

DEVELOPMENT OF SAFE METHODS FOR SERVICING TRANSFORMERS AT LOW AND MEDIUM HEIGHTS

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Abstract:

IN this article, we will discuss the possibilities of using a suspended hydraulic unit to safely service oil-immersed transformers at high and low altitudes.

Keywords: transformer, electrical insulation , cooling, maintenance, regular monitoring, automation and alarms.

Introduction

Oil-filled transformers, despite certain difficulties in their operation, currently remain without alternative in the high and ultra-high voltage segment. Due to the electrical insulating properties of transformer oil and the advantages of liquid cooling of the active part, medium voltage transformers in use from 6 to 35 kV are also mostly oil-based.



The operation and maintenance of oil transformers has a number of specific features:

- the need to organize oil production on the territory of substations with oil transformers;
- potential environmental hazards and penalties in the event of an oil spill;
- regular monitoring of the condition of the oil, including its chemical analysis.

Maintenance is carried out in accordance with the factory regulations and the requirements of



current regulatory documents. Maintenance goals for oil-filled transformers include:

- maintaining all devices and transformer systems in working condition;
- timely identification and elimination of various deviations from the normal operation of transformers;
- extending the life cycle and minimizing the cost of major repairs.

Maintenance of power oil transformers consists of performing standard routine procedures at established intervals, as well as unscheduled work when the need arises.

Periodically performed scheduled work includes:

- external inspection to identify visible violations;
- control of basic technical parameters - currents, voltages, temperature and oil level in the expansion tank;
- laboratory analysis of transformer oil, including determination of the following indicators:
 - acid number, characterizing the degree of oxidation of the oil;
 - moisture content undissolved in oil;
 - dielectric loss tangent, which determines the value and nature of the electrical conductivity of the oil;
 - quantitative determination of the presence of mechanical impurities;
 - electrical breakdown voltage of a standard spark gap located in oil;
 - flash point of oil vapor in a closed crucible.
- series of electrical measurements of transformer parameters:
 - insulation resistance of transformer windings;
 - winding resistance to direct current, deviation of which may indicate the presence of interturn short circuits;
 - determination of the actual value of the transformation ratio.
- testing windings with increased voltage in order to determine the insulation safety factor.

In addition to the above measures, it is necessary to regularly check the functionality of protection, automation and alarm systems. Some of these devices are not included in the transformer package, but provide its protection in emergency situations, signal dangerous deviations in operating parameters, and also automatically maintain them within acceptable limits.

Internal damage inside the transformer is accompanied by the occurrence of an electric arc, significant local heating of the windings and abundant gas release due to the chemical decomposition of the oil. Gas bubbles, rising upward, quickly fill the upper part of the float chamber of the gas relay. As a result, the position of the large float changes and the protection contacts close, acting to disconnect the transformer.

For testing, gas relays are equipped with a test button located under the protective cap.

Differential protection. It is the main electrical protection of single transformers with a power of 6300 kVA, as well as those operating in parallel with a power of 4000 kVA. Absolutely selective, reacts only to damage occurring in the gap between the current transformers of the high and low side of the transformer. Some transformer models are equipped with built-in current transformers. They are checked and tested as part of the maintenance of the power transformer.

All of these listed activities require, first of all, lifting vehicles that lift the service personnel to the required height. Sometimes in populated areas, when checking or diagnosing oil-filled transformers at low or medium height, ladders are used. But these stairs when diagnosing oiled



transformers firstly it's inconvenient and secondly it doesn't respect the safety of the service personnel. For this reason I suggest hydraulic suspension.

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