The critical study on safety practices in reducing accidents due to electroculation

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Introduction

As per National electricity policy power to all is main aim of government. Electricity Act 2003 added the trust about it.life without electricity in these era is impossible and beyond acceptable. National crime record breau highlight the increasing trend in fatal accident to mankind due to electrocution.Electricity is unseen and intensionally or unintentionally miscontact result in fatal or non fatal accident to defaulter and damage unrepairable loss. The study investigates on human errors and implementation of effective awareness program and the role of HRM in reducing electrical accidents in the company. An accident is undesirable, unplanned ,unwanted & causing in human loss, property loss, or both. It is need of today to reduce the accident and develope a safe culture and to provide key insights which helps in reducing electrical accidents and improving workplace safety and builing a confidance in common man while using electricity.The effective implementation of appropriate public awareness programs will help to reduce outsider accidents.

An statical data of accidents due to electrocution from 2018 to 2019 and 2020 is tabulated below

Sr.No.	Years	Male	Female	Total
1	2017-18	1157	276	1433
2	2018-19	1269	230	1499
3	2019-20	1271	279	1550

(Source:www.ncrb.gov.in)

It is observed that accident percentage due to electrocution is increased to 3.6% from 3.0% within three years. Former president of India, Hon Dr S.Radhakrishnan Sir has rightly quoted, "***Preventable accident, if they are not prevented due to our negligence, It is nothing a short of Murder.***"

The aim of Power distribution companies should be zero accidents in the company.But in Maharashtra this is not achieved by any company.

Motivation of Study

As accident rate is inversely proportional to safety. An Accident that happened means there is violation of safety rules. As Trevor Kletz rightly said, **"Don't try to change people's attitude; just help them with their problems."** It is time to prompt everyone about the fundamental uses of electricity and what is safety? Why is it required? What is the need for guard? What is an accident? Accidents can be classified into fatal and non-fatal and it may happened to humans and animals. Departmental means a person working in power utility as an employee, outsource means those are working and engaged by contractors, and Outsider means ordinary people. Which measures should be taken to avoid an accident? And How? Why is electrical safety essential?

Literature Gap

An comprehensive literature review was motivated from 1978 to the latest, 2022 as below

Sr. No	Nature of kinds of literature	Nos.
1	Books	06
2	Reports	14
3	Research Papers	21
4	Doctoral Thesis	13
5	Website referred	05

In addition to this 120 places where the accident occurred were inspected to have close research findings. After a literature review it is noticed that previous research has been done in the field of industrial accident and safety but specially not for distribution power sector employees, outsource engaged in the company and to outsider due to infrastructure of utility. The present safety procedures in manufacturing industries are adopting prescribed safety rules and regulations. Their primary goal is to monitor and control the possible hazards and ways of handling workers' behaviour to follow prescribed safety procedures. Literature [9] highlights the standard label "A systems approach to safety" to refer to the normative approach. All the characteristics (safety policies, procedures, committees, etc.) associated with the organisation's safety management system are incorporated.

This approach focuses on management devotion and strategies to reduce accidents, avoid unsafe conditions, and deliver safety training to the workers to motivate them to avoid dangerous behaviours. To develop a workplace safety culture, workers' enforcement towards prescribed 'safe behaviour' could be built by organising safety programs like selecting the contractor, training, investigations, commitments, etc. This approach has observed significant improvements, but this still fails to accomplish the zero-accident.

Lauver's [1] research found that selecting individuals with personality, physique, and good work experience improves Occupational Hazard and Safety (OHS). Organisational practices like Human resource management play a vital role in reducing injuries and accidents are discussed.

The Key HRM practices discuss in the paper Munu [3] are Systematic Selection and Job Analysis, Performance Evaluation & Appraisal, Training and Development and Empowerment. More studies are needed to understand the connection between HRM and accidents better. Actual implementation and problems associated while implementation is not discussed. Hypothesis framed with activity resulting in achieving the desired result is not elaborated. For example, extensive training is recommended, but reduced human errors are not discussed.

A research paper on industrial accidents by M M Bagali [8] discussed the importance of personal protective equipment. But actual use, which type of PPE is to use and how to manage it is required.

Many researchers have pointed out some recommendations for the safety of industrial and mechanical accidents. But no concrete research has been done to analyse the causes of accidents in power utility and accidents to Outsider due to power utility infrastructure or electrical equipment mishandling. What safety measures are necessary to prevent accidents of innocent public due to electrocution ?

How remedial measures are implemented and how a safe culture be created?

A literature gap is observed for not elaborating implementation of safe operating procedures and the appropriate use of safety tools.It is need to provide solutions for not adopting safety practices by employees or how we can compel for it.

The study will focus on the electrical accident due to electrocution in Maharashtra and the need to reduce electrical accidents in power distribution companies in Maharashtra. The accident happened to departmental, outsource and outsider are not discussed in any literature so far reviewed. The safety measure and number of accidents occurred in particular industry is not similar to power distribution company. And same solution is not applicable. The distribution power company has vast infrastructure , huge man power and certain obligations due to government ,social problems and policies of state which are not compared to any industry.

Objective of Study

The study is carried out with the following objectives

1) To know the impact and the causes of accidents for preventing accidents and to frame the measures that will help to avoid or reduce the number of accidents and safety can be ensured
2) The study is preparing a roadmap for a proactive approach by the safety management team to prevent departmental, outsourcing and outsider accidents analyse the role and responsibilities of the employees, union, management, society and preparing an effective awareness program for public and study the utility and public's preventive and punitive actions to reduce the number of accidents.
3) To collaborate with all authorities for an accident-free atmosphere and to know the number of serious accidents that have taken place.

Methodology of Study

The methodology adopted includes descriptive survey for critical study of all types of accidents on all types of infrastructure in various areas, the causes of accidents, the importance and details about safety tools, the guidelines for safety, responsibility fixed with reasons for violation of safety rules and regulation, the statutory provisions for protection in that area and analyses thereof.The data was collected through the survey method, structured interviews, and questionnaires with modification of it after pilot study.Secondary data from various published materials, newspapers, magazines etc. The questionnaires were prepared, and a study was carried out on the utility's different human behaviour and awareness programs and their impact on the public. The detailed analysis of accidents in rural and urban areas is analysed separately.

A pilot study was done with an investigation of various accidents at different locations with the survey of the limited number of respondents and exacting reasons for accidents through structured interviews,deep observations and finding solutions to avoid accidents. How litigation aspect for controlling accidents as per Central Electricity Authorities regulations and Electricity Act 2003 be compelled ?

The public awareness approaches adopted by utilities and government, electrical network, human resources, available resources, and mindset of utilities and the public are studied with every occurred electrical accident. The age, living standard, paying capacity, profession, village, town, gender, education and many factors relevant to accidents are categorised according to human behaviour factors.

Hypotheses of the Study

H1: The distribution companies' performance in safety awareness meet the public's expectations.

H2: Awareness and use of appropriate personal protective equipment help in reducing accidents.

H3: The existing safety operating procedures are not sufficient to meet safety requirement.

H4: The present safety awareness program of distribution company is sufficient.

The hypotheses were tested by testing the following sub-hypothesis.

1)There is a significant difference between departmental,outsource and Outsider regarding accidents.2)There is a significant difference among levels of awareness about electrical safety 3)There is a significant difference among different levels of experience about the use of electricity 4)There is a significant difference among different methods of distribution of electricity in urban and rural 5)There is a significant difference between disposal income and paying for the installation and purchase of electrical materials.6)There is a significant difference among different local authorities in the implementation of policies

Scope of the Study

The research was limited to data collected from sample consumers of all categories i.e. domestic, commercial, industrial, and agriculture and the employees across various levels like frontline and back office working in Power Distribution Company in district of Nashik, Ahmadnagar,Malegaon, Dhule, Jalgaon, Bhandup, Palghar, Kalyan, Washi, and Thane.The questionnaires for employees and the public are prepared separately in regional language.The most of data was obtained from places where accidents occurred in the previously.

Research Methodology

The study is carried out on happened accidents and finding solution to avoid reoccurance of it. Methodology of research is not limited to descriptive being Ex post facto research but also under category of applied and empirical research. The methodology adopted for solving the research problem systematically.There is no single method to identify the causes of accident or the same cause cannot be observed at different locality.To search for the factors which can create effective awareness and reduce human errors in controlling electrical accidents, the mentality of employees and the public should be prepared first.The perception of consumers and employees are studied intensively to focus on needs and extraction of solution. In the case of power distribution company in Maharashtra, We have to consider a large geographical area, in terms of infrastructure, a vast network comprising thousands of kilometres of lines, hundreds of substations, and a few lakh transformers. Mahavitaran is the largest and biggest power distribution company in the state. Mahavitaran plays an vital role in the power scenario of Maharashtra. In such a situation to reduce accidents it is necessary to study the departmental ,outsource and outsider of state who are directly connected with Mahavitaran and it is not an easy task. The following two significant points rotates across the study.

1.Inspite of safety training,tools,facilities and defined operating procedure ,fatal electrical accidents occurred to departmental and outsource ?

This study was carried out to concentrate on existing working procedure of employees, to know the check list of safety in the company, availability of resources for safe operation, the tendendcy of employees to carry out work, Top management role,HR policies and planning for the safety of employees,reward and penalty in case of accidents, responsibility fixed with reasons as per electricity rules, standard and legal provision,pre-monsoon maintenance work and outage programs, recruitment policy and procedure in the company,various interfere while working, awareness about safety equipment, the internal problems, ability and capability of employees,finding deficiency in system,safety training and satisfactory contribution in making effective awareness in public and will and skill of employees.

1.What is actual need of consumers to avoid the accidents?

Consumer expectation towards resoration of supply within specified period,intimation and advance information about supply falure, availability of safety devices in market and their use, well protected company's infrastructure,safety facility and information given by the utility,security of consumer,and total satisfaction of consumers.The survey focused on some critical issues concerning different aspects of electrical safety to the consumers,installation of electrical appliances by the company,and knowledge of preventive measures to the consumers—remedial solutions in case of emergency.The fundamental use of electricity,the importance of earthing, protective devices, and the legal aspect of safety associated.Hence the questionnaire was drafted keeping in view the above critical area stated.

Most questionnaires were distributed where the accident had occurred.It was done to interact with the consumers closely and know the ground realities.Responses were also collected by distributing questionnaires to the consumers those were coming to pay their bills at collection centres, to complain at fuse call centres,subdivisions and places where accidents previously occurred and who have attended safety awareness seminar.

Focus Group Interview

A structured interviews with some prepared questions were conducted in the area where accidents were occurred previosly.It was with various groups comprising domestic, commercial,industrial and agricultural consumers. Some relevant points of expectation related to reduce accidents like awareness programs for electrical safety, the importance of earthing,use of protective appliances,planned and unplanned outage management intimation,service connection problems,electricalinstallations,fundamental use of electricity,load shading information,Behavior of employees,Connection and disconnection, Attitude of employees are discussed .

Sample Size

We surveyed employees and consumers of different cities in Maharashtra. The detailed survey reports are as below. The total size of sample=860

For consumer survey,planned to get responses from 300 respondant .After analysis and checking of data it is observed that 269 had reported rightly and For employee survey,planned to get responses from 560 respondant .After analysis and checking of data it is observed that 269 had reported accurately as below.

Sr. No	Area of survey (Consumers)	Number of responses	Percentage of respondents
1	Domestic Consumers	127	47.21%
2	Commercial Consumers	52	19.33%
3	Agricultural Consumers	66	24.53%
4	Industrial consumers	24	8.92%
Total		269	100%

Sr. No	Area of survey Employees	Number of responses	Percentage of respondents
1	Line staff	237	49.58%
2	Operators	92	19.24%
3	Outsource	106	22.17%
4	Section Incharge/EE /DyEE/AEE /SDO	43	8.99%
Total		478	100%

Research Findings, Reasons for Accidents

The data received from the survey respondent is analysised and different tests are performed.

Analysis of Dependent variable

The questioned which are framed in questionnaire are the dependent variable. On the basis of reliable and crucial variable the dependency for reducing accident can be determined. The software will gives the closely related variable to form factor. The construct is developed on these factors.

Reliability Analysis of Dependent Variables

The reliability analysis of dependent variables are done to measure the reliability of those factor which are affecting more and maximum output can be obtained on the basis of that factors.To find the most relevant factors responsible for the cause of accidents. The dependent and independent facets are compared with the significance of the incident.

Factor Analysis is done and formation of construct is done .The construct so formed shows the most relevant and dependent factors which can encircle to give the exact or most appropriate reasons for accident and solution thereof. The following table gives the reasons of accident in case of departmental,ousource and outsider which are to be addressed on top priority.

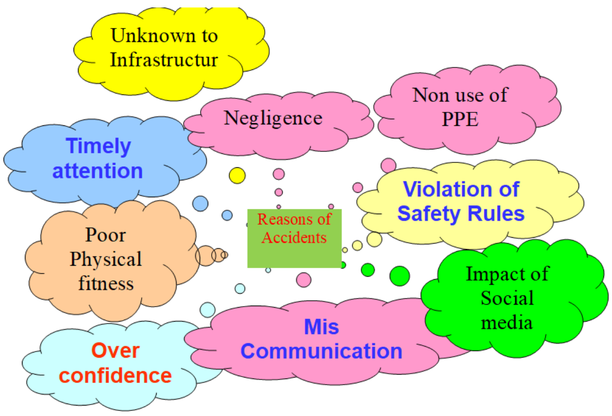
Reasons of Accidents			
Sr. No.	Departmental	Outsource	Outsider
1	During special drive program where disconnection is required, no proper safety procedure is followed.	Working alone without intimation to supervisor.	Illegal extension or construction under overhead lines. It is observed pipes are inserted in conductor assuming safety from it
2	Outages programmed are not planned.The works to be carried out are not well organised and planned before execution.	Outsource employee do not follow safe operating procedures.	Using unskill person for working as assistance
3	Co-workers do not check safe procedures and not paying attention towards working person.	No proper monitoring is done in engaging outsource employees	Changing service connections installations unsafely
4	The wrong practices had been implemented in working procedure and Neglect of safety rules	safety measure are not followed by the agency who engaged outsource employee	Maximum consumers are are not using ELCB and RCCB.
5	Most of time employees are working without safety equipment.	Outsource empolyees are doing work for which they are not authorised.	No proper safety precaution taken in underground system in keeping cable in healthy position.
6	Employee went for work without intimation to anybody.	Outsource is unknown about company infrastructure.	Agricultural installation is not as per standard i.e. Faulty starter and starter on ground.
7	Negligence in periodic inspection	Not authorised by Electrical Inspector.	Undue interfere with dummy line and electrical infrastructure of company
8	Miscommunication between operator and worker.	Verification of his qualification, training and competency in doing electrical work is not scrutinized at any level	There is no coordination between the local authority and the electricity company in terms of safety.
9	safety belt or safety zoola are not used for working at height position and not using discharge rod	Safety training is not provided to outsourced employees	The company's electrical infrastructure is not properly protected.
10	Absent of cross check of safety precaution and Haste during working is a major cause of accidents	Safety equipment is not provided to outsourced employees	Overuse of social media leads to accidents

"The causes of accidents in case of outsiders are similar,which can be controlled by adopting required safety guidelines/measures as provided in the Central Electricity Authority (Measures relating to safety and electric supply)Regulation 2010," "Centre electricity authority has mentioned some causes of accidents and classified as snapping of conductor,accidental contact with live wire/equipment,unauthorised work/illegal extension,defective appliances/apparatus/tools, violation/neglect of safety measures/ lack of supervision,inadequate/lack of maintenance and mechanical/any other reasons."

It is noticed that accidents are happening every year and in increasing trends.

The reasons for the accident are varied as per area ,and the same remedies does not apply to all areas.The study of exact need-based and behaviour-based safety training will help to a certain extent.Accidents occurred mainly due to unsafe acts,unsafe conditions, and beyond-control incidents like storms,earthquakes,floods,etc.The unsafe act involves overconfidence, unplanned work,negligence,and not following safe operating procedures.

The unsafe conditions involve unhealthy equipment,lack of knowledge/skills,no instructions for carrying out work,use of shoddy appliances and lack of safety tools.The reasons for accidents observed after research are narrated in the figure below.



Working at heightened position without a helmet, Safety Zoola

Some reasons are partially linked with discipline and policies of the company,whereas some are associated with human errors.In the case of departmental employees of power distributing companies,the reasons for the accident involve human error and system error.The human errors are overconfidence,negligence and unsafe practices.At the same time,working without personal protective equipment,an unknown infrastructure,working without planning and violating safety rules are interconnected with the company and personality of an individual employee.Nowadays, Morden types of accidents occur because of social media. Using a mobile phone while working and taking a selfie in a critical position are also reasons for accidents. After research, it found that some specific conditions regarding safety in hiring outsourced employees, the role of the human resource department and responsibility fixed with liability are not included in tender documents. Tender conditions for hiring outsourcing operators/employees should be uniform.A competent committee should watch outsourced.

In the case of Outsiders for ordinary people, the reasons for their accidents are found as building/structure illegal extension or construction under overhead lines.It observed that pipes are inserted in the overhead conductor assuming safety from it.It found that the buildings & structures are built close to an existing electrical network without maintaining adequate horizontal and vertical clearances.

Construction below-lines

Compromise on installation cost

A local authority has not taken any action on the defaulter. It is also observed that standard construction procedures have not been followed during the construction stage. Lack of knowledge regarding fundamental use of electricity . In many places,an overhead line is erected over a part of a street or other public place or on any consumer premises not protected with the earth guarding. Therefore, these lines are harmful in case it breaks. Some public try power theft by directly tapping from the pole,which is very dangerous and often causes accidents. Consumers in rural areas try to attend to HT/LT network defects without waiting for an authorised lineman.Unauthorised energisation of fences put up around agricultural fields to prevent wild animals from entering their areas and weaknesses in consumer installations. Alteration in electrical structure on the compromise of cost.

Starter on the ground

The leading cause of fires in electrical installation is improper/sub-standard devices and constituents of low quality.Insulation failure, damage due to rodents, termites and pests, and lightning are also causes of fire.Fires started by electricity are overloading of conductors/cables and equipment.The electrical heat source is too close to flammable materials, short circuits, poor connections lead to sparking, use of inferior grade materials or equipment and blowing fuses leading to heavy sparking.

Facilitation Techniques

Mitigation Techniques for prevention of fire are electrical wiring should be done as per International Standard {IS},Control room should be Hygienic,and housekeeping should be maintained according to standard sufficient space.The Earthing should be done as per IS, and Smoke Detection Alarm Circuits are to be installed.Use hydrant points in the building, fire-resistive cable for internal wiring (up to 1000C) and FRLS- Fire retardant low smoke cable should be used. It helps a lot.

The careless links

It found that people negotiated electrical safety due to costs.They used nonstandard and shoddy appliances.It may be due to a lack of awareness among the consumers. Private person dealing with electricity have a lack of knowledge level/experience for carrying out the job.The public usually bypassed the protection after the fault.There should be legal enforcement for violation of the rules with penalty and prosecution for action.The proper implementation of regulations for monitoring safety should be observed separately.

Recommendation

The best way for safety is 'Think about protection' and test before touch.Stop before working, think about what hazards and risks are associated while working and what is a dangerous point ? safeguard and protection mechanism ?,whether proper discharge or earthing is adopted or not? Skill and Knowledge level to handle it.

Existing operating practices are to be sufficient to meet safety requirement of departmental and outsourced employees.A mechanism of heavy penality for violation of rules and reward for following of rules inducted in system and close watch for implementation must be carried out.A special talk on safety should be included before proceding for work.Safety appliances should be checked and provided.

In the case of outsourcing employees, responsibility should be fixed on agency to take care of his safety.Less payment develop dishonesty in them,so they should keep in rotation.

It is observed that cardiac arrest cases were happened due to fear and perception.On-job training (OJT) is an essential part of training.CEA regulations emphasise providing OJT to Supervisors and Technicians.Timely attention and top priority is a must for minor mistake;otherwise,minor mistake makes major.Appropriate training should be given to supervisor and technician so that proper safe operating procedure follows and it promotes an inbuilt safety culture.

A strigent action required on unauthorised construction and extension below lines.All local authorities should have a dog watch on such illegalities in their jurisdiction and jointly purpose action subject to electrical safety.

Importance should be given to an entire public awareness program.Phobia should be created in the mind of employees as well as in public that stringent actions are taken against unfair practices and no compromise done on unsafe working. A mechanism should be developed to lock the system if employees are not using safety devices.The proper training to outsource employees is must. Mock drill of safety should be arranged for public frequently.More convience method of safety information sharing and timely support in case of emergency should be available to public.

Conclusion

An electrical accident is an event which is neither anticipated nor considered to occur Accidents can be avoided and controlled.Accidents due to technical problems are corrected, and reoccurrences can be avoided.But accidents due to human error and unbalanced emotions of humankind are improved only by having positive surroundings and developing a positive attitude.Unsafe practices and short-cut method leads to an increase in the accident.Structured and organized work process are to be adopted. Senior workman experiances builds false overconfidence regarding bypass of safety. Making the mind busy with multiple works has no control over the job at hand and harmful to physical activities.The inbuilt practice of following all required safety procedural steps should be ensured before proceeding for work.The mechanism for the complete safe operating procedure should be developed,and until it is not completed,work should not start,and automatically it will be locked.As we are using Mobile App,open access given to common man to upload a photograph of person working without safety and heavy penality/action should be taken against defaulters.

Employees' active involvement, management's full support and public participation is essential to create productive and safe working relationship.It is the responsibility of each one of us.A well-planned accident prevention programme should be carried out at the root level for outsiders inclusive of safety tips,guidance and fundamentals about safe use of electricity.The coordination between the power distribution company & other local authorities in respect of safety is need of today.The formation of a safety committee/groups,and safety monitors plays a significant role in accident prevention programmes.Emphasis should be given to observe whether " Safe Practices" are adopted by every one or not.

Scope for further research

The topic of proactive safety management approaches for preventing accidents due to electrocution is very sensitive.The more comprehensive the study and deeper the research reaches,the result will be closed to expectation.As research is required to avoid the reoccurrence of an accident,the rapid changes and enhancement of ideas will be beneficial.The current study is concentrated on areas where accidents had occurred to an outsider,outsourced and departmental employees of power distribution company in above mentioned district of Maharashtra.There is an opportunity for additional research on other power distribution companies and their work performance, and employee behaviour regarding safety aspects.

Limitations of the Study

The method used for finding relevant factors is based on the happened events.During data collection,reluctance on the part of employees to contribute to the research with open-mindedness.The broad view from the study was more encouraging and restricted to a specific group of employees working in various cities.The expectation of the public's response differs from expectations and suffers.

Benefits expected from the research outcome

Fundamental knowledge and awareness reduce accidents and avoid the electric short circuit and fire.Saving life is countless. Research helps to reduce both fatal and non-fatal electrical accidents of humankind and animals.It supports converting the attitude from a "Blame culture to Safe culture".The benefits achieved and expected from the research outcome are innumerable. It will create a win-win situation for the utility and the ordinary person regarding electricity utilisation.

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