**Line Loss Compensation References**

1. **Recommendation:**

Where the EPS Meter is not located at the Point of Interconnection (POI) to the ERCOT Transmission Grid, actual metered consumption must be adjusted for line and transformation losses to the POI except in the case of line loss only compensation with a calculated % Line Watt Cu Loss less than 0.001%. The preferred method for loss compensation and correction is via internal meter programming.

1. **Reasoning:**

**ERCOT**- Deviation from 100% registration is one half of the % Watt Copper Loss as calculated by the MWG approved TLC worksheet when using 5 test amps for full load meter testing (Calculations on the spreadsheet use ½ meter class amps, 10 amps, to derive % Watt Copper error). Deviation from 100% registration is equal to the % Watt Copper error at 50% PF). Therefore a % Watt Cu loss less than 0.001% will not be seen on a meter test result utilizing three decimal places.

**TDSP 1**- Regarding the minimum % Wat Cu Loss threshold, it should be determined by the ability of the meter to do something with the calculated value. We agree with ERCOT’s position that it will be worthless to input a value that can’t be used by the meter as this will be the element doing the loss compensation calculations.

**TDSP 2**- Would support ERCOT’s approach discussed in the last meeting. Line loss compensation would not have to be programmed into the meter in cases where the calculated line loss compensation values are so small that there would be no measureable difference (to two decimal points?) between meter “test runs” with and without the compensation applied.

* 1. **Recommendation:**

Line loss compensation for all Resources where the meter is not located at the Point-of-interconnect (POI), and the “percent watts loss” value is calculated at 0.05 or greater. Line loss compensation to begin at a conductor length set at “percent watts loss” value of 0.05 and greater. This recommendation will reduce annual maintenance time and associated cost for EPS metering. It will also reduce the potential for errors in the configuration of EPS meters; it will also reduce the potential for calculation errors in meter testing and in deriving loss compensation values.

* 1. **Reasoning:**

The discussion at the previous MWG meeting touched on using the “percent watts line loss” value as a determining factor if line loss compensation in the meter was justified. Please note in the *ERCOT Transformer and Line Loss Compensation Spreadsheet,* the “percent watts line loss” calculated value includes the meter point kr and meter coil watts factor multiplier. The “percent watts line loss” calculation I2R/VI(SQRT 3) is used below.

Utilizing the conductor length, size, rated current, and VLL operating voltage, the “percent watts line loss” value was calculated for conductor length increments up to 0.9 mile. An associated typical Market energy purchase price was calculated for 1 hr and for 1 year. The conductor length energy losses (I2R) costs, when compared to the cost of total energy delivered, are small. For example at $70/MWh “on peak” Market price, for 138kV, 1780 ft 1/C, 795 ACSR @ 924 amp rated current (%watts loss of 0.05) – approximate losses cost $4.42/hr or $39,000/yr; Market Energy delivered price is $77.4M.

The Energy Market operation is complex, as is the efficient power plant operation. The many unknowns make it difficult to determine what metering inaccuracy is acceptable for fair and equal treatment in the Market. See the article excerpt below by Seth Blumsack, Assistant Professor of Energy Policy at the Pennsylvania State University. While these costs are not specific to the Texas Market they illustrate differences in operating costs by plant type.

“….Operating costs for power plants include fuel, labor and maintenance costs. Unlike capital costs which are "fixed" (don't vary with the level of output), a plant's total operating cost depends on how much electricity the plant produces. The operating cost required to produce each MWh of electric energy is referred to as the "marginal cost." Fuel costs dominate the total cost of operation for fossil-fired power plants. For renewables, fuel is generally free (perhaps with the exception of biomass power plants in some scenarios); and the fuel costs for nuclear power plants are actually very low. For these types of power plants, labor and maintenance costs dominate total operating costs.”

| **Table 5.1: Typical capital and operating costs for power plants. Note that these costs do not include subsidies, incentives, or any "social costs" (e.g., air or water emissions)** |
| --- |
| **Technology** | **Capital Cost ($/kW)** | **Operating Cost ($/kWh)** |
| Coal-fired combustion turbine | $500 — $1,000 | 0.02 — 0.04 |
| Natural gas combustion turbine | $400 — $800 | 0.04 — 0.10 |
| Coal gasification combined-cycle (IGCC) | $1,000 — $1,500 | 0.04 — 0.08 |
| Natural gas combined-cycle | $600 — $1,200 | 0.04 — 0.10 |
| Wind turbine (includes offshore wind) | $1,200 — $5,000 | Less than 0.01 |
| Nuclear | $1,200 — $5,000 | 0.02 — 0.05 |
| Photovoltaic Solar | $4,500 and up | Less than 0.01 |
| Hydroelectric | $1,200 — $5,000 | Less than 0.01 |



* 1. **Recommendation**:

Where the EPS Meter is not located at the Point of Interconnection (POI) to the ERCOT Transmission Grid, actual metered consumption must be adjusted for line and transformation losses to the POI if the uncompensated line loss, when combined with the meter system error, exceeds 0.47%.

$$0.47\%< S + LL$$

Where:

**S** is the error of the system

**LL** is the uncompensated line loss (% Watt Cu calculated at ½ meter class, e.g. calculate at 10A for a 20A class meter)

* 1. **Reasoning**:

The proposal above utilizes the existing ERCOT SMOG device accuracy class requirements as a not-to-exceed baseline for allowable uncompensated line loss. The above calculation ensures that uncompensated line loss will not introduce error beyond the accepted limitations.

The attached technical paper details the below RSS (Root Sum Square) calculation for determining the meter system error.



$$S= \sqrt{VT^{2}+ CT^{2} + M^{2}}$$

Where:

**S** is the error of the system

**VT** is the error of the voltage transformer

**CT** is the error of the current transformer

**M** is the measurement error of the meter

By applying the ERCOT maximum allowable accuracy class values for the individual components

**VT** 0.3%

**CT** 0.3%

**M** 0.2%

$$S=0.47\%= \sqrt{0.3\%^{2}+ 0.3\%^{2} + 0.2\%^{2}}$$

* 1. **Recommendation**:

Where the EPS Meter is not located at the Point of Interconnection (POI) to the ERCOT Transmission Grid, actual metered consumption must be adjusted for line losses, only where line losses exceed 600 yards, and transformation losses to the POI.

* 1. **Reasoning**:

As a supporting example, within the ERCOT Nodal Protocols, acceptable electrical nearness is defined for the specific purpose of netting load and generation resources at separate POIs. Section 10.3.2.3 paragraph (6) establishes a 400 yard distance requirement where the POIs that are not directly connected nor at the same voltage level may be netted, without compensation. Some current exemption proposals suggest that the market may allow up to 600 yards for uncompensated netting.

1. 1. **Recommendation**:

Loss compensation should be calculated any time the POI (understood as the point where the ownership changes) is located outside the station’s H-Frame, meaning the station where the EPS is physically located.

* 1. **Reasoning**:

The loss compensation is a separate issue from the accuracy of the metering point and it should be treated independently. The accuracy of the EPS is defined by ERCOT’s protocols and should not be part of this discussion. Line loss compensation should be understood as an effort to match the “physical” and “electrical” locations of the EPS when they are not the same due to the POI being remote from the station where the EPS is located.