Xcel's Synergi and DRIVE Demonstration for Hosting Capacity Webinar – June 2, 2020

TODAY'S AGENDA:

12:00 – 1:30

The first half of the Workshop (12:00 to 1:30) will be a demonstration that provides an in-depth look at how Xcel Energy uses the EPRI DRIVE tool and other software tools for its hosting capacity analysis (HCA).

30-minute Break (1:30 p.m. – 2:00 p.m.)

2:00 – 4:00

The second half of the Workshop will feature a representative from EPRI who will provide an overview of DRIVE and outline the three available methodologies

Presenters

Luther Miller, Xcel Energy - Distribution Planning Engineer

Matt Rylander, EPRI - Distribution Ops and Planning's Advanced Analytics Project Set Lead

Synergi and DRIVE Demonstration for Hosting Capacity

June 2, 2020

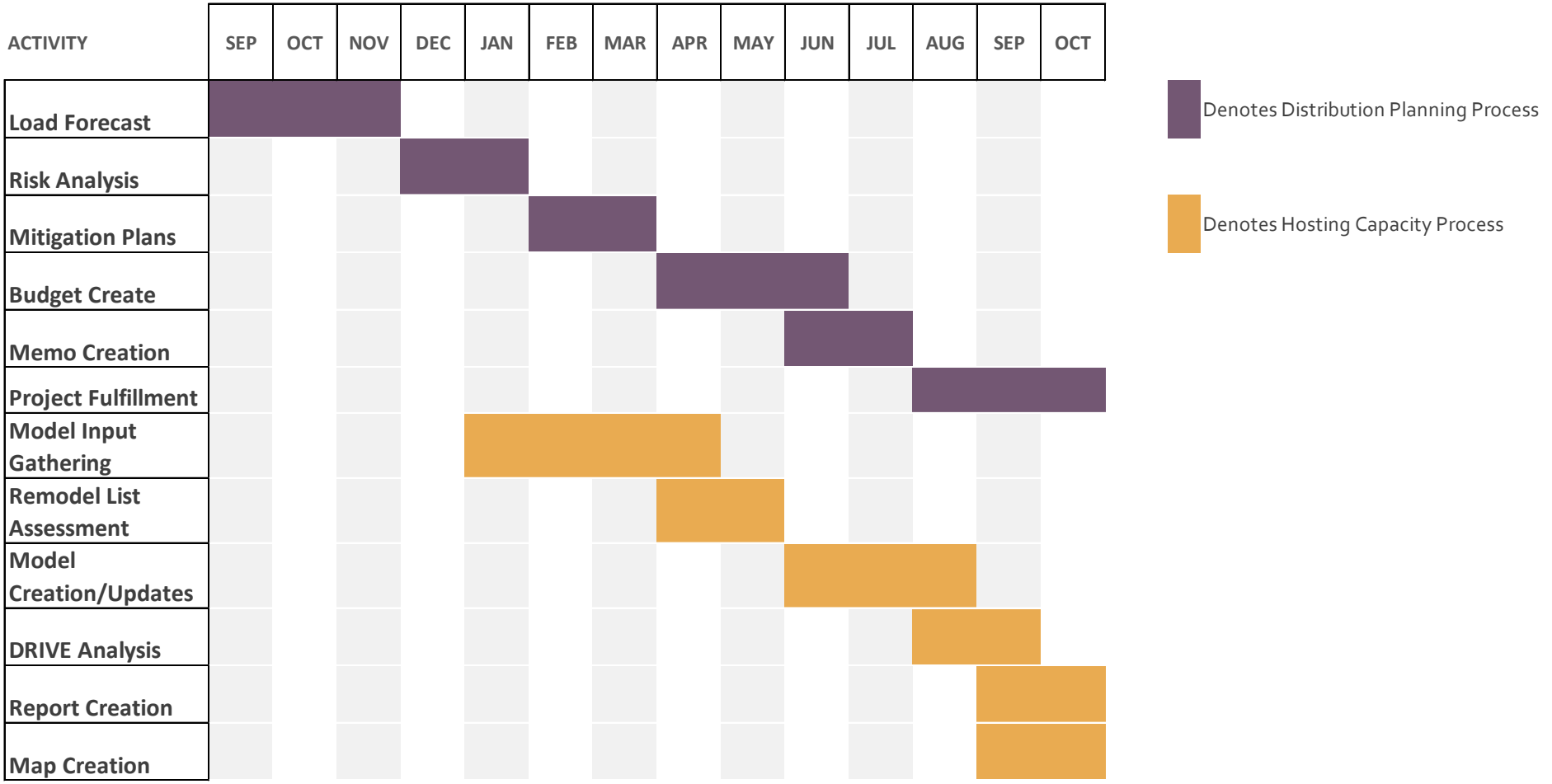
Hosting Capacity

- Xcel Energy filed its first Hosting Capacity Analysis (HCA) report in December 2016 and has continued to file HCA reports yearly with consistently updated features and accuracy
- The purpose of this demonstration is to provide a practical look at the full HCA process used by Xcel Energy in the Synergi tool and the Electric Power Research Institute (EPRI) Distribution Resource Integration and Value Estimation (DRIVE) tool.

Objectives

- Provide a practical demonstration of Synergi modeling and DRIVE analysis with respect to Hosting Capacity
- Examine additional functionality of the DRIVE tool

Distribution Planning and Hosting Capacity Process Timeline



History of DRIVE Usage and HCA

- 2015
  - Xcel Energy began working with EPRI in 2015 to begin the process of acquiring DRIVE as a tool for HCA
- 2016
  - Xcel Energy's first filed HCA
- 2017
  - Methodology changed to Large Centralized HCA in DRIVE
  - HCA heat map developed and implemented
- 2018
  - Reverse power flow was added as an analysis criteria
- 2019
  - HCA performed with actual daytime minimum loading and power factor information.
  - Unintentional islanding was added as an analysis criteria
  - Popup functionality in HCA map

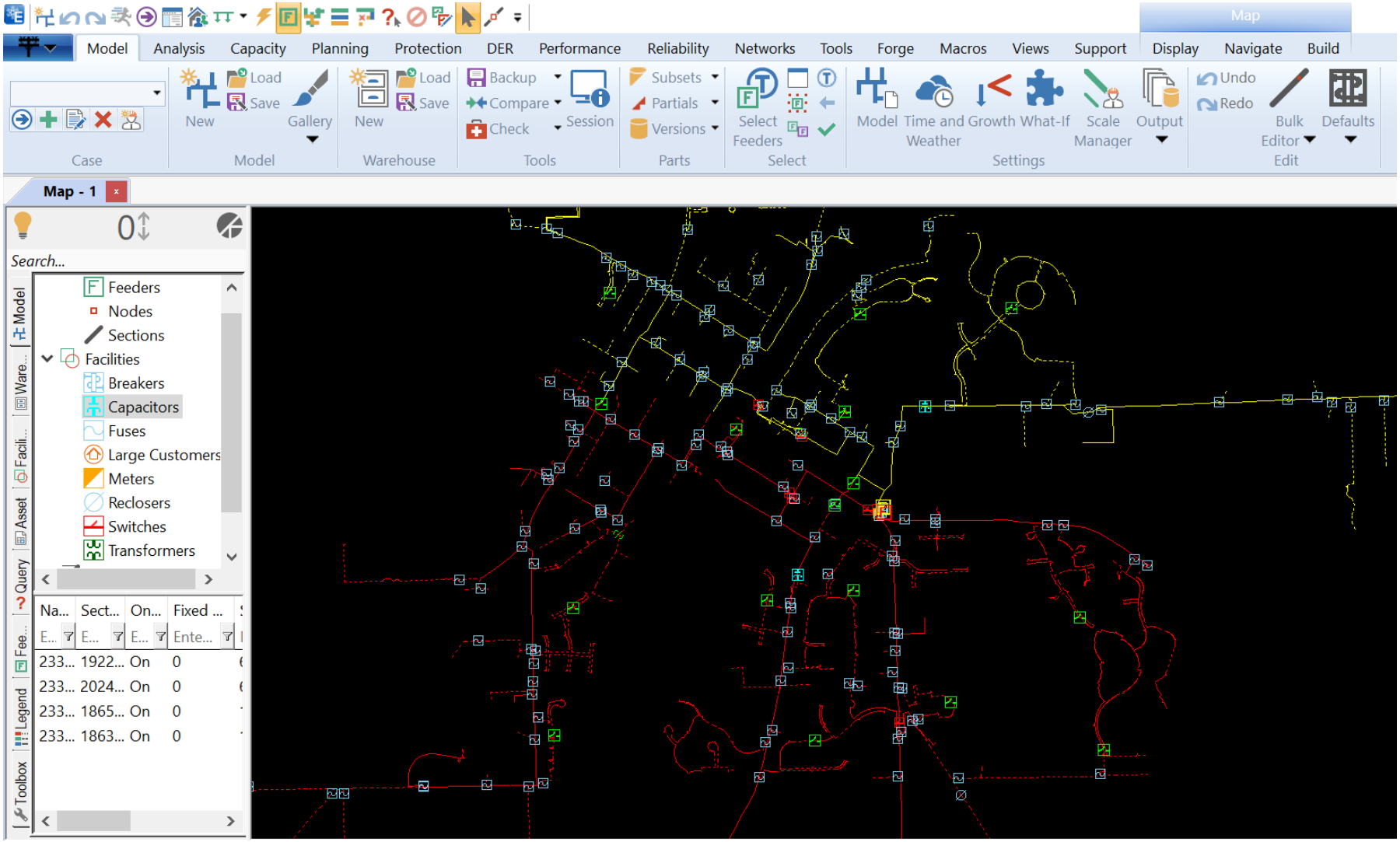
Inputs required for HCA

- GIS feeder model
- Forecasted peak load, amp balance and power factor
- Secondary customer billing data
- Primary customer and solar garden information
- Daytime minimum load

Synergi Model Creation Process

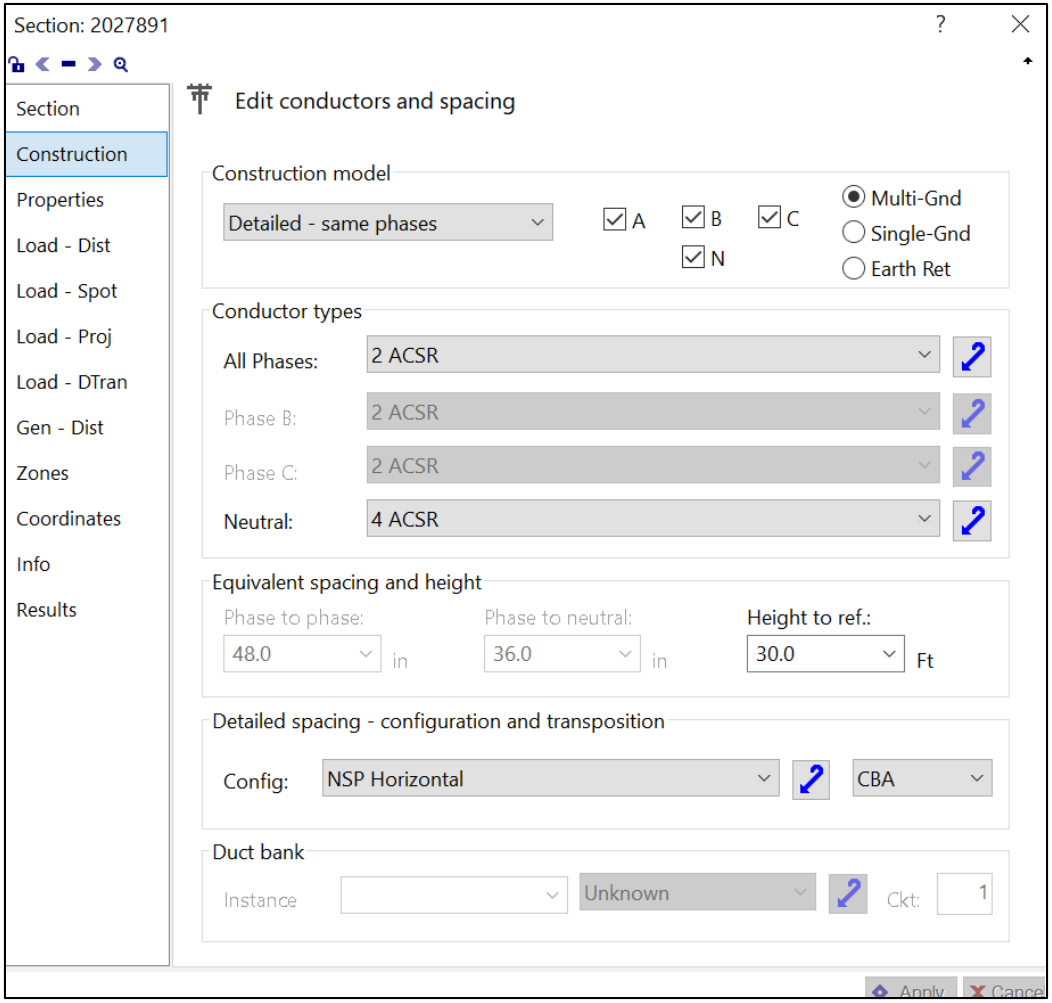
- Import feeder model from GIS
- Perform model cleanup
- Input forecasted loading, head-end impedance
- Import customer billing information and solar garden size/power factor
- Allocate load
- Perform load flow
- QA model

Model Creation and Cleanup



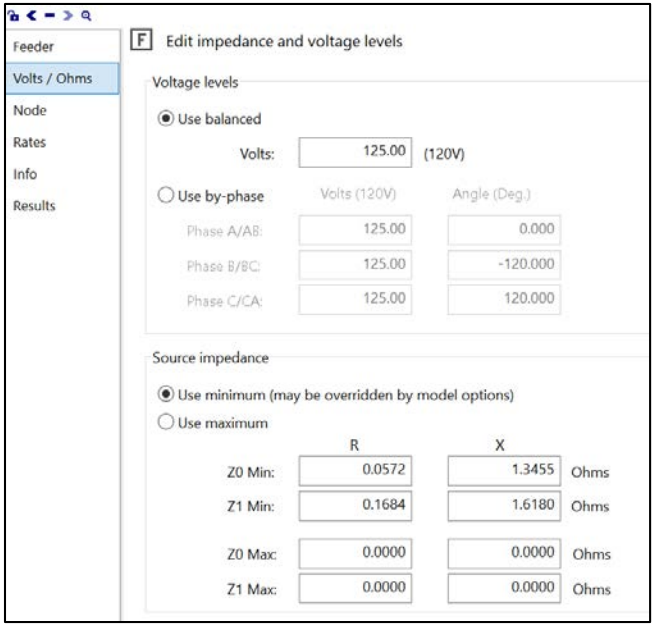
Model Creation and Cleanup

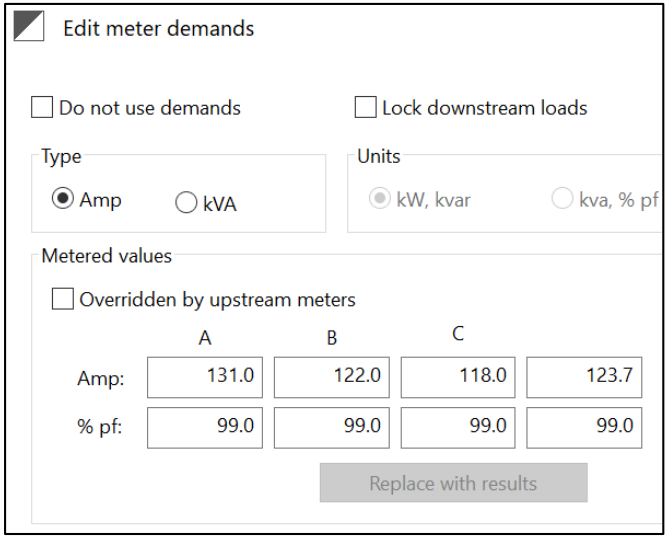
- Model is imported from GIS Database
- An automated cleanup script performs most of this work, but several facilities require further inspection
  - Conductor validation
  - Capacitor banks
  - Stepdown Transformers



Loading and Head-end Impedance

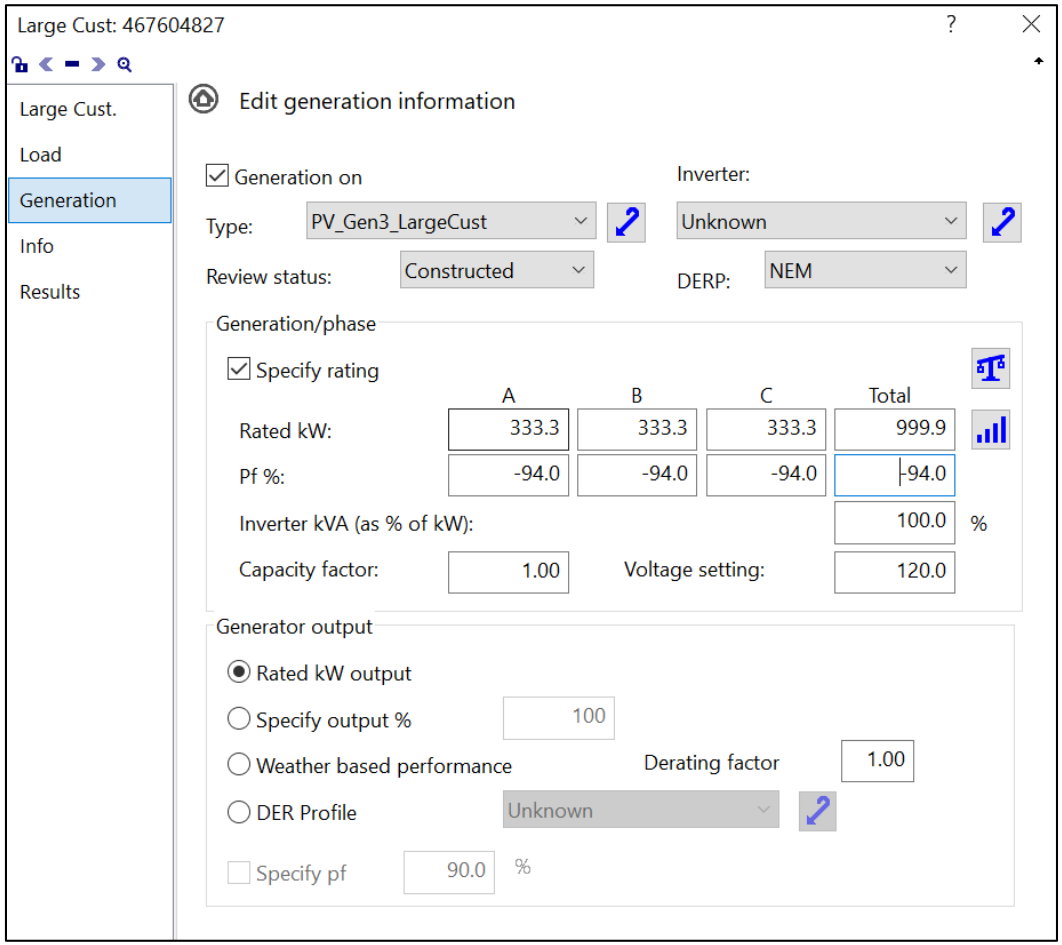
- Head-end impedance information is retrieved from an internal substation database
- Forecasted peak load data is gathered for each phase (when available) from Feeder SCADA and entered into the model's meter facility





Customer/DER Information

- **Customer metering data is imported through Synergi's CMM tool and assigned to the model's nodes/sections**
- **Primary customer and Solar Garden data is entered manually from Xcel Energy's records**



Load Allocation and Load Flow

- Load is allocated with peak load values entered in the feeder model, and distributed across the feeder based on customer metering information.
- DER is turned off for load allocation
- A load flow is performed to check for any exceptions such as low voltage, overloaded transformers and overloaded conductors
- DER is turned back on and another load flow is performed

Feeder Summary

Source Id	Exception Cnt	Exception Emr	Pct Ldg Cnt	Pct Ldg Emr	Demand kW	Demand kvar	Demand kVA	Demand pf	Amps Max	Amps % Imb	Amps Neut	Volts Avg	Connected c.Cust	Connected c.kVA	Load kW	Load kvar	Loss kW	Loss %	Generation Tot kW	Generation PV kW	Generation PV %
[redacted]	0	0	25.9	25.9	-1563	2246	2737	-57	113	3.14	12	125.00	1316	14266	-1594	2267	95	6.10	4765	4765	304.8
	4	4	36.9	36.9	4659	664	4706	99	202	11.11	32	125.00	1105	18454	4569	726	106	2.28	17	17	0.4
	4	4	N/A	N/A	3096	2910	4249	73	N/A	N/A	N/A	N/A	2421	32720	2976	2994	202	6.52	4782	4782	154.5

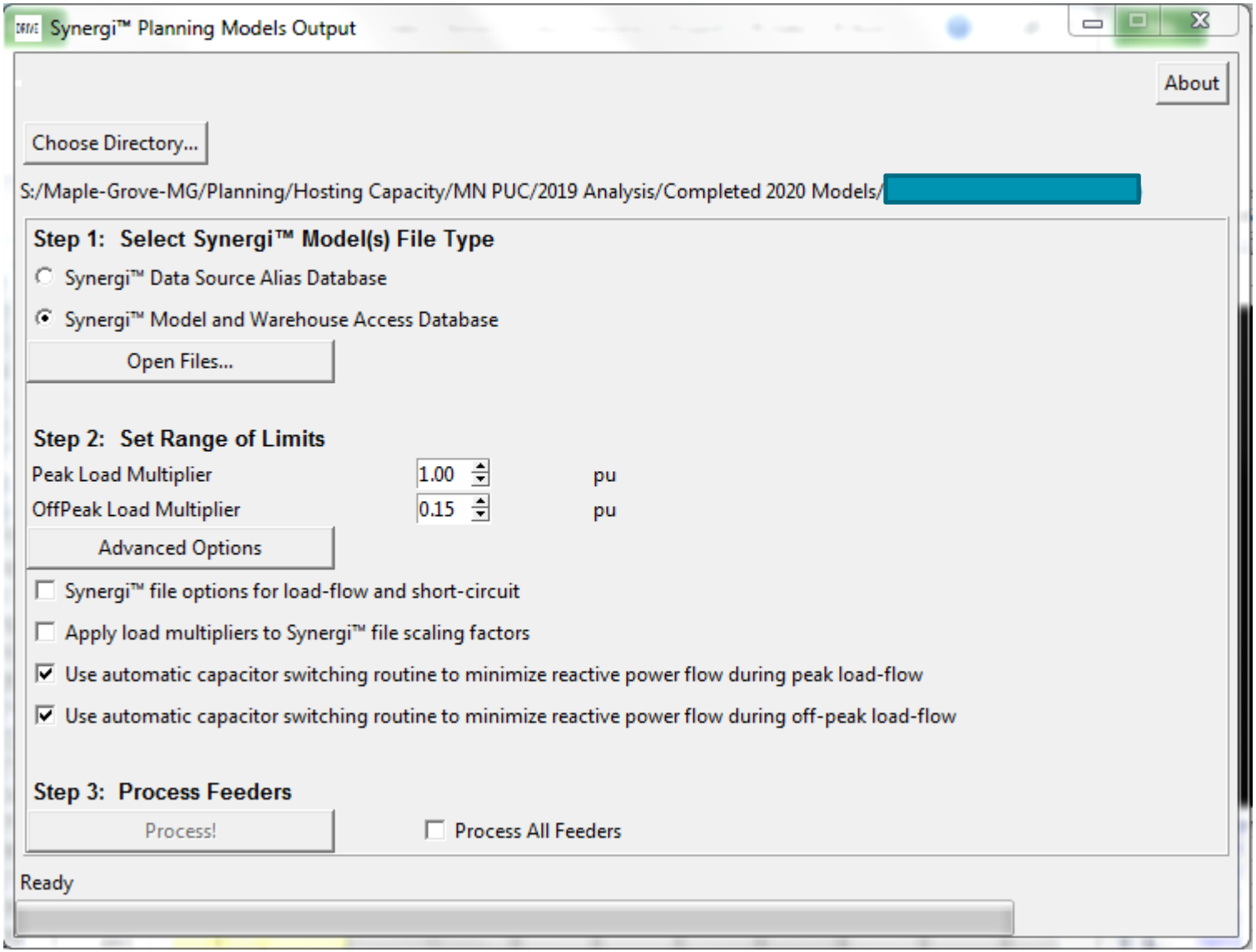
Additional functions of Synergi as used in HCA and Planning

- Queries
  - Allow sections of feeder to be highlighted and edited based on conductor type, proximity, etc.
- Building
  - Sections of conductor may be built out from an existing feeder, and equipment can be added to new sections
- Conditional Highlighting
  - Feeders may be highlighted with multiple color codes based on certain conditions such as loading or conductor type

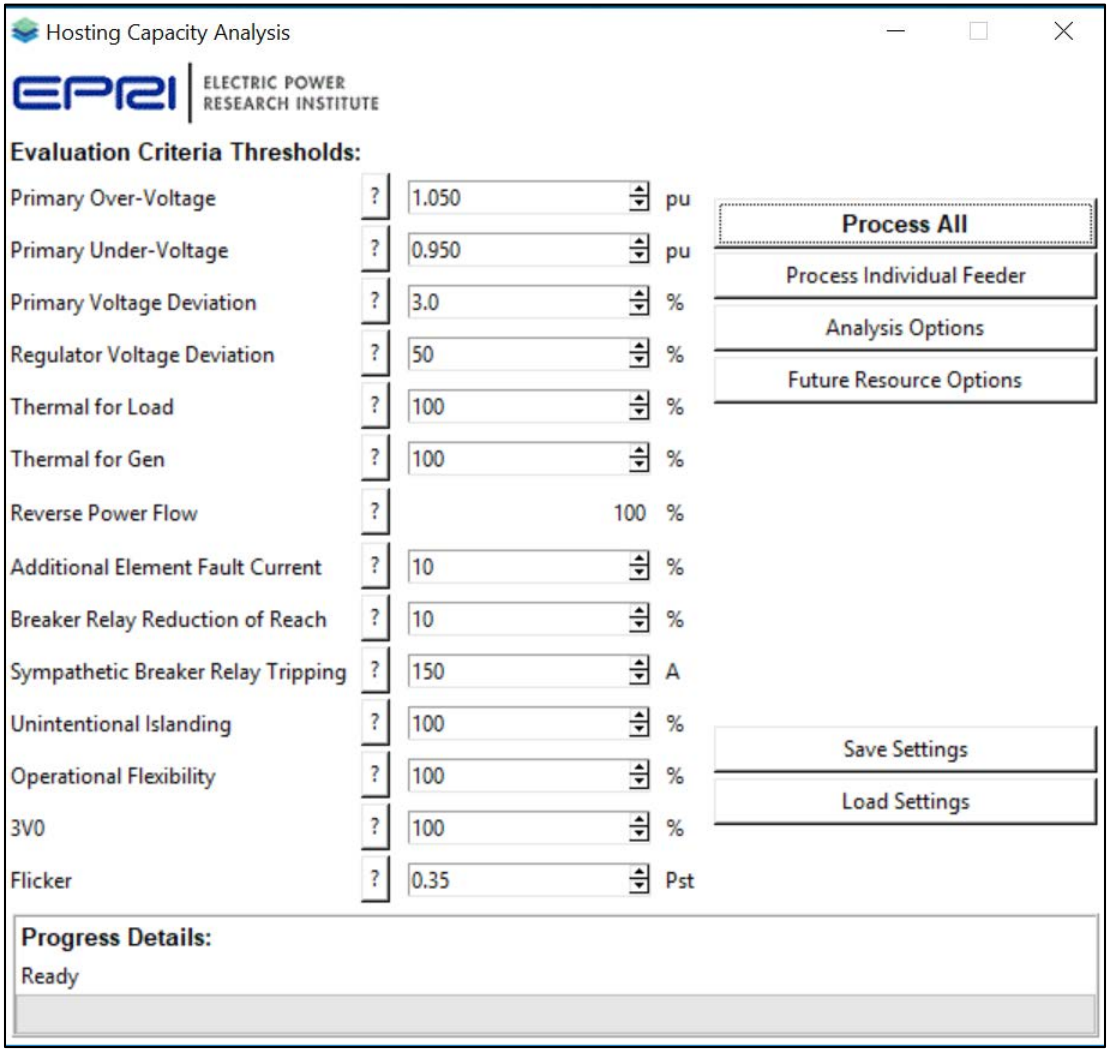
DRIVE Process

- Model A Interface (DRIVE MAI)
  - Load Synergi model
  - Assign off-peak load percentage (based on DML)
  - Convert Synergi model to DRIVE input files
- DRIVE
  - Select input folder/files
  - Load threshold and analysis settings
  - Perform analysis
  - QA Hosting Capacity Analysis and download summary file

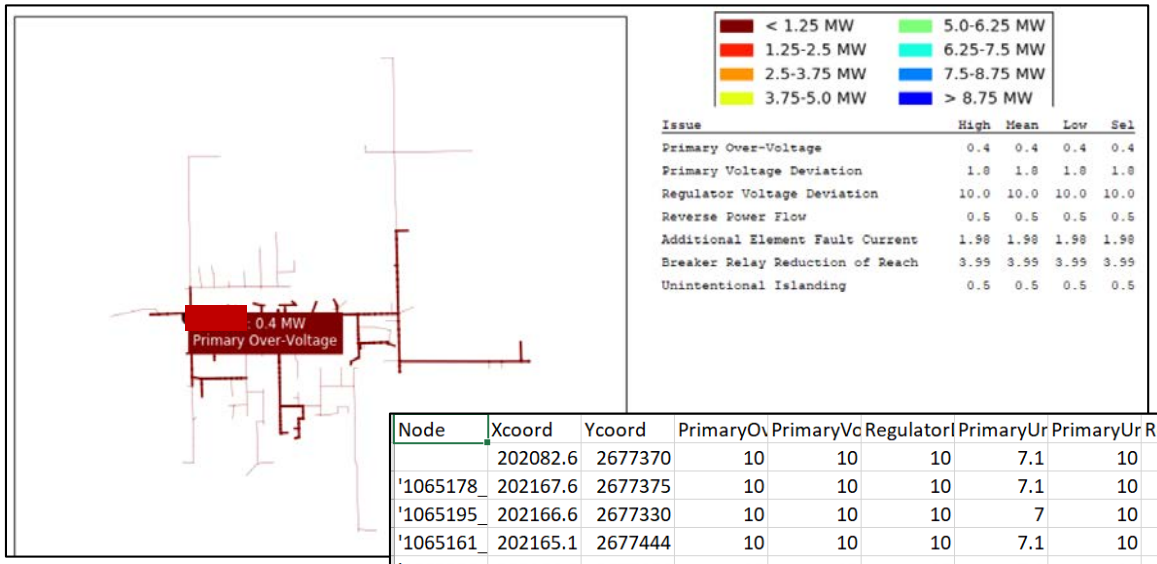
DRIVE MAI


Synergi™ Planning Models Output
About
Choose Directory...
S:/Maple-Grove-MG/Planning/Hosting Capacity/MN PUC/2019 Analysis/Completed 2020 Models/
Step 1: Select Synergi™ Model(s) File Type
Synergi™ Data Source Alias Database
Synergi™ Model and Warehouse Access Database
Open Files...
Step 2: Set Range of Limits
Peak Load Multiplier
1.00
pu
OffPeak Load Multiplier
0.15
pu
Advanced Options
Synergi™ file options for load-flow and short-circuit
Apply load multipliers to Synergi™ file scaling factors
Use automatic capacitor switching routine to minimize reactive power flow during peak load-flow
Use automatic capacitor switching routine to minimize reactive power flow during off-peak load-flow
Step 3: Process Feeders
Process!
Process All Feeders
Ready

DRIVE Hosting Capacity Interface



DRIVE Hosting Capacity Results



Issue	High	Mean	Low	Sel
Primary Over-Voltage	0.4	0.4	0.4	0.4
Primary Voltage Deviation	1.0	1.0	1.0	1.0
Regulator Voltage Deviation	10.0	10.0	10.0	10.0
Reverse Power Flow	0.5	0.5	0.5	0.5
Additional Element Fault Current	1.98	1.98	1.98	1.98
Breaker Relay Reduction of Reach	3.99	3.99	3.99	3.99
Unintentional Islanding	0.5	0.5	0.5	0.5

Node	Xcoord	Ycoord	PrimaryOv	PrimaryVc	RegulatorI	PrimaryUr	PrimaryUr	ReversePc	ThermalCl	ThermalD	Unintentic	ElementFa	BreakerRe	Sympathe
	202082.6	2677370	10	10	10	7.1	10	0.5	4.4	7.4	0.5	5.09	3.99	10
'1065178_	202167.6	2677375	10	10	10	7.1	10	0.5	4.4	7.4	0.5	5.06	3.99	10
'1065195_	202166.6	2677330	10	10	10	7	10	0.5	4.4	7.4	0.5	5.05	3.99	10
'1065161_	202165.1	2677444	10	10	10	7.1	10	0.5	4.4	7.4	0.5	5.02	3.99	10
'1062356_	202164.6	2677464	10	10	10	7.1	10	0.5	4.4	7.4	0.5	5.02	3.99	10
'1062430_	202098.3	2677487	10	10	10	7.1	10	0.5	4.4	7.4	0.5	5	3.99	10
'13031990	201967.2	2677481	10	10	10	7.1	10	0.5	4.4	7.4	0.5	4.97	3.99	10
'13032001	201968.8	2677445	10	10	10	7.1	10	0.5	4.4	7.4	0.5	4.96	3.99	10
'1062375_	202170.3	2677143	10	10	10	7	10	0.5	4.4	7.4	0.5	4.98	3.99	10
'13032047	201968.9	2677441	10	10	10	7.1	10	0.5	4.4	7.4	0.5	4.96	3.99	10
'13032003	201971.4	2677381	10	10	10	7.1	10	0.5	4.4	7.4	0.5	4.95	3.99	10
'13032037	201934.4	2677480	10	10	10	7.1	10	0.5	3.1	3.1	0.5	4.95	3.99	10
'68291948	202160.8	2677631	10	10	10	7.1	10	0.5	4.4	5.5	0.5	4.95	3.99	10
'1065588_	202256	2677332	10	10	10	6.8	10	0.5	1.4	3.7	0.5	5.01	3.99	10
'1062322_	202157.6	2677800	10	10	10	7.1	10	0.5	4.4	5.5	0.5	4.89	3.99	10
'1062376_	202174.2	2676934	10	10	10	7	10	0.5	2.4	3	0.5	4.89	3.99	10
'1062447_	201793.6	2677475	10	10	10	7.1	10	0.5	1.3	1.3	0.5	4.88	3.99	10
'1065589_	202356.8	2677334	10	10	10	6.6	10	0.5	1.4	3.7	0.5	4.96	3.99	10
'1062321	202154.5	2677958	10	10	10	7.1	10	0.5	4.4	5.5	0.5	4.83	3.99	10

Functions of DRIVE

- Hosting Capacity for Load or Generation
- Hosting Capacity Analysis with Autonomous Smart Inverters
- Hosting Capacity with N-1 switching
- Mitigation Assessment

Thank you for listening.

Are there any Questions?

30-MINUTE BREAK

1:25 p.m. – 1:55 p.m.