



Latest HAZOP Practice

James Fairburn, Process Safety Advisor, Chevron

Overview

Separate and discrete areas of latest HAZOP practice:

1. Severity Estimation and Conditional Modifiers
2. Maintaining HAZOP Evergreen
3. HAZOP of Similar Systems / Activities

Are these common practice across industry?

Hazards31



IChemE ADVANCING
CHEMICAL
ENGINEERING
WORLDWIDE

Severity Estimation & Conditional Modifiers

- Risk Ranking supports decision to recommend risk reduction
- Formalised practice and tools reduces subjectivity
- Opportunity to leverage existing quantitative data:

HAZOP:	Cause	Consequence	Severity	Preventive Safeguards	Mitigative Safeguards	Conditional Modifiers
Consequence Modeling / QRA:	N/A	LOC	Extent + number of people exposed	N/A	F&G, ESD, Blowdown etc	Ignition, weather category, wind direction etc

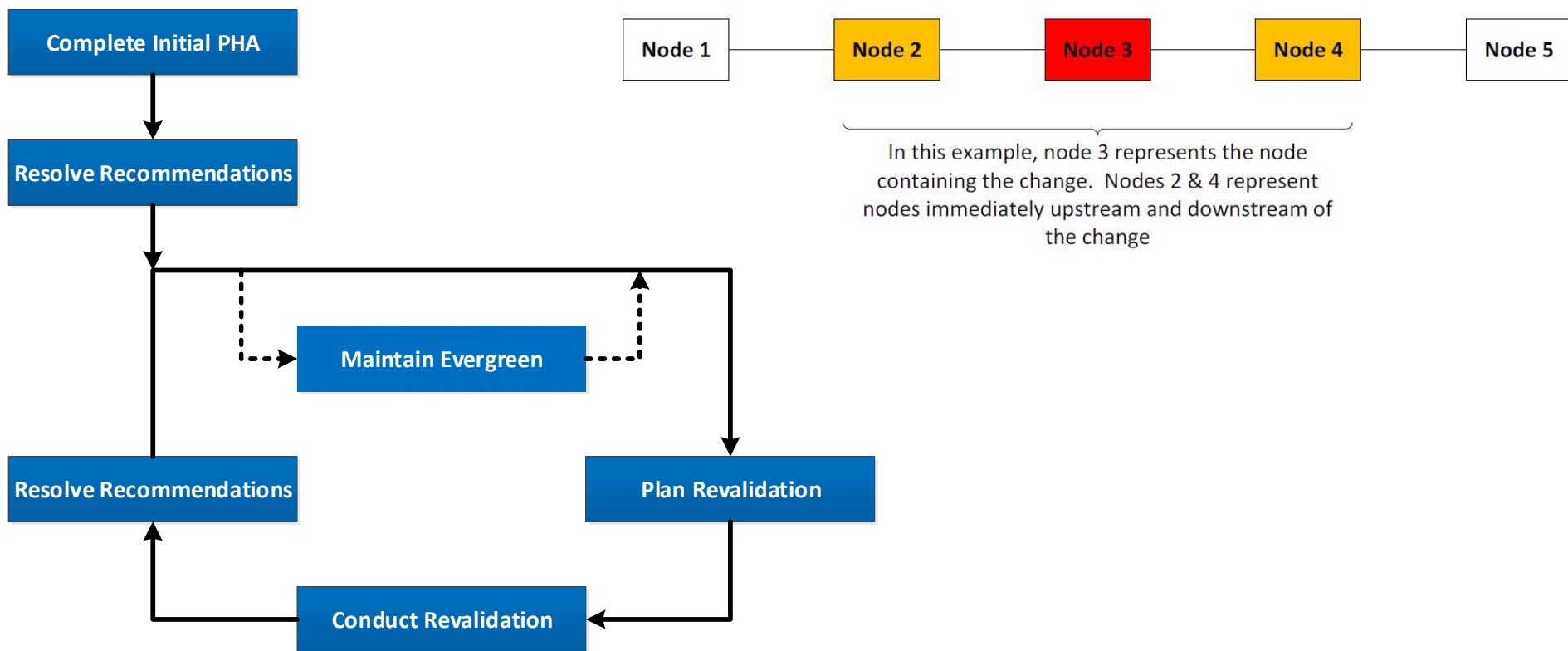
How to Estimate Magnitude of Releases

- Predictable for operational activities such as draining/sampling
- For other scenarios, require guidance on worst credible consequences, equivalent hole sizes and 'Look-Up' tables...

Hole size (mm)			
Equipment type	LEVEL I >1.0E-2/release source-yr	LEVEL II 1.0E-2-1.0E-3/release source-yr	LEVEL III 1.0E-3-1.0E-4/release source-yr
Single seal / throttle bush	2	5	10
Double seal	1	2	10

Fluid category	Release pressure bar(a)	Hazard radius R2 (m)			
		Release hole diameter			
		1mm	2mm	5mm	10mm
A	5	2	4	16	40
	10	2.5	4.5	20	50
	50	3	5.5	20	50
	100	3	6	20	50

Maintaining a HAZOP Evergreen: Concept



Maintaining a HAZOP Evergreen: Example

Deviations	Causes	Consequences	Enabling Conditions / Conditional Modifiers	Safeguards	Recommendations
1. High level	1. Failure of ATG during filling	1. Tank overfill, formation of large flammable cloud, ignition, fire/explosion, personnel impact	1. (TR1) Level gauge checked for successful operation on commencement of transfer. Proportion of time filling = $2/\text{wk} * 52\text{wk}/\text{yr} * 8\text{hr} / 8760\text{hr}/\text{yr} = 9\%$ 2. (OT1) Probability calm & stable weather 5%, based on hourly average data from Met station	1. Independent high high level alarm, annunciated in Central Control Room, with operator response to terminate gasoline blending operation	1. Concern is gasoline tank overfill, leading to large flammable cloud. Provide additional safeguard(s) to mitigate scenario. One option is to install SIL1 automatic tank overfill protection system.



Deviations	Causes	Consequences	Enabling Conditions / Conditional Modifiers	Safeguards	Recommendations
1. High level	1. Failure of ATG during filling	1. Tank overfill, formation of large flammable cloud, ignition, fire/explosion, personnel impact	1. (TR1) Level gauge checked for successful operation on commencement of transfer. Proportion of time filling = $2/\text{wk} * 52\text{wk}/\text{yr} * 8\text{hr} / 8760\text{hr}/\text{yr} = 9\%$ 2. (OT1) Probability calm & stable weather 5%, based on hourly average data from Met station	1. Independent high high level alarm, annunciated Central Control Room, with operator response to terminate gasoline blending operation 2. SIL1 automatic tank overfill protection system	[Recommendation becomes a safeguard, risk ranking revised]
2. No flow	1. Spurious trip of AOPS	1. Surge overpressure: valve closing against ship?			[Additional scenario requires consideration]

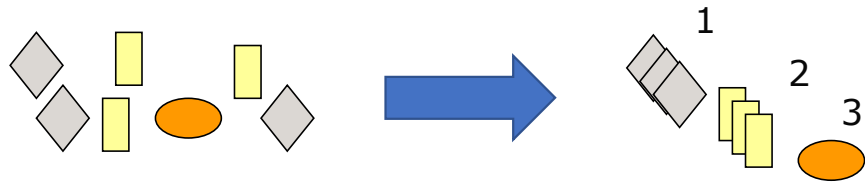
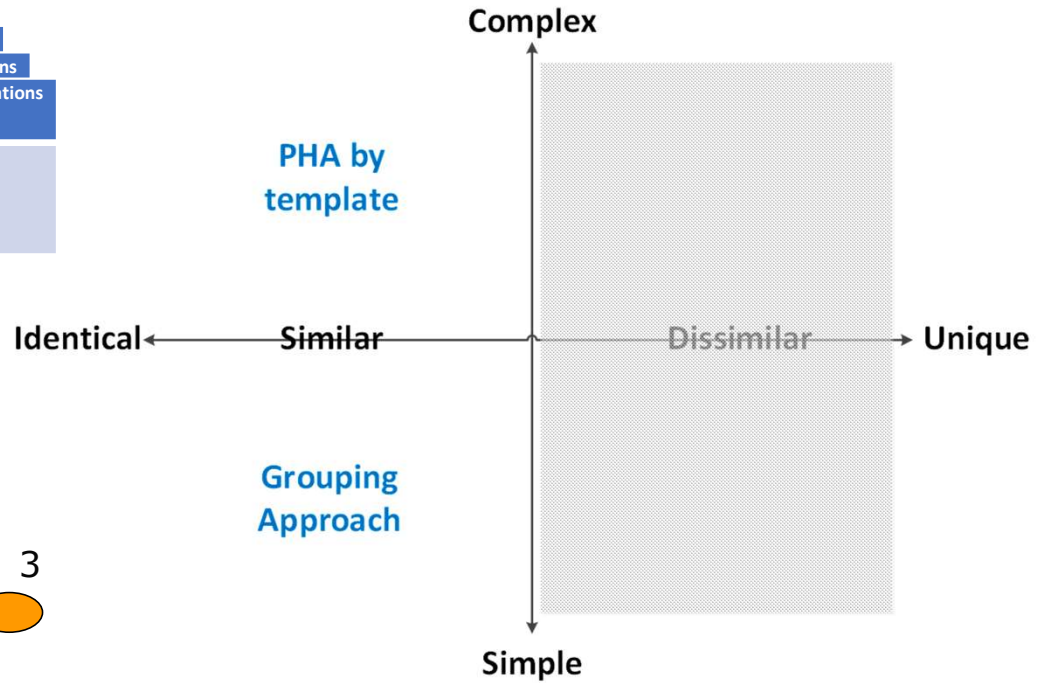
Maintaining a HAZOP Evergreen: Learning

- Commercial HAZOP software packages generally aren't evergreen friendly
- Challenge for facilitator to focus team on the scope of the update
- Implementation of latest industry good practice likely to be more practicable for new equipment vs. existing
- Approach can become more complex where MOCs remain open at next revalidation or have been cancelled

****None of these issues are unsurmountable****

HAZOP of Similar Systems / Activities

Deviations	Causes	Consequences	Enabling Conditions /	Safeguards	Recommendations
Deviations	Causes	Consequences	Enabling Conditions /	Safeguards	Recommendations
Deviations	Causes	Consequences	Enabling Conditions /	Safeguards	Recommendations
1. No/less flow			Enabling Conditions / Conditional Modifiers		



PHA by Template: Shared Learning

- The templating approach takes the PHA completed for one system and uses it as starting point for studying similar system(s)
- Examples:
 - Parallel LNG liquefaction trains
 - Refinery crude process units
- Requires facilitator's skill to maintain team's focus
- Beware the extent of pre-population of scenarios, especially where systems not subject to same design

****A rigorous facility-specific analysis always required****

Grouping Approach: Shared Learning

- The grouping approach involves grouping of multiple systems/activities to perform a single, representative risk assessment
- Examples:
 - Service stations
 - Storage tanks
- Care required with size of grouping
- Field checklist can be developed to:
 - Confirm that underlying HAZOP is representative of other facilities/activities within grouping; and
 - Perform field verification of safeguards identified