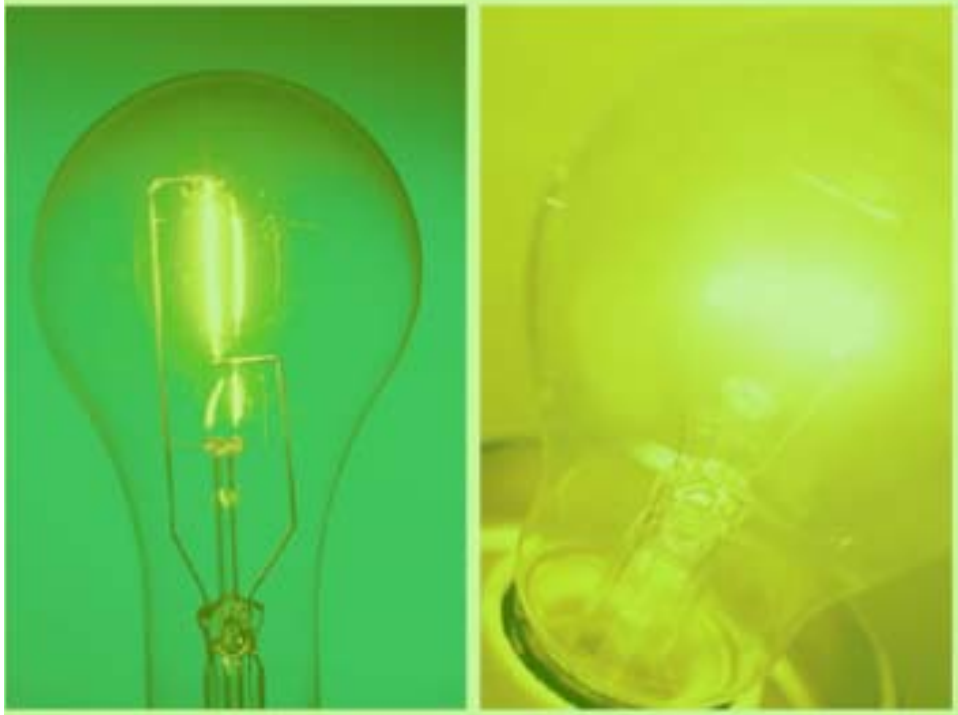
Load Research for an Energy Line Loss Study



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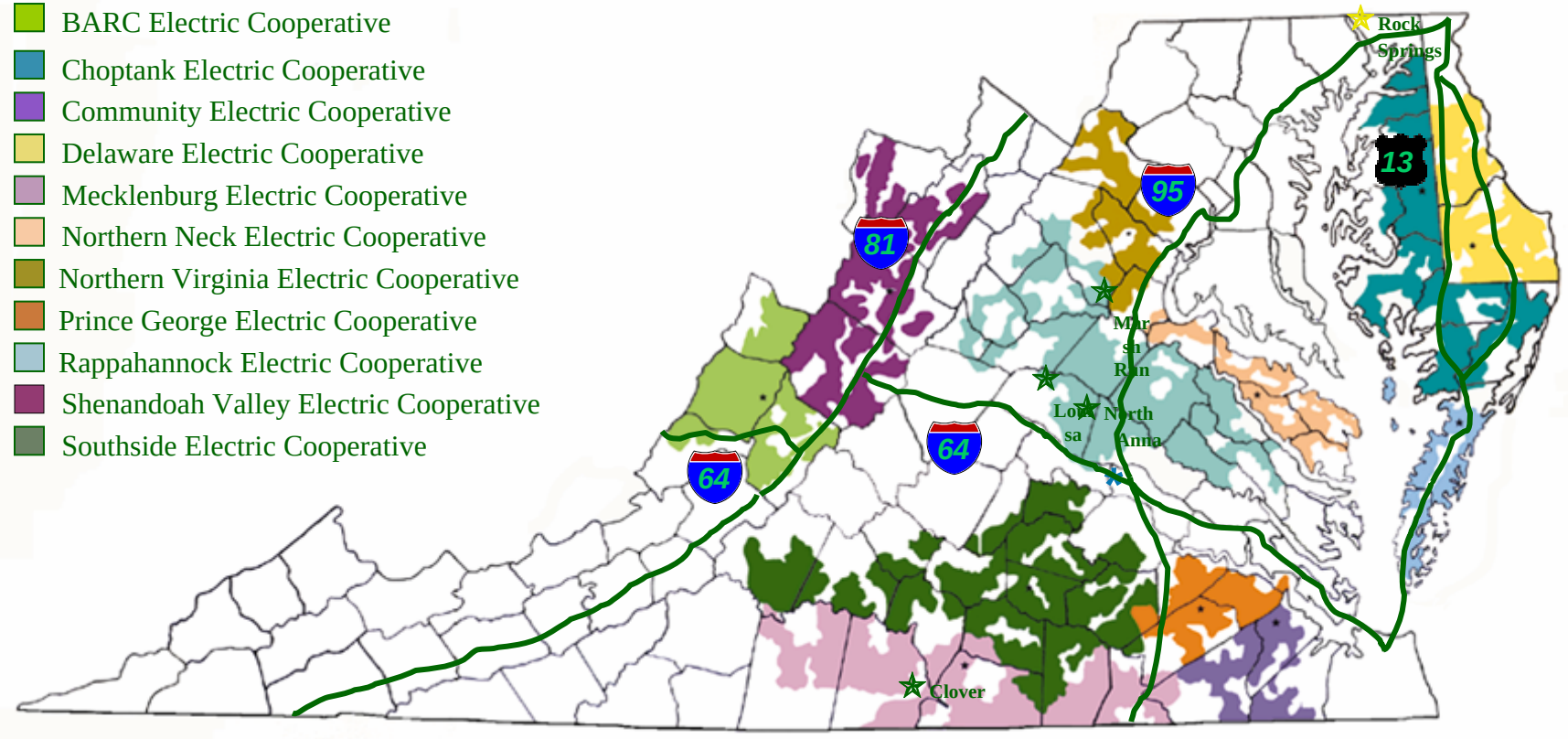
Old Dominion Electric Cooperative

ODEC & our Member Systems

* Old Dominion Headquarters
• Member Headquarters

☆ Existing Generation

- A&N Electric Cooperative
- BARC Electric Cooperative
- Choptank Electric Cooperative
- Community Electric Cooperative
- Delaware Electric Cooperative
- Mecklenburg Electric Cooperative
- Northern Neck Electric Cooperative
- Northern Virginia Electric Cooperative
- Prince George Electric Cooperative
- Rappahannock Electric Cooperative
- Shenandoah Valley Electric Cooperative
- Southside Electric Cooperative



Background . . .

- ODEC has an interest in reducing losses on member distribution systems
- Improvements support two perspectives
  - Direct benefits to the distribution cooperatives, and
  - Overall benefits from the power supply perspective, particularly during high power supply costing periods
- In current Power Requirements Studies - Line losses are calculated based on the delta between Form 7 sales data and the wholesale sales at the delivery points
  - Proverbially one of the weakest links
- Launched a 2007 initiative to improve this process by using load research data

Selection Criteria. . .

- Developed internal committee to examine the issue
- Determined that there were several criteria needed to conduct the study:
  1) AMR system with ability to remotely turn on as many meters as required in order to collect hourly interval data
  2) Ranking between the 12 distribution cooperatives on % losses
  3) Timing of 2 - 4 Year Construction Work Plan
  4) Potential savings to be realized with results
  5) Enthusiasm of the Cooperative

It's a Process, too . . .

- As the Study was developing, determined early on that this was a process-driven project
- Study needed to be documented so that it was transferable to our other distribution member-owner cooperatives
- In the first round, Northern Neck Electric Cooperative had the highest scoring for us to be able to conduct the study

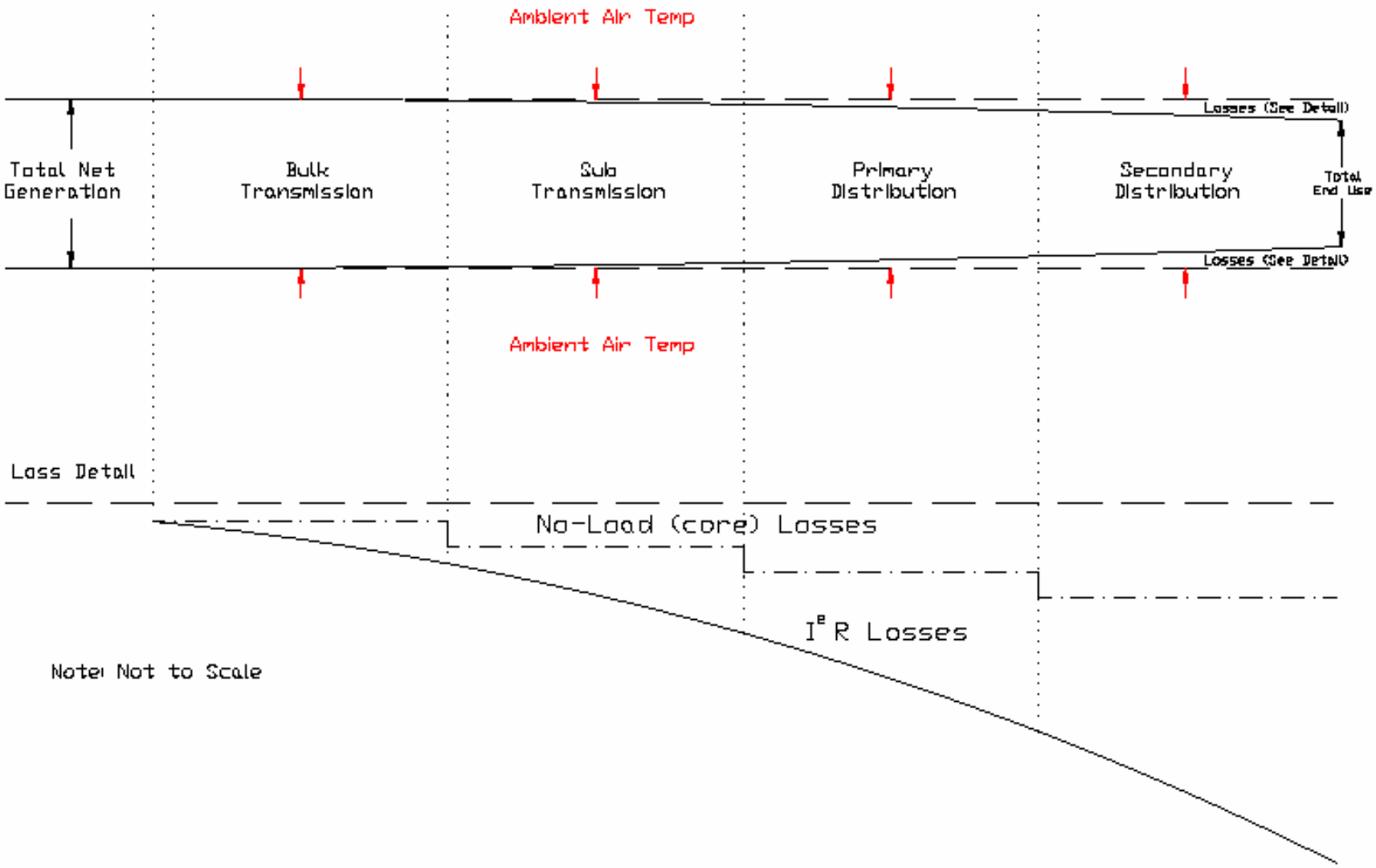
Northern Neck Electric Cooperative

- NNEC has historically had higher delivery losses (~8 to 9%)
- Recognized that they needed to do something on the distribution-side to improve losses
- They had just completed a 3-Year Construction Work Plan
- The engineering software tool they use to model their system is Milsoft's Windmil program
- NNEC's present modeling process uses hourly data captured at the substation (delivery point) level and monthly data captured at the end-use consumer

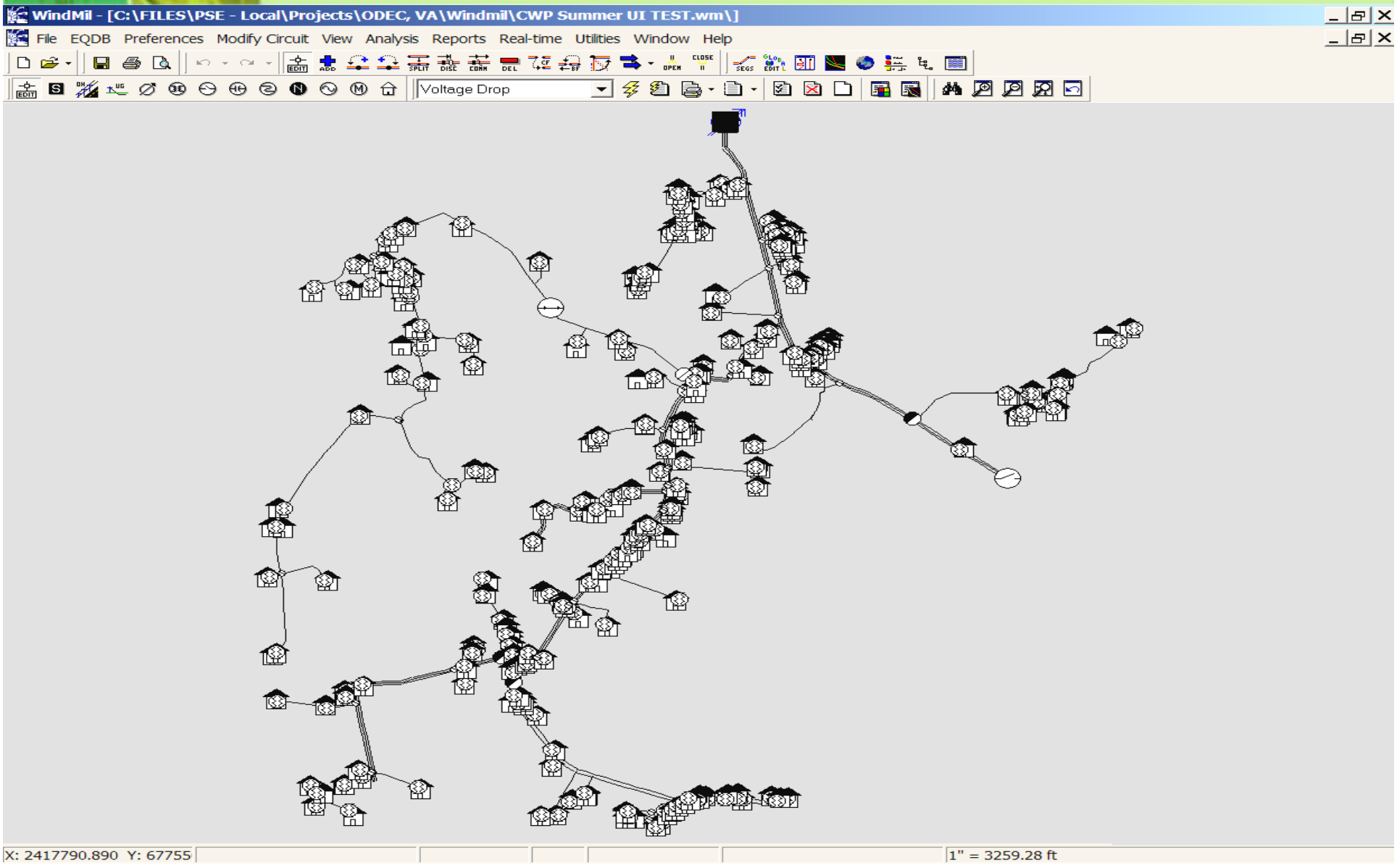
Northern Neck Electric Cooperative (cont'd.)

- They do not presently collect data at the circuit level
- We retained their Engineering firm, PSE, to develop methodologies and processes to:
  - Apply the collected load research data to the Windmil engineering model
  - Calculate losses by system component for a sufficient number of system states to more accurately determine demand and energy losses during important costing periods
- We retained RLW Analytics to support and address sample design and analysis issues

Losses...


Ambient Air Temp
Losses (See Detail)
Total Net Generation
Bulk Transmission
Sub Transmission
Primary Distribution
Secondary Distribution
Total End Use
Losses (See Detail)
Ambient Air Temp
Loss Detail
No-Load (core) Losses
I²R Losses
Note: Not to Scale

System Modeling...



Traditional Loss Analysis…

- Evaluate demand losses during peak time periods using the engineering model
  - Top-Down load allocation approach to calculate end-use load at customer level
  - Accuracy subject to engineering model and load allocation process used
- Estimate energy losses using industry accepted approaches
  - Relies heavily on assumptions
  - Focuses on peak and average demands

Our Approach...

- Utilize AMI interval load data collected at the end-use meters
  - Each customer is assigned a class and stratum
  - Sample population will be used to estimate the total end-use load at the customer level for each individual circuit
- Calculate losses on each system component for specific hours using the engineering model
  - kW demand into the system and out of the system is known
- Interpolate losses for hours not specifically analyzed using regression analysis to determine total energy losses

Our Approach...

- Deployed comprehensive coverage on a selected circuit
- Deployed a large statistical sample on two additional circuits
- Deployed more conventional samples on an additional two circuits
- Approach includes a system wide load research study directed at the class level

Expected Results...

- Much more accurate calculation of demand and energy losses by system component
  - Demand losses for any given hour
  - Energy losses for any given time period
- Examine the value of sampling circuits versus having the full circuit information
- Examine the transferability of the results within a system and external to the system

Expected Results...

- Refined calculation of financial losses for various costing periods
  - Cost of losses during both on-peak and off-peak time periods can be determined
- A transferable process that can be applied to other member owner systems

Long-Term Benefits…

- Utilize the developed process to better understand the financial impact of losses from various system components
- Better direct capital investment to lower losses
  - Reduced wholesale power costs
  - Improved voltage levels
  - Increased system capacity
- Shape practices relating to transformer sizing, metering, line extensions, bid evaluations

Additional Projects . . .

- One objective is to use a similar process to analyze transformer sizing standards –
  - Experiencing an issue with proper sizing of transformers on the McMansions across our system
- Understanding usage of these “houses on steroids” is critical from several perspectives: distribution system, demand response initiatives, power supply costs.
  - particularly with the big push towards demand response (that’s another topic for next time!)