Understanding Perception of Fire Risk from Petrol Station's Workers

[1]Mohd Shamsuri Khalid, [2]Ahmad Rahman Songip, [2]Nooh Abu Bakar,
[3]Mukhlis Chua and [1]Mohtar Musri
[1]Department Occupational Safety and Health of Malaysia, 56430 Putrajaya, Malaysia
[2]Departement of Management of Technology, Malaysia-Japan International Institute Technology,
Universiti Teknologi Malaysia-Kuala Lumpur, Jalan Yahya Petra (Jalan Semarak),
54100 Kuala Lumpur, Malaysia
[3]Interganite (M) Sdn Bhd, 25350 Pahang, Malaysia

Abstract: This research is about the perception of fire risk and its function of petrol station. Fewer researched in understanding perception of risk in petrol fuel station among its workers. Any prolong of the issues might cause catastrophic in case of leakage, pollution and fire to gas explosion engulf with it. Therefore, a need of qualitative research to carry out to justify the perception of risk not just to the workers but also to give a general information of risk precautions to the people living vicinity of the petrol fuel station. However, Petrol Fuel Station (PFS) category as a hazardous workplace. All flammable substances such as petrol, diesel and CNG are stored either underground or above ground. It is a place where various mode of transportation fuelling and refuelling at every hours. Due to the existing of the flammable substance at PFS pose a potential hazard to the staff, public, property and environment. A simple mismanagement could cause catastrotophic. The issue of risk in petrol station always regards as important since the workplace has been category as non major hazard installation. Nevertheless, the consequences of disaster are very huge. Therefore, it is very crucial to investigate in conducting and questioning of the perception of risk towards petrol fuel station. The qualitative approach will consists of reviewing design drawings (documents), semi structure interview, observation at the premise and analysis to determine and acknowledge the perception of risk among the workers. The research results shows that there is indeed a needs to understand the perception of risk characteristic in order to improve a good practice of especially petrol fuel station in Malaysia. The findings are very precious in better understanding of risk, mitigation plan and formulate a new proposal to the government especially the authority regards to petrol fuel station. The further research should also focus on the risk emulate with the petrol station in future.

Key words: Fire risk, Petrol Fuel Station (PFS), Gross Domestic Product (GDP), catastrophic, non-major hazard installations

INTRODUCTION

Incidents: Disaster or calamity always refer to the high toll of death in humans such severe accidents were Bhopal, India, Chernobyl, Russia, Mexico City, Santos, South Brazil and Sungai Buloh, Malaysia (Papazoglou *et al.*, 2000), the issue of risk disaster essentially related to the consequences of the incident especially in industrial (Zio and Aven, 2013), meanwhile in nuclear's risk has the earlier indicator category has a major accident for instance in a case of fukushima disaster (Aoki and Rothwell, 2013). Then again there is dependably an unfortunate mix-up and inquiry rises in which is the instability on the perspective of risk and do the structure adequate and workable. Moreover, what is the best apparatus to be

embraced to battle in settling on choice and does the structure suit for all industry. Along these lines, the necessity to study the risk assessment fundamental and evolution of the system must be done parallel with the developing of industry in the world.

History of risk assessment: Risk is one of the tools in decision-making, especially in the petroleum industry faces uncertainty of risk every day. Risk has been used as an early as 1940's during the World War II (WWII) on the risk of storage the explosives away from the barrack of army. Then in 1960s emerge of Probabilistic Reactor Analysis (PRA) which is focusing only on safety of nuclear reactor but not on the risk itself. In Addition in mid 1970's Quantitative Risk Assessment (QRA) has been

Corresponding Author: Mohd Shamsuri Khalid, Department Occupational Safety and Health of Malaysia, 56430 Putrajaya, Malaysia

establishing in answering 3 questions: What can go wrong? How likely is it? What are the consequences? It is a top down process. However, terminology of risk assessment stated as an overall process of estimating the magnitude of risk and deciding whether or not the risk is tolerable (ISO, 1996, 2000; HSE, 2000). Those codes and standards refer to the foundation of risk assessment is a subset of a risk management model which consists of: Hazard idenfication; risk assessment; risk control of the risk. In general, hazard identification is a tool to be used in searching for any potential danger by using methods such as survey, monitoring process, Hazop and so on. Meanwhile, risk assessment is used to analysis the hazards in which magnify the risk magnitude of the effect from the hazards. The tools are such as software safetrend, ALOHA 5.4 copert and caline 4. Furthermore, risk control is the process of countermeasure and mitigation of the effect occurred. The risk management is very subjective and can be improved from time to time. The process is a circular process in a one loop. It is unclear of the detail in explanation of the respective elements and the steps may vary from one researcher to another. Introduce 6 steps in risk management in marketing. In contra, Franks *et al.* (1995) contains only 5 steps and Prichett *et al.* (1996) 8 steps in risk in medicine whereby the process of suggested to a refine risk management paradigm. The arguments not just the procedure but the best precise of level in the risk analysis and the skeptical of unclear definition of the risk. Therefore, a simplify and holistic framework must be sought. Even thou, the risk management framework/model may vary from one organization to the other because it depends on the gold and target of the organization to achieve, process of the organization also gives a huge influence in determining the model of the risk management.

Now a days, over the 40 years of risk assessment has been used frequently in decision making and main three industry that involving in a nuclear power plant, space flight, chemical and petroleum process (Garrick and Christie, 2002). Meanwhile, those industries have been evolved for the selective of adopting a risk assessment methods including heavy industry (Bernatik and Libisova, 2004), chemical industry such process industry (Aqlan and Ali, 2014), oil and gas industry mainly offshore (Andersen and Mostue, 2010) and construction industry (Pinto, 2014). However, fewer researchers discussed on the vital of using the method or procedure to carry out the risk assessments. So, the need of a group of expertise to draw the outline of the risk, understand of the physical phenomenology of the specific risk, differ substances engulf and uncertainty of the risk.

According to Aven and Krohn (2014) to justify the method of risk assessment and knowing that it is dependable on the individual characteristic of industry. A risk always regards as an uncertainty that need to quantify by using 2 methods such as the traditionally Probabilistic Reactor safety (PRA) and quantitative risk assessment. However, Apostolakis (2004) find out that QRA must be given priority in decision making, as the due to the uncertainty of the risk, uncertainty of risk and the physical phenomenology of the risk. The probabilistic approach is the earlier approach been introduce for safety analysis on the safety risk analysis in metro construction, even thou new methods of quantitative risk assessment has been introduce a few years after that. PRA has been introducing in the 1960's in the technical safety especially in nuclear safety. The introduction of quantitative risk assessment has been introduced widely by the earlier researcher (Papazoglou *et al.*, 1992; HSE, 1989) whereby this evolving new method and procedural using QRA in risk assessment (Aneziris *et al.*, 2014). QRA is the method than regards to questions such as what? How? Why? And involving a process of top to down process.

Risk assessment in petroleum industry: In Europe, there is a query in with the researchers, managers and technical experts in using QRA in making decision the government and collaboration with DNV shell to set up a framework of the QRA in sevenso-directive 96/82/EC in this directive spell out of controlling of major accident hazard involving dangerous substances and the depth study has been ruled out. DNV Shell collaboration took up the challenge for oil and gas industry by using the QRA tool. The QRA has been used in chemical processing plant (midstream and upstream). However, seldom researchers use QRA in the downstream especially in petrol station. So, there is a crucial need of QRA in petrol station. Furthermore, risk assessment has been used rigorously worldwide in estimating of risk chemical storage regards to flammable and toxicity. Those substances include ammonia, fuels and PLG as discuss by CCPS (1995), ISO (1996, 2000) Papazoglou *et al.* (1992, 1996, 2000) and Ding *et al.* (2014). Those researchers focus study mainly on the chemical plant. However, researchers (Aneziris *et al.*, 2014; Yun *et al.*, 2009; Landucci *et al.*, 2012; Tugnoli *et al.*, 2012) discussed prolong into the risk assessment on the severity effect on LNG installation which is midstream and downstream of petroleum industry. Meanwhile, a researcher studied on the risk assessment on transportation of chemicals (CCPS, 1995). Mostly of the risk engulfing in the area of major hazard installation whereby the substance store more than its threshold limit considered as major hazard installation.

Fewer researchers focusing on downstream of petroleum industry such as petrol station. Petrol station considers as a hazardous and risk area not just onsite but also offsite by Srivastava *et al.* (2005), Walmsley (2012), Cornilier *et al.* (2012). Mostly of the risk assessment focusing on the risk of the chemical exposure such as Volatile Organic Compound (VOCs), Toluene and Xylene in the higher concentration of the substances in which could caused death to the humans and pollute the environment by Udonwa *et al.* (2009), Bindhya *et al.* (2010) and Singaraju *et al.* (2012). Beside that, there is also some pose of hazard due to the leakage of the fuel out of its containment which effect to the environment (Oh and Nam, 2014).

Therefore, due to less researchers on this area and a new paradigm of research should focusing mainly in downstream of petroleum industry such as petrol station need to be further study and clarify on the severity and impact of fire to humans and environments engulfing the petrol station even thou it's not consider as a major hazard installation under legislation. The Loss Of Containment (LOC) of consequences analysis subset of the risk assessment should look into in the future research. This review study highlights the Loss of Containment (LOC) under consequences method of risk assessment of fire explosion at petrol station evolving for the last 4 decades. Base on this noteworthy research will give a vividly understanding of phenomenology of fire explosion vicinity of petrol station.

Type characteristic of risk assessment: Risk assessment contains 2 main pillars; qualitative methods which involve of quantify the level of risk in the factor of safety purpose. Such tools are Failure Mode and Effect Analysis (FMEA), HAZOP and so on. Quantitative method is processes of calculating frequency of accident such tools are Dow indices, Fault Tree Analysis (FTA) and so on (Papazoglou *et al.*, 1992). This QRA is the essential of risk assessment for generic process so individual risk assessment will depend on the hazards, phenomenon of the physical installation, differ substance engulf. So, there is a need in using Loss of Containment (LOC) in consequences analysis in decision making of the severity effect to people surrounding area of the petrol station. This loss of containment the trigger of this procedure is of the underground storage, study o the loss of thickness of the vessel due to corrosion factors could eventually cause the loss integrity of the vessel and the instantaneous of outflow of the substances which caused a fire explosion. The procedure of the Loss of Containment (LOC); substance classification, quantity release, operation model, release site, incident cause and mitigation.

Methods in decision making in petrol station: Risk assessment should be adopted and used for the downstream in answering the question of What? How? and Why?. Therefore, Table 1 showed studies have been carried out on the risk assessment in the petrol station whereby indicated a significant researched on risk at petrol station. The methodology used in quantifies risk engulfing the petrol station. Mostly studies were conducted on the new framework of risk assessment, methodology, investigate the phenomenology of risk, humanity/sociology, monitoring on the real-time of containment and chemical exposure which could harm to surrounding area, replenishment case study in quantify earlier detection before become disaster. However, fewer researchers done one the consequence of the store substance could pose hazard not just onsite but offsite (Table 1).

Chemical exposure in petrol station: Petrol station frequently related to research which Volatile Organic Compound (VOCs) and release of chemical substance to atmospheric could harm not just to humans but also to environment (Majumdar *et al.*, 2008) and health risk assessment (Kitwattanavong *et al.*, 2013) has been done to workers at petrol station which harm to human. Otherwise its vapour exposure cause of cytogenic risk especially benzene, toluene (Bindhya *et al.*, 2010; Singaraju *et al.*, 2012) among the workers. According to Jakobsson *et al.* (1993) attendants in petrol station have a tendency of getting Acute Myeloid Leukemic (AML) which is a prolong to health risk. Meanwhile (Celik *et al.*, 2003) researched on the effect of the chemical exposure which could effected of mutagenesis for exposure of attendants to fuel. Furthermore, exposure of chemical such as bezene in petrol by using sample in urine due to attendants (Weng *et al.*, 2008). Basically all the researchers were focusing on the chemical exposure that caused severity effect not just to worker at petrol station but people surrounding the petrol station such as residents, passerby and environment.

Type of of fire in petrol station: Petrol station is the hazardous are whereby containment of chemical of unleaded fuel, diesel and natural gas. According to guideline the hazard may pose a risk factor with the existing of the triangle of fire such as ignition oxygen and heat. Therefore, study of risk pose must be to be look in to. Furthermore, fire is a hazard which could do harm to peoples, damage to property and environments. The electrostatic charge due to plastic pipeline (Walmesly, 2012) sometimes could trigger a fire. Meanwhile, fire cum with explosion in LNG storage tank where store a very

Table 1: List of the methods in researched of petrol station

Years	Summary/Methods	Result/Finding
2001	Experimental study: investigates into the distribution of hydrocarbon concentrations in underground tank	Delivery rates of up to 200 l/min so far permissible that volumes with explosive atmosphere are formed in underground storage tanks (Frobes, 2001)
2007	Remote real-time monitoring and control of contamination in underground storage tank systems of petrol products	System can diagnose the leakage and start remediation by a specific soil venting process (Sacile, 2007)
2007	Modeling system :copert and caline 4	A consequence, the population living in the vicinity (of the examined urban location) is exposed to an additive concentration ranging from 3-6 mg/mg³ increasing the leukemic risk caused by benzene alone from Karakitsios *et al.* (2007)
2007	Laboratory study case study on the bioremediation of diesel oil contaminated soil	Bioremediation strategies enhanced the natural of bioremediation of the contaminated soil and treatment nutritional amendment (Mariano *et al.*, 2007)
2008	Develop an algorithm for the petrol station replenishment	Algorithm best usage to distributor to acquire a loading and routing optimization computerized module which has been integrated within their enterprise resource planning system (Cornillier *et al.*, 2008a, b)
2009	Parametric analysis by using daily rain-fall data from 2 weather stations, different roof areas, rainwater tank capacities and rainwater demands	Using rainwater for washing vehicles in petrol stations in Brasilia is a feasible investment for most cases as the net present value is and potable positive for an interest rate of 1% per month (Ghisi *et al.*, 2009)
2010	Investigation and experimental on one-hundred-and-five Radiello; passive samplers (RAD130.Cartridge Adsorbent and RAD120 diffusive Bodie, Sigma Aldrich, Inc., St. Louis, Missouri (US)) were used to measure VOCs in the urban are	The spatial influence of petrol stations on their surroundings based on the fact that the concentration ratio of n-hexane and benzene found in the air of the petrol stations is different from that found in city air (mainly determined by motor vehicle exhaust) (Morales)
2010	Mathematically solution in tri packing for replenishment	Generalized version of the trip packing problem, gave a mathematical formulation of the problem, developed heuristic solution procedures to solve it and presented a computational experiment to assess the quality of the solutions obtained by these heuristics (Cornillier *et al.*, 2009, 2012)
2011	Set out a method for evaluating environmental impacts in the area of gas station	A theoretical basis for developing the model which by using indicators for the assessment categories: human contamination, contamination of the soil and groundwater, fire and hazardous solid waste, evaluated the real environmental situation of two gas stations (Rocha *et al.*, 2011)
2011	Develops safety and risk assessment framework by using actual field data related to hazard contributing factors at PFS	Top most hazards contributing use recorded was carelessness. Risk calculated due to carelessness at PFS is 49.28%. 2nd most significant factor was slips, tips and falls. It achieves risk value of 28.70. 3rd top most risk oriented contributor was miscellaneous cases (Ahmed *et al.*, 2011)
2013	Numerical solution: Volatile Organic Compounds (VOCs) leak into the atmosphere due to the evaporation of liquid fuels	Benzene's hazardous area was the largest calculated amongst all com-pounds even for evaporation rate at source equal to 0.1% that of n-pentane's
2013	Personal Sampling: health risk of petrol station workers from exposure to BTEX and carbonyl compounds	Levels of the 4 most prevalent compounds (benzene, ethyl benzene, formaldehyde and acetaldehyde) were used to assess the lifetime cancer risk and 95% confidence interval of the risk levels were found to be totally higher than acceptable criteria for benzene $(1.82\times10\text{-}4\text{-}2.50\times0\text{-}4)$, formaldehyde $(7.81\times10\text{-}6\text{-}1.04\times10\text{-}5)$, ethylbenzene $(4.11\times10\text{-}6\text{-}5.52\times10\text{-}6)$ and acetaldehyde $(1.39\times10\text{-}6\text{-}2.45\times10\text{-}6)$ (Kitwattanavong *et al.*, 2013)
2014	Investigate and experimental if pressures and flow rates occurring in road- tanker petrol-station systems during the delivery of petrol	Gas displacement pipe will be discharged to the atmosphere when the storage-tank system is opened in order to connect the hoses. Extent depends on the flow resistances in the gas displacement system and the resulting excess pressure in the venting system (Frobese, 1998)
2014	Study case; investigate the quantify the petroleum hydrocarbon contamination in the subsoil of the studied petrol stations	pH values in hydrocarbon contaminated subsurface are lower than in background subsurface. Geochemical instrumental techniques GC-MS and GC-FID have showed to be very adequate and reliable to quantify volatile organic compounds and semi-volatile organic compounds in gasoline and diesel, after performing a correct set up (Rosales *et al.*, 2014)

large quantity of amount of LNG, its an instantaneous release could cause disaster (Dan *et al.*, 2014). Jet fire and explosion researched (Zhiyong *et al.*, 2010) from the release of gas hydrogen at gas station will immediately transform to a jet fire. However, Boiling Liquid Expanded Vapour Explosion (BLEVE) in the storage in chemical process industry (major hazard industry) (Abbasi and Abbasi, 2007) but rare research on petrol station. In a case of pool fire on the wagon storage tank could occur (Lautkaski, 2009).

However, rare research done on the consequence analysis of fire hazard specifically in the petrol station as previous researched keener on the VOCs and chemical exposure to people onsite and offsite. The consequences risk analysis on chemical process industry is widely use (Han and Weng, 2011; Voort *et al.*, 2007). Those research discuss on the model and effect. But there is a gap on the consequences and severity effect of fire to surrounding area vicinity of petrol station. Furthermore, there is also a rare research mainly focusing on the perception of risk amongst the workers of the petrol station. The perception of risk amongst the workers is vital in petrol station so that they have some information of the risk might pose by the petrol station and prepare their mental and themselves for any unsuspected of failures or incidents engulf to petrol station.

By referring to the previous and latest research on the evolution of risk management in which focusing in the risk assessment from as early in 1930's until today. The information been gathered and analysis the methods, experiments, observation of case study especially engulf to petrol station. This study generally discussed on the terminology of risk management, explanation of risk itself and the range of risk tools has been introduced in the chemical industry (major hazard installations). According to the literature, the most researched been carried out is the health risk aspect of chemical exposure such as benzene, toluene, xylene and other toxic chemical substances to the pump attendants as well as people living surrounding area. Beside that few research on the community at the business unit such as Internet cafe/restaurant adjacent to petrol station, transportation hazards and fuel leakage. Therefore, there is definitely a need to do research and investigate on the perception of risk among workers in petrol fuel station.

MATERIALS AND METHODS

Description of participant and context: The numbers of respondents are 32 persons. All of them are pump attendants/cashiers at the petrol station. They are workers at petrol fuel stations at Rawang. Why the respondents only 32 and by right of course might not justifiable to some researcher but each research strategic does employ different of approach of method in collecting data and analyzing empirical evidence based on its own logic to prove validity. Therefore, the strategy of the research is a qualitative with a case study approaches that base on the participants understanding, qualification of the worker's petrol station. Assume that the participants are sincere, fair and honest in answering the question based on their own experience working at the petrol station. A case study, a researcher must have indicated that the interviewees where every each of them are workers or have worked before at petrol station. This is vital in guiding the researcher focusing participants in understanding of the risk and perception of risk of fire towards the petrol station. This will help the research in doing analysis and to show any correlation of risk and its perception.

Research questions: This research is aimed using to do an empirical study approach to find out the answers to the following questions:

- What perceptions of risk among workers towards petrol fuel station
- Why workers have such perceptions
- What importance of risk towards workers at petrol fuel station

Data collection: In processing of collecting data, process of triangulation of data involve such as interviewing and taking photos in site and documents. Therefore, the purpose of interview is basically to study the perception of the workers of risk at petrol station which to see either they are truly understand the meaning of the risk itself or otherwise. The interview also can be category as investigate on the ethnic on the quality and validity of the interview and how to analyses and sure readability. Interview also is the detail discussion of the case for and weaknesses in audio recording and note taking of the unstructured interviewing in evaluation. The pilot set of questions (structure or semi-structure) will be drawn by the researcher intended to respondents in finding their view and knowledge of risk and its perception at petrol station. This is very important to the researcher ensuring of the reliability of the question before conducting interview with the workers.

Furthermore, taking photos in observant activity will give a general and overall overview of the risk and perception of risk towards petrol station. Actually taking photos is a classical text from visual anthropology exploring the use of photographs in social research. It's a method of discussion of the role and examine and function of the image-based research in qualitative research. The photographs will give thousands of information to research in guiding to understand scenario at petrol station. In addition, of documents such as design drawing, codes and guidelines are another process in focusing particularly on naturalistic observation as a major method within broader theoretical and historical discussion of the use of observation. This will give researcher a broader view in doing research especially in understanding of the risk and perception of the workers towards petrol station.

However, in the process of interview has been done at the site at petrol stations at rawang. A suitable place such as an office room where found safe and easy to carry out the interview. This is very important in ensuring that the participants feel ease while doing the interview, no disruption from others, recording will be much clearer. However, the only issue is the interview was conducted in Bahasa Malaysia which needs to be translated into English. Therefore, in translation will take some time in understanding the view of the interviewees. Interviewees were ready to answer the questions but due to their background education only at a level of primary school. They tried very hard to answers the question but sometimes tends to shy away in answering and depth elaboration of the question given. They also have some difficulties in elaborating the main point and the questions were given with a direct answer.

In the interview, question has been drawn for the both interviewee conducted that only that some point

which need some further clarification, unexpected new question rise to seek further view and insight of the interviewee. So, this question and answering will be complicated and need to be control to suit the objective of the research.

Data analysis: Software of NVIVO 10 has been chosen in doing a qualitative data analysis that produced by QSR International. It suitable for researcher working with a lot of information such as interview recorded, pictures, photos documents in data gathering and analysis to derive the findings.

Theme 1: What is risk? Analysis from the recording audio: showed that both of them (respondents) refer risk as safety and they both agree risk in petrol station is very important to address to for the safety of the workers. This risk mainly refers to the robbery. Therefore, research should been done in explaining the right term of risk whereby risk and risk have a different meaning.

Theme 2: Perceptions of risk among workers towards petrol fuel station and why workers have such perceptions. Analysis from the both respondents their perception of risk is very low and they always confuse with the safety. Therefore, the perception of risk must be established than the mitigation could be pre-plan and at early stage and the right information must be disseminating to the workers.

Theme 3: Importance of risk towards workers at petrol fuel station. They both strongly agree with the need for research of the importance of risk must be lies to the management and authority in ensuring the risk at petrol station can be minimize. The countermeasure and mitigation must be drawn and communicate the info to the workers.

Theme 4: Management and authority must be responsible in mitigate the risk. Both respondents agreed that the management and authority in must be responsible in doing mitigation and preparation of the plan to avoid risk from occurred. This is because only they have the knowledge, facilities and manpower in prepared the procedure and disseminate to the workers.

RESULTS AND DISCUSSION

As a result, the researcher found that both respondents from the interviewed that referring to the risk, they will imply strongly that the need of risk to be address to the workers in petrol station. Even thou the term of risk is frequently mistakenly refer to safety. Meanwhile, perception of the risk amongst the both respondents were a little bit blur but the important to them is there is the need to be consistently highlighted to be sort out such as information, knowledge of the risk and its perception must be informed and communicated to all the worker that worked in petrol station. This information actually must be drawn and formulated by the management and authority and put in place so that the workers understand and be prepared towards the risk that they faced while working in the petrol station. The only risk or risk been put forward is the safety of the petrol stations such as safety of the money kept by the cashier and petrol risk (no smoking while refueling their cars) and human attitudes towards the cashier. The risk is must be explained clearly. The danger of risk such as health, ergonomic, human risk also need to be address beyond the question been put forward to respondents. They are a few issues that need to be address to the management and authority in making the petrol station is soundly safe. Without management and authority in helping formulating and preparing the information, procedures and risk guidelines will cause a distress to the workers if there is any accidents occur in petrol station. They will failure to react and mitigate the problem in a short period. Therefore, these arguments must be established in finding the right interpretation or beyond of the understanding of the risk and its perception towards the workers in petrol station. The in-depth interview is the best tool in studying and dealing with the issues raised to ensure that the risk of petrol station could be address properly.

However, it is best way to formulate the guideline and disseminates the risk information to all workers about the risk and its perception before they agree to work at petrol station as a hazardous premise.

CONCLUSION

The researcher found that this interview is a suitable method and effectively in gathering and answering beyond about the information about the research question that have been put forward before the researched been done. However in the process of carried out to do interviewed which involved questions and answers is very difficult to get the right and suitable answers. Furthermore, there were few limitations had been encountered by the researcher which the number of the respondents was may not sufficient enough to the give a vividly generalize of the issued rise, the time of carried out the interviewed was very short due to the commitment of the respondents to the time of works where the research found that is very difficult in getting the answering in a

good manner. In addition, monitoring of the sign from body language of the respondents they are not 100% willing to give answering when referring to the failure if the management. This also added up that their feeling of the works is the only source of family's income that if they gave the wrong answer will reflect negatively to their management. Furthermore, their background as mention at highest level was finished at a level of primary school may give them a difficulty in understanding the questions that been put forward to them and actually a simple and straight forward questions should be or must be drawn. Nevertheless, the objective is achieved and the researcher is very keen in gathering information from the both respondents as a pilot test in understanding the process of doing the interviewed and preparing the data in supporting documents in the proposal defend in the future. This primary data will be used in ensuring that there is a significantly indeed to understanding and explore beyond of the risk and its perception among the workers at.

REFERENCES

Abbasi, T. and S.A. Abbasi, 2007. The boiling liquid expanding vapour explosion (BLEVE): Mechanism, consequence assessment, management. J. Hazard. Mater., 141: 489-519.

Ahmed, M.M., S.R.M. Kutty, A.M. Shariff and M.F. Khamidi, 2011. New and improved safety and risk assessment model for petrol fuel station. Proceedings of the Conference on National Postgraduate Conference (NPC), September 19-20, 2011, IEEE, Malaysia, ISBN:978-1-4577-1882-3, pp: 1-10.

Andersen, S. and B.A. Mostue, 2010. Risk analysis and risk management approaches applied to the petroleum industry and their applicability to IO concepts. Saf. Sci., 50: 2010-2019.

Aneziris, O.N., I.A. Papazoglou, M. Konstantinidou and Z. Nivolianitou, 2014. Integrated risk assessment for LNG terminals. J. Loss Prev. Process Ind., 28: 23-35.

Aoki, M. and G. Rothwell, 2013. A comparative institutional analysis of the Fukushima nuclear disaster: Lessons and policy implications. Energy Policy, 53: 240-247.

Apostolakis, G.E., 2004. How useful is quantitative risk assesment?. Risk Anal., 24: 515-520.

Aqlan, F. and E.M. Ali, 2014. Integrating lean principles and fuzzy bow-tie analysis for risk assessment in chemical industry. J. Loss Prev. Process Ind., 29: 39-48.

Aven, T. and B.S. Krohn, 2014. A new perspective on how to understand, assess and manage risk and the unforeseen. Reliab. Eng. Syst. Saf., 121: 1-10.

Bernatik, A. and M. Libisova, 2004. Loss prevention in heavy industry: Risk assessment of large gasholders. J. Loss Prev. Process Ind., 17: 271-278.

Bindhya, S., V. Balachandar, S. Sudha, S.M. Devi and P. Varsha et al., 2010. Assessment of occupational cytogenetic risk, among petrol station workers. Bull. Environ. Contam. Toxicol., 85: 121-124.

CCPS., 1995. Guideline for chemical process quantitative risk analysis. Chesterfield County Public Schools, Virginia, USA.

Celik, A., T. Cavas and S. Ergene-Gozukara, 2003. Cytogenetic biomonitoring in petrol station attendants: Micronucleus test in exfoliated buccal cells. Mutagenesis, 18: 417-421.

Cornillier, F., F. Boctor and J. Renaud, 2012. Heuristics for the multi-depot petrol station replenishment problem with time windows. Eur. J. Oper. Res., 220: 361-369.

Cornillier, F., F.F. Boctor, G. Laporte and J. Renaud, 2008. A heuristic for the multi-period petrol station replenishment problem. Eur. J. Oper. Res., 191: 295-305.

Cornillier, F., F.F. Boctor, G. Laporte and J. Renaud, 2008. An exact algorithm for the petrol station replenishment problem. J. Oper. Res. Soc., 59: 607-615.

Cornillier, F., G. Laporte, F.F. Boctor and J. Renaud, 2009. The petrol station replenishment problem with time windows. Comput. Oper. Res., 36: 919-935.

Dan, S., C.J. Lee, J. Park, D. Shin and E.S. Yoon, 2014. Quantitative risk analysis of fire and explosion on the top-side LNG-liquefaction process of LNG-FPSO. Process Saf. Environ. Prot., 92: 430-441.

Ding, L., L. Zhang, X. Wu, M.J. Skibniewski and Y. Qunzhou, 2014. Safety management in tunnel construction: Case study of Wuhan metro construction in China. Saf. Sci., 62: 8-15.

Franks, P.J., M.I. Oldroyd, D. Dickson and E.J. Sharp et al., 1995. Risk factors for leg ulcer recurrence: A randomized trial of two types of compression stocking. Age Ageing, 24: 490-494.

Frobese, D.H., 1998. Pressures and flow rates occurring in road-tanker-petrol-station systems during the delivery of petrol. J. Hazard. Mater., 62: 199-210.

Garrick, B.J. and R.F. Christie, 2002. Probabilistic risk assessment practices in the USA for nuclear power plants. Saf. Sci., 40: 177-201.

Ghisi, E., D.D.F. Tavares and V.L. Rocha, 2009. Rainwater harvesting in petrol stations in Brasilia: Potential for potable water savings and investment feasibility analysis. Resourc. Conserv. Recycl., 54: 79-85.

HSE., 1989. Quantified risk assesment: Its impact to decision making. Health And Safety Executive, HMSO, London, England.

HSE., 2000. Designing and operation safe of chemical process. Health And Safety Executive, HMSO, London, England.

Han, Z.Y. and W.G. Weng, 2011. Comparison study on qualitative and quantitative risk assessment methods for urban natural gas pipeline network. J. Hazard. Mater., 189: 509-518.

Holden, M.T. and P. Lynch, 2004. Choosing the appropriate methodology: Understanding research philosophy. Marketing Rev., 4: 397-409.

ISO., 1996. 14001: Environmental management standard. International Organization for Standardization Standards Organization, Geneva, Switzerland.

ISO., 2000. 17776: Petroleum and natural gas industries-offshore production installations-guidelines on tools and techniques for hazard identification and risk assessment. International Organization for Standardization Standards organization, Geneva, Switzerland.

Jakobsson, R., A. Ahlbom, T. Bellander and I. Lundberg, 1993. Acute myeloid leukemia among petrol station attendants. Arch. Environ. Health Intl. J., 48: 255-259.

Karakitsios, S.P., V.K. Delis, P.A. Kassomenos and G.A. Pilidis, 2007. Contribution to ambient benzene concentrations in the vicinity of petrol stations: Estimation of the associated health risk. Atmos. Environ., 41: 1889-1902.

Kitwattanavong, M., T. Prueksasit, D. Morknoy, T. Tunsaringkarn and W. Siriwong, 2013. Health risk assessment of petrol station workers in the inner city of Bangkok, Thailand, to the exposure to BTEX and carbonyl compounds by inhalation. Hum. Ecol. Risk Assess. Intl. J., 19: 1424-1439.

Landucci, G., G. Antonioni, A. Tugnoli and V. Cozzani, 2012. Release of hazardous substances in flood events: Damage model for atmospheric storage tanks. Reliab. Eng. Syst. Saf., 106: 200-216.

Lautkaski, R., 2009. Evaluation of BLEVE risks of tank wagons carrying flammable liquids. J. Loss Prev. Process Ind., 22: 117-123.

Majumdar, D., C. Dutta, A.K. Mukherjee and S. Sen, 2008. Source apportionment of VOCs at the petrol pumps in Kolkata, India: Exposure of workers and assessment of associated health risk. Transp. Res. Part D. Transp. Environ., 13: 524-530.

Mariano, A.P., A.P.D.A.G. Kataoka, D.D.F.D. Angelis and D.M. Bonotto, 2007. Laboratory study on the bioremediation of diesel oil contaminated soil from a petrol station. Braz. J. Microb., 38: 346-353.

Oh, J.S. and C.W. Nam, 2014. A design of risk analysis system based on zone in real-time environment. Adv. Sci. Technol. Lett., 52: 27-32.

Papazoglou, I.A., G.S. Bonanos, Z.S. Nivolianitou, N.J. Duijm and B. Rasmussen, 2000. Supporting decision makers in land use planning around chemical sites: Case study; Expansion of an oil refinery. J. Hazard. Mater., 71: 343-373.

Papazoglou, I.A., M. Christou, Z. Nivolianitou and O. Aneziris, 1992. On the management of severe chemical accidents DECARA: A computer code for consequence analysis in chemical installations. Case study: Ammonia plant. J. Hazard. Mater., 31: 135-153.

Papazoglou, L.A., O. Aneziris, G. Bonanos and M. Christou, 1996. SOCRATES: A computerized toolkit for quantification of the risk from accidental releases of toxic and-or flammable substances. Intl. J. Environ. Pollut., 6: 500-533.

Pinto, A., 2014. QRAM a qualitative occupational safety risk assessment model for the construction industry that incorporate uncertainties by the use of fuzzy sets. Saf. Sci., 63: 57-76.

Prichett, S.T., T.T. Schemit, H.I. Doerpinghaus and J.L. Athearn, 1996. Risk Management and Insurance. 7th Edn., West Publishing Company, Eagan, Minnesota, ISBN:9780314064271, Pages: 785.

Rocha, S.P.B., J.O.E. Soares and D.D.D. Medeiros, 2011. A model for evaluating environmental impacts in gas stations. Manage. Environ. Qual. Intl. J., 22: 803-825.

Rosales, R.M., P. Martinez-Pagan, A. Faz and J. Bech, 2014. Study of subsoil in former petrol stations in SE of Spain: Physicochemical characterization and hydrocarbon contamination assessment. J. Geochem. Explor., 147: 306-320.

Sacile, R., 2007. Remote real-time monitoring and control of contamination in underground storage tank systems of petrol products. J. Clean. Prod., 15: 1295-1301.

Singaraju, M., S. Singaraju, R.N. Parwani and S.P. Wanjari, 2012. Cytogenetic biomonitoring in petrol station attendants: A micronucleus study. J. Cytol., 29: 1-5.

Srivastava, A., A.E. Joseph, A. More and S. Patil, 2005. Emissions of VOCs at urban petrol retail distribution centres in India (Delhi and Mumbai). Environ. Monit. Assess., 109: 227-242.

Tugnoli, A., G. Landucci, E. Salzano and V. Cozzani, 2012. Supporting the selection of process and plant design options by Inherent Safety KPIs. J. Loss Prev. Process Ind., 25: 830-842.

Udonwa, N.E., E.K. Uko, B.M. Ikpeme, I.A. Ibanga and B.O. Okon, 2009. Exposure of petrol station attendants and auto mechanics to premium motor sprit fumes in Calabar, Nigeria. J. Environ. Public Health, 2009: 1-5.

Voort, M.M.V.D., A.J.J. Klein, D.M. Maaijer, V.D.A.C. Berg and V.J.R. Deursen *et al.*, 2007. A quantitative risk assessment tool for the external safety of industrial plants with a dust explosion hazard. J. Loss Prev. Process Ind., 20: 375-386.

Walmsley, H.L., 2012. Electrostatic ignition hazards with plastic pipes at petrol stations. J. Loss Prev. Process Ind., 25: 263-273.

Weng, H.H., S.S. Tsai, H.F. Chiu, T.N. Wu and C.Y. Yang, 2008. Childhood leukemia and traffic air pollution in Taiwan: Petrol station density as an indicator. J. Toxicol. Environ. Health A., 72: 83-87.

Yun, G., W.J. Rogers and M.S. Mannan, 2009. Risk assessment of LNG importation terminals using the bayesian-LOPA methodology. J. Loss Prev. Proc. Ind., 22: 91-96.

Zhiyong, L., P. Xiangmin and M. Jianxin, 2010. Quantitative risk assessment on a gaseous hydrogen refueling station in Shanghai. Intl. J. Hydrogen Energy, 35: 6822-6829.

Zio, E. and T. Aven, 2013. Industrial disasters: Extreme events, extremely rare: Some reflections on the treatment of uncertainties in the assessment of the associated risks. Process Saf. Environ. Prot., 91: 31-45.