Automated HAZOP Revisited for Business Intelligence. Power of PyHAZOP™

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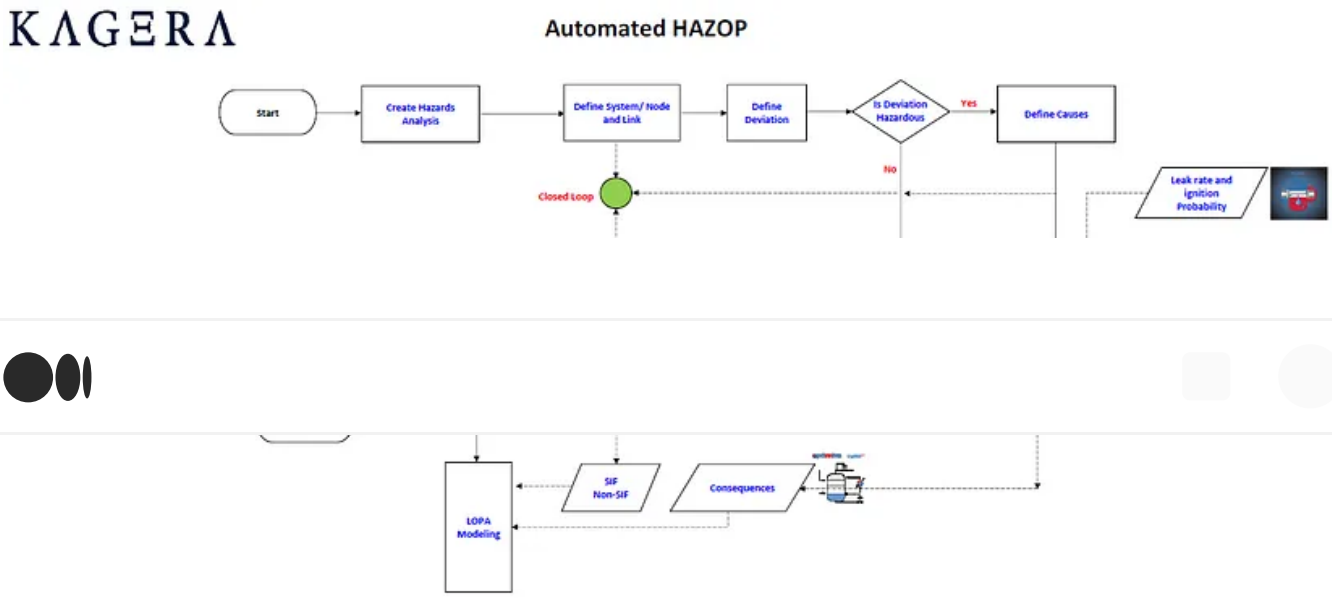


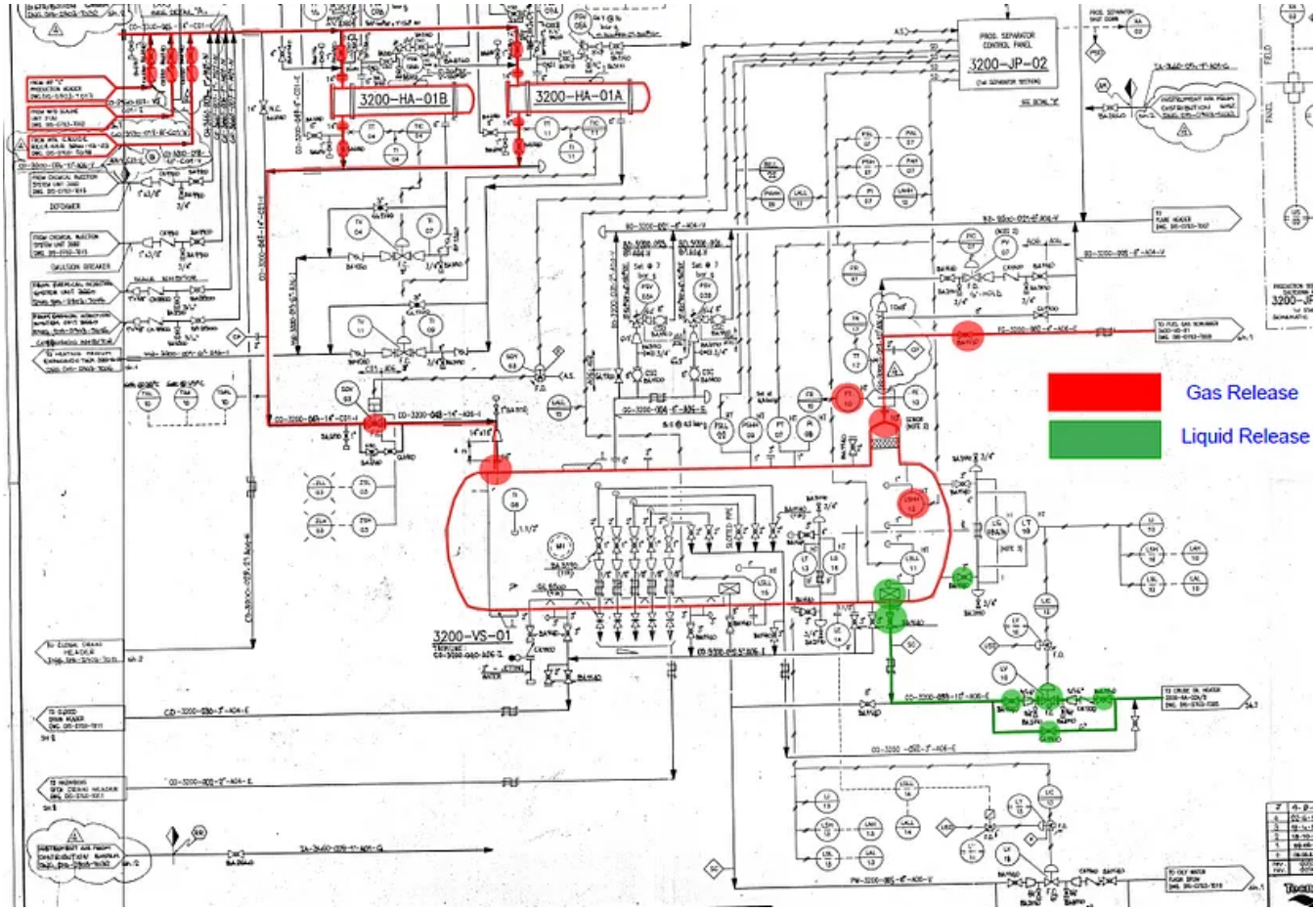
Newly holistic approach of running and managing the HAZOP studies more efficiently using the BBN (Bayesian Believe Network) to ensure highly accurate results with an objective to preclude the risk of un-necessary recommendations and extra engineering work from HAZOP and hence less effective cost saving.

Views on Manual HAZOP Technique

The purpose of the HAZOP in principal is to investigate how the system or plant deviates from the design intent and to create risk for personnel, equipment and operability problems. HAZOP studies have been used with great success within chemical and the petroleum industry to obtain safer, more efficient and more reliable plants.

Actual Case Using the Manual HAZOP Approach

HAZOP process essentially relies on the P&IDs (Piping & Instrument Diagram) by identifying the nodes subject to safety studies as a starting point.



Given the full comprehension of various philosophies e.g. control philosophy, safeguarding and shutdown philosophy from above P&ID during the HAZOP session, the team will embark on analyzing the system considering some abnormal situations such as High Pressure, Low Pressure, More Flow, Less Flow, etc.

The most common gap in manual HAZOP is drawing from the qualitative and subjective views which are not supported by any quantitative results. Albeit the criticality of the HAZOP process and its importance to confirm the design, the process of manual HAZOP lacks the probabilistic methods to quantify the likelihood of each deviations and its consequences on the human, facilities and environment. The expected outcomes from the manual HAZOP of above system is figured below.

It is quite evident from above process, the project still needs more clarifications to confirm the design. The further studies needed as as follows:

(1) SIL verification Study: Additional one month after HAZOP

(2) Pressure Safety Valve Assessment: Additional 2 to 3 weeks after HAZOP.

(3) Flare Knock-out Drum Adequacy Study: Additional 2 to 3 weeks after HAZOP.

These additional requirements for these studies are simply attributed to the lack of Fault Tree Analysis concept, the Consequence Modeling e.g. discharge modeling and effect analysis.

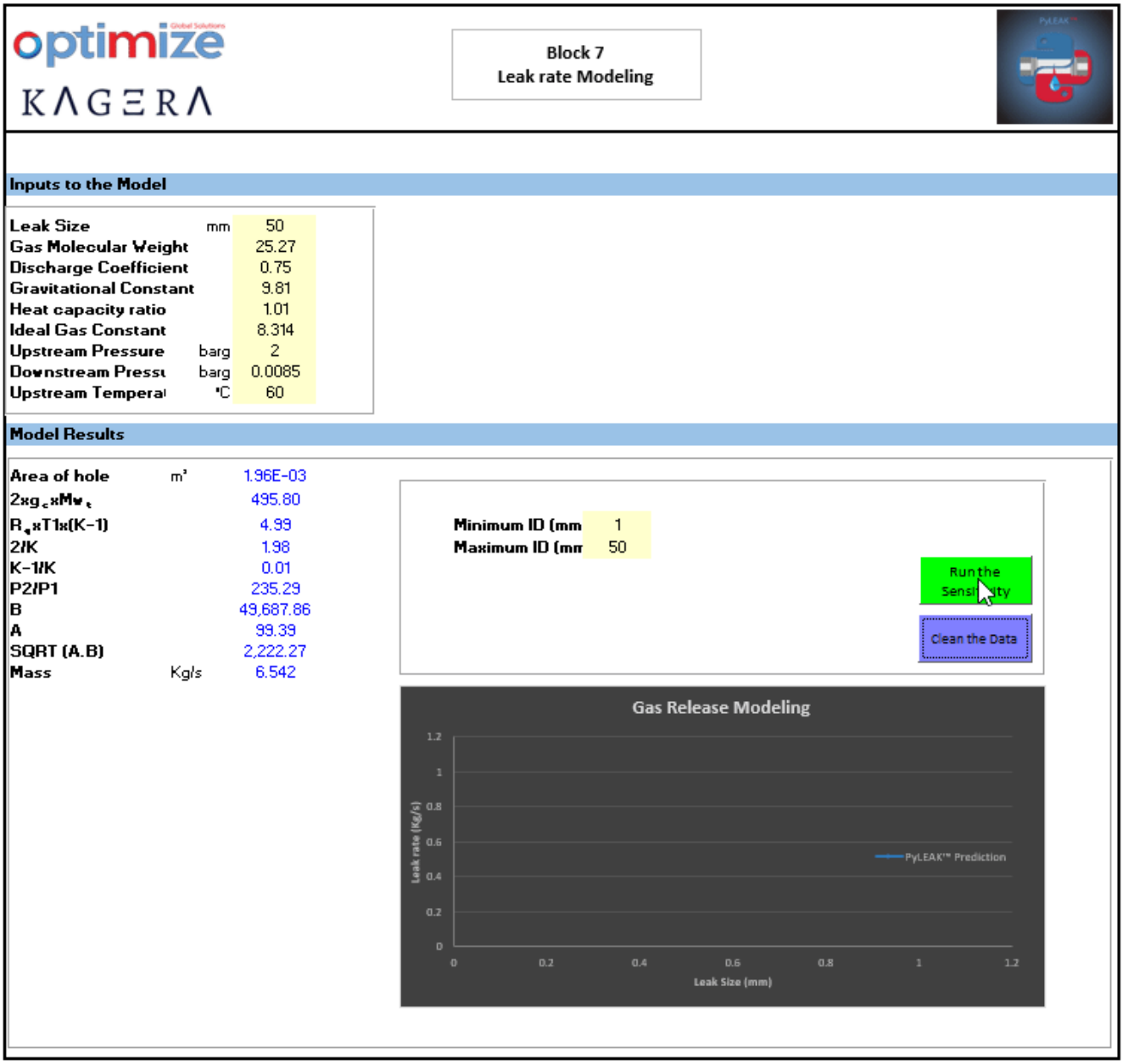
The biggest shortcoming in the manual HAZOP process is being a high-level qualitative method with no ability to pinpoint any technical debate during the HAZOP to move forward.

Modeling Convention of PyHAZOP™ Technique

The utilization of Bayesian Believe Network, and the mathematical capabilities of determining various probabilities for various initiating causes was quite instrumental to unlock the full potential of data analytics and translate it into PyHAZOP™ to overcome the common mistakes and shortcoming happens during the Manual HAZOP.

Remarkably PyHAZOP™ takes into account as a first step towards the hazard analysis the initiating causes (single or multiple) and its frequencies of occurrences as per the good engineering practices. The embedded data base can be customized and tailored to fit the historical data of the operator. This step is quite imperative to establish a benchmark between the Event Likelihood and the Target Likelihood identified by each operator. based on the completion of this step during the HAZOP, the numerical analysis can conclude whether the deviation is hazardous or not and hence the node will be closed with no further debate.

The rule of over-pressure consequence is most often overlooked in manual HAZOP since the process lacks the record of any technical evidence on the system dynamic behavior. PyHAZOP™ package integrates with DySIM™ and dynamically analyze the system and report its trend. These trends are quire important to pinpoint the consequence of over pressure, over flow and over temperature. For instance, if DySIM™ reported an over pressure less than 1.3 times the design pressure, then the system will take into account the rule of vulnerability of small release (1mm to 5 mm)



PyHAZOP™ is a unified platform where it integrates with various applications courtesy of Kageera and it integrates with PyLEAK™.

From the above step, PyLEAK™ can determine the leak rate and hence the probability of ignition can be scored in PyHAZOP™

Actual Case Using the Automated Approach PyHAZOP™

For the same business cases, the abnormal event has been studied using PyHAZOP™ unified platform integrating with PyLEAK™ and DySIM™, the analysis has reported the following:

(1) The system is safe considering the existing save guard.

(2) SIL-1 for existing safety instrumented system is adequate and the target likelihood is met.

(3) From the results of DySIM™, the existing PSVs are adequate to cater flow the relieving load required in the event of over-pressure

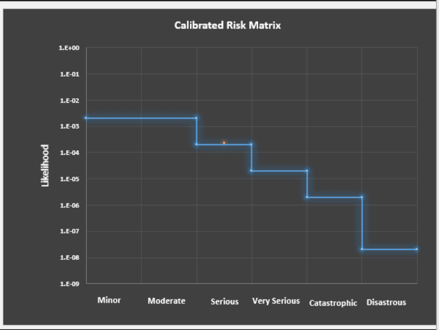
(4) various sensitivity cases were tested to examine the effectiveness of engaging the alarming system and operator intervention.

KAGERA

Study Title		P&ID No.	<<>>	Client Name:	<<>>
Reference Drawing No.		P&ID Revision	<<>>	EPC Name:	<<>>
Team Compositions		Node No.	<<>>	Consultant Name:	<<>>
Design Conditions		Node Description	<<>>		
Operating Conditions					

Guide Word	Deviations	rds				Modifiers				Intermediate Event Likelihood	Severity		TMEL	IEL	RRF	Recommendations
		IPL2 Score	IPL3	IPL3 Score	Remark	Probability of Ignition	POI Score	Time at Risk	Occupancy Factor		Total	Score	Total	Total	Total	
Pressure	More	0.05	None	1	AAAA	Confined: Gas Condensat	0.5	1	0.9	2.3E-04	Serious	2.5	6.2E-04	2.3E-04	0	AAA
		1	None	1		No Ignition	1	1	0.5	0.0E+00	Moderate	1.5				
		1	None	1		No Ignition	1	0.1	0.1	0.0E+00	Moderate	1.5				
		1	None	1		No Ignition	1	0.1	0.1	0.0E+00	Moderate	1.5				
		1	None	1		No Ignition	1	0.1	0.1	0.0E+00	Moderate	1.5				
		1	None	1		No Ignition	1	0.1	0.1	0.0E+00	Moderate	1.5				
		1	None	1		No Ignition	1	0.1	0.1	0.0E+00	Moderate	1.5				
		1	None	1		No Ignition	1	0.1	0.1	0.0E+00	Moderate	1.5				

RISK Chart



Why PyHAZOP™

(1) Dynamically updating the asset strategy management and ensuring all potential recommendations are viably and technically accepted.

(2) PyHAZOP™ supports decision making and planning to improve the risk management.

(3)Significant time reduction and cost reduction of nearly 35% to 47% compared to manual HAZOP.

Hazop | Automation | Bayesian Statistics | Probabilistic Programming | Business Intelligence

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