Energy & Petroleum Regulatory Authority

AN ANALYSIS ON THE EFFECTIVENESS OF SAFETY TRAININGS IN LIQUIFIED PETROLEUM GAS (LPG) DEPOTS IN KENYA

June 2025

Contents

Acronyms

APELL	Awareness and Preparedness for Emergencies at local level
CPR	Cardiopulmonary Resuscitation
EHS	Environment, Health and Safety
EPRA	Energy and Petroleum Regulatory Authority
ILO	International Labour Organisation
LPG	Liquefied Petroleum Gas
MSDS	Material Safety Data Sheets
NITA	National Industrial Training Authority
OSH	Occupational Safety and Health
PPE	Personal Protective Equipment
RACI	Responsible, Accountable, Consulted, Informed
SDG	Sustainable Development Goal
SHE	Safety, Health and Environment
SOP	Standard Operating Procedure
WLGA	World Liquid Gas Association

Director General's Foreword

The use of Liquefied Petroleum Gas (LPG) for cooking and heating has steadily gained popularity in Kenya, with consumption increasing by an average of 12% annually since 2016. The per capita consumption now stands at 7.9 kilograms, with a national target of 15 kilograms per year by 2030. To achieve this target, several initiatives have been introduced, including the National LPG Growth Strategy, zero rating of VAT on LPG and the Kenya Clean Cooking and Transition Strategy. The Energy and Petroleum Regulatory Authority (the Authority) plays a vital role in the LPG sector through licensing, issuing construction permits and conducting technical and Environmental Health and Safety (EHS) audits on retailers, transporters and depots.

LPG depots are critical components in the LPG supply chain. These facilities store substantial volumes of LPG in across multiple tanks and support last mile distribution by enabling the filling of LPG cylinders and the loading of LPG tankers for delivery to reticulation systems and consumer sites.As at the time of the undertaking this study, Kenya had licensed 146 depots. While LPG is a cleaner and efficient energy source, improper handling—especially at depots—can result in incidents and accidents that can lead to loss of life, property, as well as injuries and environmental pollution. Enhancing consumer protection and safety is a strategic priority for the Authority. This is pursued through public awareness efforts and the enforcement of safety regulations and standards.

In April 2025, the Petroleum and Gas Directorate launched a study to evaluate the effectiveness of safety training programs at LPG depots. The aim of the study was to evaluate whether these programs adequately mitigate risks associated with bulk LPG storage and handling. It examined factors such as operator safety awareness and alignment with regulatory requirements and industry best practices. These trainings programs are a regulatory requirement for obtaining an LPG depot licenses. A total of 70 LPG depots, seelcted from various regions in Kenya, were sampled to ensure representation of both small and large-scale operators.

The findings and recommendations presented in this report will inform actionable steps to strengthen regulatory compliance, enhance operator safety, and reduce risks within these essential facilities. I therefore invite depot owners and staff, trainers, transporters, consumers, policy makers and other stakeholders to read and interrogate the findings of this report to improve the relevance and quality of safety training in LPG depots.

Daniel Kiptoo Bargoria, OGW., M.BS.

Executive Summary by the Director Petroleum and Gas

Liquefied Petroleum Gas (LPG) is a transition fuel in the global energy landscape, offering a cleaner and more efficient alternative to traditional biomass and kerosene for both domestic and industrial applications. The safe operation of LPG depots is vital to preventing incidents and accidents such as explosions, fires, and leaks, which pose significant risk to human life, infrastructure, and environmental sustainability.

Kenya has 146 licensed depots of which, 116 were operational at the time of this study. These depots are operated by 85 companies. The Authority regularly conducts technical and EHS audits at the depots. Audit findings have revealed the occurrence of safety incidents at some depots, varying in severity. Notably, between 2020 and 2024, a total of 105 LPG-related accidents were reported involving transporters, consumers and depots. The Authority targets to have an LPG market environment that has zero accidents and incidents. There is therefore a need to enhance the effectiveness of safety training for depot operators.

This study aims to evaluate the design, implementation, and effectiveness of safety training programs within Kenya's LPG depots. It seeks to determine how well these trainings are equipping operators to manage risks and comply with safety regulations. By analyzing training methodologies, knowledge retention, and on-site compliance, the study will generate actionable insights for policymakers and industry stakeholders.

The target population for this study was the 116 operational depots in the country. For control measures, this number was scaled down to 85 to reflect the number of companies that own the depots. This scale down eliminated the possibility of repeatedly analyzing depots belonging to one company. Stratified random sampling method was used to select depots for the study. The population was stratified into regions. Depots in each region were then randomly selected. The Cochran equation was used to determine the sample size at confidence level of 95% and Z term of 1.96. The sample size was determined at 70. Data was collected using questionnaires.

The following were the salient findings of the study:

1. The demographic analysis of the education levels of the staff at LPG depots indicated that most of them (38%) had attained a high school level of qualification. This was the highest level of qualification amongst operators, safety officers and supervisors.
2. The average number of training topics conducted by each facility was 6.25 within a period of 1-3 years. This falls short of the recommended 9 mandatory training disciplines implying that critical training areas often overlooked.
3. Only 49.46% had been trained on hazard identification and risk assessment. This low coverage significantly limits preparedness for managing critical risks.
4. The staff feedback on both the training content and the quality of trainers was neutral, indicating room for improvement in both areas. .
5. The pre and post training assessment revealed statistically significant improvements in trainees' understanding of safety issues. On a scale of 1-5, the pre-training score was 2.5 while the post-training score was 3.82. The p-value was less than 0.05.
6. Despite the training, staff reported low confidence in their ability to apply the concepts learnt to real-world scenarios, highlighting a gap between knowledge acquisition and practical application.
7. An analysis of the post training behavior indicated that an average of 65.58% of the respondents had implemented new safety measures after undertaking the training. The study further analyzed the effectiveness of these measures in reducing accidents on a scale of 1-5.The respondents scored this variable at 4.1 indicating that the measures were perceived as effective.

Edward Kinyua, PE., OGW.

Acknowledgements

This study was undertaken by the following officers of the Authority.

Dr. Eng. Fenwicks Musonye
Stella Opakas
Anne Kiprotich
Clement Nadio
Moses Paul Akuno
Benter Otieno
Philemon Chebii
Kipkorir Peter
Robert Miyesa
Stella Nyayiemi
Ian Bett
Abel Miruka Somoni
Gladys N. Njoroge

The data collection was conducted by the following officers of the Authority.

Hillary Mengich
Godfrey Koech
Boaz Mokaya
Nelson Boinet
David Mweu
Gideon Maloba
Patience Gwaro
Anthony Gakuo
Daniel Muthui
Hillary Simiyu
Ian Kiprotich
Ian Waweru
Gibson Mutua
Tito Lopeyok

The success of this study was made possible by the contribution of different stakeholders. We acknowledge the leadership provided by the Authority's management under the guidance of the Director General, Mr. Daniel Kiptoo Bargoria, M.B.S., O.G.W. and Eng. Edward Kinyua, P.E., O.G.W., the Director Petroleum and Gas. Their support through provision of resources and technical guidance enabled the research team to conceptualize the study, collect data and compile this report.

Gratitude goes to the management and staff of LPG depots that participated in this study. We are grateful for their cooperation in granting access their facilities for data collection. We reckon that this gesture takes some sacrifice as it requires adjustments to scheduled operations.

Chapter 1: Introduction

1.1 Background

The Sustainable Development Goal number 7 (SDG 7) calls for universal access to energy by 2030. This goal states that energy should be affordable, reliable, sustainable, and modern. Countries should work towards providing energy services in domestic, commercial and industrial setups. Kenya has put significant efforts targeting access to energy applications in cooking, industries, agriculture, transportation and commercial sectors.

The Kenyan government has been working towards achieving universal access to clean cooking by 2028. The roadmap to this has been stipulated in the National LPG growth strategy which aims to increase LPG growth from the current 7.9kg to 15kg per capita by 2028. Achieving this goal will require a robust LPG supply chain that ensures both safety and reliability to consumers.

Safety in the LPG industry in Kenya applies both to the demand and supply sides. The demand side safety issues focus on the use at the point of application. This could be in homes, commercial and industrial setups. The supply side safety addresses the occupational issues at the points of refilling, storage and transportation. To enhance the use of LPG in the country, it is important that safety issues are addressed, to avoid risks such as explosions, fires, and leaks, which endanger human lives, infrastructure, and environmental sustainability. In Kenya, the Authority regulates the LPG market for quality and safety, through issuance of construction permits, licensing, and technical and EHS audits of licenced facilities.

Kenya's LPG industry operates within a robust legal and regulatory framework established under the Energy Act, 2019 (Cap 314) and the Petroleum Act, 2019 (Cap. 308). The Authority is empowered by these Acts and subsidiary legislations such as Legal Notice No. 100 of 2019, to ensure compliance through licensing, technical audits, and mandatory safety training requirements for licensed operators.

Globally, the World Liquid Gas Association (WLGA) and bodies such as the International Labour Organisation (ILO) (2018) emphasize the role of standardized and regulated training as a preventive tool against workplace incidents. In Kenya, the Authority has aligned with these frameworks by enforcing a minimum threshold for training disciplines and competencies for LPG depot personnel.

To enhance safety in LPG depots and other LPG facilities, the Authority conducts periodic inspections, to assess their compliance with licensing requirements. Training is a vital intervention for improvement of safety in the operations of the licensees. The trainings should focus on aspects such as basic fire safety, first aid, emergency response, LPG handling and storage procedures, environmental and spill response, safe use of equipment and machinery, hazard identification and risk assessment, use of Personal Protective Equipment (PPEs), and health and safety committee training.

The trainings provided to depot staff should enable them improve safety practices and culture. For this to be achieved, the Authority needs to understand the nature of the trainings undertaken and their effectiveness. This information is not available. The Authority therefore commissioned a study to analyze the effectiveness of the trainings.

1.2 Problem Statement

Kenya, through the National LPG growth strategy aims to increase LPG growth from current 7.9kg to 15kg per capita by 2028. This will result in an increased number of depots and LPG filling activities in the market. If unchecked, this might increase the number of safety incidents and accidents in the market. The LPG players have been proactively working towards providing their services using safe operations. One of the interventions has been through training the staff in the industry. However, little is known about the relevance of the trainings and the adequecy of the content in preventing LPG related accidents and incidents. By undertaking this study, the Authority intended to assess the quality of the trainings, their effectiveness and relevance to LPG safety.

1.3 Justification

This study will be useful for the country to meet universal clean cooking goals in a safe and secure manner. In Kenya, the LPG sector has expanded rapidly, with 146 licenced depots with this number expected to increase in response to growing demand. This growth can be hampered by safety concerns if they are not addressed. The Authority reported that there were 105 LPG-related accidents across the value chain, between 2020 and 2024. These were mainly linked to lapses in safety procedures. Effective and relevant training could help forestall such accidents. The results of this study will therefore be useful in finding ways of improving the training content and pedagogy.

It has been postulated by ILO (2018) that effective safety training has the potential to reduce accidents by up to 50 % in high risk industries. The results of this study will therefore be used by the Authority to guide trainers, LPG depot owners and relevant stakeholders on effective ways of developing and delivering safety trainings.

1.4 Objectives

1.4.1 General Objective

The general objective of this study was to analyze the effectiveness of LPG safety training in LPG depots.

1.4.2 Specific Objectives

i) To evaluate the nature and quality of safety trainings carried out in LPG depots;

ii) To assess the LPG depots staff feedback on the safety trainings carried out; and

iii) To determine the relationship between safety trainings carried out and the accidents and incidents.

1.5 Limitations of the Study

The following were the study limitations:

i) The study risked being affected by the problem of Hawthorne's Effect. This is because the respondents are licensees of the Authority and may have responded with the thought that they were being audited.

ii) Some of the information gathered relied on the ability of the respondents to recall events and facts. This may lead to distorted information, especially if the time horizon between the data collection day and the time of occurrence of the events is more than one year.

Chapter 2: Literature Review

2.1 Introduction

This chapter discusses literature related to the topic at hand. The discussion is organized in three sections. The first section delves into the theoretical concepts related to vocational training for professionals in the industry. The second section narrows down the discussion to training requirements related to safety in LPG depots. Lastly the chapter discusses some case studies of LPG safety and training.

2.2 Fundamentals of Vocational Training

To enhance the performance of employees in any field or industry it is essential to continually develop their practical skills and knowledge. One of the ways of achieving this is through offering trainings related to the work. For example, staff/employees working in hazardous environments may require constant training on how to handle or respond to emerging risks in such a place. The exact skills and knowledge required during the training can be determined using a skills gap analysis.

The quality of trainings is partly informed by the quality of the skills gap analysis conducted. This analysis involves examination of the competencies of employees required to perform their jobs. The competencies include both hard and soft skills. Soft skills are transferrable and include teamwork, critical thinking, communication, leadership, and decision making. Hard skills are technical and task oriented and are often acquired through the on-job training. When developing training content therefore, these skills have to be considered.

Research consistently shows that safety training must be context-specific, interactive, and competency-based to be effective in high-risk environments. According to Burke et al. (2006), training that includes hands-on simulations, behavioral modeling, and situational judgment exercises yields superior learning outcomes and reduces workplace accidents by up to 45%. Conversely, passive training formats such as classroom lectures and online modules tend to have limited impact unless supplemented with practical elements.

Training content should be informed by two aspects of a curriculum: purpose and learning outcomes. The purpose speaks to a general aim of the training and discusses the method through which the aim will be achieved. Learning outcomes on the other hand focus on what the learner is capable of doing after the training. The topics in a curriculum should be tailored to address both the outcomes and the purpose.

A training curriculum should design a method of testing if the learning outcomes have been achieved. Generally, testing methods can be divided into summative and formative approaches. The former refers to evaluation of learning at the end of an instructional period while the latter refers to monitoring learning and providing ongoing feedback. The choice of method to use depends on the nature of the training. One or both of these methods can be employed.

Trainee feedback is a crucial metric in evaluating training effectiveness. A high-quality training program should foster not only knowledge retention but also confidence and behavioral change. Zohar (2002a) and Neal & Griffin (2006) argue that a strong safety culture, supported by competent training and active managerial involvement, leads to better safety performance outcomes.

Findings by Joshua et al. (2020) show that depot staff value training that is relevant to their day-to-day operations, delivered by credible trainers, and includes adequate time for comprehension and practice. Similarly, Vinodkumar & Bhasi (2010) found that the perceived quality of training materials, trainer expertise, and delivery methods significantly influence learning outcomes and safety behavior adoption.

Apart from the content, the training methods also affect the achievements of the learning outcomes. Trainers can use various pedagogical approaches to deliver the content. Modern training methods such as interactive videos, podcasts, microlearning, and simulations (Goldenhar et al., 2001; Barati Jozan et al., 2023) can enhance learner engagement and retention, especially among younger staff who dominate the Kenyan LPG workforce. This can be through online platforms, recorded videos, simulations in virtual laboratories, face to face trainings and written manuals. For practical related tasks, the face to face trainings are preferred.

2.3 Safety training in LPG depots

For Industries that involve hazardous operations, employee training is a cornerstone of workplace safety. Training helps employees understand standard operating procedures, safety protocols, and emergency responses, reducing human error and enhancing operational resilience (Burke et al., 2006)illnesses, and injuries. In LPG depots, where the risk of fire, explosion or gas leakage is high, comprehensive and continuous training becomes critical for risk mitigation and safety assurance. The World Liquid Gas Association (WLGA) advocates for standardized training modules that integrate hazard identification, emergency response, and equipment handling, emphasizing practical drills like fire simulations to enhance preparedness (Nyabuto, 2021; WLPGA, 2015).

A critical challenge in the LPG sector is the mismatch between required safety competencies and the actual skills of depot personnel(Gyekye, 2010). Skills gap is often exacerbated by limited access to quality vocational training and low educational attainment among some operators. Without systematic skills assessments, training programs may fail to address the most urgent areas of need, leading to persistent operational vulnerabilities (R., U. and N, 2019). Such vulnerabilities can be downscaled through training of the staff.

The frequency, duration and timing of the trainings is essential in helping staff to carry out their duties. For example, refresher trainings are recommended for staff after an incident or near miss or after safety audits.

A core objective of safety training is the prevention of workplace incidents. The ILO (2018) states that effective training can reduce incidents by up to 50% in high-risk sectors. Numerous studies, for example Burke et al. (2006), Flin (2006), and Hale & Borys (2013) support the hypothesis that when staff are well-trained, safety performance improves, and accident rates decline.

Case studies from international contexts reinforce this conclusion. The Wenling LPG explosion in China (Yang et al., 2024) and the Port Harcourt disaster risk preparedness audit (Akpi et al., 2023) both demonstrate the consequences of inadequate training or poor safety practice enforcement, regardless of regulatory frameworks. In essence, where training is frequent, hands-on, well-structured, and supported by strong organizational safety culture, the likelihood of incidents is significantly minimized (Sadiq, 2020).

Training requirements for LPG depot staff are articulated in the KS:EAS 924:3 2020 and guidelines by WLGA. These trainings should cover:

- Emergency response
- Fire safety
- Leak detection and LPG spill control
- Occupational Health and Safety
- Environmental Safety
- Hazard identification and Risk assessment
- LPG handling
- First Aid
- Use of PPEs

2.3.1 LPG handling

LPG is highly flammable and improper handling can lead to incidents and accidents posing risks to human life, environment and property. The LPG handling training is a critical component of operational safety and environmental protection. It helps operators understand LPG properties, identify potential hazards, and adopt best practices that prevent incidents and accidents. The LPG handling training program covers the following key areas:

Introduction to LPG

Depot staff learn the properties and characteristics of LPG such as its flammability, pressure behavior and expansion, risks and hazards, and common uses. This foundational knowledge helps operators appreciate the risks associated with the product.

Safe Storage and Handling Practices

Depot staff learn proper methods for storing LPG in cylinders and tanks, safety distances, ventilation requirements, and secure placement. Staff are taught how to safely handle both full and empty cylinders and use of Material Safety Data Sheets (MSDS).

Filling and Transfer Procedures

Depot staff learn correct filling techniques, appropriate cylinder quantities , and how to detect and address leaks using appropriate tools.

Equipment Use and Maintenance

Depot staff are trained in the use of critical equipment such as regulators, valves, hoses, and pumps. Routine inspection and preventive maintenance are emphasized to reduce the likelihood of equipment failure. Emphasis is also made on equipment repairs by qualified and authorized personnel.

2.3.2 Emergency response

The LPG depot operations are characterized by events that pose environmental, health and safety risks which have financial implications for the depot owners, staff and neighbours. Even though facilities may have sufficient measures to avoid the occurrence of accidents and incidents, it is important for staff to be trained on how to handle emergency situations. Such training should consist of various elements that may be guided by the Awareness and Preparedness for Emergencies at Local Level (APELL) process. This process can be used to develop learning outcomes for emergency response training.

Emergency response trainings should be tailored to mimic the actions the staff is supposed to take in case of an emergency. Emergency response trainings should be conducted according to the Emergency Response Plan and should cover the following topics:

1. Detect and Identify Emergency
2. Raise Alarm and Notify Personnel
3. Assess Containment Possibility
4. Contain or Isolate the Incident
5. Evaluate Need for Evacuation
6. Activate Communication Protocols
7. Administer Medical Aid
8. Declare Area Safe or Continue Monitoring
9. Conduct Investigation of the Incident
10. Share Lessons Learnt

2.3.3 Fire safety

LPG is a highly flammable substance which can result in class B fire. Training content should cover; LPG basics, soft skills, fire handling and practical simulation exercises. These areas are discussed as follows:

LPG basics

This entails discussion on properties of LPG that make it highly flammable. They include reid vapor pressure, flashpoint, LPG vaporization conditions and density.

Soft skills

These are transferrable across difference roles and industries and help staff accomplish their technical assignments. They include critical thinking, communications skills, teamwork, adaptability and emotional intelligence.

Fire handling

This training should cover classes of fire, the fire tetrahedron, fire detection and warning, suppression methods and equipment and relevant PPEs.

Practical simulations exercises

These exercises involve simulating a live incident, observing the response methods, behavior and timelines, and identifying gaps in the response. It also involves instituting measures to close the gaps.

2.3.4 Leak detection and LPG spill control

LPG leaks can be caused by poor installation or maintenance, equipment failure or poor adherence to operating procedures. The odorless nature of LPG makes it hard to detect leakages. Therefore, mercaptan is added to give it a distinctive scent. There are gadgets that are used to detect leaks and it is important for depots staff to understand how to use the gadgets and where they should be placed in the plant. A training on this area should entail how to undertake routine checks, how to respond to leak detection warnings and response in the event of a spill.

2.3.5 Hazard Identification and Risk assessment

This process is crucial for LPG facilities as it enables the identification of potential hazard sources within the depots. Hazards can arise from staff activities, non-adhered to established procedures, neighborhood activities and from the environment. If not addressed, hazards can lead to accidents and incidents. A training on this area entails hazard identification, development of a hazard study, a risk matrix and controls to mitigate the risks.

2.3.6 First Aid Training in LPG Depots

Proper first aid training equips staff with the knowledge and confidence to act promptly and appropriately, thereby minimizing the severity of injuries and supporting safer working environments. The Occupational Safety and Health (OSH) (First Aid in the Workplace) Regulations, 2024, provide a structured framework to guide employers in establishing robust first aid systems. The table below summarizes the typical injury risks in LPG depots, the recommended training and emergency responses.

Table 1: Injury Types and Effective Responses

Types of Injuries Likely at LPG Depots	Types of Training and Effective Response
Burns from fire or hot surfaces	Training in burn assessment, cooling techniques (e.g. water immersion), and sterile dressing application
Inhalation of LPG fumes	Resuscitation techniques and airway management, placing victim in recovery position
Frostbite or cold burns from LPG exposure	Gentle warming of the affected area, avoiding rubbing; dressing with sterile material
Head trauma or blunt injuries	Monitoring consciousness, applying pressure to wounds, immobilization
Chemical eye exposure	Eye irrigation with sterile solution, use of lubricating drops
Fractures or crush injuries	Immobilization using splints or slings; avoid unnecessary movement
Blast injuries	Scene safety assessment, bleeding control, stabilization, CPR if necessary
Slips, falls, or trauma from LPG spills	Treatment for abrasions, strains or dislocations; spill containment training
Shock or psychological distress following a near-miss or incident	Psychological first aid; reassurance; monitoring for delayed symptoms

2.3.7 Environmental safety

LPG plant operations can affect the environment or be affected by it. If LPG is mishandled, it can cause fire or frostbites which can affect the ecosystem, animals, people and property. On the other hand, human activities and adverse weather events can hamper LPG operations. Trainings in LPG operations should make a distinction between these environmental effects and train staff on how to handle them.

When training on environmental safety for LPG plants, the following factors should be considered as part of the course content:

1. Distances between the LPG depots and adjacent structures
2. Analysis of weather conditions
3. Structural design

4. Waste management
5. Depot layout design
6. Air quality monitoring

2.3.8 Occupational Safety and Health

The OSH training is paramount in the safe operation of LPG depots. It encompasses the policies, procedures, and practices that aim to prevent workplace injuries, illnesses, and fatalities by ensuring a safe working environment. It should focus on safeguarding the health and well-being of all personnel involved in LPG operations. Key aspects of OSH in LPG depots include:

Legal and Regulatory Compliance

This deals with adherence to national and international standards and regular audits and inspection to ensure conformity.

Workplace Risk Prevention

The training should feature implementation of safety protocols to minimize exposure to physical, chemical and ergonomic hazards and use of appropriate PPEs such as flame-resistant clothing, gloves, eye protection, safety boots and use of the general register.

Health Surveillance and Medical Monitoring

This training should cover the need for medical check-ups for staff working in high-risk areas and monitoring for long-term health effects of exposure to LPG or related chemicals.

Employee Engagement and Safety Culture

The trainings should promote proactive safety culture through leadership commitment, institutionalization of a SHE committee, emergency response communications protocols, worker participation, behavior-based safety initiatives, regular toolbox talks, safety meetings, and employee feedback mechanisms.

Work Procedures and Permit-to-Work Systems

The training should cover development and enforcement of Standard Operating Procedures (SOPs) for tasks such as tank filling, maintenance, and loading/offloading operations and use of permit to work for non-routine and high-risk tasks like hot work or confined space entry.

Incident Reporting and Investigation

This training should involve mandatory reporting of near-misses, unsafe conditions, and incidents and thorough investigation of incidents to identify root causes and prevent recurrence.

Continuous Training and Capacity Building

The training should point out the need for regular OSH training to update staff on best practices, new risks, and changes in regulations and should also include mental health and wellness topics to support overall employee well-being.

2.3.9 Personal Protective Equipment (PPEs)

Personal Protective Equipment (PPEs) act as the last line of defense when elimination, substitution, engineering controls and administrative practices cannot fully mitigate and/or eliminate risks. PPEs are only effective if worn correctly, properly maintained, and used alongside other controls.

In an LPG depot, PPEs are especially critical due to the flammable, pressurized, and potentially toxic nature of LPG. Trainings on PPEs should cover the type of PPE, the integrity of the PPEs, the usage and duration of use.

A PPE inspection checklist should cover the following:

Physical Integrity

Tears, holes, or wear in clothing or gloves?
Cracks or clouding in goggles/face shields?
Fraying or broken stitching?

Cleanliness

Free from oil, grease, or chemical contamination?
Not saturated with flammable materials?

Functionality

Zippers, fasteners, and buckles working?
Goggles: fog-free and lenses clear?
Gloves: still flexible and form-fitting?

Fit

Proper size to ensure maximum protection?
Not too tight or loose?

Certification and Approval

Meets relevant safety standards (e.g. EN, ANSI, IS)?
Markings and tags still legible?

Shelf Life or Expiry (especially for helmets and respirators)

Check manufacturer's recommended life span. Helmets typically have a 5-year lifespan.

Special Checks for LPG-Related PPEs
Antistatic clothing/shoes: Check conductivity ratings.
Flame-resistant gear: Look for Flame Retardant (FR) labels and wear.

2.4 Case Studies

In Kenya, the National Industrial Training Authority (NITA) plays a central role in accrediting and standardizing training programs for various industrial sectors, including LPG. Standardization ensures that all trainees receive consistent content aligned with national safety and competency benchmarks. The effectiveness of standardized training can be examined using the Kirkpatrick Model, a theoretical framework that evaluates training on four levels: reaction, learning, behavior, and results(Kirkpatrick and Kirkpatrick, 2006). While NITA-accredited programs cover theoretical and practical modules, their effectiveness depends on regular curriculum updates, qualified trainers, and follow-up evaluations. Few empirical studies have tested whether NITA-approved trainings result in sustained behavior change or reduced incident rates in LPG depots.

Traditional training in the LPG sector has often relied on in-person lectures and safety briefings. The new pedagogical methods offer greater flexibility and engagement. These include audio-visual aids, simulations, podcasts, and interactive e-learning platforms (Vinodkumar and Bhasi, 2010). For instance, safety podcasts can be used as part of continuous professional development while video modules can be used for onboarding sessions for new staff and visitors. Pedagogical diversity ensures training can accommodate various literacy levels and learning preferences.

Determining the optimal duration and frequency of training is essential to balance operational needs with knowledge retention. Research suggests that short, high-intensity sessions followed by regular refresher courses are more effective than long, infrequent workshops (Burke et al., 2006)illnesses, and injuries. In the LPG depots, initial training often ranges from one to three days, but refresher training every six to twelve months is recommended, particularly for high-risk roles such as bulk loading and plant operations. The duration should be sufficient to cover core topics such as fire safety, emergency response, and hazardous materials handling while allowing for practical drills.

Training programs must incorporate feedback mechanisms to assess effectiveness and improve future sessions. Common approaches include pre and post-training assessments, participant surveys, and observation-based evaluations. Digital tools, such as mobile apps or QR code-linked surveys, can facilitate real-time feedback collection. Engaging with depot supervisors in post-training performance reviews can help link training content to on-the-ground behavior (Gyekye and Salminen, 2009). Failure to have training programs structured feedback systems makes it difficult to measure learning outcomes or identify content gaps.

The ultimate goal of training in LPG depots is to reduce accidents and near-misses. Effective training is associated with heightened hazard awareness, improved use of personal protective equipment, and faster response to emergencies. LPG Depots that integrate training into their broader safety management systems may end up experiencing fewer incidents over time (Meteku, Ankudey and Ocran, 2019). However, for training to be truly impactful, it must be accompanied by a supportive safety culture, regular monitoring, and enforcement of standard operating procedures.

A growing body of literature emphasize the role of safety education in preventing accidents, improving hazard recognition and reinforcing compliance with operational standards(Zohar, 2002; Joshua et al., 2020; Mensah, 2021). Effective training is dependent on several factors including but not limited to the educational background of workers, language barriers, availability of practical and scenario-based exercises (Joshua et al., 2020) . Studies have emphasized that for a training to be impactful, it must be specific to the operational hazards faced by depot workers, such as gas leaks, fire risks, and equipment handling (Burke et al., 2006)illnesses, and injuries.

Research suggests that when safety culture is strong and training is continuously reinforced by management, learning outcomes are significantly improved (Mavroulidis et al., 2022). On the global perspective, training methods that actively engage trainees through behavioral modeling, hands-on simulations, and dialogue-based learning have proven to have an edge over passive approaches like lectures or computer-based modules. A meta-analysis of 95 quasi-experimental studies proved that active engagement methods reduced accidents by 28-45% compared to passive training (Burke et al., 2006)illnesses, and injuries. This underscores the importance of practical skill application.

Nigeria's Port Harcourt disaster risk preparedness assessment study revealed that 5% of stations lacked gas detectors despite the staff being trained (Akpi, Mmom and Olanrewaju, 2023). The 2020 Wenling, China, LPG tanker explosion which resulted in 20 deaths highlighted the role of environmental factors such as vegetation in accelerating flame propagation, emphasizing the need for hazard identification training that is specific to the subject site (Yang et al., 2024). These findings emphasize the need for improved technical instruction and routine safety performance audits.

Poor safety culture, driven by the prioritization of profits over compliance by facilities' management may undermine training outcomes. Recent studies emphasize the role of management in the effectiveness of safety training. Facilities with safety committees led by management reported relatively higher compliance rates than those with top-down enforcement (Sadiq, 2020). There is need for transformation of management styles and adoption of emerging innovative training methods and systematic research studies to develop the available human resource.

Overall, literature underscores the importance of conducting skills gap analyses to guide targeted training, adopting standardized curricula such as those approved by NITA, and embracing varied pedagogical tools to enhance learning outcomes. The duration and structure of training programs must be optimized for retention, and mechanisms for obtaining feedback should be embedded in all phases of the training cycle. When effectively implemented, training programs significantly contribute to reducing workplace incidents and enhancing the safety culture in LPG depots across Africa.

Chapter 3: Study Methodology

3.1 Introduction

This chapter presents an account of the steps and methods that were used to meet the study objectives.

3.2 Population, Sampling and Sample Size

The study targeted a population of all 116 operational EPRA-licenced LPG depots in the country. These depots are operated by 85 licenced companies. To prevent duplication, where more than one depot owned by a single company might be studied, the population was scaled down to 85. This ensured that only one depot per company was selected for the study.

To determine the ideal sample size for the study, Cochran's formula was applied, which is suitable for estimating proportions in a population. The parameters used included a 95% confidence level (Z = 1.96), a margin of error of 5% (e = 0.05), and an estimated proportion (p) of 0.5 to account for maximum variability. Since the total population is relatively small (N = 85), the sample size obtained using Cochran's formula was further refined using the finite population correction. The final adjusted sample size was calculated to be 70 companies (Robb, 1963).

$$n_0 = \frac{Z^2 \cdot p \cdot (1-p)}{e^2}$$

Where:

- n_0= Required sample size
- Z = Z-score for the confidence level (1.96 for 95%)
- p = Estimated proportion of the population (0.5 for maximum variability)
- eee = Margin of error (0.05 for 5%)

$$n_0 = \frac{(1.96)^2 \times 0.5 \times (1-0.5)}{(0.05)^2}$$

$$n_0 = \frac{3.8416 \times 0.25}{0.0025} = \frac{0.9604}{0.0025} = 384.16$$

Since the population (N = 85) is small, the researchers adjusted using the finite population correction:

$$n = \frac{n_0}{1 + \frac{n_0 - 1}{N}}$$

$$n = \frac{384}{1 + \frac{384-1}{85}}$$

$$n = \frac{384}{1+4.52} = \frac{384}{5.52} = 69.57$$

Rounding up, the study targeted 70 depots to participate in the study.

To ensure equitable and meaningful representation across regions, a stratified random sampling method was employed. Stratification was carried out on two levels: initially by region, and subsequently by the number of depots operated by each company. The sample size for each region was determined using this formula:

$$Sample\ Size\ for\ Region = \left(\frac{\text{Companies in Region}}{\text{Total Companies}} \right) \times 70$$

In this method, the depots were segregated into regions, namely Nairobi, Central, Coast, Nyanza Western, North Rift, South Rift, North Eastern regions and North Western. These regions have been delineated by the Authority for energy and petroleum Regulatory services coordination. The sample size per region is as presented in table 3.1.

Table 3.1: Sample size per region

Region	Companies	Proportional Sample
Central	10	(10/85) × 70 = 8
Coast	8	(8/85) × 70 = 7
Nairobi	44	(44/85) × 70 = 36
North Eastern	4	(4/85) × 70 = 3
North Rift	7	(7/85) × 70 = 6
Nyanza	7	(7/85) × 70 = 6
South Rift	5	(5/85) × 70 = 4
Total	**85**	**70**

In the first stratum, companies were grouped based on the regions in which their depots are located. Proportional allocation was applied to determine the number of companies to be sampled from each region. For instance, of the 70 companies sampled, 36 were from Nairobi, 8 from Central, 7 from Coast, 6 from Nyanza, 6 from North Rift and 4 from South Rift, and 3 from North East. This ensured that all geographic areas were adequately represented according to their share of the total populations.

In each selected depot, four key personnel (managers, operators, supervisors, safety officers) were purposively sampled to provide multi-level perspectives.

3.3 Data Collection Tools and Approach

The study employed a mixed-methods approach to collect comprehensive data on the effectiveness of LPG safety training programs. The study used two data collection tools: questionnaires and direct observations. The questionnaires were used to collect data on the demographics and trainees' feedback on the quality and effectiveness of the training. Direct observations on the other hand was used to study the ability of the trainees to demonstrate application of the knowledge gained during the trainings.

The structured questionnaires comprised of Likert-scale questions, multiple-choice items, and open-ended responses. The questionnaires were administered during face to face meetings with the respondents. The questionnaire administrators assisted the respondents to fill in questionnaires in the SurveyMonkey tool. Researchers conducted non-participant observations at each LPG facilities to assess aspects such as compliance with safety procedures (e.g., PPE usage, emergency drills) and workplace safety culture.

A subset of participants was asked to demonstrate safety procedures such as leak detection and fire extinguisher use to evaluate practical competency. A Scoring Rubric tool was used to access performance on the correct use of equipment, adherence to emergency protocols, and accuracy of response.

3.4 Ethical Considerations

Participants were briefed on the study's purpose and their rights (BERA, 2018). To ensure compliance with ethical standards, the identities of the respondents were omitted from the questionnaires. Identifiable data was anonymized in reports. Practical demonstrations were supervised to prevent accidents.

3.5 Data Analysis and Presentation

The study employed both descriptive and inferential statistical methods to analyze the collected data. The study used measures of central tendency and inferential statistics. The analysis was executed using Microsoft Excel. Data was presented using tables, pie charts and bar graphs.

Chapter 4: Results, Findings and Discussion

4.1 Introduction

This chapter presents the findings of the data collected in this study. The findings have been discussed to answer the research questions. It is broken down in four sections. The first section discusses the response rate while the three sections discuss the findings as per the objectives.

4.2 Survey response rate

The study analysed the response rates for the sampled facilities and staff. The results are presented in figure 4.1.

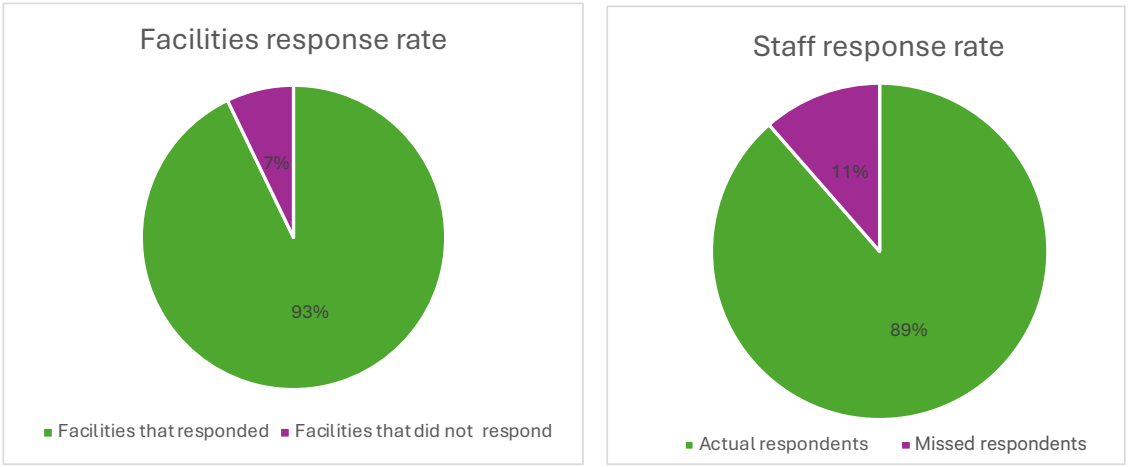

Figure 4.1: Response rate of facilities and staff

The response rate for facilities was higher than that of the staff. Some of the facilities that responded could not get all the targeted staff to respond to the survey. The responses were however sufficient for the study results to be suitable to represent the entire population.

4.3 Population demographics

This study postulated that demographics can have an implication on both trainings and safety practices in LPG depots. It thus analyzed these variables in terms of age, gender, education level and years of experience.

4.3.1 Age Distribution

The age distribution of respondents is presented in figure 4.2.

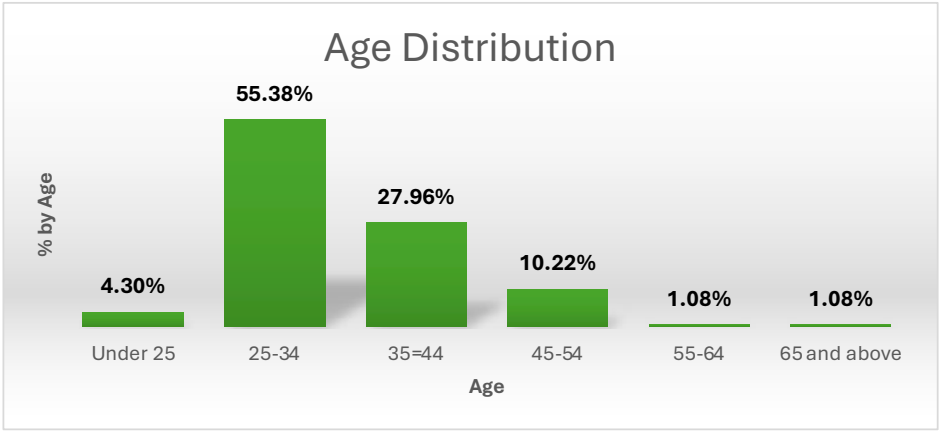

Figure 4.2: Respondents age distribution

From the findings, the majority of the respondents fall within the youth age bracket. This is the most productive age group in any economy. Further, this is the age group where most employees are learning and establishing themselves in their professions. Training should therefore be targeted to mostly handle their training needs.

4.3.2 Gender distribution

The gender distribution shows a significant male majority, with 163 males (87.6%) and 23 females (12.4%) out of a total of 186 individuals. This reflects the nature of the LPG sector which is predominately dominated by men.

4.3.3 Education Level

Figure 4.3 presents the education level of all the respondents.

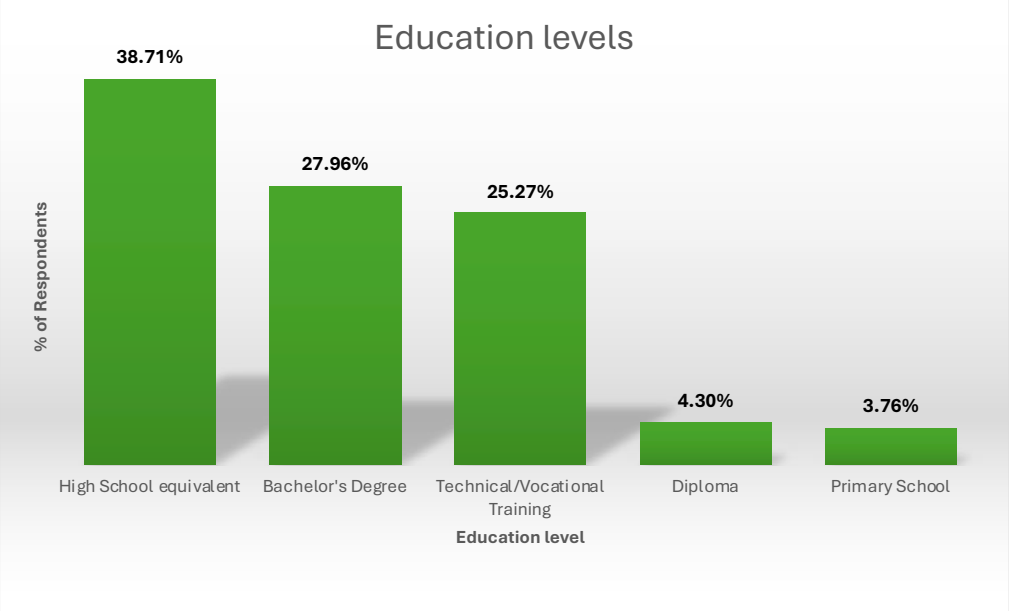

Figure 4.3: Respondents education levels

Contrary to what would be expected of the education levels for staff in a filling plant, this study revealed that most of the respondents had attained high school level education. In operations of this nature, the staff should have at least a vocational level training.

The study further investigated the education level for each staff cadre. The results are presented in figure 4.4.

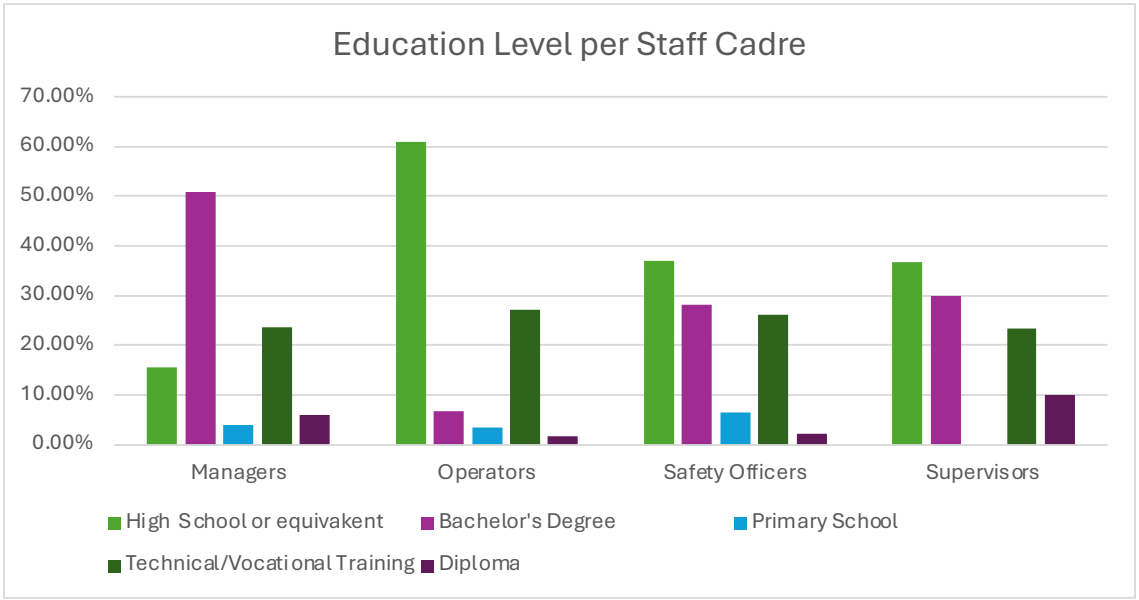

Figure 4.4: Education level for each staff category

Apart from management levels, high school education dominates all cadres of employees in the depots. The nature of LPG operations requires operators and safety officers to have prior formal training. Such trainings equip the learners with life-long learning skills which are essential for safety in depots.

4.3.5 Experience levels

The experience levels for the various categories of staff are indicated in figure 4.5.

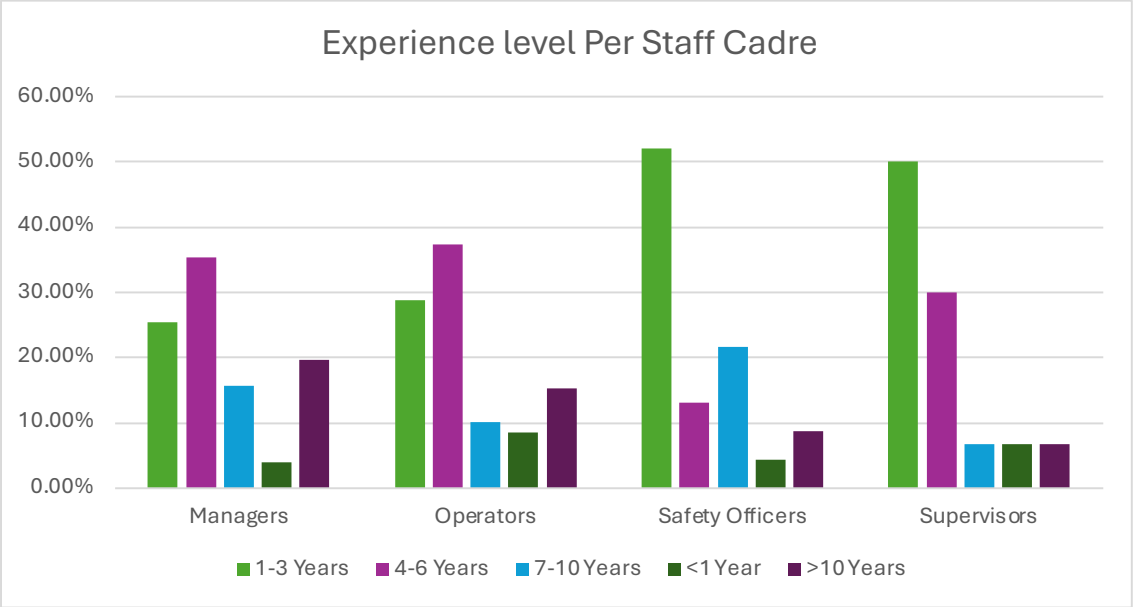

Figure 4.5: Experience levels for each staff cadre

The study reveals that most of the staff have less than 10 years of experience in the LPG industry. This may have an impact on skills level and institutional memory which is a critical aspect of safety.

4.4 Nature, types and quality of safety trainings carried out in LPG depots

The survey aimed to assess the distribution of trainings for each staff cadre. The results are presented in figure 4.6.

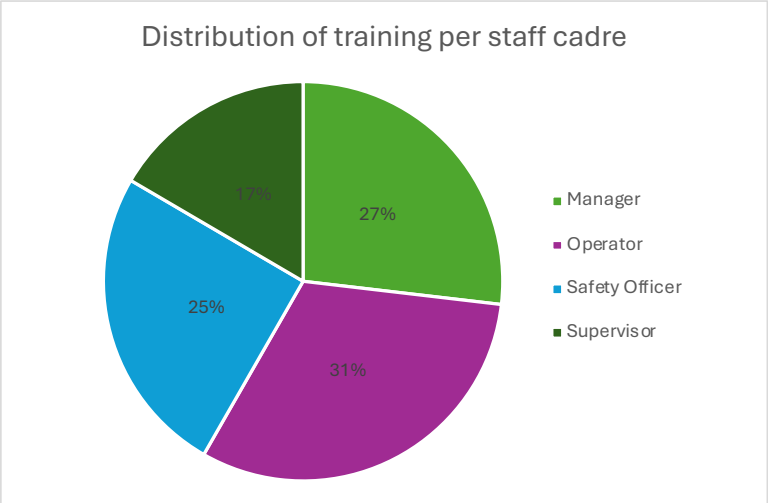

Figure 4.6: Distribution of training per staff cadre

From the results of the survey it was observed that the operators received most training, followed by managers, safety officers and supervisors.

The findings are confounding because one would expect more trainings to be focused on safety officers and supervisors compared to the managers. These findings could also imply the existence of skills gaps in management levels compared to supervisors and safety officers. These findings, however, require more investigation.

4.4.1 Types of training conducted

The percentage of respondents who have attended the various trainings is presented in figure 4.7.

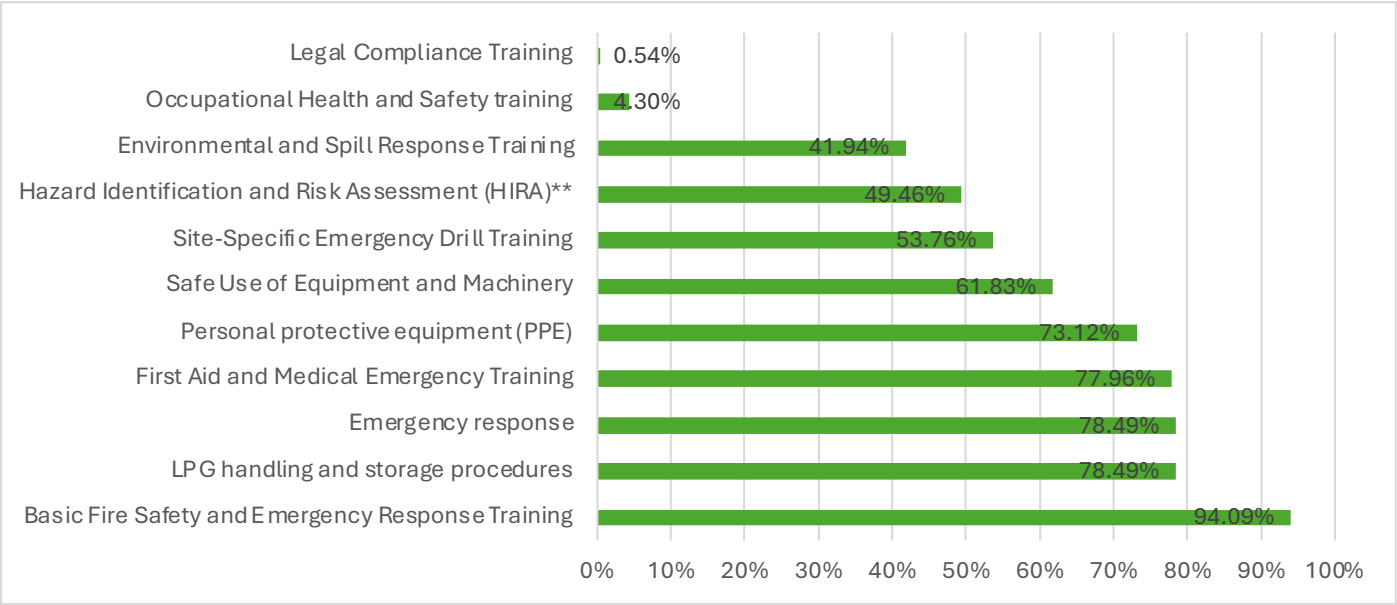

Figure 4.7: Type of training by role

From the findings, it is surprising that less than 50% of the respondents have attended training on Hazard Identification and Risk Assessment (HIRA) and Environmental and Spill Response Training. These trainings areas are vital for all cadre of staff in the LPG depots. It is therefore expected that all staff should be trained on these areas.

Despite undertaking the training, the respondents exhibited little confidence in practical handling of LPG leakage, administering first aid and correctly using PPEs. This may suggest that the training provided in these areas was insufficient or lacked practical emphasis.

The study further analyzed the training distribution per facility in each region. The results of this analysis are presented in table 4.2.

Table 4.2: Training distribution per region

Region	Weighted Score
Central Region	6.02
Coast Region	5.82
Nairobi Region	5.55
North Eastern Region	5.60
North Rift Region	7.89
Nyanza Western Region	7.58
South Rift Region	5.33

It was noted that the average training conducted for facilities in the country was 6.25. From table 4.2, it is clear that only facilities in two regions exceeded this average. For safe operations of depots it is expected that facilities should conduct trainings in at least 9 disciplines. These findings therefore imply that the facilities in all regions conduct trainings below the recommended threshold.

To determine the quality of the training, the respondents were asked to give an account of their understanding of several topics before and after training.

A paired T-test was used in assessing the feedback from the respondents with regard to their understanding of safety protocols before and after training. The average Likert score before the training was 2.5 while that after the training was 3.82. The result from the paired T test gave a P value of 0 and a T statistic of 1.10207E-39 at 5% level of significance.

Therefore, there was a statistically significant difference in the understanding of safety protocols before and after the training.

Further to this, the respondents were required to demonstrate understanding of tasks in key areas covered during the trainings. The findings are presented in table 4.3.

Table 4.3: Respondents understanding tasks after the trainings

Question	Score
I can confidently explain emergency shutdown procedures	4.05
I understand how to use fire suppression equipment effectively	4.23
The training included clear instructions on leak detection and response	4.03
Do you know how to use the first Aid Kit	3.93
I can confidently explain the First Aid and Medical Emergency procedures	3.72
I can confidently explain Environmental and Spill Response procedures	3.33
How confident are you in identifying potential LPG hazards?	3.75
Average	3.86

The average score was 3.86 indicating a generally good understanding of the concepts under training. The lowest confidence levels were exhibited in response to environmental spills and administering First Aid. This highlights need to enhance the delivery of content in these areas to improve learning outcomes. It can also be inferred that this low confidence is due to the limited trainings conducted in the areas as discussed in the previous sections of this chapter.

4.5 LPG depots staff feedback on the safety trainings

The perception of trainees on the quality of the training plays an important role in achievement of desired learning outcomes. Their feedback is critical as it provides insights on the relevance of training, the suitability of delivery, the time adequacy of time allocated, training materials provided and trainers' expertise on the training and delivery

4.5.1 The overall impact of the training on reducing LPG-related incidents

The study sought to understand the opinion of trainees on the overall impact of trainings using a likert scale of 1 to 5 where 1 represents No impact and 5 represents significant impact. The findings are presented in table 4.4.

Table 4.4: Impact of training on reducing LPG related incidents

Impact	Percentage response
Significant Impact	45.03%
Major Impact	41.52%
Moderate Impact	11.11%
Minor Impact	1.75%
No Impact	0.58%

The average weighted score reflecting the trainees' opinion on the training's impact on reducing LPG related accidents was 4.29 an equivalent of major impact on the rating scale. This suggests that the respondent strongly believe that the trainings significantly contribute to the overall reduction of LPG related accidents. The confidence of the trainees in the effectiveness of the trainings offered is a positive indicator and reinforces the importance of continued investment towards strengthening training in the LPG industry.

The respondents were requested to rate the trainer's expertise on a scale of 1-5 where 1 signified 'poor' and 5 'excellent'. The findings are summarized in figure 4.8.

Figure 4.8: Respondents' rating on trainers expertise

On average, the respondents rated the trainers' expertise in safety trainings at 4.44 indicating a 'very good' level of proficiency. This suggests that the trainers currently in the market are well experienced and well-equipped to deliver safety related trainings at LPG depots.

The study also evaluated whether the duration allocated to each topic was sufficient. Using the same Likert scale—where 1 represented 'poor' and 5 'excellent'—respondents provided their ratings. The results are as presented in figure 4.9.

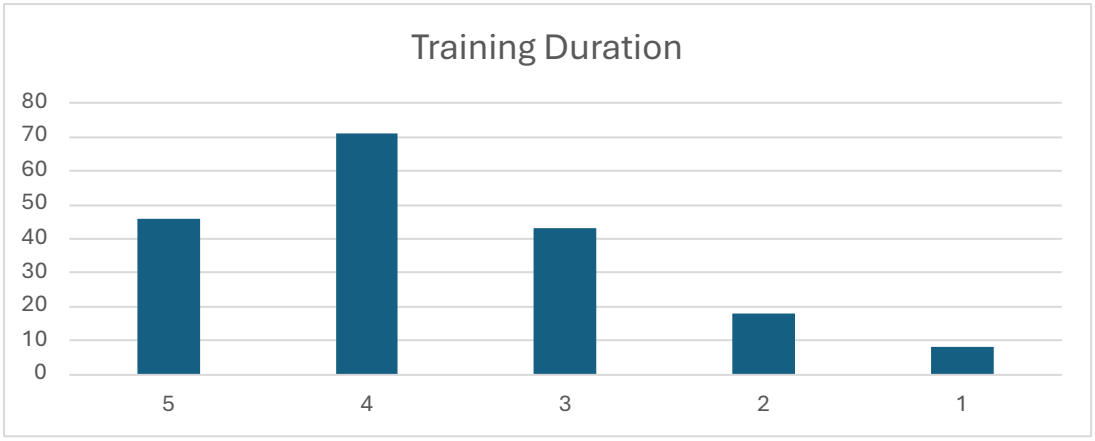

Figure 4.9: Rating on training duration

From the findings the respondents rated the duration of the training as 'good' at an average of 3.69. There is however need to investigate why the respondents did not feel that the duration was sufficient. This is necessitated by the fact that among the respondents, some rated this duration to be poor (4.3%) and fair (9.68%). With the policy of zero accidents and incidents, the training duration should be tailored in such a way that, all the respondents should be sufficiently satisfied with the training contact time.

The study sought to analyze the adequacy of the knowledge content of the training. The respondents were requested to rate the training material with the highest rating being 'strongly agree' and the least rating being 'strongly disagree'. The ratings were converted to a likert scale of 1 to 5 as presented in figure 4.10.

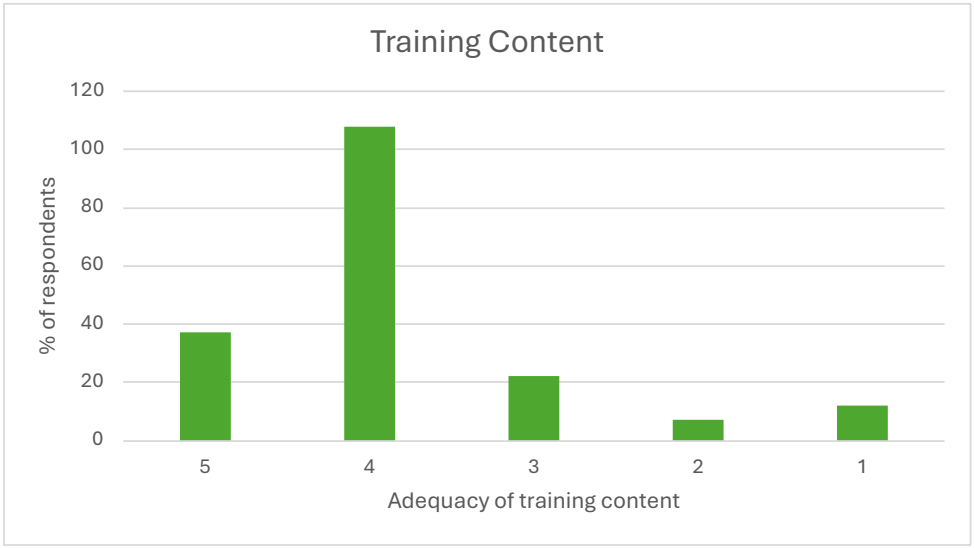

Figure 4.10: Rating of training content adequacy

From the findings, the respondents rated the adequacy of the training material at 3.81. This implies that they neither disagreed nor agreed on the adequacy. The results suggest that there is more to be done in terms of fortification of the content to meet the needs of the trainees and their expectations.

One of the ways of improving the knowledge content in such trainings would be conducting skills gap analysis and subjecting the course content to peer review.

The study examined trainees' perception on the quality of content delivery. They were asked to rank on a scale of 1-4, 1 meaning 'strongly disagree' and 4 'strongly agree' regarding whether the material was easury to understand. The results are presented in figure 4.11.

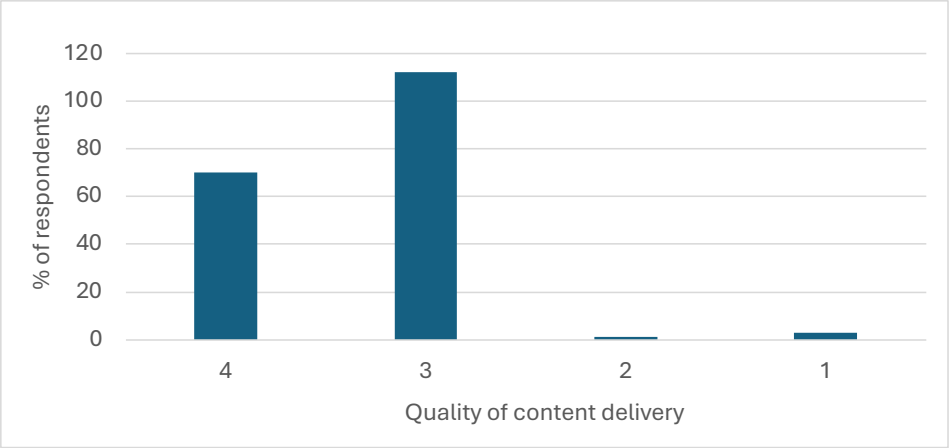

Figure 4.11: Rating on content delivery

The average ranking for this variable was 3.19. This indicates that the trainees are moderately satisfied with the pedagogical approach of the training. The respondents were asked to indicate what could be done to improve the quality of the trainings. Some of the salient recommendations are as follows;

1. Increase the training duration;
2. Improve practicality through methods such simulations;
3. Hire qualified trainers and often vary them for deeper perspectives;
4. Improve the training content by introducing visuals and;
5. Regular post-training assessments.

4.6 Relationship between trainings and incidents and accidents

This study tested the effect of the trainings undertaken by the trainees influenced the number of incidents and accidents in their depots. Two key variables were analysed: implementation of new safety measures and the effectiveness in preventing LPG related accidents.

To assess the first variable, the respondents were asked to state if they had introduced new safety practices in the facility after training. The results are presented in figure 4.12.

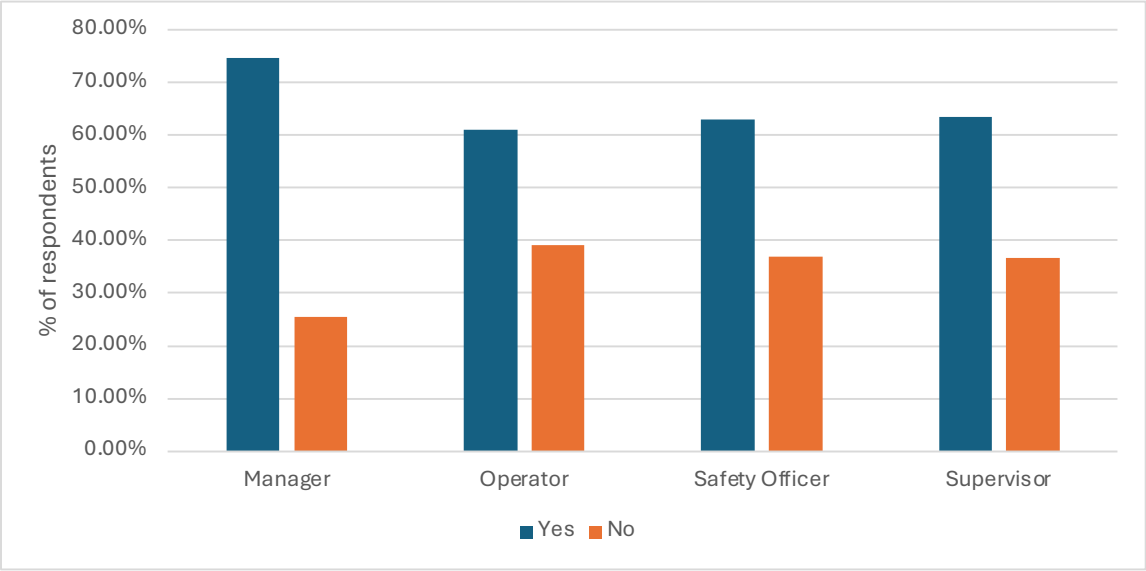

Figure 4.12: Rating on post-training implementation of safety measures

On average 65.48% of the respondents stated that they had implemented new safety measures after the trainings. This suggests that the training had an effect on the behavior of the trainees. There is however need for further studies to understand why the remaining 34.52 % had not implemented new safety measures.

Further, this study sought to analyze the effectiveness of the new safety practices in preventing LPG incidents. The respondents ranked this on a scale of 1-5 where 1 meant 'not effective at all' and 5 meant 'extremely effective'. The results are presented in figure 4.13.

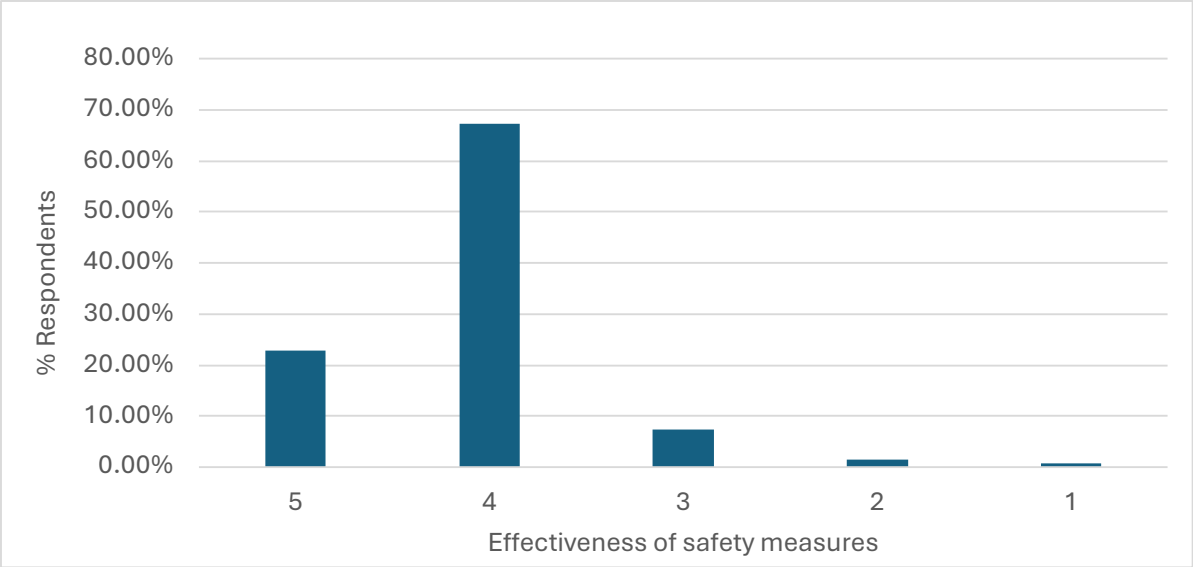

Figure 4.13: Effectiveness of safety measures.

The average score for this variable was 4.10 meaning the measures were effective in preventing accidents and incidents. This could point out to the positive effect the training has had on helping facilities improve their safety measures.

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CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

This study set out to analyze the effectiveness of the safety trainings provided to staff working in LPG depots. The study was guided by three objectives and it concludes as follows:

i) The demographic analysis of the education levels revealed that 38% of staff had attained a high school level of education. This was the highest qualification among operators, safety officers and supervisors. This study therefore concludes that a majority of LPG depot staff lack formal post- secondary education qualifications.

ii) It was further noted that the majority of the staff had between 1-3 years of experience. This study therefore concludes that this limited duration, which could be as a result of high staff turnover, may have an impact on the retention of institutional memory.

iii) A majority of the staff (94%) had received basic fire safety and emergency response training. Only 49.46% had been trained on hazard identification and risk assessment. The limited coverage of this training may undermine preparedness for critical risks.

iv) The study established that managers formed the biggest group (27%) of the employees who had undergone most of the trainings. These results were confounding as the trainings should ideally prioritise direct supervisors, operators and safety officers who are more likely exposed to operational risks.

v) The study also established that the average number of training topics conducted per facility was 6.25 within a period of 1-3 years. This indicates that the average trainings undertaken per facility is less than the 9 mandatory training disciplines. This implies that there are training areas that are often left out.

vi) The feedback on the content adequacy and the quality of content delivery was neutral scoring 3.81 and 3.99 respectively. This therefore calls for efforts to improve the quality of the training to enhance the confidence of the trainees. In contrast, the trainees rated the expertise of the trainers highly at 4.44, reflecting strong confidence in the qualification of the trainers.

vii) This study posited that trainings offered to LPG depot staff could influence staff behavior. An analysis of the post training behavior indicated that an average of 65.58% of the respondents had implemented new safety measures after undertaking the training. The study further analysed the effectiveness of these measures in reducing accidents on a scale of 1-5, the respondents scored this variable at 4.1 indicating a strong positive impact on accident prevention.

5.2. Recommendations

From the findings and the conclusions, this study makes the following recommendations.

i) To enhance safety of operations in LPG depots, there is need for stakeholders to develop and adopt minimum education requirements for staff involved in LPG depot operations. This should take into incorporate formal post-high school education.

ii) The training curriculum should be redesigned to balance theoretical knowledge with practical experience.

iii) The Authority should ensure that all LPG depots comply with the requirement to train staff on the 9 essential LPG safety training disciplines.

iv) To improve the effectiveness of the trainings content offered, this study recommends that the industry stakeholders should develop a standardized safety training curriculum. This curriculum should be developed in collaboration with government agencies, academia and other relevant stakeholders to ensure alignment with industry needs and practices.

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Appendices

Appendix I: EPRA Regional Offices Clusters

No.	Regional Office	Cluster of Counties	
1.	Lodwar (North West Region)	1. Turkana 2. West Pokot	
2.	Isiolo (North East Region)	1. Isiolo 2. Mandera 3. Marsabit	4. Wajir 5. Meru 6. Samburu
3.	Eldoret (North Rift Region)	1. Uasin Gishu 2. Nandi 3. Elgeiyo Marakwet	4. Transzoia 5. Bungoma
4.	Kisumu (Nyanza and Western Region)	1. Kisumu 2. Busia 3. Homa Bay 4. Migori 5. Siaya	6. Vihiga 7. Kericho 8. Kakamega 9. Kisii 10. Nyamira
5.	Mombasa (Coast Region)	1. Mombasa 2. Kwale 3. Kilifi	4. Tana River 5. Taita Taveta 6. Lamu
6.	Nyeri (Central Region)	1. Nyeri 2. Kirinyaga 3. Laikipia	4. Muranga 5. Tharaka Nithi 6. Embu
7.	Nakuru (South Rift Region)	1. Nakuru 2. Bomet 3. Narok	4. Baringo 5. Nyandarua
8.	Nairobi (Nairobi Region)	1. Nairobi 2. Kiambu 3. Machakos 4. Kajiado	5. Makueni 6. Garissa 7. Kitui

Appendix II: Letter of study notification to depot owners

Energy & Petroleum Regulatory Authority

Eagle Africa Centre, Longonot Road, Upperhill
P.O. Box 42681 - 00100 GPO, Nairobi - Kenya
Tel: +254 - 20 - 2847000
Cell: +254 730 947 000
Hotline: +254 709 336 000
Email: info@epra.go.ke; Website: www.epra.go.ke

Our Ref: EPRA/PG/1/MA/an

18th March, 2025

CEOs and Owners - LPG Storage and Filling Facilities

Dear LPG Storage and filling Owners/CEOs,

RE: PARTICIPATION IN THE STUDY ON THE EFFECTIVENESS OF TRAINING FOR LPG STORAGE AND FILLING FACILITY OPERATORS

The Energy and Petroleum Regulatory Authority (EPRA) is undertaking a study to assess the effectiveness of training programs for operators of bulk LPG storage and filling facilities. This study aims to evaluate the impact of training initiatives on safety awareness, compliance with regulations, and overall risk reduction in the industry. The findings will help enhance future training programs, ensuring they are aligned with industry needs and best practices.

As part of this study, your facility has been selected to participate, along with a representative sample of other licensed LPG depot facilities across the country. The data collection exercise is scheduled to take place from 31st March to 18th April 2025, during which our technical team will visit your premises to conduct structured interviews, administer questionnaires, and, where necessary, carry out facility observations. The information gathered will strictly be used for the purposes of this study and will be handled with the highest level of confidentiality.

We kindly request your full cooperation in facilitating this important exercise. Your participation will contribute significantly to strengthening LPG safety standards in Kenya. The insights from your facility will play a crucial role in shaping policies and training programs that directly benefit the industry and enhance operational safety.

EPRA appreciates your willingness to support this initiative and recognizes the valuable role your facility plays in promoting safety and compliance in the sector. Should you have any questions or require further clarification, please do not hesitate to contact us at petroleum@epra.go.ke.

We look forward to your cooperation and thank you in advance for your support.

Yours Sincerely,

Daniel Kiptoo Bargoria, MBS, OGW
DIRECTOR GENERAL

Appendix III: Study Consent Form

CONSENT FORM

Dear Participant,

The Energy and Petroleum Regulatory Authority (EPRA) is conducting a study to evaluate the effectiveness of safety training programs provided to LPG depot operators in Kenya. Your insights are invaluable to improving safety standards, reducing workplace risks, and ensuring compliance with national regulations.

This questionnaire seeks to understand:

1. Your experience with safety training programs.

2. How well the training has been applied in daily operations.

3. Challenges faced in implementing safety protocols.

Your responses will remain anonymous and used only for research purposes. No individual or depot will be identified in the final report.

We encourage you to answer all questions honestly and thoroughly. Your feedback will directly contribute to enhancing safety training quality and safeguarding Kenya's LPG sector. Please note that All data collected shall comply with Kenya's Data Protection Act (2019).

Thank you for your time and cooperation.

Yours Sincerely,

Eng. Edward Kinyua, PE, O.G.W.

CONSENT

I voluntarily agree to participate in this study

Name: _____Sign_____Date_____

Appendix IV: Study Questionnaire

"Effectiveness of Safety Trainings for Bulk LPG Storage and Filling Facility Operators"

Survey Questions:

1.0. Demographics

Purpose: To gather background information about the respondents.

1.1. **Age:**

- ☐ Under 25
- ☐ 25-34
- ☐ 35-44
- ☐ 45-54
- ☐ 55 and above

1.2. **Gender:**

- ☐ Male
- ☐ Female
- ☐ Prefer not to say
- ☐ Other: _____

1.3. Current Position:

- ☐ Operator
- ☐ Supervisor
- ☐ Manager
- ☐ Safety Officer
- ☐ Other (specify):_____

1.4. Years of Experience in LPG Operations:

- ☐ Less than 1 year
- ☐ 1-3 years
- ☐ 4-6 years
- ☐ 7-10 years
- ☐ More than 10 years

1.5. Educational Background:

- ☐ High School or equivalent
- ☐ Technical/Vocational Training
- ☐ Associate Degree
- ☐ Bachelor's Degree
- ☐ Postgraduate Degree
- ☐ Other(Specify):_____

1.6. Location of Facility:

- ☐ Nairobi Region
- ☐ Nyanza Western Region
- ☐ Coast Region
- ☐ North Western Region
- ☐ Central Region
- ☐ North Rift Region
- ☐ South Rift Region
- ☐ North Eastern Region

2.0. Training Details

Purpose: To understand the nature and extent of the training received.

2.1. How many safety training sessions have you attended in the past 3 years? _____

2.2. Have you received formal training on LPG safety protocols?

- ☐ Yes
- ☐ No

If no, why? _____

2.3. **If yes, how long ago did you receive the training?**

- ☐ Within the last 6 months
- ☐ 6 months to 1 year

- ☐ 1-2 years
- ☐ More than 2 years

2.4. **What was the duration of the training program?**

- ☐ Less than 1 day
- ☐ 1-2 days
- ☐ 3-5 days
- ☐ More than 5 days

2.5. **Who conducted the training?**

- ☐ Internal trainers (employer)
- ☐ External training providers
- ☐ Industry associations
- ☐ Government agencies
- ☐ Other (Specify): _____

2.6. **What topics were covered in the training?** (Select all that apply)

- ☐ Basic Fire Safety and Emergency Response Training
- . ☐ First Aid and Medical Emergency Training
- ☐ LPG handling and storage procedures
- ☐ Emergency response
- ☐ Environmental and Spill Response Training
- ☐ Safe Use of Equipment and Machinery
- ☐ Site-Specific Emergency Drill Training
- ☐ Personal protective equipment (PPE)
- ☐ Hazard Identification and Risk Assessment (HIRA)**
- ☐ Others (specify):_____

2.7. Rate your understanding of LPG safety protocols prior to the training:

- ☐ Poor
- ☐ Fair
- ☐ Good

- ☐ Very Good
- ☐ Excellent

2.8. **Rate your current understanding of LPG safety protocols after the training:**

2.9. ☐ Poor

2.10. ☐ Fair

2.11. ☐ Good

2.12. ☐ Very Good

2.13. ☐ Excellent

3.0. Knowledge of Safety Protocols

Purpose: To assess the respondents' understanding of safety procedures.

(Likert Scale: 1 = Strongly Disagree, 5 = Strongly Agree)

3.1. The training covered all critical safety protocols for LPG handling.

[1] [2] [3] [4] [5]

3.2. I can confidently explain emergency shutdown procedures.

[1] [2] [3] [4] [5]

3.3. I understand how to use fire suppression equipment effectively.

[1] [2] [3] [4] [5]

3.4. The training included clear instructions on leak detection and response. [1] [2] [3] [4] [5]

3.5. Do you know how to use the first Aid Kit

[1] [2] [3] [4] [5]

3.6. I can confidently explain the First Aid and Medical Emergency procedures

[1] [2] [3] [4] [5]

3.7. I can confidently explain Environmental and Spill Response procedures

[1] [2] [3] [4] [5]

4.0. Scenario-Based Questions

4.1. What steps would you take if you detected an LPG leak?

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How would you respond to a fire outbreak during cylinder filling? _____

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How do you inspect PPE before starting work? _____

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5.0. Practical Applications

5.1. Do you conduct daily safety checks? [ ] Yes [ ] No

5.2. Have you ever used training knowledge to prevent an incident? [ ] Yes [ ] No

5.3. Are safety drills conducted regularly at your depot? - [ ] Monthly [ ] Quarterly [ ] Semi-annually [ ] Annually [ ] Never

6.0. **How confident are you in identifying potential LPG hazards?**

6.1. ☐ Not Confident

6.2. ☐ Slightly Confident

6.3. ☐ Moderately Confident

6.4. ☐ Very Confident

6.5. ☐ Extremely Confident

7.0. Application of Safety Practices

Purpose: To determine how effectively operators apply safety knowledge in their work.

- **7.1. How frequently do you apply the safety protocols learned during training in your daily operations?**
  - ☐ Never
  - ☐ Rarely
  - ☐ Sometimes
  - ☐ Often
  - ☐ Always
- **7.2. Have you implemented any new safety measures at your facility as a result of the training?**
  - ☐ Yes
  - ☐ No
  - If yes, please specify: _____
- **7.3. How effective are the safety practices in preventing LPG-related incidents?**
  - ☐ Not Effective
  - ☐ Slightly Effective
  - ☐ Moderately Effective
  - ☐ Very Effective
  - ☐ Extremely Effective

8.0. Incident Reporting and Safety Outcomes

Purpose: To evaluate the impact of training on safety incidents.

- **8.1. Have you experienced any LPG-related incidents since completing the training?**
    - ☐ Yes
    - ☐ No

8.2. If yes, how many incidents have occurred in the past year?

- ☐ 1-2
- ☐ 3-5
- ☐ 6-10
- ☐ More than 10

8.3. How has the frequency of incidents changed since the training?

- ☐ Increased
- ☐ No Change
- ☐ Decreased
- ☐ Not Applicable

- **8.4. Rate the overall impact of the training on reducing LPG-related incidents:**
    - ☐ No Impact
    - ☐ Minor Impact
    - ☐ Moderate Impact
    - ☐ Significant Impact
    - ☐ Major Impact

9.0. Feedback on Training Programs

Purpose: To gather insights for improving training effectiveness.

9.1. Rate the trainers' expertise:

[1] [2] [3] [4] [5] (1 = Poor, 5 = Excellent)

9.2. Training duration was sufficient to cover all topics.

[1] [2] [3] [4] [5]

What improvements would you suggest for future training?

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9.3. How would you rate the overall quality of the training program?

- ☐ Poor
- ☐ Fair
- ☐ Good
- ☐ Very Good
- ☐ Excellent

9.4. Was the training delivered in a way that was easy to understand?

- ☐ Strongly agree
- ☐ Agree
- ☐ Disagree
- ☐ Strongly disagree

9.5. **How relevant was the training content to your daily operations?**

- ☐ Not Relevant
- ☐ Slightly Relevant
- ☐ Moderately Relevant
- ☐ Very Relevant
- ☐ Extremely Relevant

9.6. **Were the training materials (e.g., manuals, presentations) adequate and helpful?**

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree

- ☐ Strongly Agree

9.7. **What aspects of the training did you find most beneficial?**

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9.8. *Open-Ended Response*

9.9. **What improvements would you suggest for the training program?**

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Open-Ended Response

9.10. **Would you recommend this training to other LPG operators and facility managers?**

- ☐ Yes
- ☐ No
- ☐ Maybe

10.0. Challenges and Barriers

Purpose: To identify obstacles in implementing safety practices post-training.

10.1. **What challenges have you encountered in applying the safety measures taught during the training?**

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10.2. **Are there any barriers (e.g., resource constraints, organizational culture) that hinder the effective implementation of safety protocols?**
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10.3. **How have you addressed these challenges, if at all?**
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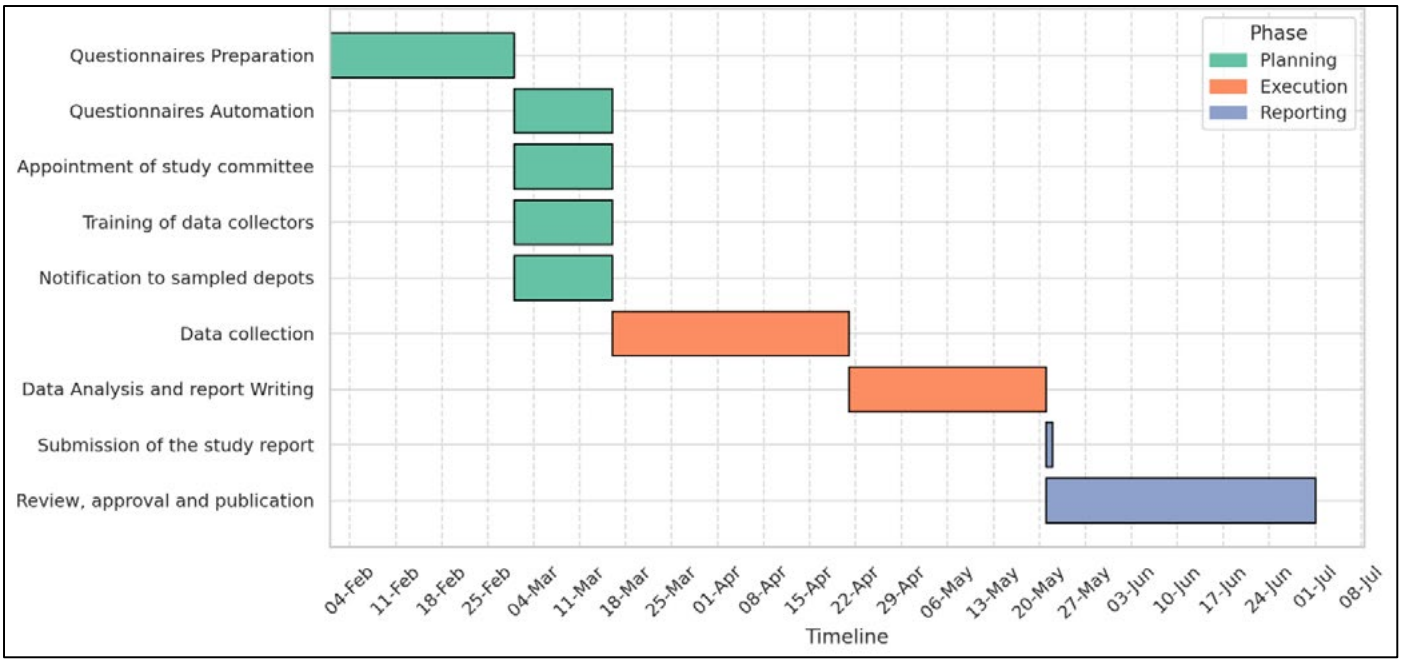
Appendix V: Activity Work Plan



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