American Council for an Energy-Efficient Economy
Appliance Standards Awareness Project
Alliance to Save Energy
Consumers Union
National Consumer Law Center
Natural Resources Defense Council
Northeast Energy Efficiency Partnerships

January 21, 2014

Ms. Brenda Edwards
U.S. Department of Energy
Building Technologies Program
Mailstop EE-2J
1000 Independence Avenue SW
Washington, DC 20585-0121

RE: EERE-2011-BT-TP-0042 (RIN # 1904-AC53): Test Procedures for Residential Water Heaters and Commercial Water Heaters. Notice of Proposed Rulemaking.

Dear Ms. Edwards:

This letter comprises the comments of the American Council for an Energy-Efficient Economy (ACEEE), the Appliance Standards Awareness Project (ASAP), Alliance to Save Energy (the Alliance), Consumers Union, National Consumer Law Center, Natural Resources Defense Council (NRDC), and Northeast Energy Efficiency Partnerships (NEEP) in response to the Department of Energy's ("DOE" or "the Department") Notice of Proposed Rulemaking (NOPR)[1] regarding a uniform efficiency descriptor and accompanying test method for residential water heaters and commercial water heaters.

INTRODUCTION

The challenge to DOE has been great. Public Law 112-210, the American Energy Manufacturing and Technical Corrections Act, instructed DOE to respond to growing concerns about water heater classes and ratings. In this rulemaking, DOE proposes to extend "residential" ratings to larger products often marketed for residential applications. DOE also proposes to implement a new rating method intended to allow better comparisons between technologies, and to better reflect actual use patterns in residences. To do this, DOE proposes distinct water heater classes for "point-of-use", small, medium, and large household applications, with separate simulated use tests (SUTs), to help consumers choose appropriate products for their houses.

We commend the Department for its efforts to develop a much improved method for rating performance of water heaters. It is clear that DOE has carefully observed and incorporated findings of parallel efforts at AHRI and ASHRAE (SPC 118.2), and carefully considered research findings, such as field studies of actual draw patterns in occupied houses. The comments below

[1] http://www.regulations.gov/#!documentDetail;D=EERE-2011-BT-TP-0042-0051

suggest further "tuning" to make the proposed rule better, but we support the general framework the Department proposes.

MAJOR ISSUES

1. Differential Effects of the New Rating Method

At the outset, it is important to recall that the legislation requiring development of the Uniform Descriptor (UD) reflected growing concern that the current 6-draw SUT was obsolete. Since its development, water usage patterns have changed[2] and new technologies, notably tankless gas water heaters, have gained customer acceptance. It has never been clear that the 6-draw test applied to tankless water heaters would yield EF values that fairly compared energy use in the field between a tank and a tankless water heater. Limited field experience suggests that the 6-draw test gives higher ratings to tankless units than field performance might justify.

DOE, AHRI, ASHRAE, NRCan, and others have spent enormous effort to find out how hot water is actually used (representative draw patterns) and to use the information as a basis for improved ratings. At the aggregate level of technologies (e.g, non-condensing tank v. non-condensing tankless), it is expected that the new ratings will differ by varying amounts between classes. To the extent that the new SUTs are much more soundly rooted in field data than the old SUT, we consider the "new" ratings more representative of field performance in consumer homes. Thus, any effort to differentially adjust new ratings by technology group *must* be rejected.

2. Conversion of Existing Ratings

We appreciate the Department's efforts to study changes in ratings that might accompany conversion to the new draw patterns and rating method (Slides 54 – 59). We assume that DOE's initial reconnaissance tested each of the 20 water heaters with both the current and proposed draw pattern relevant to the capacity of the units tested (rather than relying on the certified values for the "present method" values). Although we all want a perfect, seamless conversion, we'd make the following precautionary observations:

- In the new system, First Hour Rating (FHR) and maximum flow are principally used to assign models to capacity classes. It will be important to study the sensitivity of EF to the class to which the product is assigned – variability in FHR and maximum flow may or may not be important.
- As noted above, one of the driving forces for the new method and new SUTs was a sense, supported by very limited data, that tankless units performed better in the field than atmospheric tank units, but not as much better as the difference in rated EF might suggest. That is, a 0.82-rated tankless unit might not perform 22 points better than a 0.60-rated tank unit. It would be expected that there would be systematic differences between average "new" values and "old values" for several technologies.

[2] For example, decreased use from more efficient fixtures and appliances.

3. **NAECA v EPAct 1992**

The transition of certain products from "commercial" to "residential" raises some concerns. Consider a 76,000 Btu/h storage water heater. Today, it would be rated as commercial equipment, by its thermal efficiency (TE) and idle loss. If this NOPR is adopted and enters the CFR, how would this product (currently considered "commercial") be rated before the new "residential" efficiency regulations take effect in 2015? More broadly, what does the transition look like?

4. **Rated Capacity** (including slide 42)

Under the proposed test procedure, the Department will classify products within the residential and light commercial[3] category on the basis of their FHR for tank units and maximum flow rate for tankless units (slide 38). These are the parameters used to determine the capacity class and applicable SUT for each product (slides 38 and 39).

The Department also proposes to use *Rated Storage Volume* (RSV) as a certified parameter, in 10 CFR 429 (slide 42), and offers a definition and discussion (slides 43 – 45). RSV does not seem to be used in the Test Procedure at all, but is only a matter of concern for determining the minimum EF of water heaters with volume > 55 gal. Assuming that the definition of RSV needs clarification, is the test method rulemaking the appropriate place for it?

The Department has established that measured volumes of a sample of water heaters are invariably lower than the capacity class to which they are assigned. Industry argues that this has been accepted industry practice for decades, incorporated in ANSI Z21.10.1-2009/CSA 4.1-2009, ANSI Z21.10.3-2011/CSA 4.3-2011, and UL 174, which set tolerance bands for volume. While water heaters are commonly marked and sold by storage volume, industry also notes that the *service* delivered is better described by FHR. The Department seems to recognize this in basing the new capacity classes on FHR (and maximum flow for tankless units).

Consider a similar case: the key capacity metric for general lighting is shifting from *watts* input to *lumens* output, to accommodate the introduction of more efficient technologies (CFL, LED). This requires ongoing consumer education, but yields a much more useful tool for consumers. Similarly, FHR and maximum flow, together with the proposed capacity classes, are potentially much more useful to consumers than raw volume.

In this context, we argue that the question of rated storage volume only matters in one context, and that is the threshold capacity at which EF requirements change from conventional to advanced technology (55 gal). When advocates introduced this product class concept, all analysis by ACEEE was carried out with market information based on capacity class, that is, nominal volume (e.g, 38 gal. for a 40 gal. class). This was also true in discussions between advocates and NRECA in 2013, while developing a consensus for legislation in a related issue. Thus, we generally support continued use of the industry's (nominal) classes, in which the name given to the "capacity class" is conventionally the largest possible unit in the class, and all other members are smaller. This does not seem to be codified in the ANSI, CSA, and UL standards

[3] For purposes of our comments, we use the Department's proposed nomenclature for clarity. Other participants may advance sound reasons for shifting to different terms in some cases.

noted above. We urge DOE to clarify that capacity classes have an upper limit of the named capacity class, so we do not develop a loophole in which 60 gal. electric resistance water heaters enter the 2015 market (55 gal + 10% = 60.5 gal).

5. **Scope of Test Method** (slides 19 – 28)

Our comments on the Department's approach to "light commercial" products are in **Item 1** below. For gas, electric, and oil products, we commend the Department for eliminating coverage gaps in the existing residential test procedure, and covering both residential and "light commercial" water heaters. The graphics of slides 22, 25, and 28 are innovative and helpful.

We have some concerns about the presentation around eliminating *upper* storage volume and input rating limits (slides 20, 23, and 26). For example, slide 22 (gas) shows a 200,000 Btu/h upper limit for tankless units characterized by >4000 Btu/gal. Would a 210,000 Btu/gal 30 gallon unit really be residential, as suggested by the slide? Similarly, given ASME codes and similar considerations, what does it mean to allow rating a 150 gal storage WH with 200,000 Btu/h input capacity? These examples hardly seem to be residential or "light commercial" products.

Also, although we can think of no exceptions now, we can imagine that a product "near" the 4000 Btu/gal slope might have quite different ratings depending on whether it is classified as an (extended) tankless or (extended) storage product (slide 22). We can imagine products for which waivers might be requested. We recommend that the Department do enough simulations with WattSim or newer engines to get a sense of sensitivities between tank and tankless, and behavior near transition points between adjacent capacity classes.

6. **Nomenclature: Energy Factor**

DOE proposes to continue using the term Energy Factor (EF) for the new rating system, without change from the prior system. We regard this test procedure change as almost as significant as the change in central air conditioner 'ratings' from EER to SEER when federal annual standards replaced industry steady-state ratings. In addition, DOE is dividing the residential – light commercial product universe into four capacity classes, with different SUTs for each. Thus, we strongly recommend that DOE change the term used to describe the efficiency of water heaters from EF to a new term, and that the new term include a modifier for each capacity class. We offer an example that meets these criteria:

- **PUD** Point of Use Uniform Descriptor
- **SUD** Small Uniform Descriptor
- **MUD** Medium Uniform Descriptor
- **LUD** Large Uniform Descriptor

These particular terms are awkward and sometimes humorous. We're not marketers skilled in these arts, but recognize that a felicitous descriptor acronym with subscript modifiers might be more user-friendly, as might many other choices. But the term EF is no longer correct, and modifiers are needed to avoid confusion when "similar" models get different ratings because they are actually in different classes.

7. Ambient Conditions for Testing Heat Pump Water Heaters (HPWH)

Extensive performance testing in the lab and the field in the Pacific Northwest, to be presented separately by the Northwest Energy Efficiency Alliance (NEEA), shows the importance of the low-temperature cut-out to the field performance of heat pump water heaters. Because so many HPWH are installed in cool basements or garages, it is important to test them at a representative temperature, such as 50°F, with appropriately high humidity levels. Alternatively, but less usefully, a separate compressor cut-out test could be required, to assure that the vapor compression cycle is the dominant operating mode in likely operating conditions.

ITEMS ON WHICH DOE REQUESTS COMMENTS

Item 1 (slide 30): "Light commercial water heaters"

1. *Is the definition for light commercial water heaters (slide 19) appropriate?* In general, the proposed three-part definition looks good.
    a. Single-phase electricity seems appropriate.
    b. <180F operating limit. The limitation to units that are "…not capable of delivering hot water at temperatures of 180°F or above…" captures the intent, but may require some tuning. At present, industry seems to prefer demonstrating this with a thermostat whose control settings are limited to <180F. For tank units, requiring a TP relief valve with this limit could be a stronger requirement. In either case, we propose that DOE require prominent prescriptive language on the water heater to the effect that modifying the (residential) unit to operate at higher temperatures is dangerous[4] and voids the warranty.
    c. ASME code stamp. At the public meeting, it was noted that some jurisdictions do not require the observed testing and ASME stamp, implying that manufacturers could make and sell otherwise identical models with and without the stamp. This could be addressed by excluding from light commercial any models that are identical but for the code stamp, as well as those that are so stamped. However, we believe that there is a better route. This would exclude from the "light commercial" category products with very large first hour ratings (tank) and delivery rate (tankless). We believe that agreement on these values could be reached easily, giving the Department objective criteria that are good enough to launch, and could be modified if required by later experience (since they would be in the CFR instead of legislated).
2. *Is testing these "light commercial" units with the Uniform Descriptor appropriate?* Yes, in our opinion. Customers for such products include true light commercial ones, and these consumers (and their contractors) are unlikely to be familiar with TE and idle loss, while they may be familiar with the "Energy Factor" from their personal lives. Consumers sophisticated enough to have encountered TE should be able to adjust easily, since almost all will still be comparing products with the same ratings basis.
3. *Are TE and idle loss still appropriate for the larger units?* Yes, for at least two reasons. First, "if it ain't broke, don't fix it." It seems to work now, and carries over rating concepts used also in boilers. Second, at larger capacities, the simulated use rating method is increasingly onerous, and affects decreasing shipments per model. We do not believe that any possible

[4] Assuming, as we do, that it is.

benefits of a simulated use approach for large commercial water heaters outweigh the real drawbacks.

Item 2 (slide 53): Translation of 135°F to 125°F
We have no relevant information, but agree that the topic warrants evaluation. We support the lower temperature, because it accords with most common settings and may mitigate test challenges some technologies face at higher temperatures.[5]

Item 3 (slide 40): Water heater characterization and classes
We believe the characterization of point-of-use, low, medium, and high usage is appropriate. As Mr. Klein pointed out at the public meeting, the term "point of use" is awkward, since it describes a location instead of a service category. We're not wedded to the specific nomenclature, but support the intent and the four classes.

Item 4 (slide 40): Are the proposed draw patterns appropriate for each capacity class?
The principle is right: lower capacity water heaters should be challenged with fewer draws and a smaller total delivery than larger ones. We have not compared the Department's proposed draws with those suggested by AHRI or members of ASHRAE 118.2, because, as one commenter noted, there are lots of adequate SUT draw patterns that are roughly equivalent and good enough, given our knowledge of actual hot water use. Even with the heroic efforts of LBL, NRCan, and others, far too few North American houses have had draw patterns measured over time. To us, the most important findings from field studies are that hot water use varies enormously from house to house with similar occupancy, and from day to day in almost any given house. Given this, the proposed draw patterns appear reasonable. However, it is conceivable that ongoing testing by manufacturers (and the Department?) may discover systematic issues that might warrant modification. For example, there might be substantial "discontinuities" when two very similar units respectively just smaller than or just larger than a FHR capacity break are tested. This is more likely if the two are dissimilar, with different technologies. We urge the Department to consider minor adjustments to minimize results that could be misleading.

As in our response to **Item 3,** we urge the Department to remain open to adjustments if the data presented by others suggests that such would help level the playing field and/or improve accuracy.

Item 5 (slide 32): Burden of 24 hour pre-conditioning
There is substantial agreement that the thermal capacity of a tank water heater is significant, so a long enough conditioning period before the SUT is required. There seems to be some consensus that 24 hours "thermal soak" is about right. We have not been convinced that this "heat soak" needs to include the full SUT, which would require that each water heater be allocated 48 hours on the test stand. Requiring a thermal soak at 125°F for 24 hours before the SUT may be adequate. Unless the Department can show benefits from conditioning with the full SUT, we would support constant temperature pre-conditioning, which can be done with a much less elaborate fixture.

[5] For example, some HPWH working fluids lose efficiency at higher temperatures, and designing condensing gas water heaters is more challenging to preserve the cold sink of incoming water, particularly during long inactive periods.

Item 6 (slide 36): 125°F test temperature

We strongly support the change from 135°F to 125°F delivery temperature. It more closely corresponds to the default temperatures set by the manufacturers for new units, and it removes ratings and design disadvantages of the higher test temperature for some technologies. For example, at the lower temperature some heat pump water heaters will require less (or no) resistance boost. It is also likely that more cost-effective condensing water heaters can be designed and manufactured that will give condensing performance under a wider range of usage patterns. The lower temperature could ease concerns about keeping stratification of the lower part of the tank as a cold sink for condensing.

OTHER ISSUES

Slide 39, Modified draw pattern

We see two critical issues here:

1. Are the capacity class break points reasonable? If we understand correctly, AHRI proposed that one class have its break at a FHR or maximum flow corresponding to the 64.3 gal/day in the present 6-draw test. Since the capacity class basis has changed to being defined by FHR (and maximum flow for tankless), it's not clear how the 64.3 gal/day criterion is relevant going forward. In particular, different input capacities will give quite different FHRs for the same nominal volume water heater.
2. Do the proposed usage categories allow fair comparisons between different technologies? For example, how does a relatively large "low" size tank unit with FHR near 55 gal compare with a "low" size tankless with maximum flow rate between near 2.8 gpm?

We look forward to reviewing comments by those who have tested the proposed equivalences.

Slide 42, Rated values (electric water heaters)

DOE proposes to require manufacturers to test otherwise identical water heaters at all input ratings, changing the current practice that allows using a single standard input rating for otherwise identical models. To us, "otherwise identical" means units that cannot be distinguished on the production line until the resistance elements are installed and the label applied: same storage volume and dimensions, same shell, same insulation, same thermostatic controls and safety devices, etc. Thus, although they vary with heat input, they don't vary in standby losses. This would seem to be the easiest possible application of alternative energy determination methods (AEDMs) to allow use of simulations calibrated with at least two input rates – as will be allowed for much more complex commercial products. We find insufficient justification for the proposed change.

Slide 49, Calculating Annual Energy Consumption

Generally speaking, we support DOE's effort to provide more disaggregation and accuracy when calculating AEC, but caution that DOE should retain flexibility if the implementation and analytic burden turn out to outweigh the benefits. In addition, we recognize and accept that lowering the outlet temperature from 135°F to 125°F will reduce predicted energy consumption, all other things being equal in the change of rating methods.

SUMMARY

Publication of this Test Procedure NOPR is a tremendous accomplishment for the Department and all stakeholders, representing the culmination of years of work by many parties to replace a quarter-century old rating method that no longer served industry or consumers.

We offer a few comments which may 'tune' and improve the proposed test procedure, and we are confident that others will also endeavor to help bring this process to the best possible conclusion in the shortest feasible time.

Thank you for considering these comments to this critically important docket.

Sincerely,

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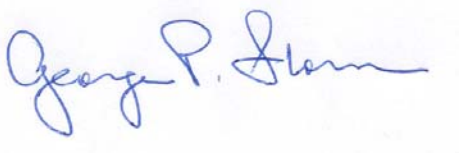

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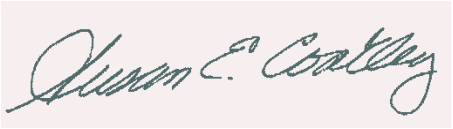

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