INTEGRATING AMI WITH GIS FOR ELECTRIC DISTRIBUTION TRANSFORMER LOAD MANAGEMENT

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AGENDA

BACKGROUND

STUDY AREA

OBJECTIVES

METHODOLOGY

RESULTS and DELIVERABLES
BACKGROUND

STEP-UP TRANSFORMER
Increase voltage and reduce current

STEP-DOWN TRANSFORMER
Reduces voltage before reaching end-user

Source: https://www.servostabilizer.org.in/what-is-step-down-transformer/
BACKGROUND

transformer load analysis

Analyze transformer consumption data against transformer capacity
BACKGROUND

TRANSFORMER LOAD ANALYSIS

OVERSIZED TRANSFORMER

- Excess fuel costs = $$

UNDER SIZED TRANSFORMER

- Transformer life reduced
  - System outages
  - Reliability
- Requires replacement = $$$$
Energy consumption is collected manually on a monthly basis by a meter reader.

Utility can read, start, and stop services remotely.

Smart meters record and transmit energy consumption to the utility throughout the day via a secure wireless network.
STUDY AREA

as of 2020 Summer Peak

territory
85 mi²

customers
85,142

installed a.m.i. meters
62,989

transformers
14,570

transmission
73.44 circuit mi

distribution
1,074.65 circuit mi
OBJECTIVES

**comparative analysis**
Determine if distribution engineering design standards used are still valid based on actual customer usage within areas of single-family residence.

**spatial analysis**
Improve criteria used when placing an appropriately sized transformer.

**custom application**
Aid our engineers in identifying areas which may require electric reconstruction to avoid future power-related issues.
METHODOLOGY

1. Connect AMI peak data to consumer feature class in GIS
2. Populate summarized AMI data within transformer feature class
3. Identify undersized transformers
4. Create a display of identified transformers
5. Engineers to determine if current design standards require updating
6. Spatial and statistical analysis to find potential patterns of under sizing
METHODOLOGY

1. connect AMI peak data to consumer feature class in GIS

- Join MDMS extract data to Consumer
- Populate data from joined Consumer into Service Points

Attribute Assistant’s Copy Linked Record function

Populate data from joined Consumer into Service Points
METHODOLOGY

2. Populate summarized AMI data within transformer feature class

```plaintext
1 
2  
3 
4 
5 
6 

Pseudocode to populate peak data within transformer feature class via an external table

1: ["List", "of", "transformers"]
2: 
3: Loop through list, for each transformer:
4: Make Feature Layer tool of single transformer to be used as Flag
5: Trace Geometric Network tool (result: all service points downstream are selected):
6: Flags - as created above | Trace Task Type - TRACE_DOWNSTREAM | Disable unneeded feature classes from trace
7: Copy Features tool to create feature class of all downstream service points
8: Summary Statistics tool to sum all peak data
9: Insert Cursor to populate external table with peak data sum

Pseudocode to populate peak data within transformer feature class via an external table.
METHODOLOGY

3. identify undersized transformers

4. create a web application display of identified transformers
METHODOLOGY

5. engineers to determine if current design standards require updating

6. spatial and statistical analysis to find potential patterns of under sizing

UNDER SIZED TRANSFORMERS

- Immediate Action
  - Evaluate
  - Monitor

- Analysis:
  - 151% - Over
  - 126% - 150%
  - 101% - 125%
  - 80% - 100%
RESULTS and DELIVERABLES

Transformer Type

Count of Overhead: 1772
Count of Underground: 6086
RESULTS and DELIVERABLES

<table>
<thead>
<tr>
<th>Transformer Type</th>
<th>Phase</th>
<th>Count of Over</th>
<th>Count of Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td>718</td>
<td>2572</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>675</td>
<td>2575</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>711</td>
<td>2711</td>
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</tbody>
</table>
RESULTS and DELIVERABLES

Transformer Type

Phase

Substation

<table>
<thead>
<tr>
<th>Transformer Type</th>
<th>Phase</th>
<th>Substation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Count of Sub | Count of Over

<table>
<thead>
<tr>
<th>1</th>
<th>4</th>
<th>6</th>
<th>9</th>
<th>10</th>
<th>12</th>
<th>14</th>
<th>16</th>
<th>20</th>
<th>21</th>
<th>23</th>
</tr>
</thead>
<tbody>
<tr>
<td>610</td>
<td>597</td>
<td>783</td>
<td>554</td>
<td>762</td>
<td>486</td>
<td>604</td>
<td>1309</td>
<td>1354</td>
<td>519</td>
<td>280</td>
</tr>
</tbody>
</table>
RESULTS and DELIVERABLES

Transformer Type
Phase
Substation
Rated kVA

Count of RatedKVA | Count of Over
---|---
5 | 3
10 | 63
15 | 273
25 | 2157
38 | 1705
50 | 2447
75 | 984
100 | 211
167 | 13
250 | 2
RESULTS and DELIVERABLES

<table>
<thead>
<tr>
<th>Transformer Type</th>
<th>Phase</th>
<th>Substation</th>
<th>Rated kVA</th>
<th>Land Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial</td>
<td></td>
<td></td>
<td></td>
<td>575</td>
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<tr>
<td>Conservation</td>
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<td>21</td>
</tr>
<tr>
<td>Institutional</td>
<td></td>
<td></td>
<td></td>
<td>42</td>
</tr>
<tr>
<td>Mixed Use</td>
<td></td>
<td></td>
<td></td>
<td>922</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td>172</td>
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<tr>
<td>Residential</td>
<td></td>
<td></td>
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<td>6083</td>
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<tr>
<td>Rural</td>
<td></td>
<td></td>
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<td>43</td>
</tr>
</tbody>
</table>

Counts:
- Commercial: Count of LandUse = 575, Count of Over = 102
- Conservation: Count of LandUse = 21, Count of Over = 21
- Institutional: Count of LandUse = 42, Count of Over = 6
- Mixed Use: Count of LandUse = 922, Count of Over = 282
- Other: Count of LandUse = 172, Count of Over = 15
- Residential: Count of LandUse = 6083, Count of Over = 1694
- Rural: Count of LandUse = 43, Count of Over = 5
RESULTS and DELIVERABLES

<table>
<thead>
<tr>
<th>Year Range</th>
<th>Count of YearRange</th>
<th>Count of Over</th>
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</thead>
<tbody>
<tr>
<td>1965-1970</td>
<td>12</td>
<td>3</td>
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<tr>
<td>1971-1975</td>
<td>45</td>
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<tr>
<td>1976-1980</td>
<td>100</td>
<td>7</td>
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<tr>
<td>1981-1985</td>
<td>350</td>
<td>56</td>
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<tr>
<td>1986-1990</td>
<td>842</td>
<td>243</td>
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<tr>
<td>1991-1995</td>
<td>786</td>
<td>237</td>
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<tr>
<td>1996-2000</td>
<td>807</td>
<td>303</td>
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<tr>
<td>2001-2005</td>
<td>1179</td>
<td>362</td>
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<tr>
<td>2006-2010</td>
<td>1031</td>
<td>223</td>
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<tr>
<td>2011-2015</td>
<td>1316</td>
<td>373</td>
</tr>
<tr>
<td>2016-2020</td>
<td>1386</td>
<td>291</td>
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<tr>
<td>2021-2025</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Transformer Type
Phase
Substation
Rated kVA
Land Use
Year Installed
PRELIMINARY FINDINGS

151% - Over Immediate Action

Short Term Rentals
PRELIMINARY FINDINGS

151% - Over Immediate Action

Short Term Rentals

Underground Transformers
PRELIMINARY FINDINGS

151% - Over Immediate Action

Short Term Rentals

Underground Transformers

Year of Installation
PRELIMINARY FINDINGS

151% - Over Immediate Action

Short Term Rentals

Underground Transformers

Year of Installation

25kVA Transformers
PRELIMINARY FINDINGS

151% - Over Immediate Action

Short Term Rentals

Underground Transformers

Year of Installation

25kVA Transformers
CHALLENGES and OPPORTUNITIES

LARGE AMOUNTS OF DATA
Multi processing

COPY LINKED RECORD
Query, calculate, populate

DYNAMIC DISPLAY
Arcade
QUESTIONS

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THANK YOU