Experience on Type Testing of Transmission and Distribution Components in High-Voltage and High-Power Laboratories

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ABSTRACT

Worldwide, the growth of High Voltage (HV) power grids is driving a proliferation of new HV Transmission and Distribution (T&D) components, such as cables, circuit breakers, power transformers, etc. Before installing these new components, utilities must be sure of their reliability. Failures can be reduced by proper resource management and by selecting T&D components with proven technical performance.

The type test according to the international standard (IEC) is the best way to demonstrate this technical performance. Long-term experience at KEMA Labs shows that 25% of initially tested T&D components fail the requirements of IEC type tests. Surprisingly, this failure rate hasn't improved in years, meaning that experience, better materials, and improved manufacturing techniques have been used to reduce costs and not improve the quality of T&D components.

KEYWORDS

Transmission & Distribution Components, Laboratory Type Tests, Failure Statistical data, Standardization, Testing experiences.

INTRODUCTION

The transmission and distribution sector faces a constant challenge to deliver reliable and affordable electricity. Test-based equipment certification is considered the most correct way to guarantee the quality of the components installed in the network and contribute to the reliability of the electricity system, representing a fundamental step in reducing the incidence of the main service supply disturbances.

In addition to the type tests which present critical issues, the Qualification Tests (PQT) which allow for the verification of the reliability of the project over time and/or diagnostic tests such as the Tan Delta measurements also have critical issues which must be considered.

KEMA Labs tests and certifies T&D components used in medium, high, and ultra-high voltage power networks. Statistical analysis of all type tests performed in our Labs over decades shows that 1 out of 4 type tests initially fails to meet the requirements of the standard.
This 25% initial failure rate remains stable over decades, an unexpected result because of improvement of materials, calculation methods and production technologies are ongoing. To maintain a low in-service failure rate, type-testing and independent certification remains a key de-risking instrument to distinguish the well-designed, well-manufactured products from the inferior ones.

LABORATORY TESTS: A REQUIREMENT TO EVALUATE THE QUALITY OF THE MARKET

Stringent international regulations are also forcing Electricity Companies and System Operators to rely on evidence as one of the most effective means of demonstrating that they are working with due diligence whenever specifying such equipment.

This requirement becomes all the more important when one considers the growing number of substations and electrical installations located near population centres, as well as the consequent drive to reduce the "fingerprint" of substations (in Figure 1 an example of an electrical substation).

Fig. 1: Example of typical substation solution.

Both trends represent an increase in risk factors in terms of danger to public safety as well as the economic consequences of collateral damage in the event of a catastrophic failure [1], [2].

OUTAGES IN POWER NETWORKS

Power system interruptions or outages are caused by various incidents. The Eaton Black Out Tracker [3] shows the distribution of outages in the US power network in 2017 with a total of 3.525 outages in that year. More recent information is unfortunately not available.

Figure 2 shows the distribution of the cause of these outages, and many are caused by external influences such as weather, animals, and vehicles.

With 22%, the main internal cause is outages by Faulty Equipment or Human Error. In the time span from 2008 to 2017, the 'Faulty Equipment or Human Error' shows a year-on-year increase in absolute incidents mainly because of the increase of the power network load.