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NEW MATERIAL TECHNOLOGY AND PROTECTION DEVICE USED IN 33/11 KV DISTRIBUTION LINE

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ABSTRACT

The increasing number of accidents on distribution system has been a cause of concern. A number of protection is needed or possible; For this 11 kv insulator plays an important role to cause these incident while manpower doing thier job. . In past years the porcelain made insulator are used in distribution system like pin insulator and disc insulator and guy insulator. All are very important device in distribution system but now a day polymer insulator are used as a new technology because it has many advantage as compare to porcelain or ceramic insulator. It is believe that polymer insulators are a far more cost effective product than porcelain insulators. As they reportedly weigh 90% less than porcelain models, loading, unloading, and shipping costs are often dramatically reduced. The insulators typically require little to no maintenance and handle electrical loads more competently than their ceramic predecessors,Fastest installation without any higher supportical instrument. The design of polymer insulators generally allows the devices to be installed or replaced easily. It is believe that polymer insulators provide a more pleasing appearance,

Keywords: Installation, Maintenance, New Technology, Polymer Insulator, Tensile Strength

I. INTRODUCTION

Distribution System: It is a network of lines receiving power at 66kv and 33kv and rerating to 11 kilovolt, and 440 volts and supplying to the consumer. The distribution is divided into two groups.

Distribution network is the gateway for interaction between power supply agency and consumers, mostly of LT and medium voltage categories. A healthy distribution network caters quality and interruption free power supply to the consumers. Low voltage at consumers` premises and frequent interruptions power supply are mostly due to long and complicated distribution net work systems which are existing with their years old style, shape and size without undergoing any appreciable renovation and modernization. The distribution networks thus require regular monitoring with regards to their maintenance. Preventive maintenance in this direction works as a life saving pill and relieves the supply agency from worries and sleepless nights to a large extent.

1.1 Primary Distribution: It is the network at 11 kilovolt emanating from 33/11 kilovolt substation or 66/11 kilovolt substation. The primary distribution system consists of the feeders emanating from the substation and

supplying power to 1 or more secondary distribution systems. Such feeders are usually 3-phase circuits. Feeders are almost always radial from substation to loads (i.e., one way flow of power) in rural areas

1.2 Secondary Distribution: It is the network operating at utilization voltage at 440/220 v at consumer premises. Branching from the main feeder are laterals, also referred to in the industry as taps or branches. The laterals may be three-phase, two-phase (two phases of the three-phase feeder with a neutral), or single-phase (one phase from the single phase feeder and a neutral). The laterals are usually protected with fuses so that faulted laterals do not cause interruption at the feeder level.

II. MATERIAL

Insulators used for 33/11 KV power distribution are made from glass, porcelain,ceramic or composite polymer materials. Porcelain insulators are made from clay, quartz or alumina and feldspar, and are covered with a smooth glaze to shed water. Insulators made from porcelain rich in alumina are used where high mechanical strength is a criterion. Porcelain has a dielectric strength of about 4–10 kV/mm.The polymer insulator has a dielectric strength is 6-12 has intalled in various part in M.P.Another Glass has a higher dielectric strength, but it attracts condensation and the thick irregular shapes needed for insulators are difficult to cast without internal strains. Some insulator manufacturers stopped making glass insulators in the late 1960s, switching to ceramic materials.

Recently, some electric utilities have begun converting to polymer composite materials for some types of insulators like pin insulator,dics insulator ,DO switch. These are typically made up of a central rod of fiber reinforced plastic with an outer weather shed made of silicone rubber or ethylene propylene Diane monomer rubber (EPDM). Composite insulators are less costly, lighter in weight, and have excellent hydrophobic capability,High mechnical strength. This combination makes them ideal for service in polluted or hazaradious areas.these materials do have the long-term proven service life of glass and porcelain in different areas across the world.

III. PROTECTION SYSTEM

Overhead distribution lines are likely to have different kinds of nearby objects along their right of path. These objects may provide natural shielding to the distrition line and very helpful protect the line from souce to destnaton. In order to recommend smart lightening arrester configuration in each case, a fully pipe with 10 ft ground and two cases of naturally galvansed wire grounded separately.

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Fig-1 Shows Polymer Anulator & Porcelain Insulaator

Fig 1 illustrates two typical types of insulator cases of naturally shielded ground considered in this study. It is observed that the plymer made arrester earth terminal connection plays a major role in determining the protection level of the line and transformer. Two cases were closely examined. Case 1: Unearthed Cross arm (Isolated surge arrester ear thing) : Earthed Cross arm (Non-isolated surge arrester ear thing). In Case 1, the surge arrester ear thing terminal was considered to be earthed with an insulated ear thing cable isolated from the wood pole and metal cross arm structure. In Case 2, it was considered to be connected to the steel cross arm strut earthed with a bare conductor passing along the surface of the wood pole structure. To simulate these two cases, two parameters were varied. The surge impedance of the wood pole in a distribution line is very large, and when a bare earth conductor is placed along its surface , the value considerably reduces. Using values calculated in the literature.

IV. NEW TECHNOLOGY (POLYMER INSULATOR)

Polymer insulators were first developed in the 1950s to replace conventional porcelain insulators. But practically in India, It is used in 2011 in some part at M.P where rajeev gandhi grameen vidutikara yojna plays an important role..They were not, however, available until the 1960s because of initial design flaws. These insulators are generally constructed of fiber reinforced polymer rods and a polymer housing. The improved insulators provide cost and weight reduction benefits over its predecessor. Polymer insulators (silicone rubber based) are seeing increasing usage. China and Russia has already developed polymer insulators having a highest system voltage of 1100kV and India is currently developing a 1200kV (highest system voltage) line which will initially be charged with 400kV to be upgraded to a 1200kV line. Polymer insulators by nature have hydrophobic characteristics providing for improved wet performance

Also, studies have shown that the specific creep age distance required in polymer insulators is much lower than that required in porcelain or glass. Additionally, the mass of polymer insulators (especially in higher voltages) is approximately 50% to 30% less than that of a comparative porcelain or glass string. Better pollution and wet performance is leading to the increased use of such insulators. Insulators for very high voltages, exceeding 200

kV, may have grading rings installed at their terminals. This improves the electric field distribution around the insulator and makes it more resistant to flash-over during voltage surges. Longer insulators with longer creep age distance for leakage current are required in these cases. Strain insulators must be strong enough mechanically to support the full weight of the span of conductor, as well as loads due to ice accumulation, and wind.

4.1 Mechanical Loading Conditions for new material technology (Polymer Insulator)

It is found that the mecnical loading between porcelaain and olymer insulator are quite different.The electricity works shall have sufficient mechanical strength to withstand anticipated mechanical stresses due to environmental and electrical service conditions.

Now a day change is going on distribution system design, material & protection such as the design of polymer pin insulator, disc insulator,guy insulator even DO switch and the protection device such as ear thing ,lightning arrestor ,guarding, DO fuse, barbed wire, guy insulator, stay set protection box of transforme.The significance of all these measures has been appreciated fully. This paper attempts to list some of the factor which influences new technology in material and safety. Distribution system is always subject to numerous faults and difficult task for intallation and maintenance. The impression is that at present the number of fault is excessive and this is reflected in frequent interruption supply to consumers.

V. FEATURES OF NEW TECHNOLOGY

1. Light weight (65-80) as compare to porcelain or ceramic insulator.
2. Silicon rubber sheds are provided perfect hydrophobic performance, good resistance to ageing, tracking and erosion.
3. Stable behavior at extreme climate condition.
4. Long term surface hydrobhobicity.
5 Suitable for polluted environment, salty atmosphere etc.
6. Resistance to breakage and vandalism practically unbreakable.
7. Superior anti tracking property.
8. High mechanical strength.
9. Ease of installation (easier handling with lighter equipment and labor at the job site.
10. Resistance to seismic shock

6. Service Condition:

The insulators to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

1. Maximum ambient temperature (Degree C) … 50
2. Minimum ambient temperature (Degree C) … 3.5
3. Maximum Relative Humidity (%) … 100
4. Maximum Annual Rainfall (mm) … 1450
5. Maximum Wind pressure (kg/msq.) … 150
6 Maximum wind velocities (km/hour) … 45

7 Maximum altitudes above mean sea level (meter) … 1000

8 Isoceraunic level (days/year) … 50

9 Seismic level (Horizontal acceleration) … 0.3 g

10. Moderately hot and humid tropical climate conductive to rust and fungus growth.

VII. TYPE TESTS

Following Type test shall be carried out on porcelain insulators as specified in IS: 731 /1971 amended up to date.

1. Visual Examination.
2. Verification of dimensions.
3. Visible Discharge Test.
4. Impulse voltage withstand test.
5. Impulse voltage flashover test.
6. Wet one Minute Power Frequency withstands test and Wet Flashover test.
7. Temperature Cycle test.
8. Electromechanical failing load test.
9. Power frequency puncture withstand test.

7.1 Acceptance Tests

The test samples after having withstood the routine test shall be subject to the following acceptance tests in order indicated below:

7.1.1. Verification of dimensions.

7.1.2. Temperature Cycle test.

7.1.3. Twenty-four hour mechanical test.

7.1.4. Electromechanical failing load test.

7.1.5. Power Frequency puncture withstand test.

7.1.6. Porosity test.

7.1.7. Galvanizing test.

7.2 Routine Tests

7.2.1. Visual Examination.

7.2.2. Mechanical test.

7.2.3. Electrical test.

7.2.4. Twenty four hours mechanical test.

7.2.5. Electro mechanical failing load test.

VIII. ADVANTAGE OF NEW MATERIAL TECHNOLOGY (SILICON BASED POLYMER INSULATOR) OVER OLD MATERIAL TECHNOLOGY (PORCELAIN INSULATOR)

8.1. Superior handling of mechanical shock loads hence convenient to handle, transport and erect.

8.2. Low weight (80% of porcelain)-easy handling, Résistance to Vandal damage.

8.3. High power arc resistance due to high thermal withstands ability.

8.4. Excellent pollution performance (Durable & Regenerative hydrophobicity), Flame resistant.

8.5. Shatter resistant, Aerofoil design offering minimum wind resistance.

8.6. Low leakage current and power loss due to its high surface resistivity.

8.7 .Lighter in weight, almost a 90% weight reduction. This weight reduction leads to easier handling, reduced shipping and installation costs.

8.8. Better performances in high contamination areas, overall better handling of shock loads.

8.9. More aesthetically pleasing the eye, and smaller profile, more resistant to vandalism and breakage due to the forgiving nature of polymer, Strong in tension.

IX. OLD TECHNOLOGY

Porcelain insulators plays an important role in 11 kv distribution line since these lines have started .as the time pased some modification and testing have done on their performance and changes as per their requirement .as new technology have came on market polymer versions are better able to resist incidents of vandalism. Porcelain insulators also frequently have housing cracks, bonding failures, or hardware separation. When these situations arise, water often penetrates the housing, producing voltage leakage. Maintenance of these devices often involves applications of protective coating along with occasional washing of the insulators themselves. In an attempt to recreate the durability of ceramic insulators, a computer operated accelerated aging chamber was developed. The harsh conditions created within the chamber were designed to simulate 30 years of conditions over the span of roughly three years. The lab regularly tests various designs of polymer insulators. Once inside the chamber, the insulators are subjected to a variety of environmental, electrical, and mechanical conditions, similar to those commonly endured, including changing temperatures and ultraviolet radiation. Humidity tests simulating fog and rain, using fresh and salt water are conducted as well.

X. BREAKDOWN IN OLD TECHNOLOGY (PORCELAIN INSULATOR)

When subjected to a high enough voltage, insulators suffer from the phenomenon of electrical breakdown. When the electric field applied across an insulating substance exceeds in any location the threshold breakdown field for that substance, the insulator suddenly becomes a conductor, causing a large increase in current, an electric arc through the substance. Electrical breakdown occurs when the electric field in the material is strong enough to accelerate free charge carriers (electrons and ions, which are always present at low concentrations) to a high enough velocity to knock electrons from atoms when they strike them, ionizing the atoms. These freed electrons and ions are in turn accelerated and strike other atoms, creating more charge carriers, in a chain reaction. Rapidly the insulator becomes filled with mobile charge carriers, its resistance drops to a low level. In a solid, the breakdown voltage is proportional to the band gap energy. The air in a region

around a high-voltage conductor can break down and ionize without a catastrophic increase in current; this is called "corona discharge". However if the region of air breakdown extends to another conductor at a different voltage it creates a conductive path between them, and a large current flows through the air, creating an electric arc. Even a vacuum can suffer a sort of breakdown, but in this case the breakdown or vacuum arc involves charges ejected from the surface of metal electrodes rather than produced by the vacuum itself. In case of some insulators, the conduction may take place at a very high temperature as then the energy acquired by the valence electrons is sufficient to take them into conduction band.

10.1 Disadvantage

1. Heavy, leading to more expensive shipping and more difficult handling.
2. Could have hidden defects that are hard to detect.
3. Vandalism is common from thrown rocks, or from being shot at.
4. Pin erosion, and coupling hardware corrosion.
5. Cement growth cracking.
6. Weaker in tension.

10.2 Power-system protection is a branch of electrical power engineering that deals with the protection of electrical power systems from faults through the isolation of faulted parts from the rest of the electrical network. The objective of a protection scheme is to keep the power system stable by isolating only the components that are under fault, whilst leaving as much of the network as possible still in operation. Thus, protection schemes must apply a very pragmatic and pessimistic approach to clearing system faults. For this reason, the technology and philosophies utilized in protection schemes can often be old and well-established because they must be very reliable. Recently in India some device are used as a protection in 33/11 kv line which are necessary because there are many accident occur in 33/11 kv line due to not found of ear thing at every pole. DO fuse not found between Transformer and Conductor, Guy Insulator are not used in stay, Jumpering not found on any line crossing and so on.

10.3 Characteristic of New Protection Device: Transformer protection requires a DO fuse, and Lightening arrestor ,New Cup type lightening arrestor are design which are light in weight, high mechanical strength, easily Maintain. It is generally 9 ka in rating for 11 kV distribution line. Which simply protect the device from over current in conductor which Measures the current in a circuit.

Polymer Protection: Now a day's Polymer protection device are used in 33/11 kV line as a DO fuse, Disc Insulator, Pin Insulator are used which are very safely.

10.4 Environmental Considerations

The maintenance of electricity works shall take into consideration environmental issues and concerns.

- Factors to consider, include, but are not limited to:
  The minimization of environmental damage, including visual impacts,
- Tree management programmers,
- reduction in and the correct disposal of waste products,

XI. APPLICATION

The distributions fuse Drop outs are intended for use on distribution transformers and have no inherent load break capacity.The dropout (swing out) fuse is an expulsion type and its main function is to protect Transformers on rural distribution network. It is also particularly useful for inaccessible Sub-stations where indication of fusing is of advantage On blowing of fuse element, the fuse carrier hangs down vertically from the bottom contact. This is advantageous locating the fault as hanging fuse carrier is noticeable from distance and this save times which otherwise would be taken in investigation.Lift out the fuse carrier by means of the insulated operating rod, rewire the fuse element and swing it up.

11.1 Easily Maintenance of New Protection and Ear thing Device: Protection and ear thing systems shall be inspected and maintained in a safe and reliable operating condition. A system of maintenance for protection and ear thing systems shall consider: inspection and/or testing programmers, maintenance programmers, and replacement programmers for components approaching the end of their serviceable life. Ear thing systems shall be inspected and tested at intervals commensurate with risk of corrosion or mechanical damage to ensure that design requirements are met. The results of visual inspections and resistance to ground tests must be recorded and reviewed to identify any changes in results that should influence the frequency of inspection, tests and maintenance. The results of visual inspections and performance tests of protection systems shall be recorded and reviewed to identify changes that would influence the frequency of inspections, tests, maintenance and replacements.

XII. CONCLUSION

Polymer insulator protection of a 33/11kV PCC pole of distribution line has investigated and petrolling with SLD. It IS shown that adequate selection of pin insulator,dics insulator,guy insulator,barbed wire,anticlambing device and surge arrester configuration can protect the line effectively against lightning. Arresters connected to earthed cross arms allow better protection of the line compared with the case of unearthed cross arms. Arrester failure probability is low in the earthed cross arms case. Adequate overvoltage line protection can be provided with surge arresters installed on the two outer phases in the case of a line in open ground or with a single surge arrester in the case of a line in naturally shielded ground.

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