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Process Hazard Analysis - Enabler to risk based decisions through facility life cycle

Prashanthi Bhupathi

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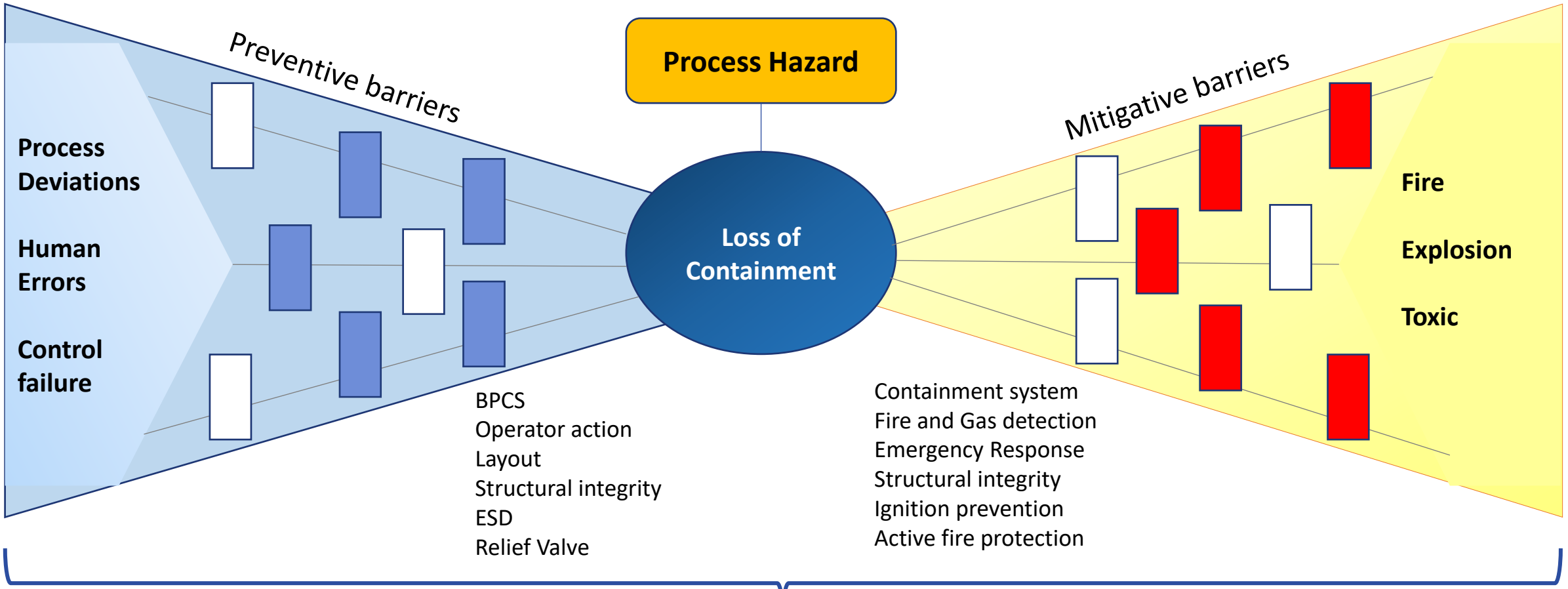
Process Event Sequence



Process Hazard Analysis

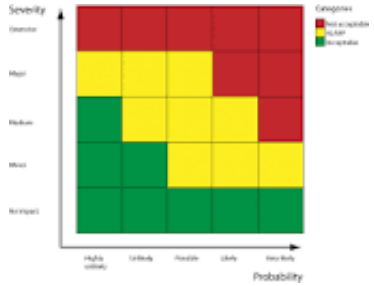
Let’s understand some large process safety events

What failed ?

- Not recognizing process hazards
- Inadequate application of PHA for MoC, cyclic reviews
- Not identifying barriers appropriate to risks
- Inadequate knowledge of hazards with PHA teams

PHA as a risk reduction tool

Process Hazard Analysis



Management review & recommendation management

- Identifying hazards
- Assess, prioritize risks
- Risk Reduction as per hierarchy of controls
  - Elimination
  - Substitution
  - Engineering controls
  - Administrative controls

Poll Question # 1

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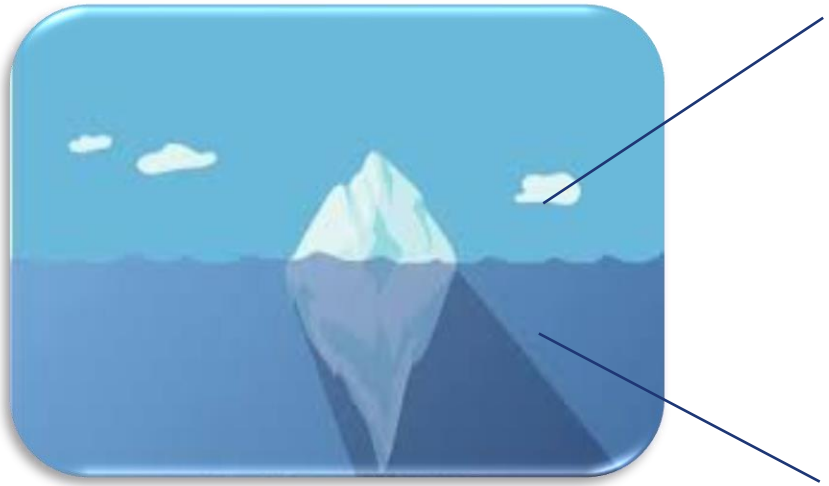
Select the option which is false in PHA studies.

a. Understand process hazards and controls better
b. Identify gaps in design and operational practices
c. Make process simpler and safer
d. Understand risks that have impact on workforce and community
e. Propose recommendations to reduce risk
f. Perform detailed design of barriers

What PHA can help identify?



Overt issues

- ✓ Human factor issues e.g.,
- ✓ Inaccessible valves, unclear instructions
- ✓ Confusing DCS graphics and screens
- ✓ Bypassed controls
- ✓ Physical degradation of assets

Inherent issues

- ✓ Chemical reactivity at normal & transient conditions
- ✓ Incompatible metallurgy used in the unit
- ✓ Deficiencies in design adequacy of barriers
- ✓ Intermediate storages (chlorine), fragile components in the unit (sight glasses) that can be eliminated
- ✓ Threats to occupied buildings due to releases

…… and many more!

Tools that strengthen PHA quality

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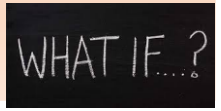
Hazard Identification

- Hazard identification checklists
- Chemical Reactivity tool
- Reactivity Screening
- Field Tour checklists
- Relative ranking methods

Hazop/What-if

- Equipment specific checklists
- Process design specific checklists
- Tailor-made guidewords



Human Factors

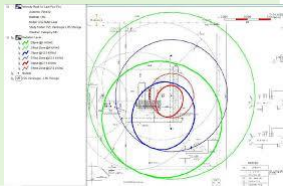
- Checklists to identify issues
- 3D model reviews

Inherently Safer Approach

- Checklist to identify opportunities for inherently safer process
- Readily available case studies on ISD

Consequence Analysis

- Simple to complex models to evaluate impacts



Facility Siting

- Checklists to recognise siting issues, including full-time and part-time occupied locations

Equipment specific scenarios – sample for storage vessel/ tank

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Tank body leaks

Tank exposed to external fire

Tank instrumentation fails

Tank filling / emptying line breaks

Tank lining deteriorates

Tank flange leaks

Inerting system fails

Tank rupture disks are sized improperly

Tank seal fails

Tank is overpressured

Tank vent plugs

Tank agitator fails

Tank overfill

Tank roof collapse

Tank relief valve fails

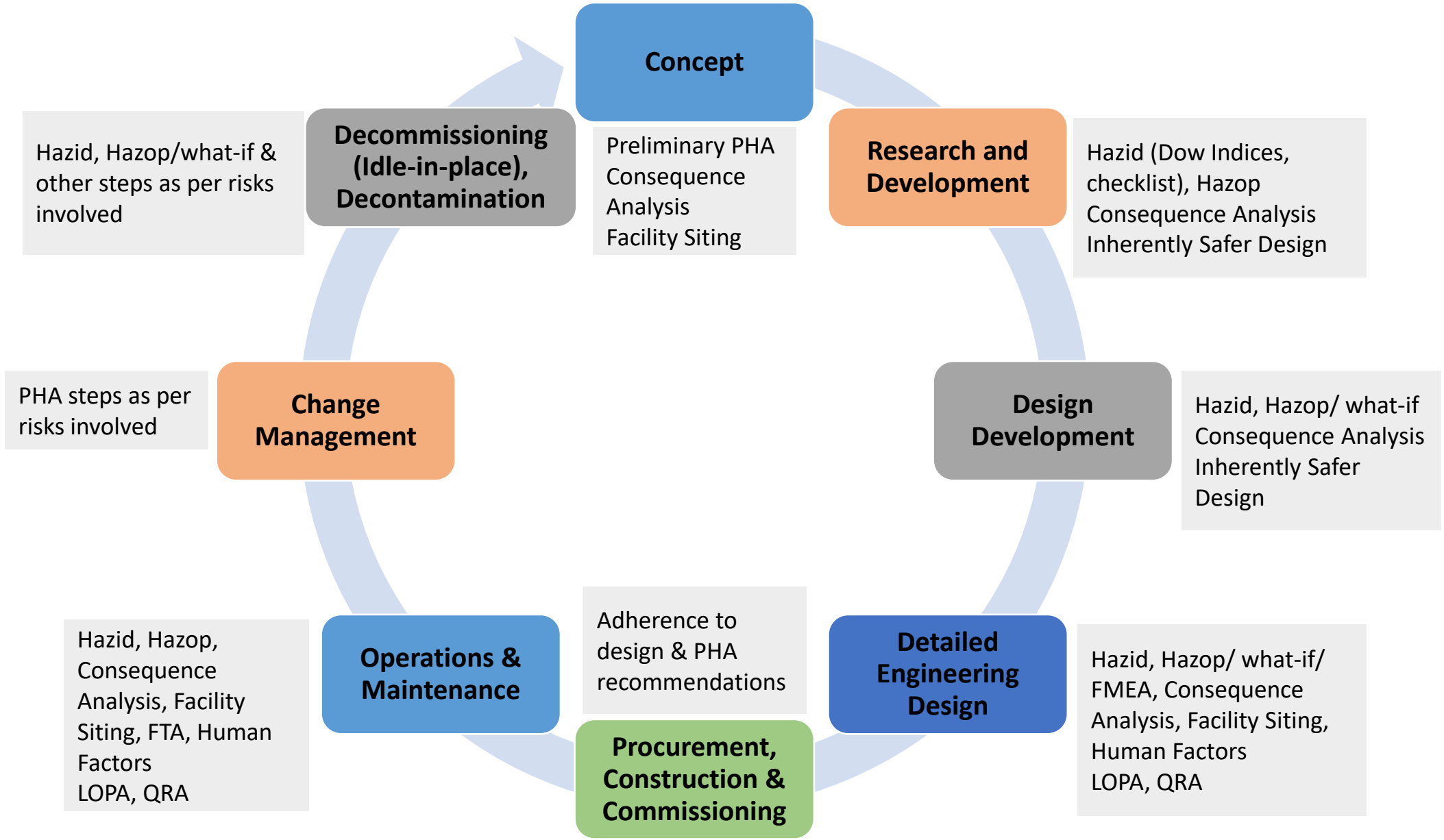
Tank rim seal fire

Tank contents circulation system fails off

Tank heating or cooling system fails

Tank contents react

PHA studies – through asset life cycle



Poll Question # 2

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Do you use different types of PHA techniques for your entire life cycle in your organisation?

a. Yes

b. No

Why PHA for MoC?

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PHA for MoC helps review potential to :

- Introduce process hazards (hazardous chemicals, larger inventory, equipment, etc.) through change
- Implement change considering safer options
- Effect on existing process safety barriers
- Predict process safety risks at proposal stage
- Assess if change meets legal/regulatory requirements/ Introduces new requirements

How to perform PHA for MoC?

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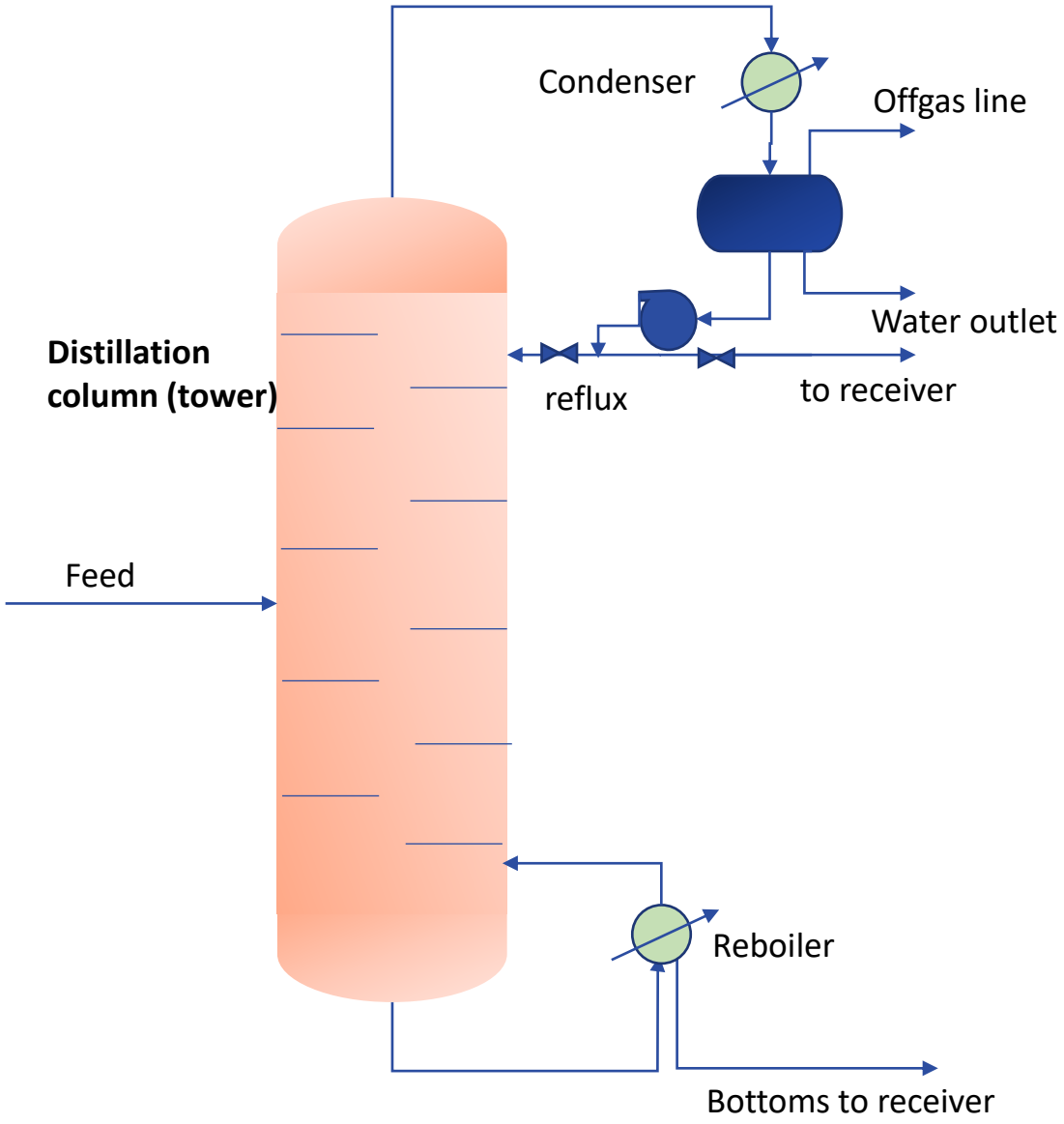
- Define minimum intensity of PHA application for each MoC
- Elaborate PHAs for changes
  - *involving highly hazardous materials*
  - *introducing new chemicals*
  - *capacity enhancements*
  - *push equipment/ process towards operating limits*
  - *involving changes to critical barriers*
- PHA often supplemented by design adequacy checks, process simulation output, major incident learnings, etc.
- Even if a PHA recommendation is implemented, detailed evaluation is needed during design engineering to ensure no new hazards are introduced

Case Study –PHA for MoC



- The column handles highly flammable material at auto-ignition temperatures
- Material also has content of corrosive material, as part of feed from upstream units that concentrates at the column overhead
- Key controls on the column include tripping of reboiler heating medium upon high pressure and feed cutoff; auto deluge activation upon sensing flammability

Case Study – PHA for MoC

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Case-1 : A parallel train of the column and associated equipment is planned to enhance capacity

Case-2 : The condenser has repetitive issues of corrosion and PHA team recommended to replace with corrosion resistant metallurgy

Case-3 : A new occupied facility is proposed to be set up at 200m distance of the column to house operations crew

Case-4 : The column is no more needed in the process due to lower capacities and needs to be taken out of service

Case-5 : The Reflux pump is facing cavitation due to low level in overhead receiver. It is proposed to maintain higher level in receiver beyond normal operating levels.

Should we perform PHA in each of these cases?

Case Study –PHA for MoC

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Case-1 : A parallel train of the column and associated equipment is planned to enhance capacity

Yes. A detailed PHA as in case of projects with a focus on impact assessment to existing process units

Case-2 : The condenser has repetitive issues of tube choking due to corrosion and PHA team recommended to replace metallurgy which corrosion resistant

Yes. Chemical-metal interaction reviews, hazard evaluation and inherently safer approach

Case-3 : A new occupied facility is proposed to be set up at 200m distance of the column to house operations crew

Yes. Hazard evaluation, consequence analysis and facility siting

Case-4 : The column is no more needed in the process due to lower capacities and needs to be taken out of service

Yes. Mothballing / decommissioning PHA with hazard identification & evaluation, human factors and inherently safer approach

Case-5 : The level in the reflux drum is maintained low and cavitating the reflux pump often; it is proposed to increase level in the receiver

Yes. The material in the receiver is highly hazardous and there is an increase in its inventory. Perform hazard evaluation and consequence analysis

Summary

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- Recognise process hazards & manage risks through PHA
- Capture learnings from technology updates and incident learnings in PHA for safer designs
- Devise effective program for periodic PHA revalidation & updates during changes
- Apply tools and techniques suiting the nature of operations

Companies may be small or large – Process Safety Culture is key

“Try to change situations, not people…” – Trevor Kletz