**Proposed RTF Measure: Refrigerated Display Case Calculator**

1. Proposed measure type: (UES Measure or Standard Protocol)

Standard Protocol

2. Title:

**Refrigerated Display Case Replacement**

3. Proposed category: (Planning, Proven or Small Saver)

Planning

4. Description:

We propose a UES measure that will account for the following several measures, including:

* Fan motor retrofits: ECM or PMSM fan motor retrofits and VSD condenser fan control
* LED lighting
* Controls: lighting motion sensors, ASH controls, on-demand defrost, floating controls
* Door retrofits: replace existing doors with high performance doors and adding doors to open cases.
* Night curtains
* Case change outs: Replace open existing cases with new closed cases, including high efficiency DX cases and propane cases
* High efficiency compressors
* High efficiency condensers, including microchannel coils and oversized-condensers

**Why This Is Important:** Replacing display cases with a UES measure is challenging because there is enough variety in the base case and proposed case, some may already have energy cosnervation measures included that are at the sub case level. Energy savings of each measure depends on measures already installed at the site and the order of implementation. Grocery stores typically will have some subset of these measures already installed. These site-specific differences are not captured by UES savings.

Uptake of several of the measures currently offered by the RTF as UES measures has not been high. Offering grocery display case measures as a “one-stop” suite of measures will improve visibility and awareness of the many measures that are possible, hopefully improving uptake.

Programmatically, using the same methodology region-wide for analyzing grocery store measures, properly accounting for measure interactions and measures already installed, will more accurately quantify captured savings as measures are implemented.

**Potential Energy Savings:** The potential savings of this calculator can be illustrated by looking at case change outs. Consider the example of an existing standard-efficiency, medium temperature vertical open case with shaded-pole evaporator motors and T8 lighting on a remote system. Replacing this case with a new vertical closed case with ECM motors, LED lighting with motion controls, and high performance transparent doors saves 1,582 kWh/year per linear foot of case, which is 90% of the baseline case’s energy use (USDOE 2013). For a typical large grocery store with about a quarter of its cases being medium-temperature vertical open cases by length, this represents 20% savings of the energy use of all its display cases.

**Calculations:** We suggest the UES measure be based on the methodology summarized in USDOE’s Technical Support Documentation for the 2017 federal efficiency standards for appliances (USDOE 2013), supplemented by references such as Arias (2005) and Thornton (1991). NREL’s Refrigeration Playbook hourly Excel-based calculator is unprotected and open source. This spreadsheet makes a good starting point for a refrigeration calculation engine.

**Preliminary Technical Potential:** Technical potential is estimated to be 30 aMW. This was developed with the assistance of Council staff by estimating savings for three prototypical stores (small, large, big box) based on PG&E (2011). These values were projected regionally using data from the CBSA (NEEA 2014) and discounted considering achievability, applicability, measure saturation and measure overlap.

**References:**

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PG&E. *Supermarket Refrigeration Codes and Standards Enhancement Initiative (CASE).* technical support document, California Air Resources Board, 2013 California Building Energy Efficiency Standards, 2011, <https://ww3.arb.ca.gov/cc/commref/supermarket%202013%20nr15%20case%20report%20draft%2017mar11.pdf>

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