January 18, 2011

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

RE: Docket Number EERE–2010-BT-STD-0037; RIN 1904–AC39: Framework Document for Automatic Commercial Ice-Makers

Dear Ms. Edwards,

This letter comprises the comments of the American Council for an Energy-Efficient Economy (ACEEE), Appliance Standards Awareness Project (ASAP), and Natural Resources Defense Council (NRDC) in response to the Department of Energy (DOE) request for comments on the framework document for automatic commercial ice-makers and the public meeting held to discuss the document on December 16, 2010. We appreciate the opportunity to provide input into this important process.

Summary and Overall Concerns

This section notes some general issues we wish to bring to the Department's attention.

"Max-Tech" evaluation and the future of US manufacturing. We do not pretend expertise in automatic ice-maker technology, but there seem to be many similarities between ice-makers and other kinds of refrigeration equipment. As an example, ambient conditions differ between locations and vary in time at many locations. More importantly, in most ice-maker applications, we expect periodic variation in ice demand, on daily, weekly, or seasonal cycles. In addition, water quality varies, as do on-board water treatment methods to assure odor- and taste-free clear or translucent ice. These observations suggest that adaptive controls and modulating components (particularly compressors and evaporator fans, and purge water quantities) might offer large energy and water savings in use, but may not be reflected in the test procedure of AHRI 810-2007.

It is important for this and future rulemakings that the Department move beyond surveying ice-makers in the US market, along three investigation axes:

- What is the "Max-Tech" in the global market today? What are the efficiency standards and technology content that define state-of-the-art? These reference points are a key for understanding both the amount of energy that could be saved and the environment in which US manufacturers will compete in the period covered by these standards.
- What technologies have been adopted in "similar" product categories (such as commercial refrigeration products) that have potential to save energy in automatic ice-makers?
- Will AHRI 810-2007 serve to set a minimum standard that incorporates savings from these new approaches? If not, it is a backward-looking standard that may not encourage innovation and competitiveness.

Automatic ice-maker classification. We believe that the primary factors in equipment classification should be those that the customer values most highly. Technology is secondary, and should influence efficiency standard classes only to the extent that technology impacts utility. With this framework:

- Size classes should reflect the most common groupings in the market. This may be influenced by application type, sales volume, or other factors.
- We infer that some customers value clear, hard ice (cubes, tubes), while others are satisfied with irregular, translucent forms (flakes, "nuggets"). To the extent that this is true, we would prefer to see product classes based on a measurable utility discriminator (clarity and/or hardness) than on process differences (batch v. continuous production). Alternatively, shape classification may better reflect customer values, with "regular" shapes like cylinders and cubes separated from irregular shapes like flakes.

This position can be contrasted with ASHRAE 90.1's requirements for chiller efficiency, which use capacity as a primary characteristic but compressor technology (positive displacement v. centrifugal) as a second classification basis with different efficiency requirements. This does not seem to have value grounded in customer utility.

In the context of the present framework stage, we find the classification proposed in Table 1.1 of the Framework and slide 12 of the hearing to be confusing. We trust that the Department will provide clear, illustrated definitions that demonstrate non-overlapping product classes.

Items on which DOE Requests Comment

In this section, we respond to *some* of the issues raised by the Department, using its numbering sequence. We have no comments on issues for which this document does not include a response corresponding to the Department's issue number.

1-2, Updating test methods.

It would be worthwhile to review the rating method for improvements that would foster innovation that improves competitiveness.

1-3, Larger equipment.

The sense that we have from the framework meeting is that the sales volume of automatic ice-makers with capacities greater than 4,000 lb/day is very low, and that these are principally products for factory processes. The manufacturers also note the challenges in finding laboratories with large enough chamber capacity to provide the required 90°F ambient air. Under these circumstances, we would encourage industry and ASHRAE to develop an alternative rating method to allow informed industrial customers to make intelligent choices. We are not convinced that establishing a federal energy standard or test procedure for capacities > 4,000 lb/day should be a high priority for the Department.

1-4, 3-7, Ice-maker categories.

We believe that classification of ice-makers should be built on a customer utility perspective, *not* ice-making technology. Please see our comments above on "Automatic Ice-Maker Classification." We believe that the framework document is on the right track in adopting capacity-based classes. Our first concern in this area is whether the provisional categories correspond well to classes expected in the market. Our second concern is that categories adopted be technology-blind in terms of the methods by which the product is made.

We also encourage DOE to ensure that the product class definitions are broad enough to encompass all types of ice-makers including combination soda/ice machines.

3-4, Including flake, nugget, and tube-type ice-making machines.

We support extending standards to all ice-maker categories that have substantial sales volumes, energy use, and utility close enough to covered products that they compete in the market. We

support including flake, nugget, and tube-type ice-making machines to avoid distorting the market and to save energy.

3-6, Tube-type machines.

Tube-type ice-makers should be subject to standards appropriate for the customer amenity and size categories in which they are sold. We are not currently aware of any factors that would lead to a different conclusion, and we look forward to reviewing the Technical Support Document to learn more.

3-7. Market categories.

Please see 1-4.

3-9, Units > 4000 lb/day.

Please see our response to Item **1-3.**

3-10, Additional technologies.

We believe that loads vary for many ice-makers in many applications. For example, there may be greater demand for ice for fountain beverages in summer than winter. To the extent this is true, it is likely that adaptive controls and modulating compressors would save substantial energy in many ice-maker categories. This may also be true for condenser fan motors. As loads go down, modulating the compressor gives a relative increase to the heat exchangers' areas, which should improve efficiency (all other things being equal). The "smarts" required are certainly available, requiring little beyond the interval durations in which the equipment is calling for an ice-making cycle.

3-11 through 3-14, Potable water use.

We support establishing an appropriate potable water use standard for each class of ice-maker. At the public meeting it became clear that the amount of potable water that must be purged depends on water quality: more must be dumped with harder water, to prevent clouding of the clear ice and scaling of the machinery. This situation seems to call for prescriptive requirements for controls that can automatically control the amount of purge water. There are many possible approaches, which include conductivity testing and turbidity sensing – widely used to minimize rinse water used by dishwashers. Adaptive purge controls that measure water quality and adjust the purge water amount are already being employed in some automatic ice-makers.[1]

We are also told that some machines employ reverse osmosis cycles to control water quality. These inherently divert several gallons of water per gallon beneficially used, but may be appropriate in specialty applications. They may require a different standard, as well as automatic controls to minimize water wasted by inefficient processes.

Potable water use is widely predicted to be a much more important issue than it is today during the expected life of equipment built under the regulations DOE will promulgate in this proceeding. It is imperative to pay attention to potable water use. On the other hand, the "embodied energy" of water, in the range of 5 Wh/gallon, is typically about two orders of magnitude less than the heat of fusion of ice, the energy that must be withdrawn to convert water to ice.

Item 5-1, Condenser water use.

Please see our notes under **Comment G, condenser water use.** Condenser water can be either open-loop, typically using potable water, or closed ("brine") loop. With adaptive modulating equipment, condenser water flow rates can be adjusted with varying loads, water temperature, and even time-of-day pricing of electricity. Experience with other water-cooled equipment suggests that there is likely to be an optimum flow rate with a fairly wide flow bandwidth. A rating method should not encourage manufacturers to rate at high flow rates that are unlikely to be economical for equipment owners, as the benefits of much higher flow may be small increases in efficiency.

[1] For example, adaptive purge control is a feature included in the Prodigy line of Scotsman ice-makers.

Item 5-6, Combined analysis approach.

We have no a priori objections to using some combination of Design Option, Efficiency Level, and Reverse Engineering approaches to learning about the cost of efficiency. However, we encourage the Department to draw lessons from retrospective studies regarding the observed impact of standards on the market (with controls for short-run impacts such as commodity price excursions).

Items 5-9 – 5-11, Size categories.

It seems that it would minimize market confusion to have the size classification breaks consistent across ice classes, such as clear vs. translucent, or tube and cube vs. flake and nugget. It is probably more important to minimize distortions in the size classifications expected by customers and customary in the industry than to apply Solomon's sword to divide size classes consistently.

Item 6-2, Impact on building space-conditioning loads.

This coin has two sides: the impact of ice-making equipment on building space-conditioning, and the potential for waste heat from ice-makers to serve beneficial purposes. For example, including the heat of compression, an ice-maker will reject about twice as much heat as is required to heat the equivalent weight of water, so a water loop connecting the icemaker to a heat pump water heater could improve the efficiency of both. This is one reason that condenser water use must be treated independently of ice-making water consumption (**Comment L, Combined total water use**).

Item 8-6, O&M costs.

We respect the statements of representatives of Scotsman and Manitowoc at the Framework Public Meeting, December 16, 2010, that they would not expect significant changes in maintenance or repair costs for more efficient products.

Item 8-7, Equipment lifetimes.

We do not know of current studies of ice-maker service life that are available in the public record.

Item 8-8, Cost of water.

It is widely acknowledged that water supplies are being over-committed. Future costs will be much higher than today's, and there are likely to be restrictions on water use.[2] Under these circumstances, the Department should use the expected value of water during the period for which this standard will be in effect. That is unknown, of course, but the arguments presented suggest that good proxies are available. Of these, the easiest to use might be the highest decile of water tariffs (including sewage disposal fees) in the US today. In addition, there are enormous variations in the price of water today. For example, one survey found that the average monthly bill for a family of four using 100 gallons/person/day in major urban areas ranged from $20 to $121.[3] We assume that commercial water rates exhibit similar variations.

Item 10-1, Rebound effects.

The term "rebound effect" refers to the assumption that ice-maker energy use might increase if demand for ice increases because more efficient icemakers would have lower (energy) operating costs. The hypothesis would seem to require that the employees who dispense ice are sensitive to cost impacts, or that managers feel that providing more ice will generate higher profits. Or, for beverages, that serving more ice would increase profits if ice costs less than beverages, or that less expensive ice allows use of larger serving glasses and serving sizes, which can be priced higher. The point of this "house of cards" is to suggest that rebound effects, if any, would be very difficult to quantify rigorously without extensive field studies, focus groups, and economic analysis. We believe that rebound effects are unlikely to be large enough to matter for ice-makers, for the reasons outlined above.

[2] IEEE Spectrum, July 2010, special section on "Water vs. Energy."

[3] Circle of Blue. 2010. "Circle of Blue's Urban Water Pricing Survey." http://www.circleofblue.org/waternews/wp-content/uploads/2010/04/allstats.pdf.

Item 12-2, Pending regulations.

Substantial national forces have led to remarkable increases in stringency for ASHRAE 90.1 and are expected to continue. Similar forces are active and underlie changes in the "green" codes, such as ASHRAE 189.1-2009 and IGCC-2009. These forces are strong enough that the present Code versions are approaching the limits for compliance through prescriptive requirements for building construction and (in particular) for building equipment. The remaining energy use is dominated by "plug" loads for equipment installed by building uses, from coffee-makers to computers and ice-makers. The next generation of Codes will need to be based on performance requirements, such as kWh/sf-yr, and W/sf. These trends will greatly increase interest in innovative systems that "recycle" heat (such as water loop systems), systems that reject heat outdoors (remote condensers and rack systems), and more efficient "plug load" or "tenant fit-out" equipment. In this context, the most basic requirement is for DOE to do no harm. In turn, this requires DOE to ensure that its standards do not inadvertently discourage products that would actually save energy. Our fears are general, but a hypothetical example would be standards that lead customers to believe that self-contained units that reject waste heat to the building's interior air are more efficient than remote condensing or water loop systems that reduce detrimental heat rejection into cooled spaces.

Additional Issues

Comment A, Additional key scoping issues.

To the customer, the thermal properties of the storage bin that is integral to many ice-makers (notably excepting ice-making heads) is an attribute that may have importance both for energy consumption and, we assume, for the frequency of issues like ice clumping in the bin. We ask DOE to consider whether a separate standard should be developed for product classes where this may be relevant for energy consumption and customer utility. We recognize that this will not be easy, since it needs to include access systems that minimize behavior that leads to greater heat gain.

Comments D and E, Remote rack systems.

From the framework meeting on December 16, we understand that a rack system is a special case of a remote condenser system, one in which the ice-maker manufacturer does not control the efficiency of the condensing unit. In the context of **Additional Comment M,** we find options 1 and 2 much more congenial than option 3 (rating the IMH only). For either option 1 or 2, it is imperative that the "proxy" condensing unit or condensing unit energy consumption not be less than that of the unit most likely to be selected by manufacturers for remote condenser units that meet or exceed the standard adopted.

Comment F, Non-standards programs.

DOE certainly should review programs from EnergyStar, CEE, and FEMP, and incentive programs conducted directly by utilities. All can serve as indicators of performance levels that are readily available to customers. However, these programs do not absolve the Department of the requirement to set standards at the maximum levels that are technologically feasible and economically justified.

Comment G, Condenser water use.

It is critical that the Department differentiate between two very different classes of water-cooled condensers. "Once-through" or "open-loop" systems may use potable or non-potable water, but the water is only used once, and then dumped into some form of drain to a sewer or equivalent. In contrast, "closed-loop" systems have sealed brine circulation, typically serving multiple devices. For example, a convenience store might feed heat rejected by all refrigeration units, including ice-makers, into the common loop. Its heat can then be beneficially used for water heating, or even for ice melting. With such systems, a single boiler and closed-circuit cooling tower balance temperatures when heat rejection and extraction are too far from balance.

We note that the ASHRAE/ANSI/ISO 13256 – 1&2 standard for water-to-air space-conditioning heat pumps offers multiple test conditions and multiple ratings for equipment, so its performance can

be shown at conditions representative of boiler-cooling tower systems, groundwater, or closed (brine) loops. It is not implausible to consider such a multiple rating method for ice-makers.

Comment I, Proposed efficiency levels.

We appreciate the effort that has gone into the proposed efficiency levels, particularly the effort to examine work by others (NRCan, etc). The selected levels appear to be reasonable.

Comment J, Updating the test procedure per AHRI 810-2007.

We support this change to update the test procedure.

Comment L, Combined total water use.

The amount of water that must be purged in a batch cycle depends on water quality, particularly total dissolved solids (TDS). As indicated in our remarks on items 3-11 through 3-14 regarding potable water use, it seems that this situation could be addressed easily with prescriptive requirements for adaptive purge or bleed controls based on turbidity or conductivity.

Condenser water flow is much larger than potable water required for making ice, and it is important to differentiate between consumptive ("once-through" or "open loop") and water loop condensing applications. The former has much greater economic implications. For both reasons, we conclude that separate metrics for potable water use and condenser water use are preferable to a combined or total water use metric.

Comment M, Remote racks.

We do not support option 3, reporting the energy use of the IMH only, exclusive of the energy required for condensing. This could be misleading to customers. We do not have a strong preference between options 1 (default factor) and 2 (proxy condensing unit), as long as the option chosen has energy use no less than a governed remote condensing unit of similar capacity. In other words, the rating requirements for an ice-maker designed for connection to a compressor rack system should be equivalent to those for other remote condensing options.

Comment N, Test procedure accuracy.

We favor rating methods and test procedures that encourage innovation to improve efficiency.

Concluding Notes

We appreciate the opportunities that the Department provides for public input, and hope that these comments will be helpful as the Department moves forward with this rulemaking. Further, we are impressed with the positive attitude demonstrated by industry representatives at the public meeting, and look forward to working with all stakeholders toward a standard that will save energy and encourage innovative ways to differentiate products that provide greater customer value and industry profits.

Our only concern now is the possibility that the proposed accelerated schedule for this rulemaking may over-compress the time required to carry out, publish, and allow stakeholders to digest and respond to findings of the analytical processes the Department will undertake.

Sincerely,

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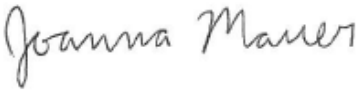
American Council for an Energy-Efficient Economy



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