Task Force to investigate Distribution Transformer Loading – DOE updates

Philip J Hopkinson, PE , David Brender, Senior Member

Presentation Items

1. Purpose of taskforce to determine RMS-equivalent load for Medium Voltage Distribution Transformers and typical load profiles.

2. Data submitted by PG&E, Con ED, Toronto Hydro, Duke Energy and Dominion Resources

3. Dan Mulkey tries to display inputs on a comparable base

4. Current data suggest light RMS-Equivalent Loading

5. Are all parts of country the same?

6. How might the data be used?

7. Future Direction

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Issue 2. DOE requests input on the initial RMS PUL values

PG&E on this subject has related the following load summaries:

Type	Rate	Peak	Annual LF	Peak Day LF	Peak Month LF
Residential	E7	7/23/06	38.6%	71.7%	46.7%
Residential	E1	7/23/06	39.3%	74.5%	51.3%
Commercial	A1	7/24/06	39.8%	62.1%	47.0%
Commercial	A10	7/24/06	47.3%	68.6%	55.0%
Commercial	E19S	7/24/06	59.2%	78.2%	65.4%
Commercial	A6	7/25/06	59.7%	85.8%	74.5%
Industrial	E20S	8/9/06	61.9%	78.7%	68.7%
Commercial	E19V	7/25/06	62.8%	83.5%	71.3%
Commercial	E19P	7/25/06	67.2%	84.6%	72.9%
Industrial	E20P	7/25/06	70.7%	89.0%	77.7%
Industrial	E20T	7/21/06	79.1%	94.9%	84.4%

Load Factor not the same as Loading per Nameplate kVA

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Rate Class Definitions

E1 Residential
E7 Residential Time of Use (TOU)
E19P, E19S, E19V - Medium General Demand-Metered TOU Service
E20P, E20S, E20T - Service To Customers With Maximum Demands Of 1000 Kilowatts Or More
A1 Small General Service
A10 Medium General Demand-Metered Service
A6 Small General Time-Of-Use Service

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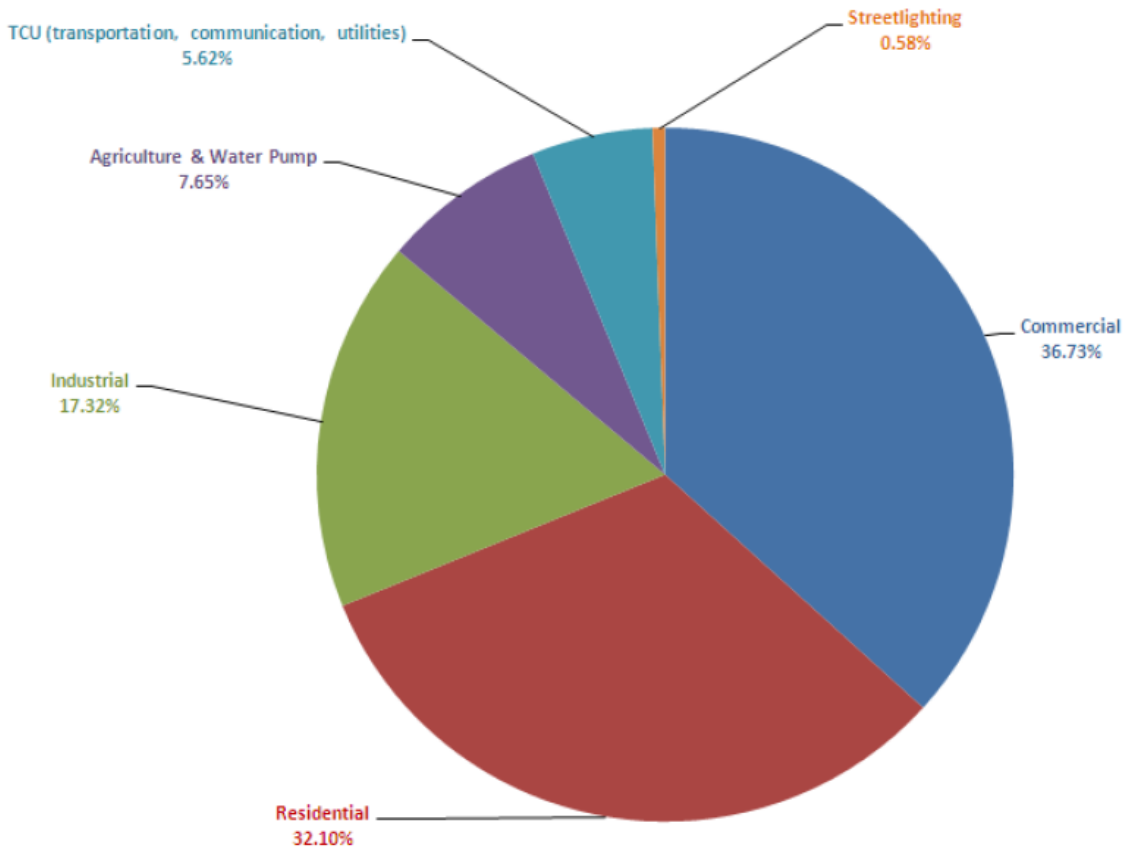
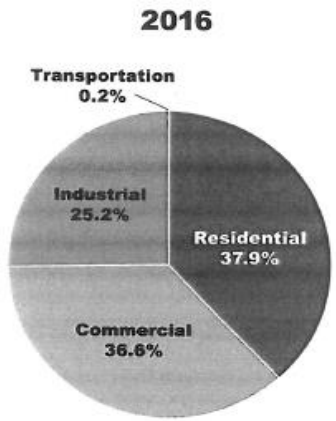
Figure D-1: Sector Shares of Total Electricity Consumption (2012)



Source: California Energy Commission staff

California energy consumption compared to total US where in 2016:

Use	California	Total US
1. Residential	32.1%	37.9%
2. Commercial	36.7%	36.6%
3. Industrial	17.3%	25.2%
4. Transportation	5.6%	0.2%
5. All Other	8.3%	0.0%



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Data Gathering Per Dan Mulkey

1. **Single-phase overhead serves residential, small to medium commercial, agricultural, and industrial**.

2. **Three-phase overhead are mostly small to medium agricultural but also used to supply small to medium commercial and industrial**

3. **Single-phase submersible is mostly residential with some small commercial**

4. **Three-phase submersible is mostly small to medium commercial with some multi-family residential**

5. **Single-phase pad-mount is mostly residential with some small commercial**

6. **Three-phase pad-mount is mostly commercial and industrial with some agricultural and some multi-family residential**

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Issue 8 Cont'd. Other comments on the continued use of a single test PUL requirement.

3.a. Many Transformers purchased in bulk and placed in stock and applied as needed.

3.b. Same transformer may be in a light or heavy loaded application.

3.c. Same transformer may be applied in residential, commercial or industrial applications.

4. Ideally, transformers should be designed to be energy efficient at light loads and at heavy loads.

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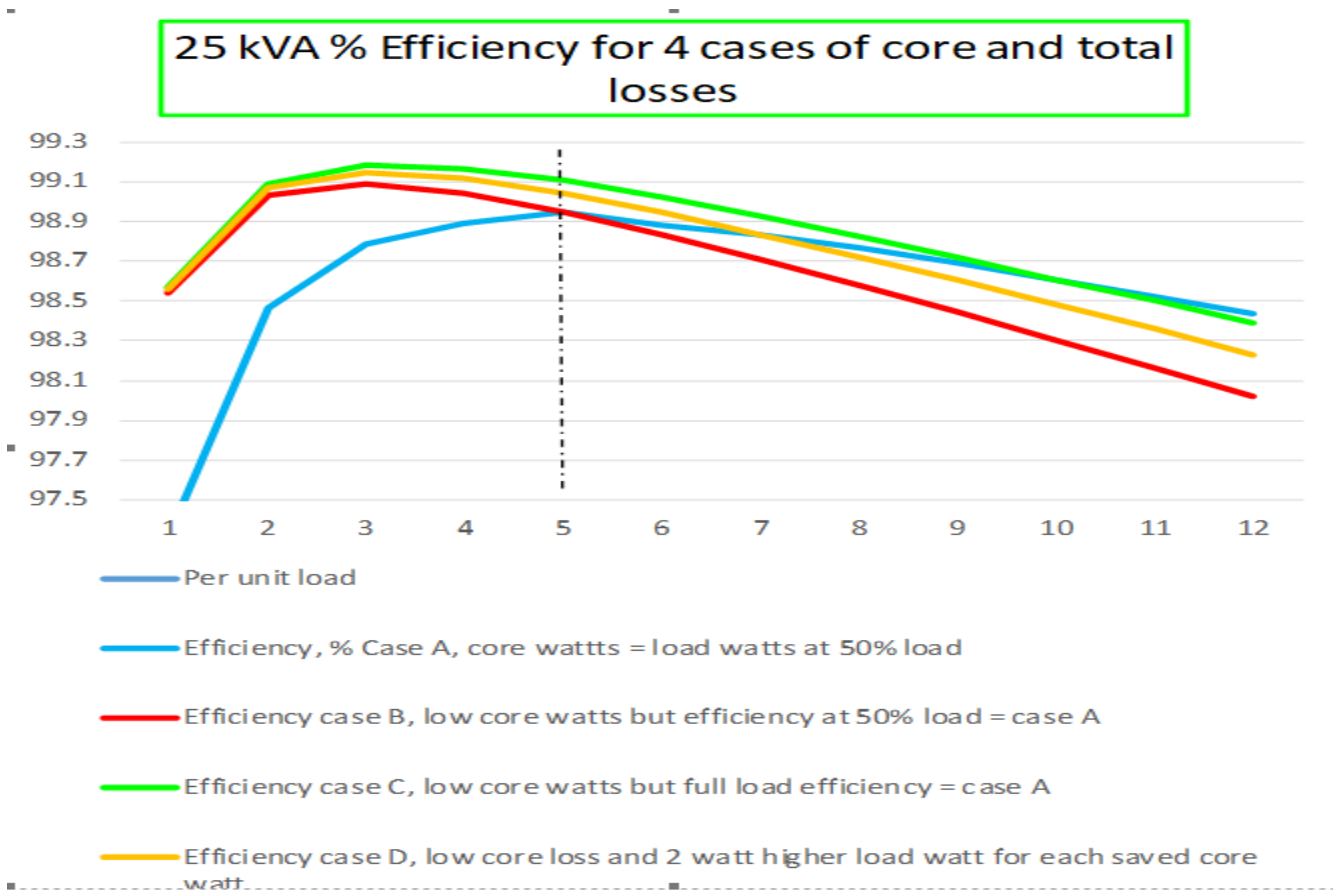

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March 12th discussions with Jeremy Dommu:

1. **Comment collection completed by DOE for now**
2. **No public meeting planned to review comments**
3. **If NOPR is issued then a public meeting will be held**
4. **Navigant Consulting is still involved**
5. **Mike Rivest is still the Navigant contact**

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Loading Task Force Activities

Current Interested Participants:

a. **EEI via Steve Rosenstock**
b. **Several large Utilities:**
    - i. **PG&E**
    - ii. **Con ED**
    - Iii. **Toronto Hydro**
    - iV **Duke Energy**
    - V **Dominion Resources**
    - VI **Con ED**

c. **Some Wind and Solar Customers**

Mechanics:

a. **Establish compatible EXCEL Data file for data reporting**
b. **Use real time data acquisition for key locations**
c. **Use neutral clearing house (EEI) for gathering data and maintaining neutrality.**
d. **Annual load cycles gathered by rate class and logged over full 8760 hourly period/yr.**

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PG& E Perspective Conclusions:

1. Load cycles by hourly data logging should be accurate.

2. Load cycles by rate class capture daily, monthly, and annual load ranges

3. Load factors can be calculated by day, month and year vs. Load Cycles

4. RMS-equivalent easily obtained from hourly data but Load Factor OK.

5. Transformer nameplate kVA is less than peak capability based on modelling

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Dan Mulkey

Utility				PG&E	PG&E	PG&E	PG&E	PG&E	PG&E
Transformer Type				1P-OH	1P-SUB	3P-SUB	3P-PM	3P-OH	3P-PM
Nameplate kVA				10	25	750	500	150	1500
# of Residential Customers				2	3				
# of Commercial Customers								5	
# of Industrial Customers						1	1		1
# of Agricultural Customers									
# of Other Customers								1	
	Date	day	hour	Time (hrs)	Transformer 126534	Transformer 126535	Transformer 126536	Transformer 126537	Transformer 126538	Transformer 126539
2	12/31/06 5:00 PM	365	17	8753	1.18	1.99	287.44	241.91	66.53	820.49
3	12/31/06 6:00 PM	365	18	8754	1.22	2.05	287.56	237.07	65.49	817.08
4	12/31/06 7:00 PM	365	19	8755	1.16	1.92	283.59	228.53	62.80	808.54
5	12/31/06 8:00 PM	365	20	8756	1.08	1.93	281.14	222.33	62.03	806.12
6	12/31/06 9:00 PM	365	21	8757	0.99	1.90	276.16	217.49	60.13	795.69
7	12/31/06 10:00 PM	365	22	8758	0.91	1.65	271.59	213.65	57.74	783.36
8	12/31/06 11:00 PM	365	23	8759	0.85	1.37	267.71	211.66	56.07	775.47
9										
10	Max				2.00	3.38	555.70	556.38	116.11	1666.77
11	Min				0.41	0.67	253.39	199.85	51.48	712.86
12	Av				0.79	1.31	373.55	329.46	72.89	1177.99

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Discussion: Possible use of data

1. **Establish new class of dual kVA nameplated transformers A/B**
2. **"A" Base kVA relates to traditional 65 C Rise**
3. **"B" higher kVA relates to thermal class of the insulation system**
4. **Example: 15/25 kVA**
5. **15 kVA is the power rating of the transformer at 65 C rise and requirements, including DOE Efficiency**
6. **25 kVA is the thermal capability of the insulation system by recognized thermal clases.**

7. **Efficiency relationships need to be explored: For some ratings, the smaller parts with lower core losses make up for higher load losses with no net loss of efficiency.**

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Future Assignments

to members of Task Force and all on web site

1. **Continue to collect Data**
3. **RMS-equivalent loading by Nameplate is the goal.**
4. **Other formats will be collected as submitted.**
5. **EEI ready to assist as needed.**
6. **Ultimate desire is to collect data for Liquid, Dry, and LV Dry.**

Next Meeting Columbus, Ohio October 28, 2019