

**Public Service Company of Colorado Transmission Loss Filing  
Docket No. ER15-266-000**

**Holy Cross Energy, Intermountain Rural Electric Association and Tri-State  
Generation & Transmission Association, Inc.**

**First Set  
Served December 4, 2014**

**DISCOVERY REQUEST COOP 1-2.g**

Loss Study Tables 5.1 and 5.2 develop demand and energy loss multipliers. The demand loss multiplier is 1.0252, which when applied to a transmission sales of 241,699 will produce an input value of 247,790. The 6,091 differential represents demand losses of 2.458 percent. Similarly, the energy loss multiplier is 1.018680, which when applied to transmission sales of 3,203,675,008 will produce an input value of 3,263,520,825. The 59,845,817 differential represents energy losses of 0.018337 percent. PSCo, however, shows in its FERC filing annual peak capacity losses of 2.52 percent, rather than 2.458 percent, and energy losses of 1.87 percent rather than 1.8337 percent.

- i. For billing purposes, does PSCo now use its FERC filed demand loss value to develop a loss multiplier, such that a filed demand loss value of 2.52 percent will result in a demand loss multiplier of 1.0258?
- ii. For billing purposes, does PSCo now use its FERC filed energy loss value to develop an energy loss multiplier, such that a filed energy loss value of 1.87 percent will result in an energy loss multiplier of 1.0190?

**RESPONSE:**

The 2.52 percent and the 1.87 percent are the loss factors that would be applied at the load (transmission output). The 2.458 percent and the 1.8337 percent are the loss factors that would be applied at the input to the transmission system. Both factors applied to the proper demands will result in the same losses.

- i. No. The loss multiplier of 2.52 percent will be applied to metered amounts at the transmission output.
- ii. No. The loss multiplier of 1.87 percent will be applied to metered amounts at the transmission output.

**Sponsor:** Jim Jordan  
Xcel Energy Services Inc.

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**DISCOVERY REQUEST COOP 1-2.i**

The Loss Study states at page vi that “[t]ransmission system losses were determined with a detailed system model provided by PSCo.”

- i. Did the PSCo detailed system model reflect the PSCo system as of the time that Siemens was conducting the loss study (i.e., 2014) or did it depict the PSCo system for some prior period (e.g., 2011)?
- ii. If the PSCo detailed system model depicted the PSCo system as of an earlier period, what was that prior period?
- iii. If the PSCo detailed system model depicted the PSCo system for an earlier period, were there any material changes in the system at the time the Loss Study was prepared? For purposes of this question a “material change” is the addition of new high voltage transmission circuits and the addition of new generation resources with an aggregate capacity of more than 200 MW.

**RESPONSE:**

- i. The loss study was conducted to explain total system energy losses within the PSCo system for the 2012 calendar year. Therefore, the appropriate transmission system power flow models to use are those that reflect the transmission lines and related facilities that were in operation during 2012. The PSCo detailed system model reflected the PSCo system for 2012, which was prior to when Siemens was conducting the loss study (2014).
- ii. The PSCo detailed system model reflected the PSCo system for 2012. The detailed PSCo system models included data from the 2011/2012 winter period, the 2012 summer period, and the 2012/2013 winter period.
- iii. The PSCo detailed system model depicted the PSCo system for 2012. The power flow cases used data for the time periods mentioned above. There were a total of 56 cases simulated to represent system models at different times of the relevant study year. There was one material change to the transmission system due to projects completed in the later part of 2012: the addition of the 345-kV circuits between Pawnee, Missile Site, and Smoky Hill. These facilities were placed in

service in late October 2012. For the loss study, these circuits were included in the 2012/2013 winter power flow cases for the months of November and December. Additional wind generation that is connected to Missile Site began commercial operation in October 2012. This was also reflected in the power flow cases and loss analysis.

**Sponsor:** Robert Zeles  
Siemens

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**DISCOVERY REQUEST COOP 1-2.t**

Please provide the Siemens calculated transmission level MWh losses during the PSCo transmission system peak hour for each of the twelve months of 2012.

**RESPONSE:**

Monthly demand losses for the transmission system peak hour were not specifically calculated for the transmission level for 2012. Monthly energy losses for the transmission level were also not specifically calculated for 2012.

In reviewing the transmission level losses that were calculated for each of the 8,784 hours in 2012, the following summary table has been prepared. This table excludes the corona losses for the transmission lines that need to be added to determine total PSCo loss values.

Date	Time	Demand Losses at Peak Demand-MW	Monthly Energy Losses - MWH
Jan 11	1900	97.94	48,525
Feb 7	1900	88.55	45,372
Mar 1	1900	82.44	43,322
April 24	1600	77.39	40,458
May 22	1800	94.80	43,583
June 25	1700	169.92	55,586
July 20	1700	153.88	62,167
Aug 8	1700	141.64	57,020
Sept 4	1800	114.17	45,025
Oct 25	1900	78.53	43,096
Nov 26	1800	89.27	43,519
Dec 19	1900	106.68	51,087

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Siemens

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**DISCOVERY REQUEST COOP 1-2.u**

The Loss Study states at 3-1 that “PSCo maintains a sophisticated load research program that enables the calculation of loss factors directly from the load research data without having to use empirical formula methods.”

- i. Does this statement mean that PSCo has software and data reference points (e.g., circuits, transformer information, voltage levels, line distances, conductor size, loadings, temperature and precipitation, etc.) that are capable of calculating losses based on actual operating conditions?
- ii. If PSCo has such software, please identify it by name and version number.
- iii. If PSCo has such software, please provide the calculated transmission level peak hour losses during the PSCo transmission system peak hour during of each of the twelve months of 2012.

**RESPONSE:**

- i. Yes. The SynerGEE software, combined with physical data from PSCo’s GIS database (including circuits, transformer information, voltage levels, etc., mentioned above), is capable of detailed modeling and analysis based on actual operating conditions, including loss calculations. PSCo currently uses the SynerGEE software only for distribution analysis, however.
- ii. The software is made by DNV GL and is SynerGEE Electric version 5.0.0.324.
- iii. The load research program mentioned on page 3-1 of the loss study is a distribution load research tool. This tool does not model the PSCo transmission system.

**Sponsor:** Chad Nickell  
Xcel Energy Services Inc.

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**DISCOVERY REQUEST COOP 1-3.a**

The Loss Study states at page 3-1 that “[n]on-coincident peak demands were used to calculate non-coincident peak demand losses, which are a function of the electric current.”

- i. What was the source of the non-coincident peak demands used for the calculation?
- ii. Were the non-coincident peak demands the actual 2012 non-coincident peak demands or were they estimated based on the transmission loads determined in the transmission loss portion of the Loss Study?

**RESPONSE:**

PSCo provided Siemens the non-coincident peak demands for year 2012 for every primary distribution circuit and substation transformer. The non-coincident peak demands were the actual non-coincident feeder and substation peak demand values as recorded by PSCo in 2012.

- i. The non-coincident peak demands used for the calculation come from PSCo’s database of SCADA data. The SCADA system records measurements such as current and voltage and stores this information in a searchable database from which both coincident and non-coincident peak demands can be identified.
- ii. The non-coincident peak demands used in the loss study were the actual non-coincident feeder and substation peak demands for PSCo in 2012.

**Sponsor:** Chad Nickell  
Xcel Energy Services Inc.

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Octavio Gutierrez  
Siemens

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**DISCOVERY REQUEST COOP 1-3.b**

The Loss Study states at page 3-4 that “[d]ue to the large number of primary lines in the PSCo system, it was not practical to perform detailed loss calculations for each circuit. Instead, the loss calculations for a representative sample of circuits, selected by PSCo, were used as the basis for all PSCo primary lines.” PSCo selected 14 of 732 12.47 kV and 13.2 kV circuits (1.9%) and 5 of 71 24.9 kV circuits (7%). The selected circuits were analyzed by PSCo using the SynerGEE distribution computer program.

- i. Table 3-2 shows that 24.9 kV lines comprise only 8.6% of the total number of PSCo primary lines and have an average peak loading of 40.8%. If there is a correlation between losses and line loadings, is there a potential to understate losses when 26.3% of the composition of the primary line “representative” group consists of 24.9 kV lines?
- ii. Table 3-2 shows that 12.47 kV and 13.2 kV circuits comprise 88.6% of PSCo’s primary lines, and have average peak loadings of 57.3 and 63.8 percent, respectively. If there is a correlation between losses and line loadings, is there a potential to understate losses when only 73.63% of the primary line “representative” group consists of 12.47 kV and 13.2 kV lines?
- iii. Does the SynerGEE distribution computer program referred to in the Loss Study have the capability to model all 825 primary line circuits?
- iv. Has PSCo included the characteristics (e.g., voltage level, conductor size, line length, etc.) of all of its 825 primary circuits in any of its software and can that software create an export file that can be used to import the data into the SynerGEE software used by Siemens?

**RESPONSE:**

With respect to the 24.9 kV lines, the sample is representative for circuits in the same voltage class. 14 circuits selected out of a population of 732 circuits for the 15 kV voltage class provided good results, as the circuits cover the whole load spectrum of the circuits in this class and supply a typical mix of different types of loads (residential, commercial, and industrial). Modeling of every circuit is time consuming and the amount of effort in

modeling primary circuits is a tradeoff between accuracy, time to complete the study, and budget.

Siemens does not use SynerGEE in loss studies. The SynerGEE files that PSCo provides are converted to the format used by Siemens proprietary software (PSS@SINCAL). Once the conversion process is completed, each circuit is modeled with the corresponding non-coincident peak load recorded for that circuit.

- i. Beyond including lines of varying primary voltage levels, the representative group is intended to capture the geographic diversity of PSCo's system. While 24.9 kV lines make up a smaller percentage of the distribution lines in PSCo's system, they are more geographically diverse. 24.9 kV lines are located across the PSCo service territory, including Denver International Airport, San Luis Valley, and the mountain resorts. Thus, enough 24.9 kV lines were selected for the study to ensure the representative group included samples from across PSCo's entire system.
- ii. Beyond including lines of varying primary voltage levels, the representative group is intended to capture the geographic diversity of PSCo's system. While 12.47 kV and 13.2 kV lines make up a larger percentage of the distribution lines in PSCo's system, they are primarily located in the Denver Metro area and are thus less geographically diverse. Enough 12.47 kV and 13.2 kV lines were included in the representative group to ensure the group accurately portrayed the PSCo system without biasing the results towards a specific geographic location.
- iii. While the SynerGEE program does have the capability to model all 825 primary line circuits, the significant amount of time and resources required for such a task would not justify the negligible improvement in study accuracy. A representative sample of the PSCo primary line circuits was chosen to eliminate the need to model all 825 circuits while still allowing for a comprehensive and conclusive study.
- iv. Yes, the characteristics of all PSCo primary line circuits are included in the PSCo GIS database. A custom tool was developed jointly by PSCo and DNV GL to manually create an export file of system characteristics from GIS that can be imported into the SynerGEE software for modeling and analysis.

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**DISCOVERY REQUEST COOP1-3.c**

The Loss Study derives primary line demand losses of 2.28 percent and energy losses of 1.81 percent, each of which is less than the corresponding transmission level losses.

- i. Is it Siemens' experience that primary line losses typically are less than transmission level losses?
- ii. What portion of the primary line loss analyses was performed by Siemens and what portion was performed by PSCo?

**RESPONSE:**

- i. The numbers cited are loss multipliers. These numbers may vary from company to company, but it is not unusual for the primary loss multiplier to be greater for the primary distribution system than for the transmission system.
- ii. PSCo provided all of the data and SynerGEE models for the study, while Siemens performed all analysis of the data.

**Sponsor:** Chad Nickell  
Xcel Energy Services Inc.

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