EVENT TREE ANALYSIS

1. Introduction
2. ETA in 6 steps
3. Case study : Separator Safety System
4. Comparison with RBD and FTA

FTA = Deductive approach

- Characterization of an critical event by the identification of all its causes

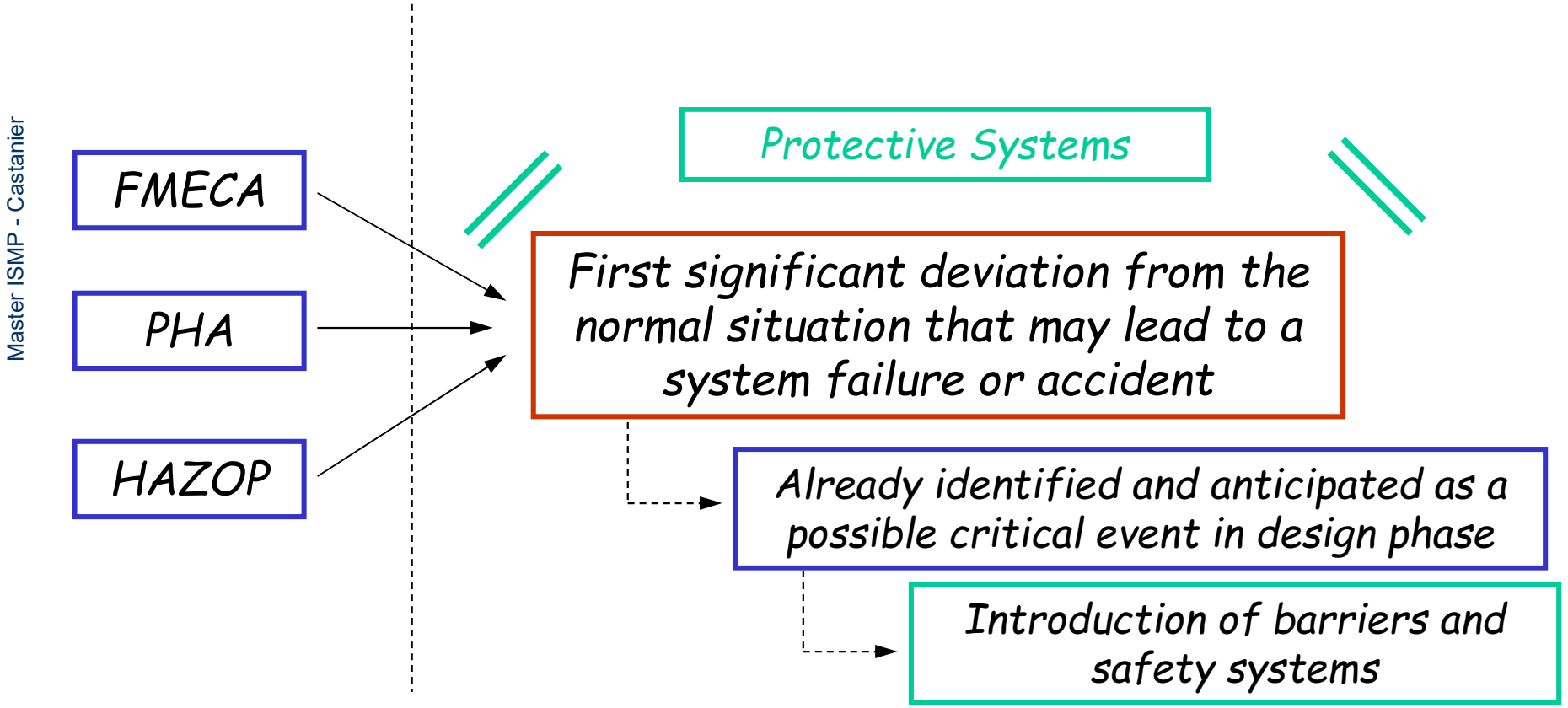
ETA = Inductive approach

- Find all outcomes from an initiating event
- Analyze the accidental progression according to the safety functions

An event tree is a logic tree diagram that starts from a basic initiating event and provides a systematic coverage of the time sequence of event propagation to its potential outcomes or consequences

- Each event in the tree (success or failure of the safety function) is conditional on the occurrence of the previous event

1 Identification of a relevant initiating (accidental) event (IE)



1Identification of a relevant initiating (accidental) event (IE)

2Safety Functions

Characterization of the whole system 's defense against the occurrence of the IE

Identification of all the safety functions (barriers, safety systems, procedures, operator actions, …)

Classification (AIChE 1985) :

- Automatic safety systems that respond to the IE (automatic shutdown system)
- Alarms (fire alarm systems)
- Operator procedures following an alarm
- Barriers or containment methods intended to limit the effects of IE

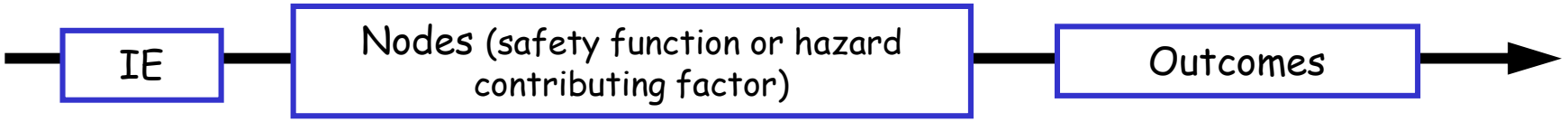
Determination of the sequence of activation of each safety functions

1Identification of a relevant initiating (accidental) event (IE)

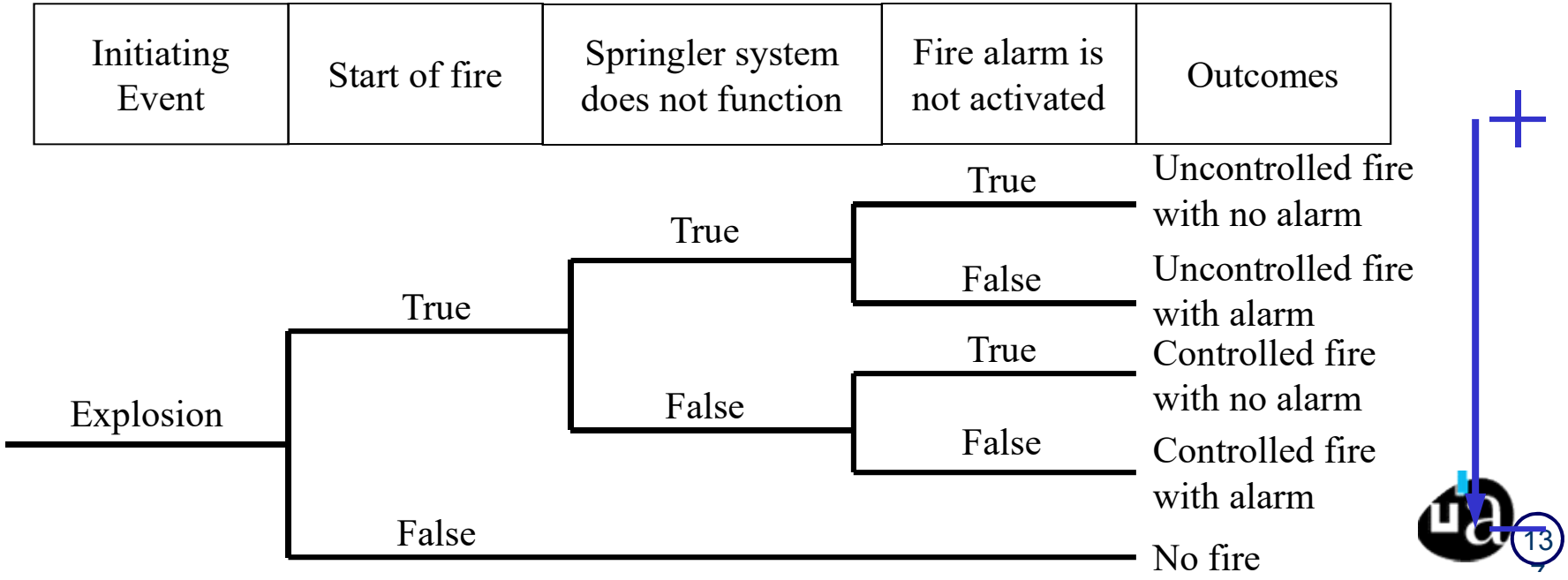
2Safety Functions

3Event tree construction

Chronological development of the event chains



Application of the propagation of the accidental situation for a dust explosion



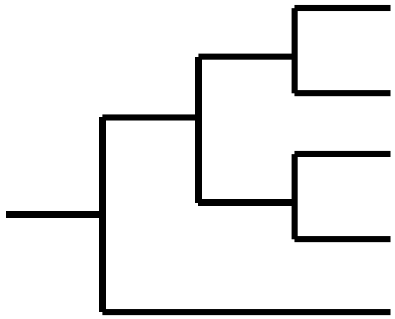
1Identification of a relevant initiating (accidental) event (IE)

2Safety Functions

3Event tree construction

4Description of the resulting event sequences

Qualitative classification of the scenarios according to their criticality



Outcome Descr.	Frequency	Loss of live					Material damage				Environmental damage			
		0	1-2	3-5	6-20	>20	N	L	M	H	N	L	M	H

ETA in 6 steps

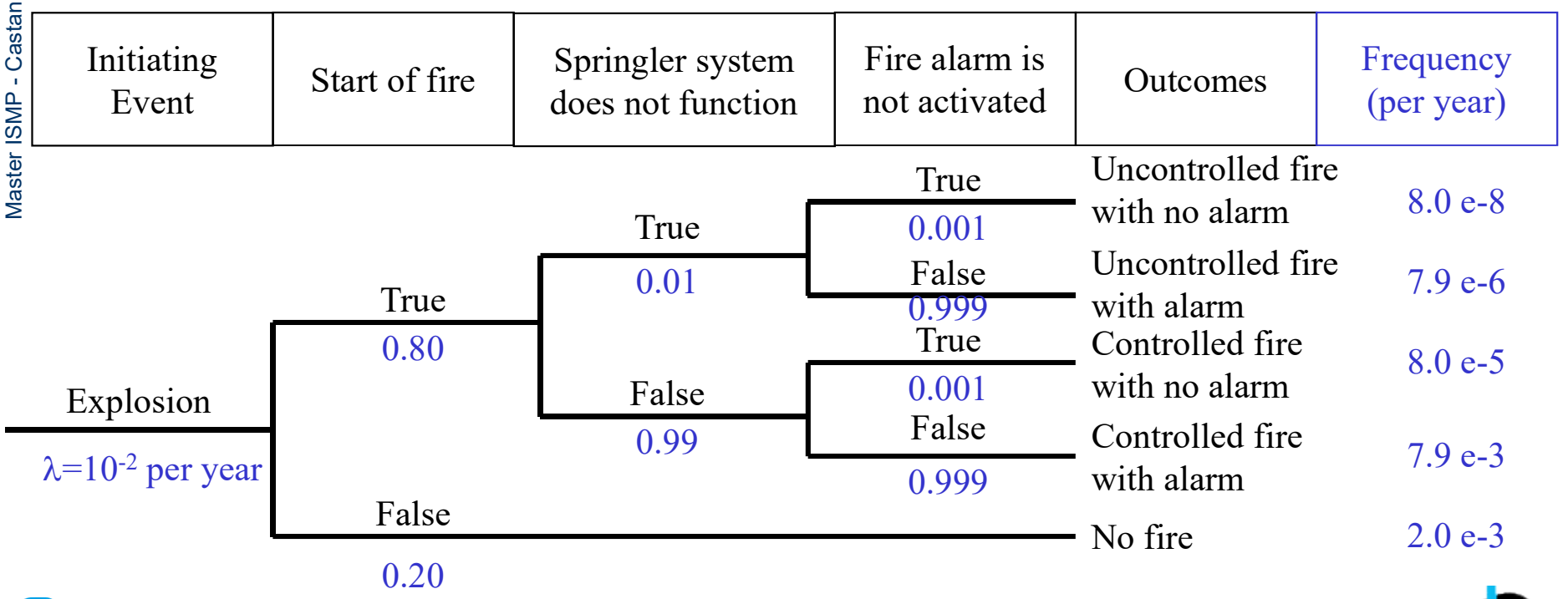
1Identification of a relevant initiating (accidental) event (IE)

2Safety Functions

3Event tree construction

4Description of the resulting event sequences

5Quantitative assessment



ETA in 6 steps

1Identification of a relevant initiating (accidental) event (IE)

2Safety Functions

3Event tree construction

4Description of the resulting event sequences

5Quantitative assessment

6Compilation and presentation of the results from the analysis

- Discussion of the different assumptions
- Outline the critical weakness of the system
- Proposition of corrective actions (possibility to evaluate the impact of the introduction of a new protective system against the IE)

Pros and Cons

Positive

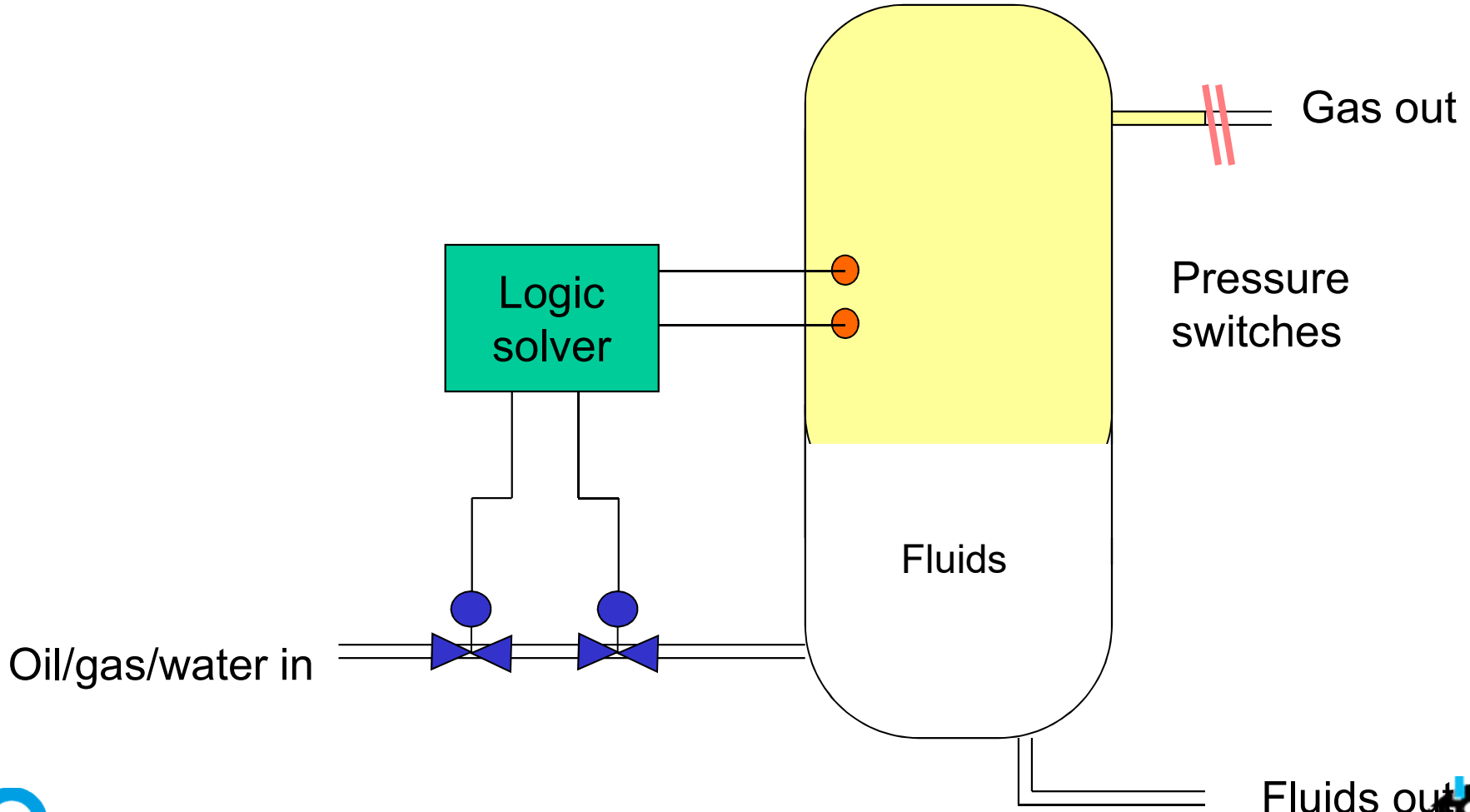
- Visualize event chains following an accidental event
- Visualize barriers and sequence of activation
- Good basis for evaluating the need for new / improved procedures and safety functions

Negative

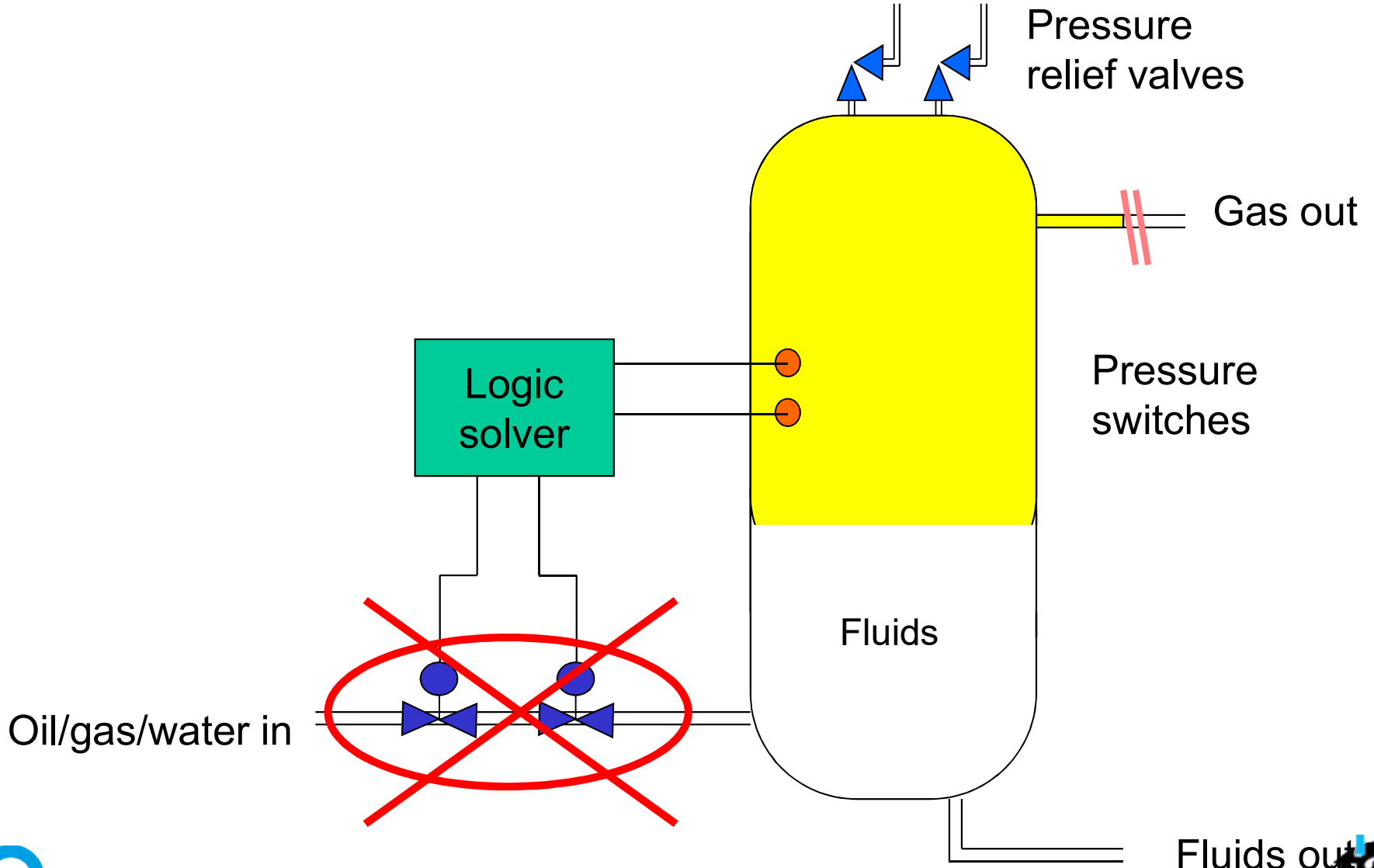
- No standard for the graphical representation of the event tree
- Only one initiating event can be studied in each analysis
- Easy to overlook subtle system dependencies
- Not well suited for handling common cause failures in the quantitative analyses
- The event tree does not show acts of omission

Analyse the reliability of the first stage separator system with

- Fault Tree approach
- Event Tree approach
- Design the Reliability Block Diagram of the system



Process shutdown system (PSD)



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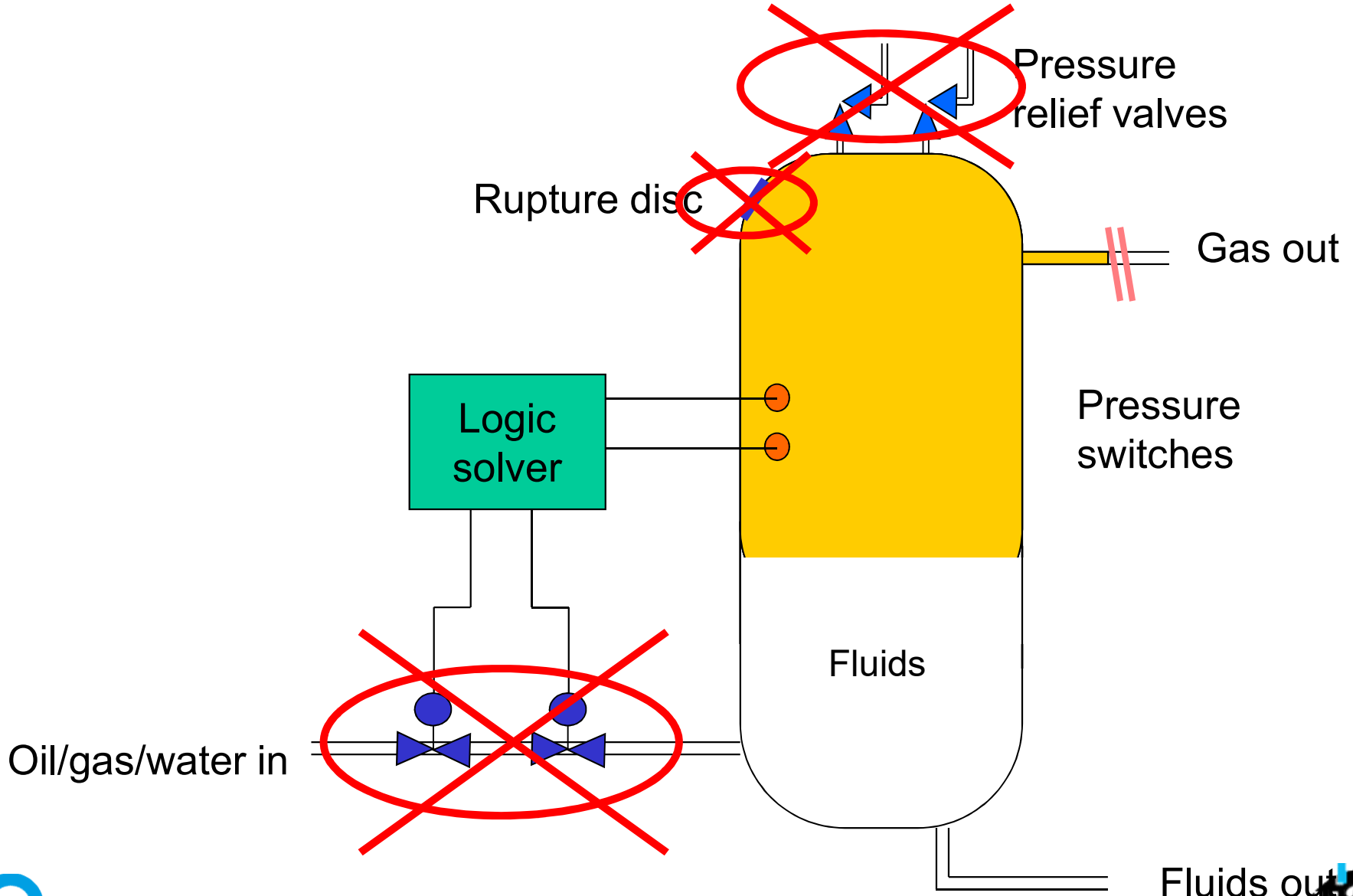


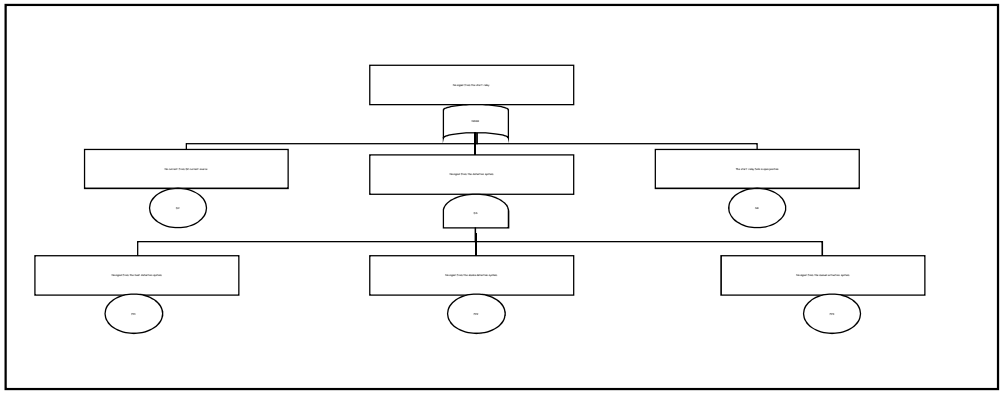
Process shutdown system (PSD)

Piper Alpha accident in 1986 – 167 fatalities

Fault Tree

Relevant top event: « Critical overpressure in the first stage operator »

- critical situation occurs during normal production
- the fluid level in the separator is normal



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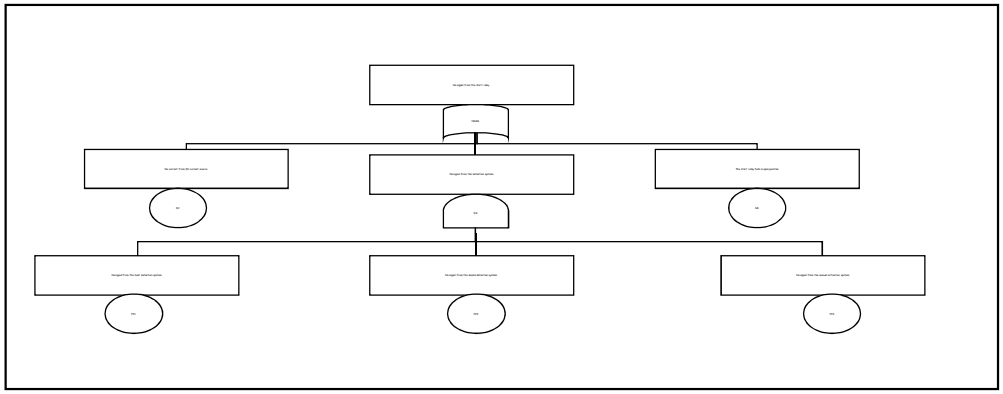

Note

- the lowest level of resolution = failure mode of a technical item
- might be of interest to break down some of the rather complex items into subitems (e.g. valves)
- failure of the pressure switches should be split in
  - individual failures (independent)
  - common cause failures (simulataneously) eg: miscalibration

Plot the catastrophic scenario according time

Construct the event tree

Construct the associated reliability block diagram