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New Energy Regulations to Impact the Commercial Transformer Market

The continual and rapid escalation of U.S. energy consumption was a major driving force behind the enactment of the first comprehensive revision of the domestic energy policy in over 14 years. This whitepaper addresses the implications of the new energy policy on the electrical industry, with specific focus on the commercial transformer segment. Distributors and end users will need to understand the impact of this new regulation as they prepare for new construction and building maintenance projects in 2007.

2005 Energy Policy Act Signed into Law

On August 8, 2005, President Bush signed into law the 2005 Energy Policy Act (EPAct 2005). EPAct 2005 addresses the conservation and development of newer energy sources through an extensive set of new regulations that stretch from hybrid cars to commercial lighting installations. Today, the United States leads the world in energy consumption by a large margin using over 3.7 trillion kilo-watt-hours and over 7.3 billion barrels of oil per year. As a gauge, U.S. oil consumption is 233% higher than the number two consumer, China. That thirst for energy is growing. Unabated, U.S. energy consumption is forecasted to continue climbing by 32% over the next 14 years, which is more than double the increase experienced since 1973. With today's elevated energy prices, EPAct 2005 seeks to quell this thirst and tap into renewable, domestic sources of energy for the long-term viability and stability of the U.S. economy.

EPAct 2005 Mandates High-Efficiency Transformers

EPAct 2005 mandates that distribution transformers meet specific efficiency levels starting January 1, 2007. The new levels use NEMA TP-1 rating standards as a reference for establishing a higher-efficiency rating for distribution transformers. The law closely mirrors TP-1 but is not based verbatim on TP-1. The TP-1 efficiency ratings for Dry-Type distribution transformers are detailed in the chart on the right.

Production of non-compliant models must be halted by the end of 2006. Unfortunately, the higher-efficiency transformers cost more to build than the non-compliant models. Builders and contractors need to be aware of these cost implications and adjust their budgets accordingly. While the non-compliant models are cheaper to buy, they do cost more, in the long term, due to the higher energy costs incurred to run them in addition to the increased pollution levels they cause. The higher cost of the compliant transformers however, is offset by reduced usage costs through lower energy bills by wasting less electricity.

The rationale for the mandate is quite clear. While standard transformers operate at 90% to 95% efficiency while under full load, their efficiency drops at lighter loads. This is due to inefficiencies in the transformer's core, a main component of the transformer. The losses in the core remain the same throughout the transformer's operating range. At 100% load, the amount of comparative loss is negligible. However, at reduced loads, the same amount of energy loss represents a higher percentage of energy being wasted. Unfortunately, average transformer loads run between 50% and 34% of the transformer's total capacity. With the majority of the electricity used in this country being run through transformers at these lower loads, massive amounts of energy are being wasted.

Improved Efficiencies During Average Loads

Compliant transformers are able to maintain Nema Class 1 efficiency levels at 35% load. This is accomplished by using higher-grade grain oriented steel in the core rather than the standard non grain oriented. Grain oriented steel's thinner gauge and purer metallic material quality reduces heat caused from eddy currents by limiting the current's direction in which it can flow. This narrowing of the magnetic field into a thinner profile also reduces the canceling effect of opposing currents.

REFERENCE CONDITION	TEMPERATURE	% OF NAMEPLATE LOAD
Low Voltage	75°C	35%
Medium Voltage	75°C	50%

SINGLE PHASE EFFICIENCY				THREE PHASE EFFICIENCY			
kVA	LOW VOLTAGE	MEDIUM VOLTAGE		kVA	LOW VOLTAGE	MEDIUM VOLTAGE	
		≤60 kV BIL	>60 kV BIL			≤60 kV BIL	>60 kV BIL
15	97.7	97.6	97.6	15	97.0	96.8	96.8
25	98.0	97.9	97.9	30	97.5	97.3	97.3
37.5	98.2	98.1	98.1	45	97.7	97.6	97.6
50	98.3	98.2	98.2	75	98.0	97.9	97.9
75	98.5	98.4	98.4	112.5	98.2	98.1	98.1
100	98.6	98.5	98.5	150	98.3	98.2	98.2
167	98.7	98.8	98.7	225	98.5	98.4	98.4
250	98.8	98.9	98.8	300	98.6	98.6	98.5
333	98.9	99.0	98.9	500	98.7	98.8	98.7
500	—	99.1	99.0	750	98.8	98.9	98.8
667	—	99.2	99.0	1000	98.9	99.0	98.9
833	—	99.2	99.1	1500	—	99.1	99.0
				2000	—	99.2	99.0
				2500	—	99.2	99.1

NEMA CLASS 1 EFFICIENCY LEVELS FOR DRY-TYPE DISTRIBUTION TRANSFORMERS

The compliant transformers will cost more than their lower-efficiency predecessors due to the higher price tag for grain oriented steel, additional labor and higher raw material costs. Unlike the market for standard Cold Rolled steel, demand for grain oriented steel is at an all-time high. This has been caused by an increased usage in today's energy-efficient products, such as hybrid cars, and from government regulations, like EPAct 2005. This heightened demand has quickly outpaced the stagnant global supply chain of grain oriented steel, causing unprecedented price hikes. Beginning from October 2005, prices for grain oriented steel have risen nearly 50%[1]. Moreover, grain oriented steel's smaller thickness requires more individual pieces to be used in the transformer to achieve the required total stack height. This requires additional labor compared to using the thicker material. In addition, other raw material markets have experienced record price hikes starting last fall. Sola/Hevi-Duty offers transformer windings in either aluminum or copper. Since 2004, aluminum and copper have experienced price growth of 46% and 91%, respectively. Supply and demand has caused much of the escalation. However, investment speculators and opportunists have also lifted metal market prices as they seek portfolio diversification and chase returns that the stock market has not seen in years.

Benefiting from Higher Energy Efficiencies

Increasing the energy efficiency of a transformer allows the unit to operate at the same level of power with less energy being wasted in the process. This has a large impact on the consumption and distribution of energy because the reduction in energy usage improves the nation's energy independence, reduces environmental impacts, lessens infrastructure investment, and protects and strengthens the economy.

Decreasing usage through reduced waste by just .03% over the next 20 years cuts the need for new power generation by 60 to 66 million kw. That drop would eliminate the need for construction of 11 new 400-megawatt power plants by 2038. Electrical power generation accounts for 35% of all U.S. emissions of carbon dioxide, 75% of sulfur dioxide and 38% of nitrogen oxides. With higher-efficiency transformers, the country will see reduced emissions of CO2, NOx and Hg of 678.8 Mt, 187.7 kt and 6.48 t over the next thirty years. Curbing energy imports also bolsters the U.S. economy by reducing the current $65 billion trade deficit and mitigating fuel prices through decreased demand.

EPAct 2005's Transformer Definitions, Exceptions and Tax Incentives

EPAct 2005 applies to "distribution transformers" which are defined as[2]:

- Has an input voltage of 34.5 kV or less
- Has an output voltage of 600 V or less
- Is rated for operation at a frequency of 60 Hz
- Has a capacity of 10 kVA to 2500 kVA for liquid-immersed units and 15 kVA to 2500 kVA for dry-type units

The following special purpose transformers are excluded from the definition of "distribution transformers" and are, therefore, not required to meet the energy efficiency standards at this time:

- Autotransformers
- Drive (isolation) transformers
- Grounding transformers
- Machine-tool (control) transformers
- Non-ventilated transformers
- Rectifier transformers
- Regulating transformers
- Sealed transformers
- Special-impedance transformers
- Testing transformers
- Transformer with tap range of 20 percent or more
- Uninterruptible power supply transformers
- Welding transformers

While the compliant transformers will add to the cost of construction and maintenance projects, the end user will save this cost over the life of the transformer. The government has also implemented a number of tax deductions and financial incentives to help offset the additional costs incurred by projects that improve energy efficiency. Visit www.eere.energy.gov/financing for details on these savings programs.

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Sola/Hevi-Duty: Your Continued Partner

As your full-range provider of power conversion and power quality related products, Sola/Hevi-Duty has been engineering and producing energy efficient transformers for the past six years. Our experienced engineers provide the best performing, most cost-effective designs on the market. The Sola/Hevi-Duty E version transformers are optimized to meet NEMA's TP-1 limits for load losses calculated to 35% of the name plate rating, yet are the same compact size and footprint as its conventional 150° C rise units. We also utilize our superior buying power, dedicated supplier network and market analysts to negotiate the lowest raw material prices possible.

We understand your business and will continue to inform you on the happenings that affect your work. That's why we ask your help in preparing our customers for the cost impact on their budgets as we move into 2007. In the meantime, please be aware that any quotes issued after November 1, 2006, will include only compliant distribution transformers, as defined by the DOE ruling.

[1]Grain Oriented Price History – SHD M6 GO Global Market Price Index, June 2004 through October 2006.

[2]Federal Register/Vol. 71, NO. 81, page 24995, Thursday April 27, 2006

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