

Replacement Program 26kV System

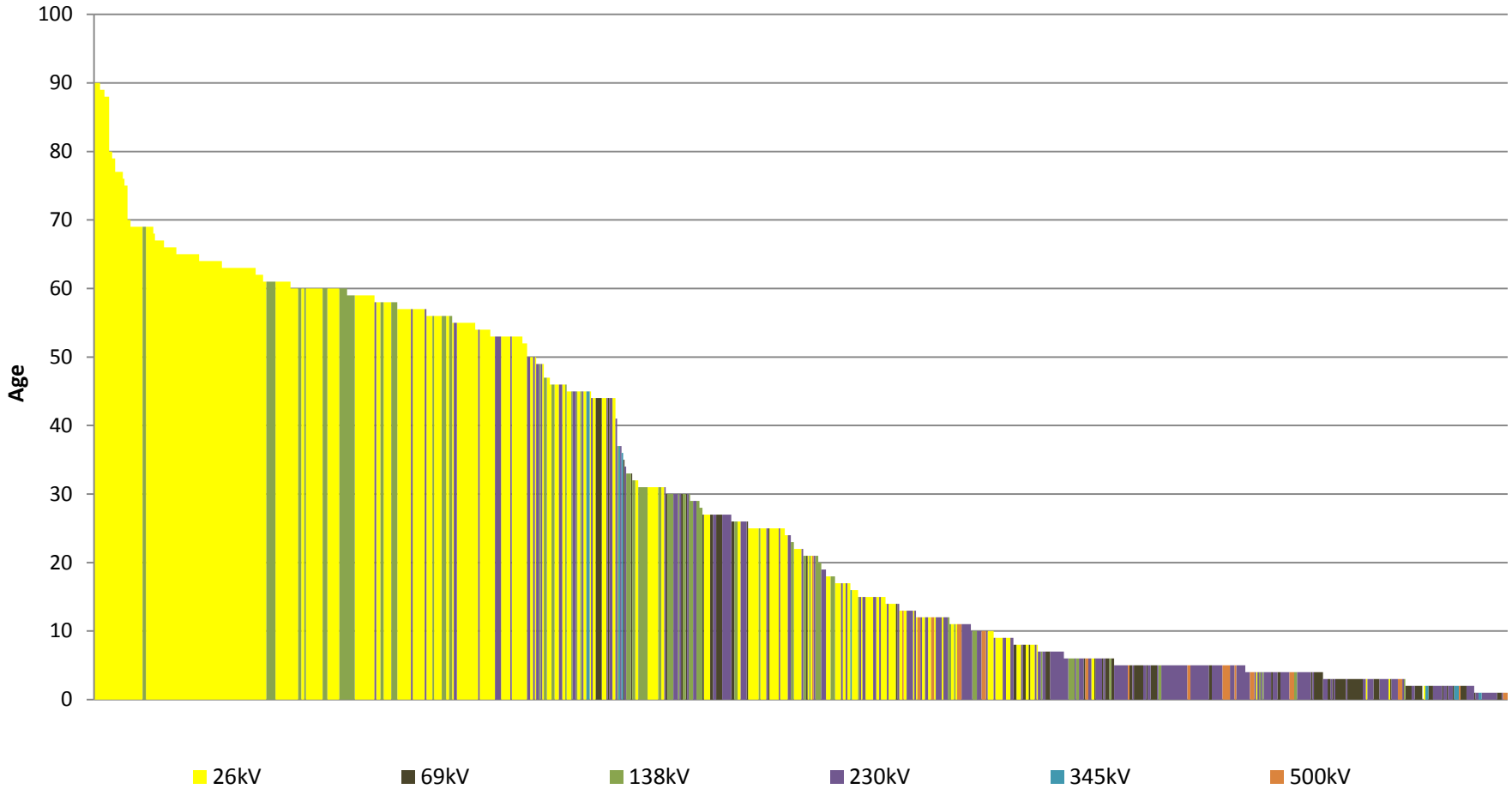


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Background - PSE&G 26kV Legacy System

- Put in service in the 1920s
- Radial system
- Resistance grounded system
- Circuit capacity of 23MVA
- Less advanced relay protection and station configuration
- 26kV relay protection remains reliable at present, but is not adequately suited to address long-term grid modernization needs

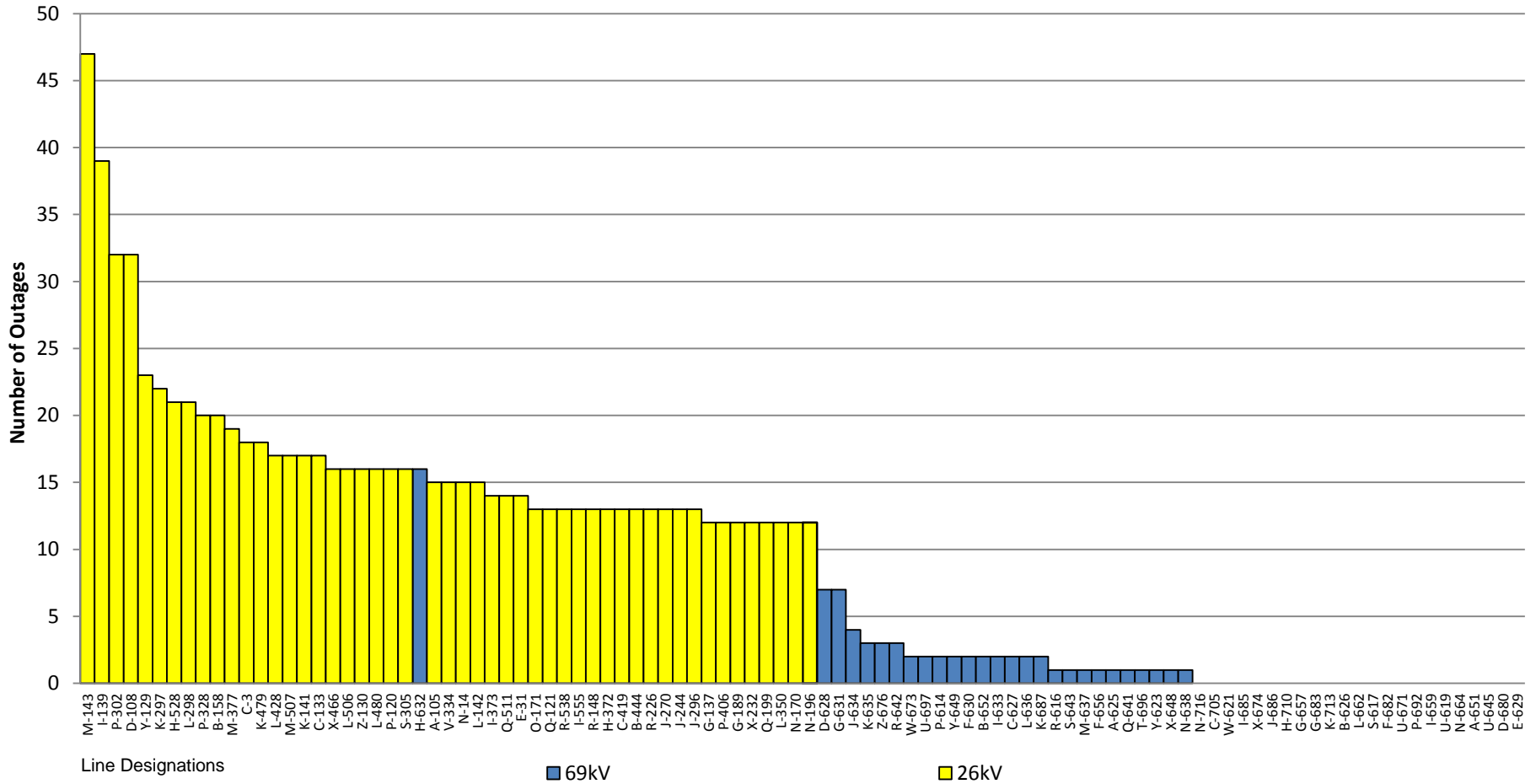
Transformer Age by Voltage Class



Graph shows ages of all substation transformers in PSE&G system

26kV v. 69kV Circuit Performance

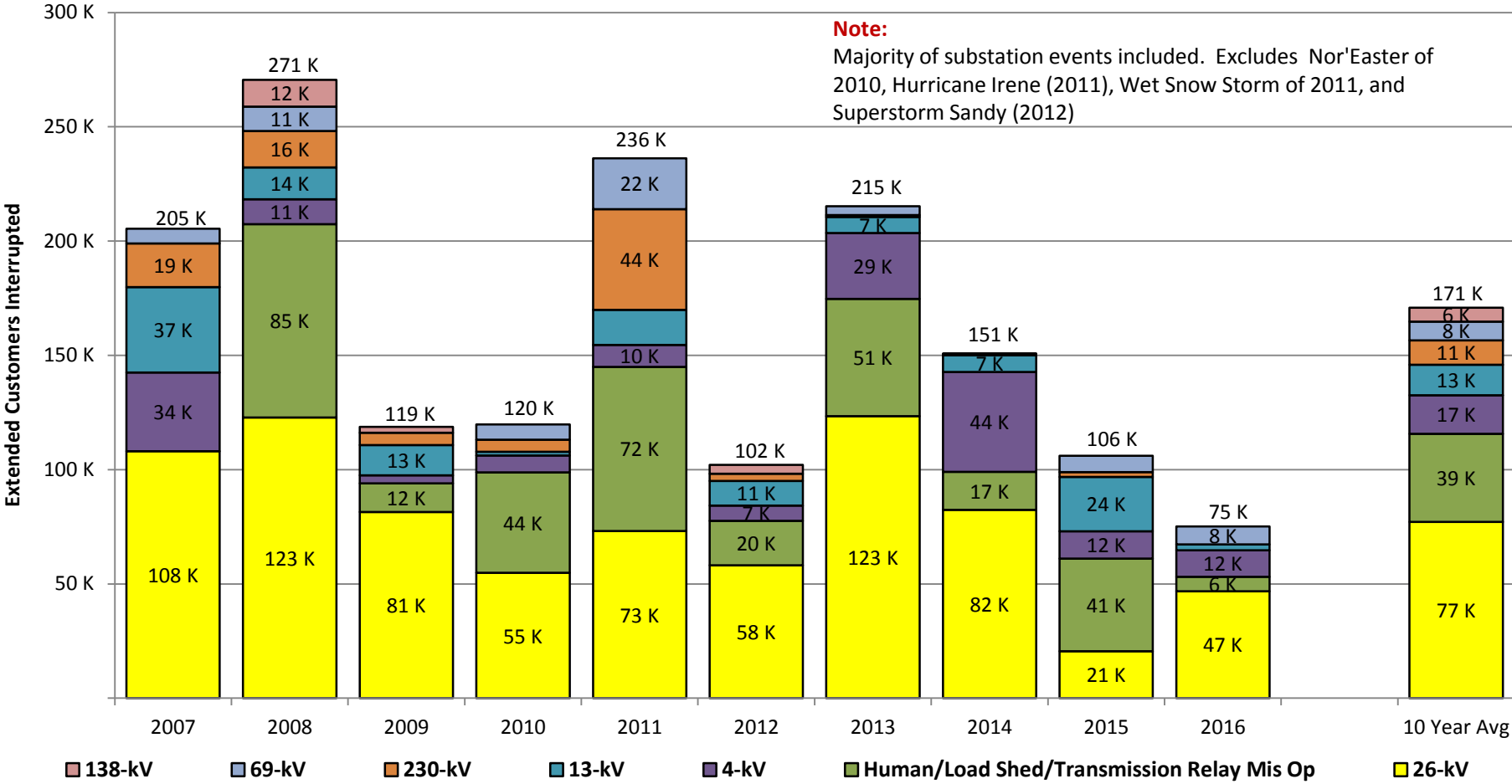
Subtransmission Outages 2012-2016



Graph compares 50 worst 26kV circuits to 50 worst 69kV circuits

26kV Faults - The Leading Cause of Customer Interruptions

PSE&G Customers Interrupted by Fault Type



Over the last ten years, 9x more customers fed from 26kV experienced outages due to a station shutdowns than customers fed from 69kV stations

Options to Address 26kV System

- **Leave 26kV system as is**
 - Heavily loaded switching stations are difficult to maintain (maintenance outages are difficult to arrange)
 - Rate of failure is likely to cause increasing impacts on system reliability
 - As load continues to grow, circuits and stations will become increasingly overloaded
- **Replace 26kV system in kind**
 - 26kV system has limited capacity for future growth - data centers and other Commercial and Industrial development continue to add load
 - Typical 69kV line is rated for 95MVA summer normal while a 26kV line is rated for about 23MVA
- **Upgrade 26kV to 69kV (Recommended Option)**

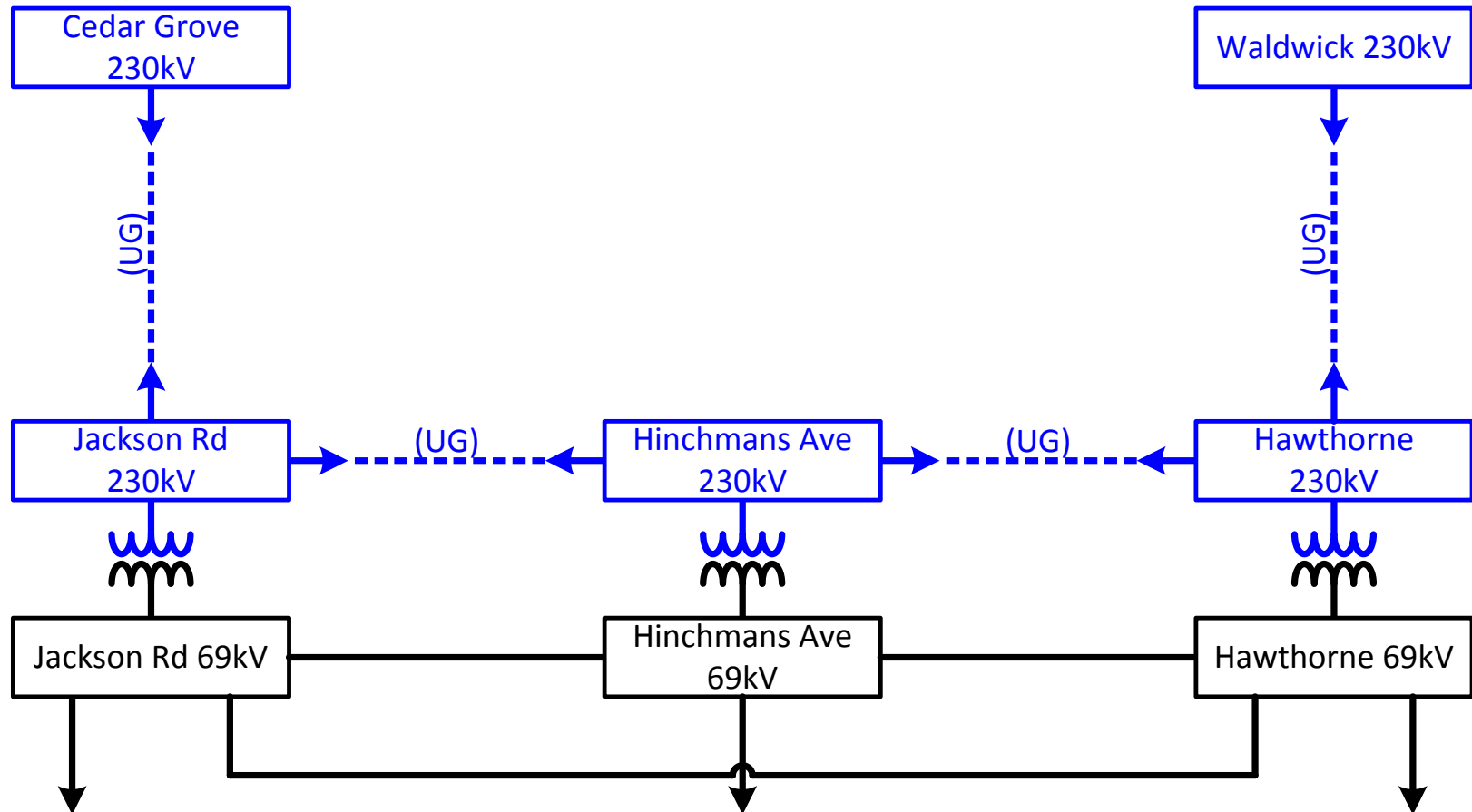
What Makes Upgrading to 69kV the Right Choice?

- 69kV Solution provides many benefits to the PSE&G System
 - 69kV benefits the Transmission system
 - 69kV improves reliability
 - 69kV provides additional capacity
 - 69kV has construction benefits

69kV Transmission Benefits

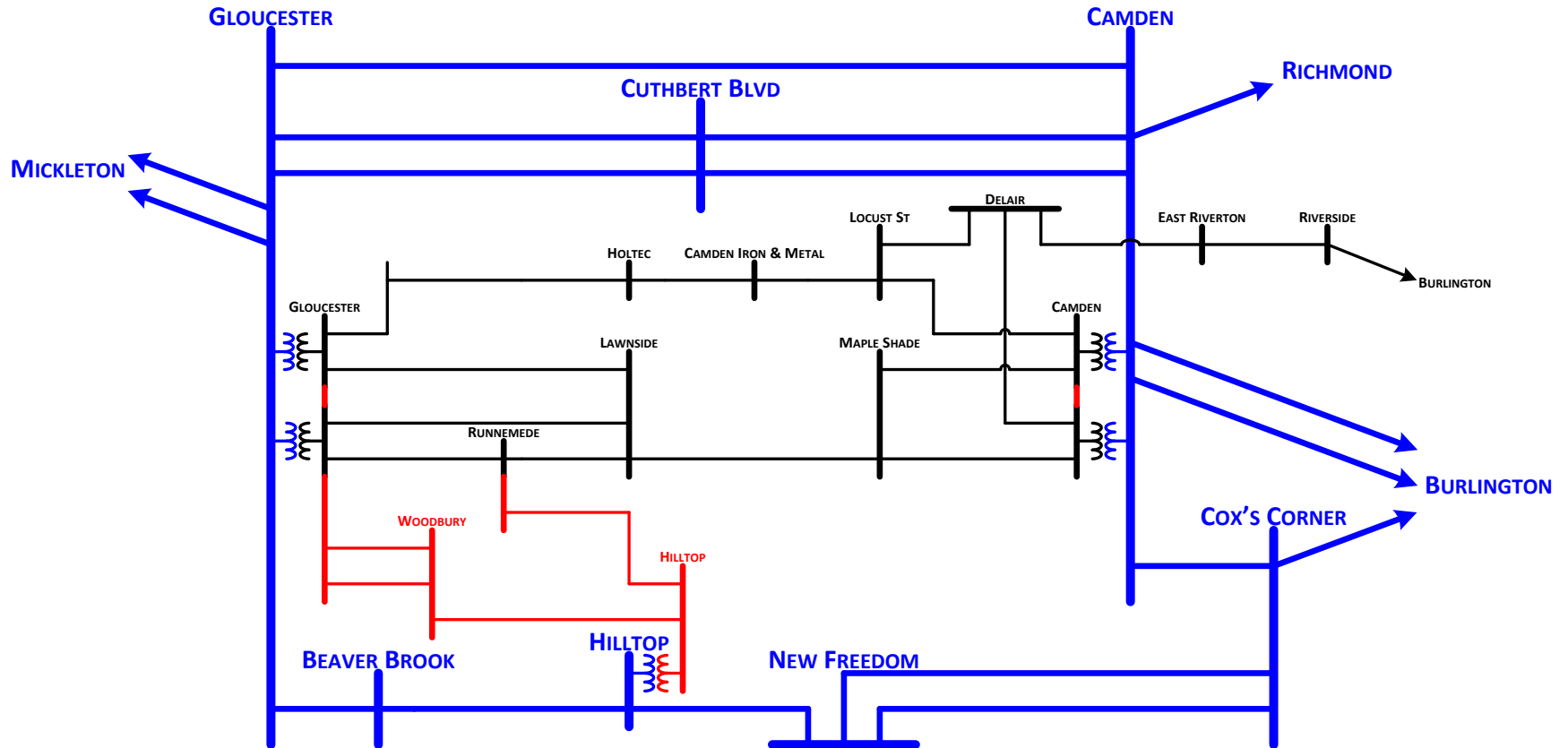
- Does not require new transmission right-of-ways
- 69kV system parallels higher voltage transmission (138kV, 230kV) and can support the transmission system
- 69kV transmission allows the installation of new substations in areas where 138kV and 230kV lines do not exist
- 69kV allows transmission expansion on existing public street right-of-ways using overhead construction standards
- Lower cost of construction to rate payer than the next lowest transmission voltage (138kV)

Avoiding N-1-1 Violations by Paralleling 69kV with Transmission



Paralleling 69kV with transmission prevents N-1-1 violations at several stations fed only by underground cables

69kV Allows Construction of Transmission and Substations in Dense, Urban Areas



69kV Reliability and Capacity

- The 69kV system provides greater **reliability**
 - Network system that is tightly connected to the transmission system
 - More reliable station configuration and design
 - Modernized protective relaying, including the use of high-speed fiber optic communication (faster clearing times)
 - Higher and stronger poles - less impacted by falling trees or car collisions
 - Reduces the need for additional lines along city streets - only three 69kV circuits supplying stations v. five 26kV circuits
- The 69kV system provides higher **capacity**
 - Provides for future growth and expansion
 - Provides adequate capacity needed to supply large data centers and large industrial customers - voltage level of choice for data centers from a reliability perspective
 - Provides higher capacity margin that helps during maintenance and construction outages

Circuit & Transformer Capacities

| | Overhead Circuit | Transformer |
|------|------------------|-------------|
| 4kV | 2.4 MVA | 9 MVA |
| 13kV | 8 MVA | 45 MVA |
| 26kV | 23 MVA | 120 MVA |
| 69kV | 95 MVA | 300 MVA |

Land and Construction Costs in New Jersey

- New Jersey is densely populated with limited land availability
- High population density results in numerous and vast highways that can be construction obstacles, in addition to mountains and other natural obstacles
- New construction is often restricted to existing right-of-ways or underground
 - Using existing right-of-ways means that increasing the voltage is often the only way to gain substantial capacity
 - Underground construction can be more than four times the cost and has less capacity than overhead construction
- **High Cost**
 - Land is more expensive, especially in PSE&G load pocket areas where the 26kV stations are located
 - Labor costs are much higher in New Jersey
- **Space limitations requires more expensive design considerations**
 - Gas Insulated Switchgear (GIS)
 - Smaller footprint
 - Multileveled stations are possible

Questions?



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