Maintaining process safety controls and knowledge

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Overview

- Maintaining process safety controls and knowledge
  - Incident case study – Failure of controls
  - Control management
    - How should it be done?
  - Incident case studies - Corporate knowledge and learning
  - Maintain corporate knowledge
    - Define the content
    - Retain the knowledge
    - Learn
  - Good process safety outcomes

Incident – Failure of Controls

- BP Deepwater Horizon – Explosion and Fire
  - 20 April 2010
  - 11 crew members died and 17 critically injured
  - Approximately 5 million barrels of oil spilled into the Gulf of Mexico
  - US Chemical Safety and Hazard Board found that there were no effective barriers in place to prevent or mitigate the blowout
  - System in place to ensure controls were functional, available and reliable was inadequate

Ref: U.S. US Chemical Safety and Hazard Board, Investigation Report Volumes 1, 2, 3 & 4, Explosion and Fire at the Macondo Well, April 2010

Incident – Failure of Controls

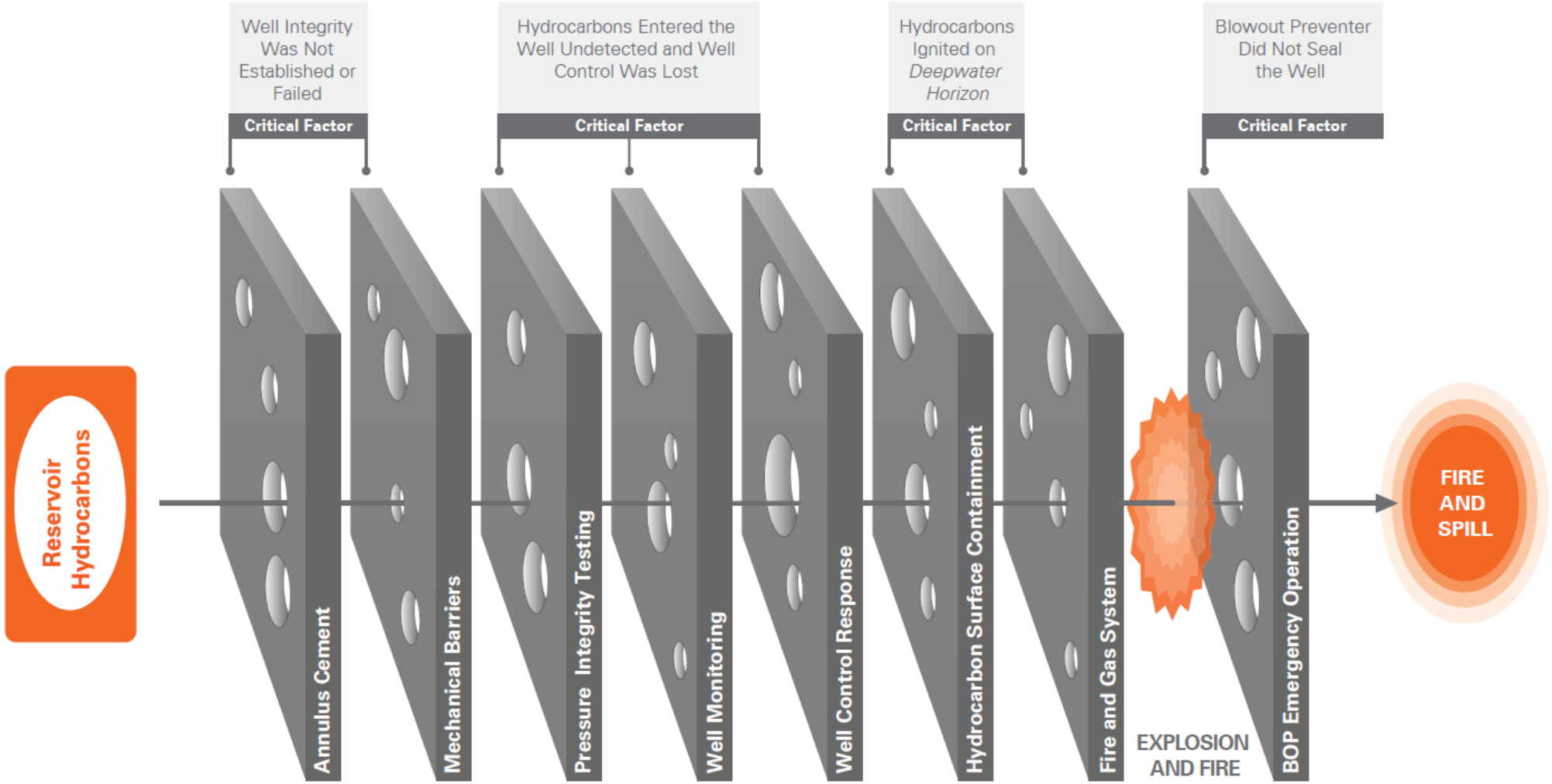


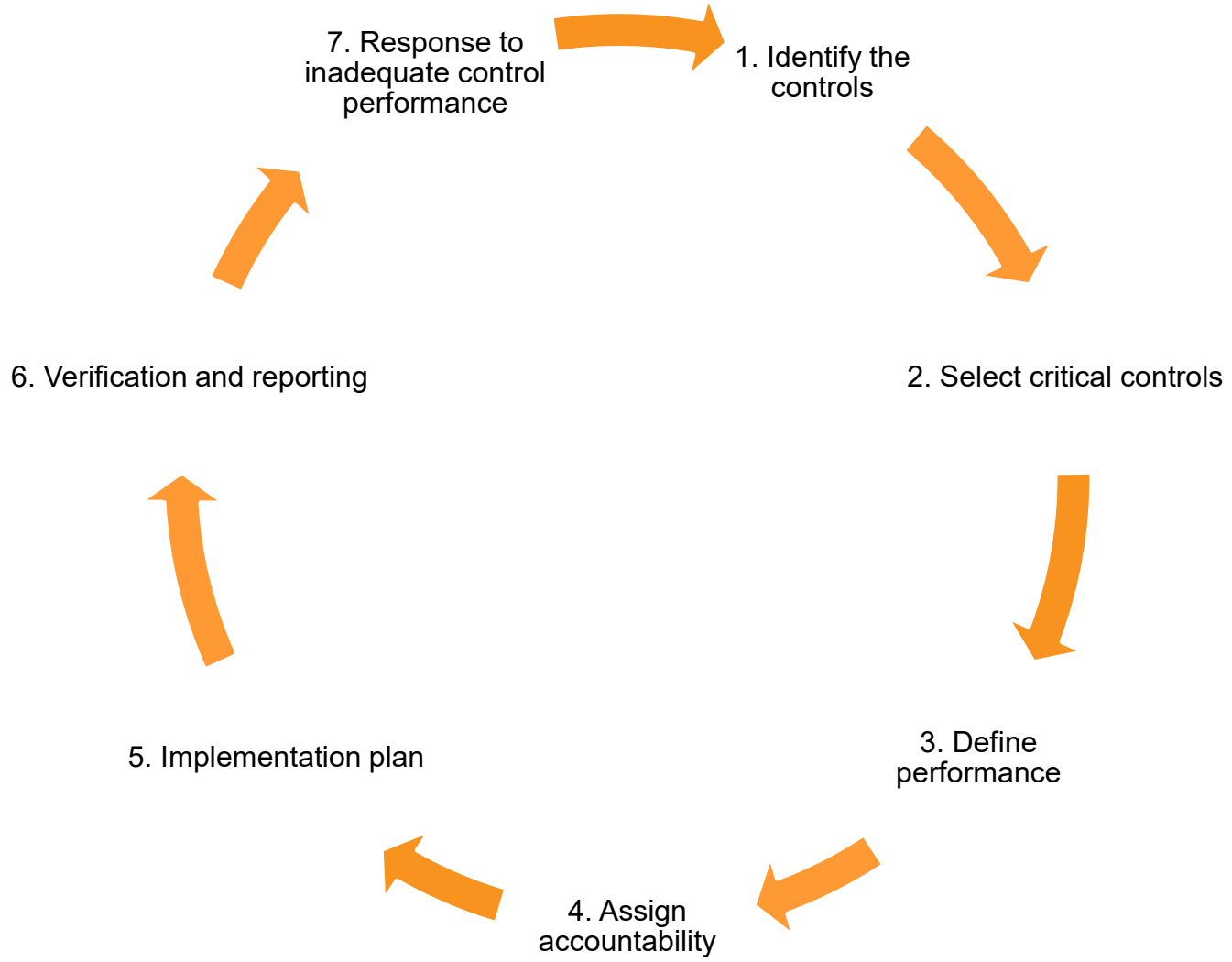
Figure 1 - Barriers Breached and Relation of Barriers to Critical Factors

Ref: BP Deepwater Horizon Accident Investigation Report, September 8, 2010.

Identify the Major Risk

- Robust hazard identification and risk assessment
  - Hazards identified
  - Control identified and linked to specific causes / outcomes
  - Risk is reduced SFARP
- Establish the required performance for controls

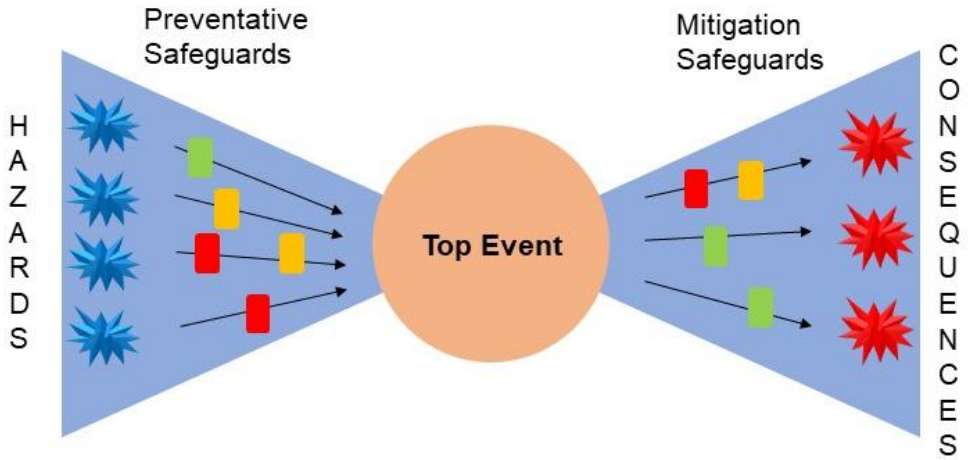
Control Management Process



Reproduced and modified from ICMM Critical Control Management

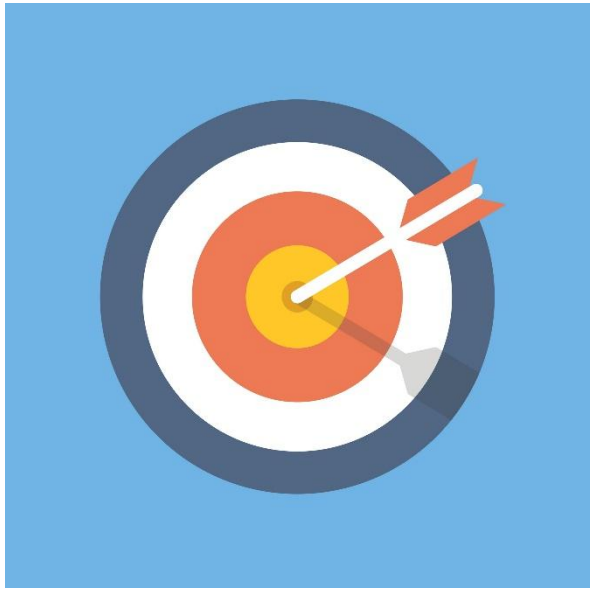
Step 1 – Identify the Controls

- Bowtie / Bowtie Analysis
  - Cause-consequence analysis
  - Identifies potential causes
  - Identifies potential consequences
  - Identifies applicable controls

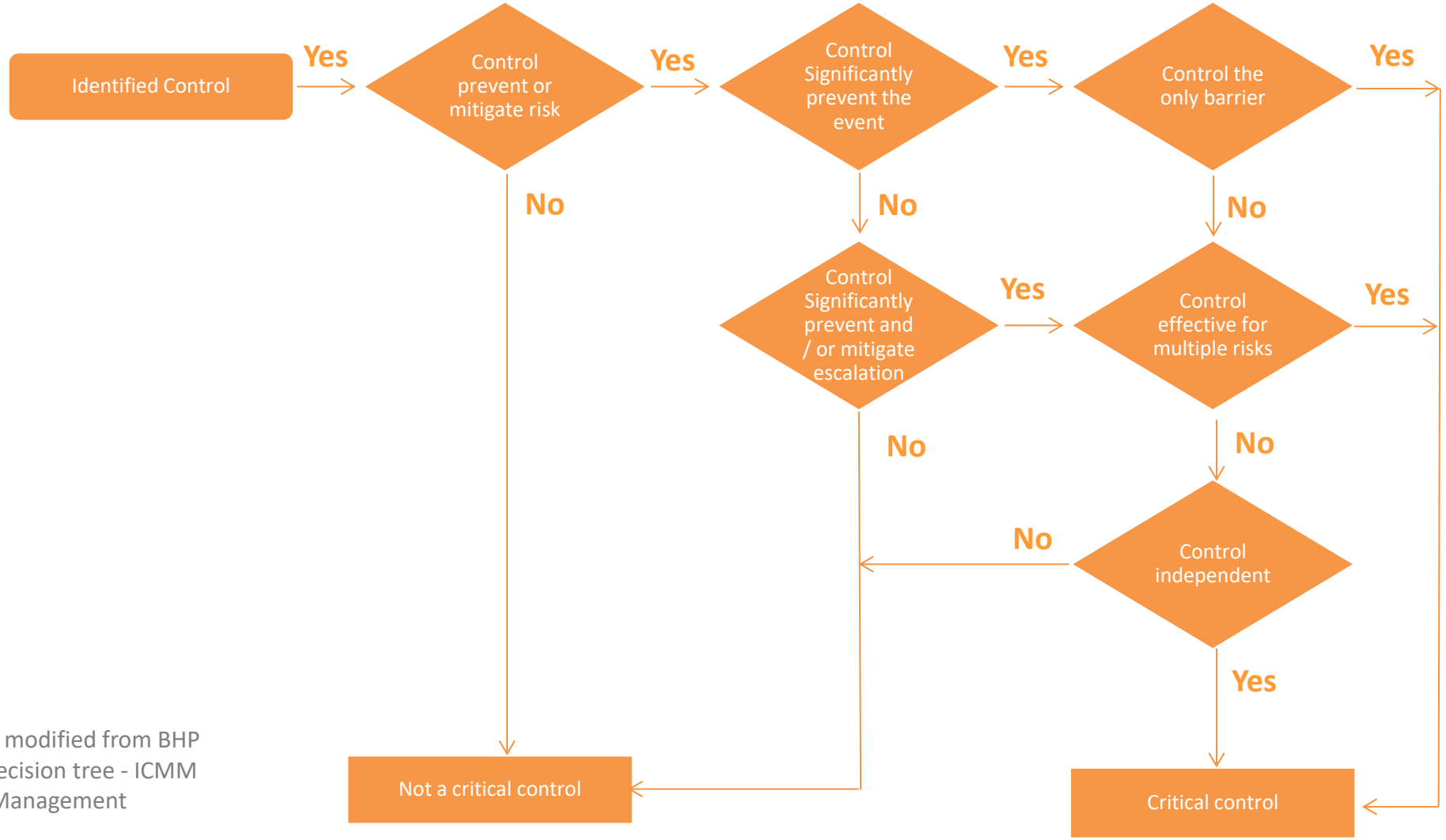


Step 1 – Identify the Controls (Cont'd)

- To assess control measure effectiveness, the following characteristics should be considered:
  - Implemented
  - Functional
  - Integrity
  - Reliable
  - Performance monitored
  - Audited



Step 2 - Select the Critical Controls



Reproduced and modified from BHP Billiton critical decision tree - ICMM Critical Control Management

Step 3 - Define Performance

- Define Performance

  – Performance Indicator: Any quantitative or qualitative information used to measure the performance of any functional aspect of a control.

  – Performance Standard: A benchmark, target or reference level of performance set for a control, as measured by the performance indicator, against which the performance of a control may be tracked.

Step 3 – Define Performance - Example

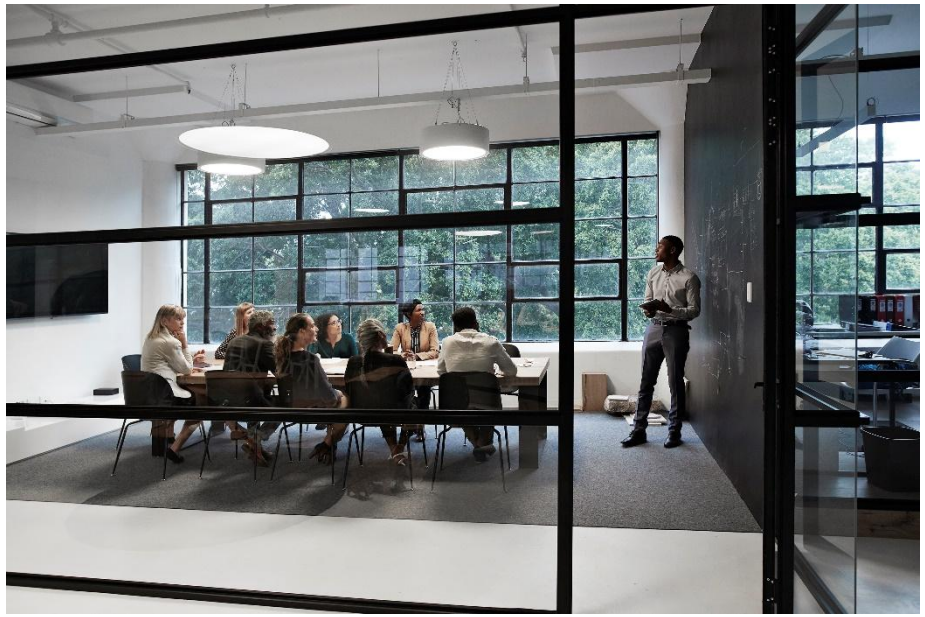
- Control - High level trip system that alarms, stops and isolates feed into a tank
- Define the system expectation
- What will be the task or activities
- Measurable
- Performance Target (for the measurable)
- Intervention

Steps 4 & 5 – Assign Accountability and Implementation Plan

- Assign ownership of the control
- Accountability of the control performance
- Implement the Plan

Step 6 - Verification and Reporting

- Implement control verification activities
  - Define resources for completing control verifications
  - Report control verification data
- Assign a Program Administrator to conduct QA of all activities and data reporting
- Regularly meet to analyse and share information
- Management leadership to drive the program



Step 7 - Inadequate Control Performance

- Review the results and act when the control performance does not meet the require standard
- Investigate the causes of the inadequate performance
  - Is the risk tolerable?
- Review with appropriate levels of management depending on the inadequate level of performance

Performance and Reporting Template - Example

Control:	Gasoline tank high level alarm and trip
Control Type:	Engineering / Procedural
Places Used:	R-0001 – LOC during flammable liquid

System Expectation / Performance	Performance Measure			
	Task/Activities	Measurable	Performance Target (Range)	Intervention
Prevent the overfilling of tanks	Function test of alarm and trip every 6 months	High level switch functions properly, alarm, isolate inlet valve and stops pump	< 5 % fail to danger	Raise a maintenance request, near miss notification and review at management meetings
		Function test completed to schedule	< 30 days overdue	Performance measurable exceptions reviewed at management meetings
Operators are competent in alarm response	Operators complete “Operating Tanks” competency training	Completing competency assessment	95 % correct	Performance measurable reviewed at Operations meeting
	Operators complete ‘Operating Tanks” refresher training every 2 years or if absent from the process for more than 6 months	Complete assessment to schedule	< 90 days overdue	Performance measurable reviewed at Operations meeting

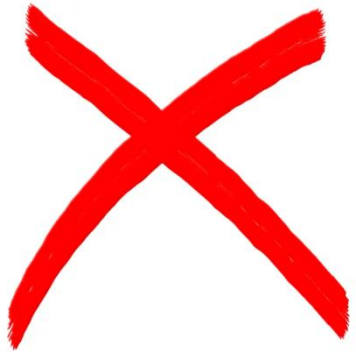
Owner:	Maintenance Manager and Production Manager

Supporting the Controls Management

- Management of Change
- Security access
- Auditing
- Manage as part of the safety management system

Preventing Corporate Amnesia

- Draw on and use existing knowledge
- Learn from incidents
- Provide that to your decision makers
- If you don’t - Increased vulnerability to a process safety incident



Incident - Corporate knowledge

- Explosion and fire occurred at the Husky Superior Refinery, Wisconsin in April 2018
- Specific safeguards were either not implemented or not effective
- Inadequate process and industry knowledge
- Licensor's service agreement included visits, reviews, and consultations
- Operating procedures had not been reviewed for at least 25 years before the incident.

Ref: U.S. Chemical Safety and Hazard Investigation Board, Investigation Report, FCC Unit Explosion and Asphalt Fire at Husky Superior Refinery, 23 December 2022

Incident - Failure to Learn

- Explosion and fire at the Caribbean Petroleum Tank Terminal, Bayamon, Puerto Rico, October 2009
- A gasoline storage tank overfilled during the offloading from a ship
- Operators used inadequate formal tank-filling procedures
- Operator failed to learn from two previous overfill incidents
- Authorities also failed to learn from incidents

Ref: U.S. Chemical Safety and Hazard Investigation Board, Final Investigation Report, Caribbean Petroleum Tank Terminal Explosion and Multiple Tanks Fires, October 23, 2009.

Define the Content

- Process Safety Information
  - Technology information
  - Equipment Information
    - Critical Operating Parameters (COPs)
      - Define safe operating envelope
      - Upper and lower design limits for process equipment
  - Material and chemical information
  - Hazards and risk information

Key Elements for Retaining Knowledge

- Capture, preserve and transfer knowledge
  - Operating procedures
  - Safe systems of work
  - Data management systems
- Using information management systems
  - Knowledge management system (searchable)
  - Industry incidents
  - Regularly updated
- Promote a learning culture
- Collaborate and communicate
  - Cross-functionally within the organisation
  - Implications of WFH

Key Elements for Retaining Knowledge (Cont'd)

- Train operators, technicians and engineers
- Subject matter experts
- Succession planning and recruitment
- Robust system to manage staff turn-over

Key Elements to Learn

- Industry standards
  - Stay up to date with standards and codes etc
  - Contribute and attend industry conferences
- Lesson learning
  - Incident and investigation
  - Past industry incidents
  - Other industries
- Learning from industry
  - Knowledge sharing, internal and externally

Other Elements

- Define an engineering standpoint
  - Maintain the engineering basis
- System based assessments
    - Know their limitations
- Outsourcing services
  - Define in-house knowledge required
  - Maintain new knowledge

Conclusion

- To achieve good process safety outcomes
  - Establish a process to identify and manage the effectiveness of controls
  - Verify that effectiveness by real-time performance
  - Act when the desired performance is not achieved
  - Define the content within corporate knowledge
  - Capture, preserve and transfer the knowledge
  - Use industry standards and learn from industry
  - Train your team and continue to learn from your past mistakes and those made by others

References and further reading

- U.S. Chemical Safety and Hazard Investigation Board, Investigation Report Volumes 1, 2, 3 and 4, Explosion and Fire at the Macondo Well, April 2010.
- BP Deepwater Horizon Accident Investigation Report, September 8, 2010.
- The International Council on Mining and Metals, Critical Control Management, Implementation Guide.
- HSE UK, Developing process safety indicators, 2006.
- WorkSafe Victoria, Guidance Note, Performance standards and indicators, October 2011.
- U.S. Chemical Safety and Hazard Investigation Board, Investigation Report, FCC Unit Explosion and Asphalt Fire at Husky Superior Refinery, 23 December 2022.
- U.S. Chemical Safety and Hazard Investigation Board, Final Investigation Report, Caribbean Petroleum Tank Terminal Explosion and Multiple Tanks Fires, October 23, 2009.
- Trevor Kletz Series – What went wrong, Still going wrong, Learning from accident.

Questions