Analysis of 220kV Oil Immersed Inverted Current Transformer Fault and Precautions during Operation

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Abstract. In this paper, a 220kV substation occurred in a 220kV oil immersed inverted current transformer failure were analyzed. Based on the principle and characteristics of the current transformer, this paper analyzes and judges the cause of the accident using the structure, characteristic analysis, accident site investigation and test diagnosis of the oil immersed inverted vertical current transformer to determine the influence of rainfall and the state of oil leakage The lower the amount of evaluation criteria for the accident the main reason. At the same time, this paper puts forward the management methods and technical measures to avoid such accidents, and provides a reference for the analysis of the same type of accidents.

Introduction

In recent years, an oil immersed inverted current transformers is widely used in China because of its structure and characteristics. However, it will inevitably appear fault in operation. Therefore, the cause of failure must be studied and analyzed, taking appropriate precautions.

The Structure of Oil Immersed Inverted Current Transformer

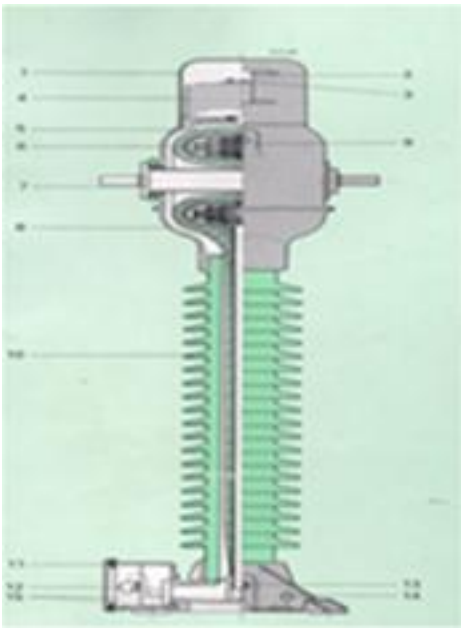

Figure 1 Oil immersed inverted current transformer structure diagram

1-The head of transformer;2- Bellows expansion indicator;3- Oil filling screw（sealed）;
4- Metal bellows expander;5- High - voltage insulation;6- Secondary winding and core;
7-Primary winding;8- Cast aluminum head shell;9-Rings;10- Porcelain insulator;
11- Terminal box;12-Secondary terminals;13- Oil drain screw（sealed）;
14- The lifting shaft;15- Earth terminal

The Characteristics of Oil Immersed Inverted Current Transformer

The advantage of oil immersed inverted current transformer.

a. Oil paper capacitor insulation expander with metal are fully sealed.

b. Partial discharge is low, the dielectric dissipation factor is small and stable.

c. Strong abilities of anti-dynamic stability and thermal stability.

d. Small corona high level of primary terminal tension.

e. Cast aluminum shell maintenance-free appearance.

f. Compared with U-shaped primary winding current transformer, no return current flowing through the conductor which will affect the accuracy of the measuring winding and the accuracy of the protection winding.

The disadvantage of oil immersed inverted current transformer.

a. Easy to leak oil. Especially in the case of poor sealing process or seal aging, the oil leakage defects are most likely to occur, resulting in body insulation damp.

b. The main insulation of primary winding is hard to make. Partial discharge is most likely occurred when process control is poor, in severe cases, it can resulting in the exploded of the transformer.

c. The operation and maintenance is relatively complex.

Analysis of Failure

The operation of current transformer.

The faulty current transformer is a LVB-220W3 oil immersed inverted current transformer, which was put into service on March 18 2011.It has no problem in interruption maintenance test on March 10 2012. Specific data is shown in Table 1.

Table 1 All previous high pressure tests data

Date	Rated Capacitance (PF)	Integral insulation (MΩ)	Measuring Capacitance (PF)	Dielectric loss angle (%)	Capacitance difference (%)	Tap insulation (MΩ)	Result
2011.3.16	235.2	10000	234.2	0.24	-0.43	10000	Qualified
2012.3.10	235.2	10000	233.6	0.26	-0.68	10000	Qualified

This year, the spacing was arrangement for interruption maintenance in the autumn inspection on November 13(has been arranged in the autumn inspection power outage plan). Operation and maintenance personnel founded that the transformer top cap on the phenomenon of oil leakage, the oil level was low, but did not form oil droplets, regarded it as general defects, registered and reported it to the operation and maintenance department.

Accident course.

On October 2016, a B-phase current transformer exploded in a substation, when the weather was good. Operation and maintenance personnel on-site inspection found that the upper B-phase current transformer porcelain damage, Metal shell collapse broken, with expander fell off. (Figure 2)

Figure 2 B-phase current transformer burst the upper part

Disintegration inspection situation.

a. The outer insulation of the low-voltage coil shield had been completely burnt, and it had a significant upper discharge point on shield metal shell. (Figure 2)

b. Insulation of the upper part of the lead-tube (where it was connected to the shield) had been burned, and the insulation below the center had not been damaged. (Figure 3)

c. Metal expander cover and expander failure was not separated, the box expander surface inspection found no leakage point, and expander tank safety valve did not action. (Figure 4)

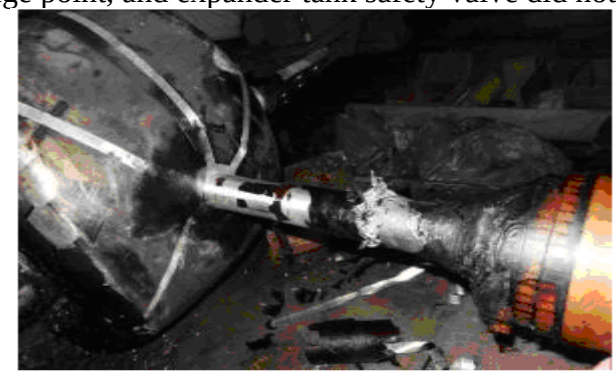

Figure 3 Insulation of the upper part of the lead pipe burns

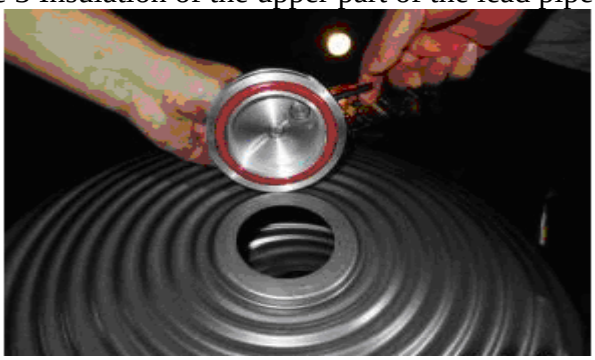

Figure 4 Expander tank safety valve did not action

Cause analysis.

The transformer was found that there is oil leakage phenomenon in the inspection on September 12, which was regarded as general defects. There was a local heavy rain on October 10, as the transformer body affected by rainfall, the temperature dropped rapidly, rainwater leakage along the parts into the body, resulting in the main insulation damp, finally the shell high voltage (phase voltage) on the secondary winding shield (ground potential) discharged breakdown. Leakage of oil storage tank caused by the main insulation breakdown was the main reason for this failure.

Pressure release device failed to timely action, was the main reason for the burst of oil conservator and porcelain sets.

In the State Grid guide for the evaluation of transformer equipment, the status of leakage oil for the state assessment is only in the state of operation. According to the guidelines, maintenance personnel determined the transformer can still run, which also led to the final transformer explosion.

Precautions

1) Organize a comprehensive investigation, take the same type of current transformers special patrol, check high-pressure side leakage, and take measures.

2) In view of the structural characteristics of the oil immersed inverted current transformer, the primary and secondary windings are both located in the head of the transformer, and the internal insulating oil is less (about 60% of the vertical current transformer), in the event of leakage of oil, it's easily lead to cause the main insulation damp, and then the occurrence of insulation breakdown discharge, resulting in transformer explosion. Therefore, it requires operation and maintenance personnel should focus on inspection of the oil immersed inverted current transformer in the routine inspection, while strengthening the infrared precision temperature measurement.

3) Revised detailed guidelines issued by the State Grid evaluation of transformer equipment, state assessment guidelines in the inverted instrument transformer oil leakage from the "state of care" to upgrade to "critical state".

4) For oil immersed inverted current transformers which are not allowed to be taken by the manufacturer, the condition maintenance cycle is adjusted to not exceed the base period of 3 years.

5) Require manufacturers to re-calculate the expansion of the release pressure value, to ensure that the when there is transformer internal failure, it can timely release of internal pressure to prevent the occurrence of body and casing from burst.

Conclusions and Suggestions

From this oil immersed inverted current transformer failure, it can be learned that once such equipment have oil leakage defects, it will easily lead to transformer explosion if not promptly take appropriate measures. Therefore, such defects should be dealt as fast as they found to avoid accidents.

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