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Performance Analysis of Repaired High Voltage Insulators

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Abstract: This research aims to study the process to repair electric insulator, study the lifetime of the insulators were repaired, and insulator erosion rates were compared within the environment and period of usage by choosing to study especially electrical insulator in high voltage of electricity of Electricity Generating Authority that was removed from the system due to deficiencies in the area of The Electricity Generating Authority of Thailand in Suratthani. By electrical properties and mechanical properties qualifying examination of insulators has been approved. By electrical properties and mechanical properties qualifying testing of insulators has been approved. As the results showed that insulators have been improved by the process of insulators, qualifying values passed the standard test method ASTM A780-01 (2006).

Keywords: Electrical insulator ; mechanical testing ; electrical testing ; standards ASTM A780-01 (2006).

1. Introduction

Loss of potential in the distribution system is a huge problem for the transmission system in the southern provinces. It is also a result of rainstorms and surrounded by the sea. The moisture and high salt. This is an important factor in accelerating the regression of the insulation. The insulation conditions are lower than the design values. Thus, the discharge between the layers of high strength And some of the discharge at the core of the cushion is caused by the substance that is coated at the axis of wear and tear. Cause of charge disintegration at the metal core. Oxygen combined with iron. Cause rust on the iron core. Make certain that the surface changes. Partial discharge will cause the core to leak. The pendulum is absent and may lead to deformation. The system is unstable. So, at present, the electricity is monitored. And when it is found, it will be used to replace the switch to the cost of replacing and investigate causes. Also check the actual condition of how many of them are actually available.

To reduce the amount of waste. Reduce the environmental impact and the need to use raw materials as well as the large amount of energy in the production of new insulators. This research has brought the old saltwater re-condition and re-use as usual. Due to limited resources, materials and equip. Consequently, rust and partial discharge in transmission line and insulators are occurred with low reliability in power system as shown in Fig. 1-3. In order to confirm the aging of repaired insulators, this study is set to approve the process and aging lifetime.

2. Repaired System

The repaired system are set in 8 steps as the following :

1. Selection insulators.
   In this step, the removed insulators from electrical system are selected to repair insulators.
2. Cleaning step.
   Removed insulators are clean before electrical test.
3. Mechanical test.
   This test is set at 25 percentage of maximum tensile strength.
4. Electrical Test.
   Testla transformer is used to test insulator capacity at 400 kVp. Flash over are recorded to check insulator strength.
5. Spraying Sand.
   Spraying sand is used to cleaning metal surface at insulator axis.
6. Zinc Coating.
   In order to prevent cathodic protection, Zinc coating are painted at axis surface.
7. Summary cleaning.
   This step clean chemical and zinc at all insulator surface.
8. Warehouse.
   The repaired insulators are put in warehouse for transportation.

Figure 1. Removed Insulator with rust and corrosion.

Figure 2. Insulator with cement vapor.

This is because the old rusted with pollution in the nature of the rust. Surface contamination Therefore, the surface condition and condition of the insulator rod must be minimized so as to minimize the contamination of the insulated foreign matter and to remove the rust from the core by means of mechanical and electrical methods using the plasma system. In order to be able to carry the cores in a ready state, the coating must be repaired with air, water, humid conditions. Or contaminated with acidity from the environment. This can reduce the corrosion caused by rust and can be stretched to continue using the test period.

3. Experimental system

Tests were performed to identify the age of pin type ceramic insulators using the following:

1. Dry Resistance Test.

Dry résistance test were performed on selected samples. Normally, the measured dry resistance exceeded 1 GΩ.

2. ESDD Tests

ESDD tests were conducted on selected strings only. Generally, most of ESDD level were classified within the very light contamination.

3. Impulse Test

Positive and negative lightning impulse tests were conducted on selected insular string. The test were conducted dry.

4. AC Wet Test.

AC wet flashover were conducted on selected insulators string. The lightning impulse is 1.2 *50 μs wave shape. Whereas the lightning impulse front time T1according to IEC 60439-1[1-2] is essentially determined by resistance of front resistor Rd and capacitor of load Cb see fig. 1, the time to half-valve T2 is determined by the impulse capacitance of the impulse capacitor Cs and the resistance of the tail resistor, T2 is varied according to Re and time constant of discharge capacitor equal Cs Re being part of impulse voltage testing generator. According to IEC 60439-1, there are the following time parameters and tolerances for the standard lightning impulse 1.2/50 μs as shown in Fig.3.

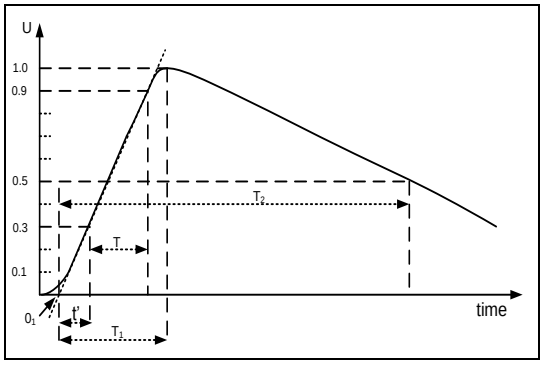

Figure 3. Lightning impulse voltage waveform 1.2/50 μs.

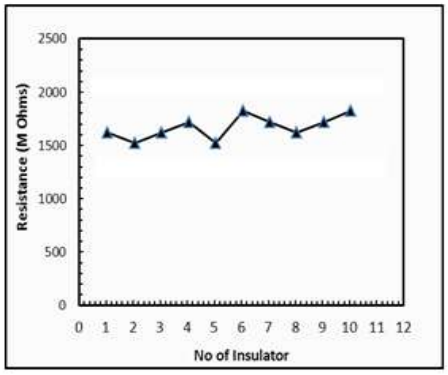

Figure 4. Dry resistance with various of insulators.

5. Mechanical Test.

Mechanical tension destruction and mechanical and electrical tests were conducted on selected cap and pin type insulators

4. Results

1. Dry resistance Test.

Fig.4. shows measured dry resistance with various of insulators. An amount of insulators are 10 pieces. Fig.5 shows the relation between resistance with insulation age. The insulation age is a long time with low resistance.

2. ESDD Test.

Insulator contamination can be responsible to cause tracking under wet conditions.

Fig.6 shows measured ESDD values for top surface of selected insulators. All of the values are in accepted region, less than 0.005.

3. Impulse Test

Fig.7 shows positive and negative lightning impulse test results as a function of length of service. All of the values are in accepted region

4. AC Wet Test.

Fig. 8. shows measured AC wet flashover test results. The wet flashover performance of ceramic insulators appears to remain relatively unaffected regardless of service. All of the values are in the accepted region

5. Mechanical Test

Fig. 9 shows measured mechanical breaking strength of the test pin type ceramic insulators. All of the values are in accepted region

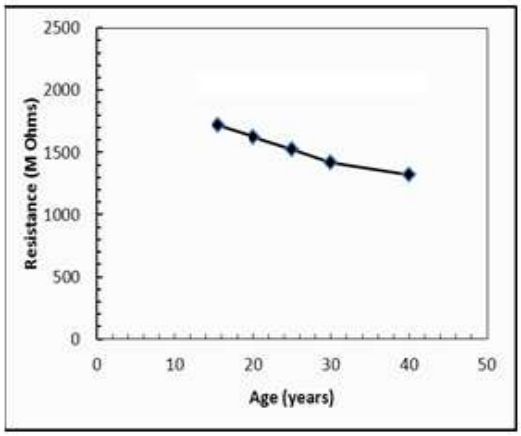

Figure 5. Dry resistance with various of insulators.

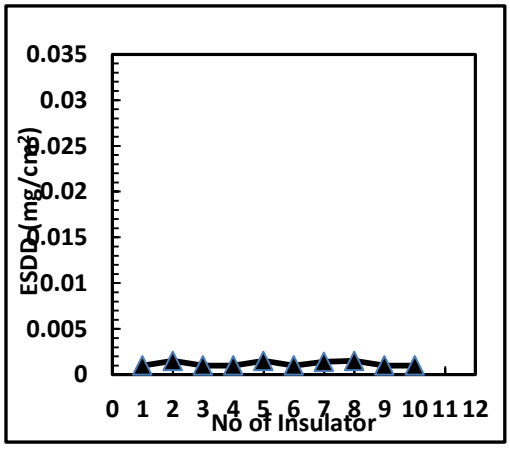

Figure 6. Dry resistance vs Age (Years).

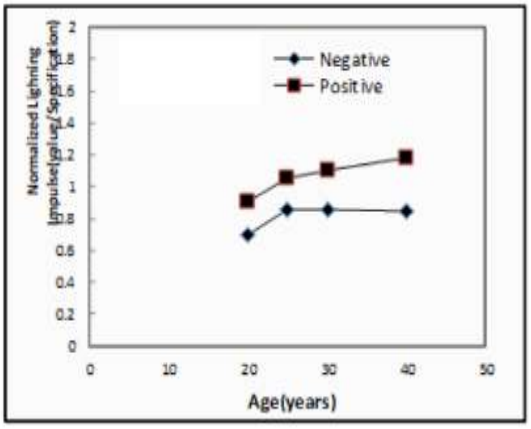

Figure 7. Positive and Negative Lightning Performance vs Age(Year).

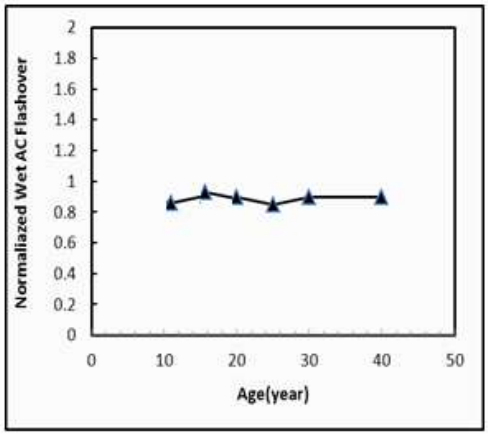

Figure 8. AC Wet Flashover vs. Age (Years).

So, in order for the newly created system to be compatible with the current data. Consistent with experience and the concept of real workers. Which can be identified. Practical disadvantages and theoretical principles that are used to help the insulator to be repaired and reused are reliable, have accepted the standards of the old ruler who has been repaired.

5. Conclusions

Determination of location, size and characteristics of the corrosion of the pile. It is essential for repairing and improving the quality of the insulator. The information provided will determine the condition of the fault condition of the cradle under conditions. And a variety of environments. This will result in targeting the primary issue. And the second is to determine the severity of the erosion. Include the sequence of problems and characteristics of the type of corrosion. To simulate the availability of time, space and location with precision. Both the mechanical and electrical effects lead to the improvement of the quality of the old insulator that covers the problem.

After improving the surface of the external insulation and coating to prevent rust. The axis of the perimeter. Electrical and mechanical conditions must be checked. The standard will be tested. Comparing the results between the old and the new ones. Simultaneous use of this computer simulation program. Electric field The durability of good insulation. The results can be compared to features that are close to or conform to the specified standards.

By electrical properties and mechanical properties qualifying testing of insulators has been approved. As the results showed that insulators has been improved by the process of insulators qualifying values passed the standard test method ASTM A780-01 (2006).

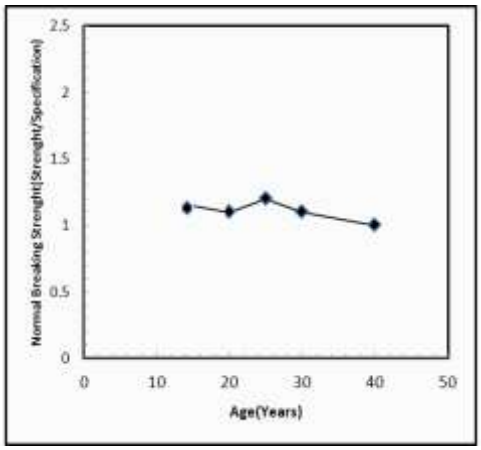

Figure 9. Mechanical Braking Strength vs Age(Years)

References

1. D. Devendranath et al., " Accelerated-ageing Test for RTV-coated Insulators: Analysis of Electrical an Material Properties", IEE Proc.-Gener. Trans. Distrib., Vol. 152, pp. 635-644, 2005
2. E. Brasca et al., "Power Arc on Insulator String: Testing Procedures and Design of Guard Devices for HV Transmission Lines", IEEE., Trans. on Power Apparatus and System, Vol. PAS-89, No. 3, 1970
3. G. Caraca et al., "Analysis of Pollution Test Methods", IEEE. Winter Power Meeting, NY, 1968
4. J. Burnham et al., "Gunshot Damage to Ceramic and nonceramic Insulators", IEEE. Trans. On Power delivery, Vol. 12, No. 4.pp 1651-1656, 1997
5. G. George et al, "Assessing the Integrity of Vintage Ceramic insulators: EPRI", ESMO-23,pp 344-351,2000
6. H.G. Cho et al, " Ageing Characteristic of Porcelain Suspension Insulators for transmission Line Cool and Heat Accelerate Method", Proc. of Inter. Con. on Properties and Applications of Dielectric Materials, pp 415-418, Nagoya, 2003.

7. EPRI, " Electrical and Mechanical Performance of Ceramic Insulators : Final report", EPRI, Palo, Alto, CA, 2000.
8. S.W. Han and et al, "Thermal Mechanical Performance Test on Suspended insulators for Transmission Line", IEEE. , Inter. Sym. on Electrical insulation, pp 300-303, Indianapolis, 2004, USA.
9. A. Naderian et al, "A Review of Artificial Contamination withstand Test methods of High Voltage outdoor Insulators," IEEE., Inter Sym. on Electrical Insulation, pp 284-287, Indianapolis, USA, 2004
10. SamrauySungsa-ard, 2004, Hi-Voltage Engineer, Julalongkorn University, Bangkok,Thailand.