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ASSESSING RISKS AND IMPLEMENTING SOLUTIONS SERIES

Risk Assessment and Disaster Management at Petrol Stations

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Abstract

Petrol stations are classified as hazardous workplaces due to the presence of flammable substances, such as petrol and diesel, which are stored underground in tanks. These substances pose risks to employees, employers, the public, property, and the environment. Handling flammable and hazardous materials at petrol stations can lead to fire and explosion hazards. Risk assessment is a crucial process that involves estimating the level of risk and determining whether it is acceptable or tolerable. The government advises petrol station operators to comply with the Petroleum Safety Measure Act 1984 in order to mitigate the risk of dangerous incidents on their premises. This article emphasizes the importance of petrol stations being prepared for disasters or crises and highlights the need for all stakeholders to have a clear understanding of risk and emergency response plans to promote best practices, particularly in Malaysian petrol stations.

Keywords: gas station, petrol filling station, fire safety, explosion

INTRODUCTION

Crude oil, petroleum products, and natural gas are the primary energy sources in Malaysia (Saari et al., 2018). Industrial, residential, and commercial sectors account for 51.7% of Malaysia's total oil demand. The demand for petroleum products in terms of energy consumption is growing at a rate of 4.5% per year. The transportation sector is the largest consumer of energy in Malaysia. Petrol stations play a crucial role in supplying these essential energy sources to consumers, not only in Malaysia but also worldwide. Apart from fuel and lubricants, petrol stations often offer additional services such as automobile accessories and parts sales, food and beverage sales, car servicing and washing, as well as vehicle accessory and part installation or repair (Saari et al., 2016). Common dangerous chemicals found at petrol stations, which can be potential air contaminants, include unleaded petrol, premium unleaded petrol, diesel, and compressed natural gas (Anuar et al., 2022).

In Malaysia, petrol stations attract public attention, regardless of whether they are located in urban or rural areas. The increasing availability of convenience facilities at petrol stations, such as ATMs, cafes, fast food outlets, car washes, Suraus (prayer rooms), and sundry shops, has attracted more visitors. As a result, petrol stations have become not only a place for refuelling vehicles but also a hub for various activities. With the growing number of visitors, the risk of fire incidents at petrol stations has also increased.

Handling flammable and hazardous materials at petrol stations can lead to fire and explosion hazards. These materials possess properties such as volatility, high flammability, explosiveness, and the ability to release vapors even at low temperatures (Luo et al., 2022). Therefore, when addressing risks associated with petrol station operations, it is crucial to have comprehensive knowledge that can help mitigate and eventually eliminate the effects of these primary hazards. Operating a petrol station entails risks to individuals, the environment, property, and reputation.

In recent years, various incidents involving petrol stations, including those in Malaysia, have been reported by the media. These incidents have resulted in property damage, injuries, and even fatalities. One notable recent event was the explosion and fire incident in Rantau Panjang, Kelantan, which was caused by static electricity resulting in the formation of sparks due to unbalanced electric charges on or within a conducting substance.

Risk assessment is a valuable approach for identifying and estimating the risk of fires and explosions from the entire layout of a petrol station in Kota Bharu, Kelantan, including the toilets, underground storage tanks, petrol pumps and retail area. Thus, an effective risk management framework was developed to highlight the hazards and risks so the operations at the petrol station would be inherently safer (Salleh et al., 2021).

Environmental, Safety & Health (EHS) Implementation among Petrol Station

The Petroleum Act (Safety Measures) 1984 (PSMA 1984) was established to ensure safety in the transportation, storage, and utilization of petroleum. The act covers various provisions concerning the transportation of petroleum via road, railway, water, air, and pipelines. It also addresses the storage, handling, and utilization of petroleum, including equipment, buildings, and materials.

Petrol and diesel are the most commonly found chemicals in gas stations. These fuels are typically stored in large quantities underground at petrol stations. As flammable materials, petrol and diesel can pose a risk of explosions if proper safety measures are not followed by operators, employees, and consumers at petrol stations.

In the state of Kelantan, there are a total of 175 petrol stations, with the highest number located in Kota Bharu, accounting for 62 stations. Records of accidents related to petrol stations in Kelantan indicate that three incidents have occurred from 2014 to 2022. These incidents have resulted in injuries, vehicle damage, and damage to the petrol station itself. Compliance with the rules outlined in the PSMA can help reduce the risk of such dangerous events.

Petrol station operators are required to adhere to seven inspection elements, which can be categorized into administrative and physical inspections. Administrative elements, such as safety management and the provision of personal protective equipment, can be managed through administrative measures. Physical inspection elements include unloading from road tankers, physical safety measures, underground storage tanks, dispensing areas, and emergency response plans. These inspections are essential to ensure the safety and proper functioning of petrol stations.

Disaster Management

A disaster is an incident that occurs suddenly, is complex in nature, and results in the loss of lives, damage to property or the environment, and disruption of daily activities in local communities. Disasters can happen at any time and in any place, and they are unavoidable. However, the impact and losses caused by disasters can be reduced through the effective management of disaster information (Torani et al., 2019; Salleh et al., 2021).

Disaster management is the process of effectively preparing for and responding to disasters. It involves the strategic organization of resources to minimize the harm caused by disasters. It also encompasses a systematic approach to managing the responsibilities of disaster prevention, preparedness, response, and recovery (Qonono, 2019). By implementing proper disaster management practices, communities can enhance their ability to mitigate the effects of disasters and improve their overall resilience.

Fire Hazard at Petrol Station: Fire Risk Assessment

In evaluating a fire risk assessment, it is crucial to identify the fire hazards and risks present in a petrol station. This ensures that owners and petrol station workers are aware of the potential hazards and risks that could arise in the event of any incident. After collecting data on the hazards specific to the petrol station, decisions must be made to mitigate and control these hazards. It is important to have competent individuals with extensive knowledge and experience in fire safety to provide guidance and advice to the premises owner during the fire risk assessment process (Spinardi & Law, 2019).

The fire risk assessment process typically involves five stages. Firstly, the fire hazards within the petrol station need to be identified. Secondly, the people who may be at risk in the event of a fire, including workers and customers, must be identified. Thirdly, the level of risk associated with each identified hazard needs to be evaluated, considering factors such as likelihood, potential consequences, and the vulnerability of individuals at risk. Fourthly, data collection is conducted, gathering relevant information to support the risk assessment process. Finally, the data collected is reviewed, analyzed, and revised as necessary to ensure continuous improvement and effectiveness (Akashah et al., 2017).

Stages of Fire Risk Assessment: Identify Fire Hazard

In the event of a fire incident at a petrol station, the presence of ignition, fuel, and oxygen is necessary for a fire to occur. This three-component model is commonly referred to as the fire triangle, and the removal of any one of these components would reduce the risk of a fire incident (Shimada et al., 2022). It is important to note that the capacity of a powder fire extinguisher may not be sufficient for extinguishing a fire involving hydrocarbon products due to their chemical properties. Instead, a high-pressure foam fire extinguisher is often needed to effectively put out the fire (Liu et al., 2022).

The second stage in fire risk assessment involves determining the origin of the fire. In a petrol station, there are various potential sources of fire, including solid, liquid, and gas materials. Solids such as textiles, wood, papers, and waste materials can serve as fuel sources. Liquids such as solvents, petrol, diesel, and adhesives are also present. Additionally, gases like liquid petroleum gas (LPG) and acetylene can be found in a petrol station (Sharma et al., 2022).

Abundant oxygen is another factor contributing to the fire hazards in a petrol station. While oxygen is present in all premises, petrol stations pose a higher risk of fire ignition due to the presence of hydrocarbon liquids, which are highly susceptible to fire. When combined with potential sources of ignition, such as hot surfaces, naked flames, sparks from activities like grinding or welding, friction, sparks, or deliberate arsonist actions, the chances of a fire incident occurring increase (Health and Safety Executive, 2022).

Stages of Fire Risk Assessment: People at Risk

In the event of a fire, the ingestion of fire and smoke by victims often leads to fatalities, even before the fire directly reaches and burns them. Therefore, ensuring the availability of adequate escape passages should be the main priority to prevent casualties. All premises should have well-designed escape routes that enable occupants to evacuate the scene before the fire spreads, utilizing all available exits (Health and Safety Executive, 2022).

When assessing fire risks, it is important to consider factors such as the speed of fire growth, the heat generated by the fire, and the smoke it produces, as each type of fire behaves differently. In the fire risk assessment, it is essential to take into account not only the safety of employees but also that of contractors, visitors, and the general public, who are categorized as "relevant persons" under the fire safety order. Adequate arrangements should be made to provide clear instructions in the event of a fire, disseminate danger rapidly, and utilize alarm systems and fire detection methods as necessary. Informing all "relevant persons" about the fire and ensuring they possess the necessary capabilities to escape quickly, easily, and safely is of utmost importance.

Stages of Fire Risk Assessment: Evaluating The Risk

To reduce the risk of fire hazards, it is important to implement actions that bring the risk to an acceptable level. Various measures can be taken to prevent ignition, such as turning off the engine while transferring hydrocarbons into vehicles, avoiding the use of mobile phones that can potentially produce sparks, and refraining from smoking cigarettes while using the pump. These measures, along with other preventive actions, should be considered to minimize the possibility of ignition (Akashah et al., 2017).

Minimizing the presence of fire-prone items in the premises is also crucial in reducing the risk of burns. Discarding unnecessary items,

particularly waste materials, helps decrease the fuel source, thereby reducing the potential for the fire to spread. Additionally, establishing an emergency response team can aid in controlling fires during the initial stages and ensure the safe evacuation of premises occupants to designated assembly sites (Akashah et al., 2017). By conducting risk assessments at an early stage and implementing preventive and remedial measures, the likelihood of fire incidents occurring can be significantly reduced. Early intervention and proactive measures play a critical role in preventing and mitigating fire risks.

Stages of Fire Risk Assessment: Record

It is important to maintain records of all significant findings from the previous stages of fire risk assessment. Premises should obtain the necessary licenses and comply with the requirements stated in the enactment and fire safety order. For large premises, providing easily understood floor plans along with proper risk assessments is mandatory. These floor plans serve as guidance for the floor commander during a fire incident, enabling them to evacuate occupants and rescue individuals trapped in a timely manner (Kuncoro et al., 2023).

In certain premises, there may be hazardous items that can increase the risk to both occupants and firefighting teams. It is essential to register and store these items in accordance with the appropriate requirements. For example, substances like Boron tribromide and Calcium carbide are highly explosive when they come into contact with water. Firefighters need specific information about these hazardous items to effectively respond to incidents involving them (Rielage, 2020).

Stages of Fire Risk Assessment: Review and Revising All Stages

Fire risk assessment is an ongoing process that requires regular monitoring and auditing to ensure its effectiveness (Shield Safety, 2016). It is crucial to keep the fire-risk assessment up to date and valid. If there are any indications that the assessment is no longer valid, such as after a near-miss incident or a significant change in the level of hazards on the premises, it should be re-evaluated.

Amendments to the fire-risk assessment may be necessary if there are changes in the premises, such as alterations to the layout that impact the availability of exits. If the occupancy increases and the existing exits cannot accommodate the larger numbers, additional exits may need to be constructed. Changes in the use of structures that pose an increased risk of fire, particularly those related to electrical causes, should also be taken into consideration. Any structural modifications must adhere to specified guidelines to prevent an increase in risk for all parties involved (Occupational Safety and Health Administration (OSHA), 2015).

Emergency Response Team (ERT) Set-up

The establishment of an Emergency Response Team (ERT) is mandated by the Occupational Safety and Health (OSH) Act of 1994, as stated in Part IV, Section 15 of the OSH Act 1994 and the Occupational Safety and Health (Control of Industrial Major Accident Hazards) Regulation 1996 (DOSH, 2002). The ERT is a specialized group formed by an organization to respond to emergency situations that may occur on its premises.

The primary role of an ERT is to respond effectively to emergencies, ensuring the safe evacuation of personnel, shutting down building services and utilities, collaborating with civil authorities in the response efforts, protecting and recovering property, and evaluating the safety of affected areas before re-entry. In the event of a major accident such as a chemical leak, release of hazardous gas, or workplace fire, the ERT works closely with relevant government authorities, such as the Fire and Rescue Department. Despite the limitations that may exist in utilizing ERTs, their impact in emergency situations is significant (Aziz et al., 2019; Pilemalm, 2020).

Psychological First Aid

Psychological First Aid (PFA) is a modular strategy based on scientific evidence that aims to provide support to children, teenagers, adults, and families in the immediate aftermath of disasters and terrorist attacks. The primary goals of PFA are to reduce early suffering and promote adaptive functioning in the short and long term (Brymer et al., 2006). It is important to note that PFA does not assume that all survivors will experience significant mental health issues or have long-term difficulties in recovering. Instead, it recognizes that individuals impacted by disasters will likely have a range of early emotions and experiences across physical, psychological, behavioral, and spiritual domains. Some of these emotions may hinder adaptive coping, and the support provided by caring disaster responders can aid in the recovery process.

One objective of PFA is to promote the well-being of employees, businesses, and profits. It can be applied in various settings, including petrol stations, where injuries, accidents, and crises may occur in different ways such as workplace hazards, natural disasters, or incidents involving violence, bomb threats, or suicide. Competent individuals, such as first responder teams, incident command systems, primary and emergency healthcare providers, or Community Emergency Response Teams (CERT), can deliver PFA according to its basic and simple principles (Brymer et al., 2006). These principles can be categorized into three main categories: Look, Listen, and Link. Table 1 provides an overview of the principles of PFA.

Table 1. Overview of The Principle of PFA

Look	- Observe safety. - Observe people with obvious urgent basic needs. - Observe people with serious distress reactions.
Listen	- Make contact with people who may need support. - Ask about people's needs and concerns. - Listen to people and help them feel calm.
Link	- Help people address basic needs and access services. - Help people cope with problems. - Give information. - Connect people with loved ones and social support.

Training plays a crucial role in ensuring that individuals are equipped to provide Psychological First Aid (PFA) effectively. It is important for trained individuals to have a comprehensive understanding of distress responses in crisis situations, the ability to identify symptoms and signals that require further intervention, and the knowledge of how to apply the principles of PFA (Amat & Ibrahim, 2018). It is recommended to provide PFA training to as many individuals as possible to enhance community resilience and reduce the emotional impact of disasters on individuals. Integrating PFA training into school health curriculums can help develop a larger pool of individuals capable of providing adequate support to those with emotional wounds during crises (Gillespie, 1963).

CONCLUSION

All hazards and risks should be managed as best as possible. All procedures and control measures should be followed and adhered to at all times. Training and competency development programs should be implemented on an ongoing basis. In managing issues relevant to disasters, several levels of action need to be implemented, namely, to prevent disasters from occurring, manage disasters when they occur, and decide what actions need to be implemented after the disaster.

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