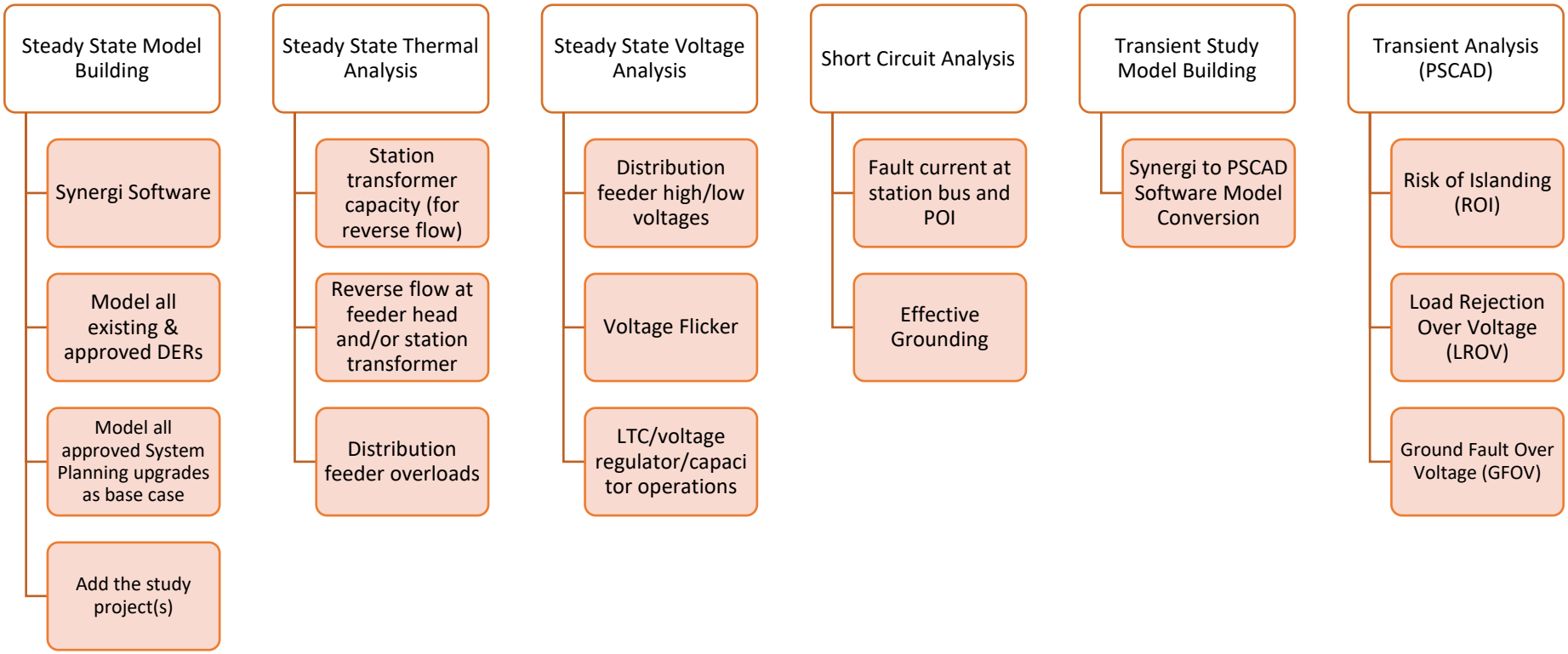
Steady State and Dynamic Studies for DER Projects

Massachusetts Technical Standards Review Group (TSRG)

Eversource MA DER Planning

December 1, 2021

DER System Impact Study Overview



Reverse Flow (Feeder Level & Substation Level)

Distribution Line Equipment

- Overhead line regulators
- Back feed through line regulators requires upgrades- cogeneration settings often requiring new hardware and software

Substation Equipment

- Substation transformers and LTCs
  - Additionally, substation engineering must validate that existing LTC hardware can support back-feed
- Protection System Upgrades
  - 3V0 protection may be required when back feed occurs from distribution

High & Low Voltages and Load Flow

- Utilize Synergi Electric for Steady-State load flow analysis
- Must ensure that no DERs cause any Safety & Reliability issue on our system
- Must ensure the DER customer does not adversely impact voltage or power quality to customers
  - Voltages must remain within the ANSI Standard +/- 5% per unit
  - Flicker cannot exceed 2% for PV arrays
- Thermal Overloads

High & Low Voltages and Load Flow- cont'd

- Model all applicable steady state scenarios
  - Peak, off-peak, night-time minimum (non-PV generation)
- Model appropriate generation interactions based on technology type and relative location

Protection & Fault Analysis

- Ensure DER maintains fault current and duties to specified equipment rating
- Ensure DER does not contribute more than 10% of the maximum fault current on the distribution feeder
- Effective Grounding
- Results reviewed and approved by P&C as appropriate

Dynamic Study

Can only be started once the Steady-State results are achieved

- Currently there is no automation between Synergi Electric and PSCAD Softwares
- A manual build of the PSCAD circuit file is required by extracting the data from the whole feeder
- Upload of all existing DERs PSCAD file
- Upload the Customer provided PSCAD models of the DERs

Risk of Islanding & Transient Over-Voltage Studies

Common Mitigations:

- ROI: Installation of DTT
- TOV: Inverter SPOV, Grounding changes, Surge Arrestors

Risk of Unintentional Islanding

- Unintentional Islanding is when a DER can feed a local area after a utility source is tripped
- Unintentional Islanding poses a risk to damaging not only customer equipment but also poses a Safety & Reliability issue
- Islanding risk increases when rotating machines are present and when load balancing can occur
- Direct transfer trip (DTT) or Dynamic Study is required if the ROI screens fail
- Additional screens exist to limit the use of DTT
- Some inverter feedback schemes work better than others at detecting potential islands
- DERs must adhere to IEEE 1547-2018 Section 6.2.2 Islanding requirements

Transient Analysis

- Transient analysis is triggered when there is high DG/load ratio
  - Load rejection overvoltage
  - Ground fault overvoltage
- DERs must adhere to the IEEE 1547-2018 Section 7.4.2 TOV requirements

Common Mitigations

High/Low Voltage

- Capacitors, Reconductoring, Off-Unity Operation

Thermal Limits

- Reconductoring, Load Transfers

Reverse Power Flow

- New LTC Controller, Line Regulator, 3V0 Protection

Transient Overvoltage

- Grounding, SPOV, Surge Arrestors

DER Impact Studies Review Process

Substation Engineering Review

- Reverse Power Flow Analysis
- Substation Transformer Loading
- 3V0
- Substation Voltage Regulation (LTC tap change)

Protection & Control Review

- Fault Current Evaluation/Screen
- Effective Grounding
- Risk of Unintentional Islanding/DTT

Distribution Engineering Review

- Voltage Evaluation
- Thermal Analysis
- Output Drop Assessment (Flicker, LTC/Regulators tap movements)

Cost Estimation Approval Process

Several Approval Committee(s)

- Massachusetts Project Approval Committee (MPAC)
- Solution Design Committee (SDC)
- Eversource Project Approval Committee (EPAC)

Questions