Analysis of Factors That Cause Damage to Transformers

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ABSTRACT

The task of evaluating and diagnosing the current condition of the transformer is set in the article. When assessing the current situation, it is necessary to know where the defects are localized and the reasons for their appearance. Therefore, classification of causes and types of transformer damage was considered and analyzed.

Keywords: transformer, damage, defects, partial discharges, wear of insulation, current letter

Today, diagnosing the current state of power plants has become one of the most important issues. Today, most of the power devices working in the electric network have passed their working life. In order to ensure reliable operation of these devices, it is necessary to constantly monitor their technical condition.

As a result of long-term operation of power transformers, defects are formed in their main active parts. That is, defects are formed. Factors such as heating in the active parts of the transformer, an increase in the concentration of insulation partial discharge, and the loss of electrical properties of the oil increase beyond the permissible value, causing defects in the power device. As a result, a short circuit occurs in the device and causes the device to fail.

The main causes of transformer failure.

1. Design errors in production;

2. The presence of a defect in a certain part of the transformer;

3. Due to the fact that the internal parts of the transformer are not hermetically sealed to the required level, the penetration of particles into it (for example: water vapor);

4. Failure of insulation during long-term operation;

5. Electrodynamic effect of currents close to the short-circuit current on the transformer core;

6. Human factor;

7. Failure to service the transformer at the level of demand:

The main design errors identified in the development of the transformer:

1. Improper selection of insulation (incompatibility with the electromagnetic process in the device);

2. The core is not suitable for the cooling system;

3. Inadequate consideration of overvoltage poles during the design period;

4. Inability of connected parts when working under load:

Occurrence of damage in the transformer circuit:

1. Damage to input insulators. In many cases, it is considered a source of internal discharge and affects other parts of the device;

2. Internal short circuits in the circuit. In most cases, such short circuits cause damage to the insulation of the circuit. As a result, the concentration of partial discharge in the device increases and causes damage to other parts of the device;

3. Insufficient electrodynamic resistance during short circuit. As a result, residual deformations occur, which lead to punctures in the insulation of the device, and as a result, in the event of an emergency short circuit, it can cause failure.

Insulation defects are classified as follows:

1. Due to the failure of the working voltage;

2. Due to reduced service life.

The causes of such defects are gas bubbles in oil and water vapor that come out of the paper when it rises above the working temperature.

As a result of long-term operation of the transformer, the insulating oil wears out [4]. Over time, the electrical resistance of the insulation decreases due to physical and chemical processes occurring in the transformer. The thermal energy absorbed by the insulating oil in the transformer does not change the chemical properties of the hydrocarbon chains, but the moving components generate free radicals.

When currents close to the short-circuit current are generated in the transformer coil, the coil is deformed. This situation is explained by the electrodynamic coupling of the transformer. The following are the reasons for the electrodynamic stagnation of the intestine.

1. Directional residual deformations;

2. Radial residual deformations;

3. Cholgam is affected by electrodynamic forces;

4. Twisting or opening of the stomach;

5. Formation of a short circuit in the circuit.

Defects in the transformer can be divided according to localization in the following elements: active part (circuits, magnetic circuit, pressing system); input isolator; switching devices; cooling system; oil compensation system; tank and oil lines; control and measuring equipment.

The main types of damage to the active part of transformers and reactors.

1. Damage develops due to heating of the connection points of current-carrying parts, structures of the active part, residual deformations in the circuit and partial discharges.

2. Abrasion, increase of moisture and solid compounds, gases, increase wear of the device.

3. As a result of wear and damage of the insulation, the mechanical and electrical characteristics of the device will be impaired.

Thus, it can be noted that the nature of transformer damage is multifactorial, therefore, conducting diagnostic measures using modern diagnostic equipment is an urgent task [5]:

1) Diagnostics of equipment that must be carried out strictly according to state requirements;

2) Special diagnostics for transformers operating in the "danger zone" in terms of operating voltage, overloads, climatic conditions, etc., exceeding the standard service life (25 years);

3) On consistent fulfillment of all requirements of regulatory and technical documents during the operation of the transformer;

4) replacement of malfunctioning elements of the transformer; to know the causes and types of injuries, as well as where these injuries are located.

Below are some commonly observed flying injuries.

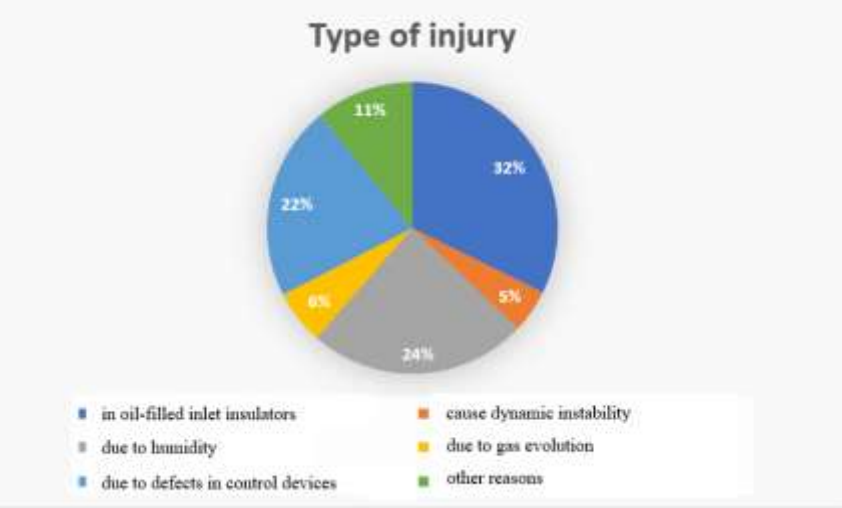

Figure 1 shows the types of damage to the transformer

From this data, it can be said that one of the most frequent injuries is the damage to the shingles, which is caused by moisture.

In conclusion, it can be said that establishing a proper maintenance and repair system for transformers is of great importance in reducing accidents. In order to correctly determine the cause of transformer failure, it is necessary to know the causes and types of damage, as well as where they are located.

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