Short Form Work Paper WPSDGEREHC0031

**Revision 0**

**San Diego Gas & Electric**

**Energy Efficiency Engineering**

**Direct Evaporative Coolers**

**October 25, 2017**

# SDG&E LED Direct Evaporative Coolers

## Introduction

This short form workpaper (WP) documents the values adopted from SCE’s WP entitled “Direct Evaporative Coolers” (SCE17HC013.0 - Direct Evaporative Coolers\_Final.docx). SDG&E adopts all the values in SCE17HC013.0 - Direct Evaporative Coolers, with the following exception:

1. SDG&E will only reference Replace on Burn-out(ROB) installation type, similar to PGE, as opposed to SCE’s REA due to installation method.
2. SDG&E will only reference units of “per 1,000 sq. ft.” similar to SCE, as opposed to PG&E’s household units.
3. SDG&E will only reference for CZ 14 only for mobile homes.

## Document Revision History

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| --- | --- | --- | --- |
| **Rev** | **Date** | **Author** | **Summary of Changes** |
| 0 | 110/17/17 | Kelvin Valenzuela/SDGE | * Adapted SCE’s workpaper SCE17HC013.0 * Utilize same methodology from LEAD PA workpaper but focused solely on climate zone 14 for mobile homes |
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## Measure Summary

Table 1: Measure Summary Table

| **Section** | **Value** |
| --- | --- |
| **Summary & Purpose** | This short form workpaper documents ex-ante load impacts and cost-effectiveness values for Direct Evaporative Coolers. The base energy consumption and measure energy consumption values are from SCE’s workpaper, SCE17HC013, Revision 0.  SCE’s workpaper details the installation of direct evaporative coolers to displace compressor based space cooling in both residential and non-residential buildings. The operation of direct evaporative coolers provides necessary cooling capacity and comfort with a fraction of the energy required for traditional DX cooling. Direct evaporative cooling is achieved by passing outdoor air over a cooling media that is saturated with water and distributing it into the indoor space.  SDG&E will utilize the same methodology, with a few exceptions to fit into SDG&E’s specific offerings in climate zone 14 for mobile homes only. |
| **1.1 Measure & Baseline Data** | Measure:  463820 – Direct Evaporative Coolers (Res)  464037 – With Dampers Direct Evaporative Coolers |
| **1.2 Technical Description** | Direct evaporative cooling is achieved by passing outdoor air through a wetted media and distributing it into the indoor space. Evaporating water from this media removes sensible heat from the airstream, lowering its dry bulb temperature. At the same time, moisture is added to the airstream, raising its relative humidity, which can sometimes reach uncomfortable levels. However, for most conditions throughout a typical cooling season, direct evaporative cooling can adequately meet cooling loads and maintain reasonable humidity levels.  For the residential sector in Southern California Edison (SCE), this measure assumes that direct evaporative coolers are added equipment to the home, i.e., they are not replacing any existing central air conditioning equipment. The evaporative coolers are used to displace the use of an existing central air conditioning system when cooling is required and the ambient dew point is less than 55 F. The residential measures in this work paper are applicable to all Southern California Edison climate zones and the associated building types shown later in the report.  For Pacific Gas & Electric (PG&E), this measure assumes that direct evaporative coolers are replacing an existing, whole house vapor-compression air conditioning system. The residential measures are applicable only for multifamily dwellings in climate zones 11, 12 and 13.  Energy savings is reported for both cases i.e. with and without pressure relief dampers within SCE’s workpaper. The use of pressure relief dampers negates the need to open windows and discharges air into the attic, keeping the attic cool and reduces heat gain in the house.  For San Diego Gas & Electric (SDG&E), this measure assumes the same characteristics as PG&E’s replacement and install, except the residential measures are applicable only for mobile homes in climate zone 14. |
| Measures | See Requirements |
| Code for All Measures | There are no energy efficiency standards or energy design standards for this measure. The Title 24 2016 Residential and Non-Residential Compliance Manual [496] provides indirect and indirect-direct evaporative coolers with compliance credits, but does not allow compliance credit for direct evaporative coolers.  The measure involves only residential retrofit, therefore, 2016 Title-24 code for non-residential efficiency requirements do not apply to this work paper.  2016 Title 20 [508] does not cover evaporative coolers, and gives the following language, “There are no energy efficiency standards or energy design standards for spot air conditioners, evaporative coolers, whole house fans, or residential exhaust fans.”  According to 2016 Title-20 code, systems installed after January 1, 2015 must have a minimum SEER of 14.0 according to Section 1605.1. Federal and State Standards for Federally-Regulated Appliances Table C-3. 2016 Title-20 code is mentioned as a reference only. Savings impacts are not updated. Below is the minimum efficiency table from Title-20 code.    **Code Summary**   |  |  |  | | --- | --- | --- | | **Code** | **Reference** | **Effective Dates** | | Title 20 (2016) | Section 1605.1. Federal and State Standards for Federally-Regulated Appliances Table C-3  Standards for Air-Cooled Air Conditioners and Air-Source Heat Pumps Subject to EPAct | January 1, 2017 | | DOE | N/A | N/A | |
| Requirements | An Advanced Evaporative Cooler Level 1 (AEC-1) must have a rigid media direct stage, manufactured evaporative media with a rated saturation effectiveness of 0.85 or better (a natural fiber pad is not allowed – the rigid media is generally 8” or 12” thick), a two speed fan, a multi-position control switch that allows two fan speed operation and fan only operation and a water quality management system that provides positive removal of sump water on a regular interval (a bleed system is not allowed).  To be eligible for these measures, customers must be a SDG&E electric customer, live in a mobile home and live in Climate Zones 14. |
| **1.3 Installation Type and Delivery Mechanisms** |  |
| Installation Type | Replace on Burn-out (ROB) |
| Delivery Mechanisms | Direct Install |
| **1.4.1 DEER Data** |  |
| Net-to-Gross Ratio | Res-Default>2yrs |
| Effective and Remaining Useful Life | HVAC-Evap-Cool |
| **Section 2. Calculation Methodology** | **Residential Sector**  **Southern California Edison**  The residential SCE savings values are represented by the equations below:  *Annual energy savings = DEER kWh Savings \* ESAF \* HEAF*  *Demand reduction = DEER kW reduction \* PDAF \* HEAF*  where: DEER savings are from the READi tool v.2.4.7, measure D03-405  ESAF is the Energy Savings Adjustment Factor  PDAF is the Peak Demand Adjustment Factor  HEAF is the Human Error Adjustment Factor  The annual energy and demand savings for the residential sector are based on the full DEER measure savings from D03-405, taken directly from the DEER 2017 READi Tool,multiplied by the appropriate adjustment factor to account for the air conditioning system runtime during the year (see Attachment #2 Residential Savings Calculations). Where dampers are installed, 38 kWh per home is added (see Attachment #1 SCE Calculation Template, “Impact” tab, column AE). This value was derived from the 2004-2005 incentive program direct evaporative cooler savings values, as given in workpaper SCE13HC013.0.  There are three adjustment factors: The energy savings adjustment factor (ESAF) which is multiplied by the annual energy savings (DEER field: ACustWBkWh), the peak demand adjustment factor (PDAF) which is multiplied by the demand reduction (DEER field: ACustWBkW) and the human error adjustment factor (HEAF) which is multiplied by both the annual energy savings and the demand reduction.  **Human Error Adjustment Factor (HEAF)**  This measure requires that only one mechanical system at a time can operate, and this will be made clear to the customer. However, the customer may forget to do so and end up operating both DX and evaporative systems simultaneously. Therefore, a human error adjustment factor is required to de-rate savings. As there have been no studies performed to measure this particular factor, the HEAF will be arbitrarily set at 75% until a study yields a more conclusive value. This implies that up to 25% of the savings will be lost due to non-ideal operation of the evaporative cooler and DX system.  **Energy Savings and Peak Demand Adjustment Factors (ESAF & PDAF)**  The ESAF and PDAF varies by climate zone and was estimated using hourly dry bulb, wet bulb, humidity ratio, and atmospheric pressure from the DEER2014 supporting Excel workbook CompareWeatherData-v4.xls. |
| Energy Savings/Peak Demand Reduction – All Measures | Referencing Attachment #2 Residential Savings Calculations from SCE, SDG&E savings for DMo CZ 14 are as follows:  **Direct Evaporative Coolers**  DEER kWh savings = 678 kWh  DEER demand reduction = 1.58 kW  ESAF = 0.880849  PDRF = 1  HEAF = 0.75  *Annual energy savings = DEER kWh Savings \* ESAF \* HEAF*  *= 678 \* 0.880849 \* 0.75*  *= 447.91 kWh*  *Demand reduction = DEER kW reduction \* PDAF \* HEAF*  *= 1.58 \* 1 \* 0.75*  *= 1.185 kW*  **With Dampers Direct Evaporative Coolers**  Where dampers are installed, 38 kWh per home is added (referenced from SCE’s Attachment #1 SCE Calculation Template, “Impact” tab, column AE). This value was derived from the 2004-2005 incentive program direct evaporative cooler savings values, as given in workpaper SCE13HC013.0.  *Annual energy savings = 447.91 kWh + 38 kWh*  *= 485.91 kWh*    *Demand reduction = DEER kW reduction \* PDAF \* HEAF*  *= 1.58 \* 1 \* 0.75*  *= 1.185 kW* |
| **Section 3. Load Shapes** | SDGE:DEER:HVAC\_Eff\_AC Annual |
| **Section 4. Cost** |  |
| **Section 4.1 Base and Measure Costs** |  |
| Base Cost | See ex ante tables |
| Measure Cost | See ex ante tables |