1. **New Designs Supporting Data** – We have received the email from LBNL with the TSL changes impacting the 8/23/11 design data curves and are working our way through them. All of our comments to follow are based on our knowledge and understanding before that latest information.

2. **DOE Designs Prices versus Efficiency Levels** - While we have issues with the absolute values of the DOE designs, and the assumptions regarding and dependence on premium core materials (ZDMH and Amorphous), our analysis of the price changes from one efficiency level to another for the DOE designs is that they are reasonably representative of what would be achieved in actual designs, if one accepts the DOE material price assumptions at increased Efficiency Levels. This analysis is based on selecting the DOE designs that produced the least cost offering at each designated Efficiency Level rather than considering a cluster of designs with a price range within two EL's. We believe that the DOE curves for Efficiency vs Price (copy attached) should be modified to only show the lowest cost design for each efficiency. The showing of all designs DOE uses to establish the lowest cost design adds confusion and mis-interpretation of the charts. Analyzing results based on the lowest price unit for a given efficiency is what would be typical practice in the industry.

3. **Core Material Supply and Price Concerns** - Due to concerns about supply limitations, single or too few suppliers, and the resulting potential for significant price increases related to the very highest efficiency core materials such as Hi-B steels and Amorphous metal, we believe an Efficiency Level that allows grades of silicon steel with proven global supply capacity such as M3 to compete economically with Hi-B and Amorphous would be the Efficiency Level that would meet the requirements for the best technology that is economically justifiable. Anything higher, in our opinion, could result in a serious disconnect between the material prices used in the DOE economic analyses and what could actually happen in the market. In that case, the projected economic benefits would not be realized and the higher standards would lead to supply issues that would affect DT manufacturers' ability to meet customer demands for critical US Medium Voltage Liquid-Filled Distribution Transformers. Manufacturers with the most access to the limited supply materials (e.g., ZDMH, M2 and Amorphous) would have an unfair competitive advantage which at higher EL’s, could not be offset by the use of conventional high efficiency core steels such as M3. Therefore, DOE should provide data/charts that clearly show the competitiveness of each of the core material options and where they can compete at both todays and future pricing.

4. **Designs versus Price at Various EL Level Plots** – We believe that the approach of plotting a high number of designs representing units that are

in the population within an EL range cause confusion and hide the important trends. We believe a more descriptive approach is to plot only the lowest cost (price) design that meets a given Efficiency Level for each critical core material. We have used the DOE design data to do exactly that and present those simplified plots at the end of this document for your review and consideration.

6. **Price Sensitivity Analysis** - We also ask that DOE perform a price sensitivity analysis for the premium grade core materials in a similar manner as above. This sensitivity analysis should clearly show the impact of higher core material prices, which might result from a move to significantly higher volumes of these core materials from a very limited number of suppliers. We believe these sensitivity analyses should include worst case scenarios on the prices for premium core materials, beyond the values that are currently being considered.

7. **Other Important Issues** – We want to make sure we do not lose sight of other important issues that should be included in the Negotiated Rulemaking process. These issues have been raised before but need to be kept in front of the entire group. Some of these issues are:

a. Efficiency Requirements for Dual/Multiple-Voltage Secondaries

DOE should align its requirements with those of IEEE standards (C57.12.00 for liquid-filled, NEMA ST20-1992: 3.3 for low voltage), requiring testing in the "as shipped" condition. For units with multiple (series-parallel) low voltage ratings, the efficiency standard should be based on the highest voltage (series) connection, which matches the IEEE standard and industry practice. To do otherwise would be counter to the current industry standards and practices of testing and shipping multiple low voltage rated units at the higher voltage (series) rating. For example, the most popular low voltage rating for single-phase US Liquid-Filled DT's is the 120/240 volt rating consisting of two half-capacity low voltage windings connected internally in series. IEEE standards require such units to be connected and tested at the higher 240 volt (series) connection. For 240/480 volt ratings, the series connection would be at 480 volts. ***Our recommendation is that DOE match this requirement for efficiency standards compliance.***

b. Dual/Multiple-Voltage Transformers with Varying Basic Impulse Levels

DOE should align its requirements with those of IEEE standards (C57.12.00 for liquid-filled, NEMA ST20-1992: 3.3 for low voltage), requiring testing in the "as shipped" condition. For units with two or more high voltage ratings, the efficiency standard should be based on the highest voltage (highest BIL) connection, which matches the IEEE

standard and industry practice. To do otherwise would be counter to the current standards and industry practices of testing and shipping D/V units at the higher voltage rating. For example, the most popular D/V rating for US LFDT's would be the 12470GrdY/7200 x 24940GrdY/14400 rating (95 kV BIL x 125 kV BIL). IEEE standards require such units to be connected and tested at the higher voltage rating – 24940GrdY/14400. ***Our recommendation is that DOE match this requirement for efficiency standards compliance.***

c. Multiple kVA Ratings

In addition to multiple-voltage secondaries and multiple Basic Impulse Levels distribution transformers also have multiple KVA ratings with natural cooling, forced cooling, or a combination of both natural and forced cooling. The current regulation does not address the situation of multiple KVA ratings.

Distribution transformers can have multiple natural cooled KVA ratings - typically ONAN/ONAN, 55C/65C for liquid, AA/AA, 80C/150C for dry-type. For such transformers the KVA specification is 12% higher at the 65C rating for liquid-filled and 30% higher at the 150C rating for dry-types. The regulation should clearly state the efficiency regulation applies only to the KVA at the base thermal rating (55C or 80C).

Distribution transformers can also have a combination of natural and forced cooled KVA ratings - typically ONAN/ONAF, 65C for liquid, AA/FA, 150C for dry-type. For such transformers the KVA specification is typically 15% higher at the ONAF rating for liquid-filled and 30% higher at the FA rating for dry-types. The regulation should clearly state the efficiency regulation applies only to the KVA at the base (lowest) thermal rating (ONAN or AA).

Distribution transformers can also have multiple combinations of natural and forced cooled KVA ratings - typically ONAN/ONAF/ONAF, 55C/65C/65C for liquid, AA/FA/FA, 80C/150C/150C for dry-type. For such transformers the KVA specification is typically 29% higher at the ONAF/65C rating for liquid-filled and 77% higher at the top FA rating for dry-types. ***The regulation should clearly state the efficiency regulation applies only to the KVA at the base thermal rating (ONAN or AA) which is the lowest kVA rating.***

8. **Alternative Perspectives on Optimum DOE Designs** – The following graphs present the DOE scatter plots from the "Engineering Data (09 September 2011)" for each key MVLF DL followed by a simplified plot of the lowest price units of each core material that meets each proposed Efficiency Level. We have a series of charts attached. The first chart is

the data plot taken directly from the DOE Report “Engineering Data (09 September 2011” and shows the Plot for Design Line 1 (DL1). The second chart uses the same data, but only shows the “lowest cost unit” by core material that meets each Efficiency Level (dEL). This simplified approach provides a much clearer understanding of the capabilities of each core material.

The Following plot (Chart 1) is taken directly from the DOE report “Engineering Data (09 September 2011). The chart shows all the data points for all designs developed by DOE for this design line. The representation of this many points makes it difficult to discern the competitiveness of each of the core materials.

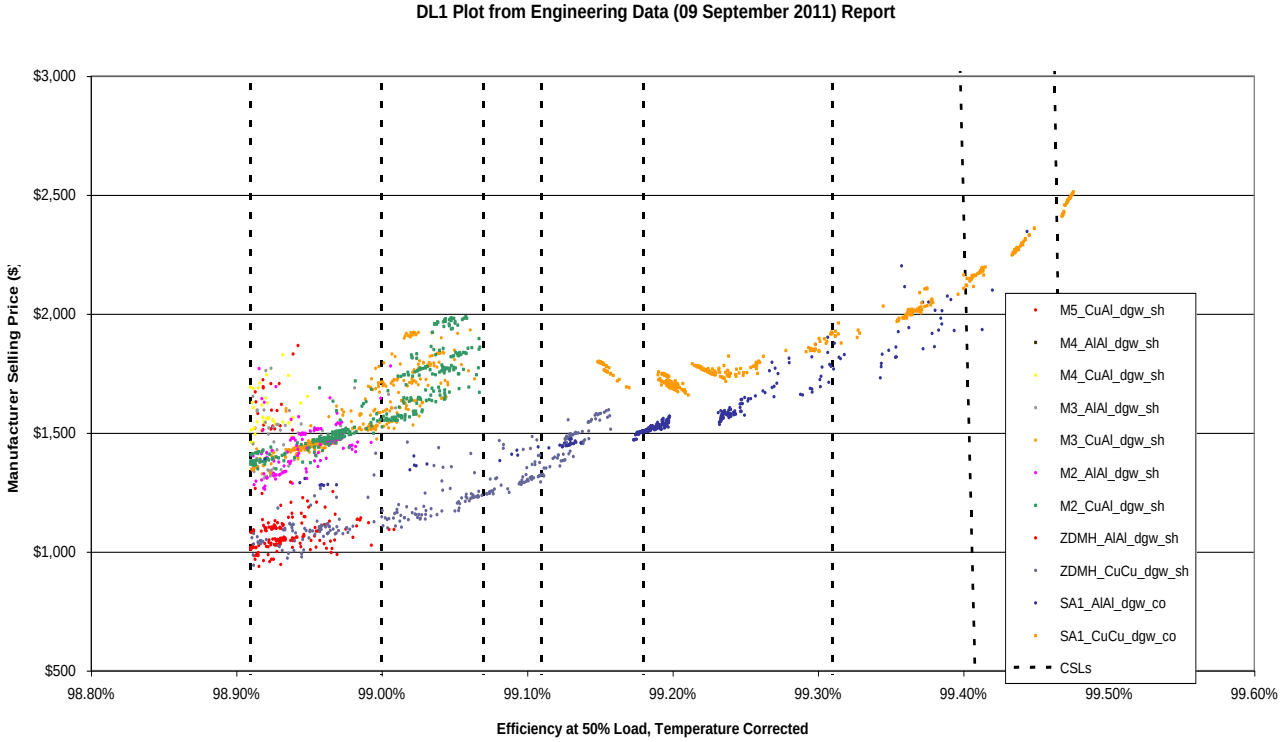

Chart 1

The following plot (Chart 2) uses the same data as the plot above, but only shows the lowest price unit by core material for each Efficiency Level. Such a chart clearly shows the trend of competitiveness of each core material.

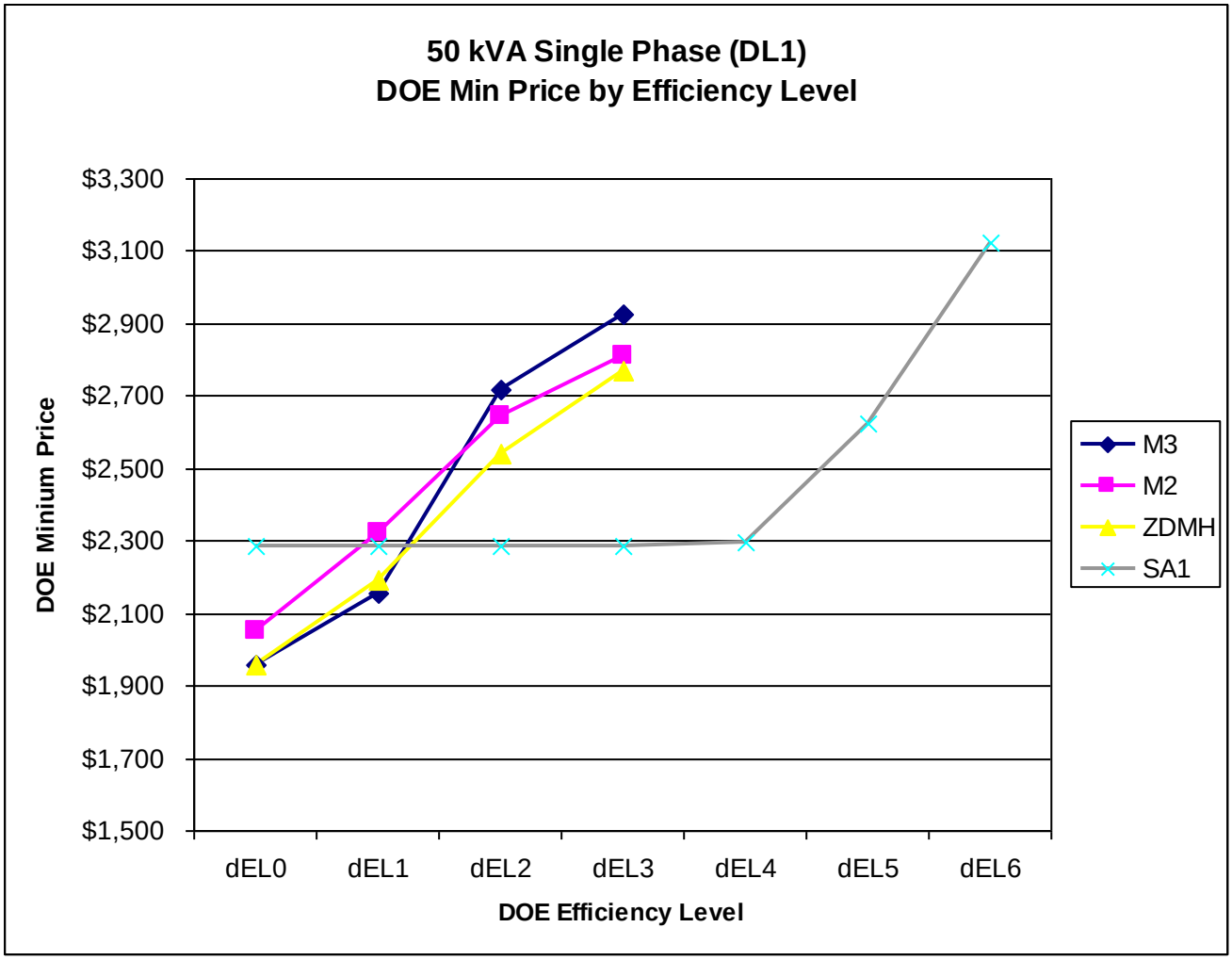

Chart 2

Plot (Chart 3) for DL2 (25 kVA) showing only most competitive unit (lowest price) for each Efficiency Level, by core material.

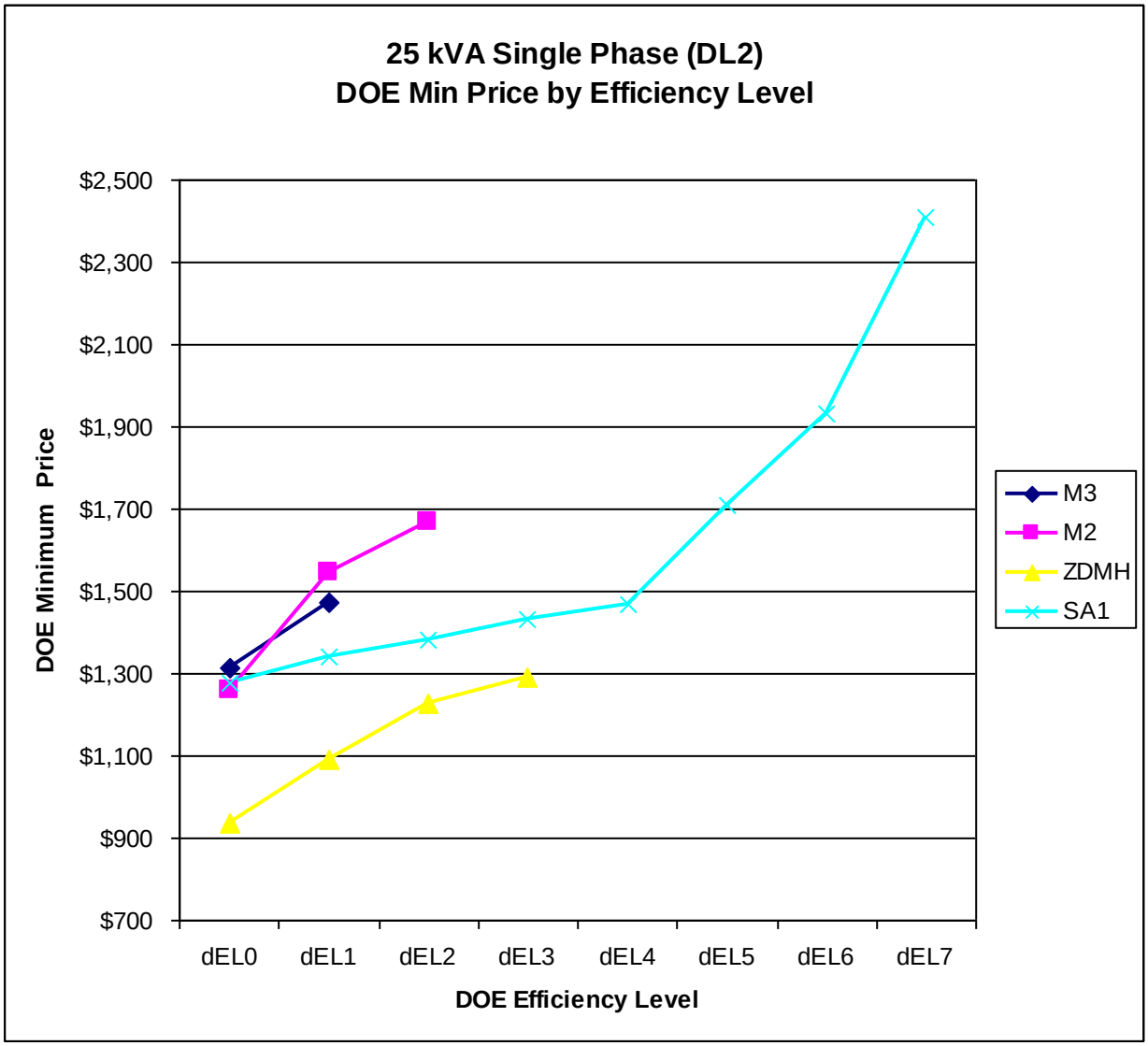

Chart 3

This shows a plot (Chart 4)of the weights for each of the units shown above. It is important to understand the relationship of weight for each core material, esp. for round (pole mounted type) liquid filled transformers.

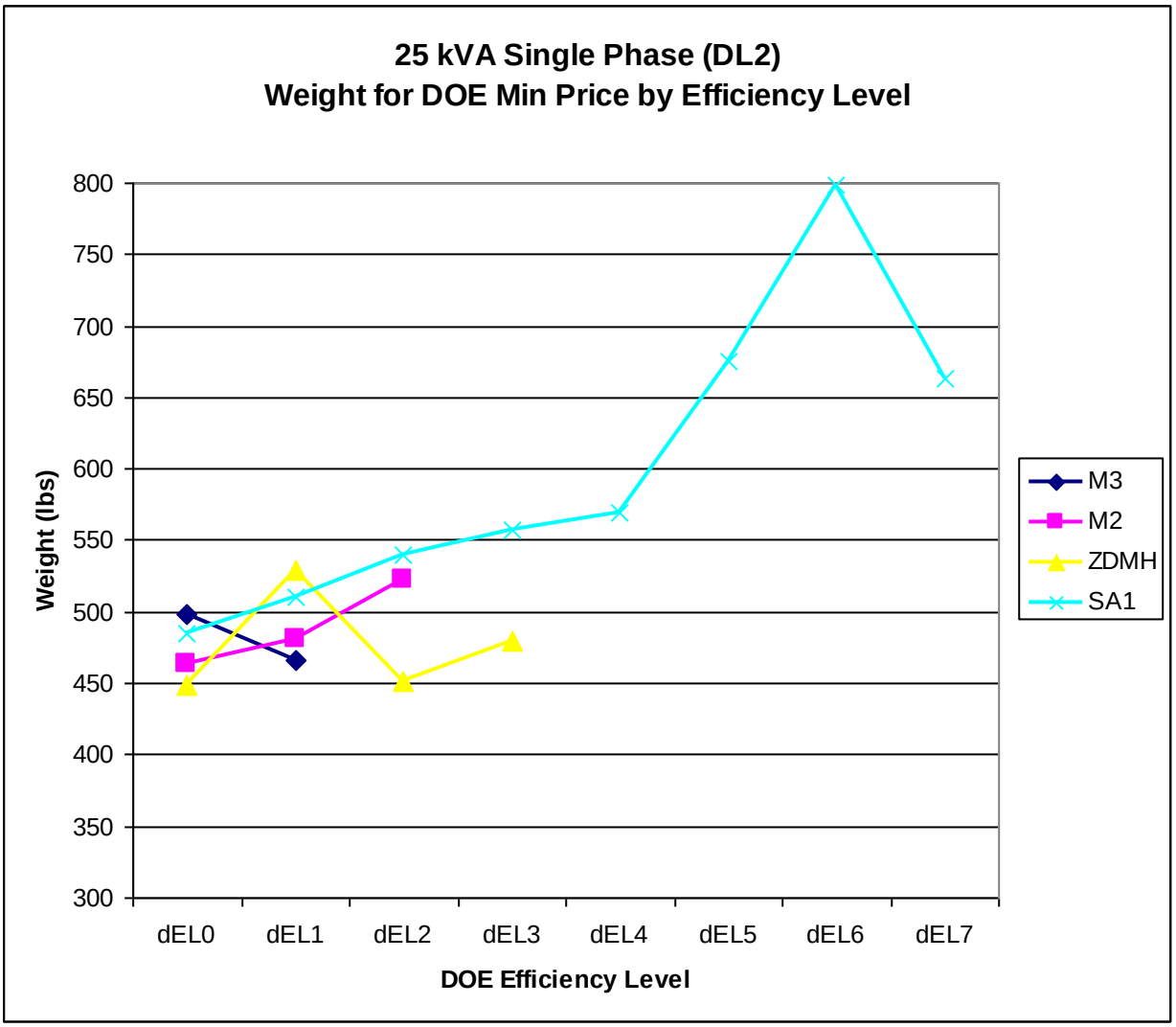

Chart 4

This plot (Chart 5) is for the 150 kVA Three Phase Liquid Filled (DL4) units, clearly depicting the relationship between price and Efficiency Level by Core Material. Again, we believe this provides are more understandable picture of the relationship between price and core material at each efficiency.

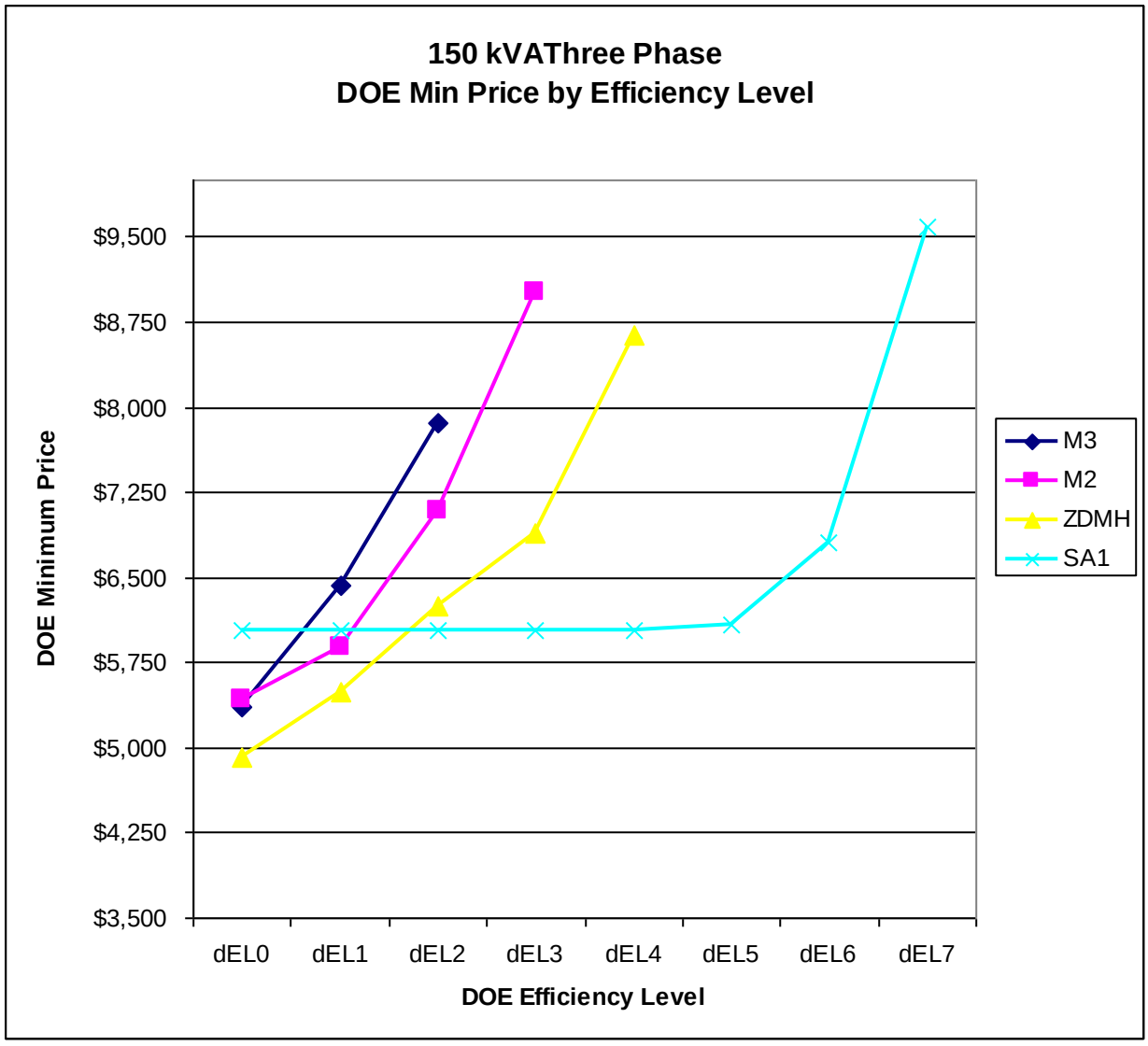

Chart 5

This final plot (Chart 6) shows the lowest price unit for each Efficiency Level by core material for the 1500 kVA, Three Phase liquid filled transformers (DL5).

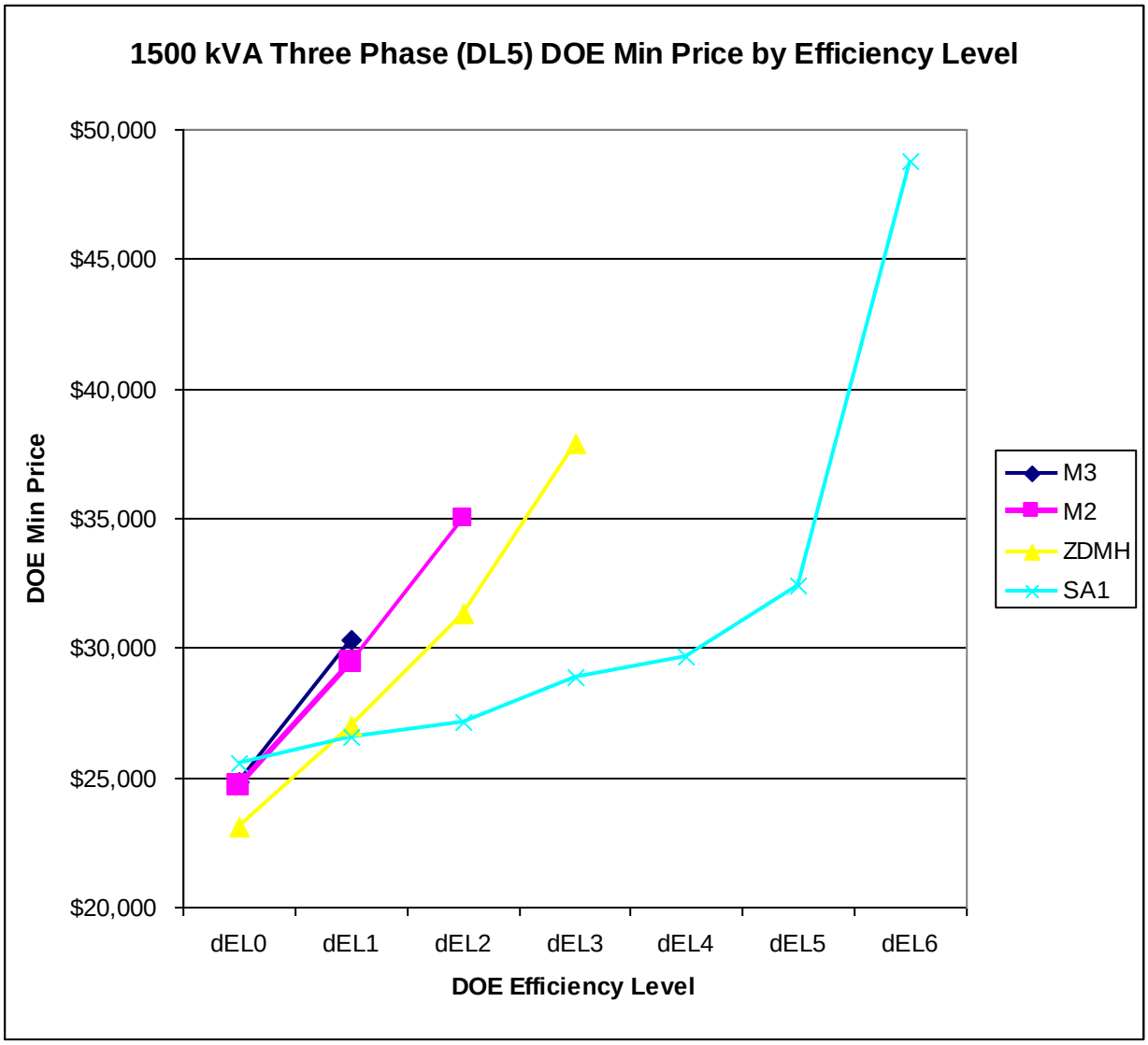

Chart 6

Prepared by:

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Prolec GE – Distribution Transformers