POWER QUALITY INTERNATIONAL

e-News

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The Solar Inverter – Utility Interconnection Problem

Utilities typically require a solar generation site be connected to their medium voltage feeder circuit via a solidly grounded (H_0 & X_0 – Ground) wye-wye configured power transformer. In addition, the utility's feeder protection scheme often requires the addition of a zig-zag or wye-delta connected grounding transformer at the low voltage side of the power transformer.

The utility's customers are also connected to their medium voltage feeder circuits via a solidly grounded wye-wye configured power transformer. Unfortunately, zero-sequence harmonic currents, produced by each customer's phase-to-neutral connected nonlinear electronic loads, pass through the wye-wye configured power transformer to pollute the utility's medium voltage distribution system.

With the solar generation site and the utility customers configured in this manner, the zero-sequence currents, which are present on the medium voltage feeder, will be attracted to the ultra-low zero-sequence impedance of the solar generation site's low voltage grounding transformer. This outcome creates several serious problems:

- The zero-sequence harmonic currents will increase the power transformer's Load Losses, the grounding transformer's Load Losses and the distribution system's I^2R Losses, all of which will be measured by the utility's revenue meter, to the solar generation site's detriment.
- Since the potential magnitude of zero-sequence current is unpredictable, the required kVA rating of the grounding transformer, which for protection purposes would probably be relatively low, must now be increased to an unknown higher rating.
- Since the zero-sequence current magnitudes in the low voltage system must be increased by the voltage ratio of the power transformer, the I^2R losses in the low voltage system will be high.

As an alternative to the feeder protection scheme described above, utilities may require the application of a zig-zag or wye-delta connected grounding transformer at the medium voltage side of the power transformer. The zero-sequence currents, which are present on the medium voltage feeder, will be attracted by the ultra-low zero-sequence impedance of the solar generation site's medium voltage zero-sequence grounding transformer. This outcome also creates several significant problems:

- The zero-sequence harmonic currents will increase the grounding transformer's Load Losses, which will be measured by the utility's revenue meter, to the solar generation site's detriment.
- Since the potential magnitude of zero-sequence current is unpredictable, the required kVA rating of the grounding transformer, which for protection purposes would be relatively low, must now be increased to an unknown higher rating.
- The cost of the medium voltage grounding transformer system is higher than the low voltage grounding transformer.

Type PVLD-S Three-Phase Dead Front TransFilter™
Medium Voltage Liquid Filled, Harmonic Mitigating Transformer
for Solar Inverter – Utility Interconnection

The Solar Inverter – Utility Interconnection Solution

As an alternative to the application of a conventional wye-wye configured power transformer and a low or medium voltage zig-zag or wye-delta connected grounding transformer, PQI's Type DVLD-S Three-Phase Dead Front TransFilter™ is designed to meet a utility's medium voltage feeder circuit protection requirements, while avoiding the problems described in The Solar Inverter – Utility Interconnection Problems.

The configuration of the Type DVLD-S TransFilter™ primary windings provides a high capacity, ultra-low zero-sequence impedance shunt for all zero-sequence harmonic currents that pollute the utility's medium voltage feeder circuit. This design feature also eliminates the imposition of zero-sequence flux on the transformer's magnetic core, zero-sequence current in its secondary windings and the related 'penalty losses' in both.

Shunting the harmonic currents in this manner eliminates the low voltage 'penalty losses' described under the first alternative given in The Solar Inverter – Utility Interconnection Problems.

The Type DVLD-S Three-Phase Dead Front TransFilter™ connection in the distribution system is identical to a conventional wye-wye power transformer.

Ultra-High Efficiency

- Exceeds US DOE 2016 efficiency requirements
- Exceeds pre-2016 [10 CFR §431.196 (c)(1)] and post- Jan 1, 2016 [10 CFR §431.196 (c)(2)] U.S. DOE efficiency legislation
- Ultra-low Excitation (no-load) Losses provide high efficiency during periods of light-loading (<15% FL)
- Peak efficiency can be matched to anticipated or measured average loading above 50% full load

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Design Capacities

- Size: 75kVA to 3MVA
- Primary Voltage: Up to 34.5kV
- Secondary Voltage: 480/277V, 208/120V, other
- Loop or Radial Feed Configuration
- Built to customer specifications in accordance with CSA C227.4 or C57.12.34 and DOE 2016 or C802.1 Energy Efficiency Standards
- Meets CSA Special Inspection Requirements
- Meets ESA Inspection Requirements
- UL Listed & CSA Approved

Standard Accessories and Features

- Tamperproof enclosure design with bolted cover
- Built In Kirk Key Interlock Primary Disconnect with Plexiglas Viewing Window
- Bay-O-Net & current limiting fuse protection
- Aluminum nameplate engraved
- Pressure relief device
- HV & LV Bushings
- Drain valve with sampling device
- Liquid level indicator
- Thermometer
- Ground Bar and X_O strap
- Parking Stands
- Jacking Steps
- Exterior Finish conforming to ANSI C57.12.28

Optional Accessories and Features

- Load break inserts complete with dust caps
- Customer stock code and stencilling
- Dual voltage selector switch
- High voltage no-load taps
- Surge arrestor elbows
- FR3 fire resistant biodegradable insulating fluid LNAN
- Additional tests may be requested by the purchaser and shall be performed in accordance with ANSI/IEEE C57.12.90
- Permanent and temporary bar coding label in accordance with ANSI/IEEE C57.12.35
- Kirk Key Interlock on cabinet doors
- Secondary Breaker
- Alternative protection devices, specified by the purchaser
- Transformer Performance Meter

Type TPM
Transformer Performance Meter

e-Rated®