

## **PQI Delivers Harmonic Mitigating Power Transformers & Filters to Wynn Resorts, Macau, China**

PQI is pleased to announce that it has recently delivered a number of medium voltage, cast-coil, harmonic mitigating power transformers and low voltage zero-sequence harmonic filters to Siemens, for installation in a new Wynn Hotel and Casino project in Macau, China. PQI has a long history with Wynn Resorts Limited in North America and China. In addition to providing products, PQI has undertaken a number of power quality improvement studies. Papers and Case Studies detailing these projects are available upon request.

### **Type PY Power TransFilter™ Description**

The Type PY harmonic mitigating, cast-coil Power TransFilters™ delivered to Siemens exceed all existing and pending energy efficiency standards under anticipated nonlinear loading. These transformers' ultra-low excitation (no-load) losses provide high efficiency during periods of light-loading (<15% FL). This benefit was achieved by using high quality, grain-oriented, silicon core steel in their full and step-lap miter-cut cores with reduced laminations per group.

Unlike excitation losses, which are constant from no-load to full-load, impedance (load) losses increase rapidly above 15% FL; particularly when the transformers' loads are nonlinear. These transformers exceed US DOE 2016 linear efficiency requirements under the nonlinear loading condition for which they were designed.

These transformers, in combination, were designed to cancel the 5<sup>th</sup>, 7<sup>th</sup>, 17<sup>th</sup>, 19<sup>th</sup>, --- positive- and negative-sequence harmonic currents at their common primary bus.

Type PY Power TransFilters™ are cost-effective alternatives to K-Rated power transformers, which are only intended to survive in a harmonic environment, or de-rated power transformers. These conventional transformers cannot reduce harmonic related 'penalty losses' or voltage distortion. Type PY harmonic mitigating Power TransFilters™ provide the most attractive 'payback' and 'return-on-investment' in the industry.



Type PY, Harmonic Mitigating Power TransFilter™

### **Type Z Zero-Sequence Harmonic Filter Description**

Unlike North American low voltage distribution systems, those in Asia do not typically require low voltage distribution transformers, since their utilization voltage is 400/231V, the power transformers' output voltage. As a result, bus duct risers and feeder circuits tend to be extremely long. This configuration presents several challenges. In addition to a potential voltage drop problem, the circuits' higher harmonic impedances can generate unacceptable levels of harmonic voltages, causing voltage distortion that exceeds IEEE Std 519-1992 recommendations at the circuits' loads.

In a single-phase, nonlinear load environment, zero-sequence phase currents add up arithmetically on the neutral conductors. With the neutrals grounded at the power transformers' X<sub>0</sub> terminals, neutral-to-ground voltage at the loads can be unacceptably high.

The Type Z *e-Rated*<sup>®</sup> I<sub>0</sub>Filters™ delivered to Siemens are highly effective, three-phase, four-wire, passive electromagnetic shunt filters with ultra-low zero-sequence impedances. These filters have been specifically designed to provide a parallel path for all zero-sequence harmonic currents that are generated by phase-to-neutral connected nonlinear electronic loads. In order to mitigate additional positive- and negative-sequence harmonic currents, PQI also supplied Type YV, phase-shifting, series I<sub>0</sub>Filters™. Power quality benefits are optimized when I<sub>0</sub>Filters™ are installed as close as possible to the electronic loads.

The application of I<sub>0</sub>Filters™ will improve any limitations on circuit length and/or loading with respect to zero-sequence harmonics. These limitations are graphically detailed in two PQI publications entitled: 'Neutral-to-Ground Voltage vs. Circuit Length & Loading for Typical Nonlinear Electronic Workstation Loads' and: 'Neutral-to-Ground Voltage vs. Circuit Length & Loading for Typical Nonlinear Electronic Gaming Machine Loads'.



Type PY, Harmonic Mitigating, Cast-Coil, Power TransFilter™ (without its enclosure)



Type Z, Zero-Sequence Shunt I<sub>0</sub>Filter™



Type YZ, Zero-Sequence Series I<sub>0</sub>Filter™

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