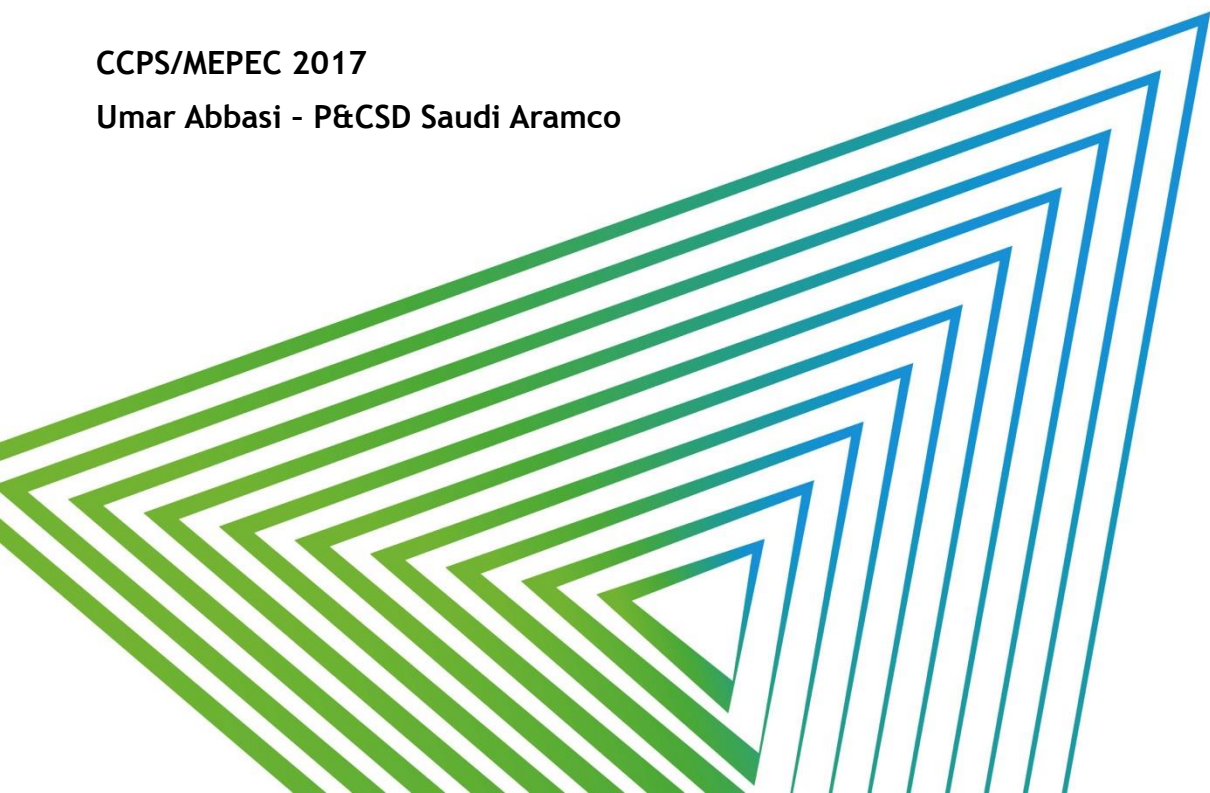




Evergreening - Process Safety Management of Flare and Relief Systems

CCPS/MEPEC 2017

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Accidents - Flare and Relief Systems - Milford Haven

Milford Haven FCCU flare system – 1994

- The immediate cause of the explosion was the failure of the flare system due to flammable hydrocarbon being continuously pumped into the debutanizer that had its outlet control valve closed
- One of the underlying cause was the modification to the flare knock-out pump out system carried out without assessing all the consequences



Accidents - Flare and Relief Systems - Texas City

Texas City Explosion - 2005

Blowdown system was an unsafe design; it was originally installed in the 1950s, and had never been connected to a flare system to safely contain liquids and combust flammable vapors released from the process.



Evergreening (Objectives)

- Evergreening Program at Saudi Aramco facilities is to efficiently manage the flare and relief systems to prevent unsafe operations endangering the life of operating personnel
- The Evergreening framework is a data and change management system which ensures that flare and relief data remains complete, accurate and up-to-date

Evergreening (Scope)

Following elements form the pillars for the Evergreening framework;



Note: For the Evergreening program, the focus areas (elements) are interrelated and dependent upon one another, and failure to properly manage any one of these elements compromises the integrity of the entire evergreening program.

Evergreening (Elements)

Process Safety Information

Process Safety Information requires complete compilation of information related to plant flare and relief systems;

- PSV/flare datasheets
- Relief/flare studies
- Softwares used for flare and relief system documentation/analysis
- PFD/P&IDs
- Equipment & instrument datasheets, access to i-plant/doc libraries etc.....

Evergreening (Elements)

Compliance with Standards

External and internal standards compliance is necessary. Incidents in the past could have been avoided by compliance with API 521 with regards to blow down drum sizing.

Evergreening (Elements)

Training

The following key principles should be addressed when developing, evaluating, or improving any management system for the training element:

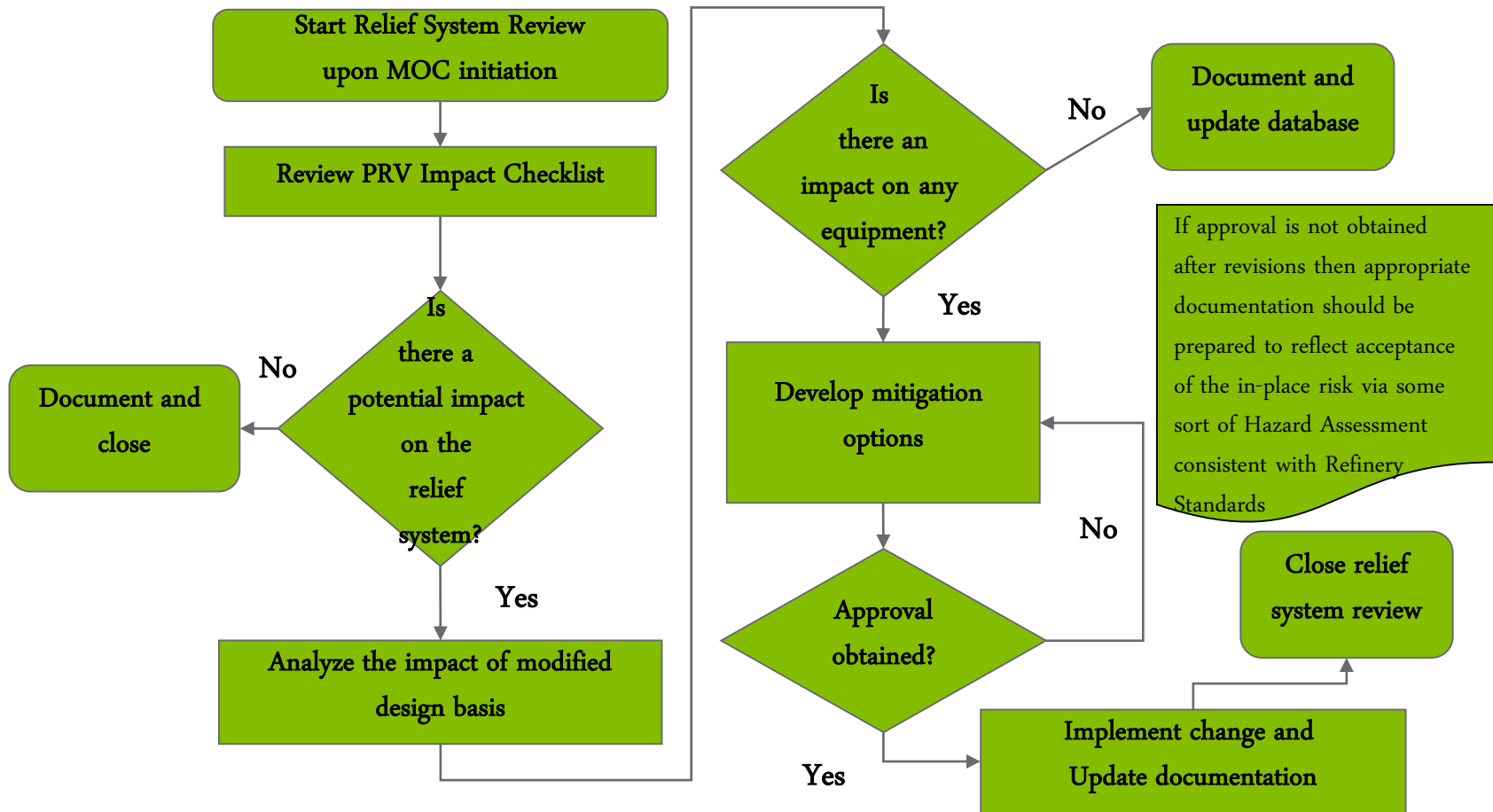
- Identify what training is needed
- Provide effective training

Evergreening (Elements)

PHA/Relief System Analysis

- Design basis for all pressure relief devices, depressuring valves, flare headers and stacks, flare knockout drums and pumps and all elements of a flare system should be documented so that it can be ensured that the plant is adequately protected
- PHA actions should be tracked
- Any changes in plant which can have an impact on the flare and relief systems e.g. capacity should flag the need for re-evaluating the flare and relief systems adequacy

Relief Systems Analysis Workflow



Excellence in Pressure Relief Systems Management_Marshall et al_2011

Evergreening (Elements)

Management of Change (MOC)

The employer shall establish and implement written procedures to manage changes (except for "replacements in kind") to the flare and relief system. The procedures shall assure that the following considerations are addressed prior to any change:

- Impact of change on safety and health of flare and relief systems
- Modifications to operating procedures
- Necessary time period for the change
- Authorization requirements for the proposed change

Evergreening (Elements)

Integrity

This includes;

- Codes and standards
- Equipment maintenance
- Inspection and testing, controlling and managing deficiencies and so on.

Note: It is not just maintenance, although maintenance is a major part of an integrity program. Information is required to identify the code or standard for the design and construction of the flare and relief systems

Evergreening (Elements)

Review/ Audit

- An audit protocol will be prepared to evaluate the performance of the Evergreening systems.
- Audits will be conducted throughout the development and implementation of the Evergreening system.
- Upon completion, a report must be distributed to appropriate parties for follow-up action.

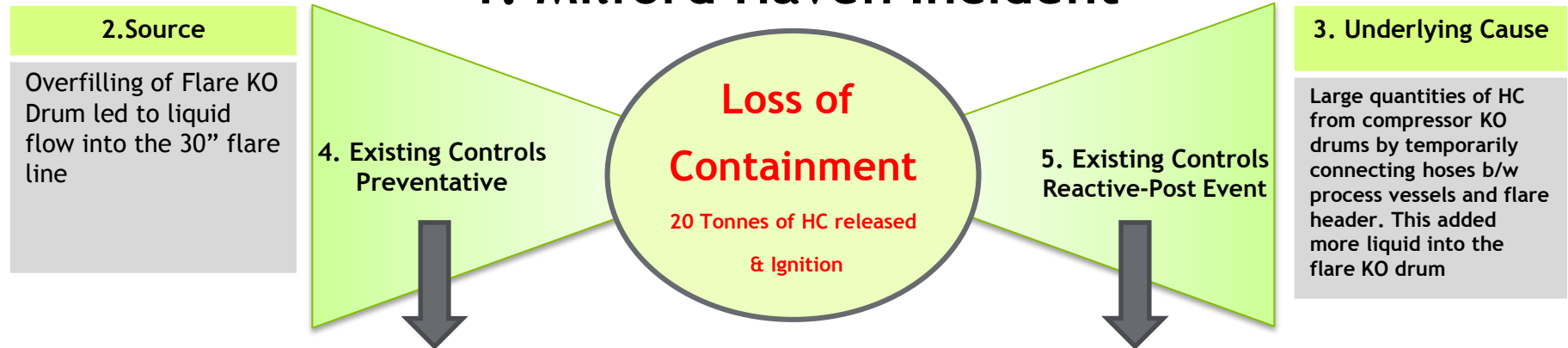
Risk Management (Bow-Tie Approach)

The Bow - Tie approach will be used to assess the effectiveness of Evergreening Elements for any potential accident scenario using the typical risk management control effectiveness rating:

Control Effectiveness Assessment		
	Rating	Description
Overall Control Strength	Effective	<ul style="list-style-type: none"> - Evidence of existence of key controls - Key controls address the related risks - The key controls provide reasonable assurance that the risk will not occur, or if it does occur the control will help detect it timely and minimise the impact - The majority of key controls (>75%) are effective - No key control is rated as 'needs improvement' or 'ineffective'
	Needs Improvement	<ul style="list-style-type: none"> - The control issues raised have been acknowledged and have appropriate action plans in place - Key controls provide some assurance that the risk will not occur, or if it does it will be detected timely to minimise the impact - The key controls are generally detective rather than preventative in nature
	Ineffective	<ul style="list-style-type: none"> - Significant issues have been identified in the control environment and require immediate management attention - Key controls provide insufficient/little assurance that the risk event will not occur, or if it does that it will be detected timely to minimise the impact

Accidents - Flare and Relief Systems - Milford Haven

1. Milford Haven Incident

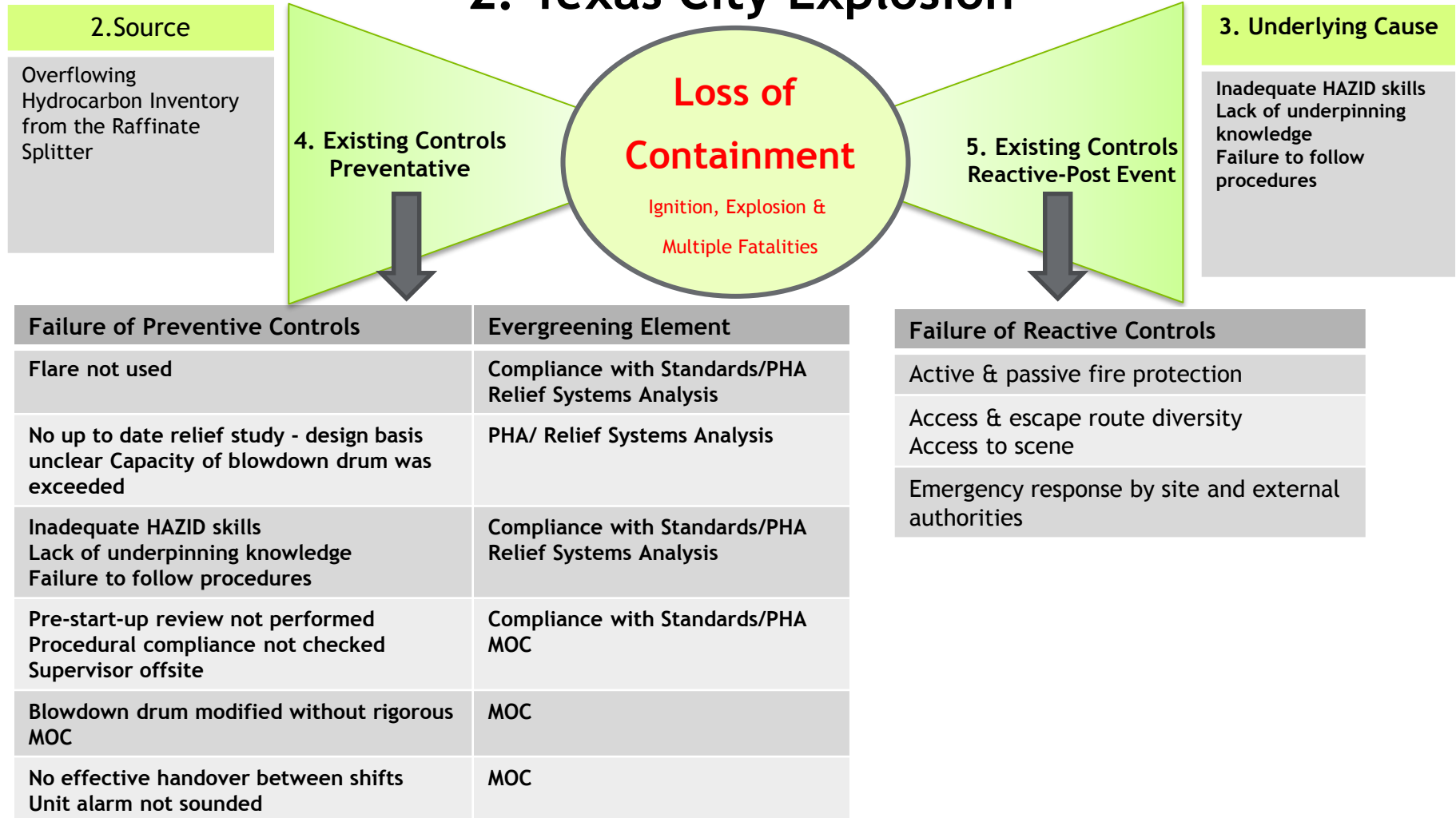


Failure of Preventive Controls	Evergreening Element
Flare header not designed for liquid weight	PHA Relief Systems Analysis
Alarm prioritisation not very efficient Alarm flooding added to confusion of operations	Integrity
Faulty valve at bottom of the debutaniser - Known corrosion in flare line	Integrity
No MOC carried out to use 2 flexible hoses to drain compressor knock out drums	MOC
No decision to shutdown despite multiple trips	Training
Failure to step back to take a wider view	Training

Failure of Reactive Controls
Door of blast proof control room left open
Lack of fire water for long duration scenarios
Multiple simultaneous fires in 3 refineries

Accidents - Flare and Relief Systems - Texas City Explosion

2. Texas City Explosion



Summary

- Although flare and relief systems have been the underlying cause for major incidents they have not received the right attention. They are a critical safety feature hence it is vital that they are efficiently managed and maintained.
- Evergreening proposes a process safety management program to ensure effective and sustainable overpressure protection for all plant equipment.

Questions?

