POLE MOUNTED SWITCHES FOR COASTAL APPLICATIONS

Author - Mr. Geoff Auton (Managing Director)
Mr Johan Du Preez (Engineering Manager)
Presenter – Mr Johan Du Preez (Engineering Manager)

NEW MATERIALS

The paper will describe a range of switches designed for applications in highly saliferous conditions, including overseas conditions where sand deposits aggravate the situation.

Silicone clad composite glass cored insulators have been incorporated, which have to be carefully selected to withstand the cantilever forces experienced in switch designs, as distinct from the standard line applications. Designs have been made for use up to 44kV insulation levels.

Drawings and photographs will illustrate typical applications, which are of very low mass compared to their porcelain counter parts.

Linegear 2000 has now accumulated nearly 15 years of experience for its range of outdoor pole mounted switchgear, which has been used in most regions of Southern Africa, and in all variations of climatic conditions.

Overseas experience has been wide, with 1000's of items in service in the UK, which has a hostile winter climate of cold, rain, ice and frost, and a significant number installed in the Middle East in hot, humid conditions with salt/sand contamination.

Never the less in the higher medium voltage range (24/36kV) there is a growing preference for insulators with silicone sheds, for which extensive world-wide testing has demonstrated the superior surface characteristic of this material. It's technical name is Hydrophobicity, where we describe the condition where a droplet of water on the surface of an insulator shed, stands-up, forming an almost spherical shape to the droplet. Most other material, particularly when contaminated in some way, may have drops in less than a hemispherical shape hydrophilic, and in a worst case may flatten-down to completely wet the insulator surface.

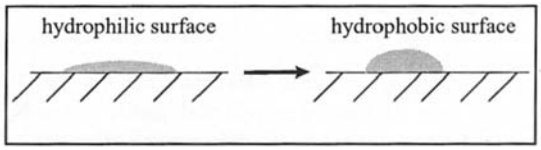

Fig 1

This latter phenomenon has been known for very many years, long before the advent of silicone, and insulator designers used their knowledge and ingenuity to create sheds of varying shapes to even-out the voltage gradients on the insulator surfaces.
It was also important to provide wherever possible, sheltered areas where sand/salt deposits were not likely to accumulate.

Insulators with smaller diameter sheds are interspersed with the larger sheds, not only to provide a sheltered area, but smaller diameter sheds will restrict the level of leakage currents which are usually the mechanism of failure and performance criteria.

Those designs that are considered to be acceptable are well illustrated in Appendix D of SABS/IEC 815 on the subject of Insulators for Service in Polluted Conditions, and the study of the surface characteristics of polymeric insulation materials is currently the subject of an IEC recommendation to analyse and quantify the nature of the droplets on the sheds of insulators.

The opening paragraphs of the paper is intended to set the scene for the main subject of the paper and readers who are more deeply interested in the design and performance of hydrophobic materials are referred to an extensive amount of literature on the subject, and to the work of the South African Insulator Test Station at Koeberg.

THREE PHASE SWITCH-DISCONNECTOR

Switchgear for use under coastal pollution requires special design consideration, because the mechanical characteristics of the insulators have a strong impact on performance, especially the cantilever strength.

The majority of silicone insulators are moulded onto a pultruded fibreglass rod, which has high tensile strength, because the main application for them is as strain/suspension insulators in over-head line construction, where the core material is only subjected to tensile loading.

For switch applications, the terminal insulators must have higher cantilever strength to withstand the bending forces that can be applied to them as a result of the moving contact systems of the switch, and the attached user connections. The moving insulator of the rocking-type of isolators/switch is a difficult proposition, because of the loading it is subjected to when opening and closing the main contacts.

The most widely used switch product on networks is the switch disconnector, which brings together all the problems at the same time and a new design, supersedes an existing extended porcelain design used by ESKOM in the Western Cape Region.

The terminal insulators embody a larger diameter fibre-glass core, with a specific creepage of 31.5min per kV for the 24kV system, but note that the contact drive insulator is a low mass silicone insulator, which is used in a linear compression mode, to drive the contacts to the closed position, but in it's maximum strength mode of tension when the contacts are to be pulled open.

This mechanical design is well proven by many years of service and the new insulators will readily fit into new system design plans.

Perhaps a larger problem exists in the overseas market, especially in the Middle East area of the Arabian Gulf, where the main pollutant is a combination of sand and salt, where even long creepage porcelain insulators have been a major maintenance problem.

The preferred insulant in the Gulf Region is the silicone insulator, but as the main distribution voltage is 36kV, we now move into a new generation of switch-disconnectors, combined with drop-out fuses.

Major schemes are in hand for rebuilding the electrification networks of oil fields which have been decimated in recent wars in that area. The illustrations show designs at 24 and 36kV which have been specially designed for these onerous conditions.

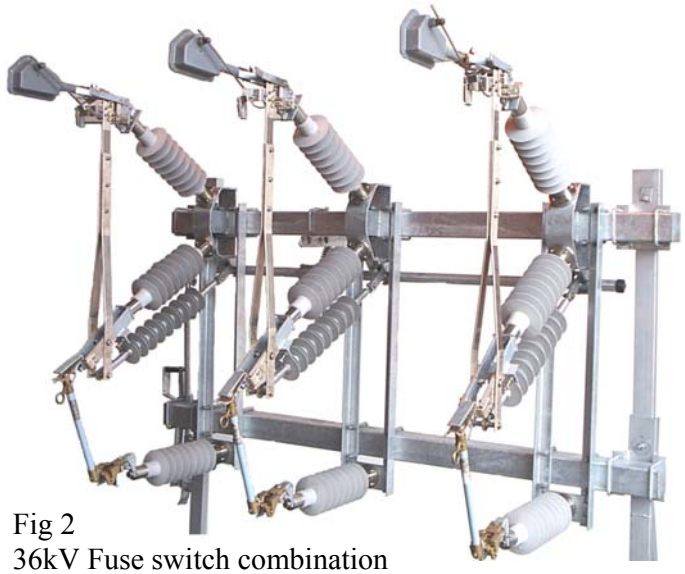

Fig 2
36kV Fuse switch combination

The client has specified a specific creepage factor of 40mm per kV equal to 1440mm and such insulators, being larger, need an even-larger diameter of the fibreglass core.

The whole switch becomes much bigger, and the length of the moving switch blade presents new problems.

Such a switch, as per the Fig 2 was recently designed, and tested at the SABS /NETFA facility for both power frequency and impulse levels, resulting in a 52kV level of insulation. The fuse switch combination was shipped to a world wide exhibition in Dubai, in the United Arab Emirates where it attracted an enormous amount of interest, and then sent on to Oman for the clients formal approval.

A Compact version of this switch/fuse combination for 24kV is currently being finalised for a large order for the same region, which also be available for the local market applications.

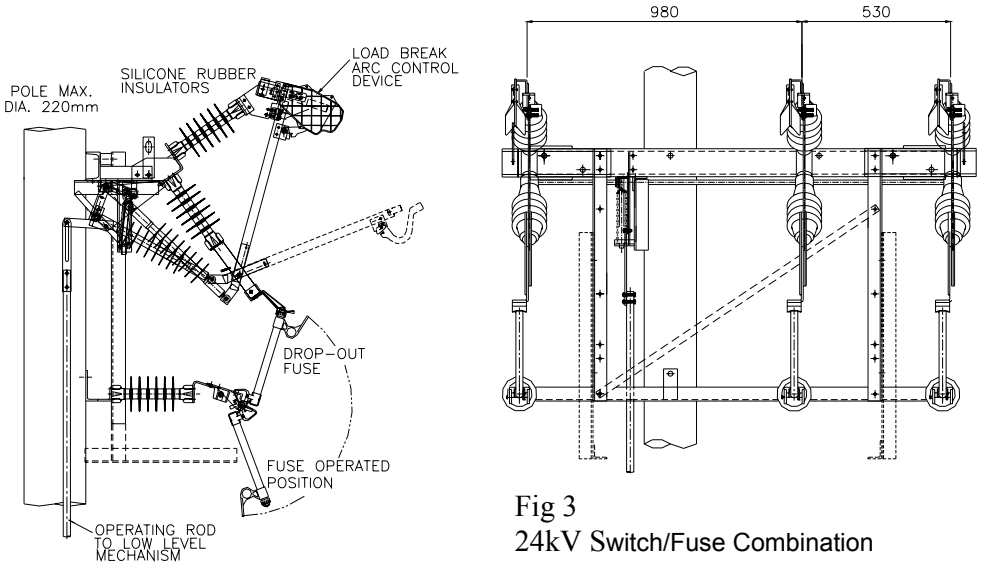

Fig 3
24kV Switch/Fuse Combination

SINGLE PHASE APPLICATIONS

Regional Electricity Companies in the UK are retro-fitting large numbers of Auto-Reclosing Circuit Breakers to improve the continuity of supply on their rural systems, and we were requested to provide a device which would allow an ARC to be connected on a pole which did not incorporate strain insulators.

The device was required to incorporate a strain insulator that could be used in two different ways:-

a) To be fitted in the line at a normal in-line pole, so that the ARC could be bypassed when required by a pivoted link

b) Also, to be fitted in series after the ARC, so that the pivoted, removable link could be removed to provide a visible isolating distance when it was necessary for men to work on the line.

See diagram Fig 5.

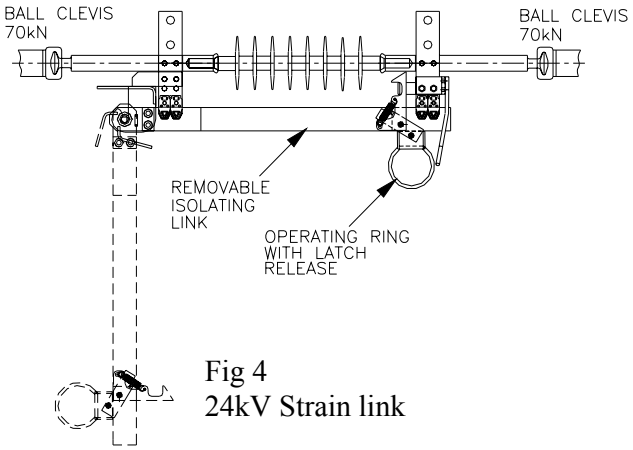

Fig 4
24kV Strain link

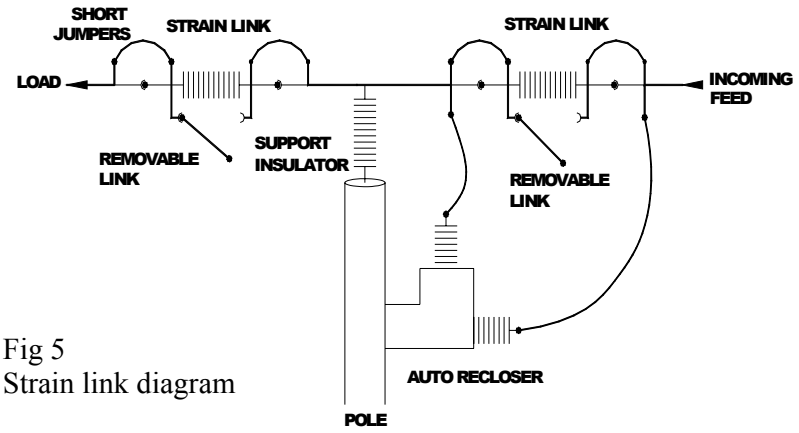

Fig 5
Strain link diagram

These strain insulators are to be fitted to existing lines, and so low mass was essential, and the removable link is hook-stick operated and securely latched to prevent displacement by conductor vibrations.

The components of the link and it's contacts, etc are all components drawn from the three phase switches in the product range.

This ingenious arrangement thought to be extremely cost effective and easy to fit, especially in a retro-fit installation, where the work can be done by 'live-line' working techniques.

ESKOM, has in the last decade used very many thousand of a product known as the HUKLINK, which is an in-line strain insulator / disconnector in township developments, but in anticipation of their wider use on distribution lines a coastal application design has now been produced, with plans for a 36kv version.

This product is fitted at a strain pole, where it is connected in the line of the jumper conductor and includes two silicone insulators – one for the strain application and one as a pilot insulator for the pivoted link.

Even though this device is mounted at the height of the conductors, they are easily operated by a hook-stick, with a Pull down to Open, and a Pull down to Close action.

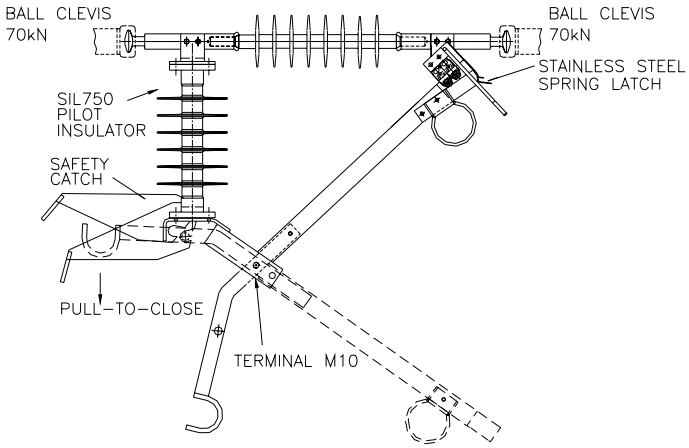

Fig 6
Huklink

This unit is now fitted with a safety catch, as used on 3 phase devices, to prevent operation by un-authorised personnel.

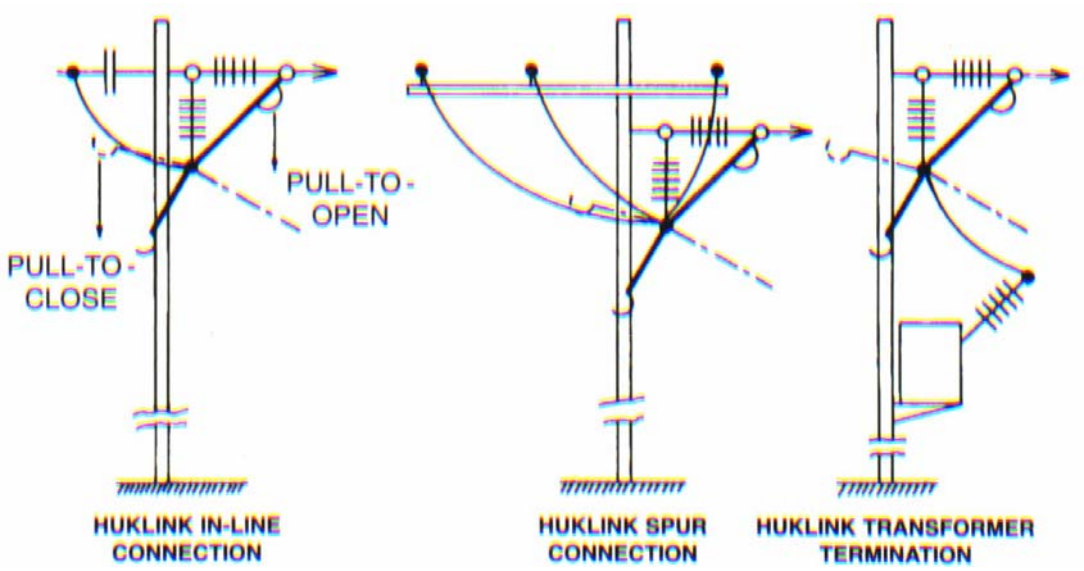

Fig 7
Huklink diagram