Work Paper SCE17WP004

**Revision 2**

**Southern California Edison**

**Faucet Aerator and Low Flow Showerhead**

# At-a-Glance Summary

|  |  |
| --- | --- |
| **Measure Codes** | WH-62220, WH-20767, WH-79994 |
| **Measure Description** | WH-62220 - 1.0 GPM Faucet Aerator for Non-Mfm (Electric and Natural Gas Water Heaters),  WH-20767 - 1.0 GPM Faucet Aerator for Mfm (Electric and Natural Gas Water Heaters),  WH-79994 - 1.5 GPM Low Flow Showerhead (Electric and Natural Gas Water Heaters) |
| **Base Case Description** | 1.91 GPM No Faucet Aerator  1.8 GPM Standard Showerhead |
| **Units** | Each |
| **Energy Savings** | Refer to Excel Calculation Attachment 1 |
| **Full Measure Cost ($/unit)** | Refer to Excel Calculation Attachment 1 |
| **Incremental Measure Cost ($/unit)** | Refer to Excel Calculation Attachment 1 |
| **Effective Useful Life** | WH-62220 & WH-20767 - WtrHt-WH-Aertr: 3.33 years;  WH-79994 - WtrHt-WH-Shrhd: 10 years |
| **Measure Installation Type** | WH-62220 & WH-20767 (Faucet Aerator): Retrofit Add-on (REA)  WH-79994 (Low Flow Showerhead): Replace-on-Burnout (ROB) |
| **Net-to-Gross Ratio** | Aerator, SF/Dmo: 0.59 (NTG ID: Res--mDHWaerator)  Aerator, MFM: 0.65 (NTG ID: Res-mDHWaerator-MF)  Low Flow Showerhead, SFM: 0.7 (NTG ID: Res-sAll-mDHWshwr)  Low Flow Showerhead, SFM: 0.55 (NTG ID: Res-Default>2) |
| **Important Comments** | This work paper has a complementary Ex Ante Database data set that will be provided in a separate submission to the California Public Utilities Commission (CPUC). |

# Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Rev** | **Date** | **Author** | **Summary of Changes** |
| 0 | 11/23/2016 | Arvind Subramanya/TRC; Andres Fergadiotti/SCE | - This work paper is an update of SCE13WP004.3  - New calculation template update for 2017 program year  - Work paper is updated with 2016 Title-24 Residential code requirement and 2016 Title-20 Code language.  - Faucet aerator measure revised to reflect 1.0 GPM faucet aerator to be compliant with 2016 Title 20 Code.  - Faucet Aerator material cost has been updated to reflect latest cost from Grainger.com source and labor cost updated to reflect RSMeans 2016 labor rates.  - All (16) California Climate Zones have been added to the calculation template.  - EUL updated in accordance with Draft Resolution E-4807 [510] |
| 1 | 11/1/2017 | Brett Reno/TRC | - Revise the Installation Type for the low flow showerhead measure to ROB.  - Based on the revised Installation Type, the following revisions were made:   * Calculation methodology was revised to reflect the savings above the code showerhead GPM * EUL was revised to 10 years * The base case costs were revised to reflect the material and labor costs for code 1.8 GPM showerhead. * The measure case material cost was updated to reflect 1.5gpm showerhead since the cost was previously based on the incremental measure cost provided in WO017.   - Remove the hard to reach NTG values. |
| 2 | 6/5/2018 | Joseph Ling/AESC | -Revised Costs as follows:   * Added scaling factor for WO17 Cost * Updated online vendor Cost * Updated Labor Cost Sources   -Updated to new Calculation Template (A1) |
| 10/12/2018 | Jesse Manao/SCE | -Revised NTG ID for Faucet Aerator in accordance to Final Resolution E-4952  -Added solution code to differentiate between Mfm and Non-Mfm BT on Faucet Aerators |

# Commission Staff and Cal TF Comments

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Rev** | **Party** | **Submittal Date** | **Comment Date** | **Comments** | **WP Developer Response** |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

Cal TF website: <http://www.caltf.org/>

# Section 1. General Measure & Baseline Data

## 1.1 Measure Description & Background

The measures are:

* 1.0 GPM faucet aerator installed on a faucet with no existing aerator (1.91 GPM) The faucet aerator heating source can be electric or gas.
* 1.5 GPM Low Flow Showerhead replacing Standard 1.8 GPM Showerhead The showerhead heating source can be electric or gas.

**Base, Standard, and Measure Cases (Faucet Aerator)**

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | 1.0 GPM Faucet Aerator |
| Existing Condition | No Faucet Aerator 1.91 Faucet |
| Code/Standard | N/A |
| Industry Standard Practice | N/A |

**Base, Standard, and Measure Cases (Low Flow Showerhead)**

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | 1.5 GPM Low Flow Showerhead |
| Existing Condition | N/A |
| Code/Standard | For Faucet Aerator; 1.8 GPM Standard Showerhead |
| Industry Standard Practice | N/A |

Measures and Codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Codes** | | | | **Measure Name** |
| SCG | SDG&E | SCE | PG&E |
|  |  | WH-62220 |  | 1.0 GPM Faucet Aerator replacing No Faucet Aerator |
|  |  | WH-20767 |  | 1.0 GPM Faucet Aerator replacing No Faucet Aerator for Multifamily BT |
|  |  | WH-79994 |  | 1.5 GPM Low Flow Showerhead replacing Standard Showerhead |

**Implementation Requirements**

Eligible building types are:

* Residential Single Family
* Residential Multi-family
* Residential Mobile Home - Double-Wide

All SCE climate zones are eligible. For direct install measures, the contractor must verify that the product is installed correctly. It is also the responsibility of the contractor working on the residence to meet all applicable code requirements if and when invoked. Additional program requirements may be needed to support each specific measure.

## 1.2 Technical Description

A faucet aerator is a device that screws onto an existing faucet head in order to reduce water flow. It splits the flow of water into multiple streams and adds air. This reduces flow while maintaining sufficient water pressure. This work paper assumes an aerator measure case flow of 1.0 gallons per minute (gpm).

There are 2 types of low flow showerheads:

* Aerating showerheads introduce air into the flow, which produces an even, misty spray while maintaining sufficient water pressure.
* Laminar flow showerheads split the flow of water into multiple parallel streams; no air is added. They produce less steam than aerating showerheads.

This work paper assumes a showerhead measure case flow of 1.5 gpm.

## 1.3 Installation Types and Delivery Mechanisms

The delivery mechanisms for these measures are:

* Financial Support – Direct Install

The program type/install types for each measure are:

* Faucet Aerator replacing No Faucet Aerator: Retrofit Add on - REA
* Low Flow Showerhead replacing Standard Showerhead: Replace on Burnout - ROB

**Installation Type Descriptions**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Installation Type** | **Savings** | | **Life** | |
| 1st Baseline (BL) | 2nd BL | 1st BL | 2nd BL |
| Replace-on-Burnout (ROB) | Above Customer Existing | N/A | EUL | N/A |
| Retrofit Add-on (REA) | Above Customer Existing | N/A | EUL | N/A |

A delivery mechanism is a delivery method paired with an incentive method. Delivery mechanisms are used by programs to obtain program participation and energy savings.

**Delivery Method Descriptions**

|  |  |
| --- | --- |
| **Delivery Method** | **Description** |
| Financial Support | The program motivates customers, through financial incentives such as rebates or low interest loans, to implement energy efficient measures or projects. |

**Incentive Method Descriptions**

|  |  |
| --- | --- |
| **Incentive Method** | **Description** |
| Direct Install | The program implements energy efficiency measures for qualifying customers, at no cost to the customer. |

## 1.4 Measure Parameters

### 1.4.1 DEER Data

Both measures were in DEER 2005, but are not included in DEER 2017/2018. Therefore, savings in this work paper are based on the Energy Division disposition dated 02/22/2013 for Water Fixtures (Attachment 2).

DEER Difference Summary

|  |  |
| --- | --- |
| **DEER Item** | **Used for Workpaper?** |
| Modified DEER methodology | No |
| Scaled DEER measure | No |
| DEER Base Case | No |
| DEER Measure Case | No |
| DEER Building Types | No |
| DEER Operating Hours | No |
| DEER eQUEST Prototypes | No |
| DEER Version | DEER 2017, READI v2.5.1 |
| Reason for Deviation from DEER | DEER contained similar measures which have since been removed. |
| DEER Measure IDs Used | N/A |

**Net-to-Gross Ratio**

The NTG values provided in the table below are referenced in both Draft Resolution E-4952 (Attachment 5) and the Energy Division’s 2013 disposition for Water Fixtures (Attachment 2). The relevant NTG values for the measures in this work paper are in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **NTGR ID** | **Description** | **Sector** | **BldgType** | **Measure Delivery** | **NTGR** |
| Res -mDHWaerator | Faucet aerators, all residential building types except multi-family | Res | Any | DirInstall | 0.59 |
| Res -mDHWaerator-MF | Faucet aerators, multi-family building types only | Res | MFm | DirInstall | 0.65 |
| Res-sAll-mDHWshwr | Low flow showerheads | Res | Any | DirInstall | 0.7 |

**Spillage Rate**

Spillage rates are not tracked in work papers; they are tracked in an external document which will be supplied to the Commission Staff.

**Installation Rate**

The IR values were obtained using the DEER READI v2.5.1 tool and are consistent with the Energy Division’s Disposition. The relevant IR values for the measures in this work paper are in the table below. Per Energy Division disposition dated 02/22/2013 for Water Fixtures (Attachment 2), installation rates for “All” utilities are used.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **GSIA ID** | **Description** | **Sector** | **BldgType** | **ProgDelivID** | **GSIAValue** |
| Res-LowF-FA-All | Residential low-flow Faucet Aerator; Annual Installation Rate | Res | Any | NonUpStrm | 0.67 |
| Res-LowF-SH-All | Residential low-flow Showerhead; Annual Installation Rate | Res | Any | NonUpStrm | 0.74 |

**Effective and Remaining Useful Life**

The EUL and RUL values were obtained using the DEER READI v2.5.1 tool. DEER defines the RUL as 1/3 of the EUL value of host equipment. For REA measures, the EUL is RUL of the host equipment or the EUL of the measure itself whichever is lower. The relevant EUL and RUL values for the measures in this work paper are provided in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **EUL ID** | **Description** | **Sector** | **UseCategory** | **EUL (Years)** | **RUL (Years)** |
| WtrHt-WH-Aertr | Faucet Aerators | Any | SHW | 3.33 | N/A |
| WtrHt-WH-Shrhd | Low-Flow Showerhead | Any | SHW | 10 | - |

### 1.4.2 Codes and Standards Analysis

**Title 20 2016 [508]:** Section 1605.1, Table H-3 provides requirements for aerators and Table H-5 provides requirements for showerheads. The measure cases in this work paper have lower flow rates of 1.5 gpm for showerheads and 1.0 gpm for aerators when compared to 2016 Title-20 standards. The faucet aerator is a Retrofit Add-On (REA) measure and is not impacted by code. The showerhead measure was determined to be a Replace-on-Burnout (ROB) measure and is impacted be code. As indicated in Table H-5 below, showerheads manufactured on or after July 1, 2018 are required to have a minimum flow rate of 1.8 gpm. As detailed in Section 2, calculation methodology, below the baseline assumed in the workpaper has been updated to be consistent with code requirements.





**Title 24 2016 [496]**: Section 110.1 references the requirements set in Title 20 [516].

Code Summary

|  |  |  |
| --- | --- | --- |
| **Code** | **Reference** | **Effective Dates** |
| Title 20 (2016) | Section 1605.1, Table H-3 and H-5 Standards for Plumbing Fittings | May 1, 2018 |
| Title 24 (2016) | Section 110.1 Mandatory Requirements for Appliances | January 1, 2017 |

## 1.5 EM&V, Market Potential, and Other Studies – Base Case and Measure Case Information

**1.5.1 Non-DEER Study Review**

No studies were reviewed for this work paper.

## 1.6 Data Quality and Future Data Needs

N/A

# Section 2. Calculation Methodology

The 2/22/13 Energy Division Workpaper Disposition for Water Fixtures (Attachment 2) provided “basis” savings values for:

* Showerheads 1.5 gpm, 1.6 gpm, and 1.7 gpm
  + The average base case flow is 2.25 gpm, according to SCG and SDG&E study data.
* Faucet Aerators 0.5 gpm, 1 gpm, and 1.5 gpm
  + The average base case flow is 1.91 gpm, according to SCG and SDG&E study data.

Values from the embedded calculation spreadsheet in Energy Division’s Water Fixture Disposition, dated February 22, 2013 (Attachment 2) were used in the calculations (Attachments 1 and 3). The embedded values for the showerheads are calculated based on a baseline of 2.25 GPM. For this workpaper, the baseline was adjusted to 1.8 GPM as per code requirements, and the savings were adjusted using a linear regression. The methodology assumes a linear relationship with the Energy Division’s “basis savings values” for the DHW fixtures and the GPM reduction for the showerheads. The GPM reduction for the showerheads is based on the measure flow rates indicated above (1.5 gpm, 1.6 gpm, and 1.7 gpm) and average base case flow rate of 2.25 gpm. Please refer to the ‘Showerhead’ tab of Attachment 3 for detailed calculations. Based on this relationship, the energy impacts for a 1.5 gpm showerhead assuming a code baseline of 1.8 gpm were extrapolated. The extrapolated energy impacts were multiplied by climate zone-specific multipliers, as provided in the Water Fixture Disposition, to determine final savings. The Single Family, Multi Family, and Mobile Home building types were included.

Based on code requirements, the most conservative ED-provided savings are used within the calculations (Attachment 3). The most conservative measures were selected as follows:

* Showerhead 1.5 gpm (“ShowerHd-Gas-1.5,” “ShowerHd-Elec-1.5”)\*\*
* Faucet Aerator 1.0 gpm (“FaucetAer-Gas-1.0-Lav,” “FaucetAer-Elec-1.0-Lav”)

\*\*Note that although the written ED disposition shows the correct savings values for Showerheads 1.5 and 1.7 gpm (Tables 2 and 3 in the disposition), the calculation spreadsheet “20132014DHWFixturesMeasures.xlsx” has reversed the two sets of values in the ‘ED\_Measure\_Impacts’ tab. This inconsistency is evident because the 1.7 gpm showerhead is showing higher savings than the 1.5 gpm showerhead, which is not expected based on a base case 2.25 gpm showerhead.

**Market Share**

For non-direct install program delivery (which is currently not supported by SCE), it is unknown whether the customer uses electric water heating. Therefore, the savings would have to be multiplied by an adjustment factor of 7%, which is the market share of electric water heaters in SCE territory, from the 2009 Residential Appliance Saturation Study [428]. However, since this workpaper only addresses Direct Install program delivery, measure impacts documented in the Disposition were not adjusted to account for market share for cases where there is uncertainty as far as the installed technology. Further, on all projects, Direct Install installations include verification of installed equipment.



Sample measure impacts adopted from Disposition for Faucet Aerators and Low Flow Showerheads for Single Family (SFM) based on the calculation methodology described above are summarized in the table below. See Attachment 1 and 3 for a full list of savings for all affected measures and building types.

**ED Disposition & Adjusted Savings – Single Family**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Faucet Aerators**  **(1.0 GPM)**  **Disposition Savings** | | | | **Electric Low Flow Showerhead (1.5 GPM)\***  **Savings** | | |
| **CZ** | | **kWh** | **kW** | **Therm** | **kWh** | **kW** | **Therms** |
| 1 | | 37.25 | 0.00374 | 1.617 | 72.20 | 0.0073 | 3.2643 |
| 2 | | 37.07 | 0.00372 | 1.610 | 71.85 | 0.0072 | 3.2487 |
| 3 | | 36.26 | 0.00364 | 1.575 | 70.30 | 0.0071 | 3.1784 |
| 4 | | 35.02 | 0.00352 | 1.521 | 67.88 | 0.0068 | 3.0691 |
| 5 | | 36.00 | 0.00362 | 1.563 | 69.78 | 0.0070 | 3.1550 |
| 6 | | 34.13 | 0.00343 | 1.482 | 66.15 | 0.0066 | 2.9910 |
| 7 | | 33.32 | 0.00335 | 1.447 | 64.60 | 0.0065 | 2.9207 |
| 8 | | 32.34 | 0.00325 | 1.405 | 62.70 | 0.0063 | 2.8348 |
| 9 | | 32.97 | 0.00331 | 1.432 | 63.90 | 0.0064 | 2.8895 |
| 10 | | 32.61 | 0.00328 | 1.416 | 63.21 | 0.0064 | 2.8582 |
| 11 | | 33.86 | 0.00340 | 1.470 | 65.63 | 0.0066 | 2.9675 |
| 12 | | 34.93 | 0.00351 | 1.517 | 67.70 | 0.0068 | 3.0613 |
| 13 | | 32.70 | 0.00329 | 1.420 | 63.39 | 0.0064 | 2.8660 |
| 14 | | 34.57 | 0.00347 | 1.501 | 67.01 | 0.0067 | 3.0300 |
| 15 | | 27.44 | 0.00276 | 1.192 | 53.20 | 0.0053 | 2.4053 |
| 16 | | 38.76 | 0.00389 | 1.683 | 75.13 | 0.0075 | 3.3971 |

\* The embedded values in the Energy Division’s Water Fixture Disposition, dated February 22, 2013 (Attachment 2) for the showerheads are calculated based on a baseline of 2.25 GPM. For this workpaper, the baseline was adjusted to 1.8 GPM as per code requirements and the savings were adjusted using a linear regression. Refer to attachment 3 for linear regression equations.

# Section 3. Load Shapes

The ideal load shape for net benefits estimates would represent the difference between the base case and measure case. The closest load shapes that are applicable to the measures in this work paper are listed in the table below.

Building Types and Load Shapes

|  |  |  |
| --- | --- | --- |
| **Building Type** | **Load Shape** | **E3 Alternate Building Type** |
| Residential Mobile Home - Double-Wide | HeatPump\_WtrHt-RC | Residential |
| Residential Multi-family | HeatPump\_WtrHt-RC | Residential |
| Residential Single Family | HeatPump\_WtrHt-RC | Residential |

# Section 4. Costs

For Direct Install measures, SCE directly utilizes one or more contractors as part of the program. The actual cost can vary by contractor, the date in which the work occurred, and by the volume of business. Contractor costs are confidential information and are based upon contractually agreed upon pricing as established in their purchase order with SCE; therefore, the SCE program tracking system is the only source for this data

## 4.1 Base Case Cost

The base case cost for faucet aerators is $0 because this is a Retrofit Add-On (REA) measure and the base case is the customer’s existing equipment. The base case material cost for the showerheads is based on an average of cost quotes collected from online retailers in October 2017, costs were updated in June of 2018, for 1.8 gpm showerheads (Attachment 4). A labor cost of $15.67 is used based on WO017 [475] and scaled up at a rate of 0.8% per year over 6 years (2012 – 2018) for a total increase in labor cost of 4.8% based on RS Means [513].

**Base Case Costs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure** | **Base Case Cost Source** | **Base Case Material Cost** | **Base Case Labor Cost** | **Unit** |
| 1.0 GPM Faucet Aerator replacing No Faucet Aerator/1.0 GPM Faucet Aerator replacing No Faucet Aerator for Multifamily BT | N/A | $0.00 | $0.00 | Each |
| 1.5 GPM Low Flow Showerhead replacing Standard Showerhead | Online Retailers (Attachment 4) | $16.17 | $16.42 | Each |

## 4.2 Measure Case Cost

The measure material costs for the faucet aerator and showerheads has been calculated based on an average of cost quotes collected from online retailers in October 2017 for 1.0 gpm faucet aerators and 1.5 gpm showerheads (Attachment 4).

For the faucet aerator measure, the labor rate was not available in the CPUC’s supported WO17 cost evaluation; however, it was estimated using DEER 2008 assumptions with installation time for the faucet aerator = 7.2 mins (0.12\*60). This is multiplied by the average national plumber labor rate based on 2018 RSMeans ($65.50) [513]. For the low flow showerhead measure, the labor rate is based on WO17.

Measure Case Costs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure** | **Measure Case Cost Source** | **Measure Case Material Cost** | **Measure Case Labor Cost** | **Unit** |
| 1.0 GPM Faucet Aerator replacing No Faucet Aerator/1.0 GPM Faucet Aerator replacing No Faucet Aerator for Multifamily BT | Online Retailers (Attachment 4) | $5.20 | $7.86 | Each |
| 1.5 GPM Low Flow Showerhead replacing Standard Showerhead | Online Retailers (Attachment 4) | $28.53 | $16.42 | Each |

## 4.3 Full and Incremental Measure Cost

**Full and Incremental Measure Cost Equations**

|  |  |  |  |
| --- | --- | --- | --- |
| **Installation Type** | **Incremental Measure Cost** | **Full Measure Cost** | |
| **1st Baseline** | **2nd Baseline** |
| ROB | (MEC + MLC) – (BEC + BLC) | (MEC + MLC) – (BEC + BLC) | N/A |
| REA | MEC + MLC | MEC + MLC | N/A |

MEC = Measure Equipment Cost; MLC = Measure Labor Cost

BEC = Base Case Equipment Cost; BLC = Base Case Labor Cost

**Full and Incremental Costs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure** | **Installation Type** | **Incremental Measure Cost** | **Full Measure Cost** | |
| **1st Baseline** | **2nd Baseline** |
| WH-62220 | REA | $13.06 | $13.06 | N/A |
| WH-20767 | REA | $13.06 | $13.06 | N/A |
| WH-79994 | ROB | $12.36 | $12.36 | N/A |

# 

# Attachments

1. SCE17WP004.2 A1-Calculation Templates\_Final
2. SCE17WP004.2 A2-Energy Division Workpaper Disposition for Water Fixtures
3. SCE17WP004.2 A3- Energy Savings Calculations
4. SC317WP004.2 A4-Cost Documentation
5. SCE17WP004.2 A5-Draft Resolution E-4952

# References

References\_10252018\_101513

[428] Residential Appliance Survey

[475] 2010-2012 WO017 Ex Ante Measure Cost Study Final Report

[496] 2016 Building Energy Efficiency Standards for Residential and Nonresidential Buildings (Title 24)

[516] 2016 California Code of Regulations, Title 20, Public Utilities and Energy

[513] RS Means 2018