

# **Electric Standard Offer Program**

## **Procedure No. 360-17**

### **Limits Used To Verify Energy Savings**

#### **1. Purpose:**

To document the rationale and intent for the use of limits in the energy savings calculations utilized in verifying invoiced energy savings submitted for payment under the Standard Offer programs (Standard Offer No. 1, No. 2, and No. 3).

#### **2. Description:**

PSE&G evaluates the Measurement and Verification (M&V) Plan for each Energy Savings Measure (ESM) on a Host Facility by Host Facility basis. The specifics of each ESM are reviewed independently. The verification of savings from a specific ESM is evaluated based upon site-specific information such as, but not limited to, equipment design, system operation, existing practices and/or performance data. This site-specific information may result in establishing limits to ensure energy savings are in line with the physical limits of the ESM and/or within a reasonable range.

To be more specific, PSE&G may use “upper limits”, “lower limits”, and/or “regression equation limits” when verifying kWh savings. Typically limits are applied on an interval basis. As specified in the Measurement and Verification Protocols the maximum allowable interval is one hour. PSE&G typically uses upper limits to ensure that the total calculated kWh savings for each interval does not exceed the total possible kWh consumption that could have been used under pre retrofit conditions. Lower limits are typically used to ensure that kWh savings are only calculated for intervals that work is being performed (output cooling, air flow, water flow, etc.). Regression equation limits are typically used to ensure that calculated kWh savings for equipment that operates at part load conditions are supported by part load performance data. The discussion and examples below illustrate the rationale for applying Upper, Lower and Regression limits to energy savings calculations:

#### **Upper Limits**

PSE&G typically applies upper limits to ensure energy savings that are submitted for an interval do not exceed the energy consumption that can be verified for equipment replaced under this program. This is especially necessary for cases in which the post retrofit equipment is capable of generating output that exceeds the output of the old replaced equipment. In most cases, the upper limit values are based on the old equipment capacity.

For example, if a 1,000 kW electric heater was replaced with a gas unit of equal output heating capacity or greater, an upper limit of 1,000 kW per interval would be

incorporated into the energy savings calculations. For each metered interval that the total calculated kW reduction exceeded 1,000 kW, the calculated kW reduction would be limited to (or capped at) a maximum of 1,000 kW.

When the post retrofit equipment's output capacity is less than that of the pre retrofit equipment capacity, the upper limit is based on the post equipment's capacity.

For example, if the same 1,000 kW electric heater was replaced with a gas unit with a smaller output heating capacity, the upper limit would be based on the post equipment's capacity. In this case, the upper limit set on the post equipment capacity acts as a check for PSE&G to confirm that the submitted savings for each interval do not exceed the physical limitations of the post equipment.

### **Lower Limits**

All energy savings are based upon a relationship between energy input to useful work, output. Lower limits are typically applied in situations when no useful work is being performed and the equipment is considered off. It is important to note, that absent an Energy Management System, turning equipment off does not qualify for Standard Offer energy savings or incentives.

For example, consider a Variable Speed Drive (VSD) that is installed on a fan motor. At lower fan speeds, a small amount of energy is used to drive the fan, yet no air is moved due to static pressure in the system. Using field measurements and/or accepted engineering standards, a lower limit would be set based on the lowest metered kW at which the fan can overcome the static pressure in the system and move air. Intervals when metered kW is below the lower limit are considered to have zero energy savings.

### **Regression Equation Limits**

Regression equation upper and lower limits are typically used when calculating the energy savings for equipment with variable end use demands (such as chillers). Calculating energy savings for measures with variable end use requirements requires relating the energy input of the post retrofit equipment to the output work that is being performed (such as output in Tons of cooling). As the input to output relationship for this type of equipment is typically nonlinear, PSE&G requires part load performance data derived from manufacturers specification sheets, actual field measurements, or Standard Offer default tables to develop regression equations (generally referred to as the load curve) to relate the energy input to output. The Measurement and Verification Protocols support the requirements for this type of information.

Since the input to output relationship is not linear and, among other reasons, is based upon the physical limits of the equipment, it is unknown how the specific equipment will operate outside

of the range of data used to develop the regression equation. In some cases a regression equation, load curve, used without limits could predict an infinite, or even negative, amount of input for low rates of output. Consequently, PSE&G incorporates upper and lower regression equation limits into its energy saving calculations to ensure that the kWh savings are in line with the physical limits of the ESM, within a reasonable range, are verifiable according to the Measurement and Verification Protocols, and are supported by part load performance data.

For example, consider a situation where an electric chiller is replaced with a gas chiller. As part of the projects Monitoring and Verification Plan (M&V Plan), the Seller submits part load performance data for the new gas chiller at 25%, 50%, 75%, and 100% full load energy inputs. Operation below 25% and above 100% could not be substantiated. On an interval basis, PSE&G calculates the % of full load energy input of the gas chiller. For intervals when the calculated input is determined to be greater than 100% full load, the savings will be calculated using a default energy input value based on 100% full load input. For intervals when the calculated input is determined to be below 25% full load, the savings will be zero. It is important to note that had the M&V Plan included part load performance data up to 110% and down to 15% full load input, PSE&G would use these values as the upper and lower limits for the regression equation.

### **3. Seller Responsibilities:**

The Seller is responsible for incorporating into its project's energy saving calculations the appropriate upper limits, lower limits and regression equation limits. All other requirements of the Measurement and Verification Protocols, including the requirements for part load performance data, must be adhered to. This will ensure that the invoiced energy savings are based upon the requirements of the Standard Offer Program.

The Seller may submit to PSE&G proposed revisions to its project's M&V plan that include updated part load performance data for variable end use equipment. The Seller should coordinate with PSE&G to ensure that the necessary backup documentation and/or field measurements/audits are included as part of its proposed revised M&V Plan.

### **4. PSE&G Responsibilities:**

Based on the project specific information provided in the Seller's M&V plan, PSE&G will verify the limits are proper.

PSE&G will review any proposed revisions to existing M&V plans that include updated part load data for variable end use equipment. As part of its review, PSE&G will determine if the part load equations and corresponding limits used to calculate the savings are proper. PSE&G reserves the right to grant (or deny) approval of proposed revisions to existing M&V plans.

## 5. References:

### Standard Offer Energy Savings Agreement

#### Article V Monitoring

##### Billing and Payment

“Seller shall determine, and PSE&G shall verify, the amount (in kWh) of Energy Savings delivered by Seller to PSE&G for all Periods of each billing cycle during the Term of this Agreement. Such determination shall be made in accordance with the Board approved Measurement and Verification Protocol set forth in Appendix A (Project Proposal) hereto which may be through the use of meters and monitoring devices including, in PSE&G’s reasonable judgment, elapsed time indicators, paid for and owned by Seller, or by such other methods of calculating Energy Savings consented to in writing by PSE&G either as part of the Measurement and Verification Protocol or as supplement thereto.”

### Measurement Protocol For Commercial, Industrial and Residential Facilities

#### C. Method 3: Measures Affecting Variable End Use Requirements

##### 2. Measurement Methodology

- b. Develop Load Curves:
  - i. Develop a Load Curve that reflects Pre-and, where applicable, Post-Installation kW versus Output relationship. This curve can be developed based upon a regression analysis using acceptable historical data and/or operating measurements **subject to Paragraph 2.b.iii below**. This Load Curve will be used to establish baseline electrical consumption for savings calculations.
  - ii. Use of Load Curves are appropriate only where there is no significant change in the process from which the Load Curve was derived.
  - iii. When regression analysis is used for developing the Load Curve, the intervals of data should be selected to match the practical operation of the end use or process being evaluated. In general, hourly data can and should be used to evaluate end used such as chillers, lighting, water heating, etc. since the output of the system coincides with the electric input to the system.

However, certain processes involve production cycles such that the hourly output of the system significantly lags energy input, and/or has little or no relation to hourly input. For example, a production cycle for a batch process may involve a warm-up, production, cool down and clean-up/preparation cycle. The relationship between energy and output of such process is meaningful on a cycle basis.

Therefore, a modeling procedure should specifically test and justify the intervals of data to be used, based on descriptions of the operation of the facility or process, and the end uses involved. Hourly data is recognized as the standard where use of hourly data is: (a) practicable (measurement of hourly output can be obtained); and (b) meaningful based on the description of the production cycle or processes involved.

**This model must be statistically valid in accordance with the following Regression Statistical Criteria:**

- A. **Functional form of model is correct in the judgment of the Utility, NJ BRC and Rate Counsel (e.g. in terms of appropriate signs on**

**parameters, use of proper variables, incorporation of only relevant variables, model limits and restrictions).**

- B. T-statistic for all estimated parameters in the model is at least 2 (90% confidence that the coefficient is not zero).
- C. Allowance for known measurement errors, elapsed time over which data is gathered and data sources are clearly documented, and acceptable to the Utility, NJ BRC Staff, and Rate Counsel.
- D. The model's correlation coefficient ( $R^2$ ) is not less than 90%, unless otherwise accepted down to 80%.
- E. **Limits of the model used need to be specified.**

**Approved By:** \_\_\_\_\_

**Date:** \_\_\_\_\_

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