The WSU Microgrid

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Outline

- *Introduction to Microgrid at WSU*
- *Microgrid operation*
  - *Connected to grid*
  - *Islanded*
- *Data management and communication*
- *Microgrid Modeling*
- *Transactive signal based demand response*
- *Planned future activities*

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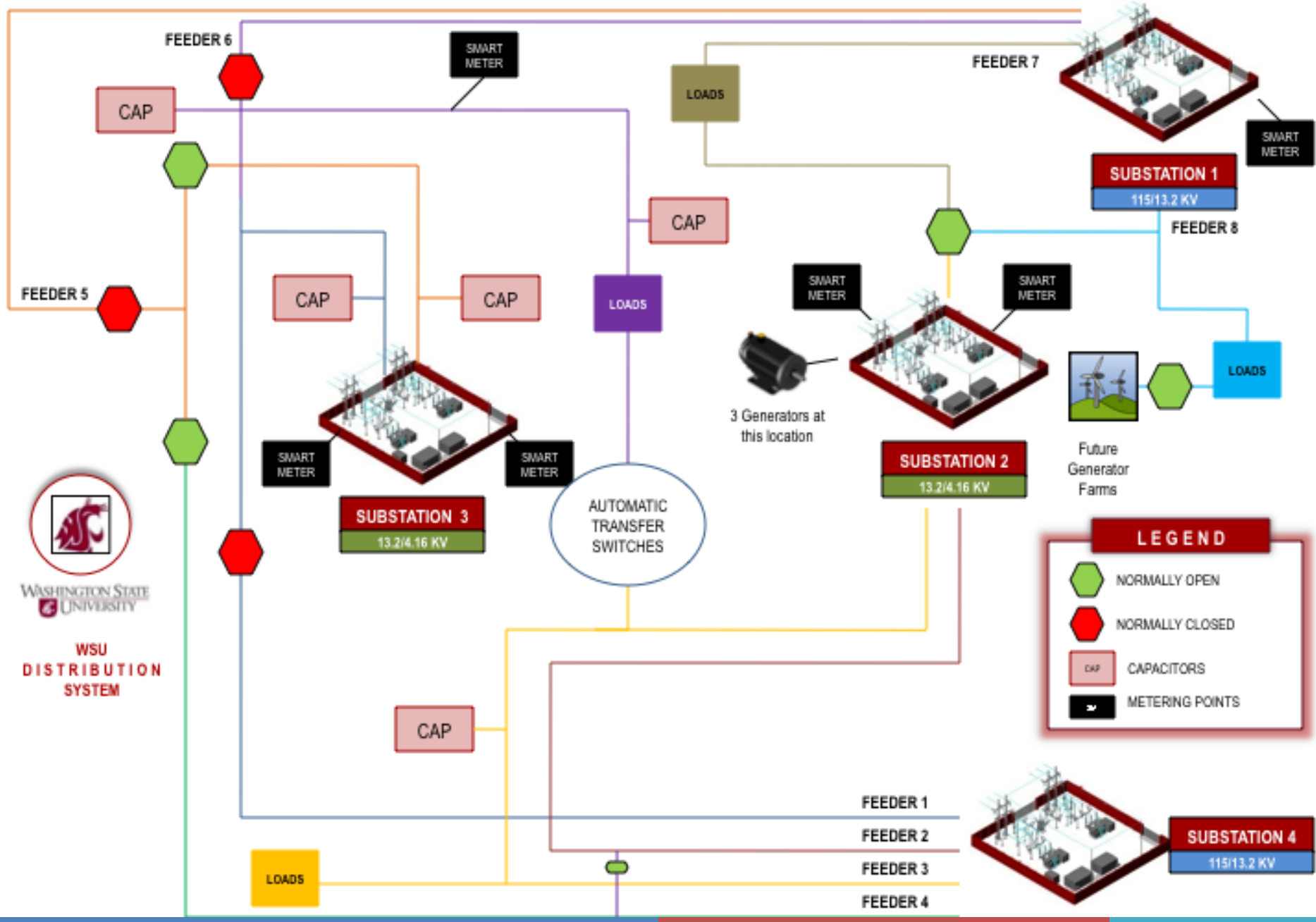
Campus Electrical Power System

- Avista provides service to the campus at 13.2 kV
  - Three 115kV-13.2kV substations
  - Six Master-metered circuits nominally rated at 9.2 MW each
  - Two of the Master-metered circuits serve buildings directly
  - Four primarily serve the WSU substations (two per substation)

Campus Electrical Power System

- WSU has two “5kV Substations”
  - Each has two switchgear lineups with a tie breaker connection
  - Each switchgear lineup has 10 to 15 5kV circuit breakers
  - Service to buildings is provided at 4.16kV
- Three Generators @ GWSP – 3.95 MW combined capacity
- One Generator @ the Biotech facility – 1.0 MW capacity

WSU Distribution System Feeders



WSU Load Summary

Peak MW (Last 12 months) = 28.169 MW

Average MW (Last 12 Months) = 19 MW

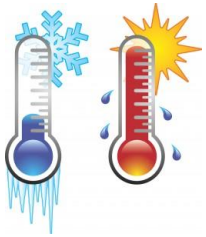
Total Energy Consumption = 166 million kWh

Total Energy Cost = ~10 Million

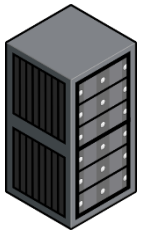
kVAR Peak = 11,278 kVAR

kVA Peak = 30,286 kVA

Main types of load in WSU



STEAM/ CHW PLANT



COMPUTING

RESEARCH LABS

RESIDENTIAL

COMMERCIAL & OFFICES

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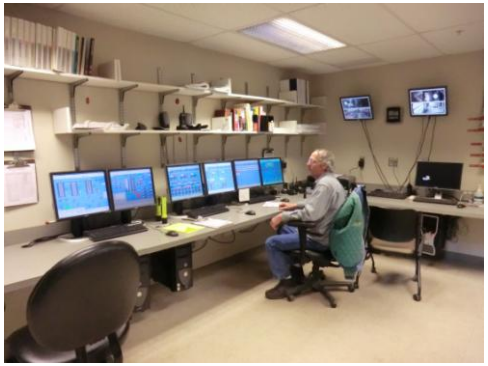
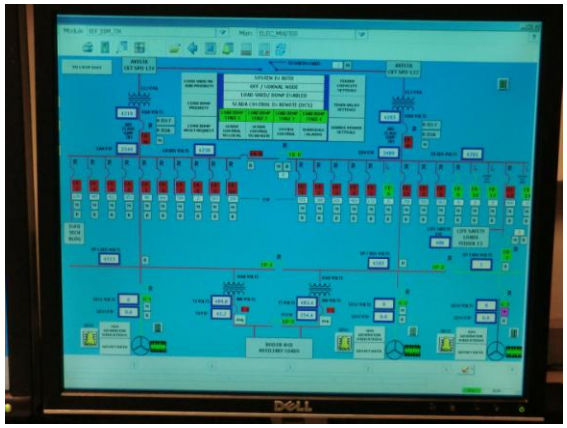
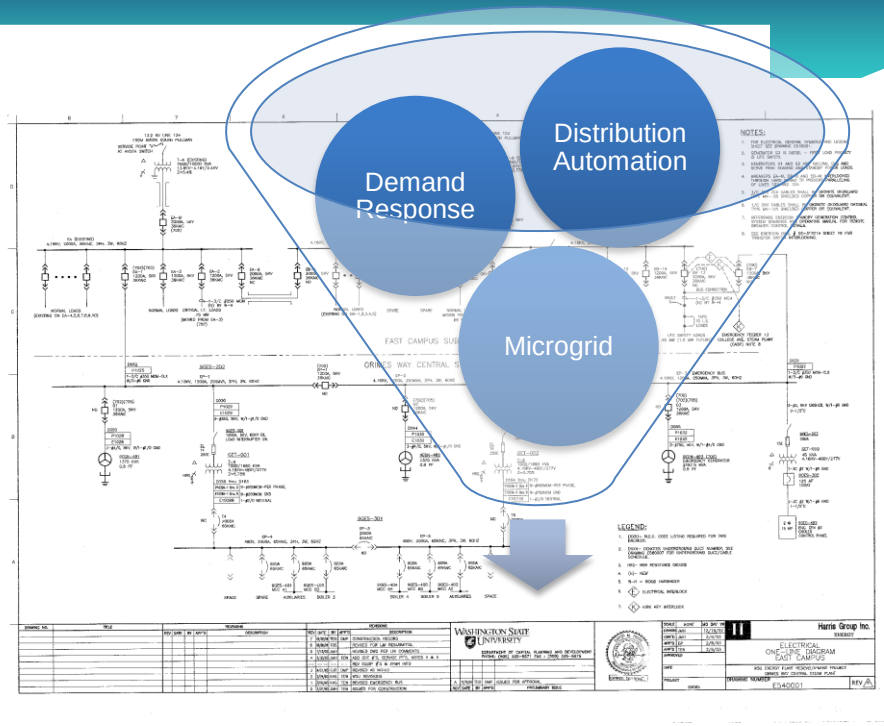
WSU microgrid

Microgrid Operation





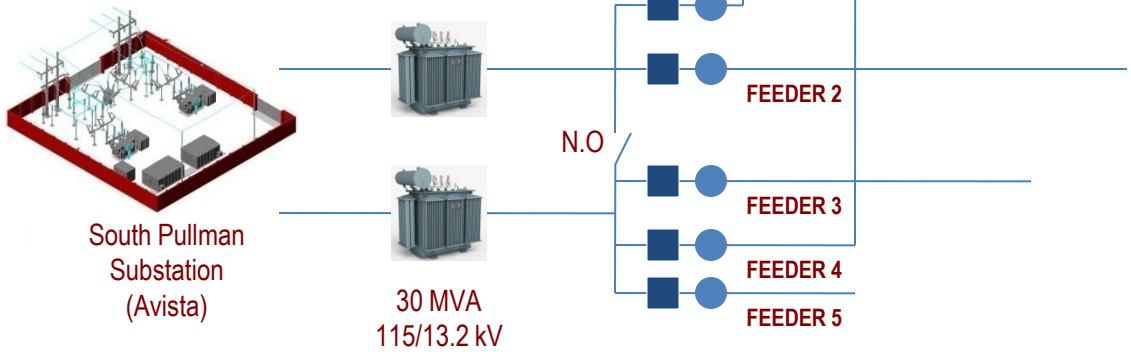


- Integrated Volt-Var Control (IVVC) Power Quality improvements
- Networked Smart Meter Installation (data for load sheds, gens, IVVC)
- Sitect SCADA system for meter polling, historian etc.
- Enterprise Energy Management System (EEMS) Software
- Building Automation by Siemens
- ENERCON system for generator SCADA, Control and Management

WSU PULLMAN MICROGRID

Case 1. One Feeder Loses Power.

1. GEN 3, 2, 1 starts after 0.5, 1.0, 1.5 seconds respectively. After 5 sec. main and feeder breaker on de-energize bus open
2. After **10 sec**, Master Gen 3 picks up life safety loads.
3. Generators sync to each other and remaining utility service.
4. Within 180 sec, steam boiler fan and pumps are started.
5. Feeder breakers reclose to pick up loads at **60 sec intervals.**



Case 2. Both Feeders Lose Power

Gens start after 0.5, 1.0, 1.5 sec respectively. Primary loads of steam plant start within 180 sec, followed by other loads at 60 sec interval each. **Building Loads with own back-up generators are picked up last.**

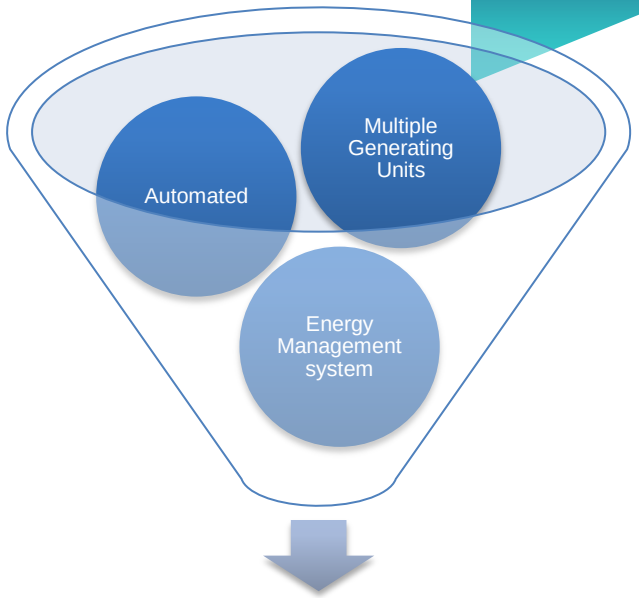
Critical Loads outside campus to be connected to On-Campus Generators with N.O switches

Logic developed by **Enercon.**

Automated Response to AVISTA outage
Automated peak load response

WSU microgrid

Islanded Operation



- 1 MW Diesel generator with switchgear Modicon PLC control at Building 1
- Serve to take mission critical loads
- Automated response to AVISTA outage and peak shaving

- Local non-synchronized generation with double circuit utility feed at building 2
- Serve to take mission critical loads and automated response to AVISTA outage and peak shaving

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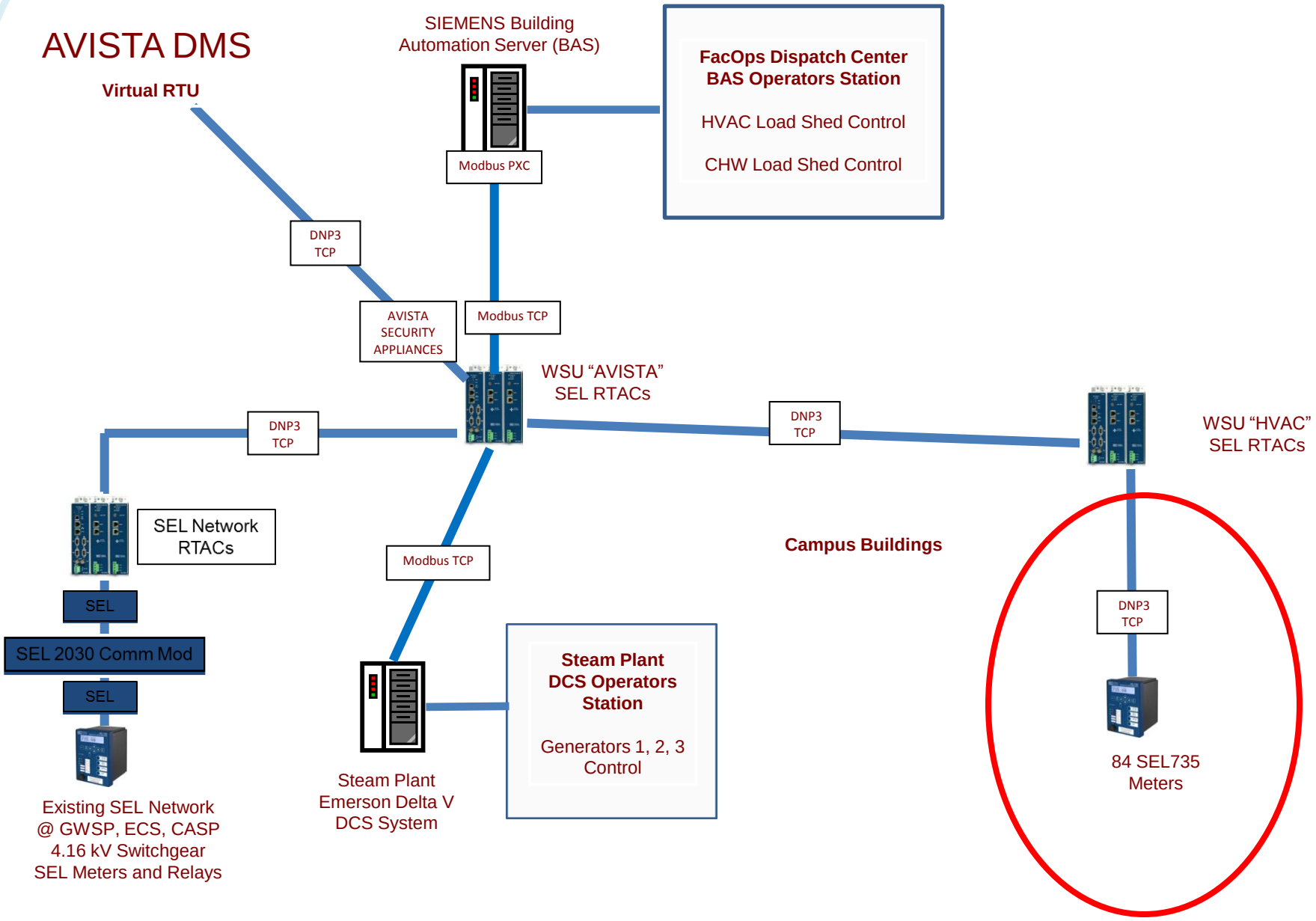
WSU Data Network Overview



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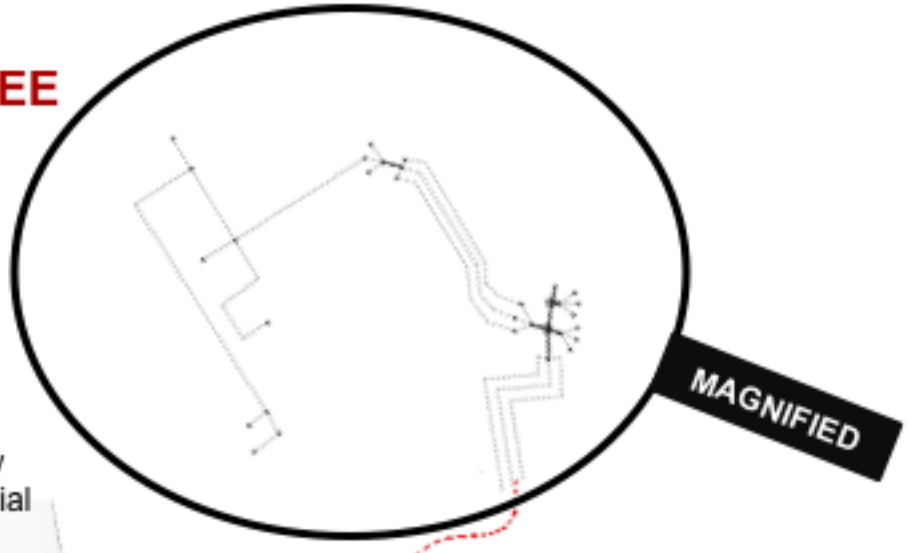
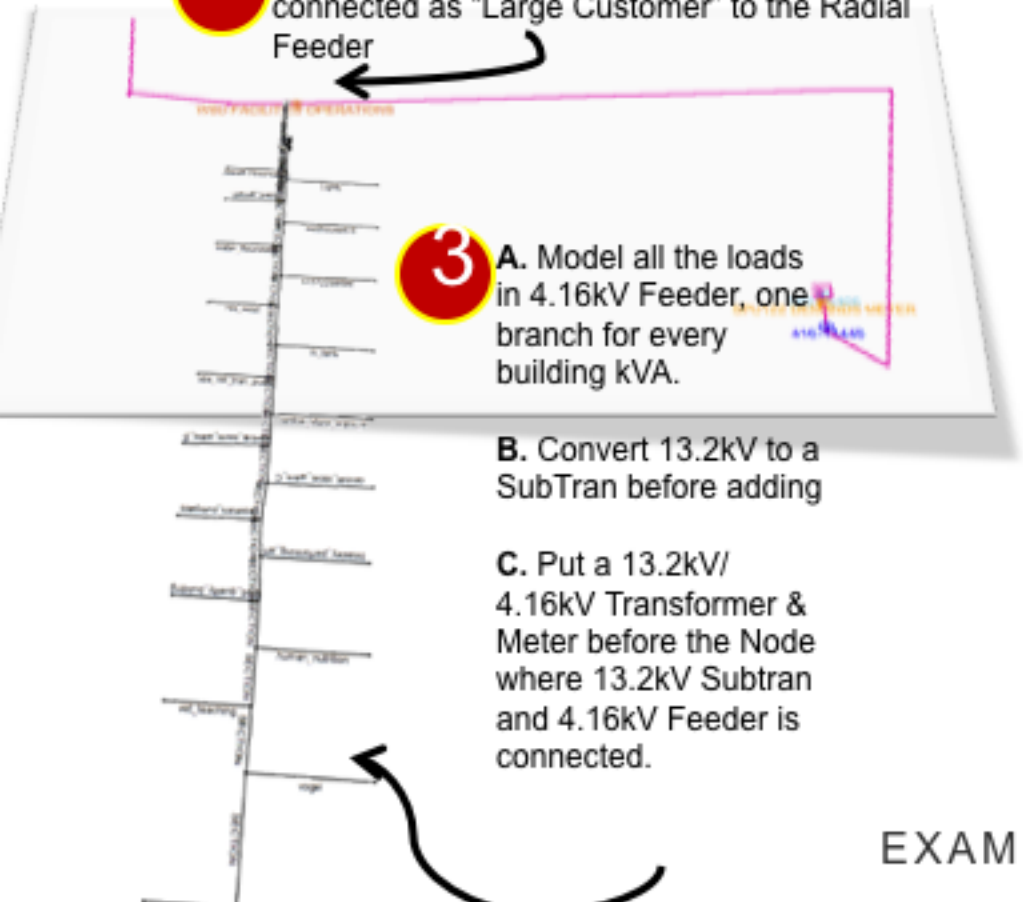
Modeling of WSU MicroGrid in SynerGEE

1. Extending the network to include lower voltage circuit



2. Observing how WSU Loads are collectively connected as "Large Customer" to the Radial Feeder



3. **A.** Model all the loads in 4.16kV Feeder, one branch for every building kVA.

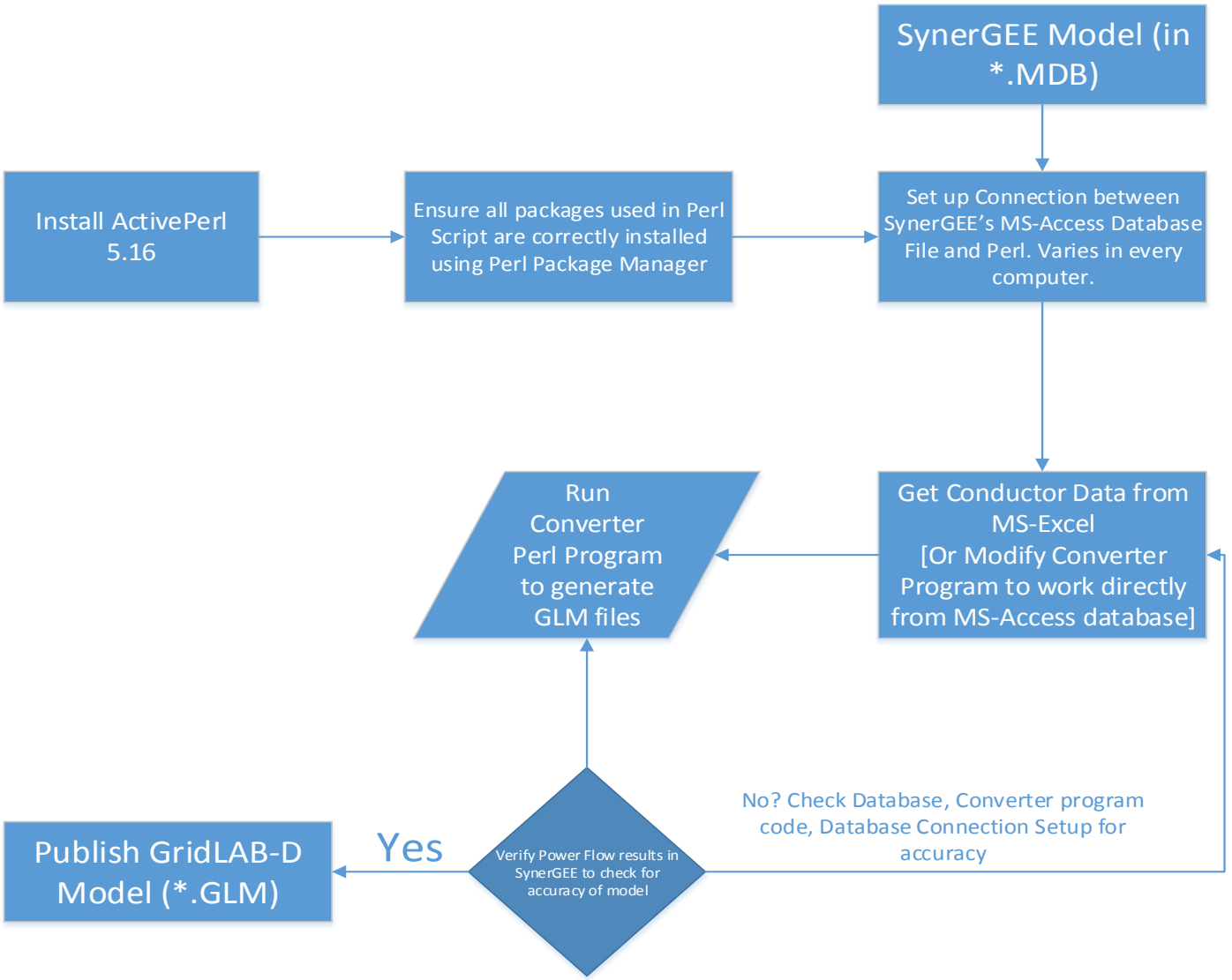
B. Convert 13.2kV to a SubTran before adding

C. Put a 13.2kV/ 4.16kV Transformer & Meter before the Node where 13.2kV Subtran and 4.16kV Feeder is connected.

Current Model

EXAMPLE FEEDER SYNERGEE MODEL

Converting SynerGEE Models into GridLAB-D Models for further analysis



Real Time Digital Simulator and Other Hardware

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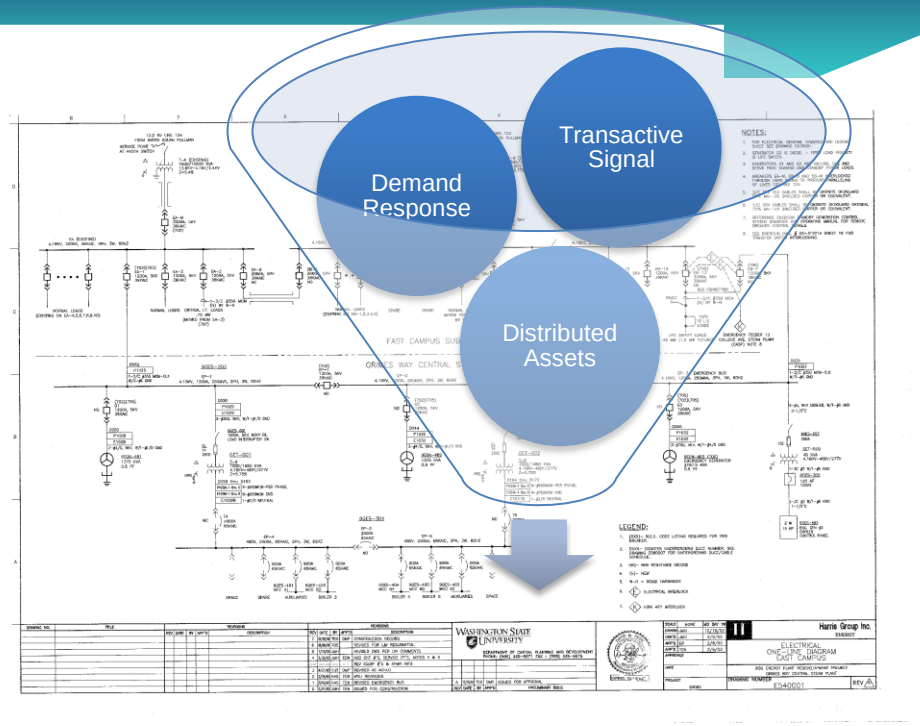
Demand Response



Transactive Signal
- HVAC Load Shed: 0.5 MW
- Chilled Water Load Shed: 1.25 MW
- Dispatch Three GWSP Generators – 3.0 MW support level

WSU Chilled Water Load Shed
CHW Source Options

1500 Ton VFD Electric Chiller

2 Million Gallon Thermal Storage Tank

Status: Transactive Signal defined
All programming completed.

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Smart Grid – Smart Investment

- $4.2 million WSU Smart Grid Project Cost
  - $1.8 million DOE Grant
  - $1.0 million Energy Savings
  - $618k Avista Rebates/Funds
  - $552k Commerce Job Act Grant
  - $256k Capital Funding

- $6.3 million - Other WSU Energy Projects
  - $3.7 million from Commerce Job Act Grants
  - $465k from Avista rebates

Future Goals: WSU Power Systems

- Expand 13.2kV system to eliminate 4.16kV
  - Improve knowledge of 4.16kV system operations
- Automate existing/future 13.2kV switching
  - Define cost-effective communications method
- Explore options for emergency/backup power
  - Eliminate most Generators if possible
- Investigate added switched Capacitor Banks
- Other?

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