PQI

POWER QUALITY INTERNATIONAL

CASE STUDY

The Principal Financial Group
Des Moines, IA

Facility Description

The Principal Financial Group is a global financial investment management leader headquartered in Des Moines, Iowa. The company offers businesses, individuals and institutional clients a wide range of financial products and services including retirement, asset management and insurance, through its diverse family of financial services companies. Principal has offices in 18 countries throughout Asia, Australia, Europe, Latin America and North America.

Challenge

The Principal Financial Group recently found a distribution transformer with unacceptably high operating temperatures in one of their head office campus buildings. They also found that the overheated transformer was causing high electrical room temperatures. In addition to these temperature problems, the transformer was producing unacceptably high noise levels.

Our local representative suspected these temperature and noise problems were the result of load-generated harmonic currents.

Harmonic current injection into the secondary windings of a conventional distribution transformer will result in a substantial increase in its load losses and a proportional decrease in its energy efficiency. Harmonic currents also increase sound levels in the magnetic core and enclosure in a conventional distribution transformer, since it has no means of canceling zero-sequence flux in its secondary windings.

With a 114kVA nonlinear load, their conventional 300kVA distribution transformer's calculated 6kW linear load losses had increased to 8.5kW nonlinear load losses, a 42% increase. With reference to *Figure 1*, which was supplied by the facility engineer, the transformer's higher losses caused the average temperature in the electrical room to increase from an ambient of 73°F to 91°F, an increase of 18°F.

The increase in transformer losses had also reduced the transformer's published linear load efficiency from 95% to 92.5%, a decrease of 2.6%.

Solution

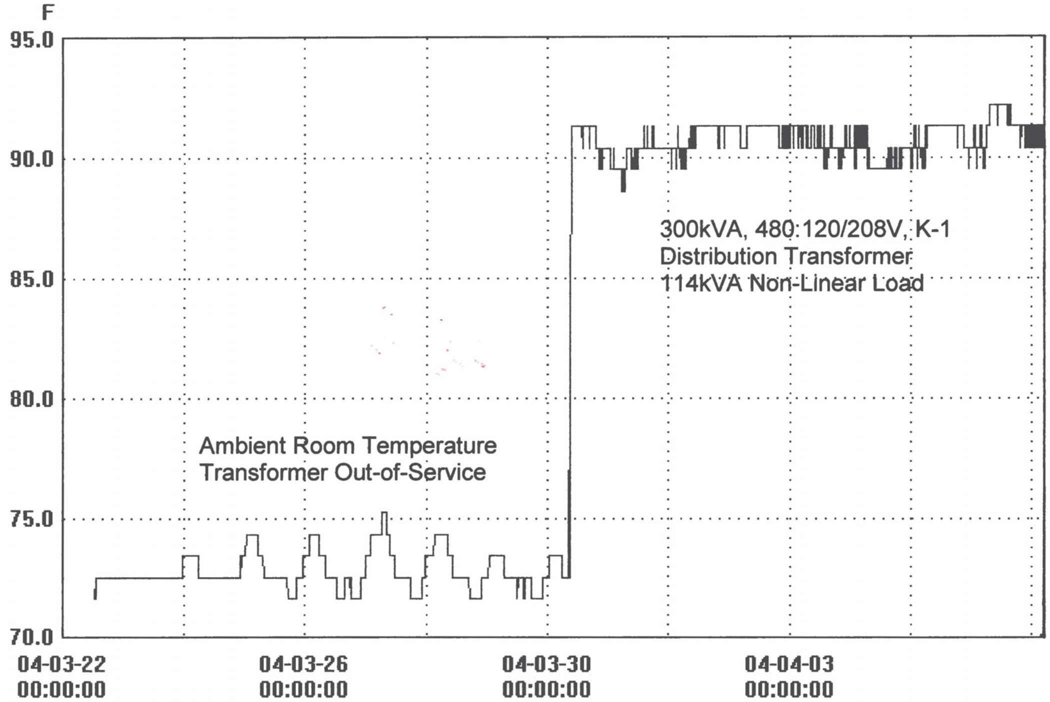
To reduce transformer and electrical room temperatures and noise levels, our representative recommended the application of an ultra-high efficiency e-Rated®, harmonic mitigating Distribution TransFilter™.

Impact

Under the same loading conditions, this transformer produced 2kW of nonlinear load losses, compared to the original transformer's 8.5kW of nonlinear losses, a 6.5kW reduction. With reference to *Figure 2*, which was also supplied by the facility engineer, the replacement transformer's significantly lower load losses have resulted in an average electrical room temperature increase, above ambient, of only 0.6°F, a reduction of 17.4°F, when compared to the original room condition.

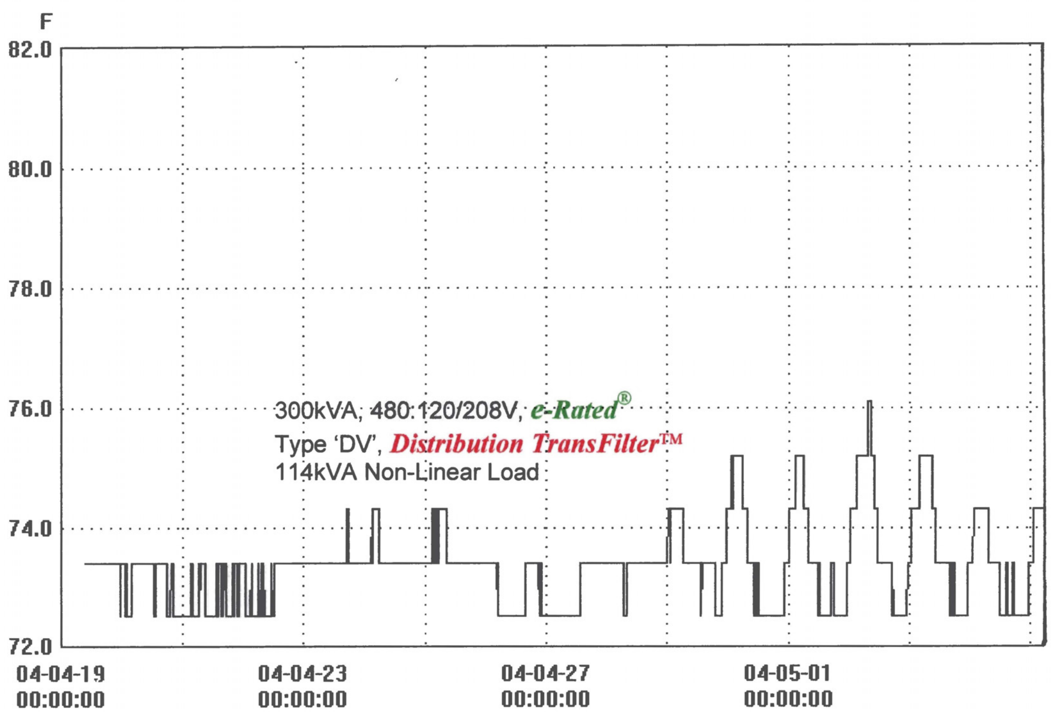
The replacement transformer's lower nonlinear load losses have also produced an energy efficiency of 99.2%, an increase of 6.7%, when compared to the original transformer. Based on present power costs, the increase in transformer efficiency will produced a 'payback' in only 5.3 months and a return-on-investment of 228.3%.

The cancellation of zero-sequence flux in the replacement transformer's secondary windings provides a significant 'power quality' benefit, since this winding configuration reduces zero-sequence impedance from approximately 0.1Ω to less than 0.001Ω. In an Ohm's Law relationship with zero-sequence current, this reduction has produced a significant reduction in zero-sequence voltage and total harmonic distortion of voltage.



ELECTRICAL ROOM TEMPERATURES BEFORE TRANSFORMER REPLACEMENT

Figure 1



ELECTRICAL ROOM TEMPERATURES AFTER TRANSFORMER REPLACEMENT

Figure 2