Mobile High-Voltage Transformer Test Unit

Cost effective and efficient on site testing

Royal Smit Transformers / Smit Transformator Service

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Introduction
Smit Transformator Service, a division of Royal Smit Transformers, based in Nymegen, The Netherlands, owns the most modern and accurate mobile High Voltage test unit. This mobile HV test unit is used for on-site testing of new and/or refurbished transformers as well as factory acceptance testing at the Smit Transformator Service facility.

This mobile HV test unit is custom designed and consists of several modules which can be easily set-up for different test modes.
Features
The high voltage tests, as traditionally performed in a controlled factory environment, can now be performed on new or repaired transformers on site using the mobile HV test unit, thus providing accurate and detailed verification of compliance with the requirements of the end customer OEM specifications and/or international standards.

Advantages and benefits
The mobile HV test unit can be deployed anywhere in the world, offering the most cost effective testing and accurate diagnostics.

On Site Testing, no need to remove & transport the transformer
The mobile HV test unit avoids the need to remove and transport the transformer to the test facility, reducing the risks of transport damage and the costs involved. As a result, this provides a full test diagnostic at the lowest cost.

Saving costs and maintenance (asset) management
The fully flexible and mobile HV test unit provides on the spot detailed and accurate assessments, enabling the customer to make fact based decisions, plan maintenance programmes and reduce overall operating costs.

Minimum Transformer downtime during routine and/or planned outages.
The mobile HV test unit can be deployed anywhere in the world to provide routine electrical tests, dielectric measurements and high voltage tests in a period as short as 3 days. These shorter transformer down times result in a more reliable and lower cost service with minimum disruption.

Fast and accurate fault detection
Unplanned down-time and transformer failures are extremely costly both in time and money. The mobile HV test unit gives a fast and efficient means of determining the fault or the reason for the trip thus enabling the customer to make the most economic decision.

Fully flexible, all types and brands
The new, modern design of the mobile HV test unit provides a full range of common diagnostic methods used under field conditions and give a full range of tests on all types of transformers. Supporting the full range from small distribution transformers and grid transformers up to large step up power transformers.

Condition assessment (installation // commissioning)
The mobile HV test unit can be on site and ready to test new or repaired transformers during (re-) installation, providing a detailed condition assessment prior to energizing, removing the risk of costly delays.

Test capabilities and standards
The mobile HV test unit is based on a 3 phase static frequency converter. It is custom designed and built to perform both routine and special tests in accordance with all internationally recognized standards, e.g.:

- IEC 60076-1
- IEC 60076-3 and
- IEEE STANDARD C57.12.00
The mobile HV test unit tests provides:

**Routine tests**
- Measurement of static winding resistance
- Measurement of voltage ratio and check of phase displacement
- Check of ratio and polarity of built-in current transformers
- Check of core and frame insulation for liquid immersed transformers with core or frame insulation
- Measurement of d.c. insulation resistance between each winding to earth and between windings
- Determination of capacitances windings-to-earth and between windings (also bushings)
- Measurement of dissipation factor (tanδ) of the insulation system capacitances (also bushings)
- Measurement of frequency response (Sweep Frequency Response Analysis or SFRA)
- Measurement for moisture determination in solid insulation, non-destructive, based on PDC-FDS measurements
- Measurement of dynamic resistance over the contacts of the on-load tapchanger

**High voltage tests**
- Separate source AC withstand voltage test in resonant circuit up to 360 kV
- Induced AC voltage tests ACSD and/or ACLD (supply single or three phase up to 80.9 kV)
- Electrical and acoustical Partial Discharge (PD) measurements
- Measurement of No-load Losses and No-load currents
- Measurement of Load Losses and short-circuit impedance (for transformers with a power rating \(\leq 30\) MVA)

**Additional tests**
- Thermo vision scan
- Noise level measurements (sound pressure)
- Full range of oil testing

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Fig. 1: SAT GSU transformer 615MVA / 160-21kV

Fig. 2: SAT Rectifier group 136MVA / 225-100-20-1-1kV
Succes stories
- A new Generator Step-Up Transformer (307 MVA, 420/17 kV) was switched off the HV grid after 1 week in service. Gas was formed inside the Buchholz relais. The owner urgently needed advice from an independent transformer manufacturer regarding the condition of the transformer. Three phase induced voltage tests, combined with PD measurements, were used to locate the fault. A high PD level was recognized and the location pinpointed using a 3-PARD analysis. It was decided to ship the transformer back to the original manufacturer for further investigation and possible repair.
- A 28 year-old Grid transformer (450 MVA, 380/150/50 kV) was switched off the HV-grid after a 420 kV surge arrester in the switchyard exploded. Due to unknown circumstances the Buchholz relais subsequently tripped and the valves in the cooler pipes and de-aeration pipe immediately closed. The transformer cooled down, creating a vacuum inside the transformer tank. The owner was concerned that gas bubbles were formed in the oil in the transformer tank due to the vacuum. Three phase induced voltage tests, combined with PD measurements, were used and the PD pattern showed that gas bubbles inside one of the HV winding sets were present. The oil was drained from the transformer and the transformer tank, cooler bank and conservator were placed under vacuum. The transformer was re-filled with the original oil after it was degasified, dried and filtered.
A complete condition assessment was performed combined with separate source AC withstand voltage tests, three-phase induced voltage tests and measurement of no-load losses and no-load currents to proof the condition prior to re-energizing.

Conclusion
Everyone is fully aware of how critical power transformers are to their operations and how devastating and costly a failure or unplanned outage can be. Valuable time is lost when a transformer is out of service for maintenance which highlights the need for fast, reliable and efficient condition monitoring and proficiency testing. With the mobile HV test unit, fast and reliable diagnostic evaluation and condition assessment can be made without removing the transformer from site. Saving costs and with the shortest turn-around-time and minimum disruption.
As the transformer is tested on site, there is no need to transport the transformer to the test facility, further reducing the risks of transport damage and the costs involved.