QUANTA TECHNOLOGY

DER Gateway to Support Real-Time Control and Situational Awareness in Distribution Grids

April 12, 2022

Project Team

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NEW YORK STATE OF OPPORTUNITY. NYSERDA

VR ENERGY

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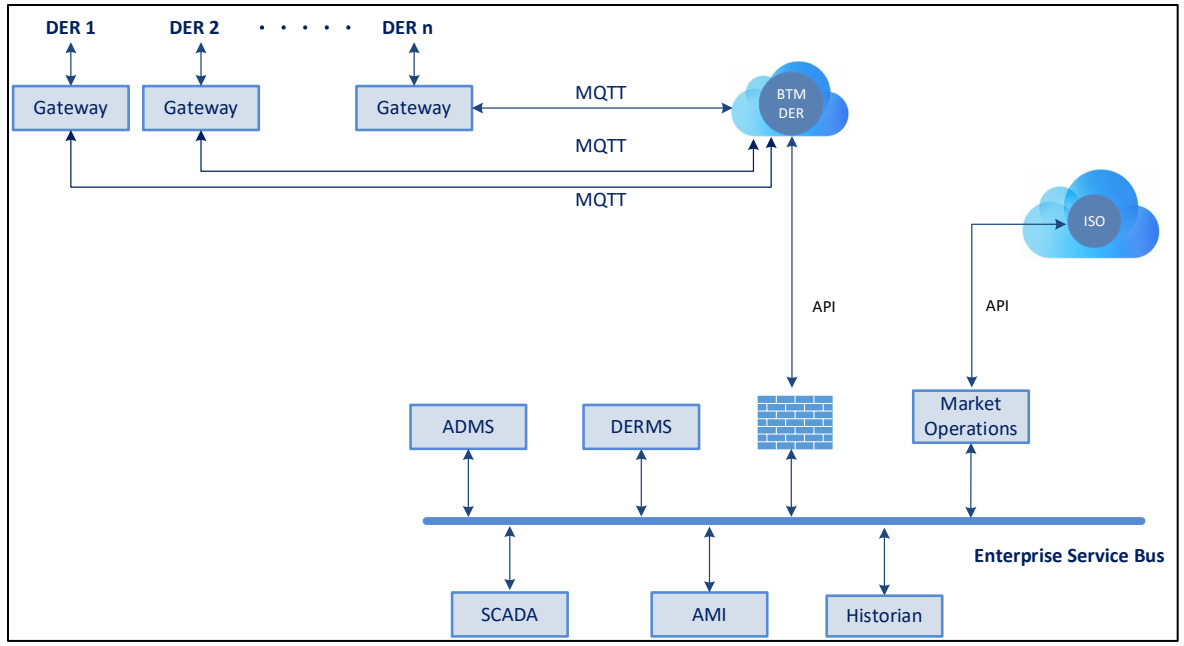
Project Statement and Project Objectives

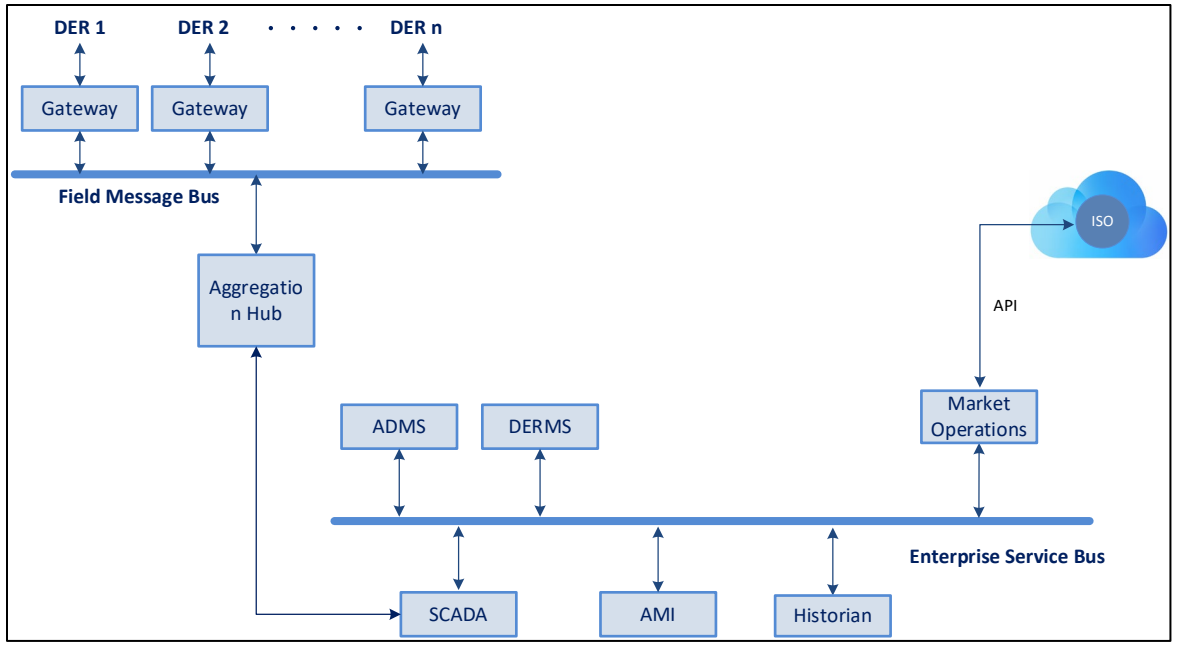
- Challenge:
  - Cost-effective solutions for smaller DER (<500kVA) are not readily available on the market
- Project Objective:
  - Investigate options for making DER more visible to distribution operations and support real-time control
  - Develop a technology solution that addresses the monitoring and controls gap associated with smaller DER (<500kVA)
- Specifically, a gateway was developed with the following objectives:
  - Enhance situational awareness and state estimation
  - Employ the same interface to manage DER to enhance grid modernization applications such as
    - Fault location, isolation, and service restoration (FLISR)
    - Voltage and VAR optimization (VVO)
    - Dispatch of DER assets into wholesale markets

DER Gateway Architectures

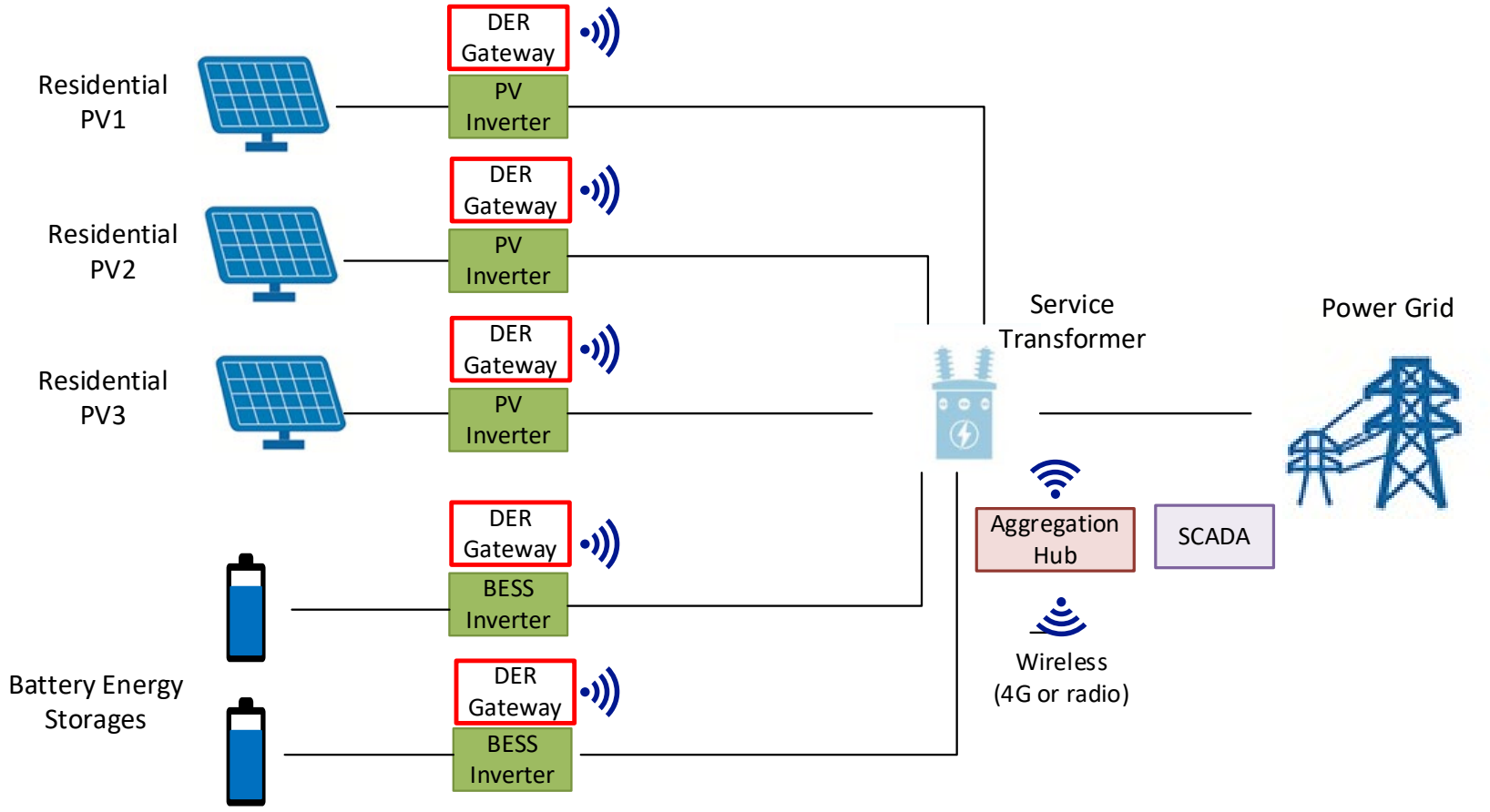
Cloud-Based Third-Party Aggregator Communications and Control Diagram



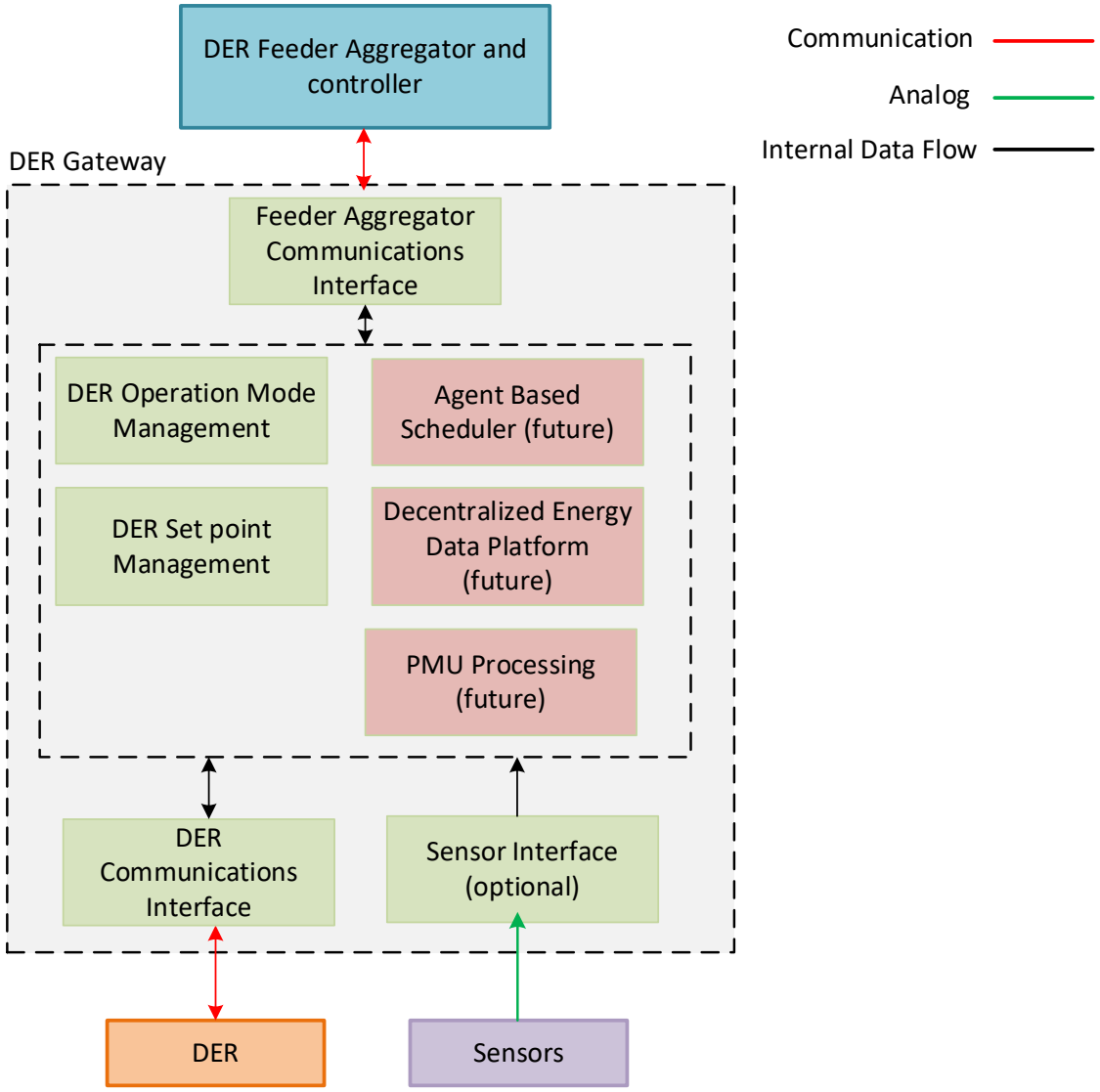
Field Message Bus Communications and Control Diagram



DER Gateway for Integration of Small DER Assets in Distribution Systems



DER Gateway Block Diagram and Data Flow



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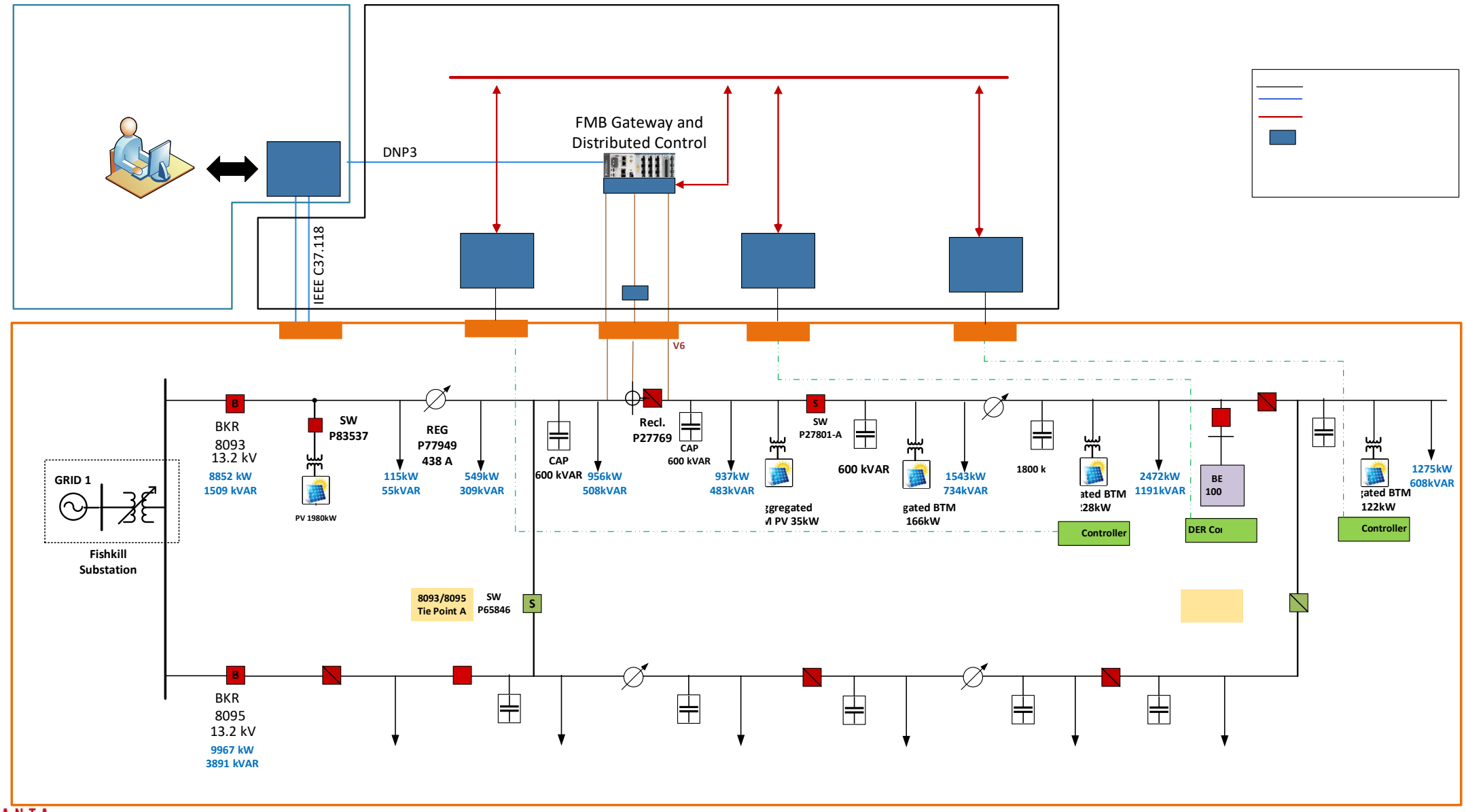
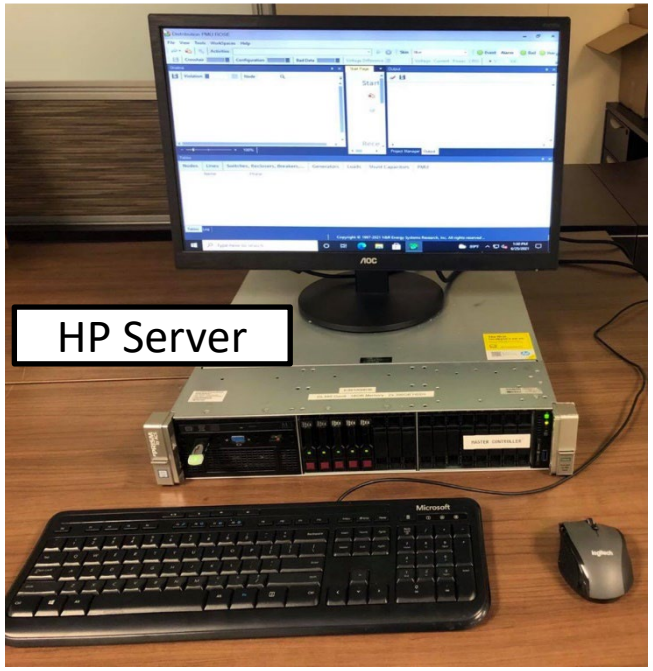
Test Set up

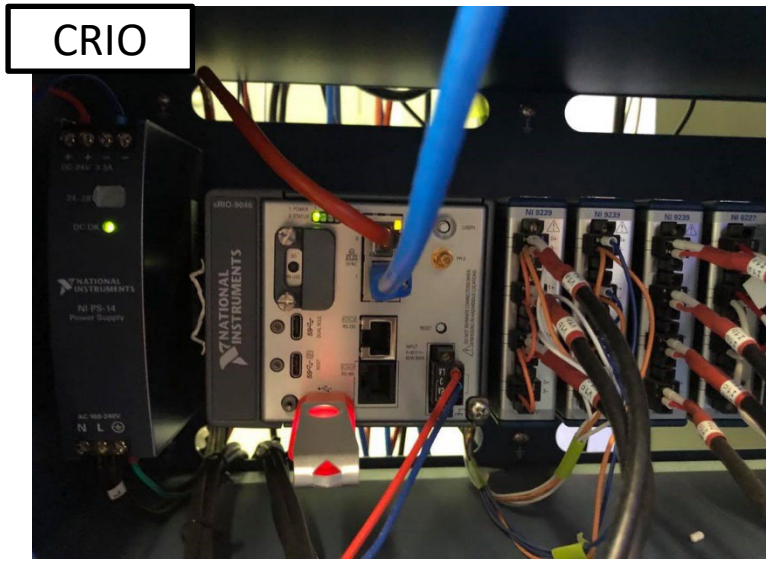
Overview of Lab Set-up



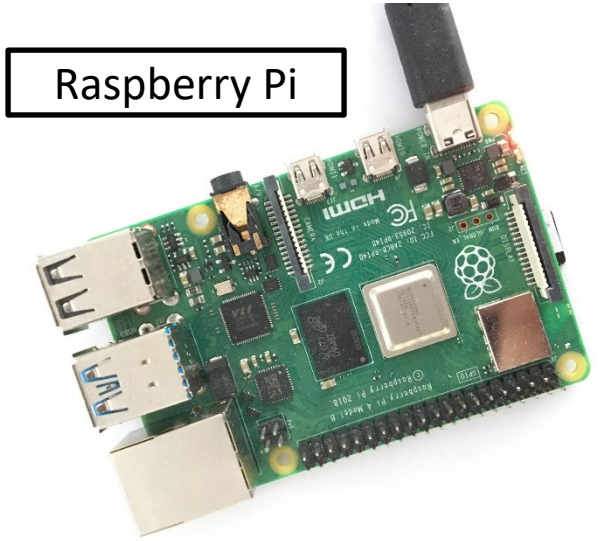
Laboratory Setup



CRIO

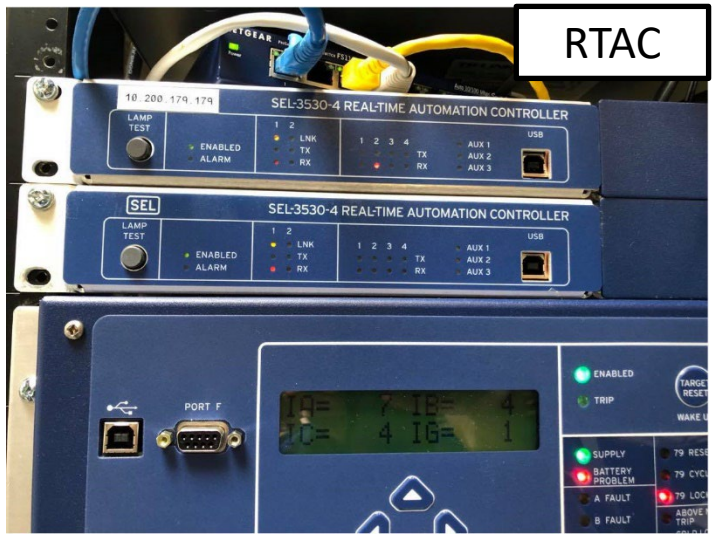


Raspberry Pi

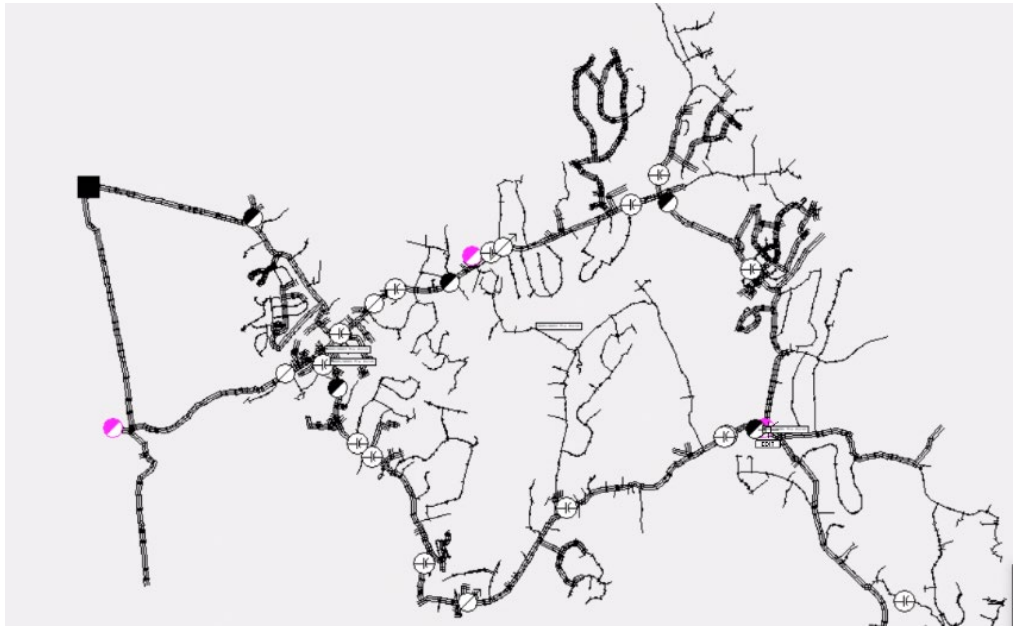


RTDS Lab

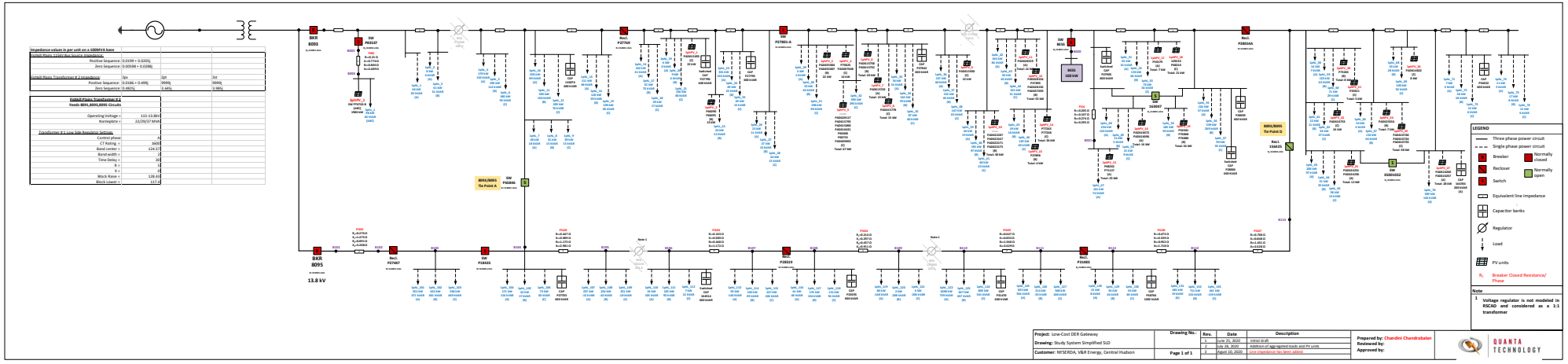
RTAC



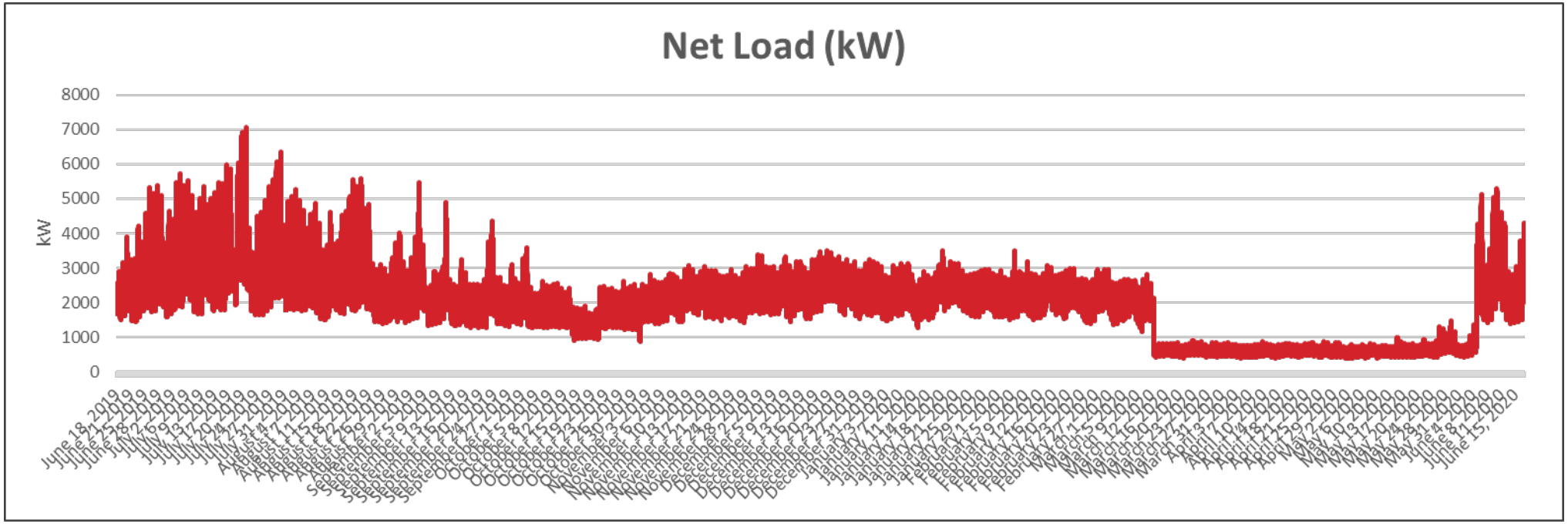
Fishkill Plains Milsoft Model Reduction

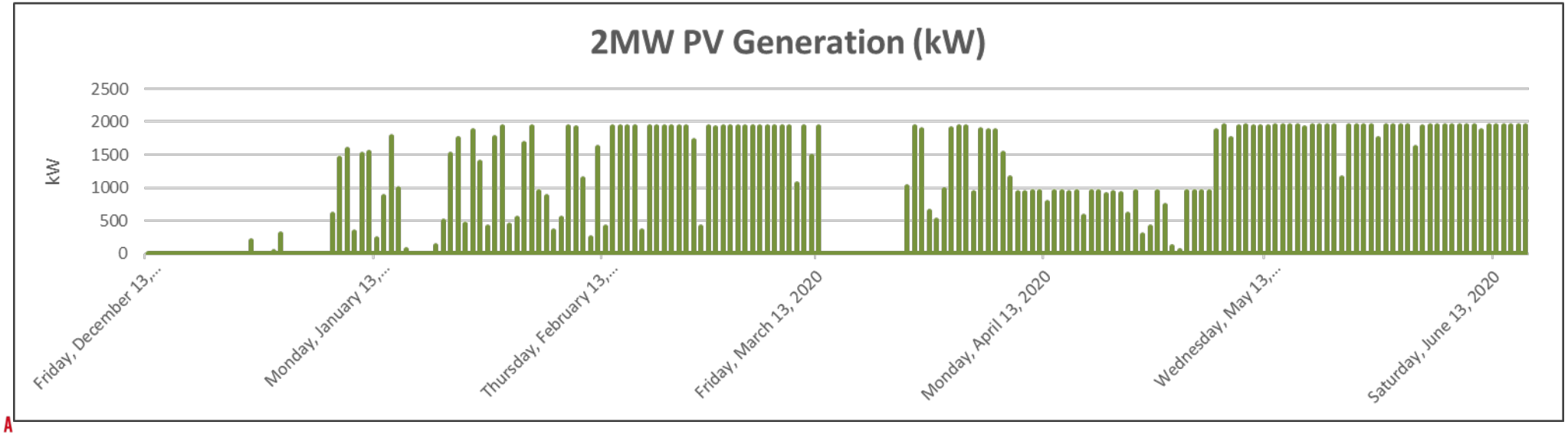


- Grouped load and PV into subset of buses, separated by major overhead conductors
- Developed the reduced SLD in RSCAD
- Validate by comparison of load flow in both software
- Shared SLD, excel format of network, and load flow results with V&R Energy for implementation in DSE

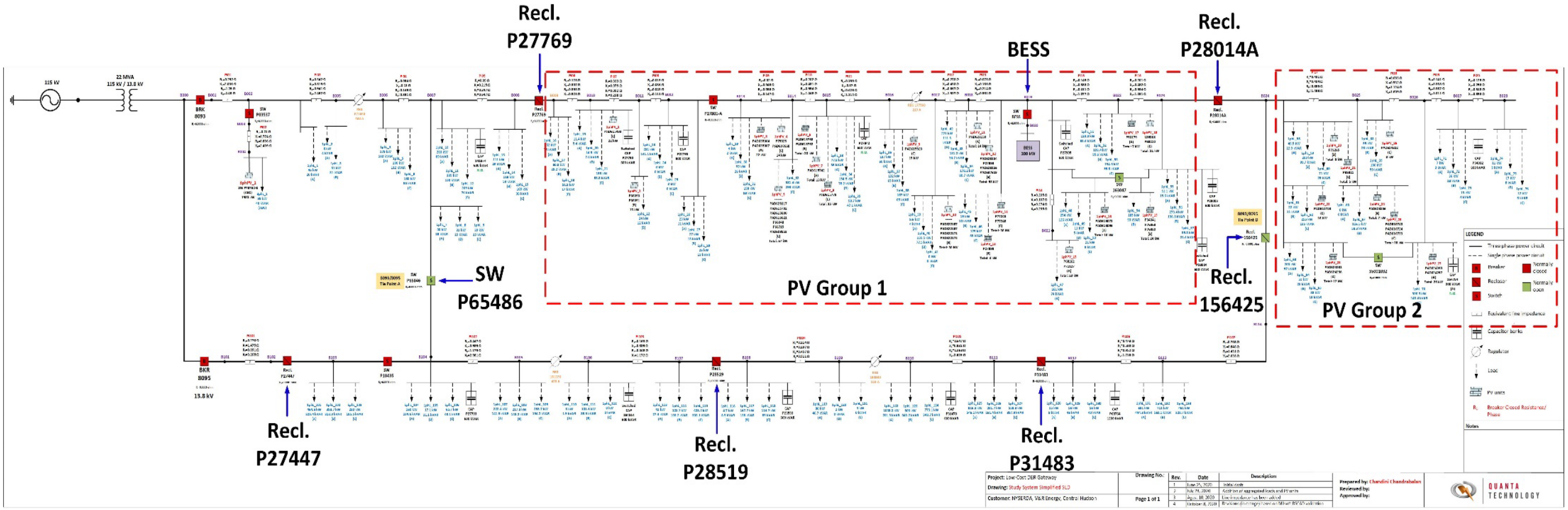


Load and PV Profile (Circuit 8093)

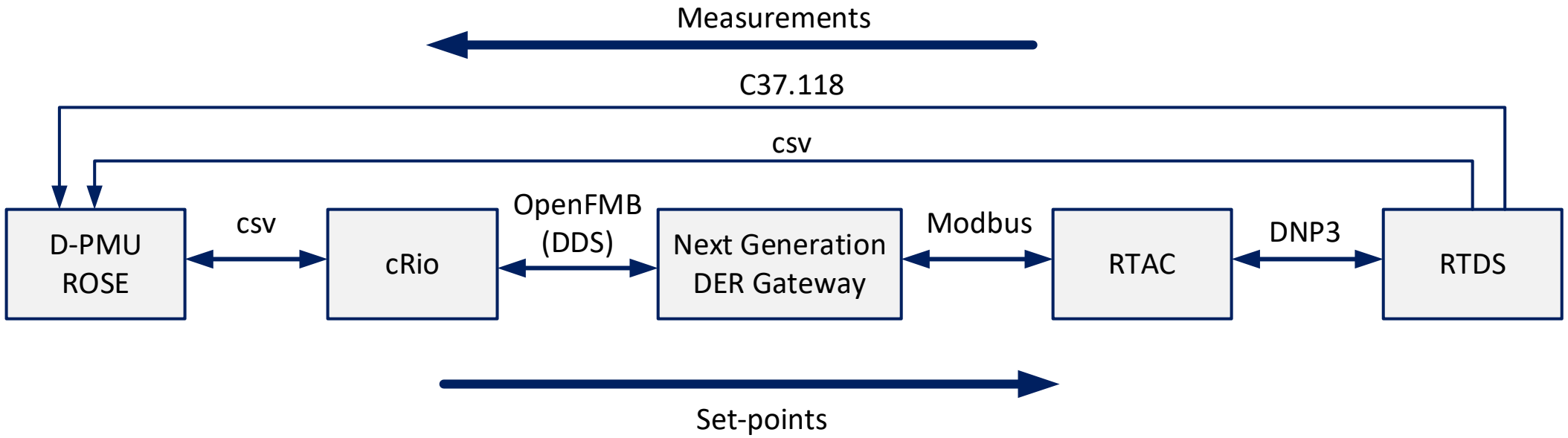




RTDS Model of Test System



Data Flow between RTDS and V&R Energy



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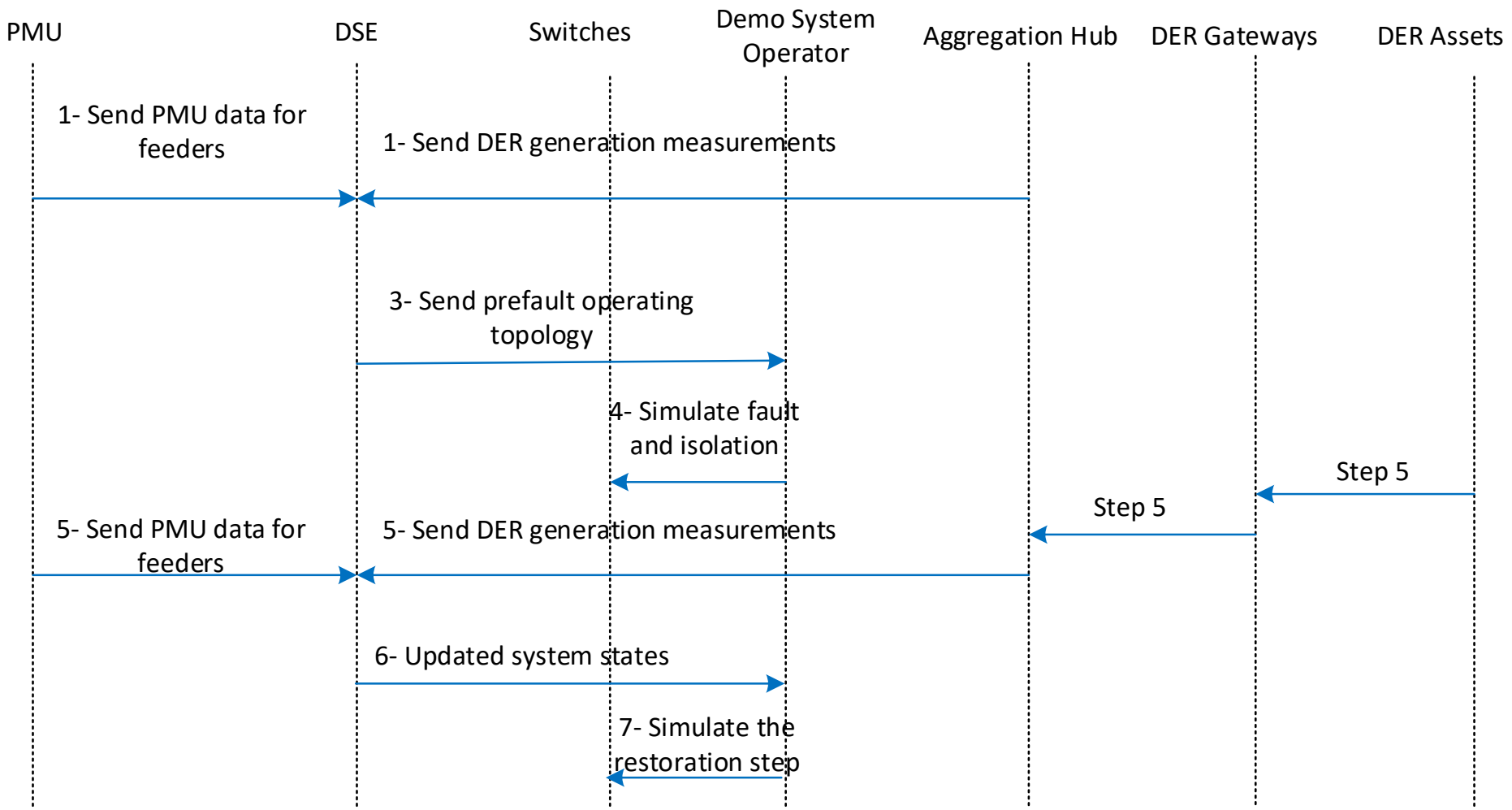
Use Case Testing

Gateway Use Cases

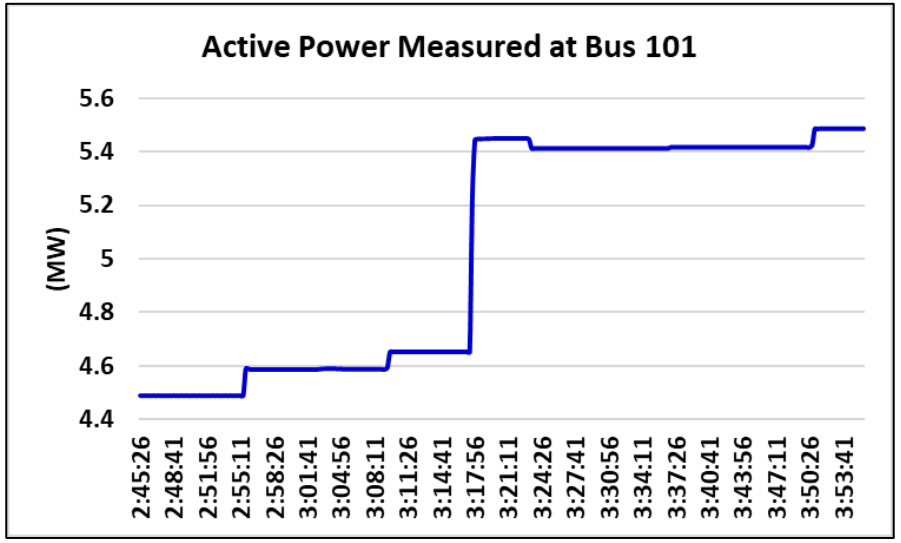
#	Application	Use case	Project Scope
1	**Distribution System Monitoring and Situational Awareness**		
1.1		Disaggregation of load and DER	
1.2		Monitoring of voltage compliance for DER locations	
1.3		FLISR enhancement through improved prefault load calculation	✓
1.4		Micro-phasor measurement unit (uPMU) for improved state estimation	
2	**DER Management**		
2.1		Managed operation of BTM DERs and FTM assets for thermal constraints	
2.2		BTM DER operation for dispatch	✓
2.3		DER Volt-Var Optimization integration	✓
3	**Market Participation**		
3.1		Community energy market participation using agent-based controls	
3.2		Blockchain for local market settlement	

FLISR

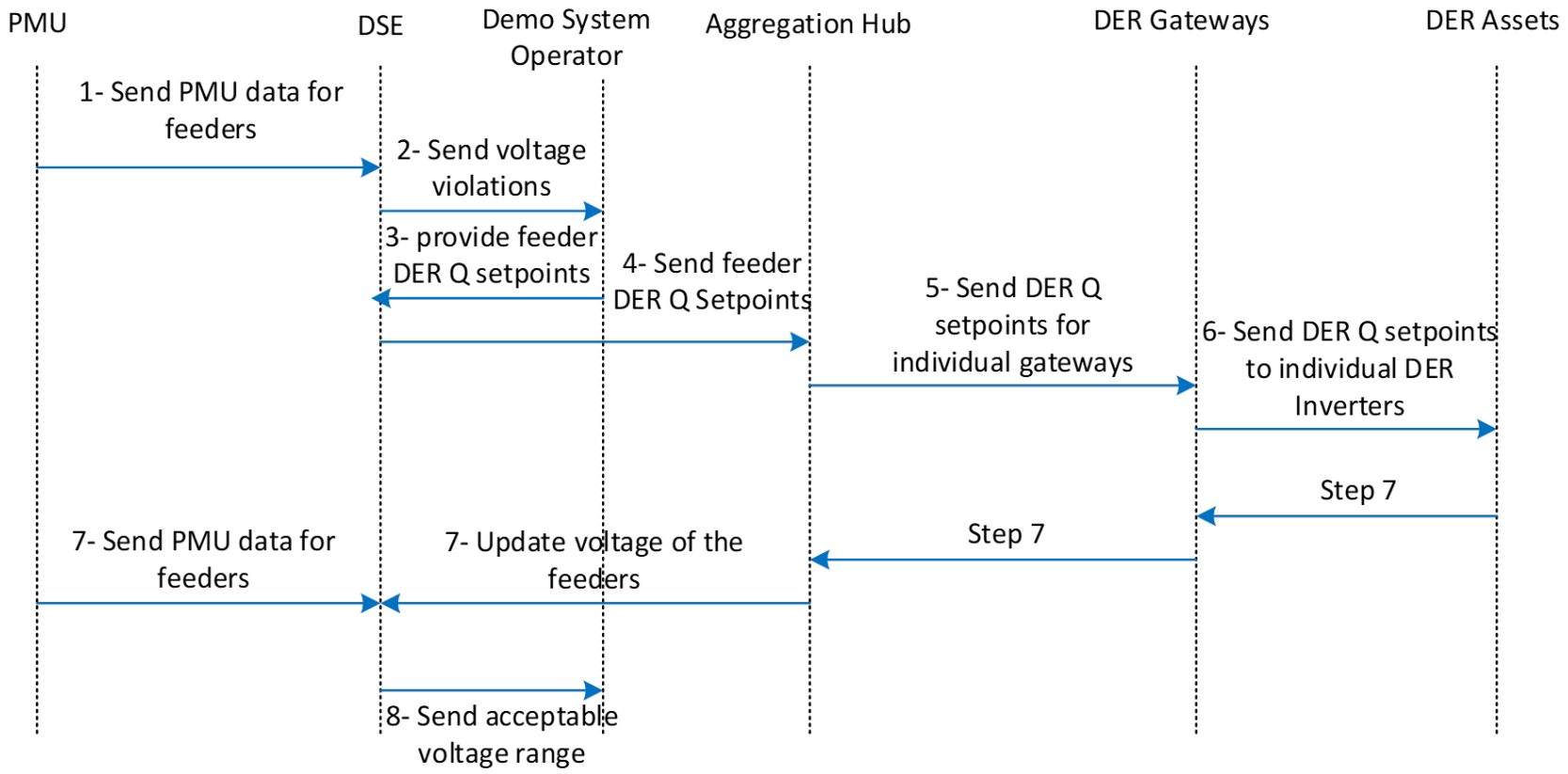


FLISR

Test Day	Error in estimation of prefault load (kW)
June 9, 2020	467
June 14, 2020	475
March 5, 2020	473
March 7, 2020	470

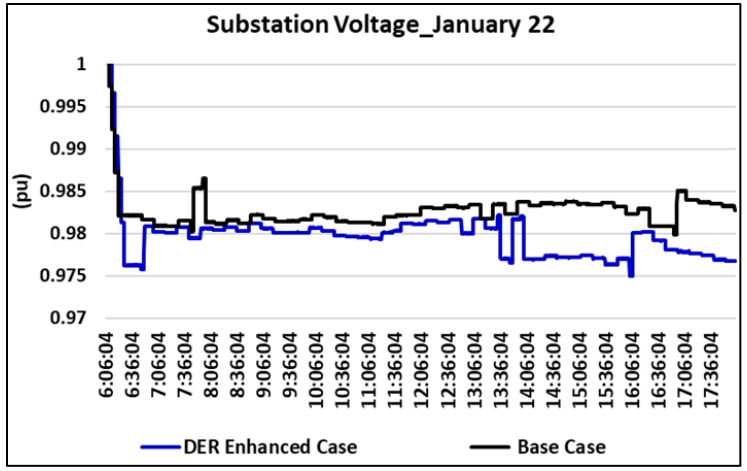


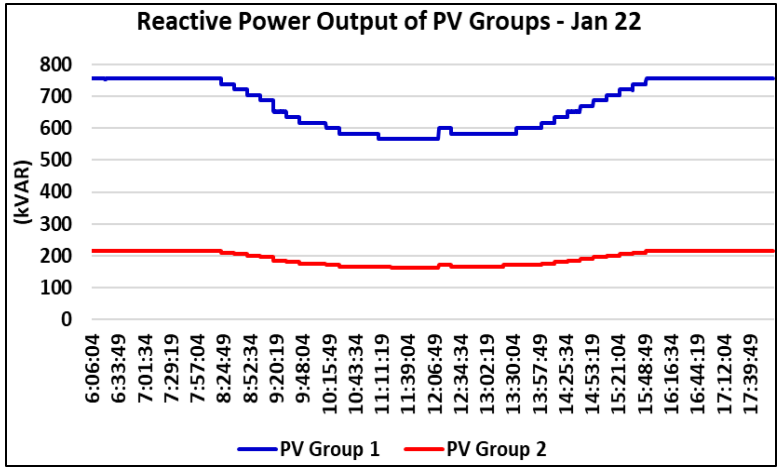
VVO

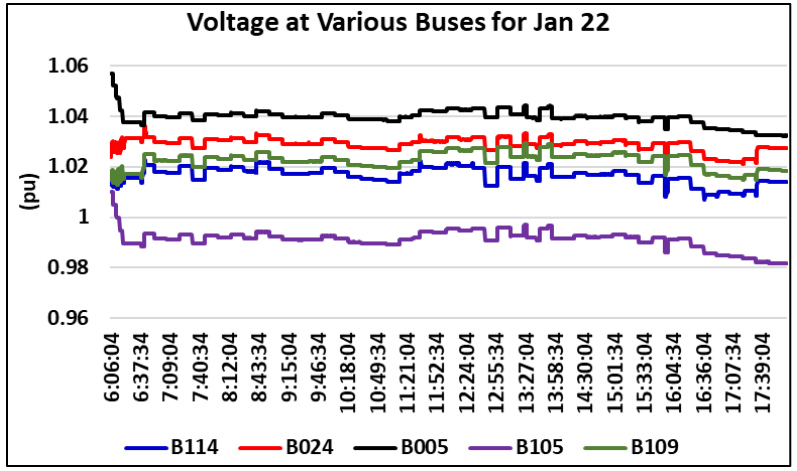


VVO

Test Day	Average Incremental Voltage Reduction (%)	Maximum System Voltage (pu)		Minimum System Voltage (pu)	
		DER Enhanced Case	Base Case	DER Enhanced Case	Base Case
22-Jan-20	0.30%	1.06	1.07	0.98	0.97
26-Jan-20	0.33%	1.09	1.10	0.93	0.93
5-Mar-20	0.13%	1.08	1.08	0.97	0.97
7-Mar-20	0.19%	1.08	1.08	0.96	0.97
9-Jun-20	0.17%	1.10	1.11	0.95	0.95
14-Jun-20	0.12%	1.09	1.09	0.96	0.96





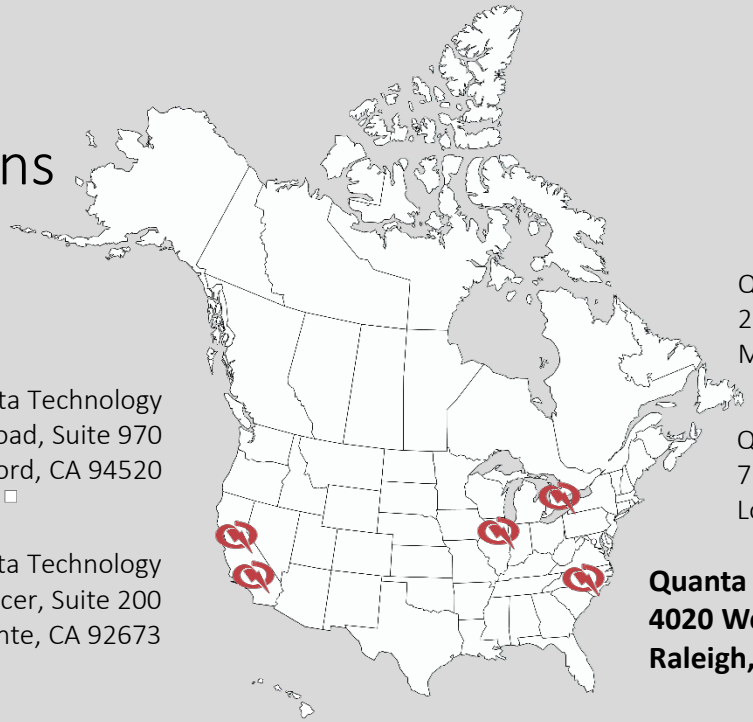


Summary

- DER gateway was successfully implemented in hardware and shown to enhance many distribution applications
- The gateway provides many useful measurements to a hybrid DSE
- Hybrid DSE represents a logical interim step to full DSE before sufficient distribution connected PMUs are deployed for a fully observable system
- The distributed control architecture offers many benefits relative to integration of BTM DER via third-party aggregators cloud interface
- Field demonstration of the concept will be required to better understand field deployment challenges and costs

Thank you!

Office Locations



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