

Fault analysis and treatment of 220kV Gas Insulated Substation pillar insulator adjusting bolt

Su Hainan¹, Yao Zheng¹, Yang Sen¹, Li Lin¹, Li Xueyan², Wang Di¹, Shi Qiang¹, Dai Xiaojia³, Xu Haihang⁴, Jin Dai⁴, Zhu Jiahui⁴

¹Dandong Power Supply Company, Liaoning Electric Power Company Limited, State Grid, China

²Shibei Power Supply Company, Shanghai Electric Power Company Limited, State Grid, China

³Anshan Power Supply Company, Liaoning Electric Power Company Limited, State Grid, China

⁴Fushun Power Supply Company, Liaoning Electric Power Company Limited, State Grid, China

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Abstract: At present, GIS combined electrical appliances are widely used in substation in China. The safe operation of GIS combined electrical appliances is related to the safe production of power grid and enterprises. This paper introduces a 220kV GIS pillar insulator adjustment bolt loose fault in a substation, through on-site inspection and treatment, analyzes the cause of the fault, and puts forward the corresponding improvement measures.

1. Introduction

With the widespread use of GIS equipment in power stations and substations, and the voltage level of GIS equipment increased from 110kV to 1000kV, GIS equipment has reached the popularity stage of high-voltage electrical equipment, and its design structure and performance have been greatly optimized. Due to the characteristics of GIS, such as small floor area, non-environmental impact on component sealing and high operation reliability, the research, production and use of GIS equipment have entered a period of rapid development. With the wide range of use, the problems found in GIS operation also follow. Then, how can the electrical operators ensure the safe, reliable and stable operation of GIS? Similar problems are more and more concerned by people.

2. An accident case of 220kV GIS pillar insulator adjusting bolt

A substation 220kV GIS, junction group YN,d11, products delivered in July 2015. It was put into operation in 2015, and chromatographic tracking test was conducted according to the provisions of "maintenance procedures for power transmission and transformation state" after operation. August 26-29, 2019: at the request of the equipment department of the provincial company, contacted sichuan saikang intelligent technology co., ltd. to conduct X-ray detection and vibration test on 220kV composite electrical appliances of a substation. It was found that the main primary interval of bus in 220kV section was between the 220kV busbar and the 220kV busbar, and a pillar insulator adjustment screw was loose near the 220kV busbar. Danbao 2 line 22201 knife brake B phase contact protruding shield about 5.97mm. As shown in figure 1:

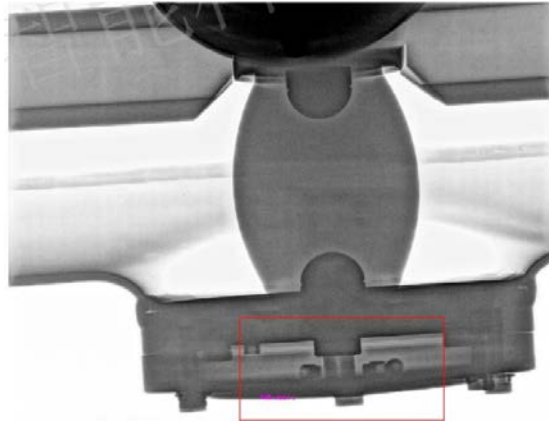


Figure 1 Adjust screw loose

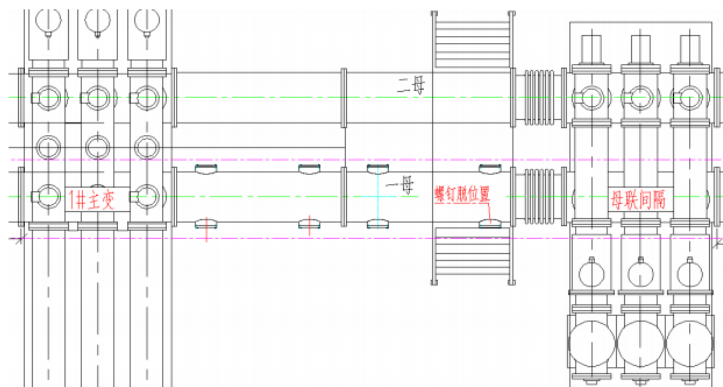


Figure 2 Screw drop position

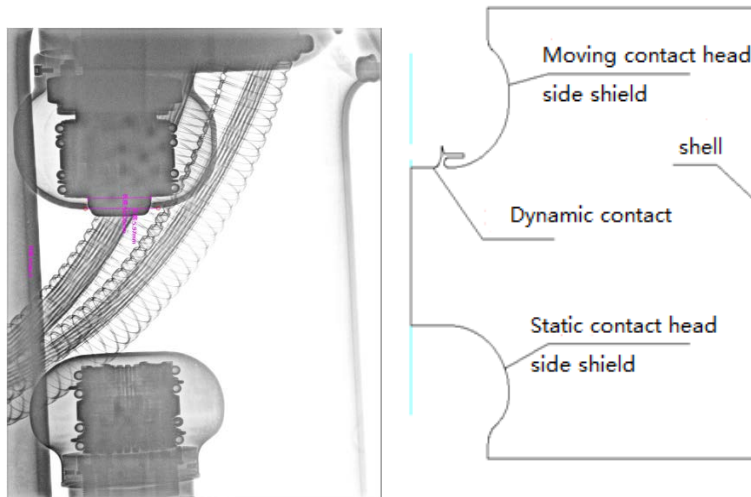


Figure 3 X - ray photo of highlight shield of danbao 2 - line I female switch B

3. An accident case of 220kV GIS pillar insulator adjusting bolt

With the increasing promotion of high-voltage and ultra-high-voltage transmission and the continuous improvement of line voltage levels, insulator pollution flashover becomes increasingly dangerous. According to statistics, under the existing voltage level, pollution flashover has become more dangerous than lightning stroke. There are three main reasons for the pollution flashover accident: 1, environmental pollution in China is rapidly worse, which is related to local industrial structure; 2, the insulation level of the electrical equipment does not meet the local pollution requirements; 3, power sectors lack effective technical means to detect equipment pollution. In the area where the transmission line passes, the insulators in operation gradually accumulate a layer of

pollutants on the surface, which is due to the atmospheric environment such as nitrogen oxides and particulate dust. In dry weather, these insulators with dirt on the surface maintain a high level of insulation, and the discharge voltage is close to that of the insulators in a clean, dry state. However, when there is humid weather, the pollutants on the surface of insulators absorb moisture, causing the electrolyte in the pollution layer to dissolve and ionize, resulting in an increase in conductance. In this case, the insulators leak more surface current. Under the impact of the shape and structure size of the insulator and the uneven distribution of the surface of the insulator, and moisture differences, the current density of each part of the surface of the insulator varies, and as a result, a drying zone is formed at a portion where the current density is relatively large. A drying zone makes the voltage distribution on the surface of the insulator even more uneven, and the drying zone carries higher voltage. Therefore, when the electric field strength is sufficiently large, the insulator makes an electric discharge and then creates a local electric arc. At this time, the surface discharge model of the insulator corresponds to a local arc in series with a layer of resistance. The local arc might be extinguished or be enhanced. When the local arc continuously takes place and becomes enhanced beyond a critical state, the arc runs through the two poles to produce a flashover.

4. Accident handling

From November 6 to 8, 2019, power was cut off at the no.1 main transformer of a 220kV substation. From November 6 to 9, 2019, power was cut off at the 220kV bus line I and 220kV danbao line 2. Open the cover for the defect parts, and tighten the suspected internal fastener loose parts.

1) Operation and maintenance personnel shall restore loose adjustment screws and tighten the remaining screws.

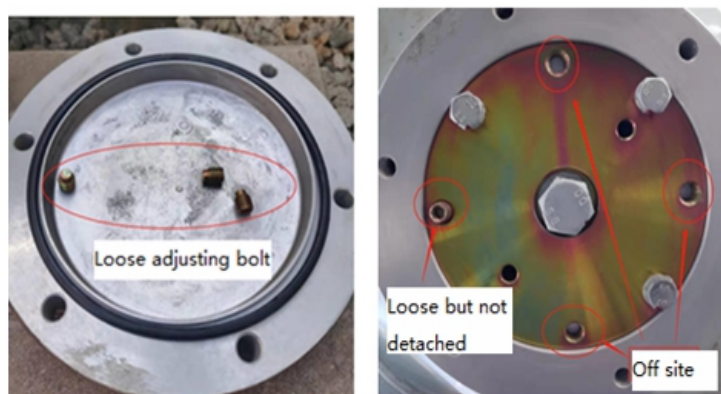


Figure 4 Adjust screw loose part to open cover

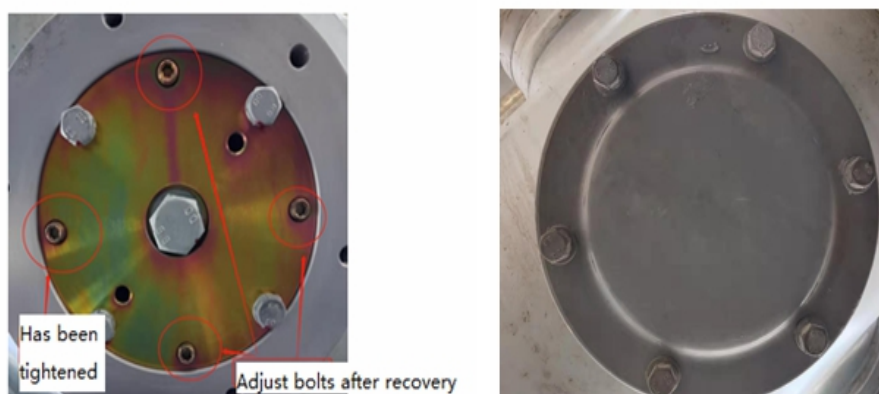


Figure 5 After the screw looseness is restored

2) The 3-phase dynamic contact of danbao 2-wire return to normal, that is, the tripping of the

brake is in place (no shielding cover is protruding), and the insertion depth of closing meets the requirements (greater than 38mm).

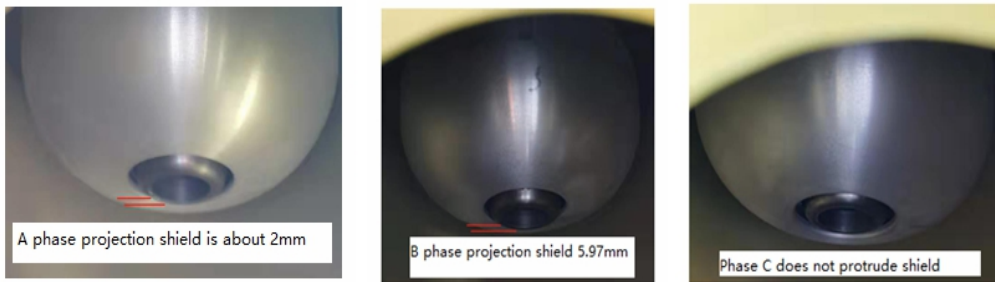


Figure 6 Danbao 2 - line I female switch before three - phase dynamic contact processing



Figure 7 Danbao 2 - line I female knife brake after three - phase dynamic contact processing

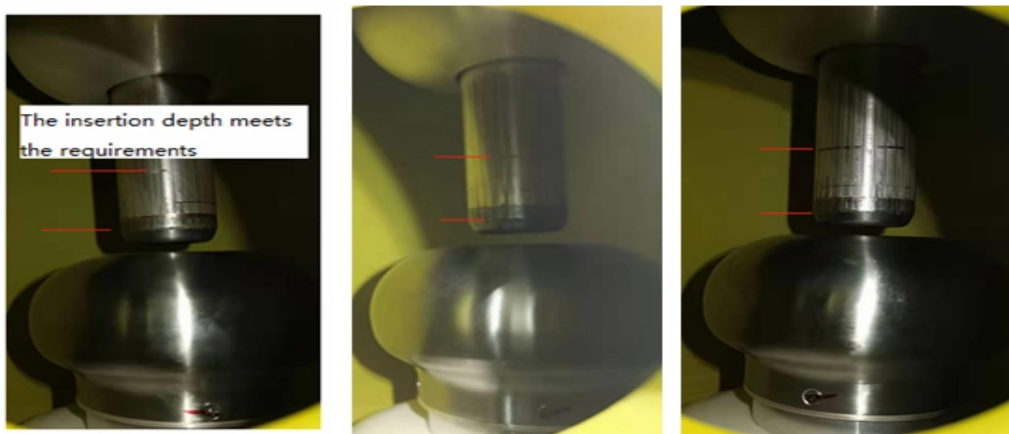


Figure 8 The insertion depth of danbao 2-wire I female knife gate can meet the requirements after three phase dynamic contact processing

3) The equipment manufacturer shall tighten the suspected loose part of the internal fastener. The bolts that can be observed in the field are marked, and the looseness is not found in the field.



Figure 9 Maintenance maintenance personnel on the site busbar fastening bolt inspection
The field test of sectional circuit resistance is qualified.

Table 1 Circuit resistance test data qualified

Loop resistance test ($\mu\Omega$)	A primary and primary reserve 1 line		One main and one main danbo 2 line		Bus 6 air chamber main danbao line 2				I period of bus	
					Before the repair		After repair			
AB	983.6	AB	2161	AB	880.8	AB	878.9	A	1520.2	
BC	984.5	BC	2213	BC	894.2	BC	893.8	B	1489.4	
CA	991.3	CA	2222	CA	915.8	CA	913.9	C	1565.9	

4) The hexagon socket bolts dropped off in the field for adjustment bolts do not play the role of fixing the support insulator, which is fixed by one M20*45 and four M12*25 bolts in the center. The adjustment bolts may have poor fastening in the assembly process in the factory, which may lead to looseness due to electrodynamic vibration during a period of operation.

Danbao 2-wire moving contact highlights the problem of shield cover. Since the onsite opening and closing of the switch has been aligned, there is no problem with the external indicator inspection. It is only possible that there is an oversight in the assembly process of the manufacturer, leading to the failure of all moving contacts to be retracted into the shield cover.

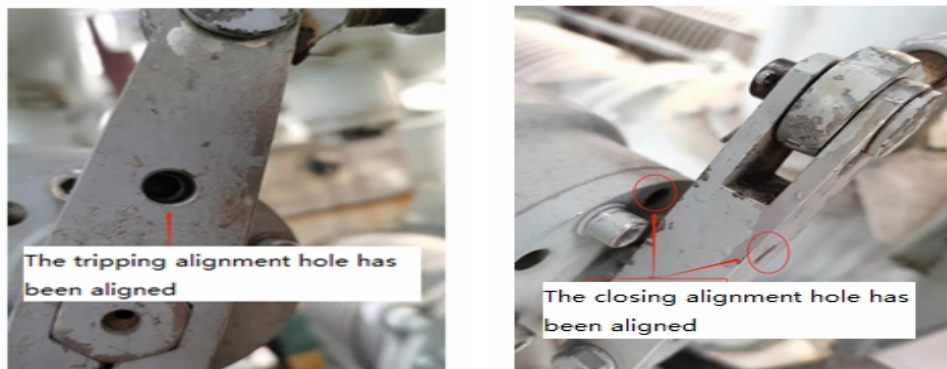


Figure 10 The opening and closing alignment holes have been aligned

The bolts in the open-cover inspection all meet the requirements of five links and counter measures, meet the requirements of torque (greater than 20N/m), and have been marked. The factory explained that each section of bus was constructed in different operation groups in the factory, inevitably there were construction personnel with weak sense of responsibility, and the construction was not conducted in accordance with the standard operation requirements. Bolts loosening in 2019 was an individual case.

5. Conclusion

In the future, operation, maintenance and maintenance personnel to strengthen equipment supervision, strictly according to the state grid five factory inspection, improve product quality. The acoustic wave vibration detection is in the early stage in China, and the test manufacturers are also doing a lot of case data analysis, so the accuracy and accuracy of the vibration detection of manufacturers need to be improved. Further improve the quality of handover test, first inspection and routine test of new equipment, as well as the level of live discharge test, carefully analyze and compare test data, and timely find hidden dangers of equipment. The failure rate of GIS bus is much higher than that of HGIS and open type substation. In the future, GIS equipment should not be used in outdoor stations.

References

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