American Council for an Energy-Efficient Economy
Appliance Standards Awareness Project

November 6, 2017

Mr. Jeremy Dommu
U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Building Technologies Program, EE–5B
1000 Independence Avenue SW
Washington, DC 20585–0121

RE: Docket number **EERE-2017-BT-TP-0055**; Test Procedure for Distribution Transformers; Request for Information

Dear Mr. Dommu:

This document constitutes the comments of the American Council for an Energy-Efficient Economy (ACEEE) and the Appliance Standards Awareness Project (ASAP) with respect to the Request for Information (RFI) on the Distribution Transformer test procedures (82 FR 44347). ACEEE and ASAP were involved in the development of the original efficiency standards legislation for transformers and the subsequent standards rulemaking docket (EERE-2010-BT-STD-0048), including the negotiated rulemaking. We appreciate the opportunity to provide input as DOE considers revisions to the test procedures.

As DOE recognizes in the RFI, the appliance standards law, "requires that any test procedure prescribed or amended under [the statute] must be reasonably designed to produce test results which measure energy efficiency, energy use, or estimated annual operating cost of a covered equipment during a *representative* average use cycle or period of use" (*emphasis added)* (82 FR 44348). This provision helps ensure a well-functioning market in which buyers of equipment receive accurate information about the performance of products, enabling valid comparisons and well-informed purchase decisions. To ensure that test procedures reflect up-to-date data and information, the law requires DOE to review all test procedures once every seven years to determine if amendments are warranted.

DOE's explanation in the RFI of the representativeness of the load used for liquid-immersed transformer ratings, which cites to the previous standards rulemaking (78 FR 23336), appears erroneous. Based on that prior rulemaking record and recent EIA load growth projections, DOE must amend the test procedures for each type of regulated transformer in order to improve representativeness. DOE's current ratings for both liquid-immersed and dry-type transformers are based on loads that are higher than per-unit loads developed during that prior, thorough rulemaking process. We recommend that DOE amend the test procedure so that it yields ratings based on rated loads that are more representative of

field conditions than those used in the current procedure. DOE should also consider whether ratings based on a weighted average of multiple load points would improve representativeness and foster improved efficiency across the range of typical average loads commonly observed in the field.

The RFI assertion that the record supports a 50% load for liquid-immersed transformer ratings appears erroneous.

The current DOE test procedure requires rating liquid-immersed transformers at 50% of rated load. (In the RFI, DOE refers to this value as the "per-unit load" or "PUL.") The RFI states that, in the previous standards docket, DOE estimated average root mean square (RMS) PUL[1] at initial installation of 34% for single-phase and 40% for three-phase transformers. The RFI says that these initial loads are subject to, "a one percent annual increase over the life of the transformer to account for connected load growth" (82 FR 44349). Based on an average product lifetime of 32 years, the RFI claims lifetime average PUL of 49% for single-phase and 56% for three-phase equipment.

We have reviewed the specific citation provided in the RFI as well as the final rule, technical support document and other spreadsheets from the prior docket. The lifecycle cost (LCC) spreadsheets in the docket do contain the initial loads[2] referenced in the RFI, but not the RFI's claimed load growth or lifetime average PULs. We could not find lifetime average PULs in the prior docket – they must be calculated. The rate of load growth would need to be more than 2% to reach the lifetime average PULs asserted in the RFI. In the previous standards docket, DOE used a growth rate of 0.5% for its lifecycle cost analysis (78 FR 23373, Table IV.6). Elsewhere in the 2013 final rule, DOE says the analysis used a one percent annual growth rate (78 FR 23375). Both a .5% and 1% growth rate yield a substantially lower average lifetime load than the lifetime average PULs claimed in the RFI. A growth rate of 0.5% would increase an initial load of 34% to about 37% after 16 years (halfway through the average lifetime of a transformer) and a load of 40% to about 43%. A one percent rate of increase would boost initial loads to 40% and 47%, respectively. (We think that DOE's error in the RFI may have been to add one percentage point per year to the RMS load percentage rather than to increase the load by one percent.)

A 0.5% growth rate is consistent with the federal government's most recent forecasts. EIA's Annual Energy Outlook 2017 projects load growth of 0.56% per year in its reference case.[3] This latest forecast suggests that the 0.5% growth rate used in the prior docket is about right.

We recommend that DOE begin the process of revising the test procedure to adopt a more representative rating load. Based on the substantial information included in the previous docket, we recommend rating liquid-immersed transformers at 40%, roughly the midpoint between single-phase and three-phase transformers' average lifetime load assuming a 0.5% load growth rate.

[1] As explained in footnote 4 of the RFI, RMS PUL is the commonly used industry method for estimating typical or average load for a given transformer.

[2] We infer that these values are initial loads, but the spreadsheet does not label them as such. We assume that the RFI is correct, but request that DOE double-check that the values in the spreadsheets are initial rather than lifetime average loads.

[3] See Table 8, cell AM66.

For liquid-immersed transformers, DOE should consider ratings based on a weighted-average of multiple loads.

Other DOE test procedures (e.g. pumps, external power supplies) use a weighted average of efficiency at multiple load points to ensure products provide efficiency for buyers across a range of real-world operating conditions. As DOE states in the RFI, transformers operate under widely divergent loading. Therefore, a test procedure based on a single load point may do a poor job of reflecting efficiency across the range of operating conditions, depending on the actual variation in loads and transformer designs. Fortunately, DOE thoroughly evaluated the range of RMS loads in the previous docket and reports that range in the LCC spreadsheets.[4] DOE should consider the benefits of ratings based on a weighted average of multiple load points, where weightings are based on expected hours of operation within bands around each load point. For example, ratings based on the average load point (about 40%), and the 25th and 75th percentile load points (about 30% and 50% respectively), may improve representativeness and foster improved efficiency in the field. DOE should investigate whether using such a weighted average would make much of a difference in transformer designs and field efficiency compared to using the single RMS load of 40%. Our understanding is that manufacturer AEDMs allow ratings at any load point, therefore manufacturers should be able to certify to weighted-average ratings at very low additional costs.

In no case should DOE base ratings on extreme load conditions rarely seen in the field. For example, the data from the prior docket show that an RMS load of 100% is above the maximum initial load for all design lines evaluated. Data from utilities in this docket filed by another commenter show that even peak day loads do not reach 100% in the data submitted.[5] Ratings should not be based on rare occurrences and, under the statute, they cannot be so based.

For low-voltage and medium-voltage dry-type transformers, DOE should adopt loads of 25% and 35%, respectively.

DOE states in the RFI that the agency estimated that, on average, RMS PUL for low voltage dry type transformers ranged from 20 to 25% and for medium voltage dry type transformers from 32 to 38%. DOE projected that loads did not grow over transformer lifetimes for this equipment. The current test method is based on loading at 35% for the low-voltage dry type and 50% for medium-voltage dry-type. DOE should amend the test procedure to use more representative loads contained in the prior docket. We recommend 25% load for low-voltage and 35% for medium-voltage dry-type equipment.

DOE should also consider ratings based on a weighted average of multiple loads for these equipment types. The spread between the mean and 25th and 75th percentiles is narrower than for liquid-immersed transformers, but a weighted average would be more representative.[6] DOE should investigate if ratings

[4] See LCC spreadsheets available at https://www.regulations.gov/document?D=EERE-2010-BT-STD-0048-0767. Under the tab named "Forecast Cells," RMS loading is contained in line 4. The line shows results from a statistical run of 10,000 transformer installations, showing the minimum, maximum, median, mean RMS loads as well as RMS loads at 5th, 25th, 75th and 95th percentiles of installations.

[5] Comments filed by Phil Hopkinson.

[6] The medium-voltage dry-type LCC spreadsheets are laid out similarly to those for liquid immersed products and are available in the DOE docket at https://www.regulations.gov/document?D=EERE-2010-BT-STD-0048-0764.

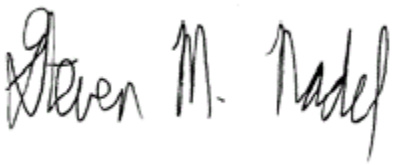
based on such an average would affect field efficiency for both medium-voltage and low-voltage dry-type transformers.

Timing of revisions.

We encourage DOE to undertake these revisions to the transformer test procedure now so they can be used in the next transformer standards rulemaking. Although a revised test method should be developed in the near term, DOE may want to consider making a revised test method take effect with the next revision to the transformer standards to avoid the need to re-rate products between standards compliance dates.

Thank you for considering our input.

Sincerely,



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