



# The impact of the Tolerable Event Frequency



Starr Tze, P.Eng.

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# Disclaimer

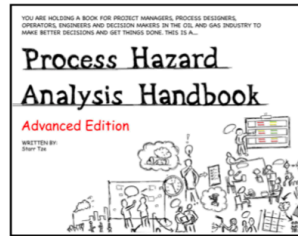
This presentation is designed as a 10 minute presentation in partner with Strathcona County to review the Tolerable Event Frequency value used in decision making. All examples are conceptual in nature.

This presentation does not go into the details of Layer of Protection Analysis.

## Training Materials



### Process Hazard Analysis Handbook - Advanced Edition

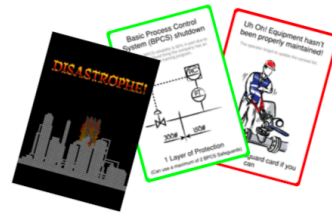


Hardcover available on  
Amazon

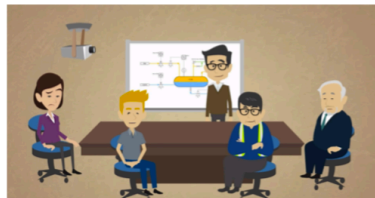
Electronic version available  
on Knovel

### Disastrophe! A Card Game About Process Safety

Available on Amazon



### Process Hazard Analysis Online Certification Course



[www.icarus-orm.com/academy](http://www.icarus-orm.com/academy)

## Icarus-ORM Operational Risk Management



## Consulting Services

Hazard and Operability Study (HAZOP)

Layer of Protection Analysis (LOPA)

Safety Integrity Level (SIL) Study

Reliability, Availability, Maintainability  
(RAM) Analysis

Consequence Modeling

On-site Training

[http://www.icarus-orm.com/  
risk\\_inspired@icarus-orm.com](http://www.icarus-orm.com/risk_inspired@icarus-orm.com)



# Impact of Tolerable Event Frequency in Strathcona County

- 6000 + Direct Jobs
- 12000 + Indirect Jobs
- 40+ Industrial companies
- 75% of petrochemical refining in Western Canada is in Strathcona County



Source: <https://www.strathcona.ca>



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Source: <https://www.strathcona.ca>

# Impact of TEF

- OpEx
- CapEx
- Daily Operations

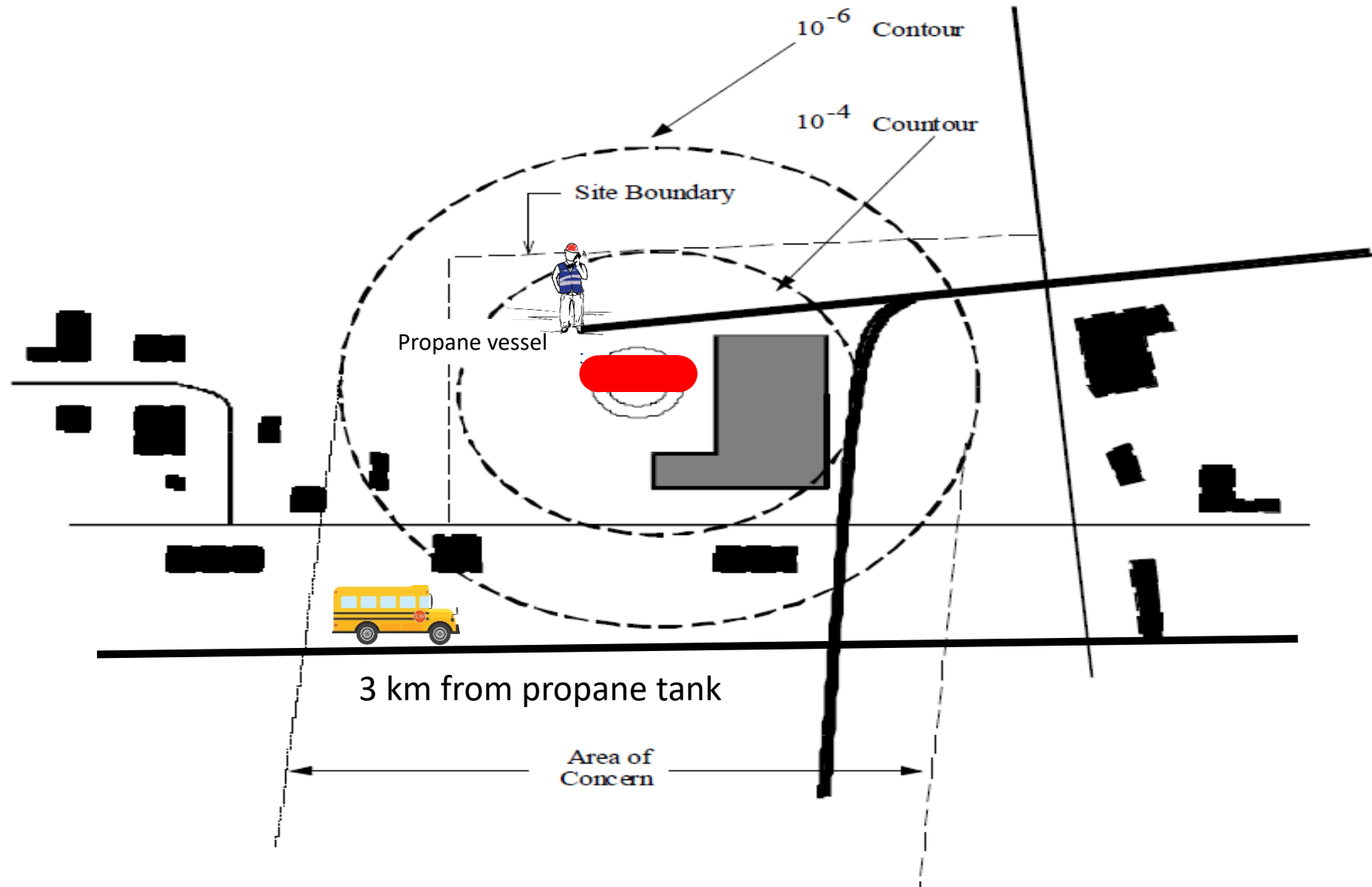


# Conceptual Scenario

- Control valve failure downstream of a propane storage vessel
- Blocked flow overpressure
- Release of flammable hydrocarbon
- Fire and vapour cloud explosion

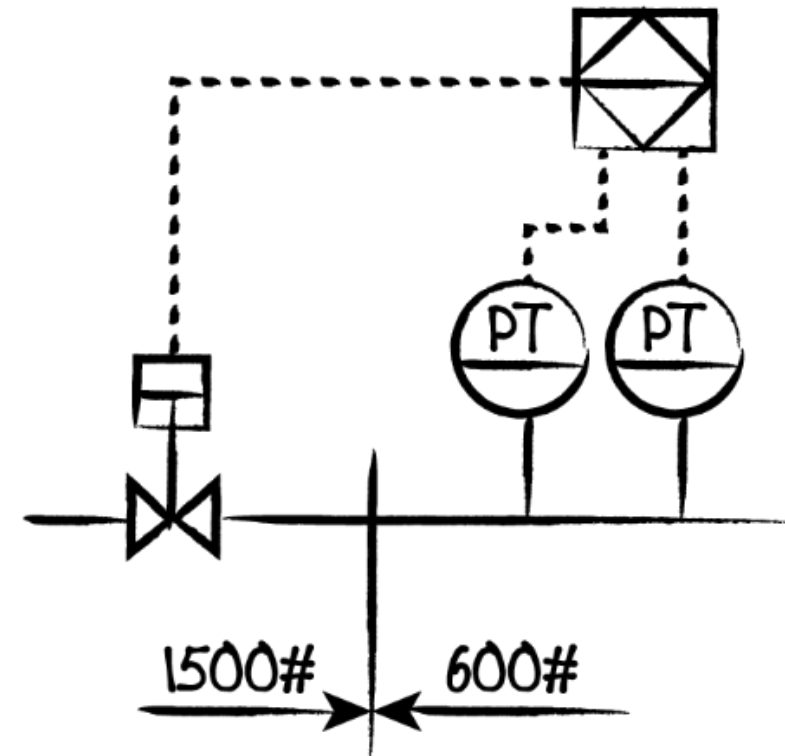


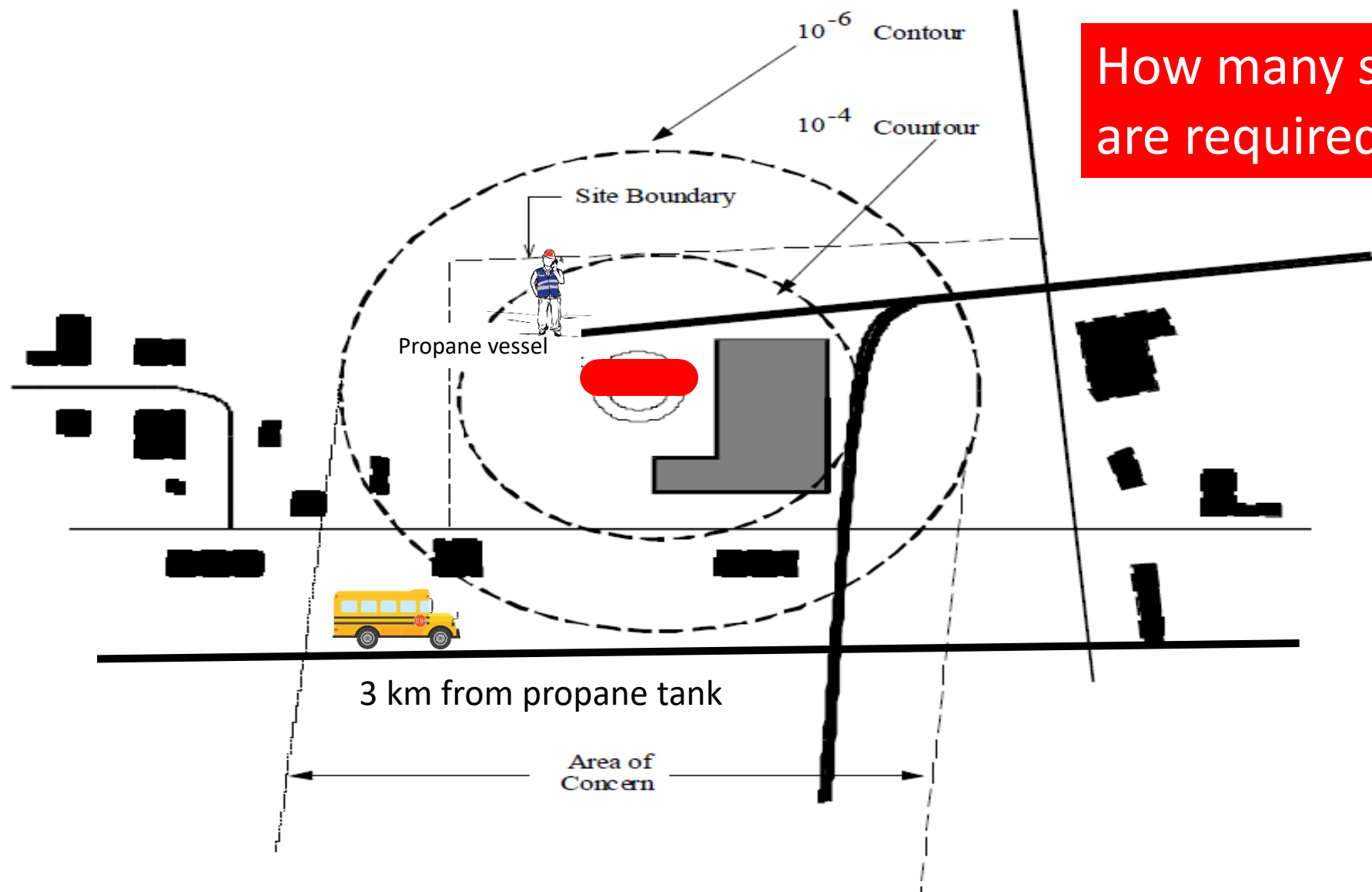




# Potential Safeguards

- Pressure Safety Valve (PSV) (\$)
- High pressure shutdown (\$)
- High integrity SIL rated shutdown (\$\$\$)





How many safeguards are required?



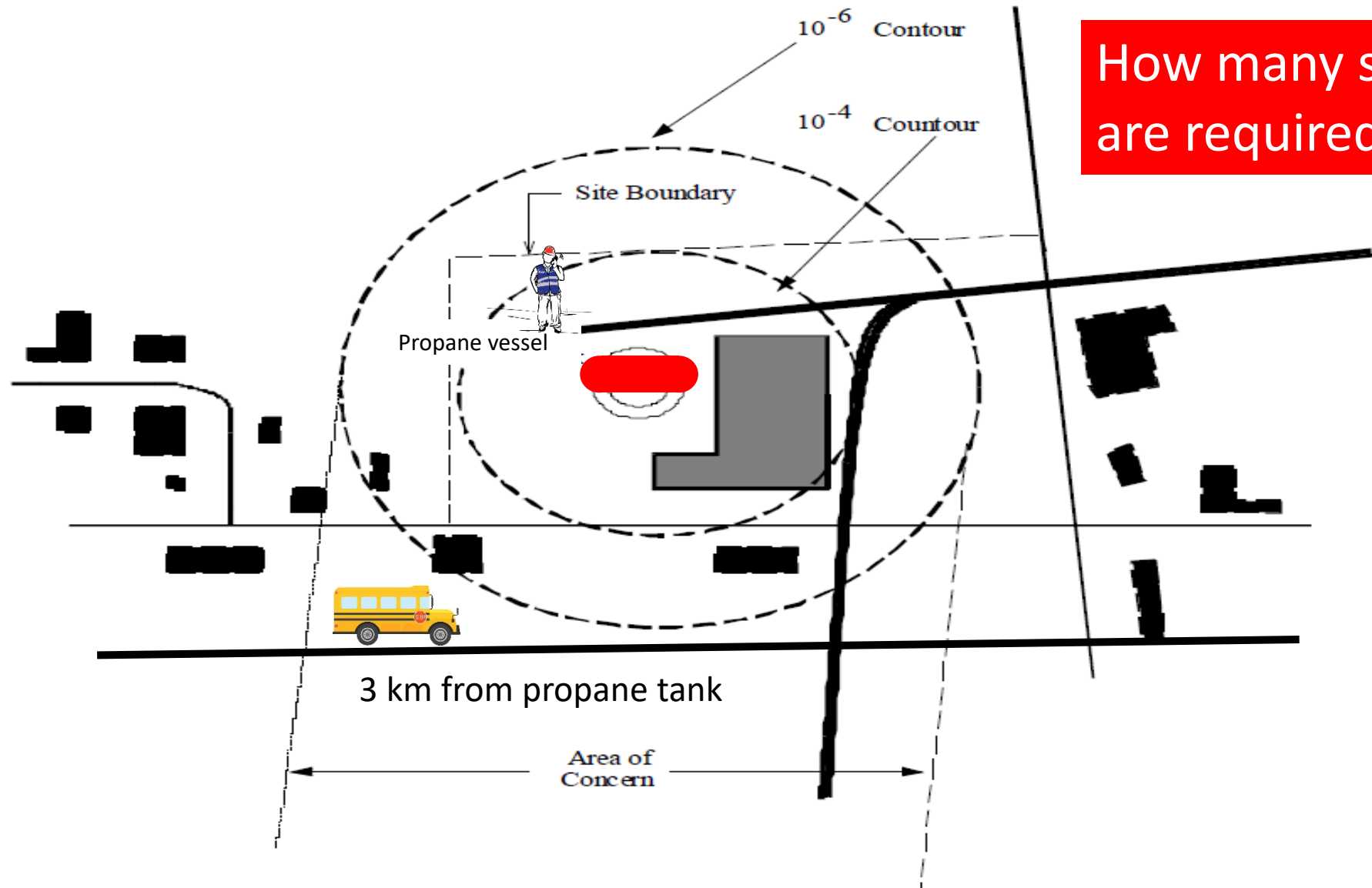
# Layer of Protection Analysis (LOPA)

- Combines probability of failure and probability of safeguard failure
- Identifies gaps based on TEF
- Decision framework for engineering
- Safety Integrity Level (SIL) determination



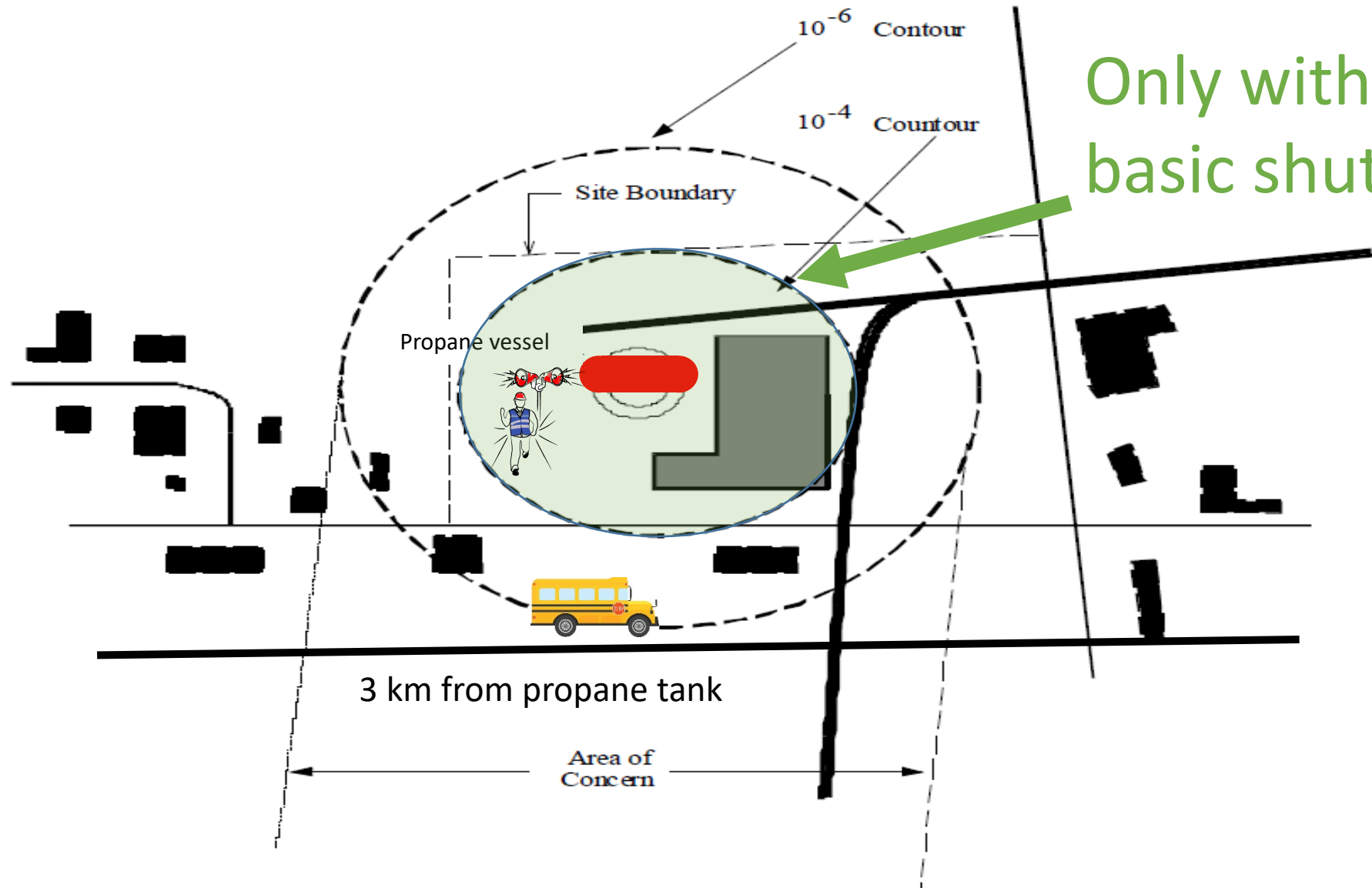
# LOPA

Initiating Event	Frequency (# event / year)	Independent Layer of Protection	Probability of Failure on Demand	Mitigated Event Frequency	Tolerable Event Frequency	Risk GAP
Control valve inadvertently closed	0.1	Pressure Safety Valve	0.01	$10^{-4}$	$10^{-2}$	Good
					$10^{-3}$	Good
					$10^{-4}$	Good
		High Pressure Shutdown	0.1		$10^{-5}$	10 x
					$10^{-6}$	100 x



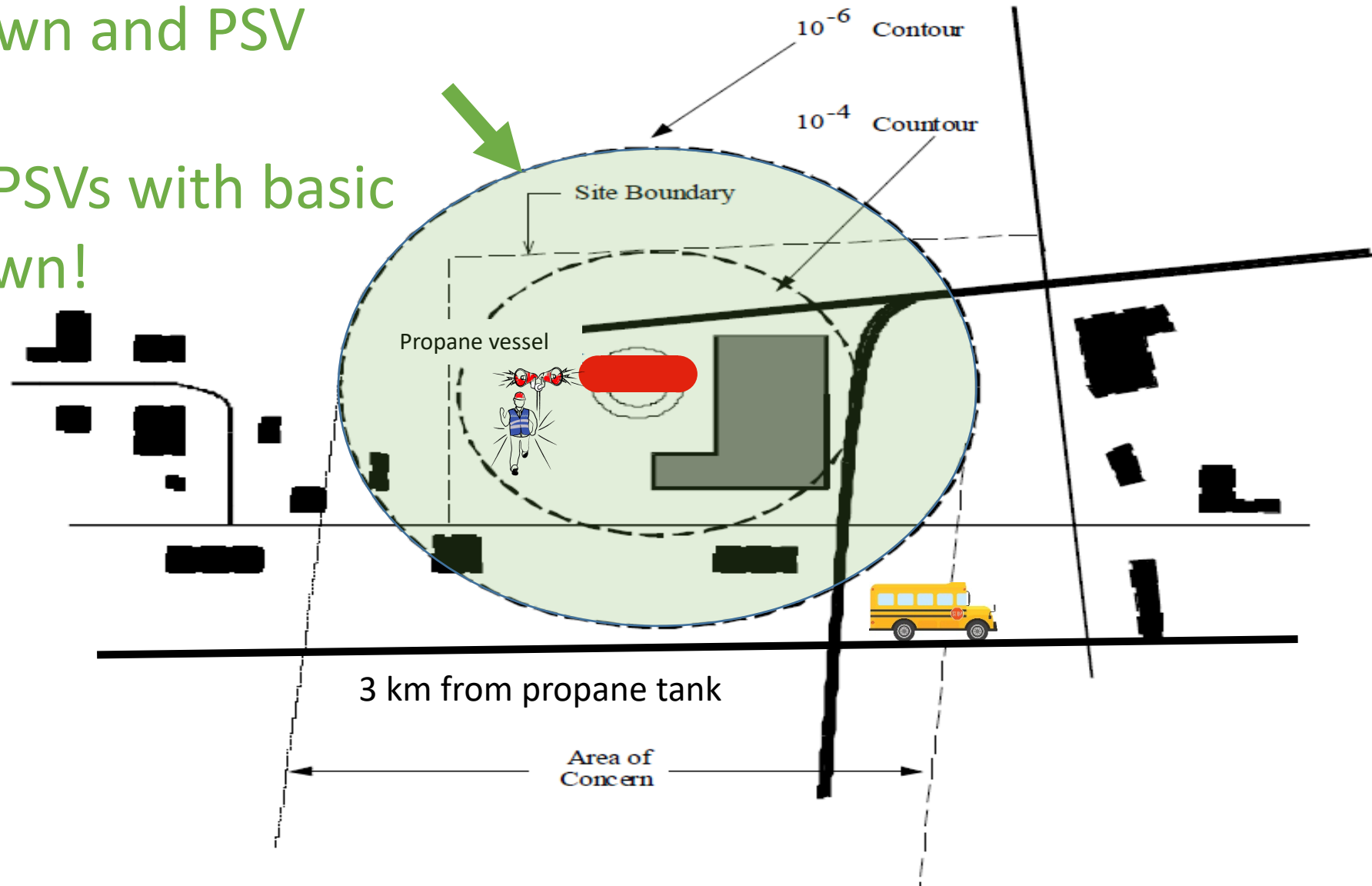
How many safeguards are required?





Only with PSV and  
basic shutdown OK!

High Integrity Pressure  
Shut Down and PSV  
or  
Double PSVs with basic  
Shut down!





## COMMODITIES

DECEMBER 12, 2018 / 9:09 AM / 9 MONTHS AGO

# U.S. probe cites 'ineffective' safeguard in Husky oil refinery blast

Erwin Seba

3 MIN READ



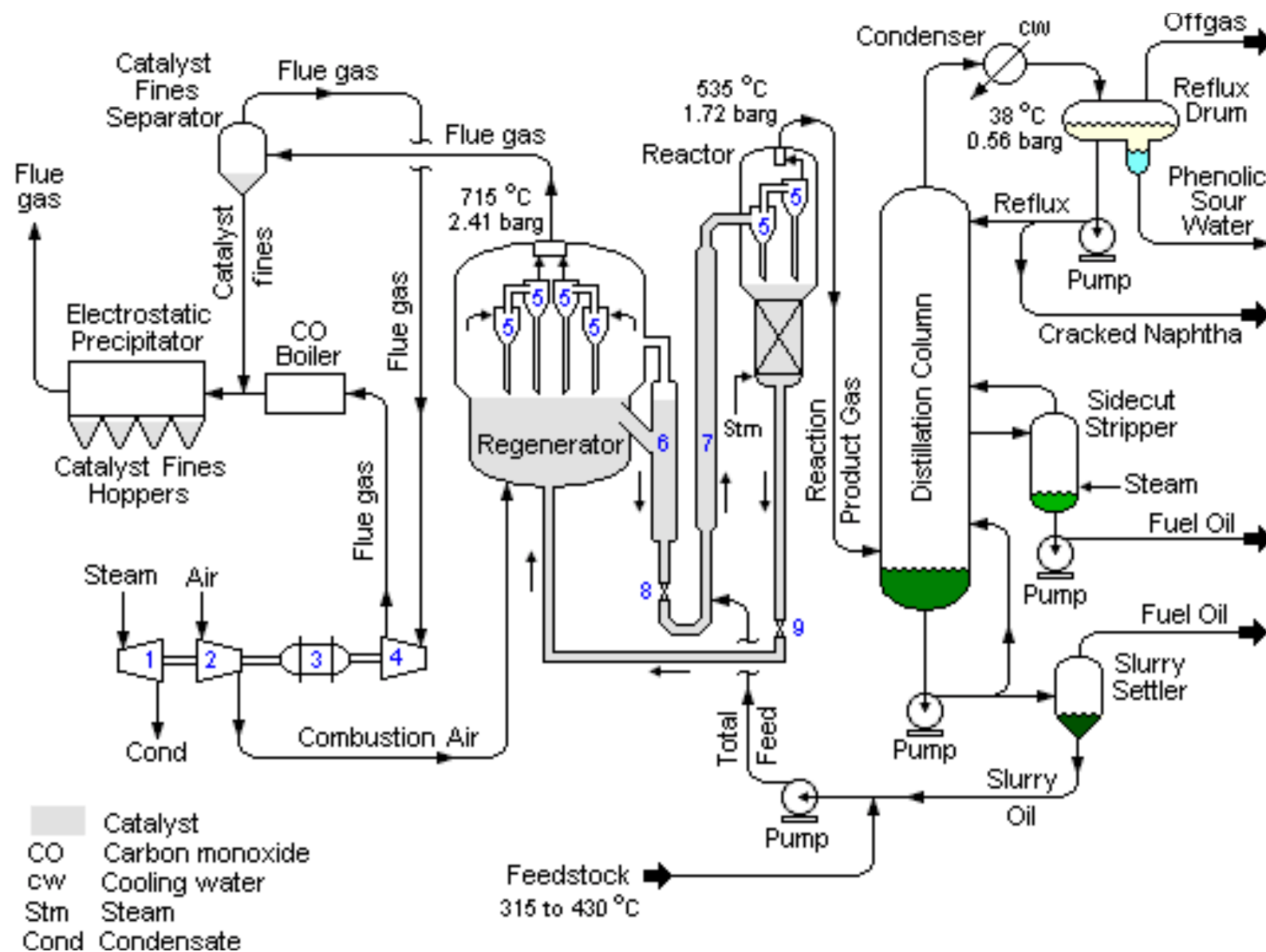


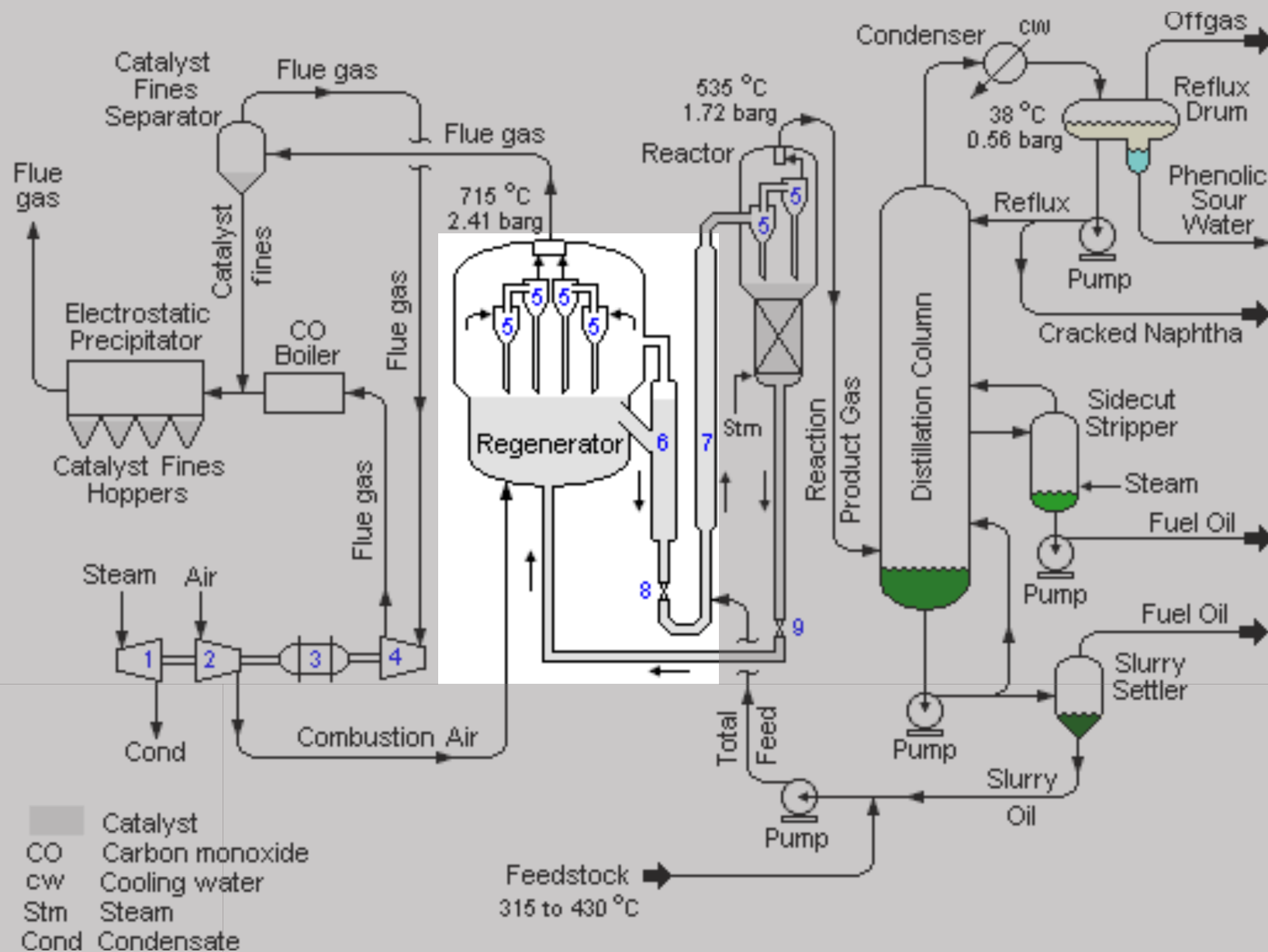


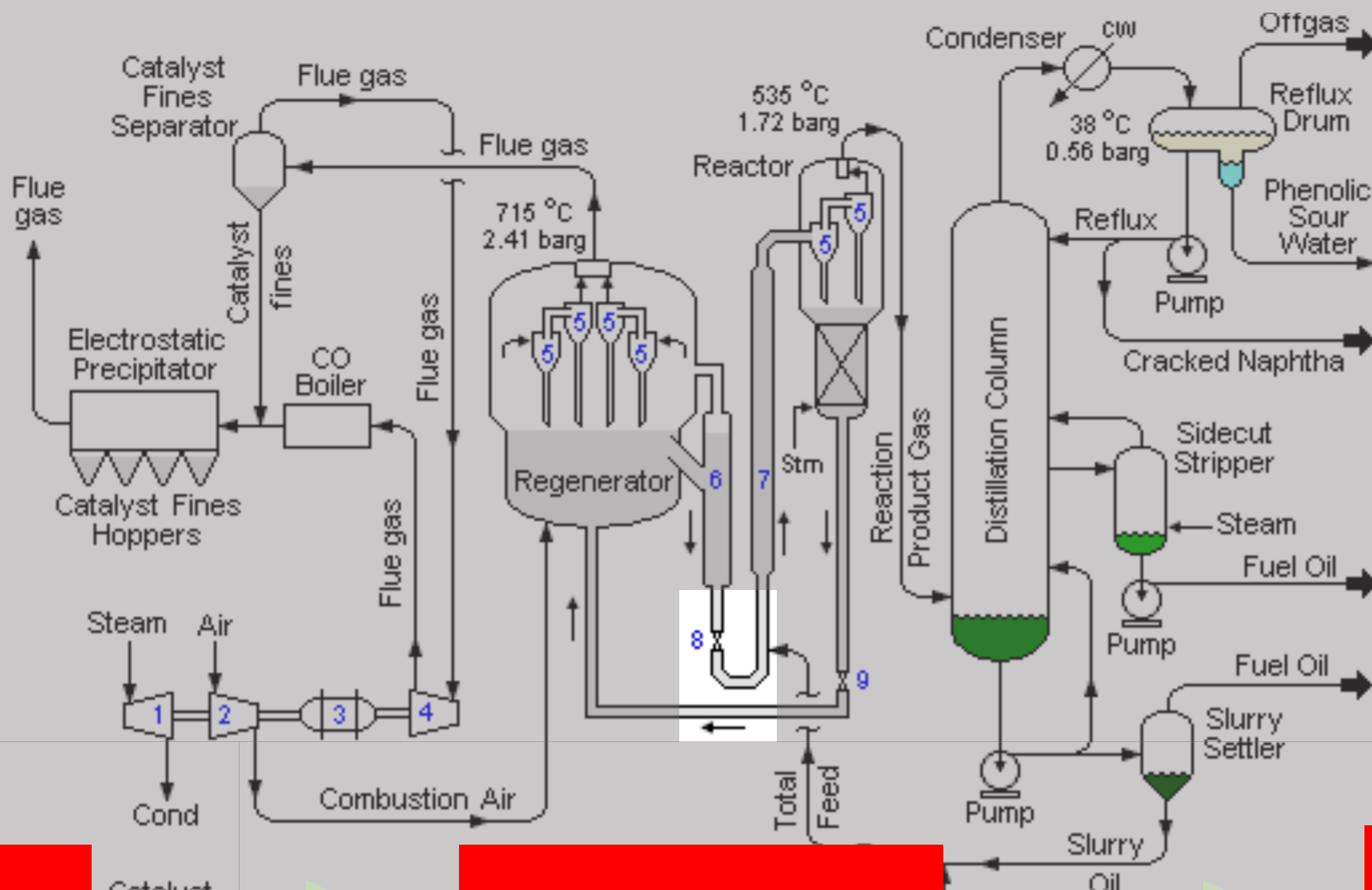
“Prior to both incidents, the process hazard analyses identified scenarios in which hydrocarbons flowed into the air side of the FCCU and vice versa due to a failure of the spent catalyst slide valve (SCSV), but the safeguards listed to protect against those scenarios were ineffective,” the board said.



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# TEF

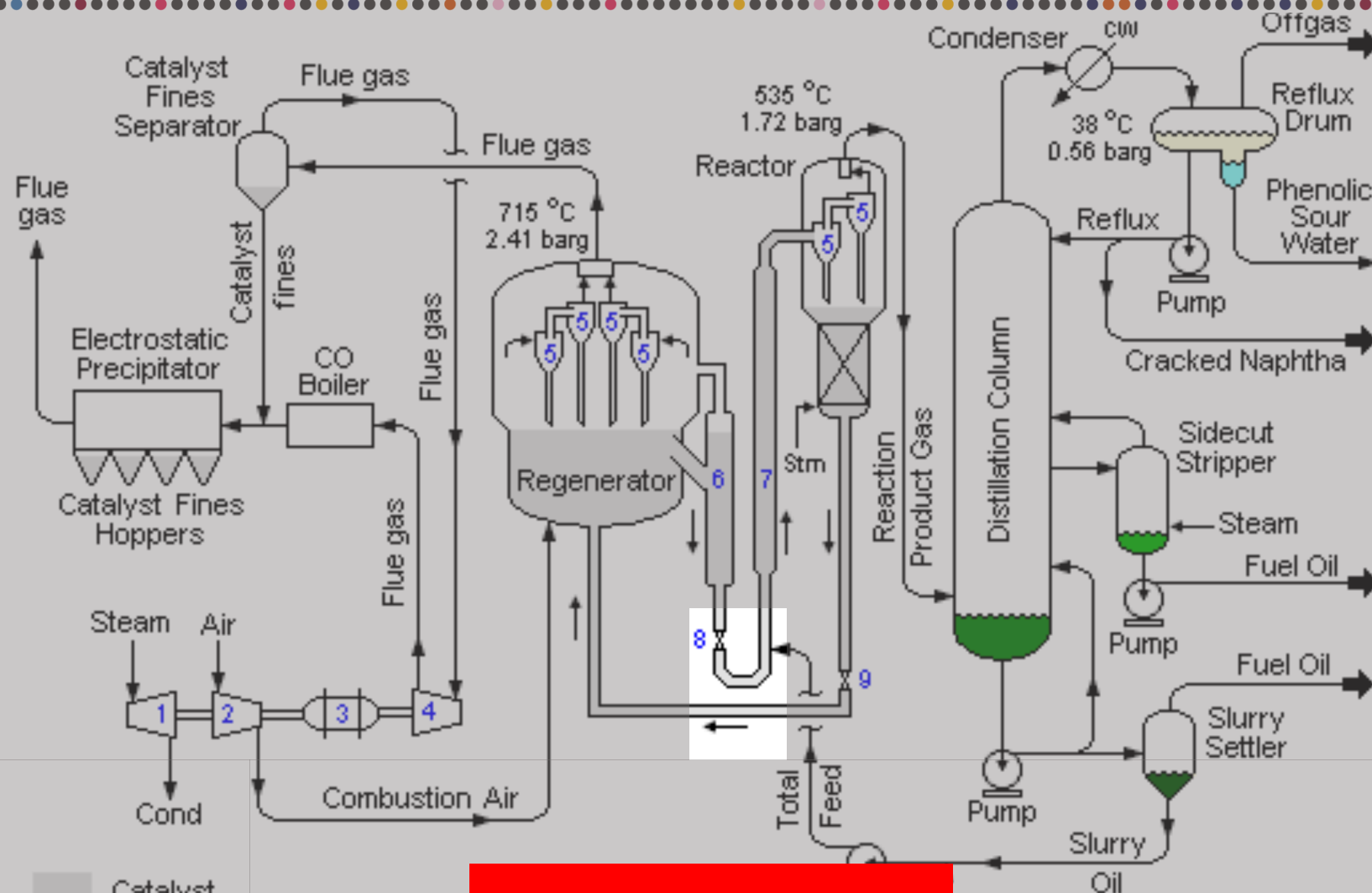
Catalyst  
Carbon monoxide  
Cooling water  
Steam  
Condensate

teering Committee 2019

# LOPA

SIL 2  
Single Slide  
Valve

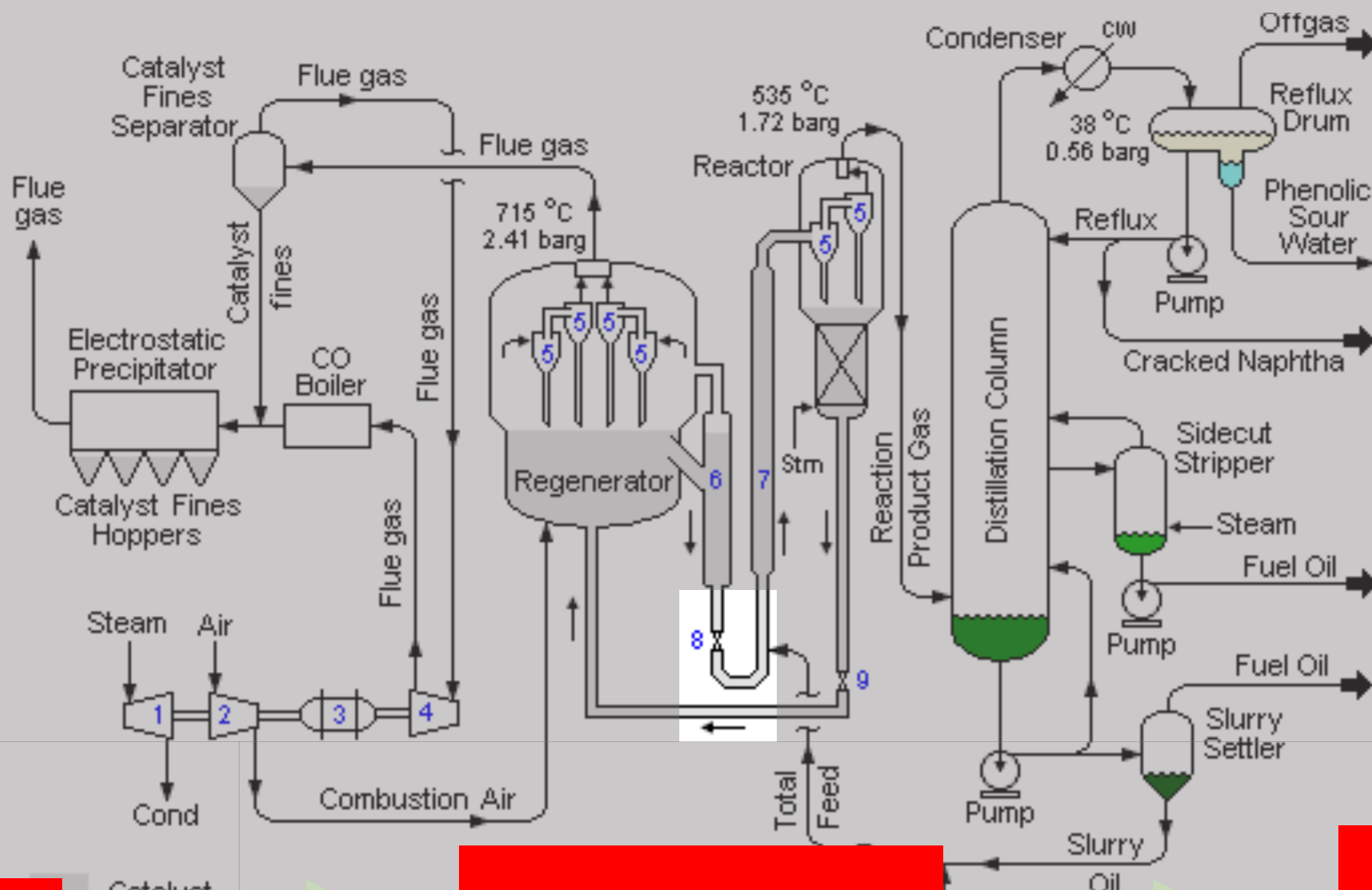




TEF

Catalyst  
Carbon monoxide  
Cooling water  
Steam  
Condensate

LOPA



TEF

Catalyst  
Carbon monoxide  
Cooling water  
Steam  
Condensate

al Steering Committee 2019

LOPA

SIL 3

Double Plates  
Slide Valve

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