Common Faults and Treatment Methods of Power Capacitor

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Abstract: As a kind of reactive power compensation device, the power capacitor is an important equipment for safe operation of power grids. Power capacitor plays an important role in adjusting grid voltage, reducing line loss and improving power quality. However, in practical applications, due to various factors such as human factors and environment, capacitors frequently fail during operation, which affects normal work. The basic knowledge of power capacitors, common faults, and preventive measures for power capacitor faults are explained in detail, and solutions to the problem are proposed.

1. Introduction

The power capacitor is a static reactive power compensation device whose main function is to provide reactive power to the power system and improve the power factor. As important electrical equipment in the power grid, the long-term normal operation of capacitors is an important basic condition for ensuring the safety of power grid operation, improving power quality and ensuring the efficiency of enterprises. In order to improve the operating efficiency of the capacitor, reducing the failure rate of the capacitor, and strengthen the analysis of common faults, a corresponding method is established to ensure its safety performance.

2. Common Faults in Power Capacitors

2.1 Seepage Oil Leakage

Capacitor leakage and oil leakage are common faults. The reasons are manifold, such as improper handling methods, or the use of porcelain sleeves to cause cracks in the flange joints. When connecting wires, damage to the porcelain bushing due to excessive force on the screw or excessively tight wire connection; and defects in the manufacturing process of the product can cause leakage and leakage of the capacitor.; After the capacitor is put into operation, due to the temperature change, the internal pressure will increase the leakage and oil leakage; Due to improper operation and maintenance and lack of maintenance for long-term operation of the capacitor, the paint layer of the outer casing peels off and the iron sheet is corroded, which is also a reason of leakage and oil leakage of the capacitor during operation. Therefore, it must be processed in time[1].

2.2 Shell Deformation

Since the internal medium of the capacitor is free under the action of a high-voltage electric field, the medium is decomposed to precipitate a gas, or due to the breakdown of some components, the capacitor pole is grounded to the outer casing and the like, and the medium is allowed to evolve gas. These gases in the sealed enclosure will cause an increase in internal pressure and will cause the casing to expand and deform. Therefore, the deformation of the capacitor casing is a symptom before the capacitor fails or fails.

2.3 Capacitor Explosion

Capacitor explosion in operation is a malignant accident. Generally, when the internal

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component occurs between the poles or the insulation of the casing, other capacitors connected in parallel will release a large amount of energy to the capacitor, which may cause the capacitor to explode and cause a fire. The reasons are as follows:

(1) Breakdown of internal components of capacitors: mainly due to poor manufacturing processes.

(2) Damage to the insulation of the capacitor casing: The high-voltage side lead wire of the capacitor is made of thin copper. If the manufacturing process is poor, the edge is uneven and has burrs or severe bending, the tip container will corona, corona will cause oil to decompose, the box shell expands and the oil level drops, causing a breakdown. In addition, during the sealing, the welding time at the corner is too long, and the internal insulation is burned and oil and gas are generated to cause the breakdown voltage to be greatly reduced and damaged.

(3) Poor sealing and oil leakage: Due to poor sealing of the assembled casing, moisture enters the interior, which reduces the insulation resistance: or the oil level drops due to oil leakage, resulting in pole-to-shell discharge or component breakdown.

(4) Drum and internal free: mainly due to the internal corona, breakdown discharge and severe free, the capacitor will reduce the initial free voltage of the component to the working electric field strength under the action of overvoltage. So, a series of physical and chemical effects to accelerate the aging, decomposition, and generation of gas will be caused. A vicious circle is formed, causing the pressure of the casing to increase, causing the outer drum of the casing to explode.

(5) Capacitor explosion caused by live closing: Each time the capacitor bank is reclosed, the capacitor must be discharged for 5 minutes with the switch disconnected. Otherwise, the polarity of the voltage at the closing moment may be the same as the residual charge on the capacitor. The opposite is true and causes an explosion. For this purpose, a capacitor bank with a capacity of 160 kvar or more is generally required, and an automatic trip device without voltage should be installed, and the switch of the capacitor bank is not allowed to be equipped with an automatic reclosing. In addition, explosions may occur due to excessive temperature, poor ventilation, excessive operating voltage, excessive voltage harmonic components, or operating overvoltage[2].

2.4 Capacitor Temperature

The main reason is that the capacitor operates over a long period of time, and the higher harmonics generated by the nearby rectifying device cause the capacitor to overcurrent. In addition, due to the aging of the capacitor after long-term operation of the capacitor, an increase in the dielectric loss tangent (tan δ) may cause the temperature to rise too high. An increase in the temperature of the capacitor will affect the life of the capacitor and cause damage to the capacitor insulation breakdown.

2.5 Fuse Blown

When there is no obvious fault after the appearance of the capacitor is detected, an experimental test can be performed to see if there is a fuse blown. Under normal circumstances, if there is no obvious fault in appearance and the capacitor fails, the fuse may be the cause of the fault.

3. The Method of Power Capacitor Failure

3.1 The Method of Seepage and Oil Leakage

(1) When installing capacitors, it is better to use a separate cord to connect the busbars. Do not use hard busbars to prevent damage to the capacitor casing caused by assembly stress and damage the seal and cause oil leakage.

(2)When carrying the capacitor, it should be placed upright. It is strictly forbidden to take the casing and handle it gently to prevent the impact. When wiring, pay attention to the tightness of the wire. The screw cannot be used too much and the casing should be protected.

(3)Oil leakage in the capacitor casing and casing welds, the osmosis and leakage can be trusted, and then repaired with tin brazing. When repairing the casing weld, the soldering iron should not be

overheated to prevent the silver layer from falling off. Painted after repair. Replace the capacitor if the leakage and oil leakage are serious.[4]

3.2 The Method of Casing Deformation

The appearance of the capacitor bank is often checked. If the expansion of the capacitor casing is found, measures should be taken in time. If the expansion is severe, stop using it immediately, and find out the cause and replace the capacitor. If the expansion of the casing is not serious, ventilation measures shall be taken to enhance the operation inspection work.

3.3 The Method of Capacitor Explosion

When the capacitor is put into operation, in order to prevent the capacitor from exploding, in addition to the requirement to strengthen the inspection during operation, the most important thing is to install a capacitor protection device to remove the capacitor before the burst accident. During operation, if the capacitor is found to be “beep”, it is a precursor to the internal insulation breakdown of the capacitor and should be stopped.

3.4 The Method of Temperature Increase

The ambient temperature of the capacitor chamber should be strictly monitored and controlled during operation. In order to monitor the ambient temperature during operation, the thermometer should be selected at the worst temperature (two-thirds of the capacitor height) and the thermometer should be installed to be easy to observe. In order to monitor the temperature of the capacitor's case, temperature wax can be attached to the capacitor case (near the nameplate). If the room temperature is too high, the necessary ventilation and cooling measures should be taken. If the room temperature is still below 40 °C, the operation should be stopped immediately.

3.5 The Method of Fuse Blowing

When the fused fuse of the capacitor is blown, the circuit breaker of the capacitor should be disconnected. After the power is cut off and the capacitor is discharged, an external inspection is performed first, such as whether there is a flashover trace on the outside of the bushing, whether the casing is deformed, whether the oil leaks and the grounding device are short-circuited, etc., and then the pole and the pole are shaken with an insulation resistance meter. Insulation resistance value to ground. If no signs of failure are found, the fuses can be replaced and the fuses can continue to be put into operation. If the fuse of the fuse is still blown after power transmission, the faulty capacitor should be exited.

4. Capacitor Inspection and Operation and Maintenance

4.1 Strengthening Inspections

Whether there is leakage in each part of the outer casing, whether the outer casing has a bulge, whether the expansion amount exceeds the elastic permitting degree of normal thermal expansion and contraction; if the outdoor capacitor group is not coated with cold zinc, it should also check whether the outer casing paint falls off or rusts, when it falls off or When the rust is serious, it can be solved by applying cold zinc; whether the casing is clean and complete, whether there is crack or discharge phenomenon; whether there is looseness, detachment or disconnection, heat discoloration everywhere in the lead connection. Capacitor capacity and fuse capacity configuration must be consistent, etc. It is forbidden to operate the capacitor.

4.2 Environmental Requirements

It should be ensured that the capacitor chamber should have good ventilation. The indoor temperature should meet the requirements specified by the manufacturer. It must also ensure that the capacitor is not exposed to oil, water, rain or snow, and is not exposed to direct sunlight. If there is no special regulation, the general operating environment temperature range should be controlled at ±40 °C.

4.3 Exiting the Operating Conditions

When an abnormal noise occurs in the capacitor during operation, it indicates that partial discharge phenomenon has been triggered, and capacitor should be turned off. In addition, when the capacitor is sprayed or ignited, the joint is severely overheated, the casing is severely flashed, and the capacitor is exploded, the capacitor must be stopped.

4.4 Full Discharge before Testing

The grounding should be good. The discharge resistance and its circuit should be checked once a month during operation and confirmed to be good. The power-off inspection work shall be strictly carried out in the "Electrical Safety Work Regulations". The capacitors shall be fully discharged phase by phase before the grounding of the capacitors. The neutral point of the star-connected capacitors shall be grounded. The series capacitors and capacitors separated from the entire group of capacitors shall be discharged one by one. The capacitor housing on the insulating bracket should also be discharged.

4.5 Capacitor Investment and Cutting Operation Requirements

The switching operation of the capacitor is performed correctly. The input or exit of the capacitor should be realized according to the bus voltage curve or by the fixed value by the reactive automatic switching device. Check the capacitor protection in the added position before putting the capacitor line. Under normal circumstances, the capacitor switch is in the hot standby state. After the input, the switch position and current and voltage changes should be carefully checked.

5. Conclusion

Through the analysis and processing of common faults of power capacitors, it is possible to timely understand and master the operation of capacitors, detect capacitor defects in time and take effective measures to avoid further expansion of capacitor faults, thus ensuring the safe operation of capacitor banks and capacitors.

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