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Process of Risk Analysis for Iranian Insurance Companies

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ABSTRACT: The main challenge for any insurer/reinsurer has proved to be underwriting major refinery/Petrochemical risk. Insurers have already considered process risk management measures while accepting and evaluating the risks all over the world. Erstwhile petrochemical tariff was adopting experiencing methodology as basis for premium calculation in Iran. In the present de-tariff scenario decisions will be crucial for underwriters on accepting the risk and deciding the terms and conditions. On the other hand the insured will be looking for merit based rating instead of general market driven premium calculations. Generalizing the risks based on the type of occupancy or the past experience also won't do well either to the insured or to the insurer. Chemical process quantitative risk analysis (CPQRA) is a methodology designed to provide management with a tool to help evaluate overall process safety in the chemical process industry (CPI). Management systems such as engineering codes, checklists and process safety management (PSM) provide layers of protection against accidents. However, the potential for serious incidents cannot be totally eliminated. CPQRA provides a quantitative method to evaluate risk and to identify areas of cost-effective risk reduction. This method can be used as an effective tool in the entire gamut of underwriting of petrochemical risks in case of property insurance**.** One of the most important issues in insurance companies, is the making the wise decision on insurance risk. Insurers to cover risks in the process of motivation and a desire to identify and eliminate conditions that risk. Premiums payable by the insurer that the insurance will be commensurate with risk. Insurers attempt to identify and reduce risk plays an important role in increasing safety in the community. One major concern to insurers or reinsurers is whether to accept the risk of petrochemical refineries, and the tariffs and conditions commensurate with the identified risks. Insurers always seek ways to reduce risk insured. The present paper introduces the effective process of risk analysis that can be applied by the Insurance companies in order to identify and predict this kind risks.

Keywords: *CPQRA,PML,VCE, Poolfire, BLEVE, Risk analysis*

INTRODUCTION

The Chemical process quantitative risk analysis (CPQRA) methodology has evolved since the early 1980s from its roots in the nuclear (Amendola, 1986), aerospace and electronics industries (Arendt, et al., 1989). The most extensive use of probabilistic risk analysis (PRA) has been in the nuclear industry. Procedures for PRA have been defined in the PRA Procedures Guide the Probabilistic Safety Analysis (Keivanlu and Atash faraz, 2009)**.** PML is a ratio, expressed as a percentage initially developed by the insurance industry to quantify the expected insured loss after deductible for structural and contents damage (Najafi, 2004). In the current study release model, steam cloud explosions models (AIChE/CCPS,1989) fire effects model (AIChE/CCPS, 1988a, 1995) and TNT Equivalency Models (American Institute of Chemical Engineers,1989) were used to assess the consequences of major events. The TNT equivalency model is easy to use and has been applied for many CPQRAs Models (American Institute of Chemical Engineers, 1989; AIChE/CCPS, 1989, 1995; Keivanlu and Atash faraz, 2009). Other models like TNO Multi-Energy Method

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(AIChE/CCPS, 1994; Keivanlu and Atash faraz, 2009) and Baker-SPrehhw method is a modification of the original work with added elements of the TNO multi-energy method (AIChE/CCPS, 1995). BLEVE and projectile models are primarily empirical (AIChE/CCPS,1989,1994,1995) Pool fire modeling is well developed, Detailed reviews and suggested formulas are provided (AIChE/CCPS, 1988a, 1989, 1995) Moreover, extensive research has been done on risk management in Iran , that includes different issues such as Risk management for project managers (Najafi, 2004), Risk analysis in selecting and developing suppliers (Rughanyan, 2006), introducing risk management systems ,including case study in the aviation industry (Office of Safety and Technology, Department of Transportation, Department of Technology Education and Research, 2007) and thesis such as model based on risk analysis in dam projects and hydro power plants(Sohrabi, 2006), etc. As mentioned before, there are a set of different methods of risk assessment (Keivanlu and Atash faraz, 2009) in this paper CPQRA that is regarded as the best method for risk analysis in chemical industry process is outlined.

Oil and Gas Industry is exposed to major risks like fire and explosion, oil spill, etc simply by virtue of its nature and operations. Such risks are caused by failure of hardware systems and procedural lapses. In addition to man-made disasters the natural hazards like Earthquake, Floods, and Hurricane also contribute to major losses in the oil and gas sectors all over the world. Such risks lead to consequences like human fatality, sever injury, environmental pollution, property damage and business interruption. The above consequences usually lead to huge liability claim from the various stakeholders of the company and also by the third parties. Over 300 Losses of over $ 100 Million for each charts gives the synopsis of the major losses experienced by the oil & gas sector in one of insurance companies during the ten year period (2001-2010). A total loss of $ 40 million property damage, debris removal and cleanup costs while the costs of business interruption, extra expense, employee injuries and fatalities, and liability claims are excluded. The direct, on premises clean up costs due to asbestos abatement, PCB removal or released hydrocarbons and chemicals flowing a fire, explosion or other loss event traditionally have been considered part of the property damage loss. These costs, to the extent insurance is applicable, are paid by property insurance underwriters, Although nearly all the losses involved fire or explosions, many losses occurred as direct result of flood, windstorm and pressure vessel rupture related events. The major explosions and fire that happened in Naftshahr, Khuzestan during 2010 can be cited as examples. As oil industry transfer such risks to the insurer on payment of agreed premium insurers share the concern of the insured in managing the risks and exercise care while underwriting the above petrochemical risks. In addition to obtaining the suitable protection from the insurance companies' better risk management systems and practices fetches the attractive insurance deal as well. In this paper a new approach for risk analysis, based on CPQRA procedures and PML (PML is probable maximum loss) methodology is presented and the fallowing questions and objectives are addressed.

The Main Research Question

How the proposed model for risk analysis of fire insurance policy on oil and gas sector can be designed?

Specific research objectives

✓To provide a systematic risk assessment process to better insure

✓To provide a new model for risk analysis and decision on acceptance or rejection of risk by insurers (the combination of fire detection and explosion and risk analysis methodologies Insurance)

RESEARCH METHOD

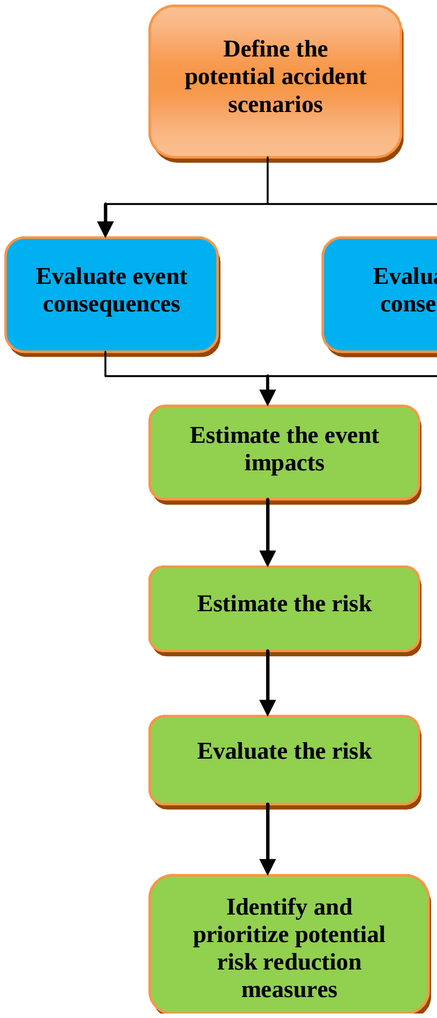
Petrochemical Installations

The use of Insurance Risk Surveys and PML/EML (Estimate maximum loss) calculation is now a generally accepted practice in the Onshore Energy Sector. Chemical process quantitative risk analysis is part of a larger management system. CPQRA provides a tool for the engineer or manager to quantify risk and analyze potential risk reduction strategies. The value of quantification was well described provided a similar definition (American Institute of Chemical Engineers, 1989) (a quantitative approach to safety is not foreign to the chemical industry. For every process, the kinetics of the chemical reaction, the heat and mass transfers, the corrosion rates, the fluid dynamics, the structural strength of vessels, pipes and other equipment as well as other similar items is determined quantitatively by experiment or calculation, drawing on a vast body of experience).

CPQRA enables the engineer to evaluate risk. Individual contributions to the overall risk from a process can be identified and prioritized. A range of risk reduction measures can be applied to the major hazard contributors and assessed using cost-benefit methods. Comparison of risk reduction strategies is a relative application of CPQRA. At each stage of increasing safety (decreasing risk), the associated changes may be evaluated to see if they are worthwhile and cost-effective. Some organizations also use CPQRA in an absolute sense to confirm that specific risk targets are achieved. Further risk reduction, beyond such targets, may still be appropriate where it can be accomplished in a cost-effective manner (Keivanlu and Atash faraz, 2009; American Institute of Chemical Engineers,1989).

CPQRA Methods

As is clear in figure1 seven steps has been determined for CPQRA. It is convenient (for ease of understanding and administration) to divide the complete CPQRA procedure into component techniques. Many CPQRAs do not require the use of all the techniques. Through the use of prioritized procedures, the CPQRA can be shortened by simplifying or even skipping certain techniques that appear in the complete CPQRA procedure (figure1).



Figre1: CPQRA Flowchart / Steps

The full logic of a CPQRA involves the following component techniques:

1.CPQRA Definition
2.System Description
3.Hazard Identification
4.Incident Enumeration
5.Selection
6.CPQRA Model Construction
7.Consequence Estimation
8.Likelihood Estimation
9.Risk Estimation
10.Utilization of Risk Estimates

For example, the first step *(CPQRA Definition)* goal insurer, risk measurement location is great. in next steps *(System Description)* are the compilation of the process/plant information needed for the risk analysis. For example, site location, environs, weather data, process flow diagrams (PFDs), piping and instrumentation diagrams (PFDs), layout drawings, operating and maintenance procedures, technology documentation, process chemistry, and thermophysical property data may be required. This information is fed to the analysis data base for use throughout the CPQRA. *Hazard Identification* is another step in CPQEA. It is critical because a hazard omitted is a hazard not analyzed. Many aids are available, including experience, engineering codes, checklists, detailed process knowledge, equipment failure experience, hazard index techniques, what-if analysis, hazard and operability (HAZOP) studies, failure modes and effects analysis (FMEA), and preliminary hazard analysis (PHA). *Incident Enumeration* is the identification and tabulation of all incidents without regard to importance or initiating event. This, also, is a critical step, as an incident omitted is an incident not analyzed.

Selection is the process by which one or more significant incidents are chosen to represent all identified incidents, incident outcomes are identified, and incident outcome cases are developed. *CPQRA Model Construction* covers the selection of appropriate consequence models, likelihood estimation methods and their integration into an overall algorithm to produce and present risk estimates for the system under study. While various algorithms can be synthesized, a Prioritized form can be constructed to create opportunities to shorten the time and effort required by less structured procedures. *Consequence Estimation* is the methodology used to determine the potential for damage or injury from specific incidents. A single incident (e.g., rupture of a pressurized flammable liquid tank) can have many distinct incident outcomes (e.g., unconfined vapor cloud explosion (UVCE), boiling liquid expanding vapor explosion (BLEVE), flash fire). These outcomes are analyzed using source and dispersion models and explosion and fire models. Effects models are then used to determine the consequences to people or structures. Evasive actions such as sheltering or evacuation can reduce the magnitude of the consequences and these may be included in the analysis. *Likelihood Estimation* is the methodology used to estimate the frequency or probability of occurrence of an incident. Estimates may be obtained from historical incident data on failure frequencies, or from failure sequence models, such as fault trees and event trees. Most systems require consideration of factors such as common-cause failures (a single factor leading to simultaneous failures of more than one system, e.g., power failure, human reliability, and external events). *Risk Estimation* combines the consequences and likelihood of all incident outcomes from all selected incidents to provide one or more measures of risk. It is possible to estimate a number of different risk measures from a given set of incident frequency and consequence data, and an understanding of these measures is provided. The risks of all selected incidents are individually estimated and summed to give an overall measure of risk. The sensitivity and uncertainty of risk estimates and the importance of the various contributing incidents to estimates are discussed. *Utilization of Bisk Estimates* is the process by which the results from a risk analysis are used to make decisions, either through relative ranking of risk reduction strategies or through comparison with specific risk targets.

Before insurance companies accepting insurance risks, safety expert (initial visit) are doing. By the safety expert (initial visit) System Description and Hazard Identification and the next by the experience risk resolution is done, and an incident scenario is estimated. By the consequence models, risk and percentage of loss and effective distance estimates for the system. According to the arrangement of equipment at intervals and the percentage of damage calculated and PML is estimated.

Consequence Models

By the consequence above models, risk and percentage of loss and effective distance estimates for the system. According to the arrangement of equipment at intervals and the percentage of damage, amount of loss is measured and probability of loss estimated.

VEC

TNT Model (TNT models Baker et al., 1983):

1. $W_{TNT} = \frac{\eta m E c}{E_{TNT}}$; 2. $Z_1 = \frac{R_1}{W^{1/3}}$;

1. $Z_2 = \frac{R_2}{W^{1/3}}$; 2. $Z_3 = \frac{R_3}{W^{1/3}}$;

3. $\text{Log}\ \varphi = \sum_{i=0}^{n} ci(a + b\log Z)^i$;

Pool fire (TNT models Baker et al., 1983)

Pool Fire Model for Calculate Both Physical Parameters and Radiation

1. $y'_{max} = 1.27\times10^{-6}\frac{\Delta Hc}{\Delta H*}$;

2. $\Delta H^* = \Delta H_V + \int_{Ta}^{TBP} Cp$;

3. $m_B = 1\times10^{-6}\frac{\Delta Hc}{\Delta H*}$; 4. $D_{max} = 2\sqrt{\frac{VL}{\pi\ ymax}}$;

5. $\frac{H}{D} = 42\left(\frac{mB}{\rho a\sqrt{gD}}\right)^{0.61} \longrightarrow$

If u_w=0 Then use this formule ;

6. $\frac{H}{D} = 6.2\left(\frac{mB}{\rho a(\sqrt{gD})}\right)^{-0.254} u^{*}{}_{10}^{-0.044}$

7. $u^{*}_{10} = \frac{uw}{[(gmBDmax)/\rho v]^{1/3}}$

8. $\cos\theta = 1$ for $u^{*}_{10} < 1$ and $u^{*}_{10} = 1$;

9. $\cos\theta = \frac{1}{\sqrt{u*}}$ for $u^{*}_{10} > 1$ and $u^{*}_{10} = 1$;

10. $F_p = \frac{1}{4\pi x^{\wedge}2}$;

11. $X = (H^2 + (D^2 + L^2))^{1/2}$;

12. $\tau_{a0} = 2.02(P_W X_0)^{-0.09}$;

13. $E_{rp} = \tau_a \eta m_B \Delta H_c A F_p$;

14. $E_{av} = E_m e^{-SD} + Es(1 - e^{-SD})$;

15. $F_{21} = \frac{H_{BLEVE}(\frac{Dmax}{2})^2}{(L^2 + H_{BLEVE}{}^2)^{3/2}}$;

$F_{21} = \frac{L\left(\frac{Dmax}{2}\right)^2}{(L^2 + H_{BLEVE}{}^2)^{\frac{3}{2}}}$;

16. $E_{rs} = \tau_a \Delta H_c F_{21}$;

a) $F_p = \frac{1}{4\pi x^{\wedge}2}$; b) $X_1 = (H^2 + (D^2 + L_1{}^2))^{1/2}$;

c) $\tau_{a1} = 2.02(P_W X_1)^{-0.09}$; d) $E_{rp1} = \tau_{a1} \eta m_B \Delta H_c A F_p$;

e) $F_p = \frac{1}{4\pi x^{\wedge}2}$; f) $X_2 = (H^2 + (D^2 + L_2{}^2))^{1/2}$;

g) $\tau_{a2} = 2.02(P_W X_2)^{-0.09}$; h) $E_{rp2} = \tau_{a2} \eta m_B \Delta H_c A F_p$;

i) $F_p = \frac{1}{4\pi x^{\wedge}2}$; j) $X_3 = (H^2 + (D^2 + L_3{}^2))^{1/2}$;

k) $\tau_{a3} = 2.02(P_W X_3)^{-0.09}$; l) $E_{rp3} = \tau_{a3} \eta m_B \Delta H_c A F_p$;

BLEVE (AGA, 1974; Moorhouse, 1982; Mudan and Croce, 1988; BLEVE models AIChE, 1994):

BLEVE Model for Calculate Both Physical Parameters and Radiation

1. $E = \frac{RMHC}{\pi D_{max}{}^2 t_{BLEVE}}$;

2. $F_{21} \frac{H_{BLEVE}(\frac{Dmax}{2})^2}{(L^2 + H_{BLEVE}{}^2)^{3/2}}$;

3. $F_{21} \frac{L(\frac{Dmax}{2})^2}{(L^2 + H_{BLEVE}{}^2)^{3/2}}$;

$X_{s0} = (H_{BLEVE}{}^2 + L^2)^{1/2} - \frac{Dmax}{2}$

$\tau_{a0} = 2.02(P_W X_{s0})^{-0.09}$

$E_{r0} = \tau_a E F_{21}$

4. $F_{21}\frac{L(\frac{Dmax}{2})^2}{(L^2+H_{BLEVE}{}^2)^{3/2}}$;

$X_{s1} = (H_{BLEVE}{}^2 + L_1{}^2)^{1/2} - \frac{Dmax}{2}$

$\tau_{a1} = 2.02\ (P_W\ X_{s1})^{-0.09}$

$E_{r1=}\ \tau_{a\ 1}E\ F_{21}$

5. $F_{21}\frac{L(\frac{Dmax}{2})^2}{(L^2+H_{BLEVE}{}^2)^{3/2}}$;

$X_{s2} = (H_{BLEVE}{}^2 + L_2{}^2)^{1/2} - \frac{Dmax}{2}$

$\tau_{a2} = 2.02\ (P_W\ X_{s2})^{-0.09}$

$E_{r2=}\ \tau_{a\ 2}E\ F_{21}$

6. $F_{21} = \frac{L(\frac{Dmax}{2})^2}{(L^2+H_{BLEVE}{}^2)^{3/2}}$;

$X_{s3} = (H_{BLEVE}{}^2 + L_3{}^2)^{1/2} - \frac{Dmax}{2}$

$\tau_{a3} = 2.02\ (P_W\ X_{s3})^{-0.09}$

$E_{r3=}\ \tau_{a\ 3}E\ F_{21}$

How Percent of Damages (Losses) Calculated

To calculated percent of damage (loss) we use below tables, the following tables indicate the severity of the damage. With regard to equipment located at various distances from the source of the event we can show the different layers. The severity of damage and losses in each of these layers are different.

To estimate the resulting damage, table1a is used for general structures; table1b is used for the estimation of process equipment.API (1996a) RP 521 provides a short review of the effects of thermal radiation on people that it calculated as a output of above models. The values may be compared to solar radiation intensity on a clear, hot summer day of about 320 Btu/hr ft2 (1 kW/m2). Based on these data, API suggests thermal criteria (table 2), excluding solar radiation, to establish exclusion zones or determine flare height for personnel exposure. Other criteria for thermal radiation damage are shown in table 3.

Given the above tables, the percentage of damage to different layers is summarized in the following table (table4).

Statistical Review Since 2001-2010 in Oil and Gas Losses in One of Insurance Company in Iran

Browse, Statistics losses by insurers in their views about potential risks will be completed with regard to past events can have on insurance rates and terms more comfortable decision. (figure2-5).

RESULTS AND DISSCUSSION

Conceptual Framework

The conceptual framework of the study is as follows (figure6).

In the first step, a disaster scenario is defined, in the second step based on the identified risks, we used the consequences of the incident models, by the consequence above models, risk and percentage of loss and effective distance estimates for the system. According to the arrangement of equipment at intervals and the percentage of damage, Effective distance shows with circles with different colors (figure7), amount of loss is measured and probability maximum of loss estimated (PML) (table5). Considering the amount of damages calculated as well as previous incidents happened (figure1-4) and the percentage of damage is calculated, in particular insurer can accept or reject the offer or provide insurance and safety tips and provide feedback to rate conditions.

Incident Scenarios

Oil Field Plant

✓In one of the oil fields in southern Iran, 500000 barrel per day oil will be produced in the first phase.
✓By second phase, production rate should be raised to 160000 bblpd.
✓In which phases gas is injected to field.
✓All these processes were designed in three Banks (trains) that are completely the same as each other.
✓Each bank consists of a series of separators, desalters, stabilizer, and gas injection compression facilities.

Description

✓In pricing the oil field facilities we applied the CAPCOST software.
✓This software has been utilized to estimate the Base cost and the bare module cost.
✓Bare module cost includes direct and indirect project expenses. These include material used for installation, installation cost, labor, insurance, and taxes
✓We chose the last chemical engineering plant cost index (CEPCI).

✓For certainty, all outputs of software checked by manufacturer and supplier.
✓List of materials and operation conditions are the base data for this software.

Case Study

✓Any place that included more light gases and also harsh conditions is the most dangerous and suitable point for explosion.
✓First stage separators produce more Methane and have highest pressure and temperature in separation unit.
✓Assuming a circle that has 50 m radius and the exploded vessel is located in its center.
✓So, all vessels and tools at this circle will be destroyed.
✓We calculate the cost of explosion for one of first stage separators.

Tabl 1a: Damage estimates for common structures based on overpressure (Clancey, 1972)

	Pressure (kpa)	Damage
1	0.14	Annoying noise (137 dB if of low frequency 10-15 Hz)
2	0.21	Occasional breaking of large glass windows already under strain
3	0.28	Loud noise (143 dB), sonic boom, glass failure
4	0.69	Breakage of small windows under strain
5	1.03	Typical pressure for glass breakage
6	2.07	"Safe distance" (probability 0.95 of no serious damage below this value); projectile limit; some damage to house ceilings; 10% window glass broken
7	2.76	Limited minor structural damage
8	3.4-6.9	Large and small windows usually shattered; occasional damage to window frames
9	4.8	Minor damage to house structures
10	6.9	Partial demolition of houses, made uninhabitable
11	6.9-13.8	Corrugated asbestos shattered; corrugated steel or aluminum panels, fastenings fail, followed by buckling; wood panels (standard housing) fastenings fail, panels blown in
12	9.0	Steel frame of clad building slightly distorted
13	13.8	Partial collapse of walls and roofs of houses
14	13.8-20.7	Concrete or cinder block walls, not reinforced, shattered
15	15.8	Lower limit of serious structural damage
16	17.2	50% destruction of brickwork of houses
17	20.7	Heavy machines (3000 Ib) in industrial building suffered little damage; steel frame building distorted and pulled away from foundations
18	20.7-27.6	Frameless, self-framing steel panel building demolished; rupture of oil storage tanks
19	27.6	Cladding of light industrial buildings ruptured
20	34.5	Wooden utility poles snapped; tall hydraulic press (40,000 Ib) in building slightly damaged
21	34.5-48.2	Nearly complete destruction of houses
22	48.2	Loaded train wagons overturned
23	55.1	Brick panels, 8-12 inches thick, not rein forced, fail by shearing or flexure
24	62.0	Loaded train boxcars completely demolished
25	68.9	Probable total destruction of buildings; heavy machine tools (7000 Ib) moved and badly damaged; very heavy machine tools (12,000 Ib) survive
26	2068	Limit of crater lip

Table 1b: Damage estimates based on overpressure for process equipment (AIChE, 1994)

Equipment	3.5	7	10.5	14	17.5	21	24.5	28	31.5	35	38.5	42	45.25	49	52.5	56	59.5	63	66.5	70	84	98	112	126	140
Control house steel roof	A	C	D				N																		
Control house concrete roof	A	E	P	D			N																		
Cooling tower	B			F			O																		
Tank: cone roof		D				K							U												
Instrument cubicle			A			L M						T													
Fire heater				G	I					T															
Reactor: chemical				A				I					P												
Filter				H					F												T				
Regenerator						I				I P					T										
Tank: floating roof						K							U					T							D
Reactor: cracking							I							I					V		T				
Pine supports							P					S O													
Utilities: gas meter									Q																
Utilities: electronic transformer									H						I					T					
Electric motor										H								I							V
Blower										Q										T					
Fractionation column											R			T											
Pressure vessel: horizontal												P I						T							
Utilities: gas regulator												I								M Q					
Extraction column													I							V	T				
Sream turbine															I						M	S			V
Heat exchanger															I			T							
Tank sphere																I						I	T		
Pressure vessel: vertical																					I	T			
Pump																					I		V		

Key to table 1b

A. Windows and gauges broken
B. Louvers fall at 0.2- 0.5 psi
C. Switchgear is damaged from roof collapse
D. Roof collapses
E. Instruments are damaged
F. Inner parts are damaged
G. Brick cracks
H. Debris — missile damage occurs
I. Unit moves and pipes break
J. Bracing falls
K. Unit uplifts (half tilted)
L. Power lines are severed
M. Controls are damaged
N. Block walls fell
O. Frame collapses
P. Frame deforms
Q. Case is damaged
R. Frame cracks
S. Piping breaks
T. Unit overturns or is destroyed
U. Unit uplifts (0.9 tilted)
V. Unit moves on foundation

Table 2: Recommended design flare radiation levels excluding solar radiation (API, 1996a)

Permissible design level (K)		Conditions
Btu/hr/ft2	kW/m2	
5000	15.77	Heat intensity on structures and in areas where operators are not likely to be performing duties and where shelter from radiant heat is available, for example, behind equipment
3000	9.46	Value of *K* at design flare release at any location to which people have access, for example, at grade below the flare or on a service platform of a nearby tower. Exposure must be limited to a few seconds, sufficient for escape only
2000	6.31	Heat intensity in areas where emergency actions lasting up to 1 min may be required by personnel without shielding but with appropriate clothing
1500	4.73	Heat intensity in areas where emergency actions lasting up to 1 min may be required by personnel without shielding but with appropriate clothing
500	1.58	Value of *K at* design flare release at any location where personnel are continuously exposed

Table 3: Effects of thermal radiation (World Bank, 1985)

Radiation intensity (kW/m2)	Observed effect
37.5	Sufficient to cause damage to process equipment
25	Minimum energy required to ignite wood at indefinitely long exposures (non piloted)
12.5	Minimum energy required for piloted ignition of wood, melting of plastic tubing
9.5	Pain threshold reached after 8 sec; second degree burns after 20 sec
4	Sufficient to cause pain to personnel if unable to reach cover within 20 s. however blistering of the skin (second degree burns) is likely; 0% lethality
1.6	Will cause no discomfort for long exposure

Table 4: Percent of the loss

Range of radiation	Loss	Percentage of loss
6.3-15 kW/m^2	Low damage	0-40%
16-37 kW/m^2	Repairable high damage	40%-80%
38-39 kW/m^2	Total loss	80%-100%

Table 5: Proposed of shape of calculating maximum possible of loss

Name of equipment	Distance from fire resource	Number	Percentage of loss	Value	Total value
TOTAL:					

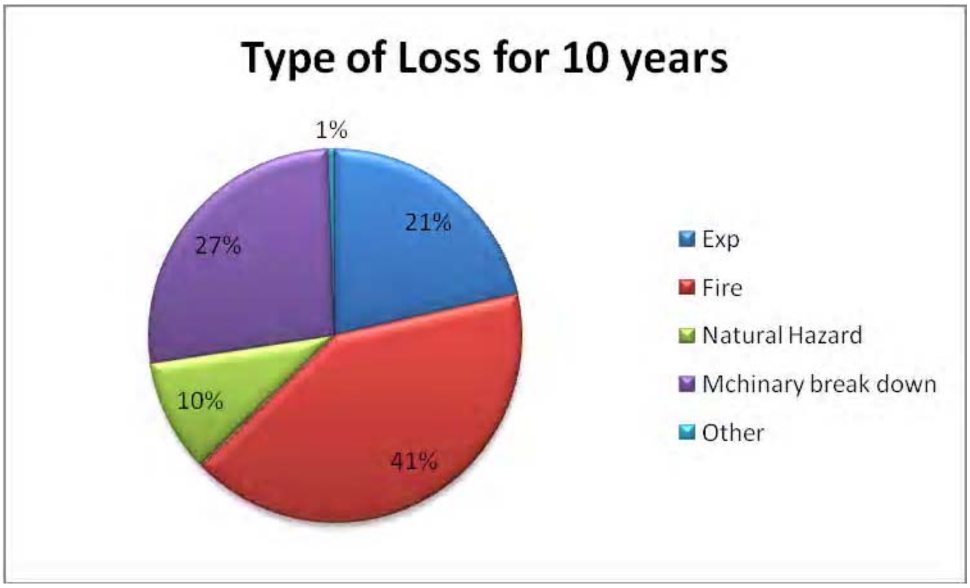


Figure 2: Percent of type of the damage in ten years

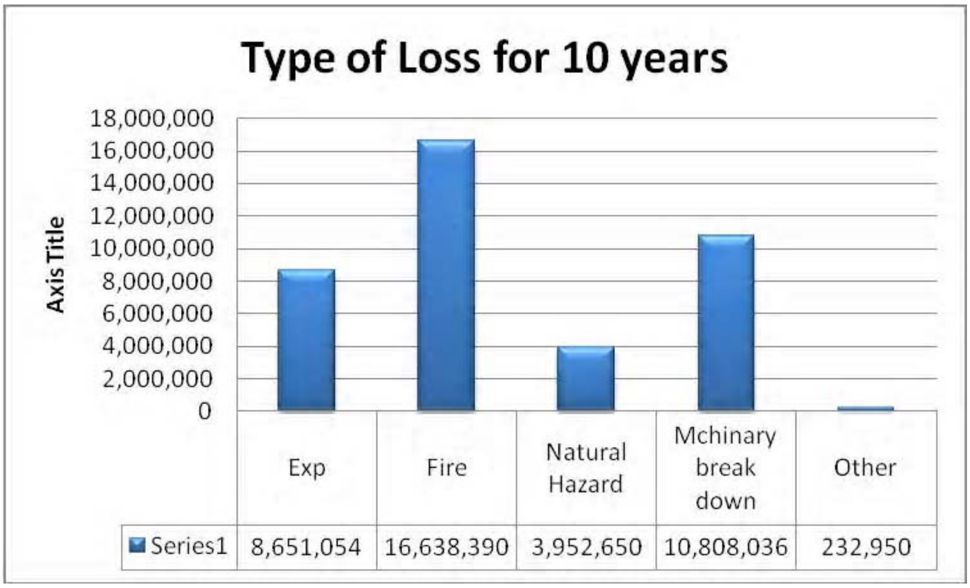


Figure 3: Dollar value of type of damage in ten years

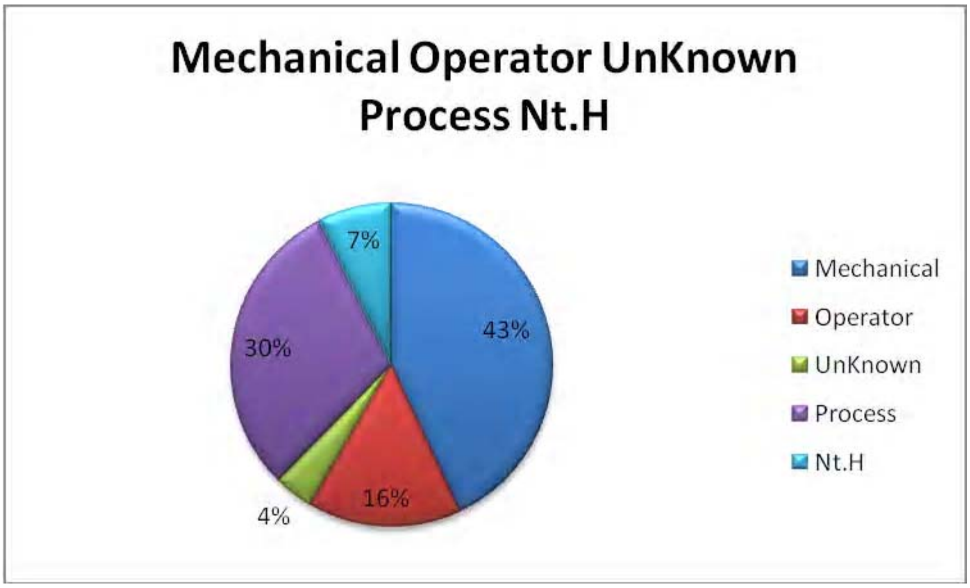


Figure 4: Percent of cause of loss in ten years

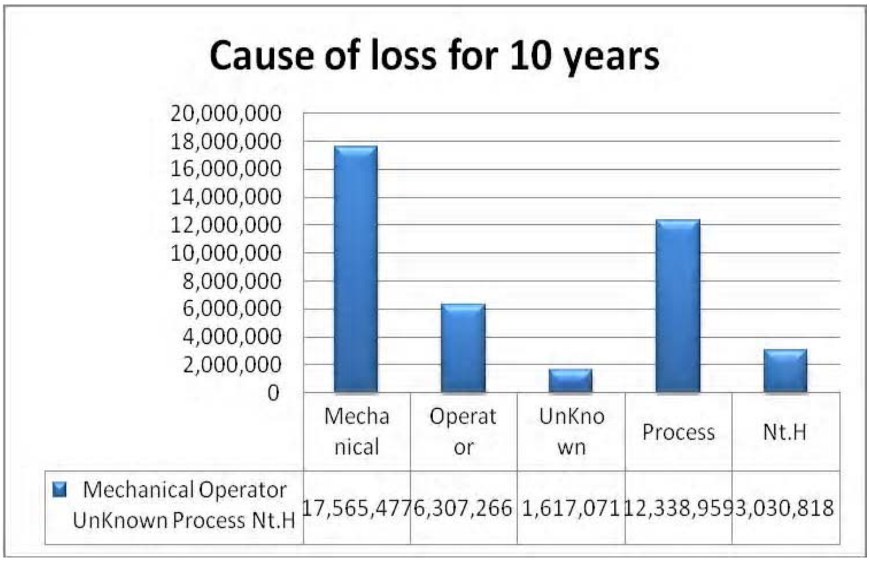


Figure 5: Dollar value of cause of loss in ten years

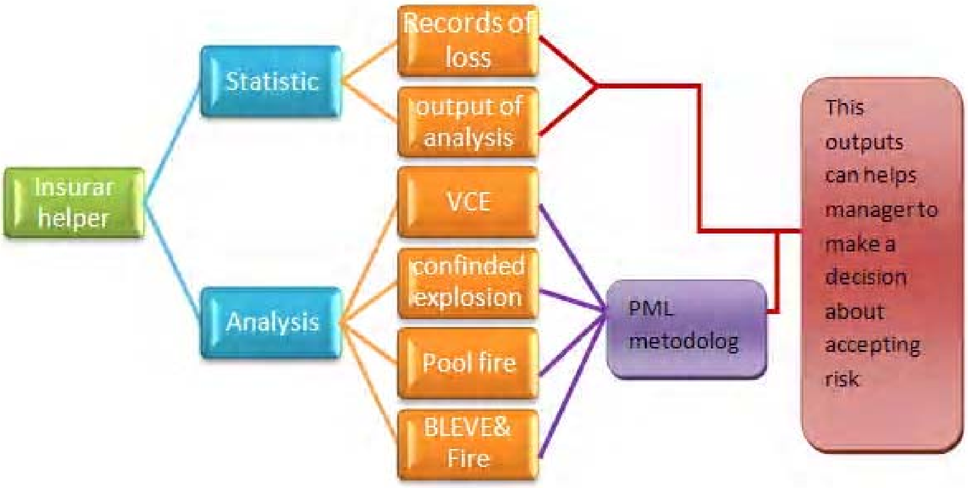


Figure 6: Conceptual models/CPQRA Analysis

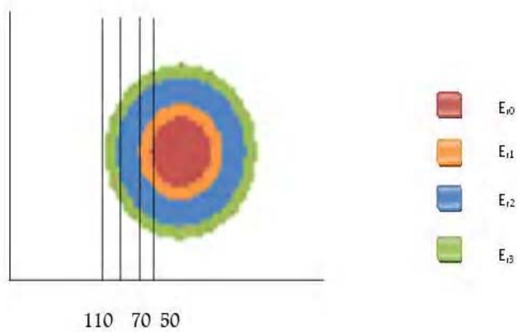


Figure 7: Effective distance of loss

Calculation

✓In the case of fire or explosion of 0200-VS-002, mentioned vessels in below table6 will be destroyed.
✓In next level of destruction, the following vessels will be damaged (table7).
✓Finally, the explosion of central first stage separator has minimum 14,422,231 USD cost in 50 m radius.

Conclusion of This Scenario

✓This methods are able to calculate all vessels and tools price based on last chemical engineering plant cost index (CEPCI).
✓The minimum data is required.
✓Required time for pricing facilities is minimum
✓Cost of explosion of all vessels and tools will be calculated easily only by adding damaged vessels prices.
✓Also, Calculating cost of destruction needs site plan to find distance between vessels.
✓The offset of this procedure is less than ±5%
✓*AIChE/CCPS (1987b). Internutiimul Conference on Vapor Cloud Modeling. November 2-4, Cambridge, MA. New York: American Institute of Chemical Engineers*

CONCLUSION

According to the traditional context of insurance companies, risk management, using past experiences and traditionally is done. Due to expanding insurance market, insurance and a variety of disciplines and increase the speed of servicing customers with the best possible quality, being competitive Insurance industry and increase private companies and competing and trying to attract portfolio companies have more speed to make decisions (based on the rejection or acceptance of risk insurance) to pay. So in this paper we proposed a good approach to help an insurance to make a better decision about risk of insurance.

Table 6: Damaged equipment specifications

Equipment	Base cost	Bare module cost	No.	Total bare module cost	Estimate loss
0211-VH,UV		2296817	3	6890451	3100703
0210-VE-001,2,3	159451	870709	3	2612127	1175457
0210-FA-001,2,3	1147415	2650529	3	7951587	3578214
0210-PA-001,2,3	63809	288288	6	1729728	778377.6
0210-HA-001,2,3	5907	11519	3	34557	15550.65
0210-VA-001,2,3	34829	153583	3	460749	207337.1
0210-PA-004,5,6	58278	302380	6	1814280	816426
0210-HC-001,2,3	20316	50408	3	151224	68050.8
Sum					9740116

Table 7: Damaged equipment specifications

Equipment	Base cost	Bare module cost	No.	Total bare module cost	Estimate loss
0200-VS-001,2,3	44009	355227	3	1065681	799260.8
0200-VS-004,5,6	28165	145882	3	437646	328234.5
0200-VS-007,8,9	47821	192703	3	578109	433581.8
0200-VA-001,2,3	28839	89111	3	267333	200499.8
0200-PH-002,3	58527	229076	4	916304	687228
0200-PA-002,3	47495	157206	4	628824	471618
0200-TA-001	540239	2279809	1	2279809	1709857
0200-H-001,2,3	11814	23038	3	69114	51835.5
Sum					4682115

This paper tried to set forward a proposed model for risk analysis of fire insurance policies in the oil and gas sector and proposed CPQRA methodology (figure 1) to this end. The researchers used fire and explosion models to determine the severity of fire and explosion in this stage. The percentage of damage to equipment arranged at different distances is calculated (table 4). Finally, the outputs of those models in PML tables were calculated to measure the damage to the equipment (table 5).

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