

Memorandum TNMP DLF Calculations

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Subject: Calculation of Annual Distribution Loss Factors

DISTRIBUTION LOSS FACTOR CALCULATION

Texas New-Mexico Power (TNMP) is a Distribution Service Provider (DSP) in the ERCOT region and is subject to compliance with ERCOT Nodal Protocols Section 13.3¹ Distribution Losses and, as such shall calculate and provide ERCOT the annual Distribution loss coefficients to be applied to distribution voltage level Loads in its area of certification. The Distribution Loss Factors (DLF) calculations for TNMP's certificated regions have been updated per ERCOT Nodal Protocol Section 13.3.1 paragraph (1), and the associated calculations and methodology are summarized herein.

The equation below calculates the DLF based on information provided by each DSP.

$$SILF_i = F1 * \left(\frac{SIEL_i}{AAL} \right) + F2 + \frac{F3}{\left(\frac{SIEL_i}{AAL} \right)}$$

where:	<i>i</i>	=	Interval (15 minutes)
	<i>SILF_i</i>	=	Settlement Interval Distribution Loss Factor
	<i>SIEL_i</i>	=	Settlement Interval ERCOT System Load
	<i>AAL</i>	=	Annual Interval Average ERCOT System Load
	<i>F1, F2, F3</i>	=	Coefficients determined by the DSP to allow calculations of its <i>SILF_i</i> from the ERCOT System Load

Within the pages that follow is a summary of the calculations associated with DLF coefficients for each of TNMP's certificated regions.

ASSUMPTIONS AND APPROACH

ERCOT System Load

TNMP energy and demand data from calendar year 2024 were collected from meter data at each distribution substation power transformer. ERCOT load profiles from the same time period were collected from the ERCOT

¹ See <http://www.ercot.com/mktrules/nprotocols/current> for the most recent iteration

² See http://www.ercot.com/gridinfo/load/load_hist for 2024 ERCOT Hourly Load Data

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website². The analysis assumes that AAL, defined previously, and the peak for TNMP corresponds to the AAL and peak for ERCOT. The table below details the demand and energy figures utilized for this analysis.

	ERCOT	TNMP North TX	TNMP Central TX	TNMP Gulf Coast	TNMP West TX
1-Hr Peak (MW)	85,199	421.38	127.27	704.48	146.56
15-Min Interval (MWh)	21,300	105.34	31.82	176.12	36.64
Total Energy (MWh)	461,491,692	2,381,236	719,212	2,456,287	704,182
AAL (15-min)	13,170	68	21	70	20

Loss Analysis Methodology

A representative sample of the circuits within each TNMP region were selected for detailed analysis. The detailed analysis results of said sample circuits were extrapolated to develop loss factors at each level of the distribution system. System loss percentages are developed at each of the following levels of the distribution system: power transformers, primary line, distribution service transformers, and distribution services (secondary of service transformers). Due to system consistencies with respect to nominal operating voltages, circuit topology, and geographic proximity, the North Texas and Central Texas regions were consolidated in the analysis.

In each case, the following loss equation was utilized to calculate the total losses in TNMP's distribution system.

$$Losses = Ax^2 + B$$

where:

<i>A</i>	=	Constant
<i>B</i>	=	Constant (no-load losses)
<i>x</i>	=	Input to the system (MW)

The constants 'A' and 'B' were subsequently utilized to determine loss percentages at varying load levels. The analysis conducted at each distinct system level to determine the system input values is summarized further in the sections below.

Power Transformers

To compute no-load losses in TNMP power transformers, linear regression was utilized based on typical values from a Cooperative Research Network (CRN)³ report on distribution system losses. The expected transformer full load and calculated load factor during the coincident peak month were utilized to calculate full-load losses.

³ CRN Report can be obtained at [ElectricDistributionSystemLosses.pdf](#)

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Typically observed load factor values were applied based on calculated values using historical TNMP load data from the calendar year 2024. This methodology yields values consistent with power flow estimates.

Primary Conductor and Cable Systems

Computation of primary line losses was accomplished via extrapolation of the aggregate overhead and underground primary losses in the six (6) sampled circuits from each region. The six sample circuits were used to determine a representative loss factor for urban and rural classified circuits. Said loss factors were applied to the input to the distribution system derived after considering losses through the distribution power transformers. It was assumed that all circuits emanating from a power transformer would have consistent classification as either urban or rural.

Distribution Service Transformers

An audit of the distribution service transformers from the circuits selected as part of the sample set were utilized in determining losses through the distribution service transformers. A typical transformer was assigned to each of the following:

- Single-phase overhead services
- Single-phase underground services
- Three-phase overhead services
- Three-phase underground services

Load and No-Load losses for TNMP distribution service transformers were derived utilizing typical loss magnitudes as depicted in the Cooperative Research Network (CRN) publication, "Electric Distribution System Losses," Project 13-01 from November 2014. Typical loss values associated with service transformers are found in Table 3.2 on page 18 of the CRN report (see footnote 3 for report location). Regression analysis was utilized to determine load and no-load losses for those transformers with ratings outside the range depicted in the table. Pad-mounted transformer load and no-load losses data were collected from manufacturer produced typical performance tables.

Distribution Secondary Service Drops

An analysis similar to that associated with the distribution service transformer audit was engaged in an audit of distribution services/service wires. Customers within each region's sample set were first subdivided into the following classifications:

- Residential (Rural) – assumes 150' 1/0 Triplex service drop
- Residential (Urban) – assumes 100' 1/0 Triplex service drop
- General Service (< 100 kW) – assumes 100' 4/0 Triplex service drop
- Large General Service (> 100 kW) – assumes 100' 500 MCM cable service

Average load magnitudes for customers falling within each stratum referenced above were determined using loads from the sampled circuits. Subsequently, these demand values were translated through the transformer to 240 V

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(or 480 V large three 3Ø services). The voltage drop through a typical service was calculated using cable impedance drawn from the WindMil EQDB. Line loss per service was extrapolated to capture anticipated total system losses through all system secondary service drops

CALCULATED SYSTEM LOSSES

Found within the tables below are the calculated system losses at both peak and AAL for each of the TNMP certificated regions. These values were derived via the methodology described in the preceding sections.

Peak Loss %	TNMP CTX/NTX	TNMP Gulf Coast	TNMP West TX
Urban	3.4656	3.3057	N/A
Rural	4.7998	6.7454	3.9263

AAL Loss %	TNMP CTX/NTX	TNMP Gulf Coast	TNMP West TX
Urban	3.4789	3.2528	N/A
Rural	4.9761	6.1884	3.9539

DLF COEFFICIENTS

Calculated losses for each voltage levels analyzed were aggregated within each region and reported against corresponding load levels. Subsequently, the calculated system loss percentages were plotted against system load and the DLF coefficients were adjusted to “fit” the loss vs. load curve. The table below shows the DLF coefficients computed for each region of the system selected for analysis.

Classification	TNMP CTX/NTX		TNMP Gulf Coast		TNMP West TX	
	Urban (A)	Rural (B)	Urban (C)	Rural (D)	N/A	Rural (E)
F1	0.0126	0.0180	0.0086	0.0195	-	0.0131
F2	0.0003	0.0007	0.0000	-0.0007	-	0.0000
F3	0.0223	0.0298	0.0288	0.0494	-	0.0264

LOSS CALCULATIONS AND LOAD VS LOSS CURVES

The following pages summarize the loss calculations completed for each region and the load versus loss percentage curves for both the calculated values and the DLF coefficients.

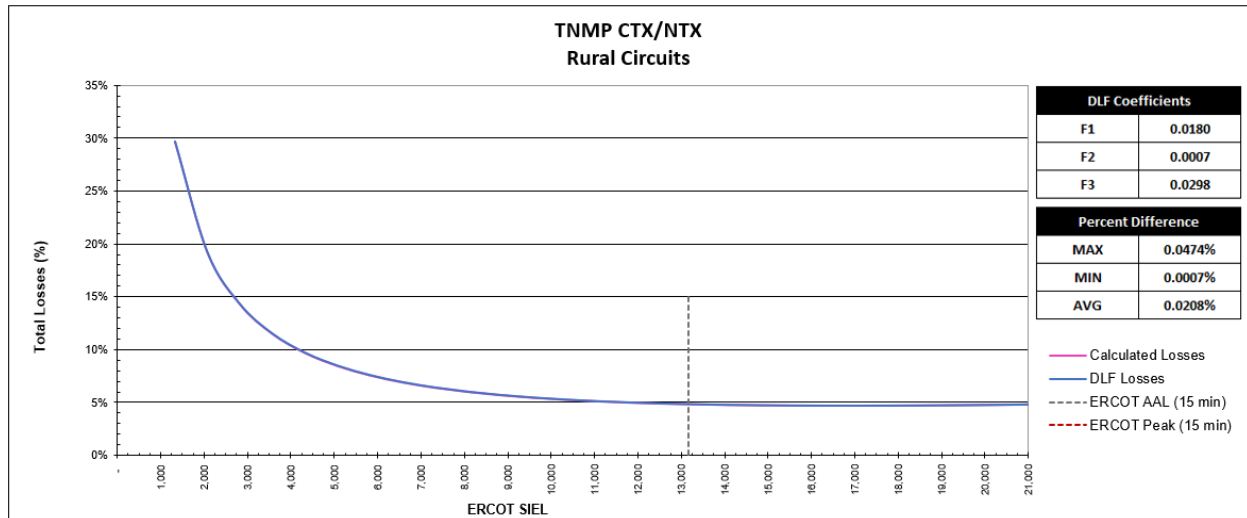
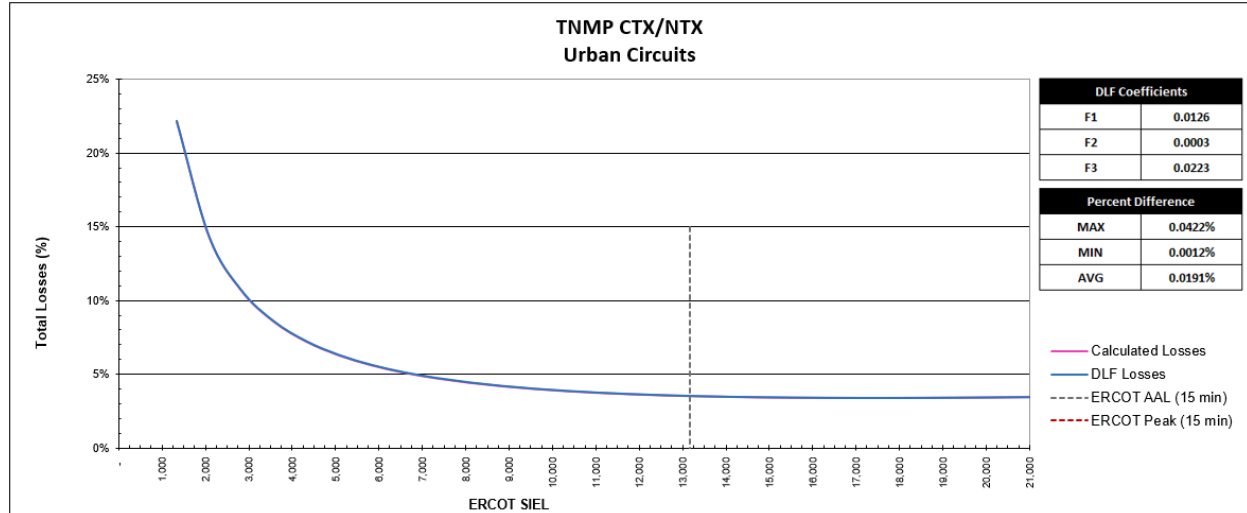
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North Texas/Central Texas Regions

		Coincident Peak Loading (MW)		Coincident Peak Loading (kW)							
		341.468		341,468							
Substation Transformers	URBAN	Total Losses (MW)	A	B	X	No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Losses (kW)	Losses (kW)	Total Loss Ratio
A =	0.0000212	3.569	0.0000212	1.0961	341.47	1.0961	2.4732	1,096.10	2,473.15	3,569	30.2%
B =	1.0961	Total No-Load Losses For Substation Transformers = 1.096 MW									
Primary Conductor	URBAN	Total Losses (MW)	A	B	X	No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Losses (kW)	Losses (kW)	Total Loss Ratio
A =	0.0000273	3.118	0.0000273	0.0000	337.90	0.0000	3.1180	0.00	3,117.98	3,118	26.3%
B =	0.0000										
Distribution Transformers	URBAN	Total Losses (MW)	A	B	X	No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Losses (kW)	Losses (kW)	Total Loss Ratio
A =	0.0000030	4.062	0.0000030	3.7294	334.78	3.7294	0.3325	3,729.38	332.54	4,062	34.3%
B =	3.7294	Total No-Load Losses For Substation Transformers = 3.729 MW									
Secondary Conductor	URBAN	Total Losses (MW)	A	B	X	No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Losses (kW)	Losses (kW)	Total Loss Ratio
A =	0.0000059	1.085	0.0000059	0.0000	330.72	0.0000	1.0850	0.00	1,084.97	1,085	9.2%
B =	0.0000										
										Total System Losses	11,834 kW
										Percent System Losses	3.47%
		Coincident Peak Loading (MW)		Coincident Peak Loading (kW)							
		88.156		88,156							
Substation Transformers	RURAL	Total Losses (MW)	A	B	X	No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Losses (kW)	Losses (kW)	Total Loss Ratio
A =	0.0000921	1.169	0.0000921	0.4528	88.16	0.4528	0.7158	452.80	715.82	1,169	27.6%
B =	0.4528	Total No-Load Losses For Substation Transformers = 0.453 MW									
Primary Conductor	RURAL	Total Losses (MW)	A	B	X	No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Losses (kW)	Losses (kW)	Total Loss Ratio
A =	0.0001838	1.391	0.0001838	0.0000	86.99	0.0000	1.3909	0.00	1,390.89	1,391	32.9%
B =	0.0000										
Distribution Transformers	RURAL	Total Losses (MW)	A	B	X	No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Losses (kW)	Losses (kW)	Total Loss Ratio
A =	0.0000147	1.319	0.0000147	1.2114	85.80	1.2114	0.1080	1,211.37	108.01	1,319	31.2%
B =	1.2114	Total No-Load Losses For Substation Transformers = 1.211 MW									
Secondary Conductor	RURAL	Total Losses (MW)	A	B	X	No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Losses (kW)	Losses (kW)	Total Loss Ratio
A =	0.0000496	0.352	0.0000496	0.0000	84.28	0.0000	0.3524	0.00	352.42	352	8.3%
B =	0.0000										
										Total System Losses	4,231 kW
										Percent System Losses	4.80%

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North Texas/Central Texas Regions (continued)



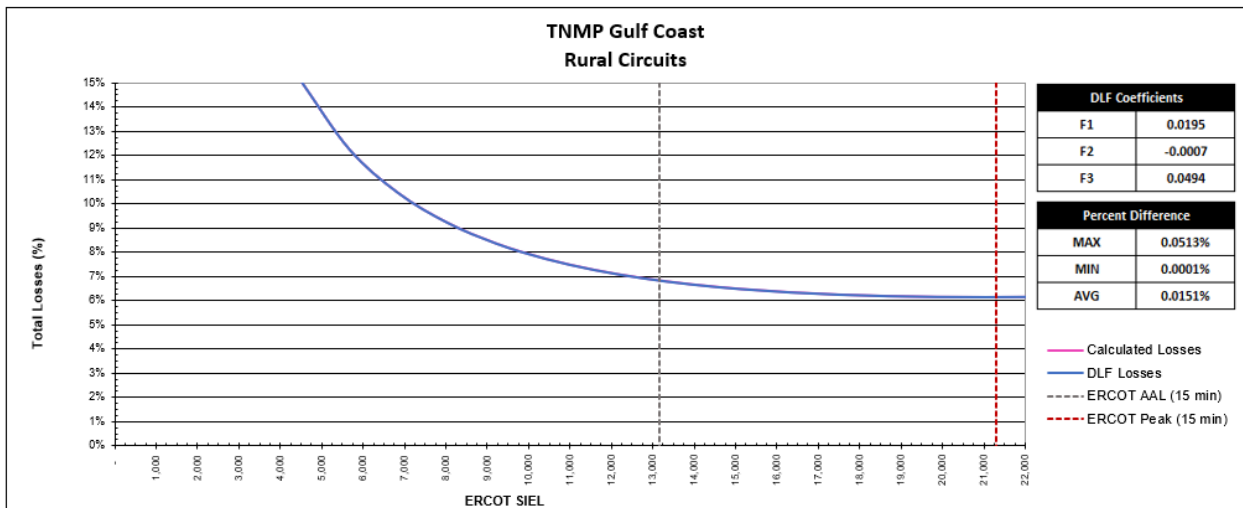
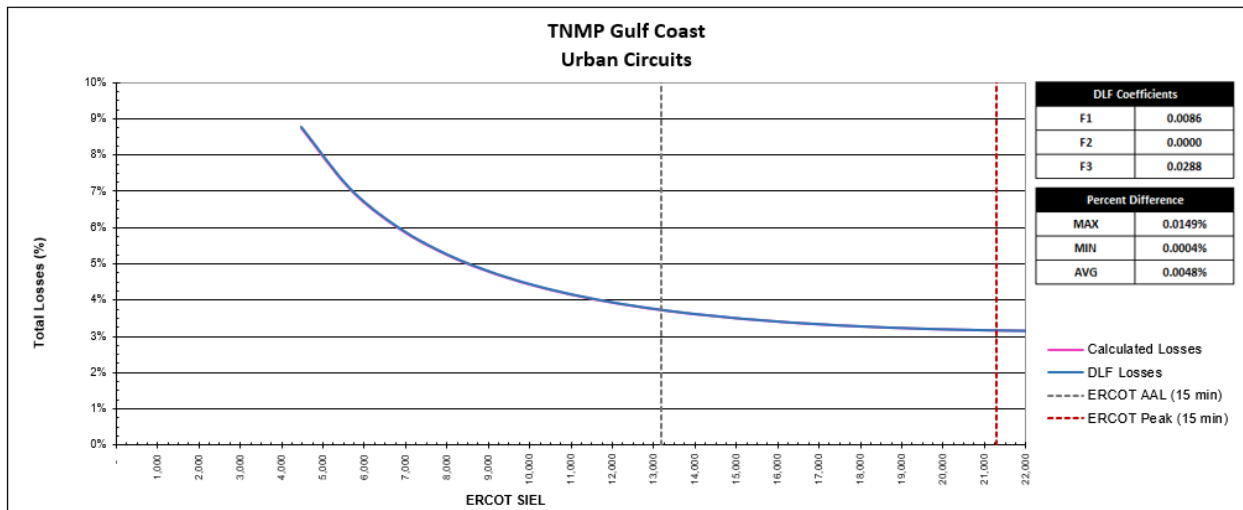
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Gulf Coast Region

		Coincident Peak Loading (MW)	Coincident Peak Loading (kW)								
		653.158	653,158								
Substation Transformers	URBAN	Total Losses (MW)	A	B	X	No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Losses (kW)	Losses (kW)	Total Loss Ratio
	A =	0.0000047	0.0000047	1.2230	653.16	1.2230	2.0031	1,223.01	2,003.08	3,226	14.9%
	B =	1.2230	Total No-Load Losses For Substation Transformers = 1.223 MW								
Primary Conductor	URBAN	Total Losses (MW)	A	B	X	No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Losses (kW)	Losses (kW)	Total Loss Ratio
	A =	0.0000198	0.0000198	0.0000	649.93	0.0000	8.3758	0.00	8,375.78	8,376	38.8%
	B =	0.0000									
Distribution Transformers	URBAN	Total Losses (MW)	A	B	X	No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Losses (kW)	Losses (kW)	Total Loss Ratio
	A =	0.0000047	0.0000047	6.3005	641.56	6.3005	1.9153	6,300.51	1,915.33	8,216	38.1%
	B =	6.3005	Total No-Load Losses For Substation Transformers = 6.301 MW								
Secondary Conductor	URBAN	Total Losses (MW)	A	B	X	No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Losses (kW)	Losses (kW)	Total Loss Ratio
	A =	0.0000044	0.0000044	0.0000	633.34	0.0000	1.7740	0.00	1,774.03	1,774	8.2%
	B =	0.0000									
Total System Losses										21,592 kW	
Percent System Losses										3.3057%	
		Coincident Peak Loading (MW)	Coincident Peak Loading (kW)								
		47.221	47,221								
Substation Transformers	RURAL	Total Losses (MW)	A	B	X	No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Losses (kW)	Losses (kW)	Total Loss Ratio
	A =	0.0001232	0.0001232	0.1917	47.22	0.1917	0.2748	191.70	274.81	467	14.8%
	B =	0.1917	Total No-Load Losses For Substation Transformers = 0.192 MW								
Primary Conductor	RURAL	Total Losses (MW)	A	B	X	No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Losses (kW)	Losses (kW)	Total Loss Ratio
	A =	0.0007080	0.0007080	0.0000	46.75	0.0000	1.5476	0.00	1,547.63	1,548	48.6%
	B =	0.0000									
Distribution Transformers	RURAL	Total Losses (MW)	A	B	X	No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Losses (kW)	Losses (kW)	Total Loss Ratio
	A =	0.0001099	0.0001099	0.7386	45.21	0.7386	0.2245	738.59	224.53	963	30.2%
	B =	0.7386	Total No-Load Losses For Substation Transformers = 0.739 MW								
Secondary Conductor	RURAL	Total Losses (MW)	A	B	X	No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Losses (kW)	Losses (kW)	Total Loss Ratio
	A =	0.0001062	0.0001062	0.0000	44.24	0.0000	0.2080	0.00	207.96	208	6.5%
	B =	0.0000									
Total System Losses										3,185 kW	
Percent System Losses										6.7454%	

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Gulf Coast Region (continued)



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West Texas Region

		Coincident Peak Loading (MW)	Coincident Peak Loading (kW)								
		158.360	158,360								
Substation Transformers	RURAL	Total Losses (MW)				No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Load Losses (kW)	Total Losses (kW)	Loss : Total Loss Ratio
	A = 0.0000703	2.562	0.0000703	0.7991	158.36	0.7991	1.7632	799.10	1,763.18	2,562	41.2%
	B = 0.7991	Total No-Load Losses For Substation Transformers = 0.799 MW									
Primary Conductor	RURAL	Total Losses (MW)				No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Load Losses (kW)	Total Losses (kW)	Loss : Total Loss Ratio
	A = 0.0000417	1.013	0.0000417	0.0000	155.80	0.0000	1.0132	0.00	1,013.25	1,013	16.3%
	B = 0.0000										
Distribution Transformers	RURAL	Total Losses (MW)				No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Load Losses (kW)	Total Losses (kW)	Loss : Total Loss Ratio
	A = 0.0000035	1.412	0.0000035	1.3273	154.78	1.3273	0.0845	1,327.32	84.51	1,412	22.7%
	B = 1.3273	Total No-Load Losses For Substation Transformers = 1.327 MW									
Secondary Conductor	RURAL	Total Losses (MW)				No Load Losses (MW)	Load Losses (MW)	No Load Losses (kW)	Load Losses (kW)	Total Losses (kW)	Loss : Total Loss Ratio
	A = 0.0000523	1.230	0.0000523	0.0000	153.37	0.0000	1.2304	0.00	1,230.35	1,230	19.8%
	B = 0.0000										
Total System Losses										6,218	kW
Percent System Losses										3.9263%	

