

Snakebite Prevention and Management Action Plan for Petrol Filling Stations

M. M. Ahmed

Civil Engineering Department
Universiti Teknologi PETRONAS
Tronoh, Malaysia
drmirzamunirahmed@gmail.com

Mohd Faris Khamidi

Civil Engineering Department
Universiti Teknologi PETRONAS
Tronoh, Malaysia
mfaris_khamidi@petronas.com.my

S. R.M. Kutty

Civil Engineering Department
Universiti Teknologi PETRONAS
Tronoh, Malaysia
shamsulrahman@petronas.com.my

I. Othman

Civil Engineering Department
Universiti Teknologi PETRONAS
Tronoh, Malaysia
idris_othman@petronas.com.my

Abstract— Issues related to occupational health & safety is quite common at Petrol Filling Station (PFS) sites. It includes snakebites, electrocutions, fall/slips, fire/explosions, vehicle accidents, wind/rain storms and robbery. PFS are located all around the world to fulfill the fuel demands of nations. They are available in urban as well as rural areas. Problems related to occupational health safety vary from country to country and sometimes even from place to place. The present study was conducted in Pakistan to collect data related to unsafe acts and unsafe conditions in Company 'X' (not a true name as the permission to use their real name was not given). Company 'X' is a petrol filling station operator organization. It has more than 2500 PFS all over Pakistan. Besides, these PFS it also helps to meet the fuel demands of armed forces and airports. Six months data collected related to accidents, incidents and near misses from 2500 outlets. Total 674 unsafe acts and unsafe conditions were reported. 47 accidents, 137 incidents and 476 near misses recorded. All hazards were categorized by using Risk Assessment Criteria. Total 14 snakebite cases reported. Although, the probability of occurrences of snakebite cases found low but it got highest ranking as per risk assessment criteria. Snakebite found one of the most occurring causes that can lead up to fatality, if not treated properly. This study will elaborate the snakebite and prevention action plan for PFSs. This study will propose preventive actions against snakebite, snakebite control program and management of snakebite.

Keywords- Accidents, control, management, prevention, snakebite

I. INTRODUCTION

Petrol Filling Station (PFS) is a common facility available in urban and rural areas. Due to increase in number of vehicles and populations the growth in number of PFS is obvious. Pakistan has four provinces. i.e. Sindh, Punjab, Balochistan and North West Frontier Post (NWFP). The study mainly focused on PFS that were located in Sindh province. The Sindh region contains a number of venomous snakes. The two most common snakes in the region are Saw Scaled Viper and Russell's Viper. The other two venomous snakes found were Cobra and Common Krait. Most of the land spaces in Sindh province consists of agricultural areas. Therefore, the snakebite cases were mainly recorded at those PFS that were

located closer to agricultural areas. The incidence increased during the harvest time. Snakes are seen more often in the spring or fall as they search for food or move to and from a hibernation area. More than 80% of snakebites occur when a person is trying to kill or handle a snake. In general snakes are just as frightened by a person as possibly person frighten by them. Most of the snakebite cases reported during data collection were on ankle, feet and hands. The snakes observed during operation and maintenance stage at PFS are shown in Figure 1-3.



Figure 1: A Snake entered the PFS fuelling area and was killed by attendant.



Figure 2: The Snake was observed besides the boundary wall at PFS in rural area.



Figure 3: Snake was found closer to PFS.

II. LITERATURE REVIEW

Snake bite remains an important public health issue. It was reported in that the total incidences related to snakebite cases exceed five million per year [1]. A petrol filling station (PFS) is a facility most commonly available in urban and rural areas which sells fuel and lubricants for automobiles. Different countries know them with different names such as retail outlets, filling stations, gas stations, fuelling stations or service stations. PFS have harmful effects on surrounding area, water and air [2, 3]. Accidents due to occurrences of fire, explosions, transportation accidents and serious effects on human health was highlighted in a study conducted in France [4]. Commonly availability of snakes closer to PFS was reported in a report published by PSO (Pakistan State Oil) [5].

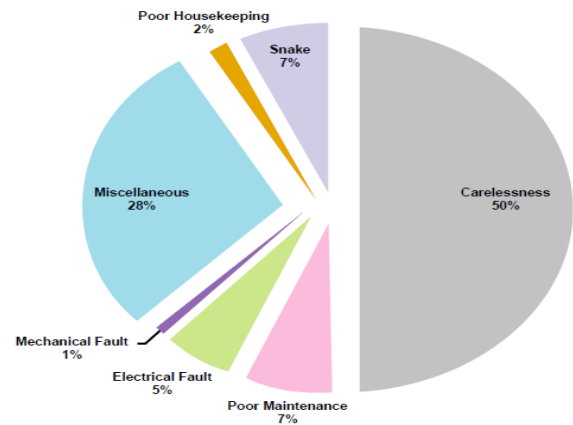


Figure 4: PSO Incident cause analysis [5]

As illustrated in Figure 4 during the year 2007 major accidents in PSO were reported in seven areas. Among them 7% cases were reported due to snakebite cases. Snake bites cases at PFS and other rural areas were also highlighted in [6, 7]. Fatalities cases due to snake bites were also reported in studies conducted by [8, 9].

III. PREVENTION AGAINST SNAKE BITE

During operation and maintenance of PFS, the snakes were found after sunset. Snakes reach the PFS due to darkness and less movement of people at the PFS. The necessary preventive measures that were found workable at PFS are described below;

- 1- Wear protective leather or rubber boots and trousers during walking at PFS area. Aim to protect your feet and ankles.
- 2- Keep your eyes open in snake – infested areas. Look where you are stepping.
- 3- Avoid walking in the dark, thick bushes and rocky places overgrowth with weeds.
- 4- Never work at PFS after sunset alone without adequate footwear and a torch.
- 5- Keep hands and feet out of areas you can't see. Don't pick up rocks or firewood unless you are out of a snake's striking distance. (A snake can strike half its length).
- 6- Be cautious and alert when climbing.
- 7- Wear gloves and look before placing your hands when collecting equipment, lifting pipes from ground.
- 8- Avoid sleeping on the ground.
- 9- Do not tease others with dead snake – it may not be dead enough!
- 10- Do not molest any snake – provocation may lead to snake biting.
- 11- Do not pick up a dead snake! It may only be injured, stunned or playing dead.
- 12- A recently killed snake may bite by reflex action.

In case if someone suddenly encounters a snake then don't run. Must walk around the snake; give it some room--at least six feet. Otherwise, walk away. Leave it alone and don't try to catch it. Many people are bitten when they try to kill a snake or get a closer look at it.

IV. SNAKE CONTROL PROGRAM

There are two forms of control measures that can be taken (nonlethal and lethal). The difference is that while nonlethal measures can be taken at any time, lethal measures can only be taken when a snake is seen. A few species of snakes in Pakistan are categorized endangered and are protected by Law.

The most commonly practiced non lethal forms of control are;

- 1- Snakes can be discouraged from staying in an area by cutting off their food supply and cover.
- 2- Reduce mulch layers around shrubs to about 2 to 3 inches in depth to discourage small animals.
- 3- Close cracks and crevices in buildings and around pipes and utility connections with 1/4-inch mesh hardware cloth, mortar or sheet metal.
- 4- All doors and windows should have tightly fitting screens.
- 5- At PFS areas and around boundary wall always maintain a good illumination.
- 6- Staff gathering areas like prayers area should always be secured and have good illumination.
- 7- Fumigation using high concentration of Deltamethrin in preferred location within PFS and its roof with thermal fogger and aerosol sprayer.
- 8- Snake proof fence: The fence is made up of ¼ inch mesh wire screening built up 30 inches and buried 6 inches underground. It should slant outward at a 30 degrees angle. Vegetation must be removed along the boundary wall/fence both inside and outside.
- 9- Chemical Repellent: Application of chemical repellent near the boundary wall / fence is helpful to stop snakes enter inside the area.
- 10- Snake Guard Snake Trap: This specific trap allows snake to enter and then become entrapped in special non toxic glue. This disposable trap gives an option of relocating the snake or disposing it.

Lethal Control measures are;

- 1- Venomous snakes should only be killed if their presence endangers humans.
- 2- Any snake found inside the fence should immediately be reported to the PFS in charge. The PFS in charge in turn inform the Snake Response Team.
- 3- The Snake Response Team will be responsible for capturing / killing snakes at site within the boundary wall/fence and should be properly trained in handling snakes and are provided with proper PPE's which includes, Snake Prong (Long handle Snake Capturing rod/ shovel), Long Boots, Rubber gloves, face mask, goggles, hand held powerful lights.
- 4- Selection of Snake Response Team should preferably be from the security guards (retired military) having past experience of working in snake infested area.

Attempts should be made to relocate the captured snake at a distance outside the boundary wall/fence area and killed snake should be buried under the ground.

V. MORPHOLOGICAL DIFFERENCES BETWEEN POISONOUS AND NON-POISONOUS SNAKES

The bites of poisonous and non-poisonous snakes leave different imprints on the skin of the victim. The fangs of the poisonous snake penetrate deep into the skin and leave two deep and distinct punctures. On the other hand, non-poisonous snakes leave a series of less deeper punctures. The bite of a poisonous snake causes swelling, heavy bleeding and discoloration of the skin while that of a non-poisonous snake does not cause any reaction. One can distinguish between poisonous and non-poisonous snake on the basis of the following morphological characteristics. The scales present on the ventral surface of the poisonous snakes are large and plate like while those of non-poisonous snakes are small in size. The head of the poisonous snakes possesses small scales, large shield and a pit, present between the eye and nostril. No such characteristic is found in non- poisonous snakes. In poisonous snakes the hard shield of the upper lip touches the shield of the eye and nose. No such arrangement of shield is present in non-poisonous snakes.

VI. CLINICAL FEATURES OF SNAKEBITE POISONING

Many victims are terrified and it is important to distinguish this from the symptoms of systemic poisoning. The symptoms of fright and anxiety occur immediately after the bite, whereas the symptoms of poisoning start 30 – 60 minutes later. Vomiting is an early sign of poisoning.

A. Viper Poisoning

The localized symptoms are prominent and severe. There is a great persistent pain and intense swelling at the site of bite. This is an important sign since its absence after a definite viper bite suggests that systemic poisoning is unlikely to follow.

- 1- Blisters extending up the limb are a sign of high venom dose.
- 2- The venom of viper contains several enzymes which may possibly act synergistically to produce shock, consumption coagulopathy, spontaneous hemorrhages in organs and tissues, acute necrosis and death.
- 3- There is a constant and incessant oozing of blood from the punctures. Sloughing occurs permitting other infections. The constitutional symptoms are characterized by hemorrhages both external and internal.
- 4- Hemorrhages in abdomen are responsible for pain, tenderness and vomiting. Death is due to heart failure, there is no paralysis.

B. Cobra & Krait Poisoning

- 1- Constitutional symptoms are more prominent then local pain and swelling.

- 2- General intoxication is soon followed by a sense of creeping paralysis beginning in the legs and also the head by way of trunk.
- 3- Paralysis of muscles of the eyelids, staggering gait, in coordination of speech, paralysis of the limbs, drooping of the head and complete paralysis of all voluntary muscles develop.
- 4- Nausea and vomiting frequently occur.
- 5- Breathing gets more and more difficult and finally stops.
- 6- In the case of Krait poisoning in addition there are convulsions and abdominal pain due to internal hemorrhages.
- 7- Swelling in Cobra bites develop after one or more hours and is less marked than Viper bites.
- 8- Neurotoxicity is first manifested by drooping of eyelids but later spreads to the swallowing and respiratory muscles.
- 9- In untreated serious systemic venomous poisoning death may occur in hours after Cobra / Krait bites and in days after Viper bites.

VII. MANAGEMENT OF SNAKEBITE

A. First Aid Measures

The aim of the first aid treatment is to limit the spread of venom to prevent it from reaching the central circulation and causing generalized poisoning. Contrary to the popular belief the snake venom spread through specialized vessel called Lymphatic vessel therefore cutting the bite site for allowing the bite site to bleed or blocking blood vessels to prevent venom to spread is of no use.

- 1- Stay calm, get safely away from the snake, and call someone.
- 2- The less the victim moves the bitten site, the less likely the venom will be spread through the body and cause damage.
- 3- Have the victim lie down with the affected limb lower than the heart. Keep the limb immobilized. If practical, splint the limb.
- 4- Wash the bite with soap and water (if available). Apply suction cup for 5 minutes. This step is not as crucial as the others. Suctioning seldom provides any measurable advantages, however.
- 5- Treat for shock and preserve body heat.
- 6- Remove any rings, bracelets, boots, or other restricting items from the bitten extremity. (It WILL swell.)
- 7- Apply a light constricting band about 2" above and below the bite, however never place the bands on either side of a joint (such as above and below the knee or elbow). This band should be made up of wide, soft material, which could be a handkerchief or shredded clothing. The band should only be as tight as the band the nurse applies when taking a blood test.

NOTE: The purpose of constricting bands is to restrict lymphatic flow, not blood, so they should not be too tight. Check pulses below the bands and readjust the bands as necessary when they tighten due to swelling.

Transport the patient as a stretcher patient to the nearest medical facility for antivenin (rarely needed), tetanus shot and antibiotics.

If the victim has to walk out, sit calmly for 20-30 minutes to let the venom localize at the site, then proceed calmly to the nearest source of help and try to avoid unnecessary exertion which will stimulate circulation of the venom.

B. Actions to Avoid

Following actions should be avoided in case of snakebite;

- 1- DO NOT cut the bite. The additional tissue damage may actually increase the diffusion of the toxins throughout the body.
- 2- DO NOT apply a tourniquet. Such action can result in the loss of the limb.
- 3- NEVER try to suck out the venom by mouth.
- 4- DO NOT apply cold and/or ice packs. Recent studies indicate that application of cold or ice makes the injury much worse.
- 5- DO NOT attempt to capture or kill the snake if it will cause delay in treating the victim or if it will expose others to danger. Many people have been bitten when trying to catch a snake that has bitten others – remember that snakes do not use all of their venom in only one bite.

Nearly all Snakebites are preventable and most snakebites are not dangerous

C. Observation

- 1- Observe the patient closely for sign and symptoms of envenomation which usually manifest between 15 minutes and 2 hours following the bite. In some cases the symptoms starts to appear later.
- 2- It is important that the patient be placed at rest, kept warm and avoid unnecessary movement.
- 3- If there is no sign and symptoms noted after 12 hours there is a possibility that the patient had received dry bite. (no venom injected).
- 4- Very slowly begin to remove the bandages and splint watching carefully for any changes in the patient's status. If any changes occur assume the patient has been envenomated. If swelling starts to increase reapply the bandage.
- 5- Monitor the patient for at least 24 hours.

D. General Consideration

- 1- The approach towards a patient with snakebite should be proactive rather reactive.
- 2- Intravascular Coagulation the chances of survival are reduced to only 10%.
- 3- The level of erythema / swelling in a bitten extremity should be marked and circumference measured in several locations every 15 minutes until swelling has stabilized.
- 4- Large bore intravenous access in the unaffected extremity should be obtained to handle the events if hypotension develops.
- 5- Fluid reuse citation with normal saline or Ringers Lactate should be initiated.

- 6- Blood should be drawn for laboratory evaluation including determination of PT, APTT, blood type and cross matching as soon as possible, before the effects of circulating venom interfere with typing.
- 7- Tetanus prophylaxis.
- 8- Depending upon the condition of patient following parameters should be monitored,
- 9- Complete Blood Count
- 10-Coagulation parameters (PT, APTT, Fibrinogen levels, Fibrin degradation products)
- 11-Serum electrolytes, BUN / Creatinine, Calcium, Phosphorus.
- 12-Lactate dehydrogenase with isoenzyme analysis. Isoenzyme analysis may indicate multiple targets of venom component which may dictate further management.
- 13-Urine Analysis for free proteins and hemoglobin.
- 14-ECG (Place the patient on continuous monitoring).
- 15-Obtain ABG's (Arterial Blood Gas) especially if the patient is beginning to experience respiratory difficulties.
- 16-It may be necessary or practical to repeat some or of the above tests periodically over the hospital course to monitor the effects of antivenin therapy or to detect late changes in parametric values.

VIII. ADMINISTRATION OF ANTISNAKE SERUM

Majority of the people seeking medical help after snakebite will have minimal or no signs of poisoning whatsoever. Few develop only mild symptoms and a fraction (10 to 15 %) of the people require administration of antivenin. The antivenin available in Pakistan (Polyvalent Anti snake Venom) is effective against all the four poisonous snakes found in Pakistan. It is derived from horse serum, a protein alien to humans and having the potential to cause serious side effects including shock and death. The decision to administer antsnake venom should never be taken lightly and if indicated it should not be delayed. It is generally never too late to administer antivenin; responses have been seen 2 – 10 days after the bite.

A. Testing for Anaphylactic Reaction

Allergic reaction to antivenin may occur and anaphylaxis kit should always be available to treat. Allergic reactions range from rash and headache to more severe symptoms of cough, wheeze, vomiting and collapse. These reactions are more common in individual with allergic tendency or history of hay fever, eczema or asthma. Testing against the sensitivity sometimes are not predictive of adverse reaction therefore should not taken as diagnosis that the patient may not suffer from any adverse reactions.

Following are the methods for checking the hypersensitivity reactions:

- 1- Injecting 1 ml of antivenin interadermally. Redness and itching around the site of injection confirms hypersensitivity.

- 2- Putting a few ml of blood and antsnake serum together in a test tube, if blood is hemolysed it confirms the hypersensitivity.
- 3- Dilute 10 ml of antivenin in 200 ml of saline or ringers lactate and infuse over a period of 20 minutes.
- 4- A positive test is not a contradiction to antivenin therapy but alert the physician that the rate at which the antivenin is administered. The use of corticosteroid, adrenaline may be required to control potential untoward responses.

B. Management of Allergic Reaction

Mild Reaction: (General itching, rash, erythema, mild wheezing, nausea, vomiting) 0.3 to 0.5 ml of adrenaline 1: 1000 solution given intradermally. Provide supportive symptomatic treatment.

Severe Reaction: (Symptoms described above with evidence of airway narrowing and facial swelling and accumulation of fluid in soft tissue) 1: 1000 Adrenaline, antihistamine (50 to 100 mg diphenhydramine), hydrocortisone (100 to 300 mg). Provide supportive symptomatic treatment. Life-threatening reaction: (Symptoms described above with collapse or heart failure). Treatment as described with intensive care management.

THE BEST ANTIDOTE IS DON'T GET BITTEN

IX. SNAKEBITE PREVENTION AND MANAGEMENT ACTION PLAN

The snakebite prevention and management action plan for the PFS was developed for PFS with responsibilities and target dates as mentioned in Table 1.

Table1. Snakebite Prevention and Management Action Plan

No	Actions	Responsibility	Target Date
1	Source and procure Antsnake Venom from government authorized department.	Company Doctor	
2	Issue an advisory to all PFS staff.	Company Doctor	
3	Conduct awareness sessions for all field staff	PFS In-charge/ Company Doctor / HSE Advisor	
4	Arrange Fumigation against snakes at PFS locations. Source and procure snake guard snake trap . Initiate Snake away chemical treatment around the fence.	PFS In-charge/Managers / HSE Advisor / Doctor	
5	Install physical barriers around the fence (snake proof fencing / trench).	PFS In-charge/Managers	
6	Organize snake response team at site. Source a snake specialist for training of team.	HSE Advisor Company Doctor	
7	Source nearest hospital for management of snakebite cases.	Company Doctor/PFS In-charge	

X. CONCLUSION

The snakebite prevention and management action plan proposed in this study is in implementation in the company. Successful results were obtained. The occurrences of snakebite at various facilities were significantly reduced. The proposed study was found helpful to raise the snakebite prevention and management plan awareness among the employees. The PFS locations that were located in agricultural areas and in rural places were identified and snakebite safety signage's were also introduced there. In addition to, in order to respond quickly in case of any snakebite case the monthly drills are in practice and made part of health safety and environment management system at retail outlets. Necessary first aid treatment for snakebite medicines were also made part of first aid box. The proposed snakebite prevention and management action plan can be modified with respect to suitability of other organizations/plants/refineries and can be implemented.

XI. ACKNOWLEDGEMENT

The authors of this study are highly thankful to the Universiti Teknologi PETRONAS (UTP), Malaysia for providing the financial and technical support to work on ongoing research on petrol filling stations. The authors are also thankful to the PFS retail Outlet Company and owners of petrol filling stations for their help, guidance and dedication to assist us in data collection and facilitation throughout the research.

REFERENCES

- [1] BITE, E. O. F. S., (2008). Snakebite in children: a practical approach to management, *CADUCEUS*, (
- [2] Ahmed, M. M., Kutty, S. R. M., Khamidi, M. F., Shariff, A. M., Mitigation Strategies to Improve Safety Conditions at Fuel Stations, 2010 International Conference on Environment 2010 (ICENV 2010), Penang, Malaysia.
- [3] Ahmed, M. M., Kutty, S. R. M., Shariff, A. M., Khamidi, M. F., "New and improved safety and risk assessment model for petrol fuel station," 2011, in *National Postgraduate Conference (NPC), 2011*, pp. 1-10.
- [4] "Petrol Station Accidents France, 1958 - 2007," Bureau of risk analysis and industrial pollution, Ministry of Ecology, Energy, Sustainable Development and Sustainable Land Management, Paris, France
- [5] "PSO Corporate Environment Report," 2007, Karachi, Pakistan.
- [6] Ahmed, M. M., Kutty, S. R. M., Shariff, A. M., Khamidi, M. F., "Hazard Analysis and Safe Transportation Procedure for Fuel Outlets," 2011, in *1st International Conference on Safety and Crisis Management in the Construction, Tourism and SMEs sector (1st COSACM)*, Engomi, Nicosia, Cyprus, pp. 128-157.
- [7] Ahmed. M. M, K. S. R., Khamidi. M. F, Shariff. A. M., Hazard Contributing Factors Classification for Petrol Fuel Station, 2011 World Academy of Science, Engineering and Technology, Phuket, Thailand.
- [8] Bruton, S., Andrews, B., Hammond, D., (1999). Science Safety Handbook for California Public Schools, (
- [9] Tanus Jorge, M., S Sano-Martins, I., C Tomy, S., CB Castro, S., A Ferrari, R., Adriano Ribeiro, L., A Warrell, D., (1997). Snakebite by the bushmaster *Lachesis muta* in Brazil: Case report and review of the literature, *Toxicon*, 35 (4), 545-554,