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PROCESS DISTRIBUTION

Dust Collection Fan VSD

SWPR005-02

CONTENTS

MEASURE NAME

VSD on Dust Collection Fan

STATEWIDE MEASURE ID

SWPR005-02

TECHNOLOGY SUMMARY

This measure pertains to the installation of a variable speed drive (VSD) on an existing fan for a dust collection fan system, commonly known as a baghouse, utilized by agricultural and industrial customers. The use of a VSD for dust collection systems allows for fan speed modulation based on the real time load of the system while maintaining the air velocity needed for the particulates. Controls such as pressure transducers, flow sensors, or velocity sensors are needed to provide feedback to the VSD during operation.

A baghouse is used in a variety of processes to remove dust, particulates, or other air-suspended material from a specific area or equipment. These systems are used by a wide variety of customers for harvest, processing, and manufacturing of products. A typical baghouse uses a blower or fan to provide suction to the system. The collected air with suspended particulate is pulled through ducting to the entrance of the baghouse to be filtered. The filters within the baghouse use compressed air, vibrations, or a combination of both to periodically clean the filters. After filtering, the air stream is vented to the atmosphere or away from the serviced area.

During the design of a baghouse, the velocity (fpm) of the airstream is selected to ensure the particulate, dust, or other suspended particulates are removed by the baghouse and does not settle in the ducting. Within a baghouse system, the main duct entering the baghouse typically contains the largest diameter duct and therefore the lowest airstream velocity. Lighter particulates have a lower minimum velocity while heavier particulates need higher minimum velocities to operate effectively. The following table is a sample of velocity requirements, based on particulate type.

Velocity Requirements

Particulate Type	Air Velocity (Feet/min)		
	Min	Midpoint	Max
Gases	1,000	1,500	2,000
Fumes	2,000	2,250	2,500
Oil Mist	2,000	2,250	2,500
Very Fine Light Dust	2,500	2,750	3,000
Dry Dust and Powders	3,500	3,750	4,000
Typical Industrial Dust	3,000	3,500	4,000
Heavy Dust	4,000	4,250	4,500
Heavy or Moist	4,500+		

Source: Nordfab Ducting. 2011. *Quick-Fit Technical Manual.* Page 45.

The airflow demand for a baghouse is dependent on the quantity of pick-up points and their individual flow requirements to properly ventilate the area or equipment. The baghouse filters are then sized based on the airflow requirements with additional capacity for future addition onto the system or increase at the pickups. The baghouse fans are selected based on both the necessary airflow requirements of the system and the static pressure based on the geometry and distance of the ducting. The use of a VSD on a baghouse fan will allow the system to modulate based on either airflow or static pressure requirements. For baghouse systems that do not have variable airflow and pressure requirements, a VSD will help ensure that the fan operates at the minimum speed required to keep particulates in suspension. Based on conversations with baghouse vendors, a typical steady state system will have energy savings potential from fan optimizing system capacity based on end use requirements. For systems with variable pick-ups or automatic shut off gates to equipment, the static pressure and airflow needs will vary significantly through the system operation. During conversations with vendors and customers, systems with fan motors rated 50 hp or less typically have a single pick-up with no automatic shut-off gates. Whereas for baghouses with fan motors exceeding 50 hp, it was observed during multiple site visits that the use of actuated dampers on pick-ups is not common for agricultural customers.

MEASURE CASE DESCRIPTION

The measure case is defined as the addition of a variable speed drive (VSD) on an existing dust collection fan. As shown below, measure offerings vary by motor size.

Offering IDs

Fan Motor Size	Statewide Measure Offering ID	Measure Offering Description
10	A	Dust Collection Fan VSD (10 hp motor)
15	B	Dust Collection Fan VSD (15 hp motor)
20	B	Dust Collection Fan VSD (20 hp motor)
25	D	Dust Collection Fan VSD (25 hp motor)
30	E	Dust Collection Fan VSD (30 hp motor)
40	F	Dust Collection Fan VSD (40 hp motor)
50	G	Dust Collection Fan VSD (50 hp motor)
60	H	Dust Collection Fan VSD (60 hp motor)
75	I	Dust Collection Fan VSD (75 hp motor)
100	J	Dust Collection Fan VSD (100 hp motor)
125	K	Dust Collection Fan VSD (125 hp motor)
150	L	Dust Collection Fan VSD (150 hp motor)

BASE CASE DESCRIPTION

The base case is defined as an existing, fixed-speed dust collection fan with a rated individual motor capacity from 10 hp to 150 hp. For fan motors rated from 10 hp to 50 hp, a customer survey was performed and found the most common controls to be continuous operation or ON/OFF. The base case for fan motors rated from 60 hp to 150 hp is ON/OFF controls with dampers used for balancing. The existing fan motors cannot be two- speed and cannot have an existing VSD.

CODE REQUIREMENTS

There are no state or federal codes applicable for a variable speed drive (VSD) installed on a dust collection fan for agricultural or industrial processes. Depending on the customer and their processes, there could be applicable

Occupational Safety and Health Administration (OSHA) or National Fire Protection Association (NFPA) regulations that set limits on the velocity requirements for safety standards.

Applicable State and Federal Codes and Standards

Code	Applicable Code Reference	Effective Dates
CA Appliance Efficiency Regulations – Title 20	None.	n/a
CA Building Energy Efficiency Standards – Title 24	None.	n/a
Federal Standards	None.	n/a

NORMALIZING UNIT

The normalizing unit is per horsepower (hp).

PROGRAM REQUIREMENTS

Measure Implementation Eligibility

All combinations of measure application type, delivery type, and sector that are established for this measure are specified below. Measure application type is a categorization based on the circumstances and timing of the measure installation; each measure application type is distinguished by its baseline determination, cost basis, eligibility, and documentation requirements. Delivery type is the broad categorization of the delivery channel through which the market intervention strategy (financial incentives or other services) is targeted. This table also designates the broad market sector(s) that are applicable for this measure.

Note that some of the implementation combinations below may not be allowed for some measure offerings by all program administrators.

Implementation Eligibility

Measure Application Type	Delivery Type	Sector
Add-on equipment	DnDeemDI	Ag
Add-on equipment	DnDeemDI	Ind
Add-on equipment	DnDeemed	Ag
Add-on equipment	DnDeemed	Ind

Both agricultural and industrial sectors are applicable for fan motors 50 hp or smaller, whereas fan motors larger than 50 hp are limited to the agricultural sector.

Eligible Products

- The customer must have an existing electrically operated fixed-speed fan installed on site or plans to install a new electrically operated fixed-speed fan.
- The existing baghouse, fan, and motor must be in proper operating condition.
- The baghouse fan motor must be compatible with a variable speed drive (VSD).[1]

[1] Motors that are compatible with VSDs vary by manufacturer. Compatible motors may be labeled as inverter duty, VSD ready, or have insulation classification F.

- There must be no previous VSD or failed VSD installed on the baghouse existing fan motor.
- The minimum fan size must be 10 hp to 150 hp, as defined in the Measure Case Description.
- The installed VSD must be controlled based on static pressure, airflow rate (cfm), or velocity at the lowest required rate to keep particulates suspended in the air stream.
- The VSD is recommended to meet requirements as specified by IEEE Standard 519-2014.[2].
- The fan/blower must not be a designed high-pressure blower. High pressure blowers have designed capacities of less than 150 cfm per rated horsepower. (Applicable only to fan motors larger than 50 hp.)

Eligible Building Types

For customers with dust collection systems between 10 hp to 50 hp, the business/facility must have a NAICS Code as follows:

111000 to 112990

211120 to 213115

311000 to 339999

For customers with dust collection systems between 60 hp to 150 hp, the business/facility must have a NAICS Code as follows:

111000 to 112990

311000 to 311999

115114

Eligible Climate Zones

The measure is applicable in all California climate zones. The measure is weather independent.

PROGRAM EXCLUSIONS

This measure cannot be used for the following fan applications:

- HVAC fan
- An individual fan motor rated less than 10 hp or higher than 150 hp
- A two-speed fan motor
- A fan motor with an existing VSD

DATA COLLECTION REQUIREMENTS

Data collection requirements are to be determined.

[2] Institute of Electrical and Electronics Engineers (IEEE) Standards Association. 2014. *IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems.* IEEE Std. 519TM -2014. New York (NY): IEEE.

Data to collect for each incentive application should include:

1. Equipment manufacturer, model, and serial number
2. Nameplate information: horsepower rating, %Eff
3. AHRI or CEC ID#
4. Sales data: including price, sale date, and install date
5. Number of units and building type (NAICS)
6. Contractors contact information:
    a. Business name
    b. Contact name
    c. Address
    d. Phone, and email
7. Customer contact information:
    a. Business name
    b. Contact name
    c. Address
    d. Phone, and email
8. PA to determine the climate zone and IOU attribution based on the zip code

USE CATEGORY

ProcDist

ELECTRIC SAVINGS (kWh)

This measure will reduce the electrical energy consumption and demand of a baghouse fan by varying the speed of the motor to meet the airflow or pressure requirements. The baseline and proposed energy consumption for each measure varies based on the horsepower of the baghouse fan motor.

The baseline annual unit energy consumption (UEC) for a baghouse fan motor is a function of the fan motor power, motor efficiency, load factor, and baghouse fan hours of operation, as shown below.

UECbaseline = *HPfan x LF x C1 x (1/EFF) x HOURS*

HPfan =	*Motor nameplate power (hp)*
LF =	*Load factor*
C1 =	*Conversation factor, 0.756 kW per HP*
EFF =	*NEMA premium motor efficiency*
HOURS =	*Annual hours of operation of baghouse fan*

The calculation of the measure case power draw for a baghouse fan motor with a VSD is dependent on the average operating speed when in use. In order to determine the average operating speed, a survey of baghouse vendors was performed to determine the actual velocity of the air stream based on typical baghouse capacities (cfm) and duct diameters (inches) for various fan sizes (hp). These correlations are used to determine the proposed operating speed for smaller dust collector systems of motor size 50 hp and less. For larger systems, 60 hp to 150 hp, multiple site visits were performed for agricultural customers to measure energy consumption and typical operating conditions. The data collected was used to create correlations to determine typical operating duct velocities and therefore the proposed operating speed. The following formula is used to quantify the proposed energy consumption (UEC).

$$UEC_{measure} = HP_{fan} \times LF \times C1 \times (1/EFF) \times OS^{2.7} \times (1/EFF_{VSD}) \times HOURS$$

HPfan =	*Motor nameplate power(hp)*
LF =	*Load factor*
C1 =	*Conversation factor, 0.756 kW per HP*
EFF =	*NEMA premium motor efficiency*
OS =	*Average operating speed of the VSD*
EFFVSD =	*Efficiency of the VSD*
HOURS =	*Annual hours of operation of baghouse fan*

Baseline UEC Inputs

Baghouse Fan Motor Horsepower (hp)	NEMA Inverter-Duty Motor Premium Efficiency [3]	Baghouse Fan Operating Hours [4]	Baghouse Designed Airflow (cfm) [5]	Baghouse Main Duct Diameter Size (inch) [6]	Motor Load Factor [7]
10	91%	4,806	3,100	12	66%
15	92%	4,806	4,700	14	66%
20	93%	4,806	6,300	16	66%
25	94%	4,806	8,000	17	66%
30	94%	4,806	9,600	19	66%
40	94%	4,806	12,900	22	66%
50	95%	4,806	16,200	26	66%
60	95%	5,544	20,100	N/A	63%
75	95%	5,544	24,200	N/A	63%
100	95%	5,544	31,200	N/A	63%
125	95%	5,544	38,100	N/A	63%
150	95%	5,544	45,000	N/A	63%

[3] U.S. Department of Energy (DOE), Energy Efficiency and Renewable Energy, Advanced Manufacturing Office. 2014. *Premium Efficiency Motor Selection and Application Guide. A Handbook for Industry.* DOE/GO-102014-4107. February.

[4] System Operating Hours based on survey results of customers.
Pacific Gas and Electric Company (PG&E). 2019. "AGR Customer Survey for SWPR005-02.xlsx"

[5] The dust collector design airflow is based on vendor conversations for typical sized systems based on the fan motor size.
Pacific Gas and Electric Company (PG&E). 2019. "Calculations for SWPR005-02.xlsx" See Vendor Survey Data tab.

[6] The dust collection main duct diameter is based on conversations with vendors based on design size of the dust collection system. Duct diameter was only used in calculations for small fans.
Pacific Gas and Electric Company (PG&E). 2019. "Calculations for SWPR005-02.xlsx" See Vendor Survey Data tab.

[7] The typical Load Factor (ratio of operating load to rated capacity) for a fan is designed at 75% for optimal efficiency. For small fans (10 hp to 50 hp), a 66% load factor was used based on experience of the load on typical fans. For large fans (60 hp to 150 hp) a 63% load factor is used based on logged data

Measure Case UEC Inputs

Baghouse Fan Motor Horsepower (hp)	NEMA Inverter-Duty Motor Premium Efficiency	Baghouse Fan Operating Hours	Baghouse Designed Air Flow (cfm)	Baghouse Main Duct Diameter Size (inch)	Motor Load Factor	VSD Average Operating Speed (%)	VSD Efficiency[8]
10	91%	4,806	3,100	12	66%	95%	97%
15	92%	4,806	4,700	14	66%	85%	97%
20	93%	4,806	6,300	16	66%	83%	97%
25	94%	4,806	8,000	17	66%	74%	97%
30	94%	4,806	9,600	19	66%	77%	97%
40	94%	4,806	12,900	22	66%	77%	97%
50	95%	4,806	16,200	26	66%	85%	97%
60	95%	5,544	20,100	N/A	63%	76%	97%
75	95%	5,544	24,200	N/A	63%	77%	97%
100	95%	5,544	31,200	N/A	63%	80%	97%
125	95%	5,544	38,100	N/A	63%	83%	97%
150	95%	5,544	45,000	N/A	63%	86%	97%

For baghouses equipped with fan motors that are 50 hp or smaller, two surveys were administered to develop inputs for this measure analysis. The first survey was a web-based of 15 customers with a NAICS code between 111000 and 112990 or between 31100 and 312140 within the Pacific Gas and Electric (PG&E) service area. The survey, administered in 2019, collected data on the facility operating hours, production rates, and various fan types used for operations. Based on the survey results, the correlations between fan motor size to baghouse size and ducting diameter were used for the UES calculation. Specific inputs and assumptions are discussed below. Survey results for fan motors of all sizes confirmed that the use of VFDs on baghouses is not a common practice.

A second survey of baghouse vendors and designers was administered in 2019 to learn about the common installation practices, design parameters, and baghouse sizes for new and existing systems. Based on the vendor outreach, four baghouse designers shared their insights on the design and selection processes for a variety of parameters that were utilized for this analysis. A common theme during these discussions is the custom nature of baghouse systems and that each system is designed based on their original end-use system operation. All four surveyed the vendors agreed that they recommend that their customers install VFDs on new baghouse systems if the customers have the additional capital.

In 2020, site inspections at five agricultural customer facilities were performed by ERI, each having different configurations, motor sizes, applications, and controls. The customers were selected to ensure a representative sample of industries and motor sizes exceeding 50 hp were selected. During the site inspections, each system was observed and data collected including duct dimensions, fan specifications, motor specifications, and operating parameters. These collected points were used to correlate fan size to the minimum duct velocity of the system for determining the proposed fan speed and are summarized in “SWPR005-02 Calculations - VSD for Dust Collection Fan.xlsx”.

[8] U.S. Department of Energy (DOE), Energy Efficiency and Renewable Energy, Advanced Manufacturing Office. 2012. “Energy Tips – Motor Systems. Motor System Tip Sheet #11.” DOE/GO-102012-3730. November.

Load Factor. The typical load factor (ratio of operating load to rated capacity) for a fan is designed at 75% for optimal efficiency.[9] Based upon professional judgement, a more conservative load factor was assumed for the measure analysis on fan motors rated between 10 hp and 50 hp. Logged data was obtained during site visits of facilities using baghouse fan motors rated between 60 hp and 150 hp and was used to calculate the respective load factor.

VSD Average Operating Speed. To determine the average operating speed, a survey of baghouse vendors was performed to determine the actual velocity of the air stream based on typical baghouse capacities (cfm) and duct diameters (inches) for each fan motor size (hp). It is common for larger dust collection systems (>50 hp) to have balancing dampers located at the inlet or outlet of the blower to ensure accurate pressures are met. Typically, these dampers are not adjusted after installation and are left locked in place. It should be noted that when systems are designed to their specific requirements for airflow and velocity, the use of a VSD to control the fan will result in either close to no energy savings or increased energy consumption due to the VSD energy losses when operating at 100% speed. Based on the vendor survey, most existing systems operate at less than the designed capacity and therefore have opportunity to reduce the fan speed and yield energy savings. The proposed velocity of the air stream was quantified using a weighted average of customers with a corresponding velocity based on the most common use of a dust collection system, see Velocity Requirements table for midpoint values used. Using the vendor survey and proposed velocity, the average operating speed can be quantified to determine the proposed power draw.

The measure case operating speed was calculated from dividing the proposed velocity by the existing velocity from the customer survey and site collected data. The operating speed adopted for this measure analysis is considered to be conservative or comparable for industrial customers.

Note the Affinity Law exponent of 2.7 is used, which is representative of higher static pressure fan systems.

Annual Hours of Operation. The annual hours of operation are estimated to be 4,806 hours per year from a 2019 survey of 15 agricultural customers (NAICS codes 111000 to 112990 and 31100 to 312140) that utilize baghouses with fan motors sized between 10 hp and 50 hp. It is assumed that the annual hours of baghouse fan operation are greater at industrial facilities, but for this measure analysis, the hours of operation at agriculture facilities is also assumed for industrial customers.

A separate survey was conducted for agricultural facilities that use baghouses equipped with larger fan motors (60 hp to 150 hp), which resulted in estimated operating hours of 5,544 hours per year. These hours are not applicable for industrial customers for motor sizes 60hp to 150hp.

PEAK ELECTRIC DEMAND REDUCTION (kW)

It is assumed that this measure operates within the peak period of 4 p.m. to 9 p.m. on weekdays at a constant load throughout the day. [10] The average demand reduction calculations utilize the inputs and assumptions specified for Electric Savings. The average demand (baseline or measure case) is equal to the annual unit energy consumption (UEC) divided by the assumed annual hours of operation.

$$kW_{avg} = \frac{UEC\_YEAR_{kWh}}{HOURS}$$

UEC_YEAR =	*Annual UEC, baseline or measure (kWh/year)*
HOURS=	*Estimated operating hours per year (hours)*

[9] U.S Department of Energy (DOE). (n.d.) "Motor Challenge Fact Sheet: Determining Electric Motor Load and Efficiency." DOE/GO-1009-517.

[10] California Public Utilities Commission (CPUC). 2018. *Resolution E-4952.* October 11. OP 1.

The average demand reduction, therefore, is the difference between the baseline and measure case average demand.

$$Avg\ kW\ Reduction = kW_{avg,base} - kW_{avg,measure}$$

kW_{avg} = *Average demand, base or measure case (kW)*

See Electric Savings for details regarding the inputs and assumptions to calculate the annual UEC.

GAS SAVINGS (THERMS)

Not applicable.

LIFE CYCLE

Effective useful life (EUL) is an estimate of the median number of years that a measure installed through a program is still in place and operable. Remaining useful life (RUL) is an estimate of the median number of years that a technology or piece of equipment replaced or altered by an energy efficiency program would have remained in service and operational had the program intervention not caused the replacement or alteration. The RUL is only applicable to the first baseline period for a retrofit measure with an applicable code baseline.

As per Resolution E-4807, the California Public Utilities Commission (CPUC) defined the EUL of an add- on equipment as the lesser of the EUL of the measure itself or the RUL of the host equipment.[11] The methodology to calculate the RUL conforms with Version 5 of the Energy Efficiency Policy Manual, which recommends "one-third of the effective useful life in DEER as the remaining useful life until further study results are available to establish more accurate values." This approach provides a "reasonable RUL estimate without requiring any prior knowledge about the age of the equipment being replaced."[12]

The EUL and RUL specified for this measure are shown below. A premium efficiency fan motor is specified as the host equipment.

Effective Useful Life and Remaining Useful Life

Parameter	Value	
EUL - Host equipment (EUL ID: Motors-HiEff)	15.0	California Public Utilities Commission (CPUC), Energy Division. 2008. "EUL_Summary_10-1-08.xls." California Public Utilities Commission (CPUC). 2014. "DEER2014-EUL-table- update_2014-02-05.xlsx."
EUL – VSD (EUL ID: ProcDist-Motor_Spd)	13.0	California Public Utilities Commission (CPUC), Energy Division. 2018. Resolution E-4952. October 11.

BASE CASE MATERIAL COST ($/UNIT)

The base case cost for an *add-on equipment installation* is equal to $0 because there are no modifications to the existing equipment.

[11] California Public Utilities Commission (CPUC). 2016. *Resolution E-4807.* December 16. Page 13.

[12] KEMA, Inc. 2008. "Summary of EUL-RUL Analysis for the April 2008 Update to DEER." Memorandum submitted to Itron, Inc.

MEASURE CASE MATERIAL COST ($/UNIT)

The measure case material costs include the VSD and pressure sensor. For motors sized between 10 hp and 50 hp, these costs were derived from data obtained from the RSMeans online in June of 2019.[13] The costs of the VSD for motors sized 60 hp to 150 hp were obtained from a phone survey of (8) electrical vendor in California. The survey was performed in May 2020 and results were averaged along with 2020 RSMeans online data to determine the material cost per motor horsepower size.

Fan Motor (hp)	Material Cost ($)
10	$3,037
15	$3,837
20	$4,637
25	$5,413
30	$6,674
40	$7,644
50	$10,118
60	$7,330
75	$8,291
100	$9,956
125	$11,795
150	$14,030

BASE CASE LABOR COST ($/UNIT)

The base case labor cost for an *add-on equipment installation* is equal to $0 because these are no modifications to the existing equipment. The customer has the option to make no changes to the existing system.

MEASURE CASE LABOR COST ($/UNIT)

The measure case labor costs include installation and commissioning of the VSD and pressure sensor. These costs were derived from RSMeans online data in June of 2019 and averaged with one vendor estimate obtained from a phone survey in May 2020. The labor costs from RSMeans 2019 are based on electrician (Elec) labor hours at an average rate of $74 per hour. Labor hours increase with the size of the motor with 11.94 hours at 10 horsepower to 40 hours at 150 horsepower.

[13] Pacific Gas and Electric Company (PG&E). 2019. “Calculations for SWPR005-02.xlsx” See Measure Cost tab.

Fan Motor (hp)	Labor Cost ($)
10	$956
15	$1,396
20	$1,396
25	$1,825
30	$1,825
40	$1,825
50	$2,304
60	$4,926
75	$4,926
100	$5,500
125	$6,163
150	$6,984

NET-TO-GROSS

The net-to-gross (NTG) ratio represents the portion of gross impacts that are determined to be directly attributed to a specific program intervention. These NTG values are based upon the average of all NTG ratios for all evaluated 2006 – 2008 agriculture and industrial sector programs, as documented in the 2011 DEER Update Study conducted by Itron, Inc. These sector average NTGs ("default NTGs") are applicable to all energy efficiency measures that have been offered through agriculture and industrial sector programs for more than two years and for which impact evaluation results are not available.

Note that the default industrial sector NTG is applicable for measure offerings of motors 50 hp or smaller.

Net-to-Gross Ratios

Parameter	Value	Source
Agric- Default>2yrs	0.60	Itron, Inc. 2011. *DEER Database 2011 Update Documentation*. Prepared for the California Public Utilities Commission. Page 15-4 Table 15-3.
Ind- Default>2yrs	0.60	

GSIA

The gross savings installation adjustment (GSIA) rate represents the ratio of the number of verified installations of the measure to the number of claimed installations reported by the utility. This factor varies by end use, sector, technology, application, and delivery method. This GSIA rate is the current "default" rate specified for measures for which an alternative GSIA has not been estimated and approved.

Gross Savings Installation Adjustments

Parameter	Value	Source
GSIA	1.0	California Public Utilities Commission (CPUC), Energy Division. 2013. *Energy Efficiency Policy Manual Version 5*. Page 31.

NON-ENERGY IMPACTS

Non-energy impacts for this measure have not been evaluated.

DEER DIFFERENCES ANALYSIS

This section provides a summary of DEER-based inputs and methods, and the rationale for inputs and methods that are not DEER-based.

DEER Difference Summary

DEER Item	Comment
Modified DEER methodology	No
Scaled DEER measure	No
DEER Building Prototypes Used	No
DEER Version	N/A
DEER Run ID	N/A
NTG	Source: DEER 2014. The NTG of 0.60 is associated with NTG ID: *Agric-Default>2yrs* and IND- *Default>2yrs*
GSIA	Source: DEER. The GSIA of 1.0 is associated with GSIA ID: *Def-GSIA*
EUL/RUL	Source: DEER 2014. The value of 15 years is associated with EUL ID: M*otors-HiEFF*.

REVISION HISTORY

Measure Characterization Revision History

Revision Number	Revision Complete Date	Primary Author, Title, Organization	Revision Summary and Rationale for Revision
01	09/13/2019	Ethan Clifford, ERI, Randy Kwok (PG&E)	First draft
02	7/24/2019	Ethan Clifford, ERI	• Added motor sizes 60hp to 150hp (ID's H to L) • Update NAICS code eligibility for motors greater than 50 hp • Measure case material and vendor cost updated based on vendor survey • Updated Effective Useful Life and Remaining Useful Life EUL ID
	11/15/2021	Adan Rosillo PG&E	• Added NAICS Code 115114 to eligible building types • Modified Data Collection Requirements