5th Chemical Process Safety Sharing (CPSS)

Topic : **Enhancing major hazard identification using Smart HAZOP**

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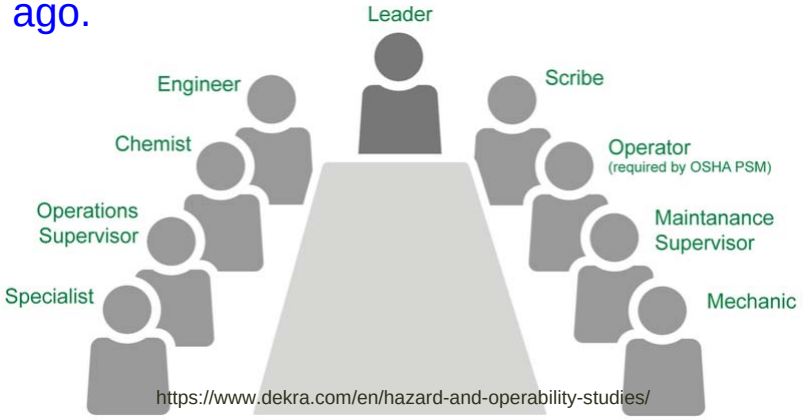
Company: **SCG**

HAZOP Review

- The Hazard and Operability Studies or HAZOP is the critical part of process hazard analysis in chemical process industry.
- The preliminary objective is to identify the safety, health , environment (SHE) and Operability concerns.
- This technique has been used since 1960s or sixty years (60) ago.



https://www.dekra.com/en/hazard-and-operability-studies/

HAZOP Pain Points

- Quality (ensure process hazards identified, consequence evaluation, adequacy of safeguards);
- Human factors (cost, emotion, attention, etc.);
- Resources (limit number of competent persons);
- Standardization among HAZOPs (Different analysis result even through similar process system be different HAZOP team);
- NO! available software in the market could answer all of our need.
- Time consuming (Long time analysis workshop);
- Follow up HAZOP actions close-out (Ensure actions follow up and implement prior to PSSR).

https://www.freeart.com/artwork/art-print/pain-point-sign-warning-danger-customer_fa22856402.html

HAZOP Challenges

- How to ensure major hazard with proper safeguards are identified?
- How can we effectively use past incident data to HAZOP?
- How to ensure the quality of HAZOP will be not influenced by human factors e.g. fatigue, emotional, cost, and etc.?
- What about competent persons are retired or unavailable to attend the workshop?
- How can we ensure standardization among different HAZOPs even though they are using the same procedure but different assessment team?
- Can we shorten the HAZOP workshop duration compare to the conventional HAZOP?

https://www.prosmatthonroemill.com/single-post/2016/09/22/Challenge-You-Talkin-To-Me

New HAZOP methodology concept

Scenario based HAZOP idea

4.6 Failure scenarios table for Pumps, Compressors

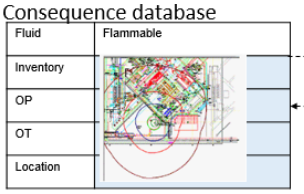
No.	Operational Deviations	Failure Scenarios	Potential Design Solutions		Pumps, Compressors
			Inherently Safer/Passive	Active	Procedural
1	Overpressure	Failure of control or closure of downstream block valve, or failure to remove blind, or plugged outlet which deadheads pump/compressor resulting in possible overpressure and/or excessive temperature	• Minimum flow recirculation line to ensure a minimum flow through the machine (flow controlled by orifice) • Downstream piping specified to withstand deadhead pressure	• High temperature shutdown interlock • High pressure shutdown interlock • Low flow or power shutdown interlock • Emergency relief device • Minimum flow recirculation line (flow automatically controlled)	• Operator action in response to high temperature, pressure and/or low flow indication • Procedural controls to avoid deadheading pump/compressor
	Overpressure	Pump/compressor used for higher than design density fluid service especially during startup and upset conditions	• Design for maximum expected pressure	• Emergency relief device • Automatic pump/compressor shutdown on high discharge pressure detection	• Operator action in response to high pressure indication

Ref. Center for Chemical Process Safety, *Guidelines for Engineering Design for Process Safety, 2nd Ed.*, ISBN 978-0-470-76772-6, American Institute of Chemical Engineers, New York, 2012.

New HAZOP methodology concept

CCPS Guideline

Consequence database



Consequence leading to:

- Loss of containment – Fire & Explosion
- Mechanical damaged
- Environmental impacts

Initial Risk

Pump → Positive displacement

Excel 2013

No flow

Loss suction → Cavitation

IE frequency

Loss level in upstream vessel → - Low level trans. - Pressure trans. → Risk Reduction

Misoperation Block inlet valve → - LOTO inlet valve - Pressure trans. → Risk Reduction

Blocked outlet → Overpressure → Risk

Control valve fails close → - PSV at outlet - Pressure trans. → Risk Reduction

Misoperation Block outlet valve → - PSV at outlet - Pressure trans. → Risk Reduction

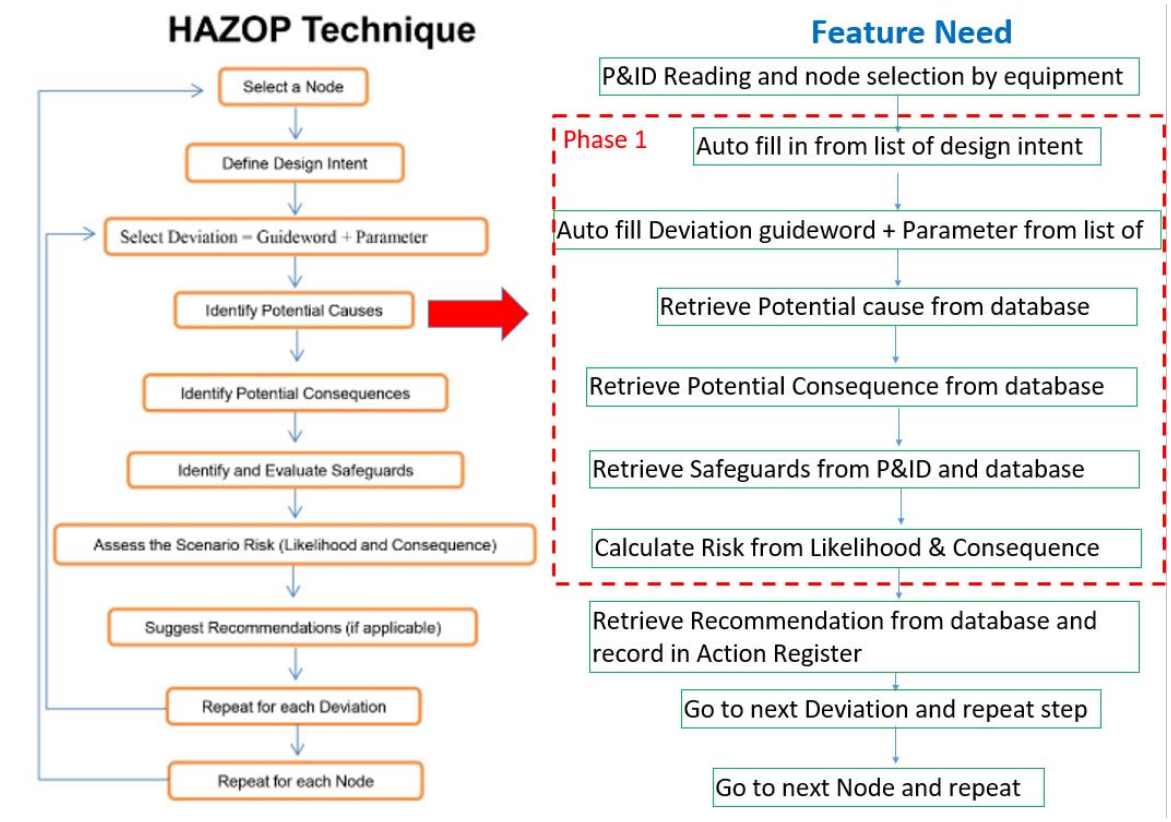
- PHA in server
- Auto suggest IE, Cons, IPLs, Risk
- Action follow up automatically

Equipment | Safeguard

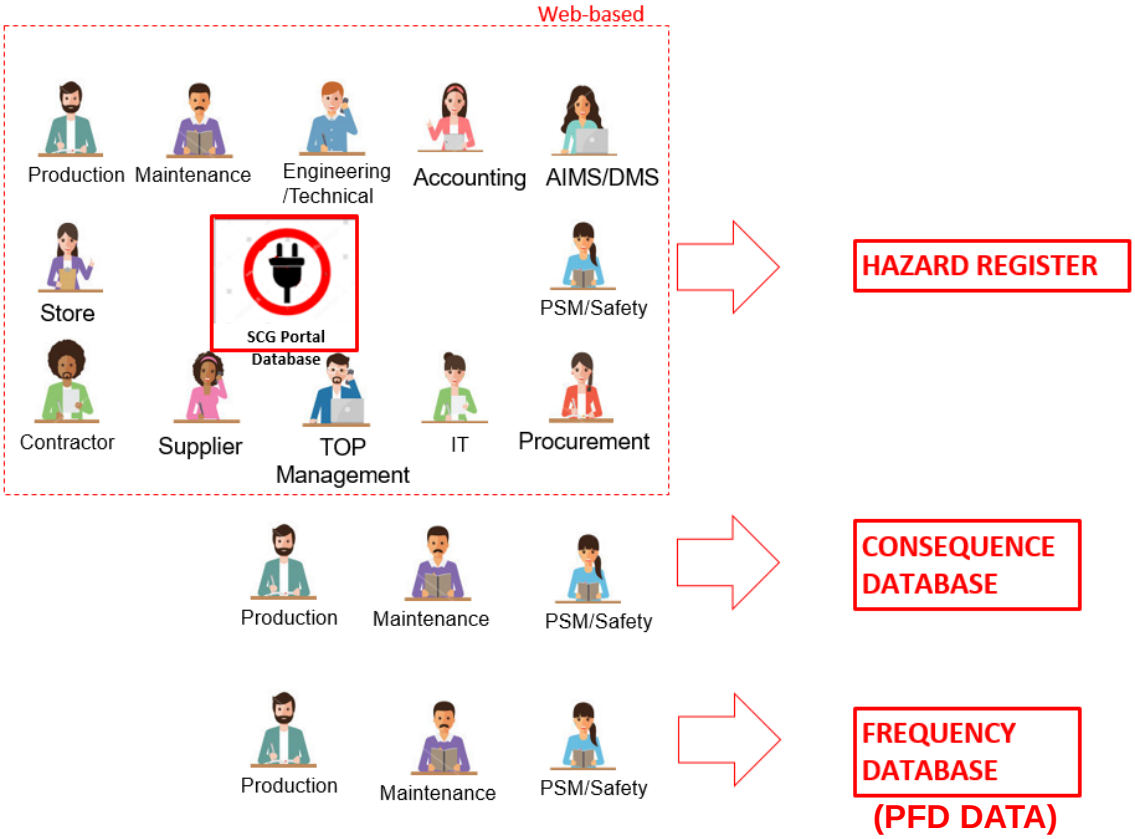
Cause

Consequence

Smart HAZOP software concept

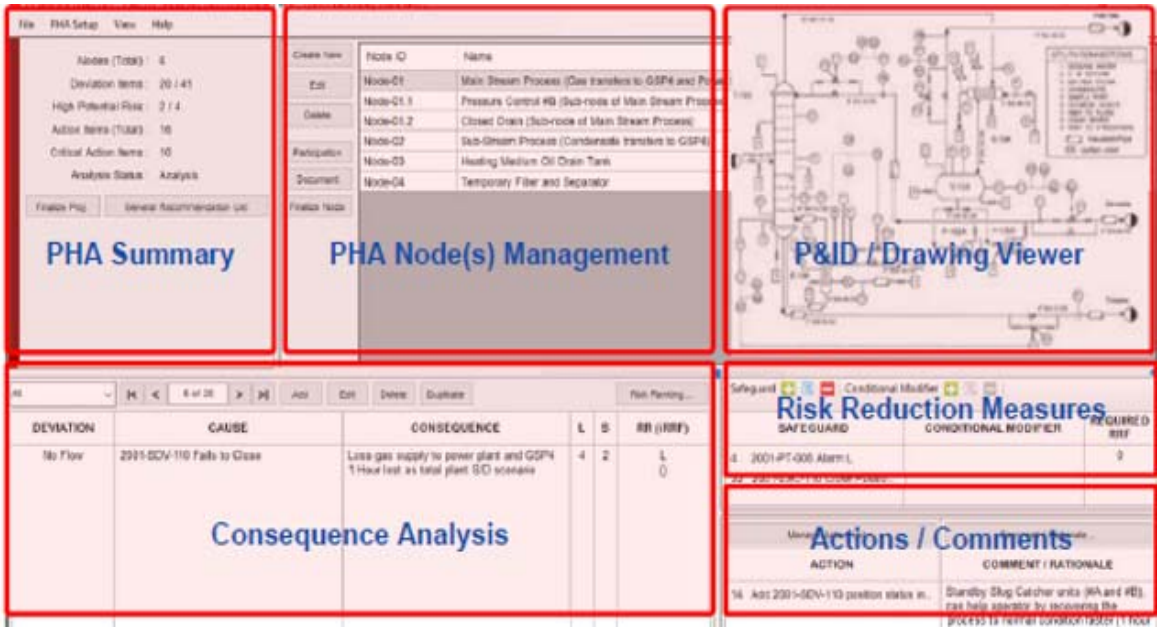


Knowledge data development



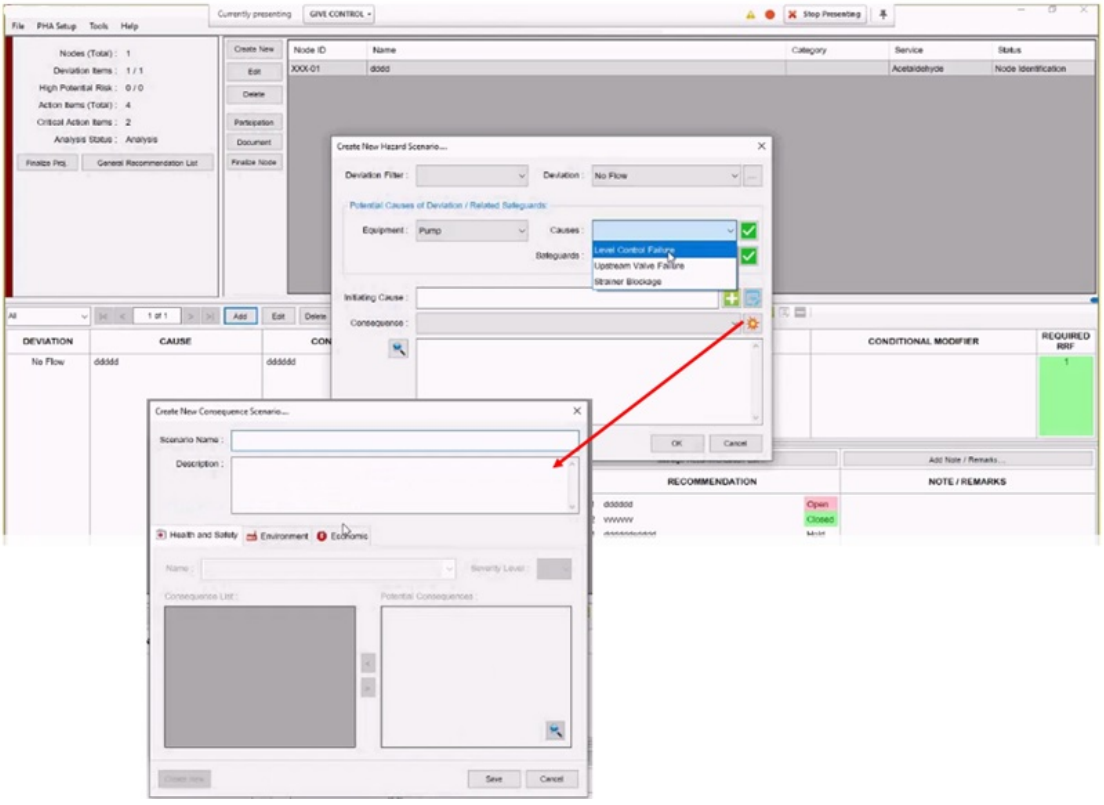
Software interface

Smart HAZOP



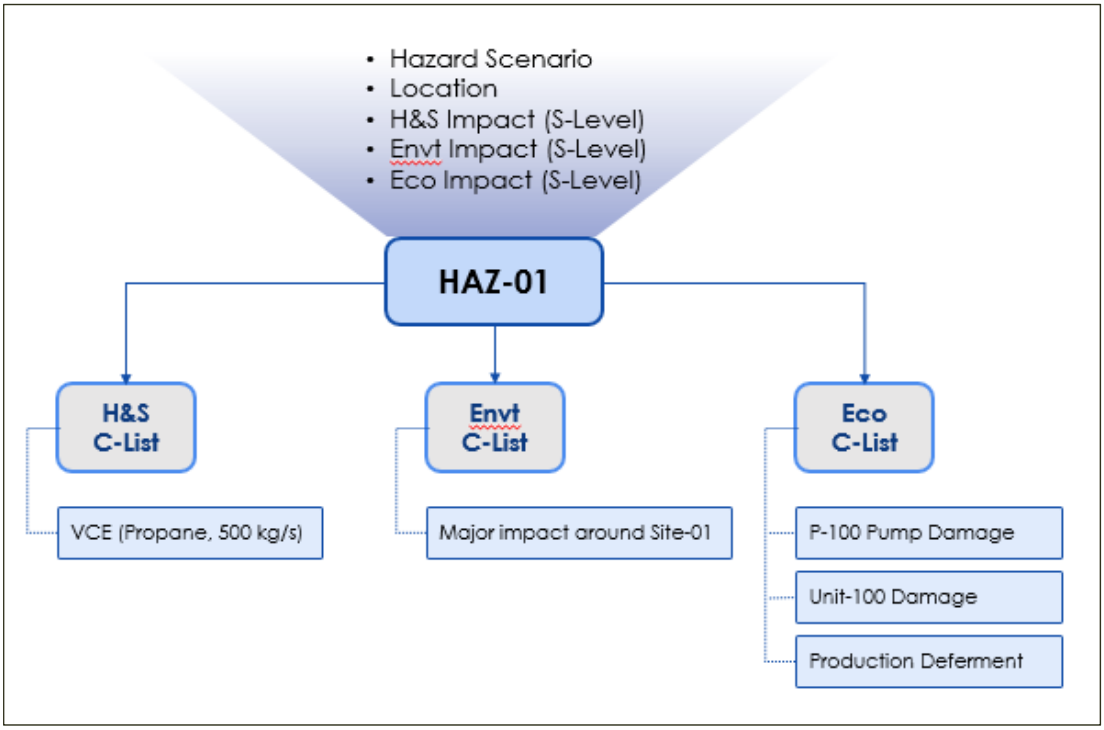
Software interface

Smart HAZOP



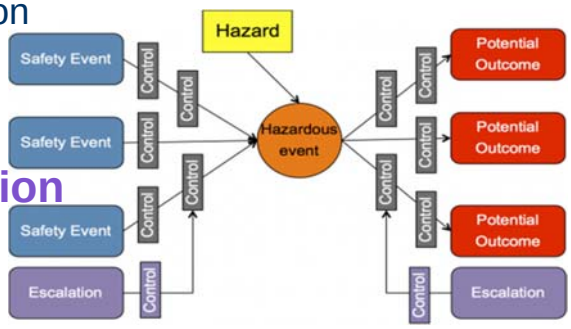
Software interface

Smart HAZOP



Software features

- Potential cause prediction
- Potential safeguard prediction
- Consequence evaluation
  - Health and Safety -> Overpressure ratio calculation, mass release calculation, consequence distance impact suggestion
  - Asset -> Asset loss calculation
  - Environment
- IPL suggestion
- Automatic LOPA calculation (RRF)
- SIL determination
- Action status for follow up
- Automatic Bow-tie generation
- Scenario based hazard register



Challenging

- Required input data of process knowledge to database
- Required input link from SAP data warehouse available for proven in use PFD data
- Required Server Application

https://www.crossfitatmonroemill.com/single-post/2016/09/22/Challenge-You-Talkin-To-Me

Chemical Process Safety Sharing

Thank you for your attention