Equipment Efficiency Standards Appendices

These appendices include tables of minimum equipment efficiency standards for cooling, lighting, and motors, as well as other supplemental information about the program. This information is also available on the program Web site at **http://www.AEPefficiency.com**.

(Portions of this section have not been updated for 2012)

A Standard Cooling Equipment Tables

A.1 Overview

This document contains reference data for estimating demand and energy savings for cooling equipment in the Commercial Standard Offer Program. The data are equipment efficiency standards or climate data that will be used to develop the baseline system models and to evaluate savings for all projects under the Commercial Standard Offer Program.

Cooling equipment installed under the program must exceed the minimum new equipment efficiency standards shown in the tables. In addition, the minimum baseline efficiencies define the baseline for calculating energy savings. The guidelines in Section III and IV (M&V Guidelines), describe the application of these equipment efficiency standards and coefficient tables for estimating baseline demand and energy use and cooling equipment demand and energy savings.

For the following types of cooling equipment, baseline efficiency ratings are provided in Table A.1 through Table A.8 below:

- Unitary air conditioners and heat pumps (air cooled, evaporatively cooled, or water cooled)
- Packaged-terminal air conditioners and heat pumps
- Room air conditioners and heat pumps
- Water-source and ground-water source heat pumps
- Water- and air-cooled water chilling packages

Table A.1 through Table A.8 are based on American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 90.1-19XX and ASHRAE Standard 90.1-XXXX (will be updated in January, 2012). The tables present the minimum efficiencies of particular types of cooling equipment. The performance standard data in these tables should be used to determine the rated baseline equipment efficiencies.

The baseline efficiency for existing equipment shall be established as the 1989 standard efficiency. The baseline for equipment for which rating conditions are not provided shall be defined as the energy consumption of the actual existing equipment.

Table A.9 of this document presents the cooling degree-days (CDD) for a weather station located in the AEP distribution service territory. Cooling degree-day data are used to normalize metered energy consumption to a typical meteorological year (TMY2). M&V Guideline 3 describes the application of weather data for estimating baseline energy use and cooling equipment energy savings.

Tables A.10 through A.13 provide the coefficients necessary to complete the air-conditioning equipment *deemed savings* calculation described in Section III.

A.2 Tables

Table A.1: Standard rating conditions and minimum performance for unitary air conditioners and heat pumps, air cooled, electric, <135,000 Btu/hr (< 11.25 tons) capacity, - Except packaged terminal and room air conditioners.

Mode	Cooling Capacity		Rating Condition, °F db	Type	Baseline Performance Standard[1]	Minimum Performance Standard[2]
	Btu/hr	tons				
Cooling mode	< 65,000	< 5.42	Seasonal	Split		
	< 65,000	< 5.42	Seasonal	Packaged		
	< 65,000	< 5.42	95	Packaged and split		
	≥ 65,000 & < 135,000	≥ 5.42 & < 11.25	95	Packaged and split		
Heating mode (heat pumps)	< 65,000	< 5.42	Seasonal	Split		
	< 65,000	< 5.42	Seasonal	Packaged		
	< 65,000	< 5.42	47 db/43 wb	Packaged and split		
	≥ 65,000 & < 135,000	≥ 5.42 & < 11.25	47 db/43 wb	Packaged and split		

$$Performance\left(\frac{kW}{ton}\right) = \frac{1}{EER}\left(\frac{Watt \cdot hr}{Btu_{out}}\right) * 12{,}000\left(\frac{Btu_{out}}{ton \cdot hr}\right) * \frac{1}{1{,}000}\left(\frac{kW}{Watt}\right) = \frac{12}{EER}\left(\frac{kW}{ton}\right)$$

[1] Reference: ASHRAE Standard 90.1-1989, Table 10-1.
[2] Reference: ASHRAE Standard 90.1-1999, Table 6.2.1.A and Table 6.2.1.B.

Table A.2: Standard rating conditions and minimum performance for unitary air conditioners and heat pumps – evaporatively cooled, electric, <135,000 Btuh (< 11.25 tons) cooling capacity.

Cooling Capacity		Rating indoor air °F db / °F wb	Rating outdoor air °F db/°F wb	Baseline Performance Standard[3]	Minimum Performance Standard[4]
Btuh	tons				
< 65,000	< 5.42	80/67	95/75		
≥ 65,000 & < 135,000	≥ 5.42 & < 11.25	80/67	95/75		

† Deduct 0.2 from the required EERs for units with a heating section other than electric resistance heat.

Table A.3: Standard rating conditions and minimum performance for water-cooled air conditioners and heat pumps, electric, <135,000 Btuh (< 11.25 tons) capacity.

Equipment	Cooling capacity, BTU/h	Rating Condition, air °F db / °F wb	Rating Condition, entering water °F†	Baseline Performance Standard[5]	Minimum Performance Standard[6]
Water cooled heat pumps	< 65,000	80/67	85		
			86		
	< 65,000	80/67	75		
	≥ 65,000 and <135,000	80/67	85		
			86		
	< 135,000, heating	70/60	70		
			68		
Ground water cooled heat pumps	< 135,000	80/67	70		
			59		
	< 135,000	80/67	50		
	< 135,000, heating	70/60	70		
	< 135,000, heating	70/60	50		
Water cooled unitary air conditioners	< 65,000	80/67	85 86		
	≥ 65,000 and <135,000	80/67	85 86		

[3] Reference: ASHRAE Standard 90.1-1989, Table 10-2.
[4] Reference: ASHRAE Standard 90.1-1999, Table 6.2.1.A.
[5] Reference: ASHRAE Standard 90.1-1989, Table 10-3 and Table 10-5.
[6] Reference: ASHRAE Standard 90.1-1999, Table 6.2.1.B.

Table A.4: Standard rating conditions and minimum performance for packaged terminal air conditioners and heat pumps, air-cooled, electric

Mode	Rating condition, outside air °F db	Baseline Performance Standard†[7]	Minimum Performance Standard[8]
Cooling	95	10-(0.16 * Cap/1000) EER	
Cooling	82	12.2-(0.20 * Cap/1000) EER	
Heating (heat pump)	47 db/43 wb	2.9 - (0.026 * Cap/1000), COP	

† Cap is the rated cooling capacity of the unit in Btu/h. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.

Table A.5: Standard rating conditions and minimum performance for room air conditioners and room air conditioner heat pumps, electric

Category	Capacity, BTUH	Baseline performance standard (EER)[9]	Minimum Performance Standard (EER)[10]
Without reverse cycle and with louvered sides	< 6,000		
	≥ 6,000 and <8,000		
	≥ 8,000 and <14,000		
	≥ 14,000 and <20,000		
	≥ 20,000		
Without reverse cycle and without louvered sides	< 6,000		
	≥ 6,000 and <20,000		
	≥ 20,000		
With reverse cycle and with louvered sides	< 20,000		
	≥ 20,000		
With reverse cycle and without louvered sides	< 14,000		
	≥ 14,000		

[7] Reference: ASHRAE Standard 90.1-1989, Table 10-4A.
[8] Reference: ASHRAE Standard 90.1-1999, Table 6.2.1.D.
[9] Reference: ASHRAE Standard 90.1-1989, Table 10-4B.
[10] Reference: ASHRAE Standard 90.1-1999, Table 6.2.1.D.

Table A.6: Baseline and minimum performance standards for large unitary air conditioners and heat pumps, electric, ≥ 135,000 Btuh (≥ 11.25 tons) capacity.

Equipment Type	Cooling Capacity		Baseline Performance Standard[11]		Minimum Performance Standard[12]	
	Btuh	tons	EER	kW/ton	EER	kW/ton
Air cooled air conditioners	≥ 135,000 & <240,000	≥ 11.25 & < 20.00				
	≥ 240,000 & <760,000	≥ 20.00 & < 63.33				
	≥ 760,000	≥ 63.33				
Water or evaporatively cooled air conditioners	≥ 135,000	≥ 11.25				
Air cooled heat pumps	≥ 135,000 & <240,000	≥ 11.25 & < 20.00				
	≥ 240,000 & <760,000	≥ 20.00 & < 63.33				
	≥ 760,000	≥ 63.33				
	≥ 135,000	≥ 11.25				
Air cooled condensing units	≥ 135,000	≥ 11.25				
Water or evaporatively cooled condensing units	≥ 135,000	≥ 11.25				

† Deduct 0.2 from the required EERs for units with a heating section other than electric resistance heat.
†† Coefficient of Performance (COP) for heating mode rated at 47 °F dry bulb, 43 °F wet bulb outdoor conditions.

$$Performance\left(\frac{kW}{ton}\right) = \frac{1}{EER}\left(\frac{Watt \cdot hr}{Btu_{out}}\right) * 12{,}000\left(\frac{Btu_{out}}{ton \cdot hr}\right) * \frac{1}{1{,}000}\left(\frac{kW}{Watt}\right) = \frac{12}{EER}\left(\frac{kW}{ton}\right)$$

[11] Reference: ASHRAE Standard 90.1-1989, Table 10-6.
[12] Reference: ASHRAE Standard 90.1-1999, Table 6.2.1.A and Table 6.2.1.B.

Table A.7: Baseline and minimum performance standards for water chilling packages, electric.

Equipment Type	Cooling Capacity (tons)	Baseline Performance Standard[13]		Minimum Performance Standard[14]	
		COP	kW/ton	COP	kW/ton
Water cooled, positive displacement (rotary screw, scroll)	< 150				
	≥ 150 and <300				
	≥ 300				
Water cooled, centrifugal	< 150				
	≥ 150 and <300				
	≥ 300				
Air cooled with condenser	< 150				
	≥ 150				
Air cooled without condenser	All				

$$Performance\left(\frac{kW}{ton}\right) = \frac{1}{COP}\left(\frac{Btu_{in}}{Btu_{out}}\right) * 12{,}000\left(\frac{Btu_{out}}{ton \cdot hr}\right) * \frac{1}{3{,}412}\left(\frac{kWh}{Btu_{in}}\right) = \frac{3.517}{COP}\left(\frac{kW}{ton}\right)$$

Table A.8: Standard rating conditions and minimum performance for water chilling packages, gas absorption

Equipment Type	Cooling Capacity	Baseline Performance Standard[15] (COP)	Minimum Performance Standard[16] (COP)
Air-cooled absorption, single-effect	All capacities		
Water-cooled absorption, single-effect	All capacities		
Absorption double effect, indirect-fired	All capacities		
Absorption double effect, direct-fired	All capacities		

[13] Reference: ASHRAE Standard 90.1-1989, Table 10-7.
[14] Reference: ASHRAE Standard 90.1-1999, Table 6.2.1.C.
[15] Reference: ASHRAE Standard 90.1-1999, Table 6.2.1.C.
[16] Reference: ASHRAE Standard 90.1-1999, Table 6.2.1.C.

Table A.9: TMY2 Cooling Degree Days (base 65) for the AEP service territory

Weather Station	WBAN No.	CDD_{65} (°F day)
Abilene	13962	**2,386**
Amarillo	23047	**1,344**
Brownsville	12919	**3,874**
Corpus Christi	12924	**3,497**
Houston	12960	**3,197**
Lubbock	23042	**1,769**
Lufkin	93987	**2,480**
Midland	23023	**2,139**
Odessa/Midland	23023	***[?]***
Port Arthur	12917	**2,823**
San Angelo	23034	**2,383**
Victoria	12912	**3,203**

Table A.10: Deemed savings coefficients for the Fort Worth, TX climate for various building types and equipment types.

Building Type	Demand Coefficient			Energy Coefficient		
	Air Cooled Chiller	Water Cooled Chiller	DX Air Cooled	Air Cooled Chiller	Water Cooled Chiller	DX Air Cooled
College	0.89	0.81	0.91	1,587	1,761	1,955
Convenience			0.92			3,831
Fast Food			0.92			3,106
Grocery		0.87	0.92		2,708	2,815
Hospital	1.15	0.83		2,453	2,733	
Hotel	0.89	0.84	0.92	1,633	1,698	2,137
Motel			0.92			2,211
Nursing Home	0.90	0.82	0.92	1,744	1,854	2,218
Large Office	0.88	0.80	0.92	2,232	2,406	2,493
Small Office	0.90	0.80	0.92	1,598	1,649	1,970
Public Assembly	0.90	0.84	0.92	2,005	2,116	2,385
Restaurant			0.92			2,405
Religious Worship	0.88	0.83	0.90	1,355	1,396	1,946
Retail	0.90	0.83	0.92	1,770	1,828	2,225
School	0.88	0.81	0.91	1,136	1,273	1,569
Service			0.92			2,262
Warehouse	0.90	0.86	0.92	1,378	1,435	2,110

Table A.11: Deemed savings coefficients for the Amarillo, TX climate for various building types and equipment types.

Building Type	Demand Coefficient			Energy Coefficient		
	Air Cooled Chiller	Water Cooled Chiller	DX Air Cooled	Air Cooled Chiller	Water Cooled Chiller	DX Air Cooled
College	0.87	0.68	0.92	1,115	1,243	1,721
Convenience			0.92			3,452
Fast Food			0.92			2,632
Grocery		0.67	0.92		1,892	2,252
Hospital	1.10	0.68		1,910	2,115	
Hotel	0.85	0.66	0.92	1,124	1,138	1,791
Motel			0.92			1,887
Nursing Home	0.87	0.65	0.92	1,230	1,260	1,873
Large Office	0.86	0.68	0.92	1,736	1,874	2,062
Small Office	0.87	0.66	0.92	1,106	1,117	1,705
Public Assembly	0.87	0.65	0.92	1,404	1,444	1,979
Restaurant			0.92			1,928
Religious Worship	0.82	0.67	0.90	848	856	1,585
Retail	0.87	0.65	0.92	1,193	1,185	1,838
School	0.87	0.69	0.92	755	806	1,462
Service			0.92			1,848
Warehouse	0.87	0.66	0.92	802	783	1,639

Table A.12: Deemed savings coefficients for the Houston, TX climate for various building types and equipment types.

Building Type	Demand Coefficient			Energy Coefficient		
	Air Cooled Chiller	Water Cooled Chiller	DX Air Cooled	Air Cooled Chiller	Water Cooled Chiller	DX Air Cooled
College	0.80	0.84	0.85	1,858	2,099	2,175
Convenience			0.88			4,168
Fast Food			0.87			3,365
Grocery		0.88	0.87		3,012	2,935
Hospital	1.05	0.85		2,781	3,172	
Hotel	0.80	0.88	0.84	1,831	1,981	2,266
Motel			0.84			2,404
Nursing Home	0.80	0.84	0.84	1,960	2,172	2,368
Large Office	0.81	0.90	0.85	2,501	2,786	2,750
Small Office	0.81	0.87	0.85	1,860	1,990	2,158
Public Assembly	0.81	0.86	0.86	2,264	2,482	2,559
Restaurant			0.86			2,548
Religious Worship	0.83	0.84	0.87	1,474	1,594	2,028
Retail	0.80	0.84	0.84	2,003	2,162	2,381
School	0.80	0.84	0.85	1,280	1,489	1,639
Service			0.87			2,429
Warehouse	0.84	0.87	0.88	1,534	1,673	2,248

Table A.13: Deemed savings coefficients for the Brownsville, TX climate for various building types and equipment types.

Building Type	Demand Coefficient			Energy Coefficient		
	Air Cooled Chiller	Water Cooled Chiller	DX Air Cooled	Air Cooled Chiller	Water Cooled Chiller	DX Air Cooled
College	0.80	0.87	0.83	2,340	2,583	2,547
Convenience			0.85			4,647
Fast Food			0.85			3,933
Grocery		0.85	0.85		3,603	3,498
Hospital	0.98	0.92		3,379	3,755	
Hotel	0.79	0.84	0.84	2,482	2,673	2,799
Motel			0.84			2,973
Nursing Home	0.80	0.85	0.85	2,634	2,890	2,953
Large Office	0.77	0.88	0.82	2,907	3,181	3,153
Small Office	0.74	0.77	0.80	2,213	2,323	2,370
Public Assembly	0.80	0.85	0.85	2,857	3,085	3,077
Restaurant			0.84			2,993
Religious Worship	0.81	0.85	0.84	1,754	1,907	2,181
Retail	0.80	0.85	0.84	2,662	2,872	2,917
School	0.79	0.85	0.83	1,537	1,753	1,778
Service			0.85			2,684
Warehouse	0.80	0.85	0.84	1,867	2,014	2,568

B Standard Motor Table

B.1 Overview

This document contains reference data for estimating demand and energy savings in Commercial Standard Offer Program for energy efficient motors and related measures. For motors installed under the program, the equipment must exceed these minimum efficiency standards. In addition, the minimum efficiencies define the baseline for calculating demand and energy savings. M&V Guideline 4 for motor measures describes the application of these equipment efficiency standards for estimating baseline demand and energy use and measure demand and energy savings.

B.2 Table

The efficiencies of permanently wired, poly-phase motors that are at least one horsepower in size and that are used for fan, pumping, and conveyance applications are defined in Table B.1. Table B.1 is based on ASHRAE Standard 90.1m-XXXX (will be updated in January, 2012). Note, however, that the following motors are exempt from these requirements:

- Motors in appliances.
- Refrigeration compressor motors.
- Multi-speed motors.
- Motors that are used as components of cooling equipment where the motors are part of the efficiency ratings listed in the Standard Cooling Equipment Tables.

The efficiency values given in Table B.1 should be used to determine the equipment baseline. Equipment installed under the Commercial Standard Offer Program must be more efficient than the standards shown in order to be eligible for incentives.

Table B.1: Minimum nominal full-load motor efficiency for single speed poly-phase motors

Motor	Horsepower	2-Pole	4-Pole	6-Pole	8-Pole
Open	1.0				
	1.5				
	2.0				
	3.0				
	5.0				
	7.5				
	10.0				
	15.0				
	20.0				
	25.0				
	30.0				
	40.0				
	50.0				
	60.0				
	75.0				
	100.0				
	125.0				
	150.0				
	200.0				
Enclosed	1.0				
	1.5				
	2.0				
	3.0				
	5.0				
	7.5				
	10.0				
	15.0				
	20.0				
	25.0				
	30.0				
	40.0				
	50.0				
	60.0				
	75.0				
	100.0				
	125.0				
	150.0				
	200.0				

C Table of Standard Fixture Wattages

C.1 Overview

The Table of Standard Fixture Wattages contains reference data for estimating demand and energy savings in the Commercial Standard Offer Program for lighting measures. The Table assigns identification codes and demand values (watts) to common fixture types (fluorescent, incandescent, HID, LED, etc.) used in commercial applications. The Table wattage values for each fixture type are averages of various manufacturers' laboratory tests performed to ANSI test standards. By using standardized demand values for each fixture type, the Table simplifies the accounting procedures for lighting equipment retrofits.

AEP posts updated versions of the Table on the program Web site at www.AEPefficiency.com as new fixtures are added. Project Sponsors should make sure that they are working with the most recent version of the Table as they prepare *Lighting Equipment Survey* forms.

If a project uses a fixture type not listed in the Table, the Sponsor should request that AEP add a new fixture code. The request should include all information required to uniquely identify the fixture type and to fix its demand. If possible, the request should be supported by manufacturer's ANSI test data.

The *Lighting Equipment Survey Form* is linked to a copy of the Standard Wattage Table and looks up wattage values for fixture codes automatically. For this reason, Sponsors should use only the identification codes included in the Table.

C.2 Table

The Table is subdivided into fixture types such as linear fluorescent, compact fluorescent, mercury vapor, etc, with each subdivision sorted by fixture code. Each record, or row, in the Table contains a fixture code, which serves as a unique identifier. Each record also includes a description of the fixture, the number of lamps, the number of ballasts if applicable, and the fixture wattage. A legend explains the rules behind the fixture codes.

The US Energy Policy Act of 1992 (EPACT) sets energy efficiency standards that preclude certain lamps and ballasts from being manufactured or imported into the US. Under the Commercial Standard Offer Program, all lighting equipment, including existing or baseline equipment, must be EPACT compliant. As a result, certain lamp/ballast combinations, which are non-EPACT compliant, are assigned EPACT demand values. Thus, a 4-foot fixture with 40-watt T-12 lamps and a standard magnetic ballast has the same demand value as a like fixture equipped with 34-watt T-12 lamps and an energy efficient magnetic ballast.

The fixture codes and the demand values listed in the watt/fixture column in the Table of Standard Fixture Wattages must be used in calculating energy and demand savings for any lighting efficiency project in the Commercial Standard Offer Program.

D M&V Sampling Guidelines

D.1 Overview

This appendix provides guidelines for defining a sample of equipment for measurement and verification purposes. In sampling, a large number of similar pieces of equipment affected by the same energy-efficiency measure can be grouped into usage groups from which samples are selected. These sampling guidelines are designed to provide assistance in determining the number of sample points that should be monitored in order to meet the program precision requirements and provide a reliable estimate of parameters such as annual energy savings or hours of operation. If alternative approaches are proposed, they must be approved by AEP and based on sound statistical principles.

D.2 Steps in Calculating Sample Size

The number of pieces of equipment requiring monitoring can be calculated according to the following steps:

1. Compile measure information

Compile the following information for the equipment affected by the measures. This step is normally undertaken during the preparation of the Final Application.

- *Number of Fixtures/Equipment.* Identify and document the fixtures/equipment that are affected by the installation of measures in a survey that includes nameplate data, quantity of equipment, and location information.
- *Projected Hours of Operation*. Project the average hours of operation of the equipment. It should be based on the experience of the building operator, on the operation of the affected equipment or even some preliminary monitoring.

2. Designate usage group

Next, provide a brief description of the functional use of the space being audited. Functional uses typically encountered in lighting for commercial and industrial facilities are provided in Section III, Chapter 2, Table 2.3 of this manual. Usage groups for non-lighting measures are dependent on type of application. Sources of information on operating characteristics, other than monitoring, used in defining usage groups include: (a) operating schedules that provide information on energy consumption or hours of operation; and (b) type of application or location that provides information on how and when equipment (e.g., fixtures or motors) are operated. In some instances, area type alone may be insufficient to designate usage groups. Usage groups may need to be further subdivided if an area type is inherently variable in nature due to different characteristics of their occupants. For example, some laboratories may have longer operating hours than others and should be divided into different usage groups (e.g., computer laboratory lighting operates for 8 hours per day while agriculture laboratories operate 4 hours per day).

3. Calculate sample sizes

Once the equipment has been divided into usage groups, the total sample size needed for these groupings can be calculated. This approach produces a sample (with a coefficient of variation of 0.5) expected to estimate the average hours of operation with sufficient accuracy. The following table shows the number of samples required in a usage group.

Table D.1: Sample Size based on Usage Group Sampling

Usage Group Population	Sample Size 80/20	Sample Size 80/20, plus 10%
4	3	4
5	4	5
12	6	7
16	7	8
20	7	8
25	8	9
30	8	9
35	8	9
40	9	10
45	9	10
60	9	10
65	9	10
70	9	10
80	10	11
90	10	11
100	10	11
125	10	11
150	10	11
175	10	11
200	10	11
300	10	11
400	11	13
500	11	13

D.3 Over-sampling

The initial sample size should be increased to compensate for potential reductions in the final usable sample due to equipment failure or loss. Suggested guidelines are that the sample size be increased by 10 percent.

E M&V Example

E.1 Project Summary

An owner of a 250,000 square foot office complex is participating in AEP's Commercial Standard Offer Program. A central chilled water plant cools the facility with a 15-year-old 700-ton centrifugal chiller. The owner of the building is planning to replace the older chiller with a new, high efficiency unit. The new unit under consideration is rated with an ARI nominal COP of 6.4 (0.55 kW/Ton). The baseline and minimum efficiency standards for water-cooled electric chillers is taken from Appendix A, Table 7 of the *Standard Cooling Equipment Tables*. For a 700-ton water-cooled chiller, the baseline efficiency is 4.7 COP, which is equivalent to 0.748 kW/ton. Likewise, for a 700-ton water-cooled chiller, the minimum efficiency is 6.1 COP, which is equivalent to 0.577 kW/ton (and the unit qualifies for the program by having a higher efficiency than the required minimum).

E.2 Assumptions

This M&V plan is written with the following assumptions:

1. The office building is not planning any major projects that would significantly alter the chiller load or schedule, such as building additions, significant changes in building occupancy, or significant changes in building schedule.
2. The chiller operating schedule will not change because of this project.

Based on the assumptions and the fact that the new chiller is similar to the existing one (similar size, water-cooled, no VFD, etc.), the only characteristic needed to estimate the demand and energy savings is the full load efficiency of each chiller.

E.3 Project Activities

The proposed method for conducting the M&V is from Section III, Chapter 3: *Guidelines for Replacement of Cooling Equipment*. Since the simplified guidelines are being used, pre-installation monitoring is not required. The project does require pre-installation and post-installation inspections, post-installation monitoring of chiller demand (kW for at least one hour at peak operating conditions), post-installation monitoring of chiller consumption (kWh for the entire year), an Installation Report, and a Savings Report. The Project Sponsor shall be responsible for all M&V activities and production of reports.

E.3.1 Inspections

AEP shall perform a pre-installation inspection to validate assumptions used in the savings calculations, and verify the existing chiller efficiency. The best source of information for the existing efficiency is the ARI certification, which accompanies the existing chiller. A post-installation inspection will be performed to verify that the chiller was installed and is operating as proposed in the approved Final Application.

E.3.2 Post-Installation Monitoring

Post-installation monitoring of chiller electrical consumption shall be conducted for the entire M&V period. This monitoring will be accomplished using an ACME Inc, self contained, three-phase, true RMS kW logger. The logger collects time stamped data at 15-minute intervals. The logger will be downloaded monthly and the data validated and stored. In the event that there is a significant gap in the data due to a logger failure, the process to replace the missing data with interpolated or averaged data will be clearly documented. The 15-minute time stamped data will be used to satisfy all post-installation monitoring requirements.

E.3.3 Reports

After the chiller is installed and commissioned, an Installation Report will be produced documenting that the equipment specified in the FA was installed and is functioning as expected. A Savings Report, following the guidelines and forms provided in the procedures manual, will be generated and submitted upon completion of the data collection activities. Savings estimates will be provided in spreadsheet form, following the template provided in Table 2, below. In addition to the reports, all monitoring data will be submitted in electronic format for review by AEP.

E.4 Metering Plan

The electrical demand of the proposed (new) chiller will be monitored to support the required M&V activities. This three-phase load will be monitored using an ACME true RMS kW meter. Current Transducers will be placed on Breakers 1, 3 and 5 of switch-gear SG-1. These breakers are the A, B, and C phases of the 460 volt service that supplies the chiller. No other devices draw power from these breakers.

The ACME meter will record electrical consumption at 15 Minute intervals for the duration of the monitoring period. This logger is capable of storing 41 days of 15-minute data using a fifteen minute interval. Data will be downloaded and stored on the first working day of each month to ensure that the logger does not run out of memory.

E.5 Accuracy Requirements

The ACME logger will be calibrated at the time of installation and then checked for calibration every 6 months. This will be accomplished using a Powersite true RMS meter calibrated at the factory to ±2 percent of reading.

E.6 Data Gathering and Quality Control

The data will be collected using quality control procedures for checking reasonableness. Any and all missing intervals will be replaced either by interpolation or use of average values. AEP will be notified of any data substitution because of missing data, and the method employed to substitute the data.

E.7 Calculations and Adjustments

The calculations described below will be performed for the Savings Report and will form the basis of incentive payments. The nominal efficiencies of the chillers are provided again in Table E.1 below.

Table E.1: Proposed and Baseline Chiller Statistics

Chiller	Efficiency (COP)	Full-Load kW
Baseline	4.7	524
Proposed	6.4	385

Using the post-installation data described above and the information in Table E.1, the savings will be calculated using Equations E.1 and E.2.

Equation E.1: Calculation of Energy Savings

$$\text{Energy Savings[kWh]} = \text{Post Installation Metering [kWh]} \bullet \left\{ \left[\frac{\text{COP of new chiller}}{\text{Baseline COP}} \right] - 1 \right\}$$

Equation E.2: Calculation of Peak Demand Savings

$$\text{Demand Savings[kW]} = \text{Max Demand Measured [kW]} \bullet \left\{ \left[\frac{\text{COP of new chiller}}{\text{Baseline COP}} \right] - 1 \right\}$$

The ratio of new to existing chiller is computed as 6.4 divided by 4.7 to yield 1.36. Table E.2 below provides a template to illustrate how monthly savings calculations will be estimated when actual M&V data are available.

Table E.2: Template for Computing Savings

Time of Day	Measured kW for peak day in June (hourly average)	Peak savings (kW)	Average demand profile in June (kW)	Days of Operation for June	Energy Consumption (kWh)	Energy Savings for June (kWh)
0:00	127.0	45.7	82.6	23	1899	684
1:00	142.4	51.3	92.6	23	2129	767
2:00	134.8	48.5	87.6	23	2015	725
3:00	127.0	45.7	82.6	23	1899	684
4:00	134.8	48.5	87.6	23	2015	725
5:00	127.0	45.7	95.3	23	2191	789
6:00	142.4	51.3	106.8	23	2456	884
7:00	173.2	62.4	129.9	23	2988	1076
8:00	269.6	97.1	202.2	23	4651	1674
9:00	288.8	104	216.6	23	4982	1793
10:00	319.6	115.1	271.7	23	6248	2250
11:00	346.6	124.8	294.6	23	6776	2439
12:00	354.2	127.5	301.1	23	6925	2493
13:00	358.0	128.9	304.3	23	6999	2520
14:00	362.0	130.3	271.5	23	6245	2248
15:00	365.8	131.7	274.4	23	6310	2272
16:00	365.8	131.7	274.4	23	6310	2272
17:00	346.6	124.8	260.0	23	5979	2153
18:00	327.2	117.8	245.4	23	5644	2032
19:00	308.0	110.9	200.2	23	4605	1658
20:00	192.6	69.3	125.2	23	2879	1037
21:00	127.0	45.7	82.6	23	1899	684
22:00	142.4	51.3	92.6	23	2129	767
23:00	115.6	41.6	75.1	23	1728	622
Total Savings:		131.7				35,248

The illustrative load data represents chiller consumption in the month of June. Energy savings (kWh) will be estimated in each month by multiplying the average hourly kWh with the number of days in the month and then applying equation E.1. The energy savings for each month will then be aggregated into an annual savings estimate. The peak data shall be used in equation F.2 to estimate the peak demand savings (kW).

F Service Territory Towns

AEP Texas Central Company

Abram
Alamo
Alice
Alleyton
Alton
Aqua Dulce
Aransas Pass
Asherton
Austwell
Banquette
Barksdale
Bay City
Bayside
Bayview
Beeville
Belmont
Benavides
Berclair
Big Wells
Bishop
Blessing
Blewett
Bloomington
Bluetown
Brackettville
Brownsville
Bruni
Campwood
Carrizo Springs
Catarina
Charlotte
Christine
Columbus
Combes
Comstock
Conception
Corpus Christi
Cotulla
Crystal City
Da Costa
Del Rio
Derby
Devine
Dilley
Donna
Driscoll
Eagle Lake
Eagle Pass
Edcouch
Edinburg
Edna
Edroy
El Campo
El Cenizo
El Indio
El Maton
Elsa
Encinal
Encino
Escobares
Falfurria
Freer
Fronton
Fulton
Ganado
Garciasville
Garwood
George West
Gillett
Glidden
Goliad
Granjeno
Gregory
Guadalupe
Hargill
Harlingen
Havana
Hebbronville
Hidalgo
Hillje
Indian Lake
Inez
Ingleside
Ingleside By The Bay
Jourdanton
Karnes City
Kenedy
Kingsville
Knippa
La Blanca
La Casita
La Feria
La Grulla
La Joya
La Pryor
La Rosita
La Villa
Laguna Heights
Laguna Vista
Lake City
Lakeside
Lamar
Laredo
Laurelles
Lazano
Leakey
Leesville
Leming
Long Mott
Los Ebanos
Los Fresnos
Los Indios
Louise
Luling
Lyford
Lytle
Madero
Markham
Matagorda
Mathis
Matthews
Mcallen
Mercedes
Midfield
Millett
Mirando City
Mission
Monte Alto
Moore

Moore Field
Nada
Natalia
Nixon
Nordheim
Normandy
Normanna
Oakville
Odem
Oilton
Olmito
Orange Grove
Palacios
Palm Valley East
Palmhurst
Palmview
Pawnee
Pearsall
Penitas
Pernitas Point
Petronila
Pettus
Pharr
Placedo
Pleasanton
Point Comfort
Port Aransas
Port Isabel
Port Lavaca
Port Mansfield
Portland
Poteet
Premont
Primera
Progreso
Progreso Lake
Quemado
Rabb
Ramireno
Ramirez
Rancho Viejo
Raymondville
Realitos
Refugio
Ricardo
Rio Bravo
Rio Grande City
Rio Hondo
Rios
Riviera
Robstown
Rockport
Rocksprings
Roma
Runge
Sabinal
San Benito
San Carlos
San Diego
San Juan
San Patricio
San Ygnacio
Sandia
Santa Maria
Santa Monica
Santa Rosa
Seadrift
Sebastian
Seco Mines
Sejita
Seven Sisters
Sinton
Skidmore
Smiley
South Padre Island
Spofford
Sullivan City
Taft
Three Rivers
Tienditas
Tivoli
Tuleta
Tulsita
Tynan
Uvalde
Victoria
Violet
Wadsworth
Weesatche
Weslaco
Westhoff
Winter Haven
Woodsboro
Yorktown
Zapata

SWEPCO

Alba
Atlanta
Avery
Beckville
Bethany
Bettie
Big Sandy
Bloomburg
Carthage
Center
Clarksville City
Cookville
Daingerfield
Dekalb
East Mountain
Fruitvale
Gary
Gilmer
Gladewater
Golden
Grand Saline
Hallsville
Hawkins
Henderson
Hooks
Hughes Springs
Jefferson
Kilgore
Lakeport
Leary
Linden
Longview
Marshall
Maud
Mena
Millers Cove
Mineola
Mt. Enterprise
Mt. Pleasant
Mt. Vernon
Naples
Nash
New Boston
New London
Omaha
Overton
Pickton
Pittsburg
Pritchett
Queen City
Red Lick
Saltillo
Scottsville
Tatum
Tenaha
Texarkana
Union Grove
Wake Village
Warren City
Waskom
White Oak
Winfield
Winnsboro
Winona

AEP Texas North Company

Abilene
Acme
Afton
Albamy
Alpine
Anson
Aspermont
Avoca
Baird
Bakersfield
Ballinger
Balmorhea
Barnhart
Benjamin
Best
Big Lake
Blackwell
Bradshaw
Bronte
Buffalo Gap
Burkett
Caps
Carey
Carlsbad
Childress
Chillicothe
Christoval
Cisco
Clarendon
Clyde
Cross Cut
Cross Plains
Crowell
Dickens
Dodson
Eden
Eldorado
Eli
Elliott
Elton
Eola
Estelline
Eula
Farmers Valley
Flomont
Fort Chadbourne
Fort Davis
Gasoline
Girard
Girvin
Glenn
Goodlett
Goree
Grayback
Hamlin
Harrold
Haskell
Hatchell
Hawley
Hedley
Hefner
Impact
Imperial
Iraan
Jayton
Junction
Kirkland
Knickerbocker
Knox City
Lakeview
Lawn
Lela
Lelia Lake
Lockett
Loco
Longworth
Lueders
Lutie
Marathon
Marfa
Margaret
Matador
May
McAdoo
McCamey
McCaulley
Medicine Mound
Melvin
Memphis
Menard
Mereta
Merkel
Mertzon
Miles
Moran
Munday
Newlin
Nimrod
Noodle
Norton
O'Brien
Odell
Oklaunion
Old Glory
Ovalo
Ozona
Paducah
Paint Rock
Peacock
Pioneer
Potosi
Presidio
Putman
Quanah
Quitaque
Rankin
Rayland
Redford
Rising Star
Roaring Springs
Robert Lee
Roby
Rochell
Rochester
Rotan
Rowena
Royston
Rule
Sagerton
San Angelo
Santa Anna
Saragosa
Scranton
Sedwick
Shafter
Shamrock
Sheffield
Sherwood
Sonora
Spur
Stamford
Sterling City
Swenson
Sylvester

Talpa
Tankersley
Tell
Thalia
Throckmorton
Toyahvale
Treut
Truscott
Turkey
Tuscola
Twitty
Tye
Valentine
Valera
Veribest
Vernon
View
Wall
Water Valley
Weinert
Wellington
Whiteland
Wilmeth
Wingate
Winters
Woodson

H Project Sponsor Participation Process

Project Sponsor (PS)

American Electric Power (AEP)

1. **PS** Reviews CSOP Manual (on web site) – AEPefficiency.com
2. **PS** Completes and submits Initial Application [IA] (on-line)
    - (*if applicable* – Project Sponsor and Customer Agreement must be received by AEP within 15 business days of IA submittal)
3. AEP Reviews and Approves Initial Application
    - (within 15 business days of IA submittal)
4. **PS** Submits applicable documentation, hardcopy (see Appendix I)
5. **PS** Submits Final Application [FA] (on-line)
    - (within 15 business days from IA approval)
6. **PS** Submits Security Deposit
    - (must be received by AEP within 20 business days of IA approval)
    - *(the greater of $500 or 5% of the requested incentive amount)*
7. AEP Conducts pre-measure installation inspection
8. AEP Approves Final Application (within 45 business days of FA submittal)
9. **PS** Accepts, saves, prints, signs and submits two copies of the CSOP Agreement (from the web site)

- (must be received by AEP within 15 business days of the FA approval)

10. AEP Signs the CSOP Agreement
11. AEP Mails one executed copy of the CSOP Agreement to the PS

12. **PS** Installs the new energy efficiency measure(s)
    - (within 6 months of the Effective Date of the Agreement)
13. **PS** Submits the Installation Report [IR] (on-line)
    - (within 15 business days from measure installation)
14. **PS** Submits applicable documentation, hardcopy (see Appendix I)
    - (*if applicable* – Customer Acknowledgement Form must be received by AEP within 15 business days from measure installation)

15. AEP Conducts post-measure installation inspection
16. AEP Approves the Installation Report
    - (within 30 business days of IR submittal)

17. **PS** Submits the Savings Report [SR] (on-line)
    - (within 18 months of the Effective Date of the Agreement)

18. AEP Approves the Savings Report
    - (within 30 business days of SR submittal)
19. AEP Processes the incentive payment

20. **PS** Receives payment

AEP
Commercial Standard Offer Program (CSOP)
Small Projects (< 25 kW Savings)
Application Process

Project Sponsor (PS)

American Electric Power (AEP)

1. **PS** Reviews CSOP Manual (on web site) – AEPefficiency.com
2. **PS** Completes and submits Initial Application [IA] (on-line)
    - (*if applicable* – Project Sponsor/Customer Agreement must be received by AEP within 15 business days of IA submittal)
3. AEP Reviews and Approves Initial Application
    - (within 15 business days of IA submittal)
4. **PS** Submits applicable documentation, hardcopy (see Appendix I)
5. **PS** Submits the Installation Report [IR] (on-line)
    - (within 15 business days from measure installation)
6. **PS** Submits applicable documentation, hardcopy (see Appendix I)
    - (*if applicable* – Customer Acknowledgement Form must be received by AEP within 15 business days from measure installation)
7. AEP Conducts post-measure installation inspection
8. AEP Approves the Installation Report
    - (within 30 business days of IR submittal)
9. AEP Processes the incentive payment
10. **PS** Receives payment

I Documentation For New & Retrofit Projects

NEW PROJECT – Documentation (hard copies)

- Lighting layout of the facility(s)
- Documentation on the square footage of the facility
- Manufacturing data on the HVAC efficiency ratings
- Signed Project Sponsor and Customer Agreement
- Signed Customer Acknowledgement Form
- Security Deposit
- Signed Agreement (between Project Sponsor and AEP)

RETROFIT PROJECT – Documentation (hard copies)

- Manufacturing data on the HVAC efficiency ratings
- Signed Project Sponsor and Customer Agreement
- Signed Customer Acknowledgement Form
- Security Deposit
- Signed Agreement (between Project Sponsor and AEP)

J Customer Acknowledgement Form

Customer Acknowledgement Form

AEP Commercial Standard Offer Program

Project Name: _____ Project Number:_____

Project Location/Site (list all sites): _____

The signatures on this document certify that the energy efficient equipment associated with the project measures listed and describe in the Installation Report have been installed.

Project Sponsor

I hereby certify that the energy efficiency measures

have been installed as described in this Installation Report:

Signature: _____

Print Name: _____

Title: _____

Completion Date: _____

Host Customer

I hereby certify that I am an authorized representative of the Host Customer and that the energy efficiency project has been installed as described in this Installation Report to the Host Customer's satisfaction:

Signature: _____

Print Name: _____

Title: _____

Approval Date: _____

K Project Sponsor and Customer Agreement

Project Sponsor and Customer Agreement

This document is only required for Project Sponsors (energy efficiency service providers) submitting a SOP Application on behalf of an AEP distribution customer. Please list each customer site.

Project Name: _____ Project Number:_____

Project Location/Site (list all sites): _____

Estimated: Start Date: _____ Completion Date:_____

1. Customer agrees to provide AEP, upon five (5) business days' prior oral notice, full and complete access to the project site for any purpose related to the Commercial Standard Offer Program. Access shall be provided during Customer's normal business hours and in compliance with Customer's reasonable access requirements.
2. Customer acknowledges that any view, inspection, or acceptance by AEP of the project site or of the design, construction, installation, operation or maintenance of the measures is solely for the information of AEP and that, in performing any such inspection or review or in accepting the measures, AEP makes no representations or warranty whatsoever as to the economic or technical feasibility, capability, safety or reliability of the measures, their installation by the Project Sponsor, or their compatibility with Customer's facilities.
3. Customer acknowledges that the energy efficiency project would not have been completed or would have been completed with less efficient measures except for the Commercial Standard Offer Program and the incentive provided through it.
4. Customer acknowledges that the Project Sponsor is an independent contractor with respect to AEP and the Commercial Standard Offer Program and that the Project Sponsor is not authorized to make representations or incur obligations on behalf of AEP.
5. A Customer acknowledgement that AEP is not a party to the Customer Agreement and that the Project Sponsor is solely responsible for performance thereunder.
6. A Customer acknowledgement that AEP makes no warranty or representation regarding the qualifications of the Project Sponsor, and that the Customer is solely responsible for the selection of the Project Sponsor.
7. A Customer acknowledgement that the Customer may file a complaint with the Public Utility Commission of Texas concerning the Project Sponsor, but that AEP will play no role in resolving any disputes that arise between the Customer and the Project Sponsor.
8. A Customer agreement to release AEP from any and all claims, demands, losses, damages, costs, and legal liability including, but not limited to 1) injury or death of persons, 2) damage to natural resources, 3) violation of any local, state, or federal law or regulation including, but not limited to, environmental and health and safety laws or regulations, 4) strict liability imposed by any law or regulation, 5) equipment malfunctions, or 6) energy savings shortfalls arising out of, related to, or in any way connected with the Project, regardless of any strict liability or negligence of AEP, whether active or passive, excepting only such claims, demands, losses, damages, costs, expenses, liability, or violation of law or regulation as may be caused by the active negligence or willful misconduct of AEP, and resulting from its acceptance of the project for participation in the Commercial Standard Offer Program.

Customer Representative	**Project Sponsor Representative**
Signature: _____	Signature: _____
Print Name: _____	Print Name: _____
Title: _____	Title: _____
Date: _____	Date: _____