Downtown Network Modeling

PowerWorld Program Users Work Group

March 14, 2012

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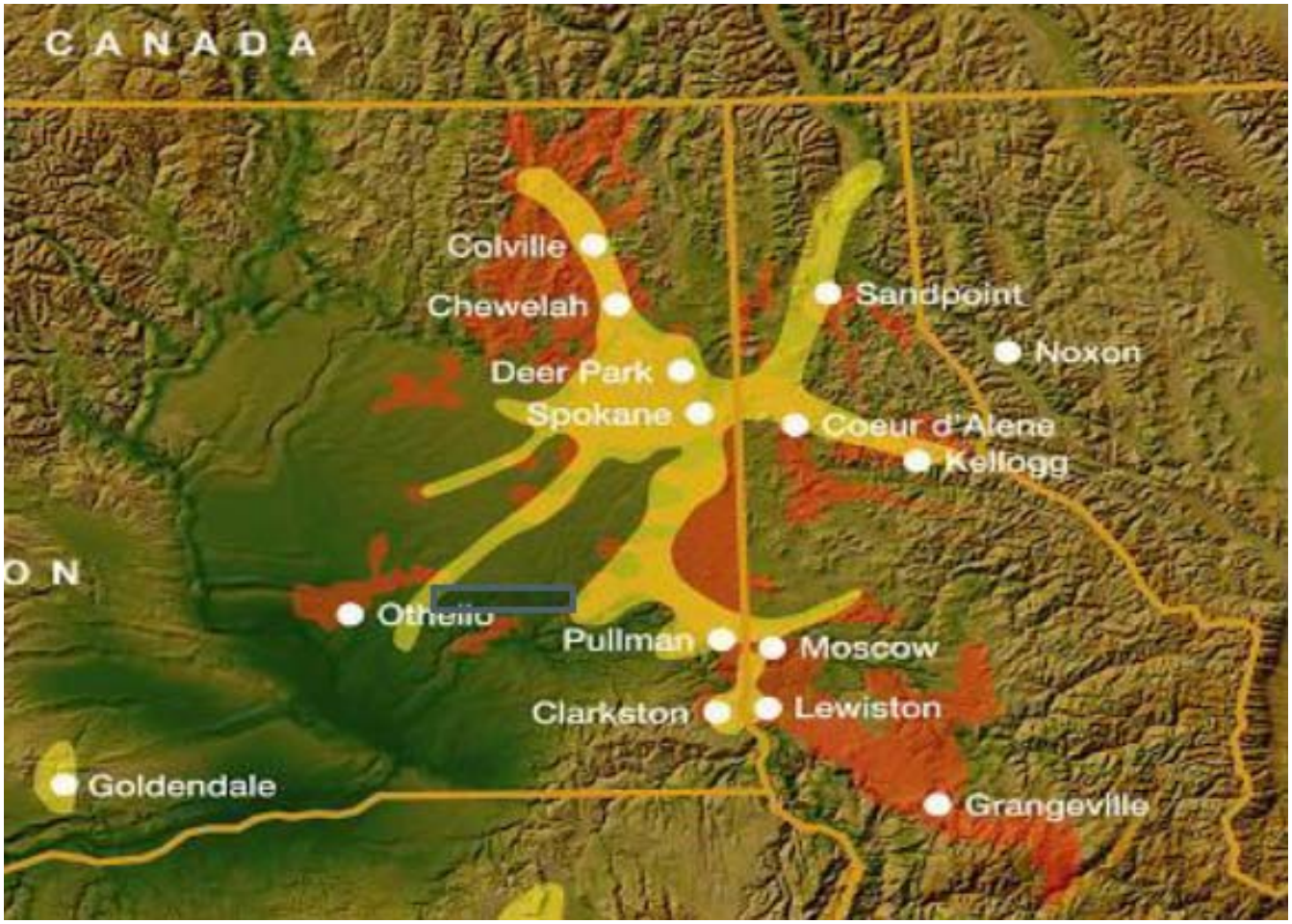
Avista Electric Utility Balancing Area

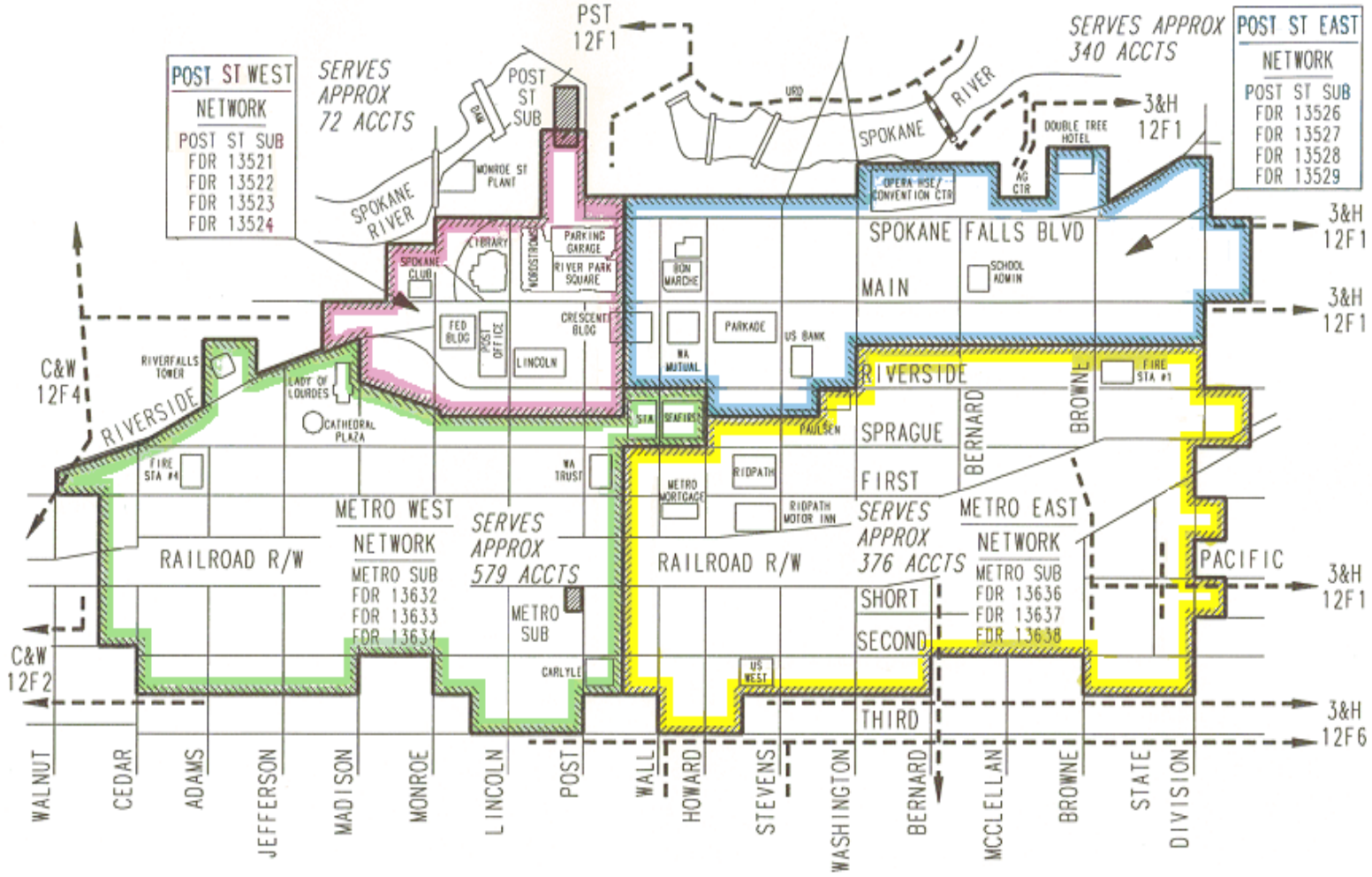


City of Spokane Downtown

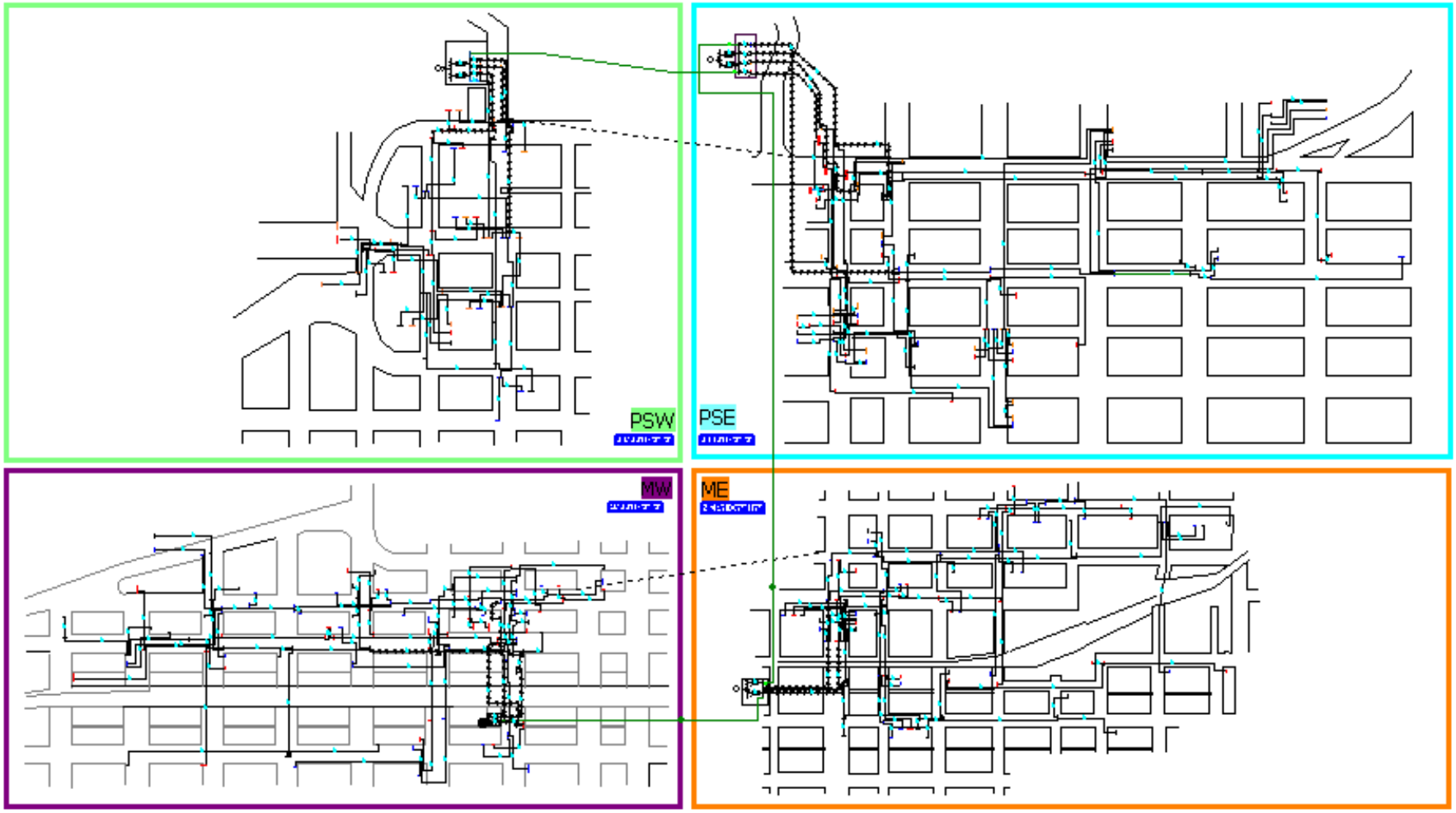
Avista's Downtown Network Overview

- Relatively small distribution network, approximately 36 MW
- Separated into four isolated and independent quadrants
- Two substations, Post Street and Metro carry downtown loads
  - Post Street east & west, (4) 13.8kV feeders per quadrant
  - Metro east & west, (3) 13.8kV feeders per quadrant
- Secondary is either 480 V or 208 V
  - 208 V secondary is networked throughout downtown in a "Grid Network" configuration
  - 408 V secondary is networked only at each customer in a "Spot Network" configuration

Spokane Downtown is Divided into Four Quadrants

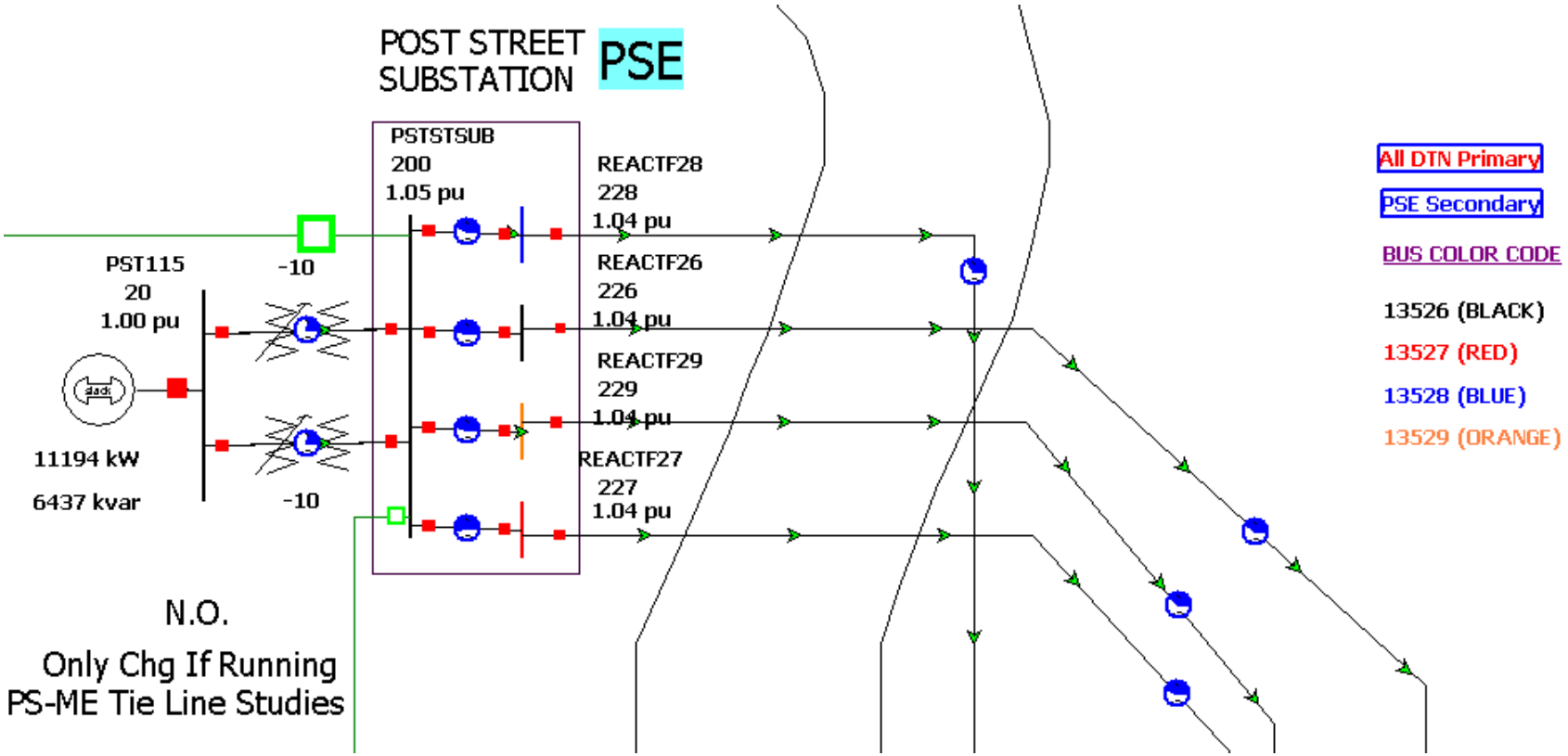


Modeled as Four Areas, with a Slack Bus for Each



13.8kV Bus and Primary Feeders

- Feeders only serve transformers with network protectors



13.8kV Bus and Primary Feeder loads

- Results in multiple feeders serving the secondary network

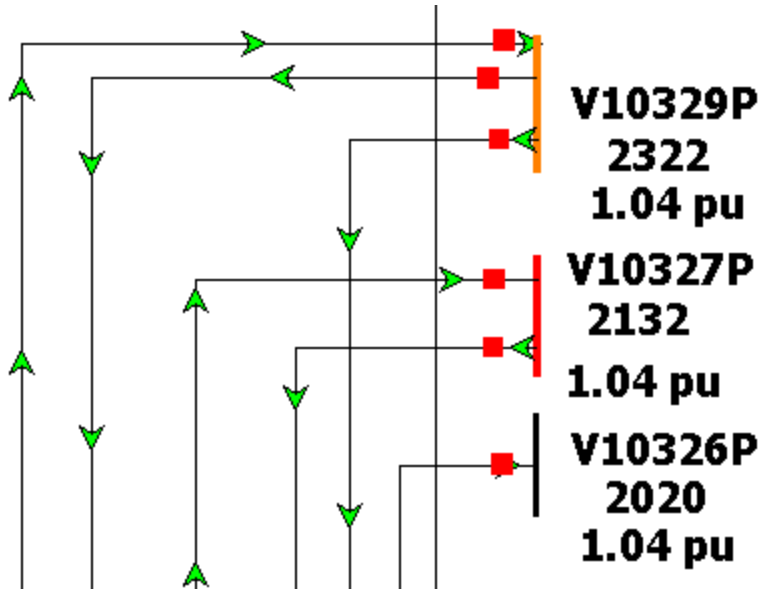
BUS COLOR CODE

13526 (BLACK)

13527 (RED)

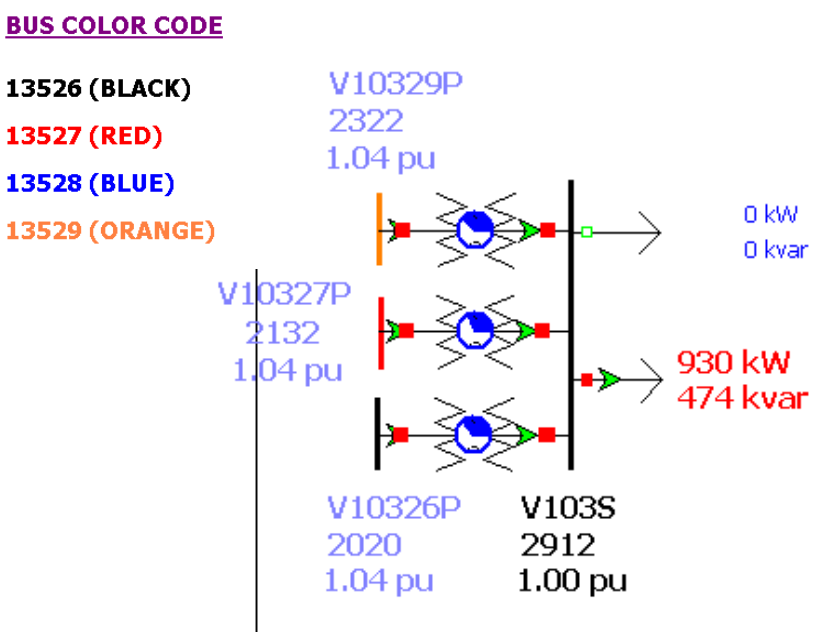
13528 (BLUE)

13529 (ORANGE)

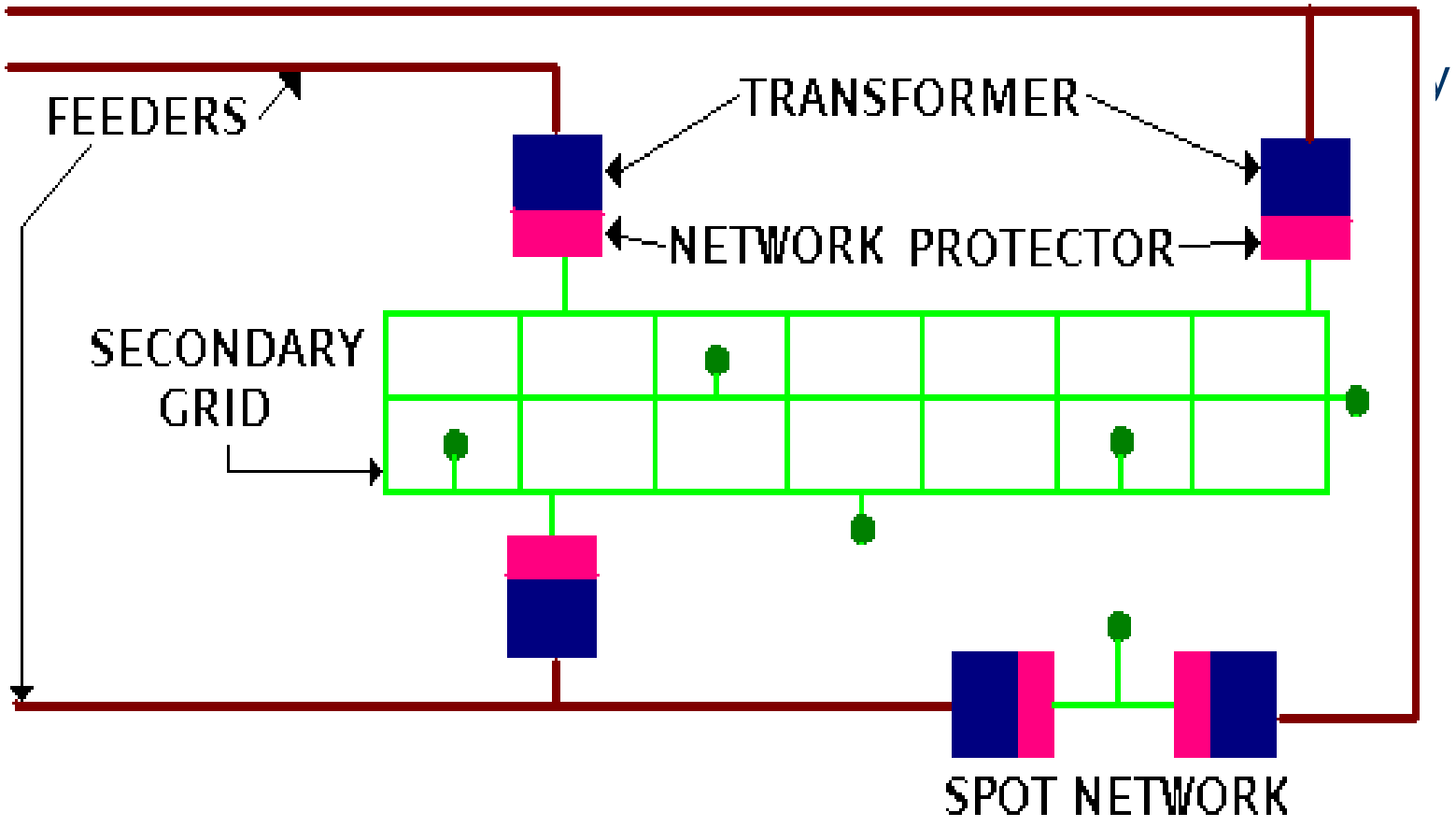


Transformations to 480 V Secondary Loads

- Results in multiple feeders serving a single 480 V point load, in this case, the Spokane Opera House



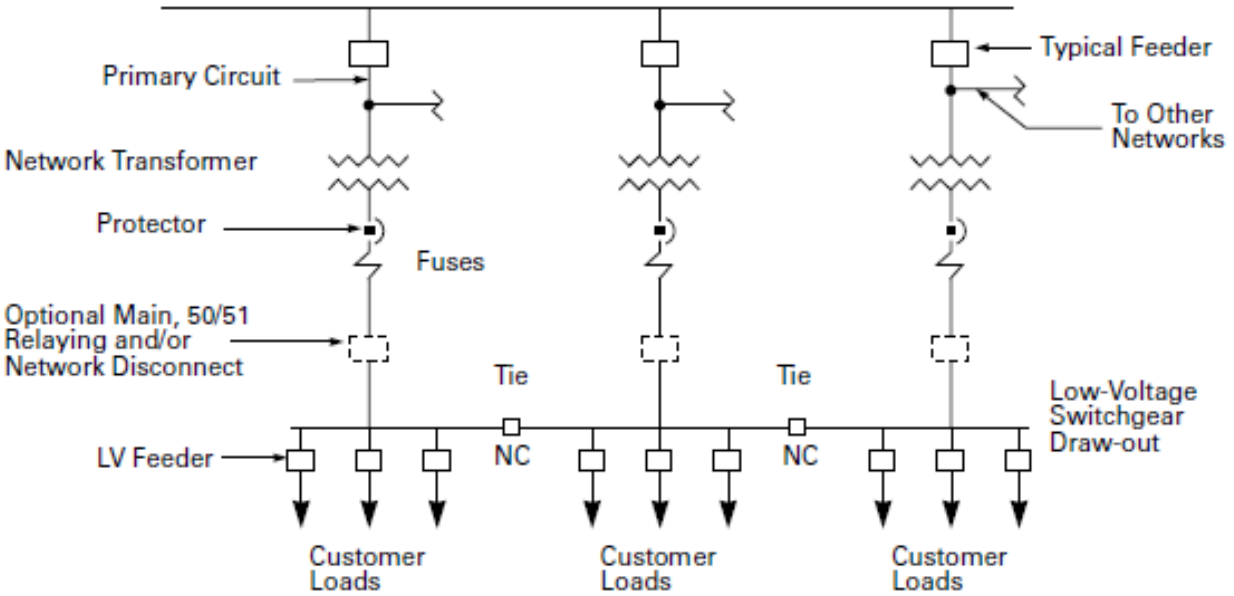
Multiple Primary Sources - Spot and Grid Network



Network Protector (reverse-power relay)

- The function of a network protector is to automatically connect and disconnect its associated power transformer from the secondary network when the power starts flowing in reverse direction.

Type CM-22 Transformer-Mounted Network Protector with Ventilated Protective Cover.

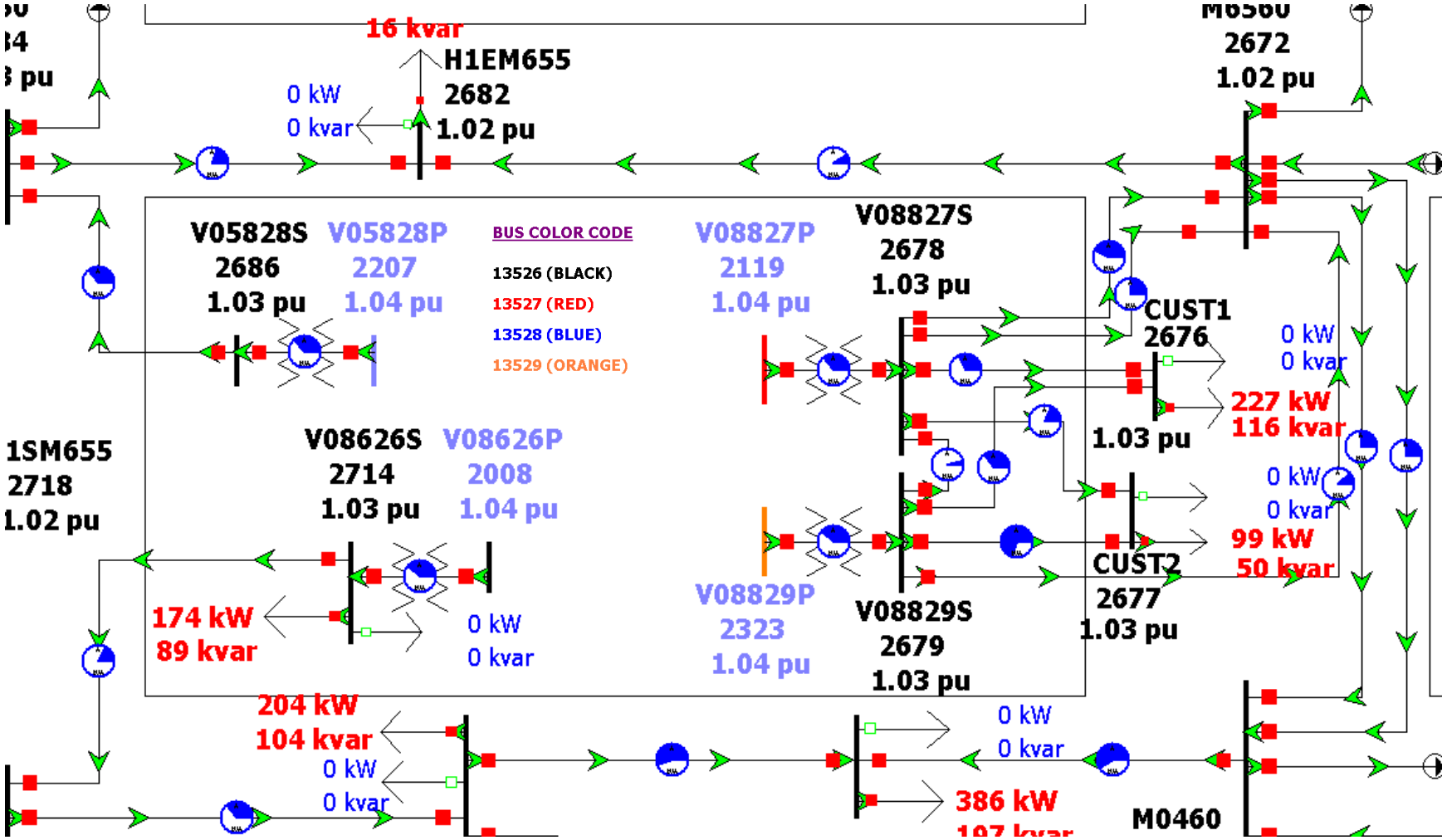


Network Protector (reverse-power relay)

- 208 V grid network fault is assumed to be “self-extinguishing”
- 480 V Spot network has fault protection at the customers load center
- Main goal of the network is to protect from primary feeder faults. The network protector opens due to reverse power flow, thus isolating the fault from the secondary network.
- Cutler-Hammer documentation is a good reference for theory

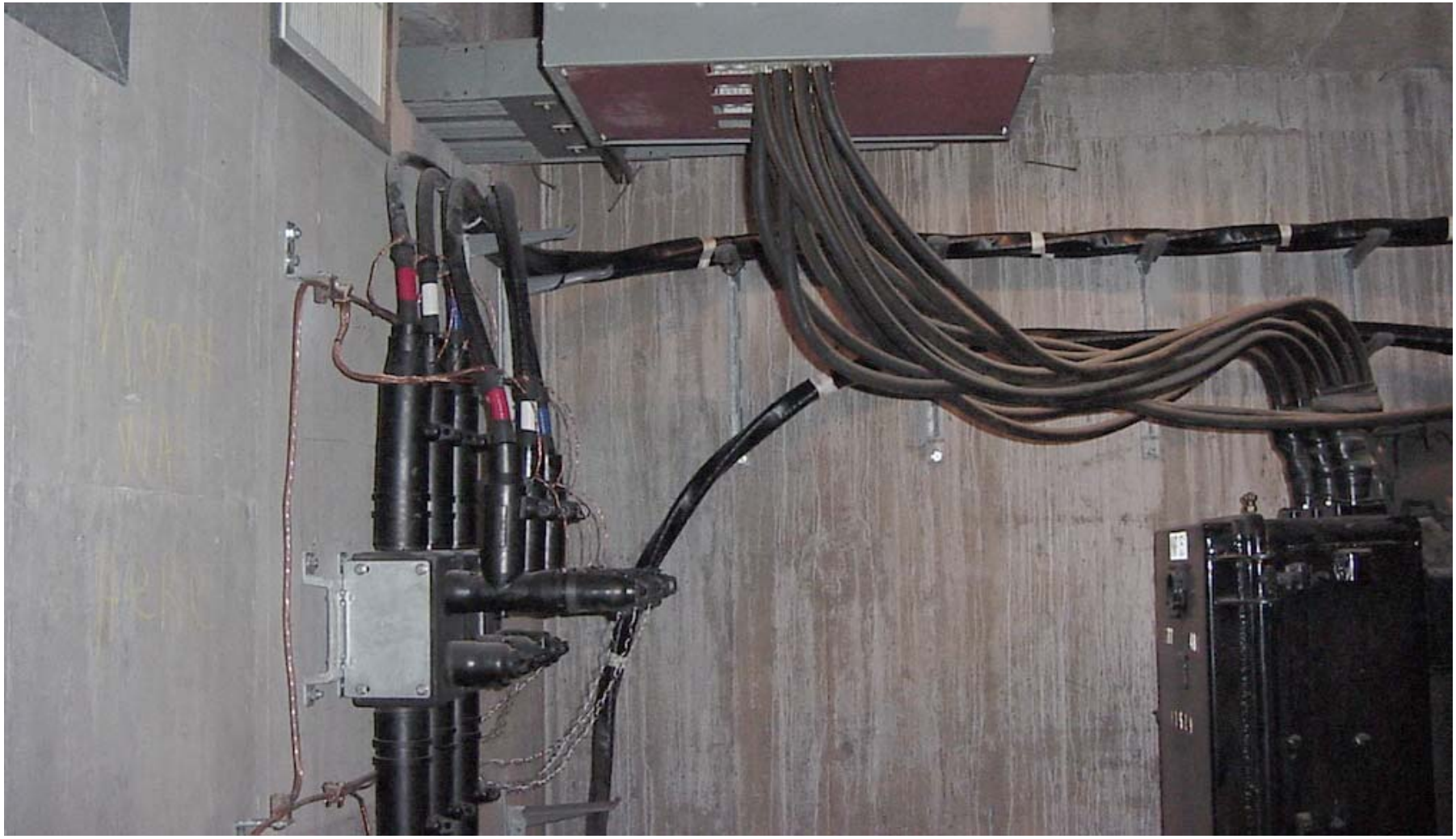
http://www.eaton.com/ecm/idcplg?IdcService=GET_FILE&allowInterrupt=1&RevisionSelectionMethod=LatestReleased&noSaveAs=0&Rendition=Primary&dDocName=TD5201ATE

Transformations to 208 V Secondary Networks



Downtown Network Model in PowerWorld Simulator

- Area slack bus for source
- Primary and secondary feeders
- Grid and spot network loads
- Contingencies
  - Loss of transformer/protector
  - Loss of primary feeder

PowerWorld Example

Questions… *{Spokane Opera House, one of three}*