How Not to Go Boom
Lessons for SREs from Oil Refineries

Emil Stolarsky | @EmilStolarsky
“If you get there and the Waffle House is closed? That's really bad.”

- Craig Fugate, Director of FEMA (2009 –2017)
Design for failure
Explosion Isolation Systems
Pressure Relief Systems
Safe and Rapid Isolation of Piping Systems
“If you think safety is expensive, try having an accident.”

- Trevor Kletz, Chemical Process Safety Expert
 Fault Tree Analysis

- FIRE & EXPLOSION
  - Flammable Material Source
  - Fire Causing Factors
    - Snip Fuel
    - Cargo Failure
      - Hot Work
    - Use of Inappropriate Equipment
      - Spark
      - Fire
  - Transported Cargo
    - Combustible Liquid Material
      - Cargo Residue
      - Cargo Leakage
    - Combustible Gas Material
      - Combustible Gas Accumulation
      - Combustible Gas Leakage
    - Use of Inappropriate Fuel
      - Use of Appropriate Fuel
      - Tank Cleaning
      - Static Electricity
      - Inappropriate Equipment
      - Fire
Subsystem A

B
1 2

C
3 4 5

D
6

E
7 8
A

Subsystem A

\[ p(B) = 2\% + 2\% \]

B

\[ p(C) = 2\% \cdot 2\% \cdot 2\% \]

C

\[ p(D) = 2\% \]

D

\[ p(E) = 2\% \cdot 2\% \]
p(A) = p(B) + p(C) + p(D)

p(B) = 2% + 2%

p(C) = 2% · 2% · 2%

p(D) = 2% + p(E)

p(E) = 2% · 2%
A

B

C

D

E

\[ p(A) = p(B) + p(C) + p(D) \]

\[ p(B) = 4\% \]

\[ p(C) = 0.0008\% \]

\[ p(D) = 2\% + p(E) \]

\[ p(E) = 0.04\% \]
\[ p(A) = p(B) + p(C) + p(D) \]
Subsystem A

- $p(A) = 6.0408\%$

B

- $p(B) = 4\%$

- $p(C) = 0.0008\%$

C

- $p(D) = 2.04\%$

D

- $p(E) = 0.04\%$
$p(A) = ??\%$

$p(B) = 4\%$

$p(C) = 0.0008\%$

$p(D) = 2\% \times 0.04\%$

$p(E) = 0.04\%$
Subsystem A

- **A**
  - **B**
    - 2%
    - 2%
  - **C**
    - 2%
    - 2%
    - 2%
  - **D**
    - 2%
  - **E**
    - 2%
    - 2%

- **p(A)** = 4.0016%
- **p(B)** = 4%
- **p(C)** = 0.0008%
- **p(D)** = 0.0008%
- **p(E)** = 0.04%
Learning from Failure
Steam Boilers
Thank you.