

ASSESSMENT OF FIRE SAFETY MANAGEMENT AND ADEQUACY OF THE EXISTING CONTROL MEASURES IN KENYA POWER; NAIROBI REGION

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Abstract

In the recent past, there has been an increase in fire incidents in Kenya which have affected dwellings and workplaces. These incidents have led to loss of life, property and injuries. In the workplaces, loss of property translates to loss of plant, product and/or information; most of the time organizations never recover fully from these effects. Not only are fire outbreaks a safety and health risk; they also adversely affect the social, economic and environmental conditions of an organization. Kenya Power has a number of operations whose incorporation of fire safety is paramount to reduce/eliminate fire incidents. The study aimed at assessing fire safety management practices and adequacy of the existing control measures in Kenya Power, Nairobi Region. Descriptive research design that adapted both quantitative and qualitative approaches was used. Questionnaires were administered to 306 respondents using stratified random sampling and simple random sampling methods. Additional information was obtained by conducting interviews on purposively selected key informants e.g. safety officers. An observation checklist containing pertinent issues concerning fire safety was also developed to aid in carrying out workplace inspections. Secondary data was also obtained from the existing records. A total of thirty two workplaces i.e. offices, stores, substations, electrical workshops, garages, vehicle parking areas and welding areas were used for the study. The findings show that the relationship between fire safety training and period of service of the respondents had the highest statistical significance ($\chi^2=15.7$, $p=0.001$, $df=3$). Some of the control measures which would assist in reducing fire risk lacked completely or lacked in most of the organization's workplaces for example conducting fire drills and fire risk assessments, presence of evacuation procedures, among others. The study found some gaps in the organization's fire safety management practices with most of practices below the set fire safety standards. This study therefore recommends for a complete overhaul of the practices so as to promote fire safety of all the employees.

Key words: Health risk, fire safety, management practices, fire incidents, control measures, fire safety standards

1.0 Introduction

1.1 Background of the study

Fire has become an important part of human civilization by providing light, warmth and ability to cook, if used safely. However among different types of disasters, fire constitutes a significant threat to life and property in urban and rural areas. Even when fires don't injure workers, they can disrupt activities quite significantly and bring most operations to a standstill. Fires can lead to the destruction of property and loss of important records and information hence the need for clear fire safety rules to minimize outbreaks and the loss that can result from such hazards (Schifiliti, 2003).

Fire outbreaks are disasters which are caused by actions of human beings directly or indirectly. Fire safety entails all the activities which are geared towards fire prevention, fire protection and fire suppression. These activities and processes are done to safeguard human life and to preserve property (Muindi, 2014). Organizations which observe good safety and health practices have highly motivated hence productive staff, lower absenteeism rates, fewer business disruptions and reductions in the costs of sick pay and temporary replacement staff. The business reputation is also improved both in the business world and as an employer of choice.

Fire outbreaks have risen to a worldwide attention in recent years as an environmental and economic issue. Globally, fire is considered a potential threat to sustainable development because of its effects on ecosystems, its contribution to carbon emissions and its impact on biodiversity (Tacconi, 2003). In Nigeria, there was a fire incident in a plastic factory in Ikorodu, Lagos in 2002 where many workers were roasted to death at night because the owners of the factory locked the workers in (Ogbonna and Nwaogazie, 2015). The Nigerian Red Cross said 37 bodies were retrieved from the West African Rubber Products Company. But newspapers put the death toll in hundreds, saying scores of workers on a night shift numbering 250 remained missing.

Fire statistics results released by Home Office (2017) indicated that in 2015/16 there were 303 fire-related fatalities and 7661 non-fatal casualties in England. Majority of the fire-related fatalities (76%) and casualties (75%) occurred in dwellings. The number of fire fatalities in other building (mainly workplaces) in 2015/16 was 21, compared to 19 in 2014/15. The number of non-fatal casualties increased by 23% to around 1000 in 2015/16. The proportion of dwellings with a smoke alarm increased greatly in the 1990's and has continued to increase since then. This is likely to be one of a number of contributing factors to the reduction in fire-related fatalities that occurred in the 1990's and 2000's. Fires where a smoke alarm was not present accounted for 46% of all other building fires.

Fires in electric power generating plants can have costly and even fatal consequences. Yet, the owners and operators of many plants have paid little if any attention to fire suppression systems since they were installed 10 or even 20 years

ago. In about one-third of the cases in which fire suppression systems fail to operate as expected, the cause is inadequate inspection, testing and maintenance (Dieken, 2018). Although the majority of electrical fires are small and extinguished quickly, some have had severe consequences. Occurrences at Thermalito Power Plant (California) in 2012, Detroit Dam (Oregon) in 2007, and Watts Bar Hydroelectric Plant (Tennessee) in 2002 resulted in major electrical fires. In almost all cases, the fires caused forced shutdowns, some for a year or more. The loss of generation as the result of an electrical fire often outweighs the actual fire damage (Dieken, 2015).

Some of the recent cases of fire incidents witnessed at workplaces in Kenya include Jomo Kenyatta International Airport's arrival unit in 2013 (Daily Nation, August 7, 2013) where property worth millions was destroyed, Canon Towers along Moi Avenue in Mombasa (Standard Digital, May 21, 2013) and Nakumatt Downtown in 2009 with 29 deaths being recorded (The Star, July 18, 2016). From Kenya Power's fire incident reports, some of the incidences that affected the organization include Kenya Power's Steel Billets Sub-station in Nairobi in 2011, 2nd floor of Stima Sacco Building (Mshembu Road) in 2013, and basement floor of Stima Plaza in 2012, among others. Though some of these incidences were non-fatal, they led to great loss of property and damage to the environment.

Fire safety is not only the business of the employer, but is also the business of the employee. Each person within the organization i.e. from employer to employees has a key role to play in promoting fire safety. Issues regarding fire safety within an organization require two way communication between management and employees and follow up to ensure that they are addressed. Management commitment to safety is necessary, but true safety excellence requires engagement from personnel throughout the organization, especially the casual employees. Such engagement in safety benefits the employees as well as the organization. In fact, studies recognize that leading a people based safety culture is for everyone, not just corporate managers and supervisors (Geller, 2012).

Kenya Power owns and operates most of the electricity transmission and distribution system in the country and sells electricity to over 4.8 million customers (as at June 29, 2016). The Company's key mandate is to plan for sufficient electricity generation and transmission capacity to meet demand; building and maintaining the power distribution and transmission network and retailing of electricity to its customers (Kenya Power official website, 2017). The company has experienced a number of fire incidents which though non-fatal, have seen some injuries, property loss worth millions of shillings and interruption of its business.

1.2 Statement of the Problem

Kenya Power workplaces are a beehive of activities. In the normal day to day routine activities, the premises have staff, customers or visitors, contracted firms e.g. cleaners. This makes the population within the premises to be high. There are also some vital documents within the premises, some of them containing sensitive

customer information. There are various ignition and fuel sources in existence which pose risk to the staff if left unchecked. Various fire incidents though non-fatal, have also been witnessed in the company and some of them have led to injuries, property loss worth millions of shillings and interruption of business. If the fire safety practices are left unchecked, the workers might get injured, and may lead into fatalities. The study therefore aimed at assessing management of fire safety in Kenya Power and whether its control measures are adequate to deal with the risk posed.

1.3 Objectives of the Study

- i) To establish the likely causes of fire within the organization
- ii) To determine adequacy of the organization's current control measures
- iii) To determine compliance level of the organization's fire safety preparedness measures with reference to Fire Risk Reduction Rules, 2007

2.0 Materials and Methods

2.1 Research Design

The study was conducted using descriptive research design that utilized both quantitative and qualitative research methodologies. Since this was a fact finding mission, descriptive research was used since it can be explained as a statement of affairs as they are at present with the researcher having no control over variables. A descriptive study is one in which information is collected without changing the environment (i.e., nothing is manipulated) Descriptive statistics tell "what is" while inferential statistics try to determine cause and effect (Knupfer and McLellan, 2001)

2.2 Study area

The study was conducted at Kenya Power Nairobi Region, in Kenya whose Central Office is at Stima Plaza located in Ngara West, Nairobi and comprised of thirty two selected sites i.e. offices, stores, substations, motor vehicle garages, electrical work shops, welding workshops and vehicle parking areas. The sites lie between longitude 36°38'38.4"E and 36°57'48.5"E and latitude 1°06'37.1"S and 1°18'25.7"S (Google Maps, 2017).

2.3 Target Population

The target population for the study was 1500 and was divided into four strata which comprised of Kenya Power staff (top management, middle level management and union staff) and contracted security firm employees (security guards), since they also hold key information. Simple random sampling technique was then used to pick samples proportionately from each stratum. The sample size for the study was 306 participants.

2.4 Data Collection

Primary data was collected using semi-structured questionnaires, face to face interviews and observation checklist. Secondary data was obtained through review of the company existing records e.g. fire incident reports, fire safety audit reports,

etc. The final questionnaire was developed after several pilot studies to test on validity and reliability of the instruments used.

2.5 Data Analysis and Presentation

The obtained data was cleaned, coded and put in Microsoft Excel 2013. It was analysed using Statistical Package for Social Scientists (SPSS). Chi square analysis was conducted to establish the relationship between variables. Results of the analysis were organized, summarized and presented using tables, pie charts, bar graphs, and bar charts showing the frequency and percentages involved where applicable.

3.0 Results and Discussion

Out of 306 respondents, 289 filled and returned the questionnaires making a response rate of 94.4%. According to Mugenda and Mugenda (2003), a response rate of 50% is adequate for analysis and reporting; a rate of 60% is good and a response rate of 70% and over is excellent. The respondents' demographics are as shown in table 1 below;

Table 1: Respondent staff level, period of service and number of employees

Variable	Aspect	Frequency	%
Gender	Male	197	68.2
	Female	92	31.8
	Total	289	100
Age category	21 to 35 years	118	40.8
	36 to 50 years	139	48.1
	51 to 60 years	32	11.1
	Total	289	100
Level of education	Secondary school	44	15.2
	Diploma	122	42.2
	Undergraduate Degree	76	26.3
	Post-graduate Degree	47	16.2
	Total	289	100
Level of service	Top management	23	8.0
	Middle level management	147	50.9
	Union staff	101	34.9
	Security guards	18	6.2
	Total	289	100
Period of service	Less than 1 year	18	6.2
	1 to 10 years	84	29.1
	11 to 20 years	122	42.2
	Over 20 years	65	22.5

Total	289	100
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Table 2 below shows distribution of the 289 respondents and the 32 study sites;
 Table 2: Distribution of sample size and study sites

Site	Sample size	Percentage of total sample size	Number of sites sampled	Percentage of total sites
Offices	170	58.8	10	31.3
Stores	40	13.8	7	21.9
Substations	28	9.7	7	21.9
Garages	18	6.2	2	6.3
Electrical workshops	13	4.5	1	3.1
Parking areas	11	3.8	3	9.4
Welding workshops	9	3.1	2	6.3
Total	289	100	32	100

3.1 Likely causes of Fire

The first objective was to establish the likely causes of fire in the respondents' workplaces. Respondents were presented with yes/no questions as shown in figure 1;

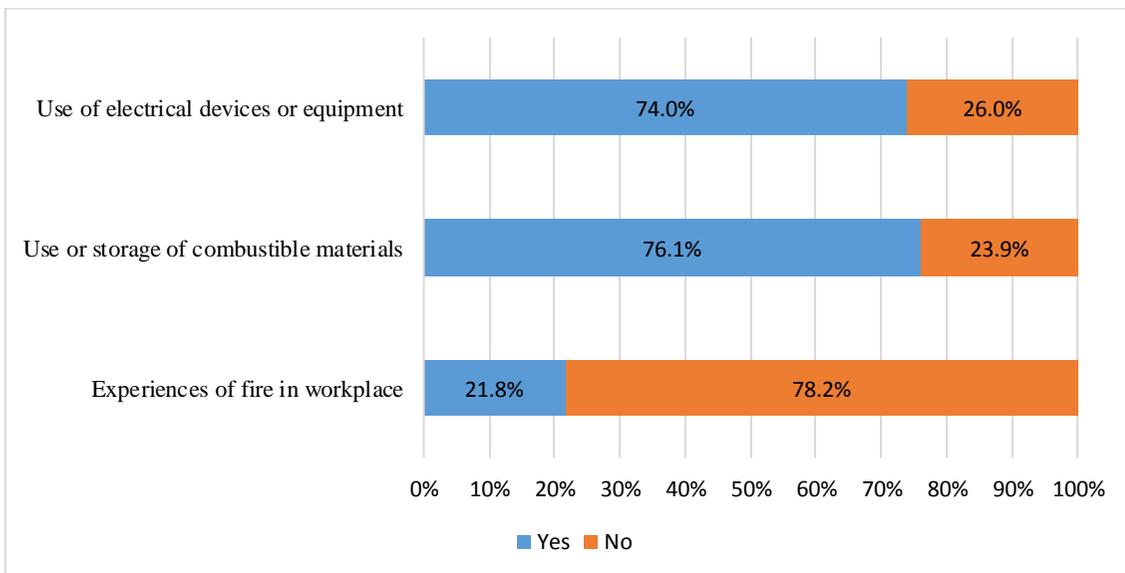


Fig. 1: Likely causes of fire and respondents' experiences of fire

With some of the respondents reporting that they had experiences of fire in their workplaces and most of them indicating use of electrical devices or equipment and

use or storage of combustible materials at their workplaces, of importance is to establish whether these items contributed in causing the fire incidents. Their use is inevitable but have the potential of causing fire if not used or stored properly. The level of risk posed by them is dependent on the control measures in place. The most common electrical devices that were noted to be in use apart from electronic devices like computers and printers included electric coils, tea urns, and electric kettles, among others. In substations, electrical equipment included circuit breakers, electrical cables, transformers, battery chargers and batteries, among others. Combustible materials in use or storage included paper, plastic, rubber, furniture, among others. Under this objective, the study also established items that posed fire risk which was as a result of them causing fire incidents.

Respondents were also asked to give opinion in their own words the likely causes of fire in their workplaces.

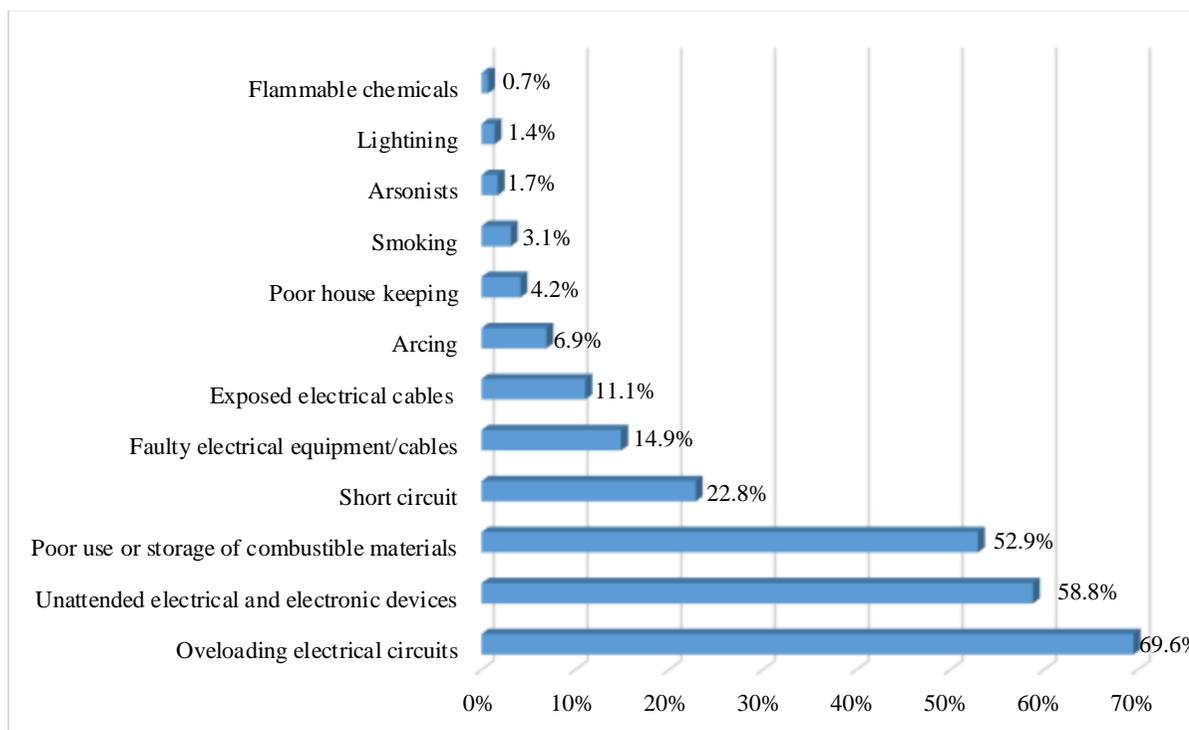


Fig. 2: Likely causes of fire at the workplace

From figure 2, the leading cause of fire according to respondents was overloading of electrical circuits followed by leaving energised electrical and electronic devices unattended while the least was flammable chemicals. This points to electrical fires being the most likely to occur in the workplaces. The above finding was supported by observations made where it was noted that in some of the workplaces, low voltage electrical cables remained exposed, which could easily lead to arcing or short circuit. Use of trailing cables especially in offices was noted to be predominant,

which could lead to circuit overloading. Use and storage of flammable chemicals, especially cleaning solvents was noted to be in very small quantities, implying a very low probability of causing fire. Ogajo (2013) noted that today's world of electronic office equipment has resulted to an increase in fire incidents due to faulty electrical equipment and power distribution systems.

From fire incident reports, it was noted that a number of fire incidents though non-fatal, had been witnessed in the recent past (within the last 5 years) and are as shown in table 3 below;

Table 3: Summary of recent fire incidents

Site	No of incidents	Cause	Outcome
Offices	3	Unattended electrical and electronic devices	Small fires, no injuries
Stores	2	Live High Voltage conductors falling on combustible materials	Large fires, no injuries, estimated average loss of Ksh. 50M
Substations	4	Explosion from electrical equipment	Large fires, minor injuries to security guard in one of the substations, estimated average loss of Ksh. 80M
Total	9		

The other workplaces i.e. garages, electrical workshops, parking areas and welding workshops recorded zero fire incidents within the period. This could be attributed to the fact that use or storage of electrical devices and combustible materials is much less compared to the workplaces where fire incidents were witnessed. From table 3 above, it was noted that the leading cause of fire incidents was electrical devices or equipment followed by combustible materials, being ranked according to the number of fire incidents each caused. This finding was in line with Wambugu (2016) who indicated that majority causes of fire in workplace were electrical in nature which included electrical fault and exposed cables (87%). This therefore calls for improved control measures so as to minimise the risk posed by their use or storage, which is inevitable.

3.1.1 How the Fire Incident would have been prevented or its Impact Reduced

With some of the respondent (21.8%) indicating that they had experienced a fire incident in their workplace, they were further asked to state how the incident would have been prevented or its impact reduced.

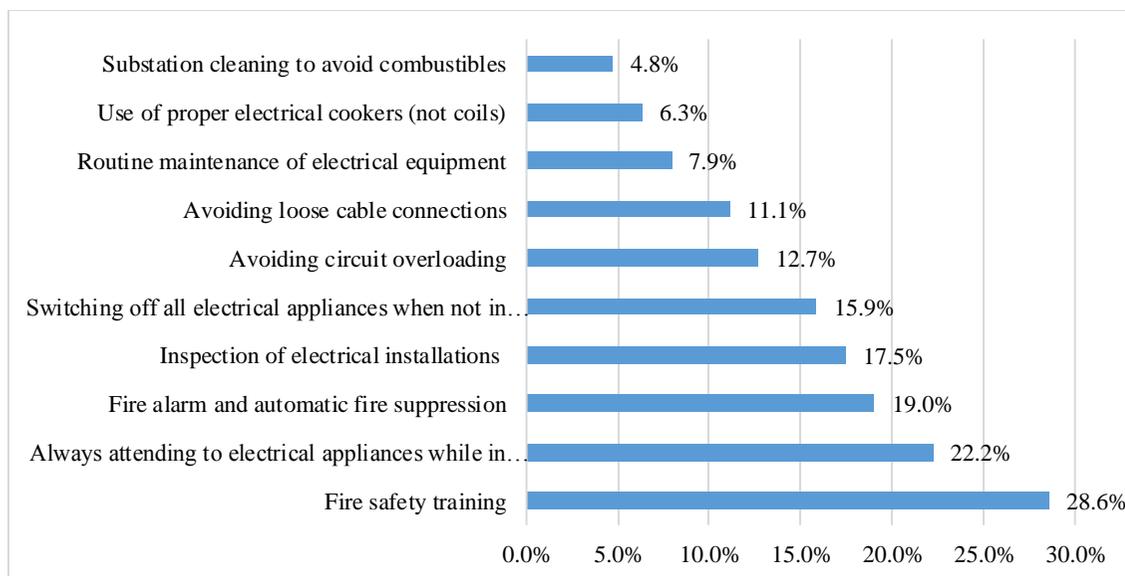


Fig. 3: How the fire incident would have been prevented or its impact reduced

From figure 3, the issue that was indicated as helping most was fire safety training, while the least was removal of combustibles in substations. The interviews conducted indicated that most of them were not aware of the evacuation procedures to follow in case of fire. While trying to escape from fire, some of them took risky measures for example wanting to pick their valuables first. This could be because most of them had not been trained on measures to take in case of fire. Training equips staff with knowledge on fire prevention measures and improves their state of preparedness in case of a fire occurrence. Murage (2012) indicated that educational and training programs pertaining to the fire safety measures help in providing knowledge to the people about the various aspects of a fire disaster. She noted that being ill prepared in the event of fire; one literally does not know what to do and while in that state of confusion the houses get raised in the inferno.

Various methods of eliminating electrical fires were also cited i.e. avoiding circuit overloading, always attending to electrical appliances while in use, routine maintenance of electrical equipment, among others. The study also established that there were also no records to show that inspection of electrical installations i.e. in buildings was carried out. Stokes and Bradley (2009) indicated that in addition to the initial verification of the installation, periodic inspection and testing are required over the lifetime of an installation. Since electrical fires were cited as the most predominant, this calls for awareness creation to the staff on the fire hazards especially of electrical type that exist in their workplaces.

3.2 Adequacy of the Current Fire Safety Control Measures

The second objective of the study was to establish whether the organization's existing fire safety control measures were adequate for the fire risks posed. This was by first determining the existing control measures then comparing them with the fire safety requirements. The questionnaire items that were used to assess this objective are as shown in figure 4 below;

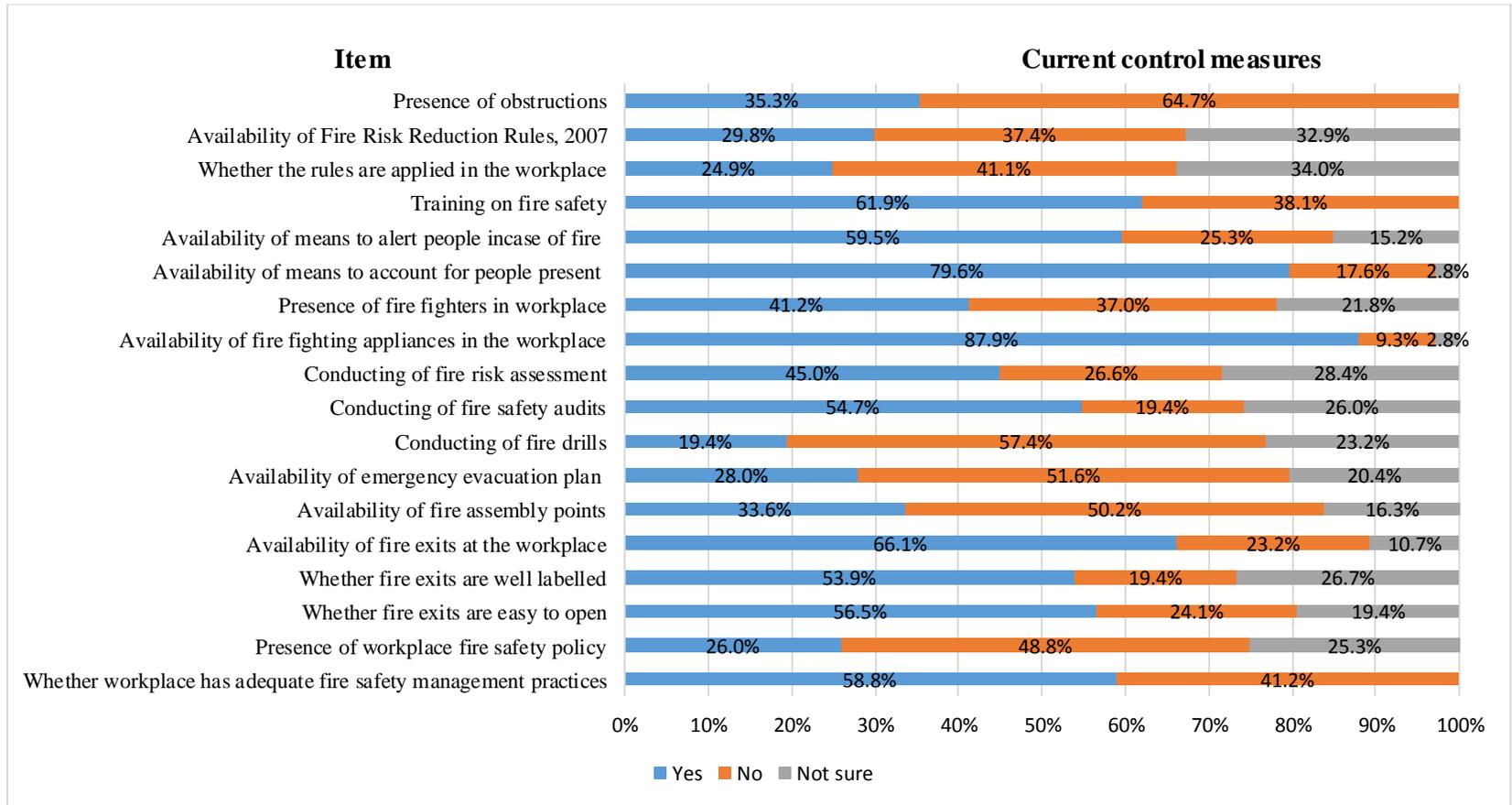


Fig. 4: Current control measures in Kenya Power

3.2.1 Presence of Obstructions

More than a third of the respondents (35.3%) reported that there were obstructions in their workplaces. A tour of the workplaces confirmed that a number of passages and exits had been obstructed, making it difficult for the occupants to escape in the event of fire. This is contrary to United States Department of Labour (2003) who indicated that when designing and maintaining exits, it is essential to ensure that routes leading to the exits, as well as the areas beyond the exits, are accessible and free from materials or items that would impede individuals from easily and effectively evacuating.

3.2.2 Fire Risk Reduction Rules (FRRR), 2007 in the Workplace

Close to a third of the respondents (29.8%) indicated that Fire Risk Reduction Rules (FRRR), 2007 were available with only a quarter of them (24.9%) indicating that the rules were applied in their workplaces. Only a few of the workplaces (15.6%) toured had FRRR, 2007 being displayed. In the workplaces having the rules being displayed, staff were not being sensitised to read and understand them. From the interviews conducted, it was established that majority of the employees were not aware about existence of the rules, thus affecting their effective application in the workplaces. Makachia (2013) indicated that lack of information as relates to the Fire Risk Reduction Rules, 2007 as the main factor affecting implementation of the rules.

3.2.3 Training of Employees on Fire Safety

Most of the respondents (61.9%) indicated that they had been trained on fire safety. However from training records, only a quarter (25.0%) of the respondents had undergone fire safety training. It was picked from interviews that the difference was arising from some of the respondents having undergone general Occupational Safety and Health (OSH) training where basic fire safety training formed part of the content, hence some of them responding as having been trained on fire safety. These results were not consistent with the provisions of Fire Risk Reduction Rules (2007) which indicate that all workers should be instructed in safe use of firefighting appliances.

The respondents further indicated when they had last attended the training. Results are presented by the pie-chart in figure 5 below;

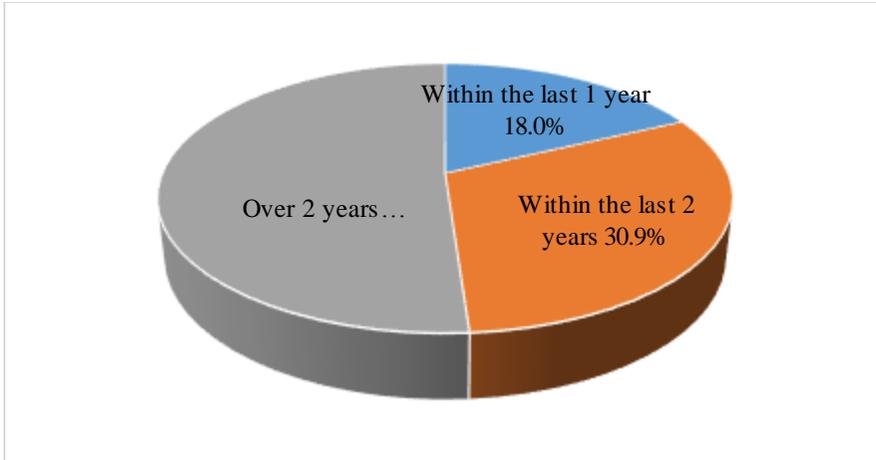


Fig. 5: Last time fire safety training was attended by respondents

The results indicated that most of the respondents (51.1%) who had attended fire safety training had lastly done so over two years earlier. There were no records in existence to show any refresher courses that had been conducted. With most of the staff having not been trained on fire safety or with no refresher courses being conducted, this puts them at risk since they have little or no knowledge on fire preventive measures or steps to take in case of fire.

3.2.3.1 Training on Fire Safety by Respondents' Demographics

Chi-square Test was used to test the relationship between respondents' demographic parameters and training of the staff on fire safety at 5% significance level as shown in table 4.

Table 4: Training of staff on fire safety

Variable	Category	Training on fire safety		
		Yes	No	Analysis
Gender	Male	62.9%	37.1%	$\chi^2=0.266$, df=1, p=0.606
	Female	59.8%	40.2%	
Age category	21-35 yrs	51.7%	48.3%	$\chi^2=9.07$, df=2, p=0.011
	36-50 yrs	69.8%	30.2%	
	51-60 yrs	65.6%	34.4%	
Level of education	Secondary Sch	59.1%	40.9%	$\chi^2=2.63$, df=3, p=0.452
	Diploma	60.7%	39.3%	
	Undergraduate Degree	59.2%	40.8%	
	Post-graduate Degree	72.3%	27.7%	
Level of service	Top management	78.3%	21.7%	$\chi^2=4.09$, df=3, p=0.252
	Middle level management	62.6%	37.4%	
	Union staff	56.4%	43.6%	
	Security guards	66.7%	33.3%	
Period of service	Less than 1 year	38.9%	61.1%	$\chi^2=15.7$, df=3, p=0.001
	1 to 10 years	48.8%	51.2%	
	11 to 20 years	71.3%	28.7%	
	Over 20 years	67.7%	32.3%	

The results showed that only the relationship between age category and training on fire safety and that between period of service and training on fire safety had a significant relationship. More respondents aged 36-50 years were trained on fire safety than respondents of the other ages. This relationship was statistically significant at $\chi^2=9.07$, df=2, p=0.011. The youngest respondents (21-35 years), who happened to have stayed least in the organization were trained least, since training was mostly conducted after a considerable period of service. With regards to the period of service, more staff who had served in the organization for less than a year were trained less on fire safety compared to those who had served for a longer period. This relationship was statistically significant ($\chi^2=15.7$, df=3, p=0.001). This was confirmed from training records, where it was noted that training on fire safety took place after staff had stayed in the organization for some time hence staff who had stayed for the least duration (less than 1 year) were trained least. This puts them at a greater risk compared to the others since they are in a new environment and are not conversant with the existing fire hazards and the appropriate preventive measures, hence need the training most.

These findings were not conforming Drysdale (2012) who identified training of all employees in proper fire prevention and emergency response techniques as one of

the strategies that affect design and implementation of successful fire safety programs.

3.2.4 Means of Alerting People in Case of Fire

This was meant to establish whether the organization has means of notifying people of fire incident in their workplace for safe escape. Most of the respondents (59.5%) reported about existence of the means. A tour of the premises revealed that most of the workplaces had manual break glasses and fire alarm bells to alert the occupants. Only a few (21.9%) had automatic smoke and fire detection equipment i.e. heat detectors and smoke detectors incorporated with fire alarm panels. This increased the risk since for the manual systems, someone might fail to trigger the warning devices. With some of the workplaces lacking means of alerting occupants, this is contrary to Drysdale (2012) who reported that an effective evacuation can take place if a fire is discovered early and the occupants are alerted promptly with a detection and alarm system.

3.2.5 Means of Accounting for People Present in Workplaces Including Visitors

Most of the respondents (79.6%) indicated that there existed means of accounting people present in the premises in the event of fire including visitors. Respondents further indicated that the leading measure in place was use of registers.

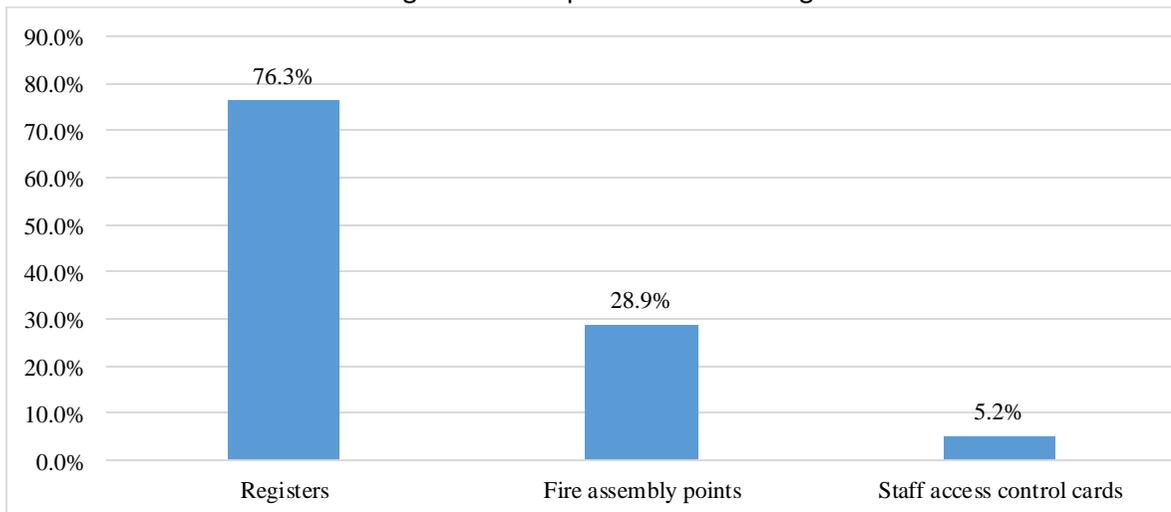


Fig. 6: Measures in place to account for people in the workplace including visitors

It was confirmed from facility tour that all the workplaces used registers for the people to sign in and out when accessing and leaving the premises respectively. These results conform to provisions of United States Department of Labour (2016) that visitors also should be accounted for following an evacuation and may need additional assistance when exiting and that some employers have all visitors and contractors sign in when entering the workplace and use this list when accounting for all persons in the assembly area. Access control cards were noted to be used in only one workplace.

3.2.6 Presence of Firefighters in Workplace

Less than half of the respondents (41.2%) reported that a firefighting team was available in their workplace. However, slightly over a half of the workplaces (53.1%) visited had a firefighting team. The firefighting teams did not undergo refresher courses. This was contrary to Occupational Safety and Health Act (2007) which requires every occupier to establish a firefighting team and for every member of the firefighting team to undergo a firefighting refresher course at least once in every two years. Also the workplaces that had firefighting teams did not meet the required size of the team as stipulated in Occupational Safety and Health Act (2007).

3.2.7 Firefighting Appliances in the Workplace

With regards to availability of firefighting appliances used to put off range of fires, most of the respondents (87.9%) reported that firefighting appliances were available at the workplaces. Respondents were further asked to state the types of fire fighting appliances available in their workplaces. The results are as shown below;

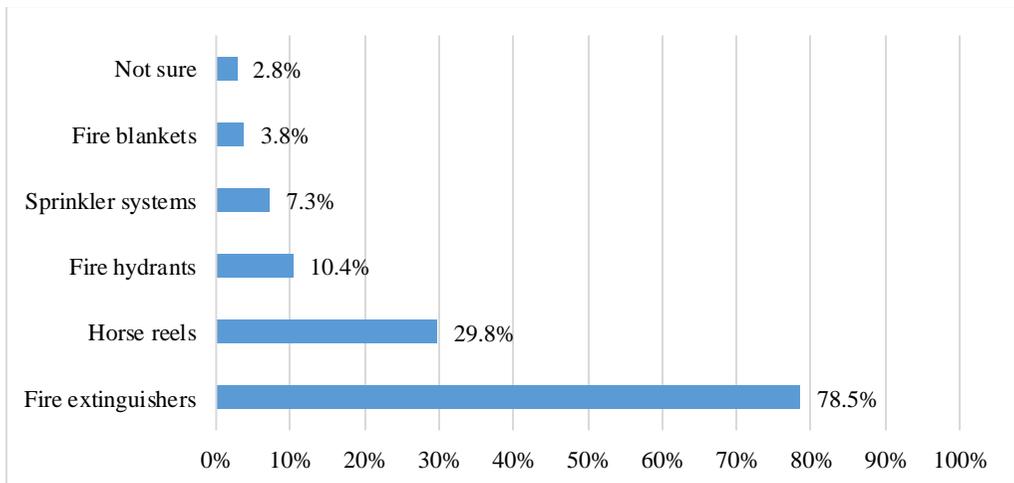


Fig. 7: Types of fire fighting appliances available in workplaces

Most of the respondents (78.5%) indicated that fire extinguishers were present with the least number indicating fire blankets (3.8%) as available. The researcher also observed that the most common fire fighting appliances available were portable fire extinguishers of different types which were available in all the workplaces, were inspected regularly and strategically placed. This finding supports Murage (2012) who indicated that firefighting equipment and facilities such as alarm systems, fire extinguishers and emergency doors must each be maintained on a regular basis and any faults, when detected, must be rectified immediately. A record of such maintenance must also be maintained.

However, fire extinguishers are convenient to fight small fires with only a few workplaces having the required resources to fight big fires e.g. fire hydrants and sprinkler systems. Also a small percentage of the respondents (25.0%) had been

trained on fire safety. These aspects put the organization at risk in the event of fire. According to Drysdale (2012), portable fire extinguishers and water hose reels are often provided for use by building occupants to fight small fires. Building occupants should not be encouraged to use a portable fire extinguisher or hose reel unless they have been trained in their use.

3.2.8 Conducting of Fire Risk Assessment

Less than half of the respondents (45.0%) indicated that fire risk assessments were conducted in their workplaces. From existing records, it was established that only general risk assessments were conducted, where fire safety issues were captured though this was not done regularly. No fire risk assessments were conducted. This finding does not support Heinz (2010) who indicated that integrated risk management requires an ongoing assessment of potential risks for an organization at every level and then aggregating the results at the corporate level to facilitate priority setting and improved decision-making. Integrated risk management should become embedded in the organization's corporate strategy and shape the organization's risk management culture.

Respondents further indicated the following means of communication as being used by the organization to relay results of fire risk assessments.

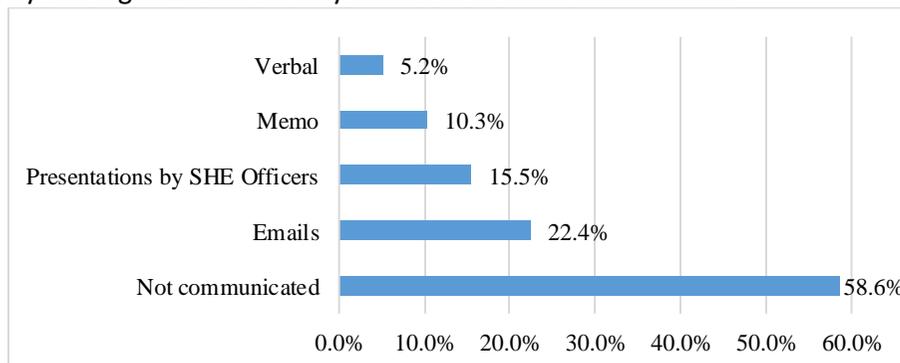


Fig. 8: Means of communication of fire risk assessment results

From the results, most of the respondents reported that results of the conducted fire risk assessments were not communicated to them. No records were also present to show feedback of the conducted risk assessments to the staff. This is a major drawback in addressing issues picked during the assessments. Kasperson (1986) noted that in order to communicate effectively, the risk communicator must have a clear objective and a target audience. Since different people have different levels of risk, specific messages will need to be targeted at those who need the most information. Communicators also must be clear about their objective, whether it is to raise awareness or to influence actions and decision making at a local level.

3.2.9 Conducting of Fire Safety Audits

Respondents were asked to indicate whether fire safety audits were carried out in their workplaces. Most of them (54.7%) indicated that fire safety audits were carried out. From the audit reports, only Occupational Safety and Health (OSH) audits were carried out annually where fire safety issues were captured among the other safety issues. Respondents were also asked to state when the last fire safety audit had been conducted in their workplaces. With most of the respondents (89.3%) indicating that the last audit had been carried out within the last one year, this was confirmed by the fact that an OSH audit had been conducted two months earlier.

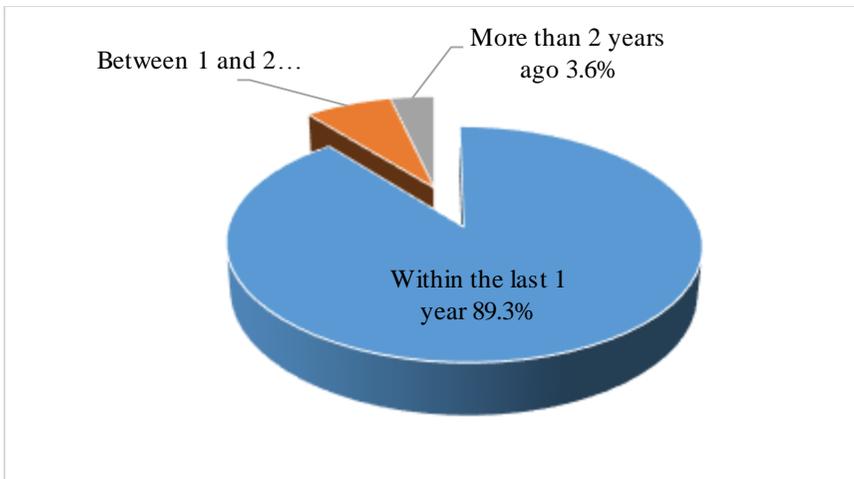


Fig. 9: When the last fire safety audit was carried out

With fire safety audits not been carried out, this does not conform to provisions of Occupational Safety and Health Act (2007) which require fire safety audits to be taken at least once every twelve months by approved fire safety auditor.

3.2.10 Conducting of Fire Drills

Fire drills are conducted to test the organization's abilities and readiness to handle a fire emergency. A few of the respondents (19.4%) reported that fire drills were carried out. Findings from interviews and documentary items revealed that the organization did not conduct any fire drills. Respondents were also asked to indicate how long ago the last fire drill had been carried out in their workplace, whose results are presented by the pie-chart below;

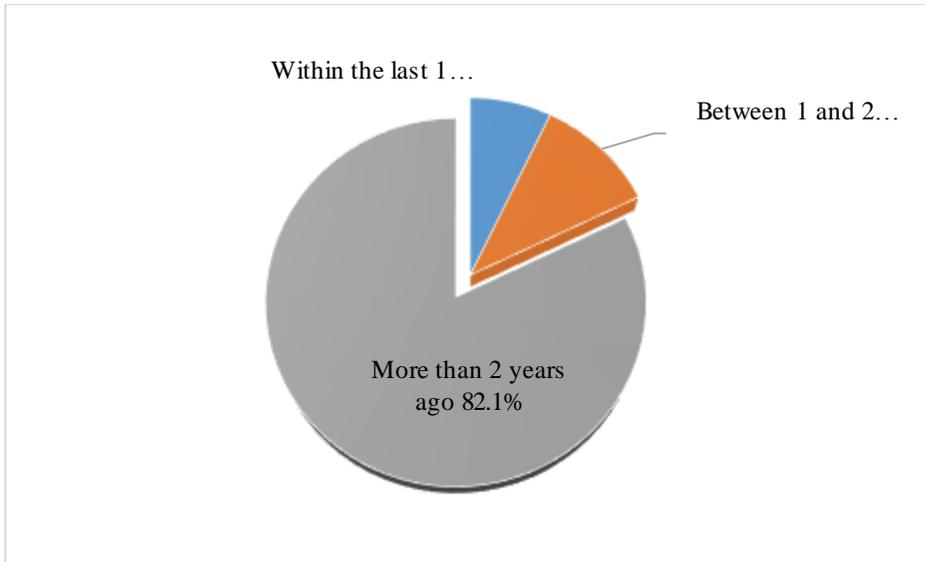


Fig. 10: When the last fire drill was carried out

With most of the respondents (82.1%) reporting that the last fire drill had been conducted more than 2 years earlier, this can be explained by the fact that no fire drills were being carried out hence most of the respondents could not remember any that had been carried out in the recent past. These findings do not conform to provisions of Occupational Safety and Health Act (2007) which requires fire drills to be conducted at least once in every twelve months and a record of the drills kept available for inspection.

3.2.11 Availability of Evacuation Plan or Procedures

Only less than a third of the respondents (28.0%) indicated that there were evacuation plans or procedures to be followed in case of fire. This was further confirmed from facilities tour which indicated that only 21.9% of the workplaces visited had them. This finding supports Muindi (2014) whose study in learning institutions revealed that most of the workplaces (73.7%) across the institutions did not have evacuation plans posted on the walls. However, Occupational Safety and Health Administration, OSHA, requires a written emergency action plan for all businesses that employ more than ten people, but for those with fewer than ten employees, the plan to be communicated orally.

3.2.12 Availability of Fire Assembly Points

A third of the respondents (33.6%) indicated that their workplaces had fire assembly points. It was observed that a few of the workplaces visited (40.6%) had the assembly points. Some of the fire assembly points were not labelled and most of them were also used for other purposes especially as car parking areas. Ayabei (2016) noted presence of assembly points in most buildings in Nairobi Central

Business District but were small and not clearly labelled and most of the time occupied as parking area. This exposed the building occupants to a lot of danger in the event of outbreak of fire. Occupational Safety and Health Act (2007) requires every occupier to identify a location in the workplace where every worker should assemble in the event of a fire. This assembly point should be labeled and known by all workers.

3.2.13 Fire Exits in the Workplaces

Two thirds of the respondents (66.1%) indicated that there existed fire exits in their workplaces. Close to a fifth of the respondents (19.4%) indicated that the exits were not well labelled and 24.1% reported that the exit doors were not easy to open. A facilities tour conducted by the researcher however revealed that some of the fire exit doors were permanently locked, due to heightened security measures. In all the premises that had fire exits, the staircase used for escape was located inside the building or had the spiral staircase for use in case of emergency. Occupational Safety and Health Act (2007) stipulates that an external staircase or ramp used as a means of escape in case of a fire should be adequately aerated, well lit and of at least one metre width and that a spiral staircase should not be considered as an emergency exit.

The same notion was supported by (Odour and Atsiaya 2004) who said that people who regularly visit or use buildings or even visitors should be aware about the presence of the exit door which should not be blocked with anything and with proper signage showing the path out. They further noted that in most of the buildings in Nairobi there were locks on doors while grilled outdoors were also locked a situation that presents doubts on their usability for escape purposes during emergency.

3.2.13.1 Presence of Fire Exits by Respondents' Demographics

To test the relationship between respondents' demographic parameters and reporting on the existence of fire exits in their workplaces, Chi-square Test was used at 5% significance level, as presented in table 5;

Table 5: Respondents' reporting on the existence of fire exists

Variable	Category	Existence of fire exits in the workplace			Analysis	
		Yes	No	Not sure		
Gender	Male	70.1	22.3	7.6%	$\chi^2=7.25$, df=2,	
		57.6	25.0			
Age category	Female	%	%	17.4%	p=0.027	
	21-35 yrs	60.2	25.4	14.4%	$\chi^2=6.29$, df=4,	
		67.6	23.0			
Level of education	36-50 yrs	%	%	9.4%	p=0.178	
		81.3	15.6			
	51-60 yrs	%	%	3.1%	$\chi^2=13.9$, df=6,	
		81.8	11.4			
Secondary Sch	%	%	6.8%	p=0.031		
	64.8	23.8				
Level of service	Diploma	%	%	11.5%	p=0.758	
	Undergraduate Degree	71.1	19.7	9.2%		
		46.8	38.3			
	Post-graduate Degree	%	%	14.9%		
	Top management	52.2	30.4	17.4%		$\chi^2=3.40$, df=6,
66.0		23.1				
Middle level management	%	%	10.9%	p=0.758		
	67.3	22.8				
Period of service	Union staff	%	%	9.9%	$\chi^2=3.98$, df=6,	
	Others (security guards)	77.8	16.7	5.6%		
		61.1	27.8			
	Less than 1 year	%	%	11.1%		p=0.679
		67.9	19.0			
1 to 10 years	%	%	13.1%	p=0.679		
	62.3	27.9				
11 to 20 years	%	%	9.8%	p=0.679		
	72.3	18.5				
Over 20 years	%	%	9.2%	p=0.679		
	72.3	18.5				

From the table above, only the relationship between gender and reporting on the existence of fire exists and between level of education and reporting on the existence of fire exists were statistically significant. Regarding gender, male respondents reported more (70.1%) on the existence of fire exits than the female

respondents (57.6%). This relationship was statistically significant at $\chi^2=7.25$, $df=2$, $p=0.027$. Gender difference brings about differences in nature of work. Work executed by male staff tends to be more technical or manual, hence interact with their working environment more than female staff, bringing about difference in reporting.

Respondents with secondary school education reported more about presence of fire exits (81.8%) than those with other higher levels of education. The relationship was statistically significant at $\chi^2=13.9$, $df=6$, $p=0.031$. Difference in level of education of staff brings about differences in their nature of work. Staff who have attained secondary school education tend to have their work being more hands on or manual, making them interact more with their working environment and are hence able to pick out a number of fire safety issues within their environment.

3.2.14 Workplace Fire Safety Policy

Close to half of the respondents (48.8%) reported about lack of fire safety policy. A tour of the facility however revealed that none of the workplaces had a fire safety policy. What existed in a few workplaces were evacuation plans or procedures. This finding supports Wambugu (2016) who revealed that there were no fire policies in place but only fire procedures which were not strategically placed in Jomo Kenyatta International Airport.

3.2.15 Adequacy of fire safety management practices

The respondents were meant to give an opinion on whether they felt their workplaces were safe or not, by considering all the various aspects concerning fire safety management in their workplaces. With 41.2% of the respondents indicating that their workplaces were not safe, this is a significant number of staff which would require addressing of the underlying fire safety issues to the satisfaction of every member of staff. This is not in accordance with the requirements of United States Department of Homeland Security (2007) which recognizes safety to be achieved through coordinated capabilities to prevent, protect against, respond to, and recover from all hazards in a way that balances risk with resources and need.

3.2.15.1 Adequacy of fire safety management practices by respondents' demographics

Chi-square Test was used to test the relationship between respondents' demographic parameters and their opinion on adequacy of fire safety management practices at 5% significant level. Results are as shown in table 6;

Table 6: Respondents' opinion on adequacy of fire safety management practices

Variable	Category	Adequate fire safety management practices		Analysis
		Yes	No	
Gender	Male	59.9	40.1	$\chi^2=0.295$, $df=1$, $p=0.587$
		%	%	
Age category	Female	56.5	43.5	$\chi^2=0.834$, $df=2$, $p=0.659$
		%	%	
		61.0	39.0	
		%	%	
Level of education	21-35 yrs	56.1	43.9	$\chi^2=12.2$, $df=3$, $p=0.007$
		%	%	
		62.5	37.5	
		%	%	
		72.7	27.3	
		%	%	
Level of service	of	47.5	52.5	$\chi^2=2.97$, $df=3$, $p=0.397$
		%	%	
		67.1	32.9	
		%	%	
		61.7	38.3	
		%	%	
Period of service	Secondary Sch	69.6	30.4	$\chi^2=1.40$, $df=3$, $p=0.705$
		%	%	
		57.8	42.2	
		%	%	
		55.4	44.6	
		%	%	
Level of service	Middle level management	72.2	27.8	$\chi^2=1.40$, $df=3$, $p=0.705$
		%	%	
		50.0	50.0	
		%	%	
		56.0	44.0	
		%	%	
Period of service	Union staff	59.8	40.2	$\chi^2=1.40$, $df=3$, $p=0.705$
		%	%	
		63.1	36.9	
		%	%	
		59.8	40.2	
		%	%	
Period of service	Others	63.1	36.9	$\chi^2=1.40$, $df=3$, $p=0.705$
		%	%	
		50.0	50.0	
		%	%	
		56.0	44.0	
		%	%	
Period of service	Less than 1 year	59.8	40.2	$\chi^2=1.40$, $df=3$, $p=0.705$
		%	%	
		63.1	36.9	
		%	%	
		59.8	40.2	
		%	%	
Period of service	1 to 10 years	63.1	36.9	$\chi^2=1.40$, $df=3$, $p=0.705$
		%	%	
		50.0	50.0	
		%	%	
		56.0	44.0	
		%	%	
Period of service	11 to 20 years	59.8	40.2	$\chi^2=1.40$, $df=3$, $p=0.705$
		%	%	
		63.1	36.9	
		%	%	
		59.8	40.2	
		%	%	
Period of service	Over 20 years	63.1	36.9	$\chi^2=1.40$, $df=3$, $p=0.705$
		%	%	
		50.0	50.0	
		%	%	
		56.0	44.0	
		%	%	

Only the relationship between level of education and opinion on adequacy of fire safety management practices was statistically significant ($\chi^2=12.2$, $df=3$, $p=0.007$). More respondents who attained secondary school education (72.7%) reported on adequate fire safety management practices compared to respondents with higher levels of education. Staff who have attained secondary school education tend to be more hands on than those with other levels of education. This makes them have a

feeling of control of a situation, boosting their confidence level pertaining fire safety, hence making them feel safer.

3.2.16 Reporting of fire hazards

This item was meant to establish whether the respondents reported fire hazards in their workplaces and to whom they reported. The results are as shown in figure 11;

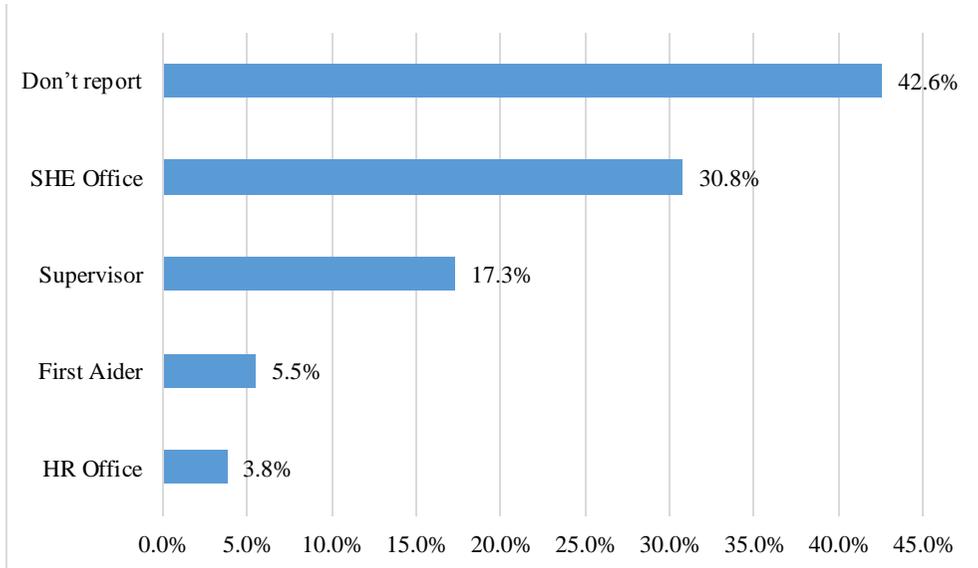


Fig.11: Reporting of fire hazards

With most of the respondents not reporting fire hazards (42.6%) where only 30.8% and 17.3% reported to the relevant authorities i.e. Safety Health and Environment (SHE) Office and supervisors respectively, this creates a gap in having the issues being addressed. This is not in line with Environmental Health and Safety (2017) which requires for all hazards to be reported immediately to the supervisor, or a person in authority. The goal of the Hazard Reporting Program is the prevention of injuries from an unaddressed or unreported hazard by providing clear communication directly. This calls for Kenya Power to come up with a procedure for employees to report fire hazards and sensitize its employees to be reporting the hazards, since they encounter the hazards first.

3.2.17 Respondents' Opinion on how Fire Safety can be Improved in the Workplace

Respondents were asked to state in their own words ways of improving fire safety in their workplaces. The results are as presented by the bar graph in figure 12 below;

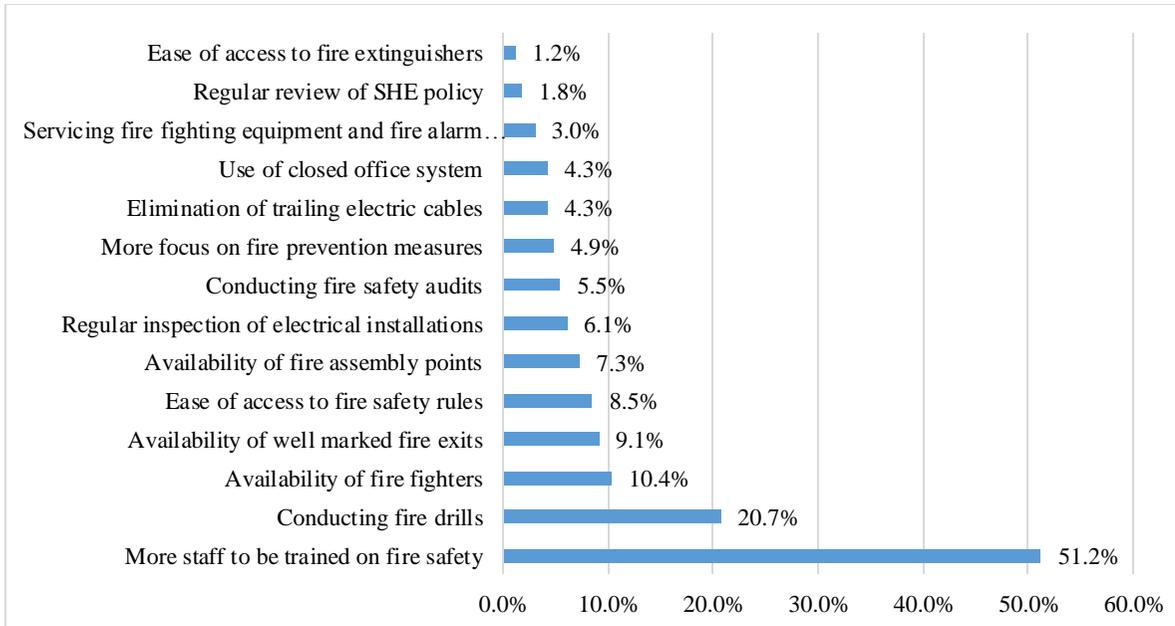


Fig. 12: How fire safety can be improved at the workplace

Respondents reported training of more staff (51.2%) on fire safety and conducting of fire drills (20.7%) as ways which could have the highest impact in improving fire safety. Wambugu (2016) noted that lack of training programmes and fire drills downgrade the usefulness of measures put in place to respond to fires as employees would still not know what to do in case of emergencies. It was also observed that the organization adopted the use of open office plan, which could lead to spread of fires over a wide area especially in case of big fires. As an improvement, it is recommended for use of closed office plan.

3.2.18 Rating of Existing Fire Safety Control Measures

Still on the second objective of the study, respondents were asked to rate the existing fire safety control measures in their workplaces on a five point Likert Scale. Results which were ranked in descending order are represented using a bar graph in figure 13;

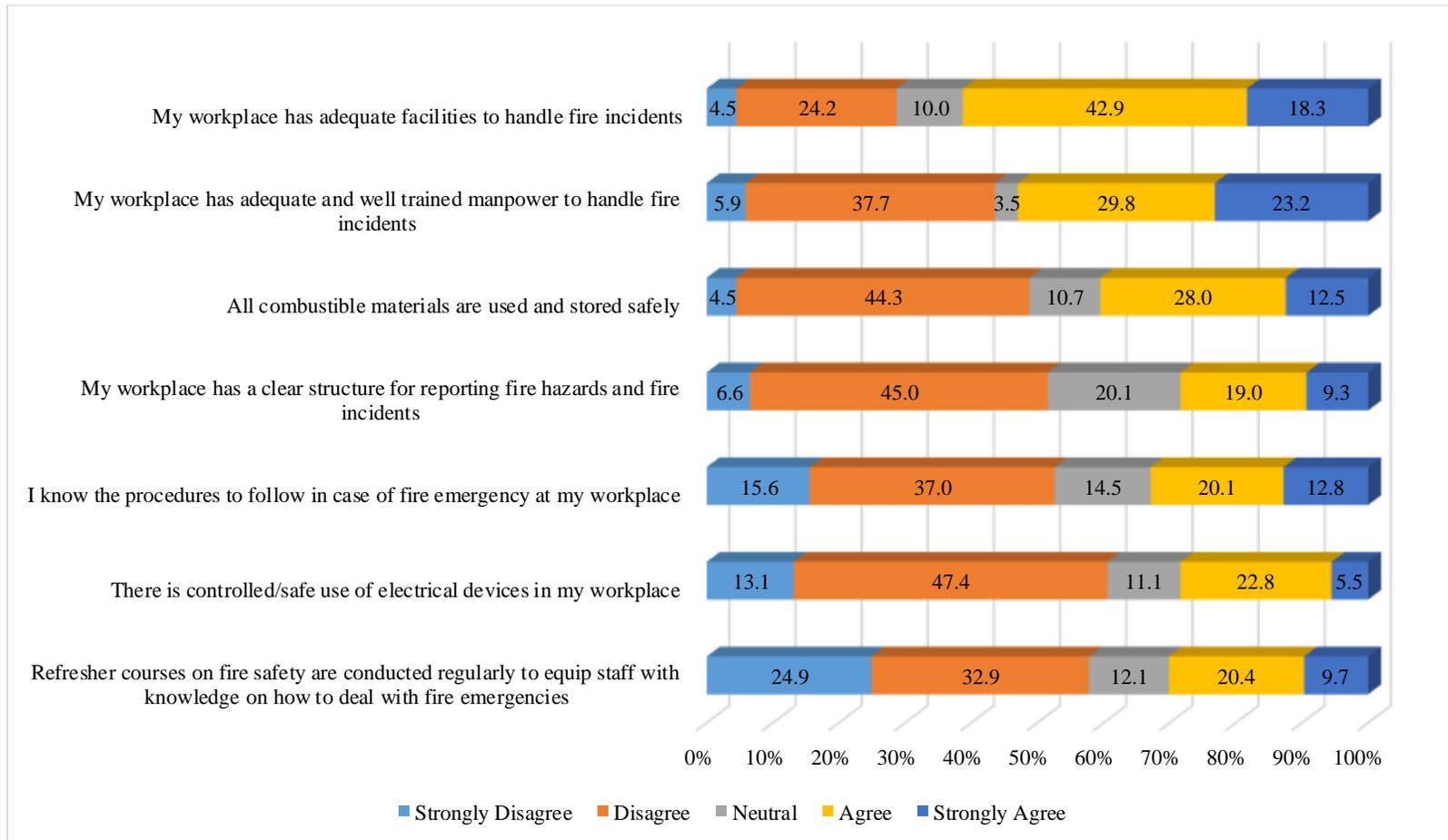


Fig. 13: Rating of the existing fire safety control measures

It is only two out of the seven existing measures highlighted above in which the respondents agreed by more than a half i.e. adequate facilities to handle fire incidents (61.2%) and adequate and well trained manpower (53.0%). This was confirmed by the facilities tour where it was noted that most of the workplaces had firefighting appliances especially fire extinguishers. However concerning training, the researcher noted that most of the respondents had not been trained on fire safety, but had rather been trained on Occupational Safety and Health (OSH), with fire safety forming part of the content. The item which scored worst was conducting of refresher courses on fire safety, which as noted by the researcher never existed. With most of the items scoring less than half, this clearly indicates that the organization's control measures require overhaul.

3.3 Compliance Level of Fire Safety Preparedness Measures with Provisions of Fire Risk Reduction Rules (FRRR), 2007

The third objective was to determine compliance level of the organization's emergency preparedness measures with reference to Fire Risk Reduction Rules (FRRR), 2007. This was to ascertain how prepared the organization was in the event of fire so as to reduce the impact. FRRR, 2007 regarding state of emergency preparedness was divided into twelve measures:

- Fire safety policy
- House keeping
- Means of communication
- Fire detection systems
- Fire exits
- Assembly points
- Fire drills
- Fire safety training
- Firefighting team
- Firefighting appliances
- Emergency water storage
- First aid

An observation checklist was developed comprising of pertinent issues for each of the above measures in order to carry out the assessment. A four level rating scale was used to rate the compliance level of each of the parts under FRRR, 2007 as shown in table 7;

Table 7: Rating scale for compliance level

Mean index	Rating	Interpretation
1.00-1.50	Poor	Complies to below 60% of the requirements
1.51-2.50	Average	Complies to at least 60% of the requirements
2.51-3.50	Satisfactory	Complies to at least 75% of the requirements
3.51-4.00	Good	Complies to at least 90% of the requirements

The results for assessment of compliance level of emergency preparedness measures are as shown in table 8 below;

Table 8: Compliance level of emergency preparedness measures

Emergency preparedness measure	Frequency analysis (Compliance level)				Mean index
	<60%	>60%	>75%	>90%	
	No. of locations				
Fire safety policy	32	0	0	0	1.00
Housekeeping	18	5	0	9	2.00
Means of emergency communication	27	0	0	5	1.47
Fire detection systems	28	0	1	3	1.34
Fire exits	18	11	1	2	1.59
Assembly points	29	3	0	0	1.09
Fire drills	32	0	0	0	1.00
Fire safety training	32	0	0	0	1.00
Firefighting team	30	0	2	0	1.12
Firefighting appliances	2	4	3	23	3.47
Emergency water storage	28	2	0	2	1.25
First aid	30	0	0	2	1.19
Overall mean rating					1.46

3.3.1 Fire safety policy (Section 34 of FRRR, 2007)

Fire Risk Reduction Rules, 2007 require every occupier to establish and implement a written fire safety policy, outlining the organization and arrangements for carrying out the policy and ensure that all workers are informed on the contents of the policy. None of the workplaces visited had a fire safety policy in place, hence scoring poor (mean index of 1.00).

3.3.2 Housekeeping (Section 13 of FRRR, 2007)

The requirements for housekeeping are prescribed under Section 13 of the rules. The workplaces were compliant by at least 60% (mean index of 2.00) of the requirements for housekeeping. Most of the workplaces especially offices were kept in a clean state. However, storage areas and some substations lacked marked gangways for movement of people and mobile equipment.

3.3.3 Means of emergency communication (Section 26 of FRRR, 2007)

The rules require every occupier to provide suitable means of alerting persons in the workplace in the event of fire, and for such means to be made known to all workers. Though most of the workplaces had manual break glasses and fire alarm bells as

means of emergency communication to alert people, most of the occupants of those workplaces had not been made aware of such means, bringing about a poor score for this measure (mean index of 1.47).

3.3.4 Fire detection systems (Section 28 of FRRR, 2007)

The requirements for fire detection systems are prescribed under Section 28 of rules. Most of the workplaces lacked fire detection systems. For the few workplaces that had the systems, they were located in appropriate places where fire risks are high and were connected to fire alarm panels. They were also inspected and maintained regularly. Due to the detection systems lacking in most workplaces, this contributed to the poor score (mean index of 1.34).

3.3.5 Fire exits (Section 17 of FRRR, 2007)

Though most of the workplaces had fire exits of at least 90 cm width and staircases for escape of at least one metre, the staircases were mostly within the buildings or were of spiral type. Most of the fire exits and emergency exit routes were well labelled with the exits also opening outwards. However, some of the emergency exit routes were obstructed and some exit doors were locked from outside. With some of the requirements of FRRR, 2007 being complied with by the organization, this measure had an average score (mean index of 1.59).

3.3.6 Assembly points (Section 24 of FRRR, 2007)

Section 24 of the rules requires for every occupier to identify a location in the workplace where every worker should assemble in the event of fire. From observations made, most workplaces lacked fire assembly points. With most of the assembly points being used for other purposes and some of them not being labelled led to a poor score (mean index of 1.09).

3.3.7 Fire drills (Section 23 of FRRR, 2007)

The rules require for fire drills to be conducted at least once every year and a record of the drills to be kept available for inspection. None of the workplaces carried out fire drills, hence the poor score (mean index of 1.00).

3.3.8 Fire safety training (Section 21 of FRRR, 2007)

Even though fire safety training was conducted, most of the requirements for this item were not met contributing to the poor score (mean index of 1.00). Only a small proportion of the staff had been trained on fire safety. Also no refresher courses were conducted to both members of staff and firefighting teams.

3.3.9 Firefighting team (Section 20 of FRRR, 2007)

Section 20 of Fire Risk Reduction Rules, 2007 requires for every occupier shall establish a firefighting team and specify size of the team depending on the number of staff. Only a few of the workplaces had a firefighting team and with the required size of the team, contributing to the poor score (mean index of 1.12)

3.3.10 Firefighting appliances (Section 30 of FRRR, 2007)

Most of the workplaces had firefighting appliances, especially extinguishers of different types that were inspected and tested regularly and a record kept. This contributed to the satisfactory score (mean index of 3.47). However, the methods of extinguishing big fires especially hydrants, sprinklers and hose reels lacked in some of the workplaces.

3.3.11 Emergency water storage (Section 33 of FRRR, 2007)

The requirements for emergency water storage are prescribed under Section 33 of the Fire Risk Reduction Rules, 2007. Most of the workplaces did not meet requirements for emergency water storage. Even though some of the workplaces had the storage, the water was also used for other purposes, especially cleaning. These contraventions led to the poor score (mean index of 1.25).

3.3.12 First aid (Section 25 of FRRR, 2007)

Most of the workplaces lacked arrangements for provision of first aid to people who are injured in case of fire incident in terms of first aid kits and personnel trained to administer first aid. This led to a poor score (mean index of 1.19).

With most of the measures (nine out of twelve) having a poor score, this contributed to the overall rating of the organization's compliance level also to be poor (overall mean rating of 1.46). Since most of the emergency preparedness measures are non-compliant, this implies that in the event of fire the risk is high. This implies that a lot of improvement on the control measures is required to ensure the existence of a safe working environment.

4.0 Conclusion

Concerning the likely causes of fire as noted from the study, the leading cause of fire in the organization was electrical devices or equipment (electrical fires) in terms of source of ignition and source of fuel. This was followed by presence of combustible materials, which act as a source of fuel. Substations also had the highest number of fire incidents, rating them as the most risky workplaces.

Regarding adequacy of the existing control measures, the study established that most of the control measures were inadequate. This was actually the most critical and important establishment of this study, since measures in place have a direct influence on the level of fire risk in terms of probability and impact. The range of measures which covered fire prevention, fire protection and fire suppression measures were established to be inadequate. Some of the measures were not practised at all for example conducting of fire drills and fire risk assessments. In a nutshell since the control measures in place are inadequate, this poses a risk to the organization.

Lastly, the study showed that compliance level of emergency preparedness measures in Kenya Power is wanting, having been rated poor. Most of the measures

scored poor, causing the overall rating to be poor. This implies that in the event of a major fire in the organization, the impact would be big. If the compliance level of emergency preparedness measures was good, it would also promote quick response, hence reducing the effect of fire.

In general, findings of the study established the organization's fire safety management practices to be inadequate. These findings can also be replicated to the other regions of the organization hence help the management in policy and decision making to improve on management of fire safety within Kenya Power.

5.0 Recommendations

The study recommends for the management of Kenya Power to demonstrate senior management commitment by facilitating establishment of fire safety policy, which is non-existent. Integrated risk management should form part of the organization's corporate strategy and strive towards transformation of its fire safety culture through demonstrated and visible leadership commitment. This can be achieved through provision of both human and financial resources. Staff and departments who demonstrate their individual and collective contributions towards fire safety improvement initiatives should be recognized and rewarded.

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