Identifying Best Mitigation Options for Higher PV Penetration in New York Distribution Grid

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Distribution Impact of PV Integration

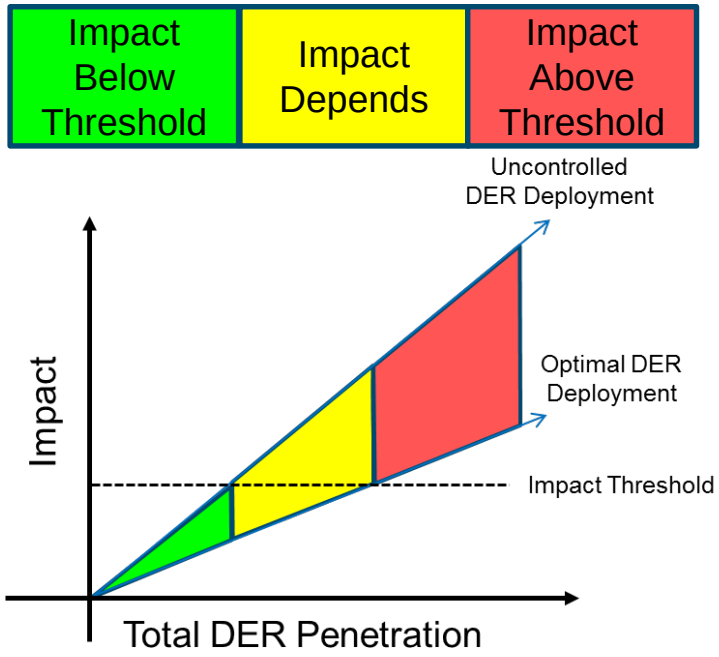
- PV size and location
- Feeder design and operation

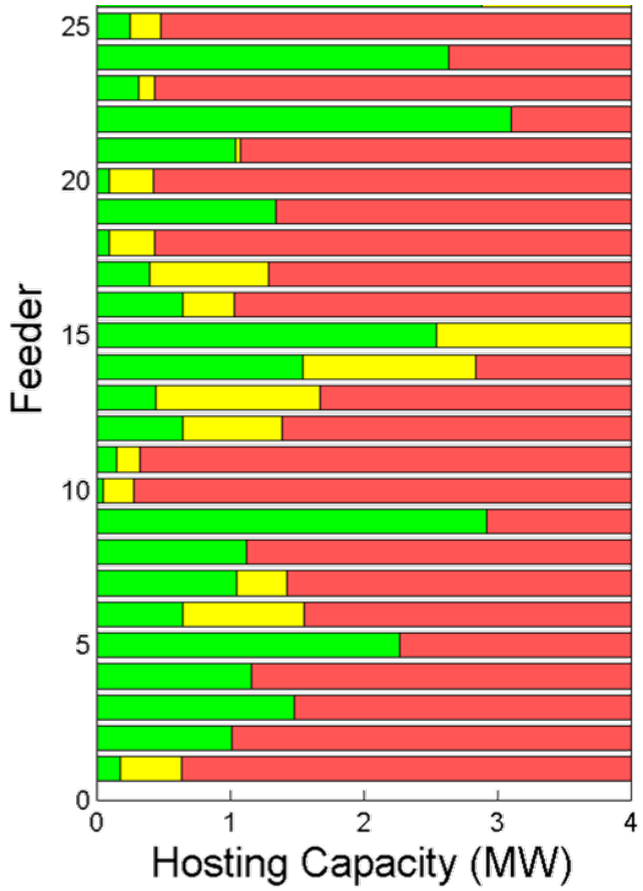
There are limitations on existing grid for hosting PV !

Voltage

Protection coordination

Thermal capacity





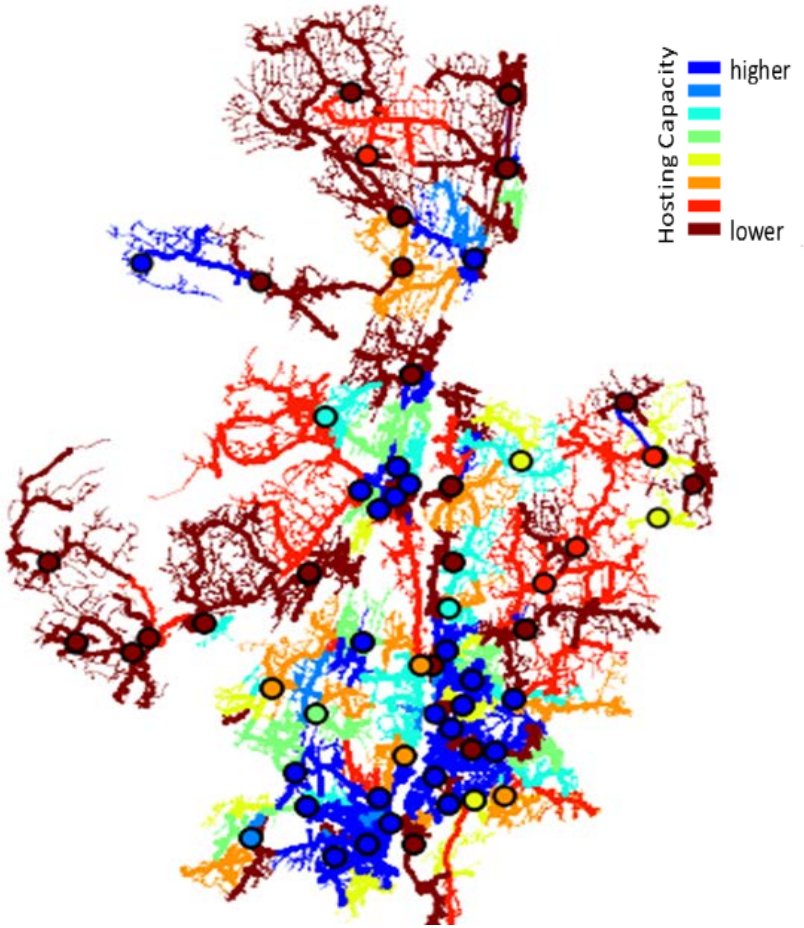
DER Impacts

DER Size and Location

Feeder Design and Operation

New York Utilities Need

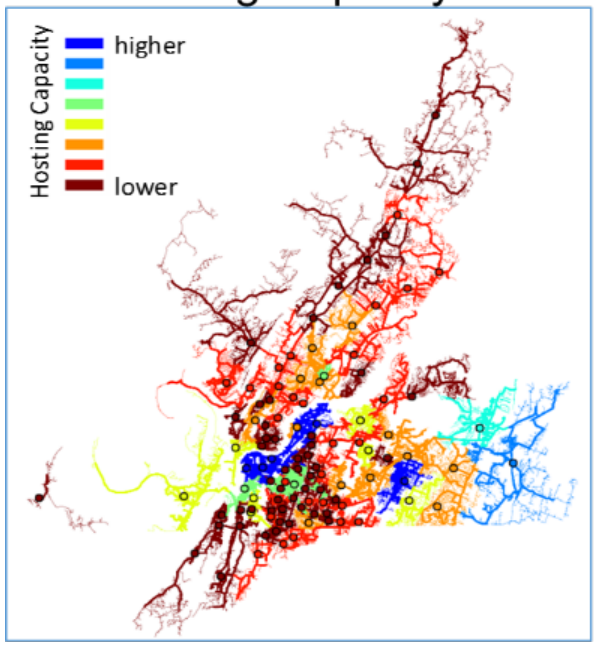
- Goal:
  - Meeting certain renewables targets and increasing the amount of PV the distribution system can host
- Utilities Need
  - Methods and tools to enable consideration of integration solutions to increase hosting capacity



Hosting capacity map
for PV integration

Integration Solutions Can Increase Hosting Capacity

Existing Hosting Capacity

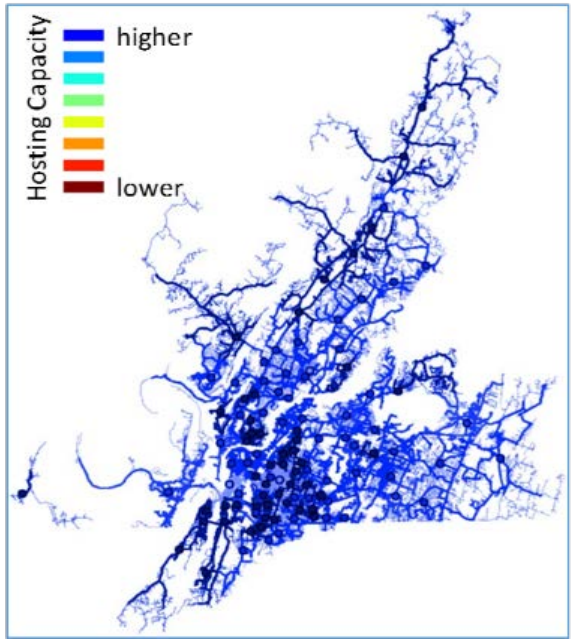


Suite of Integration Solutions

	Mitigation Solution	Hosting Capacity Violation: Voltage	Thermal	Protection
Grid-Side Enhancements	Reconductoring			
	Voltage uprating			
	Transformer replacement			
	Additional voltage regulator			
	Comm/control (curtailment)			
	Additional relaying			
Operational Changes	Voltage regulation changes (LTC adjustment, etc.)			
	Relay setting modification			
Technology Solutions	Smart Inverter (var control)			
	Smart Inverter (watt control)			
	Distributed var control			
	Energy storage			
	PV panel orientation			
	Demand response			

Yes | No | Maybe

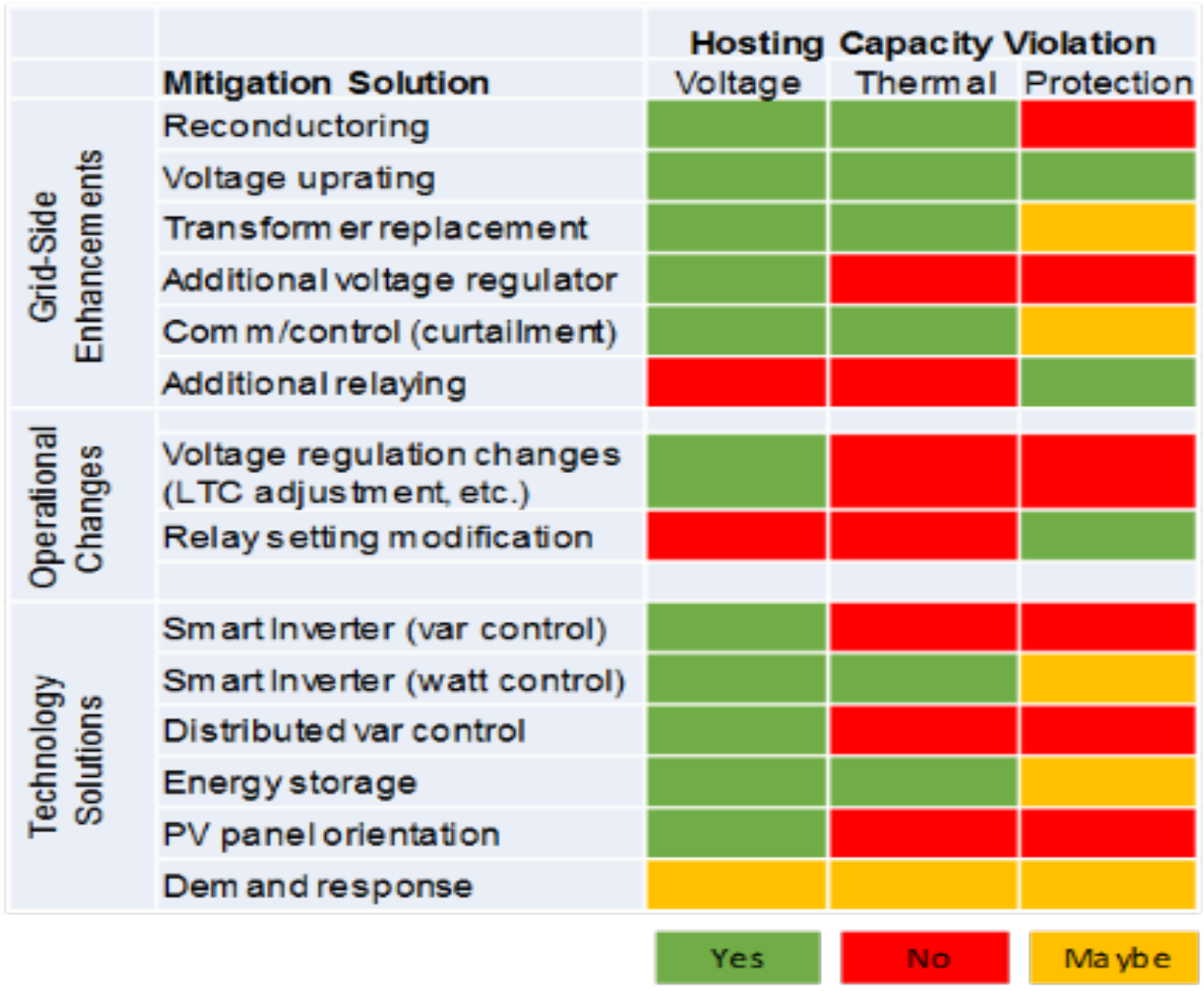
Increased Hosting Capacity After Integration Solutions



A suite of integration solutions needs to be considered

- Mitigation solutions vary within the feeder and across the system
- A single solution/technology may not resolve all power system criteria issues

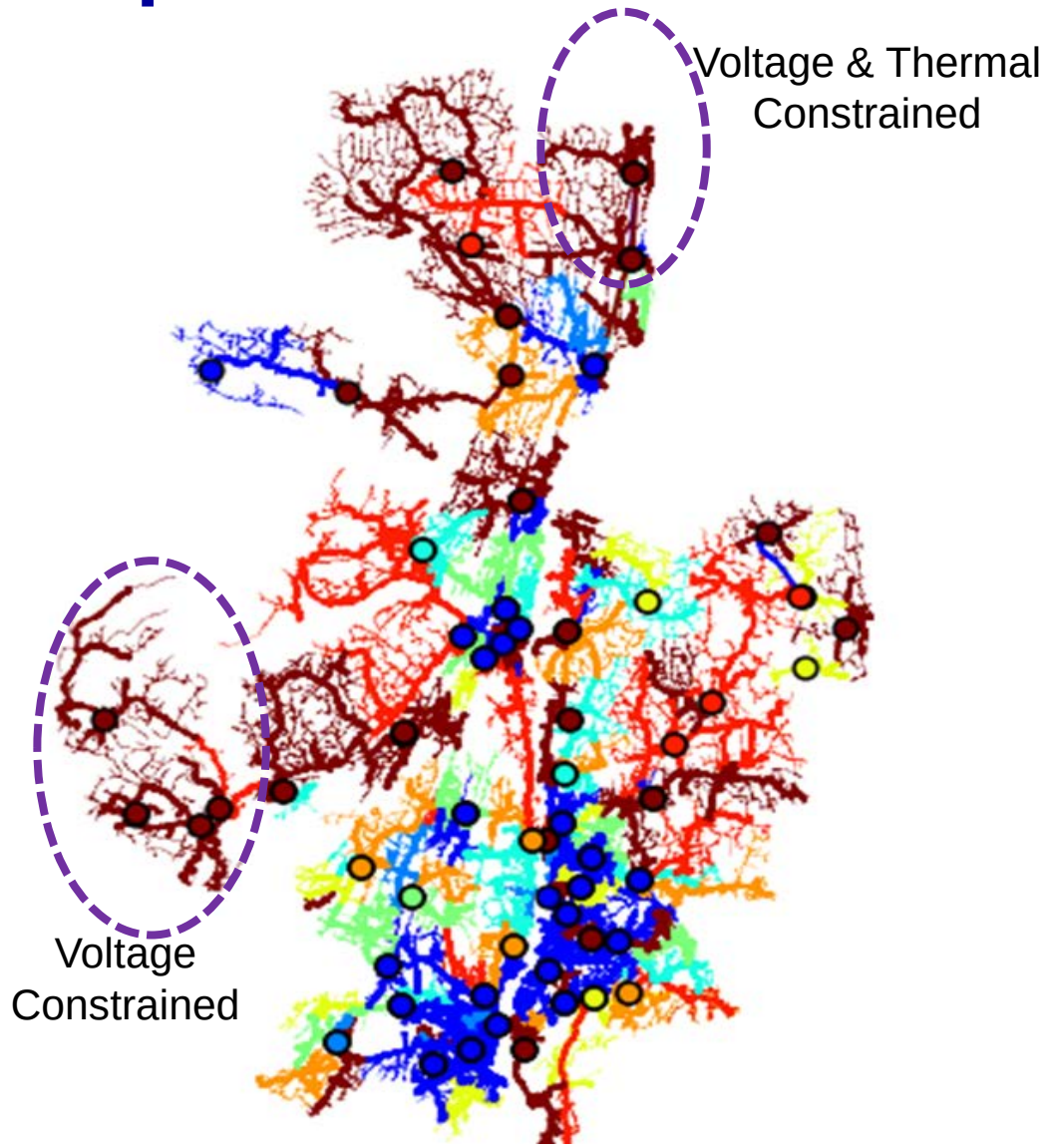
Mitigation Solutions



- Grid-side Enhancements
  - Adding/upgrading equipment
- Operational Changes
  - Adjusting existing equipment settings
- Technology Solutions
  - Determining appropriate control settings

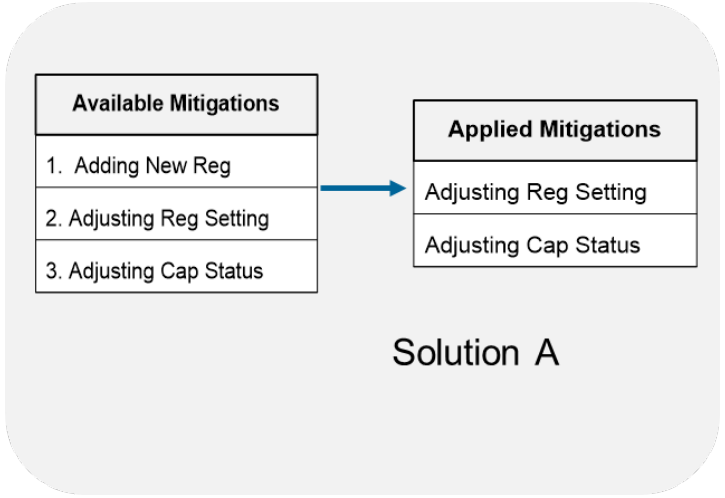
Integration Solutions Are Situation Specific

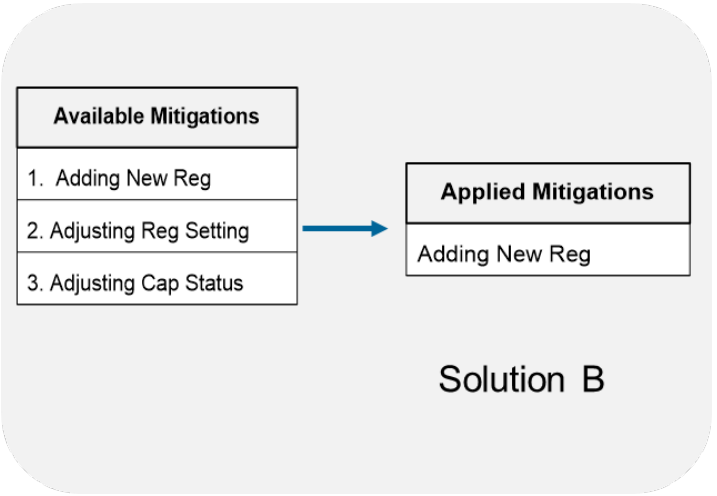
- The most effective and least-cost PV integration solutions are unique to:
  - where the PV is located
  - the impacted power system criteria
  - specific distribution system design and operating parameters
  - integration target
  - specific DER characteristics



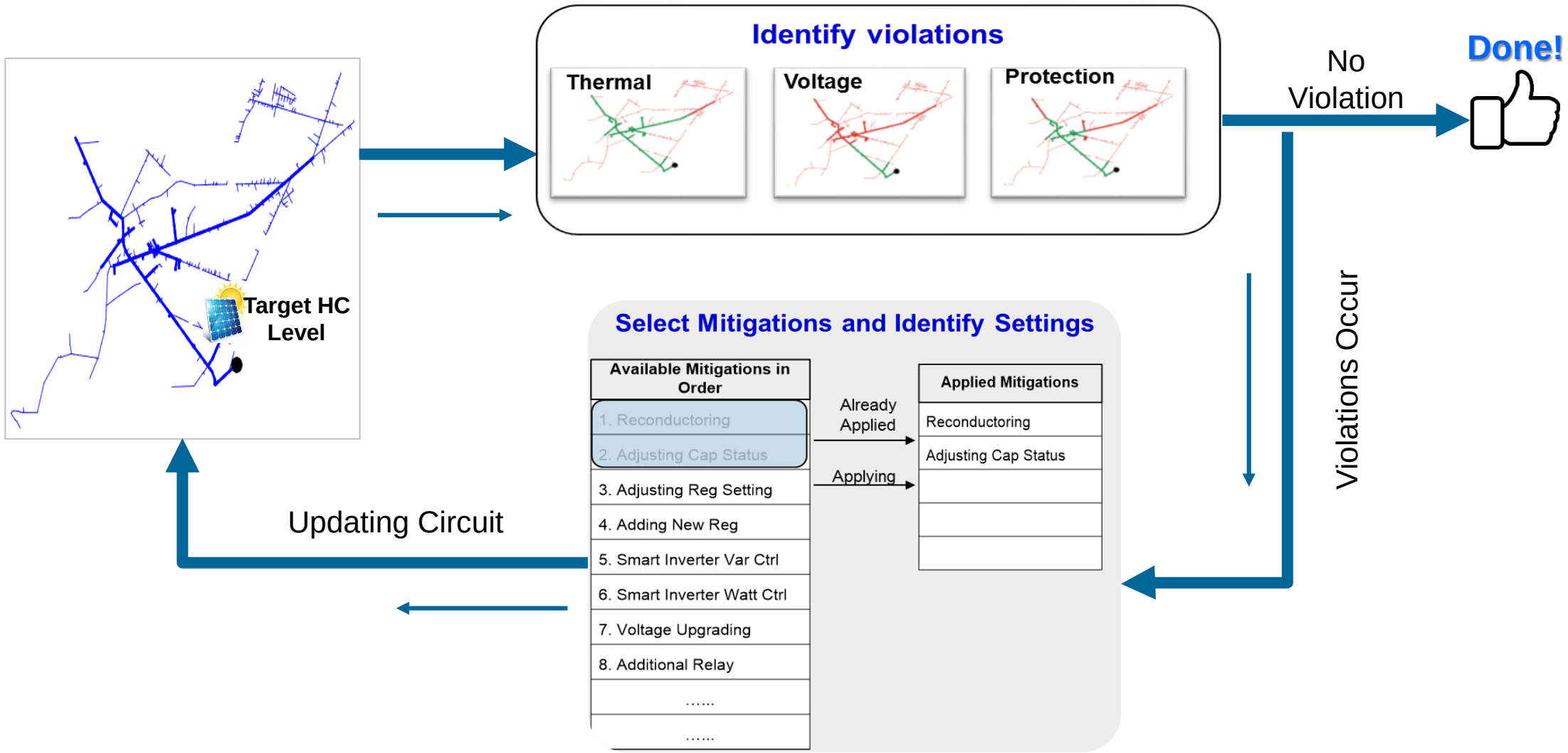
Identifying Cost Effective Integration Solution

- The most effective and least-cost solution is identified from potential solutions
  - A power system issue could have more than one solution or mixture of solutions.
  - Combining low cost solutions may be cost effective than solely relying on a single high cost solution.

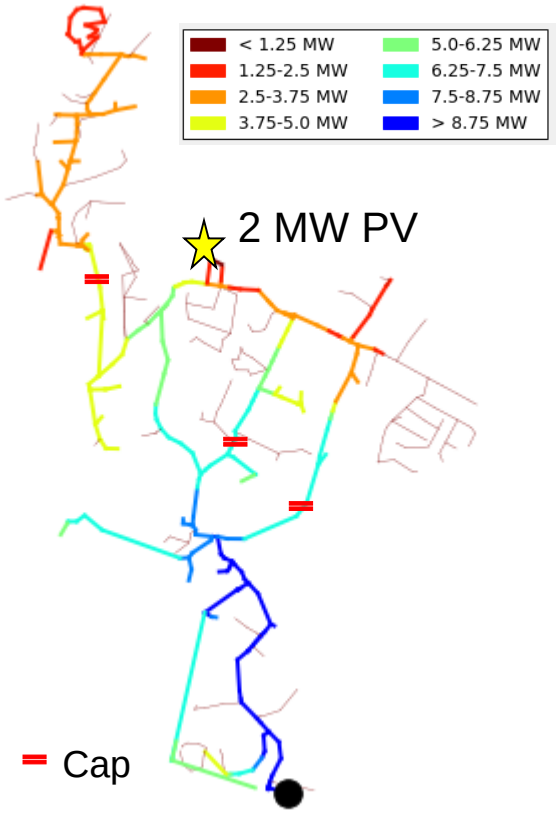




Mitigation Automation Process



Grid-side Mitigation Example:

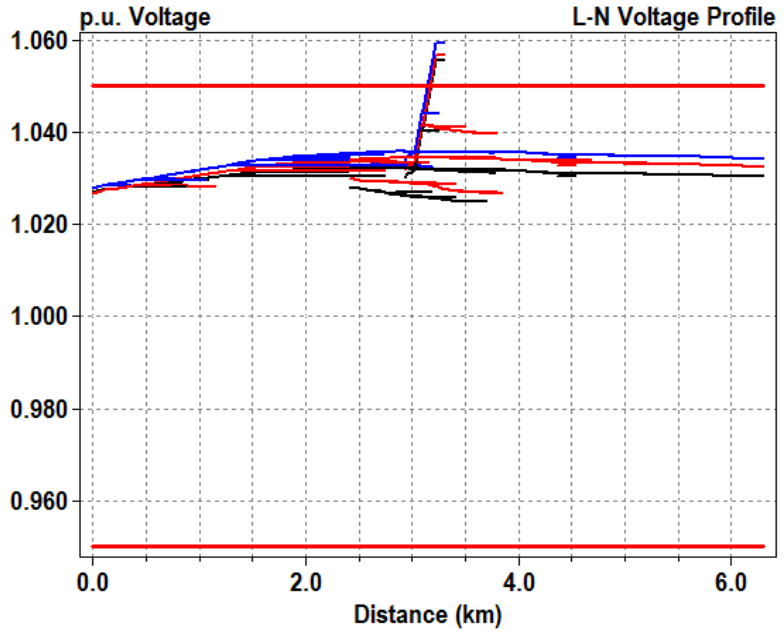


Hosting capacity map on overvoltage

Feeder Characteristics

kV	Peak Load (MW)	Min Load (MW)	Cap (kvar)	Regulator
13.2&4.2	3.7	1.0	300/600/600	123V, feeder head

Overvoltage occurs in minimum load with PV

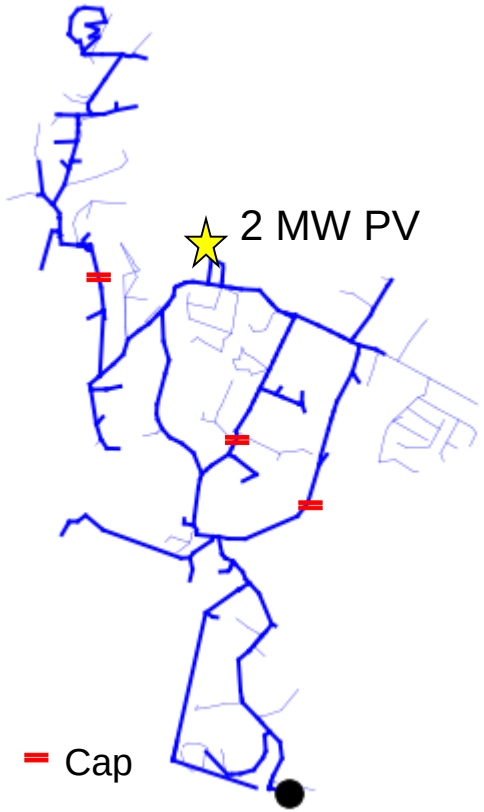


Voltage profile in minimum load with PV

Solution A – Adjusting Capacitor Banks Status

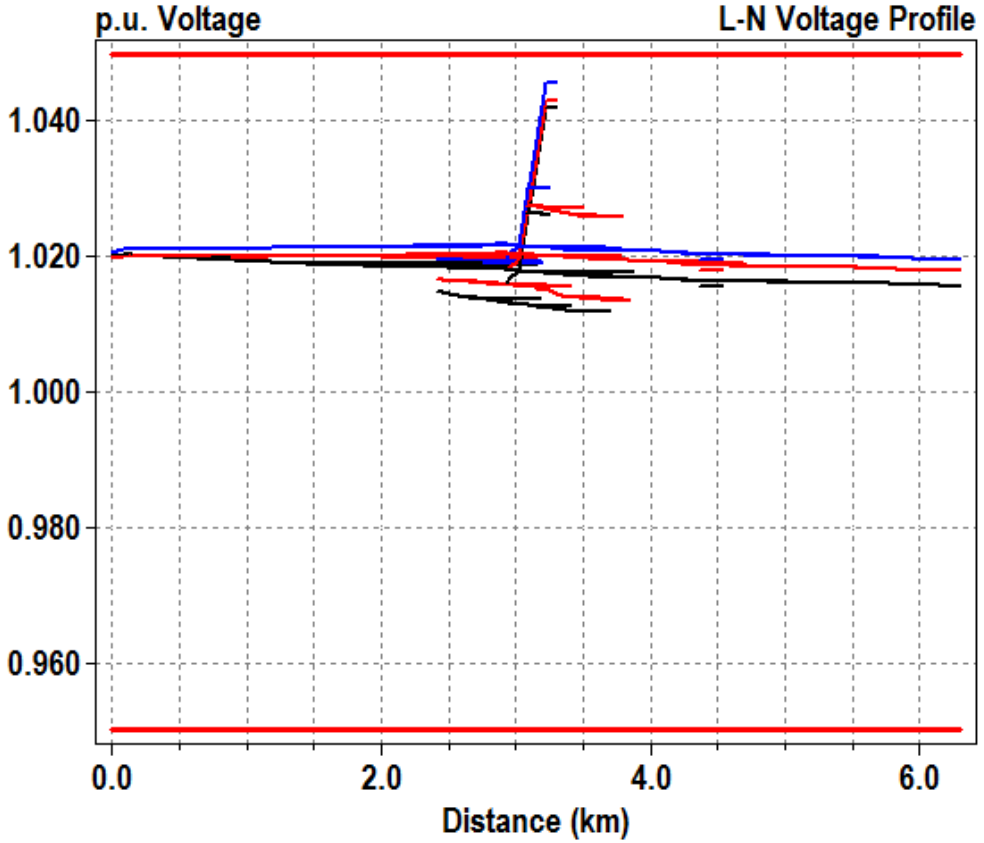
Solutions

Caps are switched off in min load until no overvoltage violations



Three caps are switched off

Voltage Results

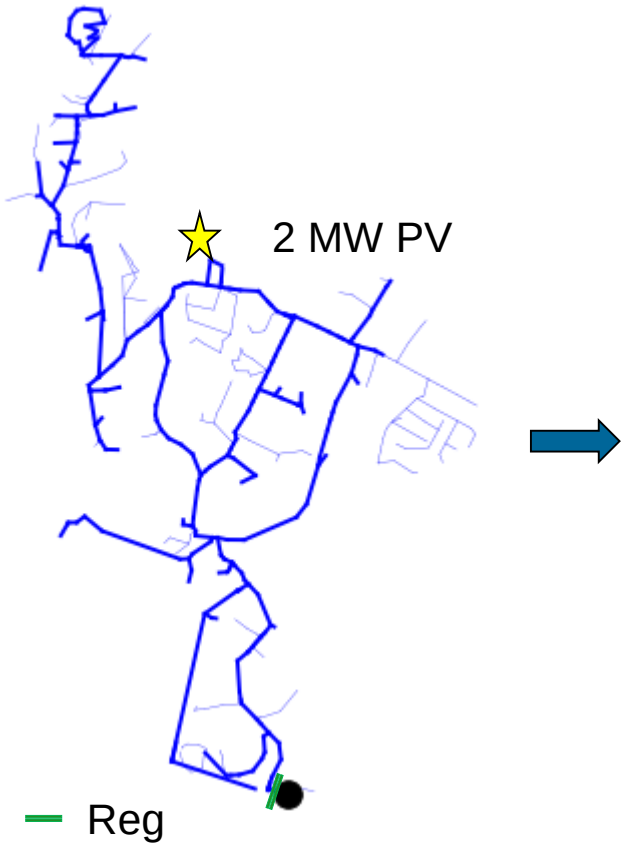


Voltage profile in minimum load with PV

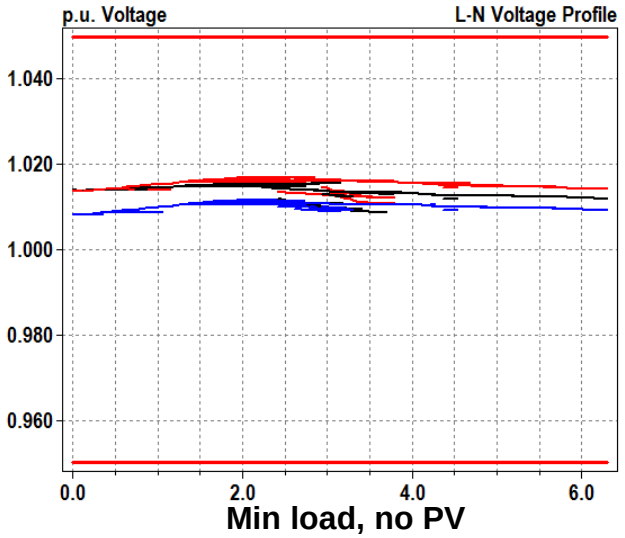
Solution B – Adjusting Regulator Setting

Solutions

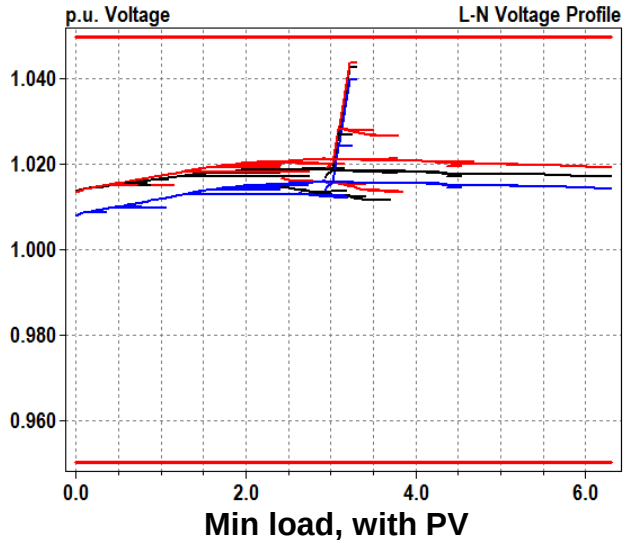
Regulator 123 V setpoint is adjusted to 121 V



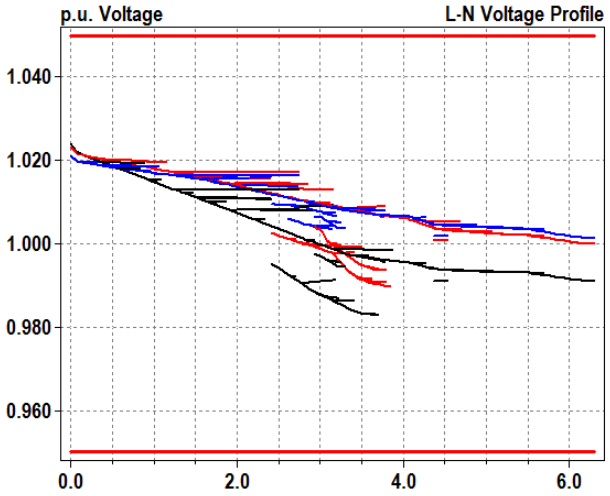
Voltage Results



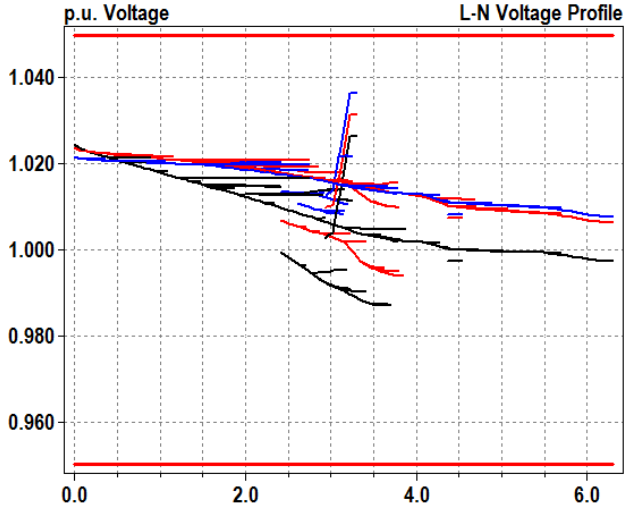
Min load, no PV



Min load, with PV



Max load, no PV

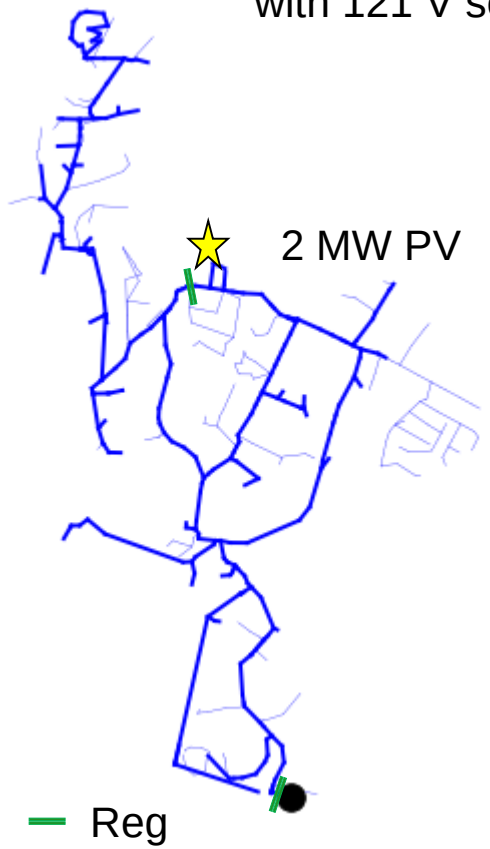


Max load, with PV

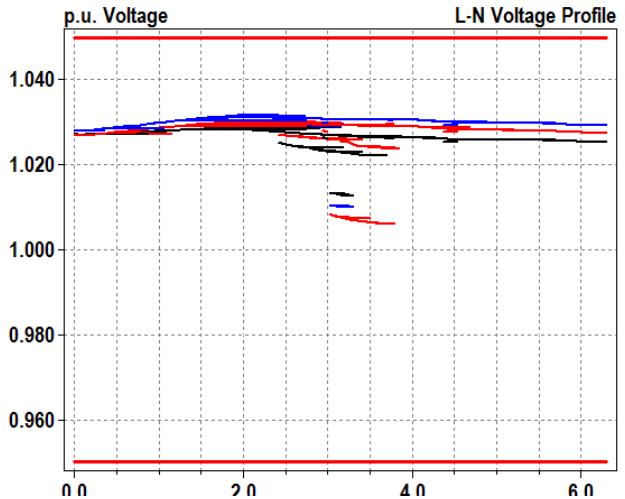
Solution C – Adding Additional Regulator

Solutions

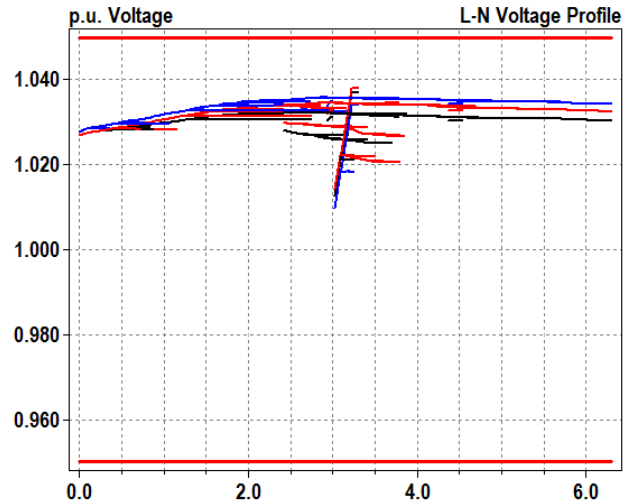
New regulator is added with 121 V setpoint



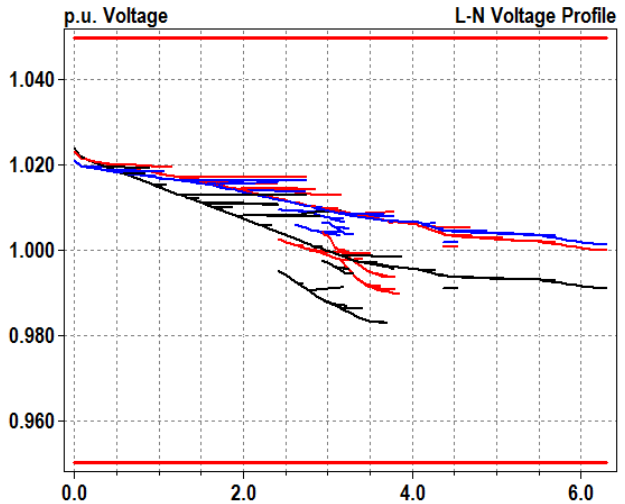
Voltage Results



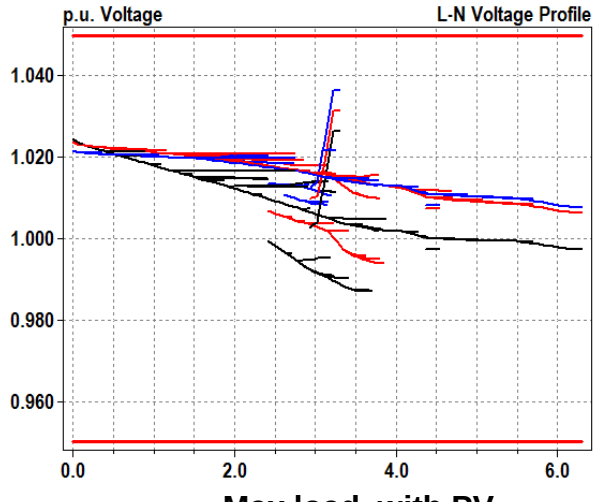
Min load, no PV



Min load, with PV



Max load, no PV



Max load, with PV

Summary

- PV integration solutions for increasing hosting capacity can be situation-specific.
- A suite of integration solutions needs to be considered.
- The methods and tools developed in this project would allow planners and engineers to evaluate both wires and non-wires alternatives to increase distribution hosting capacity.

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