Comments on EPA ENERGY STAR® Program Requirements Product Specifications for Residential Refrigerators and Freezers

(Eligibility Criteria, Draft 1, Version 5.0)

The following comments are provided to the Environmental Protection Agency (EPA) by the Electric Power Research Institute (EPRI) in response to the EPAs solicitation of stakeholder feedback regarding the draft "*ENERGY STAR® Program Requirements, Product Specification for Residential Refrigerators and Freezers, Eligibility Criteria*". EPRI appreciates the opportunity to provide feedback on this important body of work.

EPRI's review of this draft was limited to the technical aspects and our perspective is based on extensive work with utilities in the areas of energy efficiency and demand response. The comments fall along just a few topical lines, but are provided below in a repetitive fashion, following the outline and line-numbering provided by the EPA. It was thought that this approach might be easier for consideration during EPA review.

Comments Regarding the Prescription of Demand Response Characteristics

General EPRI Perspective

EPRI commends ENERGY STAR for the forward thinking to consider "Connected" product criteria to facilitate the market for "smart grid enabled" or "demand response-ready" residential refrigerators. Residential appliances, including refrigerators, have the potential to address a wide range of demand response services. The need and value of each type of service vary regionally (based on a number of local circumstances), seasonally, and over time as grid needs change. A given demand response action may provide significant value in one circumstance or at one specific time, yet have limited or no value in another.

In view of this, EPRI recommends an approach that focuses on successfully informing devices of grid condition rather than on their particular responses. This approach assumes that consumers will have the ability to set preferences and lifestyle settings that establish the extent to which they are willing to participate in demand response events. Moreover, this approach empowers appliance manufacturers to innovate in terms of the types of demand-responsive actions it makes available to consumers.

In support of a diversity of demand response services, smart metering systems can determine and validate the credit due to the customer for their participation in demand response programs in accordance with variable consumer preferences. This capability encourages creativity and innovation in the appliance industry, as manufacturers seek to maximize consumer benefits while minimizing inconvenience. It also provides consumers with a high degree of control and supports variable degrees of participation.

An example of additional grid information that is particularly useful for thermal devices is a forward-looking schedule. Advanced visibility to price increases or upcoming events can enable pre-cooling or pre-heating to ride-through the period of time when energy or capacity is in short supply or at a premium price. Another valuable example is the provisioning of information that indicates a low price or unusually opportune time to consume energy. The ability to plan ahead can be a notable advantage for extended efficiency.

EPRI suggests that the specific demand response types and levels indicated in this document might be better presented as a collection of minimum requirements, to ensure that qualified connected products can "at least shed xx% for yy hours", etc.

Finally, EPRI suggests that special consideration be given to grid security, particularly in the area of how responses to presumed grid signals might be more securely aligned with grid needs. For example, time-randomization at event edges might eliminate the possibility of sudden surges (or changes) in demand for grid services, disabling automation of undesired patterns of responses, and filtering algorithms that prevent unnatural recurrences might be specified to reduce certain risks.

Lines 265-283, Section 4A, HEM Functionality

- Simple clarification: energy consumption interval reporting should be specified as the energy consumed by the device (e.g. watt hours) during that period (line 270-271). To ensure that systems that might collect and present this data from a number of end devices can consistently and accurately present the data.

Lines 345-359, Section 4B Embedded Delay Defrost Capability

- EPRI assumes that the reference to the term "connected" in this context, as well as in general usage in this document, refers to a product/device that qualifies according to the proposed Energy Star program. This should perhaps be clarified as this section refers to the operation of Energy Star devices that are not currently "connected".
- We assume, per lines 355-357, that the embedded delay defrost feature must be fully functional for all ENERGY STAR qualified refrigerators, whether "Connected" or not. The wording is somewhat ambiguous and the message should be specified clearly in the final specification.
- The wording of the section suggests that the feature of automatically avoiding defrost operation between the "3 to 7 pm" period will be an embedded default. However, it is unclear to what extent the refrigerator's internal clock will be calibrated to its corresponding time zone "out of the box", or whether the burden falls on consumers to set the correct time. This needs to be specified.

  Moreover, EPRI notes that some utilities are winter-peaking and some are summer-peaking. The utility's annual period of maximum usage may occur in winter or summer and the hours between which this occurs vary by utility and region. As such, an assumption that 3-7 pm is the period to avoid may not be beneficial in all regions of the country and could actually increase the probability of defrost during the morning peak period. For products that have no communication connection, perhaps targeting a certain window of the day for when defrosting can occur (such as midnight to 4:00 am) would work better as the non-connected default for the defrost cycle.

- In similar support of the above notion, peak periods often exceed 4 hours. This would also be accommodated by specifying defrost hours as noted above in lieu of the specified peak as noted in this section.
- It should be clarified that this peak-time-window is to be provided to the appliance electronically in the event the appliance is connected. This is important for other design implementations that avoid energy consumption during peak hours.
- In line 349 the word "may" should be changed to "must" in the sentence "The product may provide the consumer with the option to modify the scheduling of this functionality". The reasons are noted in previous comments.
- For reference regarding the insufficiency of limiting load reduction to a 4 hour period, note that this does not satisfy the design or needs of most TOU plans. For reference, see the Salt River Project residential TOU plan (http://www.srpnet.com/prices/home/Tou.aspx), an example of a

mature program. This program is on-peak from 1 to 8PM in summer and 5-9 AM and PM in winter.

Lines 370-407, Section 4C, DR Functionality

- This section identifies two very specific demand response services out of many possibilities. In some regions, the two defined services may have little or no value, whereas other services may have significant value.

  Given that device responses may be determined through communication verification, sub-metering, or whole-home interval metering, it is suggested to avoid trying to predict the specific services that will be needed and instead define a "connected" device as: ***"A device capable of receiving information from the grid (e.g. price, events) and responding to this information according to the preferences and configuration of the consumer."***

Line 377:

- While 4 hour time duration might be selected as a minimum duration that an appliance must respond in order to qualify, it must be recognized that the duration of actual grid-need cannot be constrained. It should be recognized that DR requests from a system operators beyond 4 hours may occur and that some products may be able to sustain even a partial response for a longer period of time. The timing of high-price energy periods and other load management signals are true reflections of actual grid need, not contrived boundaries. System efficiency can only be optimized when products are provided with accurate indicators, regardless of their preconceived limitations.

Line 385:

- EPRI suggests that the 24 hour period be defined as an elapsed period and not a daily 24 hours cycle that could place two response requests back-to-back with one at the end of the 24hrs and the other at the beginning.

Line 380:

- This line allows for the deference of ice maker activity as a substitution for general energy consumption reduction. Since the relationship between this deference and actual energy reduction is not clear, it would be difficult for any value to be associated with this behavior. If the two are thought to be interchangeable, why not just focus on reduction in consumption, and allow ice-maker deference to be among the many tools that a manufacturer might utilize to accomplish the goal?
- Consistent with EPRI's general perspective, EPRI recommends dropping DR response specifics, focusing instead on the refrigerator's ability to receive unambiguous signals from the grid, and letting manufacturers creatively compete in terms of their product's responses– balancing consumer savings and consumer experience. For example, if 13% is a minimum reduction, there should be an incentive for exceeding this requirement.

Line 385:

This line specifies support of as few as one event per day. This may significantly lower the value of the demand response for these products. Many traditional load management programs and simple residential TOU rate plans include two periods of shed/high-price each day. For reference, recall the SRP program referenced above with two price periods. Direct load control programs also often use two periods.

Line 387:

- It is not clear what existing grid needs this behavior is intended to serve. It would be beneficial to provide examples associating this function with existing demand response services in the ISO/RTO Council's "*Demand Response Program Comparison*" spreadsheet, with particular attention to the ramp times and sustained-hold times provided for each existing service.

Lines 417 to 424:

- This notes-section describes the DAL (4 hour shift) vision. It is recommended that the methods by which the energy reduction would be met not be specified, but left to a competitive environment to decide.

- EPRI notes that increases in consumption prior to a curtailment period are of potential value (pre-cooling the refrigerator). Also note that such increases may be particularly valuable at any time of day when excess clean renewable energy is available. Achieving this requires communication of additional information to the end device and responses not documented in the specification.

Comments Regarding Communication Architectures and Techniques

Lines 468 to 470:

- This section requires that products use "Home Area Network" standards for communication. It is recommended that the specific reference to "HAN" be removed for a number of reasons, including:
  a. Nearly 100% of the presently managed residential load is achieved using wide-area communication signals, such as FM, Pager, Cellular, and PLC. It is not beneficial to be technologically- or architecturally-prescriptive in a document of this type, and it is unnecessary to presume that consumers or utilities will choose to utilize Home Area Networks for load management.
  b. Employment of Home Area Networks assumes additional other equipment onsite that bridge from a wide-area communication system to a local area. These additional devices drive cost, consumption, and complexity; and may or may not be desirable.

c. Elsewhere, this document acknowledges the option of communication modularity, making it possible for these refrigerator products to work equally well with any communication technology and architecture.

- EPRI recommends the addition in this section of a statement to the effect: ***"A modular communication interface may be used to enable a refrigerator to be compatible with any communication technology. If this option is used, open standards such as the Consumer Electronics Association R7-8 interface are recommended, so that the refrigerator may be compatible with any third-party module."***

Lines 468 to 470:

- This section further requires that standards used be identified as "SGIP NIST HAN Standards". Recommend modifying this statement to recognize the following:
  a. As stated above, system architectures may or may not be "HAN" based.
  b. Note that the NIST SGIP list of standards is a living list, continuously being revised. Optimal solutions may not yet be listed, and manufacturers ought not be restrained from selecting best market options at the time of refrigerator design.
  c. At the present time, there are not complete sets of standards (all layers), sufficient to enable residential demand response, so non-standard elements are required.
  d. At present, most DR communication systems, including those that allow consumers to choose third-party aggregators, are based on proprietary technologies.

Lines 500 to 502:

- Line 502 indicates that communication modules, if used, must be "provided to consumers by the manufacturer". EPRI sees this as an unnecessary restriction that would hamper innovation and limit competition. If communication modules are used, it should be possible to use those from any module supplier, and not tied to the manufacturer of the appliance. The CEA / NIST standard modular communication interface, as an example, is specifically intended to enable interoperability between any end device and any consumer-installable communication module.

Lines 509 to 511:

- These EPA notes suggest that the acknowledgment of a modular communication option was due only to immaturity of certain present communication technologies. EPRI agrees that immaturity exists, and notes that this statement conflicts with the implied maturity of standards in lines 468 to 470. EPRI suggests that the support of customer-installable communication modules via a standard interface has significant benefits to the public and suggests that it be acknowledged as a viable option for manufacturers in the context of this specification. These benefits include:
  a. Avoiding obsolescence of long-life appliances as communication technologies evolve
  b. Minimizing both cost and power consumption at the time of purchase, and deferring both until such time as a consumer elects to participate in a utility program
  c. Fostering ongoing competition among companies and technologies to provide lower-cost, lower power consuming solutions

d. Compatibility with all kinds of present and future DR programs and technologies

Lines 533 to 546:

- Testing and Certification. It is recommended that consideration be given to separate testing of refrigerators and communication technologies, whenever the refrigerator utilizes a modular communication interface. This is consistent with recognizing that a single product might be utilized with many different communication modules over its service life and in different regions of the country. In other words, it should be possible to certify a product that uses a modular communication interface by testing commands at that interface, with no foreknowledge of what communication technology might be used in field service.

- It is also reasonable to consider that various communication/networking technologies, both present and future, might benefit from a kind of "ENERGY STAR" ranking system.

Miscellaneous Editorial Comment

Line 52:

Minor change suggested. To account for some DR services involving both requests to run/increase and stop/decrease, recommend a minor adjustment to the definition here to say "… immediate or scheduled increase or reduction of residential load". Note: this point is already reflected in line 373.

In addition to regulation services, the general ability to increase load when an abundance of clean renewable energy is available may reduce consumption at other times, providing a valuable service.

Line 272 to 275:

- Manufacturer ability to use remote management as an extension of the communication ability could be safely assumed in the general sense. If, perhaps, the purpose of this line is to ensure that a product does not contain the enablement of two concurrent communication interfaces (thus increasing energy usage) it should be clearly stated as such. Otherwise these lines should be removed as they don't directly apply to the DR specification.