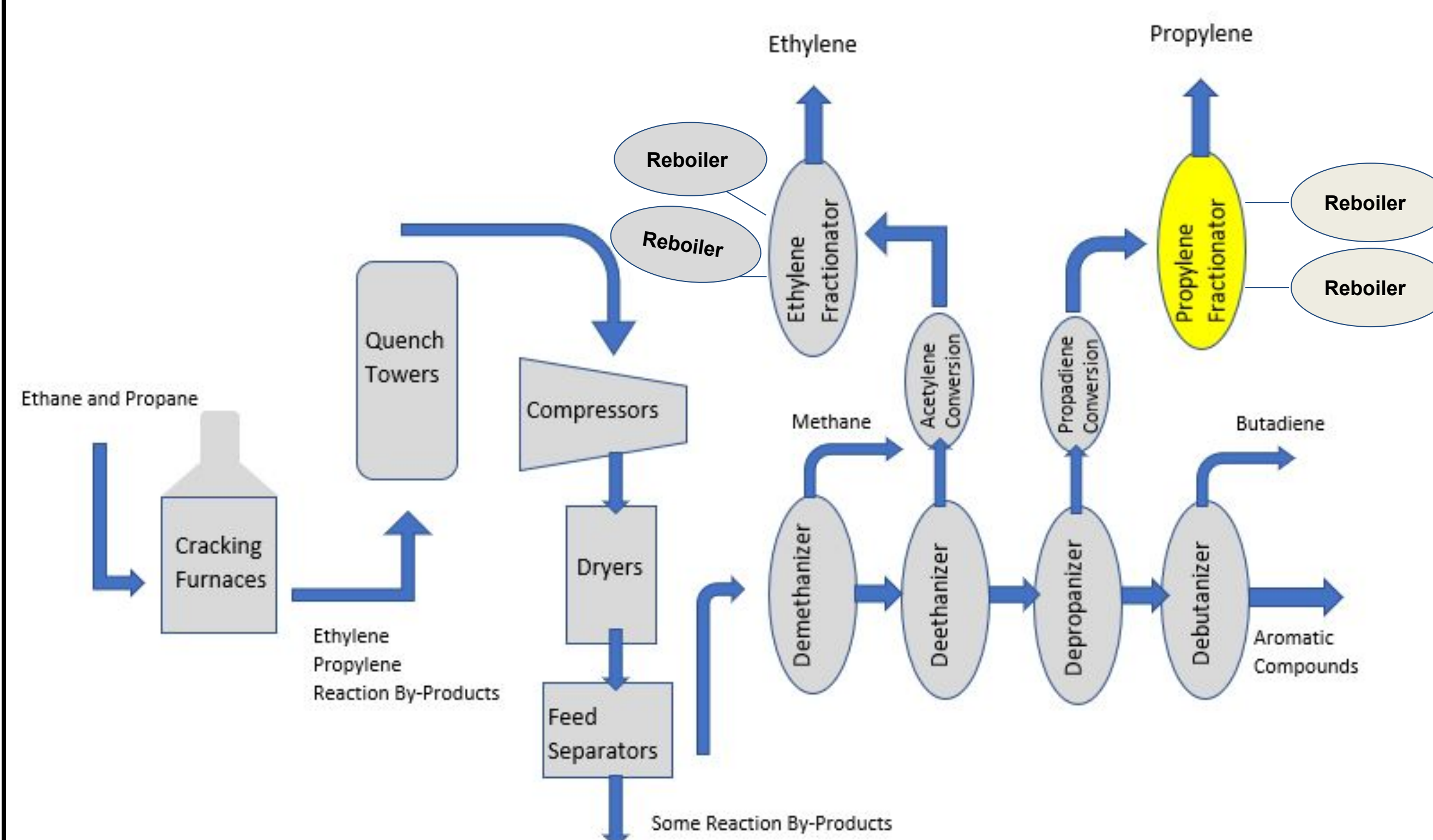
- Williams Olefins company had to pay millions of dollars of fines to mitigate:
  - Health care costs for those who were injured
  - Air emissions released due to explosion
- Regulations changed:
  - American Petroleum Institute (API) Standard 521 was modified and now requires a pressure relief device for these scenarios
- Lessons learned include:
  - A pressure relief system is a necessary safeguard for overpressure scenarios
  - Safety culture must be present in the workplace and include updated and accurate safety procedures

## Design Suggestions

- Add more pressure protection to the valves so it cannot explode under high pressures
- Have better training or have training at all. It was found by OSHA that the plant didn't document safety training.
- "adding more robust isolation methods, such as inserting a blind, can better protect offline equipment from accumulation of process fluid." (CSB)
- Design two propylene and ethylene fractionators
  - One reboiler for every fractionator
  - Easier design for the pressure relief valves



## Plant Layout



- In this plant layout, the propylene fractionator is shown in yellow. This fractionator has two attached reboilers in order to heat up the propane mixture. One of these reboilers was the cause of the explosion due to an unknown buildup of propane.

## References

- Arnold & Itkin. "Why the Williams Olefins Geismar Explosion Happened." *Arnold & Itkin LLP*, 19 Oct. 2016,
- "CSB Releases Final Case Study into 2013 Explosion and Fire at Williams Olefins Plant in Geismar, Louisiana." *CSB*, 22 Sept. 2016,
- Smith, Sandy. "Four Workers Awarded \$16 Million by Jury in Second Williams Olefins Plant Explosion Case." *EHS Today*, 16 Nov. 2016,
- "Williams Olefins Plant Explosion and Fire." *CSB*, [www.csb.gov/williams-olefins-plant-explosion-and-fire/](http://www.csb.gov/williams-olefins-plant-explosion-and-fire/).