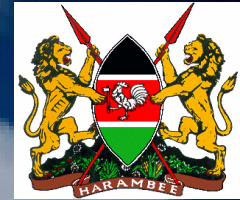


LIGHTNING PROTECTION IN KENYA – A COUNTRY STATUS REPORT

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Overview

- Historical background
- Development of Lightning protectors, Standard Codes of Practice and challenges in Kenya
- Damage and destruction by lightning
- Current status of Lightning protection in Kenya
- Current Research and the way forward

Historical Background

- Lightning - a subject of **mythology in East Africa**. Prof. Akello and Eng. Ogada (2006) – lightning, amongst the Bantu, Nilotes, East Africa, was thought to be a thunderbird or red cock which flashes down to earth as it flaps its wings.
- **Development of infrastructure** in the **early 60's** and the concept of static and related electric discharges was disseminated through the teaching of physics in secondary schools.
- Lightning Conductors (LCs) concept was obtained from observing colonial buildings. A sharp metal was erected on the building, with a down conductor to the earth as a means to protecting it. These were not professionally designed.

- In **1978** the **East African Meteorological Department (EAMD)** obtained financing from the **National Council of Science and Technology** for a project focusing on **lightning protection in Western Kenya**. This followed a series of deaths of children in schools around Kisii and surrounding environs caused by lightning, which necessitated a meeting between the then President of the Republic of Kenya and EAMD to discuss how protection could be done.
- At the time, there were no standards for protection so in **1981** the **National Lightning Protection Committee was established**. The functions of the Protection Committee project were to sensitize and educate relevant stakeholders and disseminate warning information to the public.

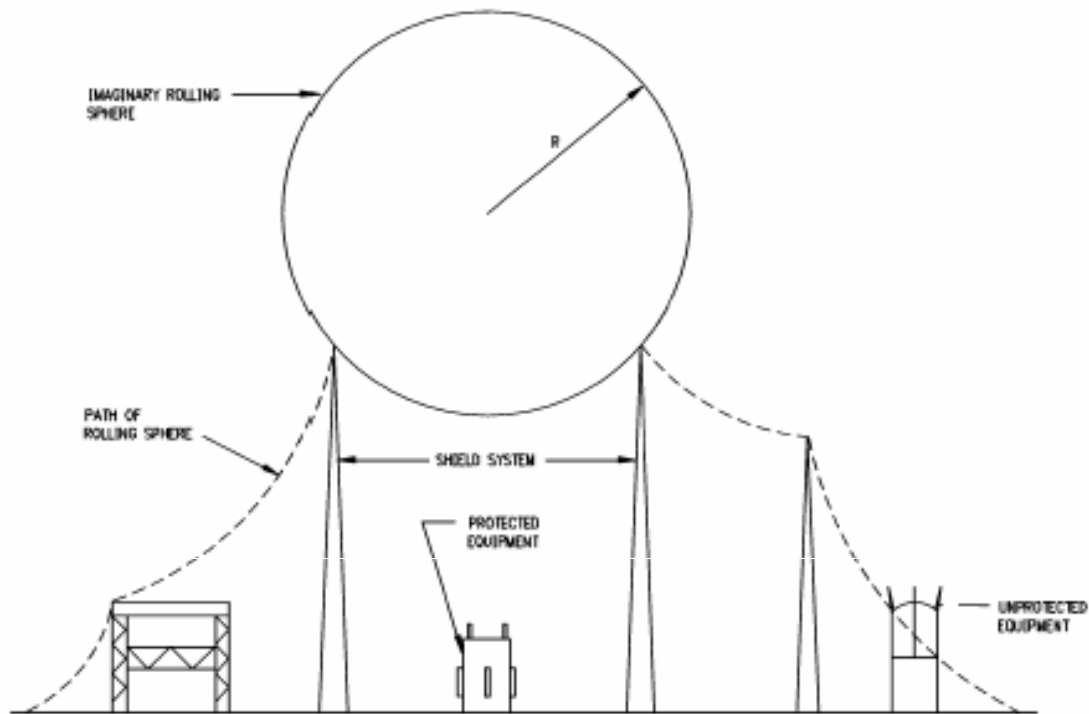
The **project was rolled out in four stages.**

- **The first stage** of the project was to create public awareness on lightning
- **The second stage** of the project was an inquiry on how lightning struck people, animals, trees from as far back as **1960s up till 1980s**. The team then conducted some literature review and drew up a poster which illustrated clearly the means by which lightning strikes. This poster was designed in Luo, Luhya and English and was sponsored by UNESCO and the Kenyan government. The media was also involved to help in disseminating the information.

- **In the third stage** - a series of trainings was done on staff from the Ministry of Public Works around the districts and provinces. Electrical personnel were also trained on the installation of lightning arrestors on buildings. Awareness of the lightning arrestors was carried out in public institutions. The private sector was targeted for sensitization since a lot of destruction had resulted from lightning e.g. UNILEVER/Brookbond and tea plucking. Prof. Akello set up an early warning system for Unilever consisting of Arizona equipment obtained from Vaisala Ltd.
- **In the Fourth stage** the National Lightning Protection committee handed the project over to the Ministry of Public Works which continued with the installations country wide. The committee then dismantled and withdrew to assess the impact of the awareness. The campaign was successful because of how vocal the Lightning committee had been in public. Following this the National Disaster Committee Authority was formed in **1991** in the office of the President.

Development of Lightning protectors, Standard Codes of Practice and challenges in Kenya

- The **functions of the Protection Committee** project were to **sensitize and educate relevant stakeholders** and **disseminate warning information to the public.**
- The Kenyan Code of Practice was developed in **1989** by this Committee with diverse stakeholders who were convened to discuss and agree on a standard code of practice surrounding lightning protection. Initially, it recommended that the designs be based on the Faraday Cone but later changed it to the Rolling Sphere Concept.



RSM involves rolling an imaginary sphere of a prescribed radius over the air termination network. The sphere rolls up and over (and is supported by) air terminal, shield wires, and other grounded metal objects intended for direct lightning protection. A piece of equipment is protected from a direct stroke if it remains below a curved surface of the sphere by virtue of the sphere's being elevated by air terminals or other devices.

Challenges experienced

- There was no enforcing agency to ascertain that the Code was followed.
- Secondly, there was no regular maintenance for both the down conductors and the earthing.
- Quality of LC products being sold to the public not verified, compromising the security of users.
- The public has also forgotten the information that was given to them in the 1980s and so more deaths are being reported.

Cases of Damage and destruction by lightning

- **Fields of Brooke Bond Tea Companies** (now UNILEVER Tea Co. Ltd.) with two specific sites in Mabroukie (Limuru) and Mufindi.
- Lightning also **killed 49 pelicans** outside Afraha Stadium in Nakuru Town in a heavy downpour in 2006 (Daily Nation, 2006)
- **Children killed** while herding their family cattle in Nkoreta area of Narok County in the South Rift. High school girls from Lwanya Girls Secondary School in Busia County in Western Province narrowly escaped death.. Sunday during heavy downpour (Odero, 2011).
- Most equipment affected are **Surge Diverters** at 11kV and 240V leading to long term vulnerability of transformers at these levels. Power lines in East Africa is transmitted at 220, 132, 66, 33 and 11 kV and distributed at 240V
- Lightning, also a source of atmospheric radio noise, affects amongst other things, **radio broadcasting**. Hence, interferes with normal workings of radio transmission.
- Lightning also **damages electronic data and gadgets**. This has cost implications not just in the domestic and private spheres but also for **insurance** companies.
- **Most records of lightning casualties and destruction over the years have featured in the press**. However it is unclear which institution has been keeping accurate records of the total numbers.

Current status of Lightning protection in Kenya

Lightning protectors and awareness creation

- National Lightning Committee in Kenya has been. Akello and Ogada (2006)
- Companies, such as HELITA of France and Lightning Eliminators Inc. of the USA respectively marketed LPSs such as the PULSAR Series and Dissipators in the East African market around 2006.
- Internationally, nor in East Africa, where there were no test facilities for confirmation of the performance characteristics of the LPSs (Akello & Ogada, 2006).
- The BOLTEK LD-250 and Vaisala TSS 928 detection and monitoring equipment are cited as being used in Kenya.
- One company currently providing lightning protection devices is Power Technics.

Current status continued..

- Organizations such as Kenya Meteorological Department (KMD), Kenya Power and Lighting Company (KPLC), cellular telephone providers, Sony Sugar Company, and Unilever Company all have their in-house awareness lightning safety campaigns in place.
- In 2011 KPLC tendered for 33kV surge arrestors with specific qualifications according to ISO 1461 and IEC 60099-4 and capable of a lightning impulse withstand voltage of 200 kVp (KPLC, 2011).
- KMD conducts analysis of cumulonimbus clouds through radar and infra-red satellite imagery every 15 minutes to be able to give accurate forecasts of lightning and thunderstorms. This information is disseminated to television stations and the aviation industry. Occasionally lightning forecasts may be sent out to grassroot communities through RANET – the local radio weather program which is broadcast in Murang'a and Narok towns, amongst other areas.

Current status cont...

- Most insurance companies have until recently been averse to offering insurance cover against damage caused by 'acts of God'.
- However this is changing slowly. For instance loss of agricultural harvests due to insufficient rainfall, could not be covered in the past. Starting 2010 APA Insurance company has covered this under the APA Index Based Weather Insurance (APA, 2011). Under the Multiperil Crop Insurance, damage to crops caused directly by fire and lightning, is covered (APA, 2011).
- Islamic Insurance company, Takaful, also offers cover against lightning damage to property (Stanley M., 2009). Similarly the Jubilee Insurance Company covers against damage from lightning under its domestic package

Current status ...

- Kengen on Wind Turbine Generators (WTGs) in 2009 stated that the WTGs and their installations would be suitably protected against damage caused by lightning and over-voltage due to lightning with a protection level 1 according to IEC 61400-24. The WTGs have since been erected and are in operation.
- The poster that was created in the 1980s has since been used by Prof. Akello as recently as in August 2011 in Durban, KwaZulu Natal in South Africa to train teachers at provincial and district level. These teachers can now go on to train others.

Kenya Gazette 21 September 2007

Some standards on lightning protection stated thus:

- KS IEC 61663 -1:1999 Kenya Standard – Lightning protection Telecommunication Lines – Part 1: Fibre Optic installations, First Edition.
- KS IEC 61663 – 2: 2001 Kenya Standard – Lightning protection – Telecommunication Lines – Part 2: Lines using metallic conductor, First Edition.

Current Research and the way forward

- Focus now is on electromagnetic compatibility in lightning detectors. There is also deploy of Cloud-to-Ground Lightning Surveillance Systems (CGLSS) which is indirectly linked with NASA and NOAA at the Multimedia University College of Kenya. The electromagnetic compatibility is based on the image theory. Other systems that are being researched and used include Lightning Detection and Ranging LDAR II and Surge Suppressors, Transient Absorbers (TRABS).
- Other institutes that are involved in research include International Electrotechnical Commission (IEC), IEEE, International Telecommunications Union (ITU), URSI and CIGRE

Climate change may affect lightning activity in the future

- Distribution of lightning around the planet depends on the earth's climate and is driven by **solar insolation**. Lightning in the tropics peaks after the peak of solar heating and on a monthly basis it peaks after the peak annual solar heating
- Lightning being a source of **nitrogen oxides** (NO_x), which is the starting point for ozone (O_3) formation, may inevitably lead to further warming of the climate which could increase prevalence of lightning including in East Africa (Price, 2008).
- Williams et al. (2005) and Sekiguchi et. al. (2006) show the positive relationships between **temperature** and lightning activity.

- **Water vapour** also impacts on lightning. When water vapour absorbs infrared radiations emitted from the earth's surface, it increases the resulting water vapour which then results in positive feedback and amplified atmospheric warming (Del Genio, 2002). Thunderstorms also deposit a lot of water in the upper troposphere, moistening it in the process (Price and Asfur, 2006a).
- In the months of August and September, which ordinarily are not known to be rainfall months in Kenya, heavy rains were experienced in Kisumu city next to Lake Victoria (153.3 mm within 24 hours - the highest amount since 1959). Similar experiences were felt in Northern Kenya – which is ordinarily very dry. **What new patterns of lightning activity might Kenya expect in the future?**

Areas for immediate action would include:

1. Mapping of lightning prone areas around the country
2. Reviewing the level of awareness on lightning amongst members of the public.
3. Retraining of staff in the Ministry of Public works and other relevant ministries on areas of lightning protection and installation of lightning protectors
4. Reducing vandalism of lightning protection equipment especially in schools since damaged equipment pose even more danger as they have no earthing.

The stakeholders would include

- Kenya Bureau of Standards, Kenya Power Ltd, Kenya Meteorological Department, Ministry of Education, Ministry of Higher Education, Science and Technology, KenGen Ltd, Communications Commission of Kenya, Orange/ Telekom, the Police force, Safaricom Ltd and other private companies such as UNILEVER.
- Media would also play an important role in helping to sensitize the public. Radio stations would include RAMOGI FM, KASS FM and others.

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- Prof. Robert Jalla'ngo Akello, PhD – Faculty of Engineering, Department of Electrical and Communications Engineering, Multimedia University College of Kenya.
- Mr. Peter Omeny' – Kenya Meteorological Department (KMD). IGAD Climate Predictions and Applications Centre (ICPAC)

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- **Some Abbreviations**

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- CGLSS - Cloud-to-Ground Lightning Surveillance Systems
- CIGRE - International Council on Large Electric Systems
- IEC - International Electrotechnical Commission
- IEEE - Institute of Electrical and Electronics Engineers
- ITU - International Telecommunications Union
- LCs - Lightning Conductors
- LDAR - Lightning Detection and Ranging
- LPSs - Lightning Protection systems
- NASA - National Aeronautics and Space Administration
- NLSI - National International Lightning Safety Initiative
- NOAA - National Oceanic and Atmospheric Administration
- TRABS - Transient Absorbers
- URSI - International Union of Radio Science

