Analysis in Disconnection Causes of the Overhead Insulated Conductor

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Abstract: Along With the continuous expansion of urban power grid in China, the rapid growth of power load and the requirement of improving the reliability of power supply, more and more urban and rural distribution networks adopt insulated overhead conductors. In order to ensure the safety of maintenance personnel, it needs to setting grounding wire after verifying the circuit without power. The insulated conductor is unable to hang the grounding wire, so a variety of electric grounding ring is used. This paper discusses the electricity testing grounding ring and lightning electricity testing grounding ring, this way trouble is: If the sealing is not tight, it is easy to influent; the extrusion pressure is too large, which leads to the deformation of the wire core and the breaking force becomes smaller. In addition, a series of precautions have been made for the burnout of the grounding ring

1. Introduction

Along with the continuous expansion of urban power grid in China, the rapid growth of power load and the requirement of improving the reliability of power supply, more and more urban and rural distribution networks adopt insulated overhead conductors. 10kV insulated overhead conductor has better insulation and corrosion resistance than overhead bare wire, It can avoid the interphase short circuit and grounding accidents by trees, kite, short wire, high winds and so on. Thereby, the line fault by Line tree contradiction and external force destruction is effectively solved, and the reliability of the power supply of the line (grid) is greatly improved; It is cheaper than the buried cable, simple construction and convenient maintenance, so it has been widely used in the urban and rural distribution network, and improved the insulation of the distribution network[1].

2. The necessity of hanging wire at the work site

The fifty-ninth rule in *Safety working rules for electric power industry*:

1) After the line is proved to have no voltage, the working class (Group) shall be immediately attached to the ground at both ends of the work area;

2) Any branch line that may send power to dead line should also be connected to grounding wire;

3) If the induced voltage is reflected on the power line, the grounding wire shall be added.

Hanging the grounding wire is the most reliable technical measures to protect line construction personnel to avoid electric shock from sudden power supply. To hang grounding wire for overhead insulated conductors, In order to suspend the grounding wire for overhead insulated conductors, an electric grounding ring or a lightning proof grounding ring is installed at some designated parts of overhead insulated conductors, Although this method solves the difficult problem of hanging grounding wire on overhead insulated conductor, but it also gives hidden danger to the safe operation of overhead insulated conductor which leads to the entrance of conductor and the reduction of breaking force

3. Hidden dangers of overhead insulated conductor

3.1 Water penetration accident

Because of its structure and installation conditions, insulated conductor is easy to influent and

nonvolatile. When the insulating layer rupture or lead head is not sealed, Water enters the aluminum wire through the suction action of the capillary, Concentrates and aggregates at the lower sag. Because of environmental pollution, water is acidic and reacts with aluminum to form white powder, This kind of oxide accelerates the corrosion of the wire under the action of electric field, reduces the wire radian, causes the bulge phenomenon, even breaks the line, shortens the wire life[2,3]. The main cause of water penetration is:

1)The wire is broken In installation, but it is not plugged, causing long-term flooding;

2)Acceptance and storage are not reasonable, it is no sealing treatment, water penetration was found many times during construction, and the wire was oxidized before installation;

3)During construction and operation, the conductor is damaged by external force, causing the insulation layer to enter the water[4].

The main countermeasures: Manufacturers should develop waterproof insulated overhead lines. New products have been on the market, whether it is completely watertight is subject to operational inspection; Strictly according to procedures design and acceptance, to do a good job of waterproof plugging measures, once the device is found illegal, immediately rectification; strictly check and close the product, keep it properly and seal the exposed lead; to strengthen the monitoring, discovery stage expansion phenomenon, immediately organized the sampling and processing. The accident of water penetration and disconnection of overhead insulated conductor is shown in Figure 1.

Figure 1 The accident of water penetration and disconnection of overhead insulated conductor

3.2 Excessive pressure accident

In recent years, due to the different geographical position and atmospheric conditions of insulated overhead conductors, it is found that the overhead insulated conductors are broken frequently in areas where the wind speed is large (wind pendulum) and ice covered are very serious. The main cause of broken line accident on the overhead insulated conductor is: the tractive effort of overhead insulated conductor is shared by wires and insulation, when the insulating layer is destroyed, it will lose tension. The entire load G will be borne by the wire core F, and it is likely to break under certain conditions. The stress analysis of wire telos is shown in Figure 2.

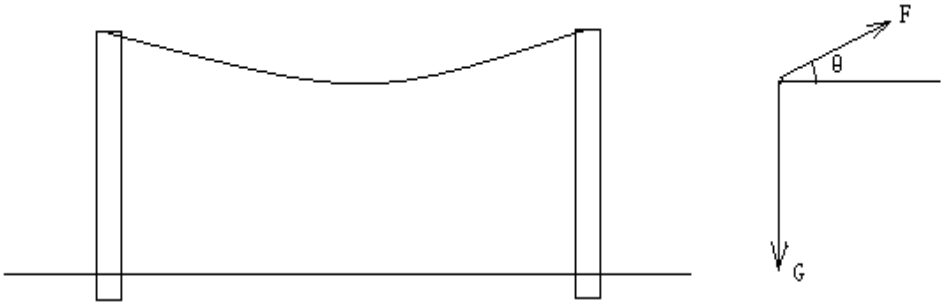


Figure 2 The stress analysis of wire telos

The main countermeasures: Pay attention to the construction quality when installing the electrical inspection grounding ring or the lightning protection grounding ring, the intensity of extrusion should be moderate, and the wire core of the lead wire should be avoided. Strengthen the operation supervision, find the phenomenon that the insulating layer breaks or wire injury, organize the sampling and processing immediately. According to the operation experience, make the design

strictly, when necessary can shorten the tower space. The pulling strength of a 10kV overhead insulated conductor shall be carried out as shown in Table 1.

Table 1 The breaking force of a 10kV overhead insulated conductor

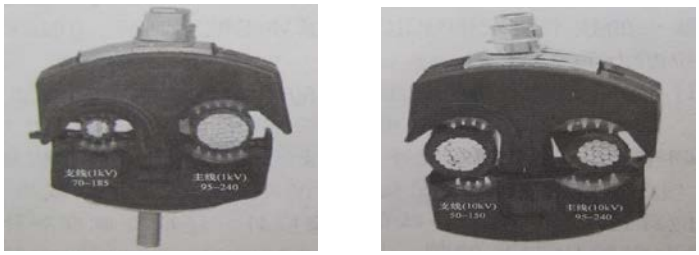
cross section area of a conductor(mm^2)	25	35	50	70	95	120	150	185	240	300
Thickness of insulating layer(mm)	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Pulling strength(N)	3762	5177	7011	10354	13727	17339	21003	26732	34679	43349

3.3 Case analysis

In choosing the type and specification of the test grounding ring, it is possible that the voltage level is wrong, or that the cross section is out of range or the model selection is wrong.

(1) The 10kV insulated conductor selects 1kV electrical inspection grounding ring. On the installation site, some 1kV electrical inspection grounding rings are installed on the 10kV insulated conductor, As shown in table 1-8 and table 1-10, the insulation of 1kV insulated conductor is thinner than that of 10kV, Obviously, whether the 1kV electrical inspection grounding ring can puncture the insulating layer of the 10kV insulated conductor is a problem; furthermore, the compressive strength of 1kV electrical inspection grounding ring is only 3.5kV, if installed in 10kV insulated conductor, obviously the insulation strength of 1kV electrical inspection grounding ring is not enough, It is easy to make the insulation of the electrical inspection grounding ring not enough and lead to insulation breakdown and other accidents [5].

(2) The 1kV insulated conductor selects 10kV electrical inspection grounding ring. When the field installation personnel in the selection of electrical inspection grounding ring, it may be that “replace large ones with small ones” is not feasible, and “replace small ones with large ones” is no problem. In fact, in choosing the electrical inspection grounding ring, in addition to considering the insulation electrical strength, should also consider the mechanical puncture force. The provisions in the technical requirements of electrical inspection grounding ring: The operating breaking force of insulated conductor shall be no less than 95% of the rated pulling strength of the conductor after the puncture. The section of electrical inspection grounding ring section does not meet the requirements are shown in Figure 3.



(a) (b)

Figure 3 The section of electrical inspection grounding ring section does not meet the requirements
(a) The range of the cross section (branch) of insulated conductor is less than that of electrical inspection grounding ring
(b) The range of the cross section (branch) of insulated conductor is larger than that of electrical inspection grounding ring

In the design of electrical inspection grounding ring, to meet the puncture performance of different voltage of the insulated conductor, the contact blade’s tooth length, curvature, shape, hardness and torsion shear bolts (or nuts) of the shear torque size needs adjusted several times, until the best electrical and mechanical performance requirements are met. Therefore, the contact blade of 10kV electrical inspection grounding rings which is compatible with 10kV insulated conductor, is required to penetrate 10kV insulated conductor insulation layer, and also puncture on the conductor, The puncture ability of the contact blade will be stronger than that of 1kV grounding ring, so as to ensure the good electrical contact performance of 10kV electrical inspection

grounding ring and 10kV insulated conductor. If the 10kV electrical inspection grounding ring is installed in the 1kV insulated conductor, the 1kV insulated conductors are punctured by electrical inspection grounding ring, this will definitely lead to contact with the blade puncturing too deep because of the thin insulating layer, although the electrical contact is good, but the running breaking force of Insulated conductor must be less than 95% of the rated pulling strength, this will inevitably cause damage to the 1kV insulated conductor, which will lead to the breakage of it, resulting in an insulated conductor disconnection accident[5] . Figure 4 is an accident caused by a model error.

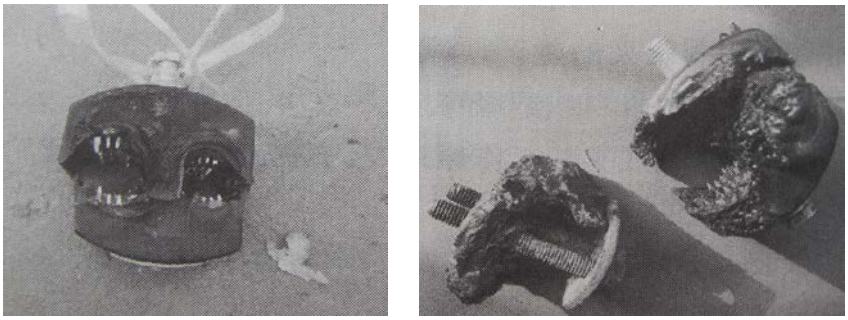


Figure 4 The burned puncture grounding ring

4. Conclusion

According to the burning accident of the electrical inspection grounding ring, Technical personnel of the manufacturer and the power supply department carry out the accident cause analysis through the scene of the accident, some power installers do not tighten the bolts (or nuts) of tensional shear type when installing an electrical inspection grounding ring, which results in poor contact between the electrical inspection grounding ring and the insulated conductor; or because the installation technique of the electrical inspection grounding ring is not understood, the installation has not been carried out according to the correct installation procedure; two bolts (or nuts) of tensional shear type are not evenly tightened, the installation is finished after one of them was twisted off, and The position of the main line and branch line is not leveled at the time of installation, this results in bad contact between the electrical inspection grounding ring and the insulated conductor, and the overheat of the electrical inspection grounding ring causes the destruction.

The following corrective measures have been formulated:

(1) Organize the technical training of power installation personnel on the installation of the electrical inspection grounding ring;

(2) It is suggested that a comprehensive examination should be made to the electrical inspection grounding ring which has been installed by the power supply bureau, and the problems can be remedied in time, in case the burnout accident occurs again.

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