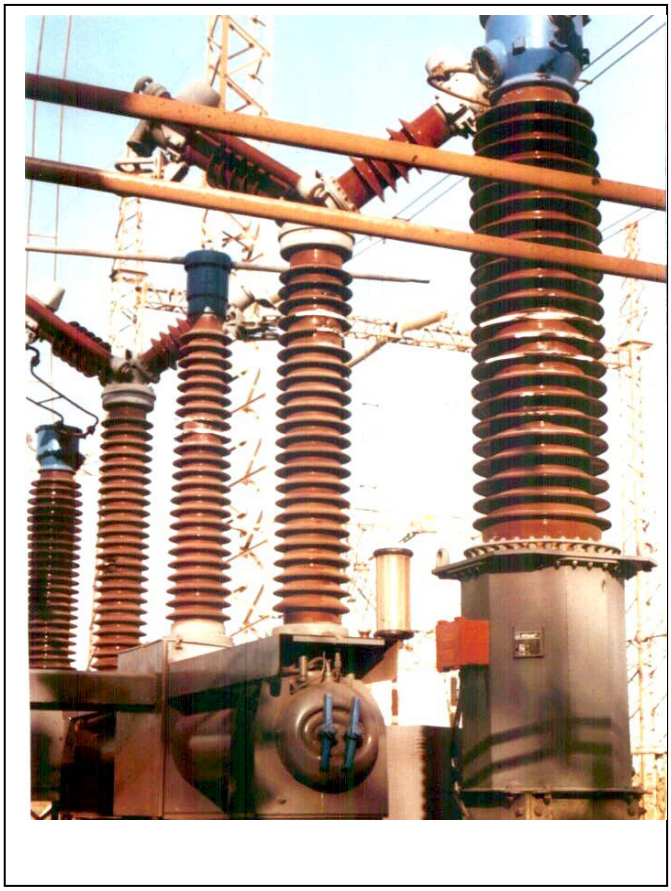
Serveron White Paper: TBM Live – New Maintenance Approach

Over the last few years, catastrophic failures in bushings in large Power Transformers and HV Current Transformers have occurred with alarming frequency in certain vintages, resulting in unscheduled downtime, collateral damage to adjacent equipment in substations, and loss of revenues. Fortunately, there have been no reported casualties. A research report by a leading North American insurance company, involved with insuring utility assets, is projecting an increasing numbers of failures of the aging installed power apparatus over the next few years.



The changes in the power industry, driven by deregulation and acquisition of power companies across border and across continents, has led to downsizing, elimination of redundant resources, and eventual loss of experienced resources. Maintenance practices are always affected, usually with an increase in the period between tests. A transformer, the single largest capital asset, is made up of several components, including Oil and Paper insulation, Coil, Core & Tank, Cooling system, Load Tap Changer (LTC), and Bushings. Bushings have a very high incidence of failures due to exposure and certain design limitations from the past.

Scheduled maintenance cycles of large power transformers have moved from 1 to 2 years to 7 years and, in some instances, to 12 years. While transformers, normally in a steel tank and oil insulated are far more ruggedly protected, some of the exposed accessories that make up the transformer, especially the bushings, are indeed vulnerable and have a higher incidence of failures. The possibility of catastrophic failure during long intervals between tests is a very high-risk proposition that must be minimized.

The most frequent problems facing maintenance groups in a changing utility market includes, however not limited to, the following:

- Difficulties in getting an outage for performing maintenance tests.
- Inclement weather providing improper result and scheduling problems.
- Decreasing budgets, resources and costs.
- Failures after successful off-line tests, what has occurred after power factor test performed on a perfect, low humidity day.
- Low-level test voltage, 12 kV, provide sufficient stress to create an effective test on 115 or 500 kV Class insulation?
- A massive replacement program for bushings and CTs with a history is an expensive and drawn out process that taxes limited resources and may still have failures.

The objective is to address the various issues raised above. Ideally one would prefer to have a way which would allow:

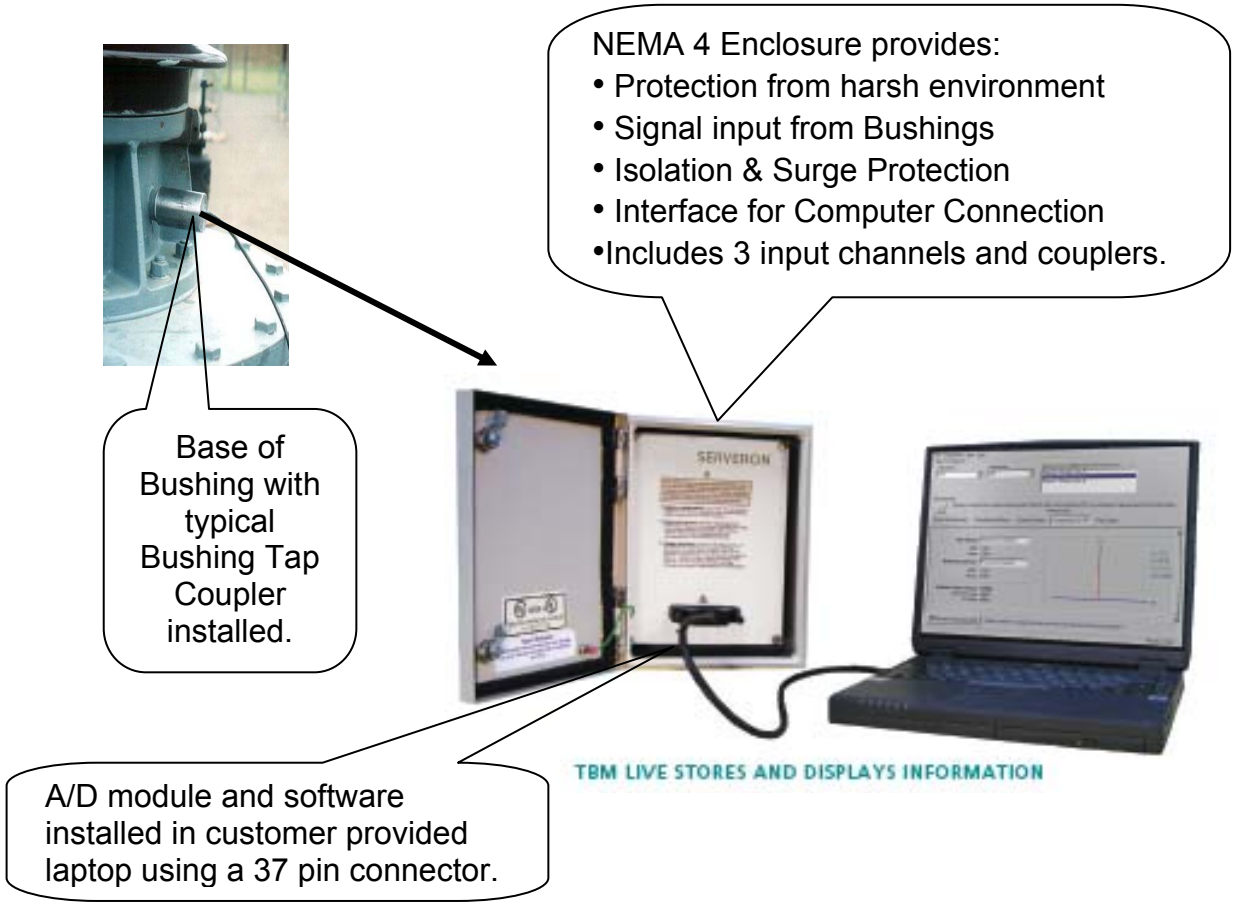
- Data download in less than 5 minutes without a need for an outage.
- Test data acquired at rated voltage.
- Viewing of raw or processed data in a graphical or tabular format.
- Instantaneous evaluation of the insulation condition.
- Exportation of data to customer's database for trending analysis.
- Establishing the frequency of tests based on the need.

TBM Live

The TBM Live Product Family has been introduced to address and mitigate the risk of failure by allowing instantaneous on-line measurement of Power Factor and/or Tan δ, (aka Loss Angle, Dissipation Factor) of Bushings of Power / Current Transformers (CTs) and Circuit Breakers (CB). The TBM Live Product Family provides the user with a low cost maintenance method of testing or monitoring bushings on-line.

The basic The TBM Live product provides a permanently installed connection to the capacitance tap of the bushings, which are terminated to an interface cabinet installed near the transformer. This cabinet contains passive devices that require no input power, and it can be safely accessed using a Megger provided interface and software installed on a customer provided laptop.

The TBM Live system provides a new innovative method for performing Insulation Power Factor / Tan δ Tests on Bushings **without a need for an Outage**, at **Rated Voltage**, and in **Less than 5 minutes.**

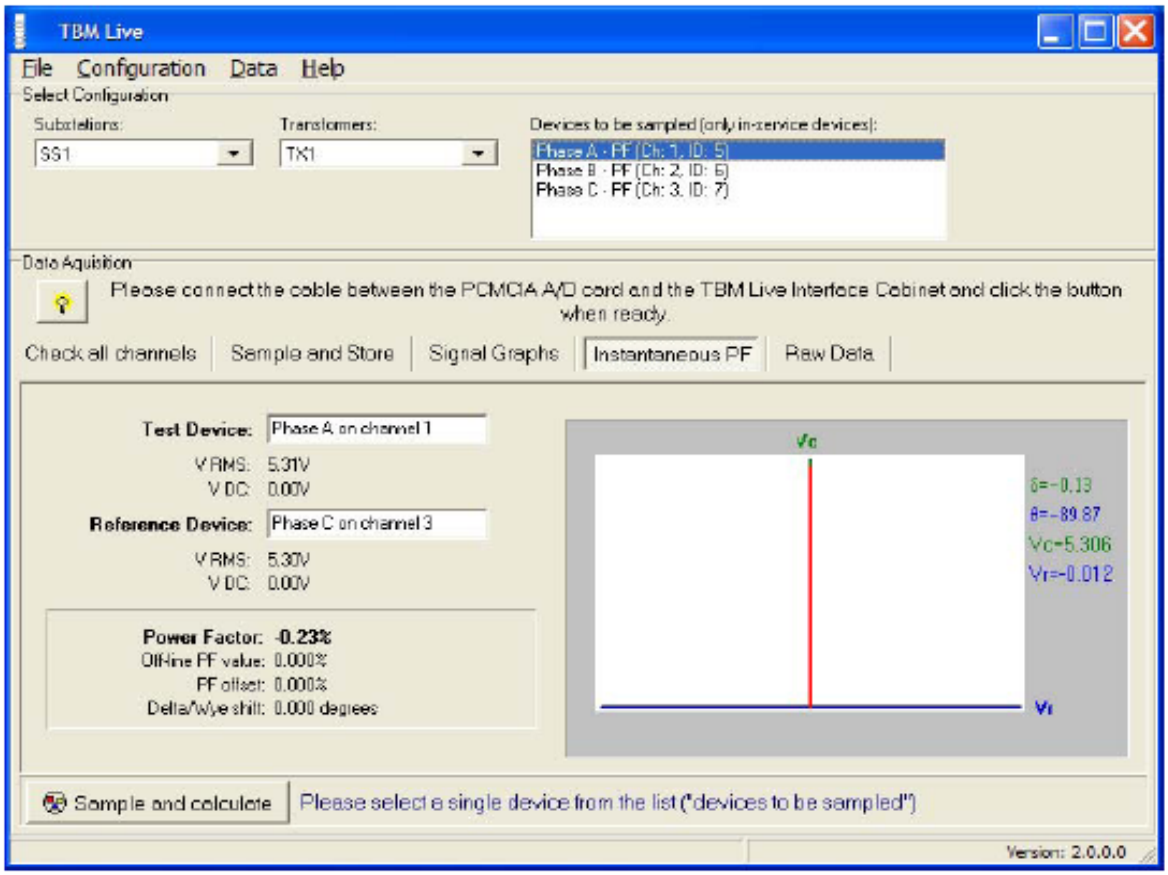


TBM Live Software

The TBM Live system software operates with Windows® 95, 98, NT or 2000. It collects the data, converts it to power factor values, and stores the results in a Microsoft Access format. Data can be reviewed for trends and analysis onsite, or at a later time.

The database portion of the software is designed for use with Microsoft Access and requires no additional server, or driver installation, or routine licenses for the user's computer. A Help File is included for assistance in running the software and a 16-channel A/D card is also supplied for data acquisition.

A pull-down menu allows the user to configure devices for tracking, trending and recording, grouping them in a 3-tier hierarchy of Substation, Transformer and Device. The system has provisions to input nameplate values of the power factor. This then permits the user to compare the on-line reading to the off-line test results.



APPLICATION SCENARIOS:

While there may be several other situations, the following situations prevalent in the industry are ideally suited for the application of the TBM Live:

Scenario – Difficulties in scheduling an outage for off-line tests on bushings.

Solution - Outages are especially difficult and outages to facilitate an increased frequency of off-line tests on bushings are impossible. The TBM Live products provide a method for testing the bushings, without an outage, and in less than 5 minutes, and provide an ideal solution for testing suspect bushings without the need for an outage.

Scenario - Scheduling on days with unsuitable weather results in not performing tests since the readings are affected and unacceptable.

Solution - Based on our experience, tests performed during inclement weather have uncovered incipient faults that would normally not be evident when tests are performed under perfect conditions. This is due to the fact that moisture and humidity impact susceptible insulation. However, under perfect conditions, the suspect insulation behaves and goes undetected. The TBM Live products provide test results that will indicate incipient problems that are only evident during the presence of moisture and/or humidity.

Scenario - Prohibitively high costs of off-line power factor tests due to the costs associated with an outage, manpower and test equipment together with shrinking maintenance budgets that have resulted in reduced human resources and limited funds for test equipment.

Solution - The TBM Live system is far less expensive because it requires a crew limited to one technician, a test that takes less than 5 minutes instead of 4-8 hours, and no lost revenues since there is no need for an outage. A one-man crew can perform more tests in one day with the TBM Live system than a full off-line test crew can do in a month with off-line test equipment. The TBM Live system uses the maintenance investment in a far more effective manner.

Scenario - Are Test and Measurement companies one of the appropriate target audiences?

Solution - Deregulation has forced the utilities to reduce budgets for maintenance related functions by streamlining resources and eliminating redundancies. The consequences of these are lost experience and skills, leading to increased outsourcing of routine test and measurement functions to Independent Service Companies. On line monitoring is the best method of extending resources by reducing the need for off line test.

Scenario - Bushing fails after a successful off-line power factor test performed on a perfect, low humidity day.

Solution - In the presence of high humidity or during the presence of excessive rains, it is quite possible that moisture ingress occurs within the bushing of power transformers and/or CTs. This moisture ingress may be a condition that will correct itself under fair weather conditions when an off-line test is performed. Fair weather, under which the off-line test is carried out, will not detect an incipient fault that may be susceptible to moisture ingress. The TBM Live system provides a method for detecting such problems by permitting tests under all weather conditions.

Scenario – Using a 10/12 kV on 115 kV Class or 500 kV Class insulation may not provide anywhere close to an effective test, and does a 10/12 kV test provide sufficient stress to create an effective test?

Solution - This concern is along the same lines as the insulation resistance test on a large power transformer. The old standards required that an insulation resistance test be performed on a large transformer at 2-5 kV. The same standard also required that the same transformer would be tested at 600-1400 kV BIL level using a lightening and switching impulse test. After reviewing the standards, it is now decided that the far more stringent Impulse test is sufficient, and the insulation resistance test at less than 5 kV, is unnecessary. The TBM Live products provide a method for testing the bushings at rated system voltage on-line.

SERVERON

For more information, contact your nearest Serveron Representative or Serveron Corporation.

BPL GLOBAL™ BETTER POWER LINES

Serveron Corporation, A BPL Global Company
3305 NW Aloclek Drive
Hillsboro, OR 97124-7101
Phone: (503) 924-3200
Toll-free: (800) 880-2552 (USA and Canada only)
Fax: (503) 924-3290
http://www.serveron.com