Distribution Transformer Loading

KNOXVILLE UTILITIES BOARD
2020 DISTRIBUTION TRANSFORMER LOAD
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  • Commercial
  • Industrial
  • Mixed
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• Overall

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(Load kW @ Sys Peak / Peak kW Load)
• Overall
• By Types of Customers served
Utility Overview
Bruce Webb graciously supplied load data for 129,955 customers in the KUB system covering the year 2020.

<table>
<thead>
<tr>
<th>Customer Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>116,685</td>
</tr>
<tr>
<td>Commercial</td>
<td>13,117</td>
</tr>
<tr>
<td>Industrial</td>
<td>153</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Customer Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>1Ø Customers</td>
<td>124,749</td>
</tr>
<tr>
<td>3Ø Customers</td>
<td>5,206</td>
</tr>
</tbody>
</table>

The 1,241,433,657 kWhr readings were consolidated onto the 44,828 distribution transformer banks, which are comprised of 48,504 individual transformers.

Data intervals for a full 2020-year readings per customer:
- 60-minute interval = 8,784 readings
- 15-minute interval = 35,136 readings
- 10-minute interval = 52,704 readings

Actual range of load data points:
- per customer: 207 to 52,670
- per transformer bank: 207 to 1,229,579
Knoxville Utilities Board (KUB)

Customers: 206,433
Service Area: 688 square miles
Service Lines: 5,362 miles
Substations: 63
Purchased Power: 5,654 GWh
Peak Day Demand: 1,328 MW (2/20/19)

“We have two distinct areas of service: (1) our metropolitan area, downtown/W & S of downtown, and (2) our rural area, typically N/NE of our downtown.” – Bruce Webb
Distribution Transformer Banks
## Transformer Ratings

<table>
<thead>
<tr>
<th>Primary Voltages</th>
<th>Secondary Voltages</th>
<th>Transformer Nameplate kVAs</th>
</tr>
</thead>
<tbody>
<tr>
<td>7620.Y/13200</td>
<td>120</td>
<td>1</td>
</tr>
<tr>
<td>7980</td>
<td>120/240</td>
<td>3.5</td>
</tr>
<tr>
<td>12470.Y/7200</td>
<td>208.Y/120</td>
<td>5</td>
</tr>
<tr>
<td>13200</td>
<td>240/120</td>
<td>10</td>
</tr>
<tr>
<td>13200.G.Y/7320</td>
<td>480.Y</td>
<td>25</td>
</tr>
<tr>
<td>13800</td>
<td>13800.Y/7960</td>
<td>37.5</td>
</tr>
<tr>
<td>14400/24040.Y</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>66000.Y</td>
<td></td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>75</td>
</tr>
</tbody>
</table>

9 Primary Voltages

7 Secondary Voltages

29 kVA Nameplate Ratings
<table>
<thead>
<tr>
<th>Type of Transformer Bank</th>
<th># of Banks</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overhead, 1-PH, 1 Transformer</td>
<td>36,472</td>
<td>81%</td>
</tr>
<tr>
<td>Overhead, 3-PH, 1 Transformer</td>
<td>1,017</td>
<td>2%</td>
</tr>
<tr>
<td>Overhead, 3-PH, 3 Transformers</td>
<td>1,715</td>
<td>4%</td>
</tr>
<tr>
<td>Overhead, 3-PH, 4 Transformers</td>
<td>2</td>
<td>0%</td>
</tr>
<tr>
<td>Overhead, 3-PH, 5 Transformers</td>
<td>1</td>
<td>0%</td>
</tr>
<tr>
<td>Overhead, Open Delta, 2 Transformers</td>
<td>234</td>
<td>1%</td>
</tr>
<tr>
<td>Pad-Mount, 1-PH, 1 Transformer</td>
<td>5,369</td>
<td>12%</td>
</tr>
<tr>
<td>Pad-Mount, 3-PH, 1 Transformer</td>
<td>15</td>
<td>0%</td>
</tr>
<tr>
<td>Pad-Mount, O.D, 2 Transformers</td>
<td>3</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>44,828</td>
<td>100%</td>
</tr>
</tbody>
</table>
## Bank Type by Customer Type

<table>
<thead>
<tr>
<th>Bank Type</th>
<th>All Residential</th>
<th>%</th>
<th>All Commercial</th>
<th>%</th>
<th>All Industrial</th>
<th>%</th>
<th>Mixed Use</th>
<th>%</th>
<th>Total Banks</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overhead 1-PH 1</td>
<td>32,690</td>
<td>87%</td>
<td>2,336</td>
<td>44%</td>
<td>9</td>
<td>7%</td>
<td>1,437</td>
<td>84%</td>
<td>36,472</td>
<td>81%</td>
</tr>
<tr>
<td>Overhead 3-PH 1</td>
<td>14</td>
<td>0%</td>
<td>891</td>
<td>17%</td>
<td>-</td>
<td>-</td>
<td>112</td>
<td>7%</td>
<td>1,017</td>
<td>2%</td>
</tr>
<tr>
<td>Overhead 3-PH 3</td>
<td>15</td>
<td>0%</td>
<td>1,645</td>
<td>31%</td>
<td>19</td>
<td>14%</td>
<td>36</td>
<td>2%</td>
<td>1,715</td>
<td>4%</td>
</tr>
<tr>
<td>Overhead 3-PH 4</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>0%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>0%</td>
</tr>
<tr>
<td>Overhead 3-PH 5</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>0%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>0%</td>
</tr>
<tr>
<td>Overhead O.D 2</td>
<td>21</td>
<td>0%</td>
<td>191</td>
<td>4%</td>
<td>-</td>
<td>-</td>
<td>22</td>
<td>1%</td>
<td>234</td>
<td>1%</td>
</tr>
<tr>
<td>Pad-Mount 1-PH 1</td>
<td>4,987</td>
<td>13%</td>
<td>185</td>
<td>4%</td>
<td>97</td>
<td>72%</td>
<td>100</td>
<td>6%</td>
<td>5,369</td>
<td>12%</td>
</tr>
<tr>
<td>Pad-Mount 3-PH 1</td>
<td>2</td>
<td>0%</td>
<td>4</td>
<td>0%</td>
<td>9</td>
<td>7%</td>
<td>-</td>
<td>-</td>
<td>15</td>
<td>0%</td>
</tr>
<tr>
<td>Pad-Mount O.D 2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>0%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>0%</td>
</tr>
<tr>
<td>Grand Total</td>
<td>37,729</td>
<td>84%</td>
<td>5,258</td>
<td>12%</td>
<td>134</td>
<td>0%</td>
<td>1,707</td>
<td>4%</td>
<td>44,828</td>
<td>100%</td>
</tr>
</tbody>
</table>
Transformer Banks by Nameplate kVA
Single-Transformer 1-Phase Overhead Banks

Number of Transformer Banks

Bank Nameplate kVA

- 1 3.5 5 10 15 25 37.5 50 75 100 167

- 738 198 20 100 167 4,652 7,581 12,165 10,671 305 133 8 1

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Single-Transformer 3-Phase Overhead Banks

Note: “Overhead” ≠ “Pole-Mount”
Three-Transformer 3-Phase Overhead Banks

<table>
<thead>
<tr>
<th>Bank Nameplate kVA</th>
<th>Number of Transformer Banks</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 – 15 kVA</td>
<td>410</td>
</tr>
<tr>
<td>3 – 25 kVA</td>
<td>508</td>
</tr>
<tr>
<td>3 – 37.5 kVA</td>
<td>284</td>
</tr>
<tr>
<td>3 – 50 kVA</td>
<td>267</td>
</tr>
<tr>
<td>3 – 75 kVA</td>
<td>128</td>
</tr>
<tr>
<td>3 – 100 kVA</td>
<td>81</td>
</tr>
<tr>
<td>3 – 167 kVA</td>
<td>17</td>
</tr>
</tbody>
</table>
Two-Transformer 3-Phase Overhead Banks

- 2–15 kVA
  - Or 5 & 25
- 2–25 kVA
- 2–37.5 kVA
  - Or 25 & 50
- 2–50 kVA
- 2–75 kVA
- 2–167 kVA

Bank Nameplate kVA

Number of Transformer Banks
Single-Transformer 1-Phase Pad-Mount Banks

Number of Transformer Banks

Bank Nameplate kVA

<table>
<thead>
<tr>
<th>Bank Nameplate kVA</th>
<th>Number of Transformer Banks</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>1,171</td>
</tr>
<tr>
<td>37.5</td>
<td>34</td>
</tr>
<tr>
<td>50</td>
<td>2,910</td>
</tr>
<tr>
<td>75</td>
<td>768</td>
</tr>
<tr>
<td>100</td>
<td>277</td>
</tr>
<tr>
<td>167</td>
<td>208</td>
</tr>
<tr>
<td>250</td>
<td>1</td>
</tr>
</tbody>
</table>
Single-Transformer 3-Phase Pad-Mount Banks

<table>
<thead>
<tr>
<th>Bank Nameplate kVA</th>
<th>Number of Transformer Banks</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
<td>2</td>
</tr>
<tr>
<td>300</td>
<td>1</td>
</tr>
<tr>
<td>500</td>
<td>1</td>
</tr>
<tr>
<td>1000</td>
<td>3</td>
</tr>
<tr>
<td>1500</td>
<td>2</td>
</tr>
<tr>
<td>2000</td>
<td>2</td>
</tr>
<tr>
<td>2500</td>
<td>3</td>
</tr>
<tr>
<td>3000</td>
<td>1</td>
</tr>
</tbody>
</table>
Two-Transformer 3-Phase Pad-Mount Banks

- **2–25 kVA**: 1 bank
- **2–100 kVA**: 1 bank
- **100 & 167 kVA**: 1 bank

Bank Nameplate kVA
Customers per Transformer Bank
All Transformer Banks

Mostly 1 customer per transformer
But up to 116 customers
Single-Transformer 1-Phase Overhead Banks

Mostly 1 customer per transformer
But up to 51 customers
Single-Transformer 3-Phase Overhead Banks

Mostly 1 customer per transformer
But up to 116 customers
Three-Transformer 3-Phase Overhead Banks

Mostly 1 customer per transformer
But up to 59 customers
Two-Transformer 3-Phase Overhead Banks

Mostly 1 customer per transformer
But up to 35 customers
Number of customers per transformer

- Mostly 4 customers per transformer
- Range of 1 to 48 customers
Single-Transformer 3-Phase Pad-Mount Banks

- Mostly 1 customer per transformer
- But up to 6 customers
Annual Load Factor: “Average” Annual Load / Peak Annual Load

Arithmetic Average or RMS (Root Mean Squared) Average?

**Arithmetic Average:** \[ \frac{\sum \text{of items}}{\text{number of items}} \]

**RMS Average:** Square root of \[ \frac{\sum \text{of squares of items}}{\text{number of items}} \]
Annual Load Factor
All Customer Types / All Bank Types

Arithmetic Average / Peak

- Mode: 0.23
- Range at ≈ ½ of the mode: 0.15 to 0.30

RMS Average / Peak

- Mode: 0.19
- Range at ≈ ½ of the mode: 0.13 to 0.24

Average Annual Load / Peak Annual Load
Annual Load Factor By Customer Type
Annual Load Factor
Residential Customers Only

**Arithmetic Average / Peak**
- Mode: 0.23
- Range at $\approx \frac{1}{2}$ of the mode: 0.14 to 0.30

**RMS Average / Peak**
- Mode: 0.19
- Range at $\approx \frac{1}{2}$ of the mode: 0.14 to 0.23

**Average Annual Load / Peak Annual Load**
**Annual Load Factor**
Commercial Customers Only

**Arithmetic Average / Peak**
- Mode: 0.23
- Range at $\approx \frac{1}{2}$ of the mode: 0.07 to 0.35

**RMS Average / Peak**
- Mode: 0.13
- Range at $\approx \frac{1}{2}$ of the mode: 0.07 to 0.26

**Average Annual Load / Peak Annual Load**
Annual Load Factor
Mixed Use Only

Arithmetic Average / Peak

Mode: 0.28
Range at ≈ ½ of the mode:
0.17 to 0.34

RMS Average / Peak

Mode: 0.15
Range at ≈ ½ of the mode:
0.09 to 0.21

Average Annual Load / Peak Annual Load
## Annual Load Factor

<table>
<thead>
<tr>
<th>Arithmetic Average / Peak</th>
<th>RMS Average / Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knoxville 2020 All Transformers: 0.23</td>
<td>Knoxville 2020 All Transformers: 0.19</td>
</tr>
<tr>
<td>Knoxville 2020 Residential Only Transformers: 0.23</td>
<td>Knoxville 2020 Residential Only Transformers: 0.19</td>
</tr>
<tr>
<td>Knoxville 2020 Commercial Only Transformers: 0.23</td>
<td>Knoxville 2020 Commercial Only Transformers: 0.13</td>
</tr>
<tr>
<td>Knoxville 2020 Mixed Use Only Transformers: 0.28</td>
<td>Knoxville 2020 Mixed Use Only Transformers: 0.15</td>
</tr>
<tr>
<td>Dominion 2018 All Transformers: 0.258</td>
<td>Dominion 2018 All Transformers: 0.288</td>
</tr>
<tr>
<td>Dominion 2018 Residential Only Transformer: 0.26</td>
<td>Dominion 2018 Residential Only Transformer: 0.28</td>
</tr>
<tr>
<td>Dominion 2018 Commercial Only Transformer: 0.37</td>
<td>Dominion 2018 Commercial Only Transformer: 0.35</td>
</tr>
<tr>
<td>Dominion 2018 Mixed Use Transformer: 0.29</td>
<td>Dominion 2018 Mixed Use Transformer: 0.31</td>
</tr>
<tr>
<td>Duke Energy Transformers: 0.2</td>
<td>Duke Energy Transformers: 0.3</td>
</tr>
<tr>
<td>Toronto Hydro 2013 Residential Transformers: 0.29</td>
<td></td>
</tr>
<tr>
<td>PG&amp;E 2006 Residential [Customer: 0.39]</td>
<td></td>
</tr>
</tbody>
</table>
Annual Load Factor
By Bank Type
Annual Load Factor
Single-Transformer 1-Phase Overhead Banks

Arithmetic Average / Peak

Mode: 0.22
Range at ≈ ½ of the mode: 0.14 to 0.29

RMS Average / Peak

Mode: 0.19
Range at ≈ ½ of the mode: 0.14 to 0.24

Average Annual Load / Peak Annual Load
Annual Load Factor
Single-Transformer 1-Phase Pad-Mount Banks

Arithmetic Average / Peak

RMS Average / Peak

Number of Transformers

Mode: 0.26

Range at ≈ ½ of the mode:
0.20 to 0.30

Mode: 0.15

Range at ≈ ½ of the mode:
0.12 to 0.21

Average Annual Load / Peak Annual Load
Annual Load Factor
Three-Transformer 3-Phase Overhead Banks

Arithmetic Average / Peak

- Mode: 0.28
- Range at ≈ ½ of the mode: 0.11 to 0.35

RMS Average / Peak

- Mode: 0.013
- Range at ≈ ½ of the mode: 0.07 to 0.20

Average Annual Load / Peak Annual Load
Annual Load Factor
By kVA Size
<table>
<thead>
<tr>
<th>Transformer Size</th>
<th>Load Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 kVA</td>
<td>Mode: 0.17</td>
</tr>
<tr>
<td>25 kVA</td>
<td>Mode: 0.20</td>
</tr>
<tr>
<td>37.5 kVA</td>
<td>Mode: 0.23</td>
</tr>
<tr>
<td>50 kVA</td>
<td>Mode: 0.26</td>
</tr>
<tr>
<td>75 kVA</td>
<td>Mode: 0.28</td>
</tr>
<tr>
<td>100 kVA</td>
<td>Mode: 0.29</td>
</tr>
</tbody>
</table>

Load Factor increases with increasing transformer size.
Annual Load Factor
Single-Transformer Single-Phase Pad-mount Banks

Load Factor increases with increasing transformer size

Average Annual Load / Peak Annual Load

Load Factor
kVA

Number of Transformers
Annual Load Factor
Three-Transformer Three-Phase Overhead Banks

Number of Transformers

Load Factor
kVA

Average Annual Load / Peak Annual Load

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Annual Load Factor
By Customers Per Bank
Load Factor is increasing with additional customers per transformer bank.
Annual Load Factor
By Customers per Bank

<table>
<thead>
<tr>
<th>Customers per Transformer</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knoxville Annual Load Factor</td>
<td>0.16</td>
<td>0.21</td>
<td>0.23</td>
<td>0.25</td>
<td>0.25, 0.26</td>
<td>0.29</td>
</tr>
<tr>
<td>Dominion Annual Load Factor</td>
<td>0.15</td>
<td>0.20</td>
<td>0.22</td>
<td>0.23</td>
<td>0.26</td>
<td>0.26</td>
</tr>
</tbody>
</table>

Annual Load Factor is increasing with additional customers per transformer bank
Peak kW Load / Nameplate kVA
Peak kW Load / Nameplate kVA
44,828 Transformer Banks

Mode: 0.52

Range at ≈ ½ of the mode:

0.31 to 0.78

466 (1.0%) with Load/NP ≥ 150%
Either overloaded or with data issues
Peak kW Load / Nameplate kVA

36,663 Residential Transformer Banks

Mode: 0.52

Range at ≈ ½ of the mode:

0.36 to 0.78

360 (1.0%) with Load/NP ≥ 150% Either overloaded or with data issues
Peak kW Load / Nameplate kVA
5,234 Commercial Transformer Banks

Mode: 0.26

Range at ≈ ½ of the mode:
0.0 to 0.56

78 (1.5%) with Load/NP ≥ 150% Either overloaded or with data issues
Peak kW Load / Nameplate kVA
2799 Mixed Transformer Banks

Mode: 0.54
Range at ≈ ½ of the mode: 0.34 to 0.75

28 (1.0%) with Load/NP ≥ 150%
Either overloaded or with data issues
Peak kW Load / Nameplate kVA

- Knoxville – Overall – Mode: 0.52
- Knoxville – Residential Use – Mode: 0.52
- Knoxville – Commercial Use – Mode: 0.26
- Knoxville – Mixed Use – Mode: 0.54

- Dominion – Overall – Mode: 0.46
- Dominion – Residential Only – Mode: 0.46
- Dominion – Commercial Only – Mode: 0.00
- Dominion – Mixed Use – Mode: 0.53

- Toronto Hydro – Residential Only – Mode: 0.9

- Duke Energy – Mode: 0.7

- ConEdison Overall Average **Capacity Factor** = 26% Network System Second contingency design
As in the Dominion data there is no clear correlation between customers per transformer and the mode of Peak/Nameplate ratio.
Average kW Load / Nameplate kVA
Average kW Load / Nameplate kVA

44,828 Transformer Banks

Mode: 0.13

Range at ≈ ½ of the mode:

0.06 to 0.19
Average kW Load / Nameplate kVA
36,663 Residential Transformer Banks

Mode:
0.12, 0.13

Range at ≈ ½ of the mode:
0.06 to 0.19
Average kW Load / Nameplate kVA
5,234 Commercial Transformer Banks

Mode: 0.01

Range at ≈ ½ of the mode:
0.00 to 0.13
Average kW Load / Nameplate kVA

2,799 Mixed Use Transformer Banks

Mode: 0.13

Range at ≈ ½ of the mode:

0.07 to 0.21
Average kW Load / Nameplate kVA

- Knoxville – Overall – Mode: 0.13
- Knoxville – Residential Use – Mode: 0.12, 0.13
- Knoxville – Commercial Use – Mode: 0.01
- Knoxville – Mixed Use – Mode: 0.13

- Dominion – Overall – Mode: 0.10
- Dominion – Residential Only – Mode: 0.10
- Dominion – Commercial Only – Mode: 0.0
- Dominion – Mixed Use – Mode: 0.13

We need more data!
Minimum kW Load / Peak kW Load
Minimum kW Load / Peak kW Load
44,828 Transformer Banks

Mode: 0.00
Utilization Factor:
Peak kW Load / kVA Capability
Knoxville Utility Board uses the transformer nameplate kVA for their summer normal loading. For winter they use 125% of the nameplate.
Utilization Factor

Peak kW Load / Nameplate kVA

Under construction
Peak Responsibility Factor:
Load at System Peak / Peak Load
Load at System Peak / Peak Load
44,828 Residential Transformer Banks

Mode: 0.00

Range at ≈ ½ of the mode:
0.00 to 1.00
Load at System Peak / Peak Load
36,663 Residential Transformer Banks

Mode: 0.00

Range at ≈ ½ of the mode: 0.00 to 1.00
Load at System Peak / Peak Load
5,234 Commercial Transformer Banks

Mode: 0.00

Range at ≈ ½ of the mode:
0.00 to 0.31 ??
Load at System Peak / Peak Load
2,799 Mixed Use Transformer Banks

Mode: 0.00

Range at ≈ ½ of the mode: 0.00 to 1.00
Peak Responsibility Factor:
Peak kW Load / Nameplate kVA

- Knoxville – Overall – Mode: 0.00, with range of 0.00 to 1.00
- Knoxville – Residential Use – Mode: 0.00, with range of 0.00 to 1.00
- Knoxville – Commercial Use – Mode: 0.00, with range of 0.00 to 0.31
- Knoxville – Mixed Use – Mode: 0.00, with range of 0.00 to 1.00
- Dominion – Overall – Mode: 0.32 with range of 0.17 to 0.94
- Dominion – Residential Only – Mode: 0.32 with range of 0.17 to 0.89
- Dominion – Commercial Only – Mode: 0.91 with range of 0.00 to 0.97
- Dominion – Mixed Use Only – Mode: 0.81 with range of 0.21 to 0.95

Both data sets show a huge range in factors, rendering the use of this factor meaningless for financial calculations.
We need more data!
Lessons Learned

1. Add details on transformers in the transformer bank – e.g. is the 45 kVA 3Ø bank a single transformer or 3 – 15 kVA 1Ø transformers?

2. Ensure that the average load calculation sums the absolute value of the load

3. Ensure that daylight savings time change does not result in an artificial report of zero load

4. Capture season of bank peak

5. The intervals for a bank are not the sum of the associated customer intervals
Transformer Loading Terms

Load Factor: (Average load / peak load) over a specified time  
Annual Load Factor: (Average yearly load / peak load for the year) – A specific case of load factor  
Capacity Factor: (Average Load / Capability) – Ratio of an actual electrical energy output over a given period of time to the maximum possible electrical energy output over that period  
Utilization Factor: (Max Load / Capability) – Ratio of the maximum demand to the capacity  

IEEE C57.120 Transformer Loss Evaluation:  
TLF: Transformer Loading Factor (root-mean-square of yearly load / nameplate) Energy cost varies by the load losses vary as the square of this factor.  
PRF: Peak Responsibility Factor (transformer load at system peak / transformer peak load)  
PUL: Peak-per-Unit Load (Average of yearly peaks over lifetime of transformer / nameplate)
Statistics Terms

**Mean:** is the "average" you're used to, where you add up all the numbers and then divide by the number of numbers.

**Median:** is the "middle" value in the list of numbers. To find the median, your numbers have to be listed in numerical order from smallest to largest, so you may have to rewrite your list before you can find the median.

**Mode:** is the value that occurs most often. If no number in the list is repeated, then there is no mode for the list.

**Standard Deviation:** is a measure that is used to quantify the amount of variation or dispersion of a set of data values. A low standard deviation indicates that the data points tend to be close to the mean (also called the expected value) of the set, while a high standard deviation indicates that the data points are spread out over a wider range of values.

**Kurtosis:** is a measure of the "tailedness" of the probability distribution. It is a descriptor of the shape of a probability distribution.