Provisional Interconnection Study Report for PI-2024-16

8/7/2025

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1.0 Executive Summary

The PI-2024-16 project is a Provisional Interconnection Service (PIS)[1] request for 250 MW Battery Energy Storage System (BESS) with a Point of Interconnection (POI) at the Pawnee 345 kV switching station. The BESS project connects to the POI via a 1-mile generation tie-line. The maximum output will be controlled via power plant controller not to exceed 250 MW during Grid Discharging and 254.28 MW during Grid Charging at the POI. PI-2024-16 is the Provisional Interconnection Service request associated with Generation Interconnection Request 5RSC-2024-11 in the 5RSC cluster.

The total estimated cost of the PSCo transmission system improvements required for PI-2024-16 to qualify for Provisional Interconnection Service is estimated to be **$11.015** million (Table 14 and Table 15).

The initial maximum permissible output of PI-2024-16 Generating Facility is 250 MW at the Point of Interconnection. Additionally, the requested Grid Charging capacity of 254.28 MW will be permitted. The maximum permissible output of the Generating Facility in the PLGIA[2] will be reviewed quarterly and updated, if there are changes to the system conditions assumed in this analysis.

During the 0.95 lagging power factor test the generator terminals bus voltages exceed 1.05 p.u. voltage.

Security: PI-2024-16 is a request for Energy Resource Interconnection Service (ERIS). For ERIS requests, security shall estimate the risk associated with the Network Upgrades and the Interconnection Facilities and is assumed to be a minimum of $5 million.

The Interconnection Customer assumes all risks and liabilities with respect to changes between the PLGIA and the LGIA[3], including changes in output limits and Interconnection Facilities,

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[1] **Provisional Interconnection Service (PIS)** shall mean an Interconnection Service provided by Transmission Provider associated with interconnecting the Interconnection Customer's Generating Facility to Transmission Provider's Transmission System and enabling that Transmission System to receive electric energy and capacity from the Generating Facility at the Point of Interconnection, pursuant to the terms of the Provisional Large Generator Interconnection Agreement and, if applicable, the Tariff.

[2] **Provisional Large Generator Interconnection Agreement (PLGIA)** shall mean the interconnection agreement for Provisional Interconnection Service established between Transmission Provider and/or the Transmission Owner and the Interconnection Customer. The pro forma agreement is provided in Appendix 8 and takes the form of the Large Generator Interconnection Agreement, modified for provisional purposes.

[3] **Large Generator Interconnection Agreement (LGIA)** shall mean the form of interconnection agreement applicable to an Interconnection Request pertaining to a Large Generating Facility that is included in the Transmission Provider's Tariff.

Network Upgrades, Distribution Upgrades, and/or System Protection Facilities cost responsibility.

The Provisional Interconnection Service in and of itself does not convey transmission service.

2.0 Introduction

PI-2024-16 is the PI Service request for a 250 MW Battery Energy Storage System (BESS) located in Morgan County, Colorado. The Study will evaluate the impacts on the PSCo transmission system and Affected Systems by modeling the Generating Facility at the nameplate amount minus any losses for the interconnection facilities.

- The POI of this project is at the Pawnee 345 kV switching station.
- The COD requested to be studied for PI-2024-16 is June 1, 2027.

The geographical location of the transmission system near the POI is shown in Figure 1. Note an approximation was used to overlay the new Colorado's Power Pathway onto the current one-line diagram.

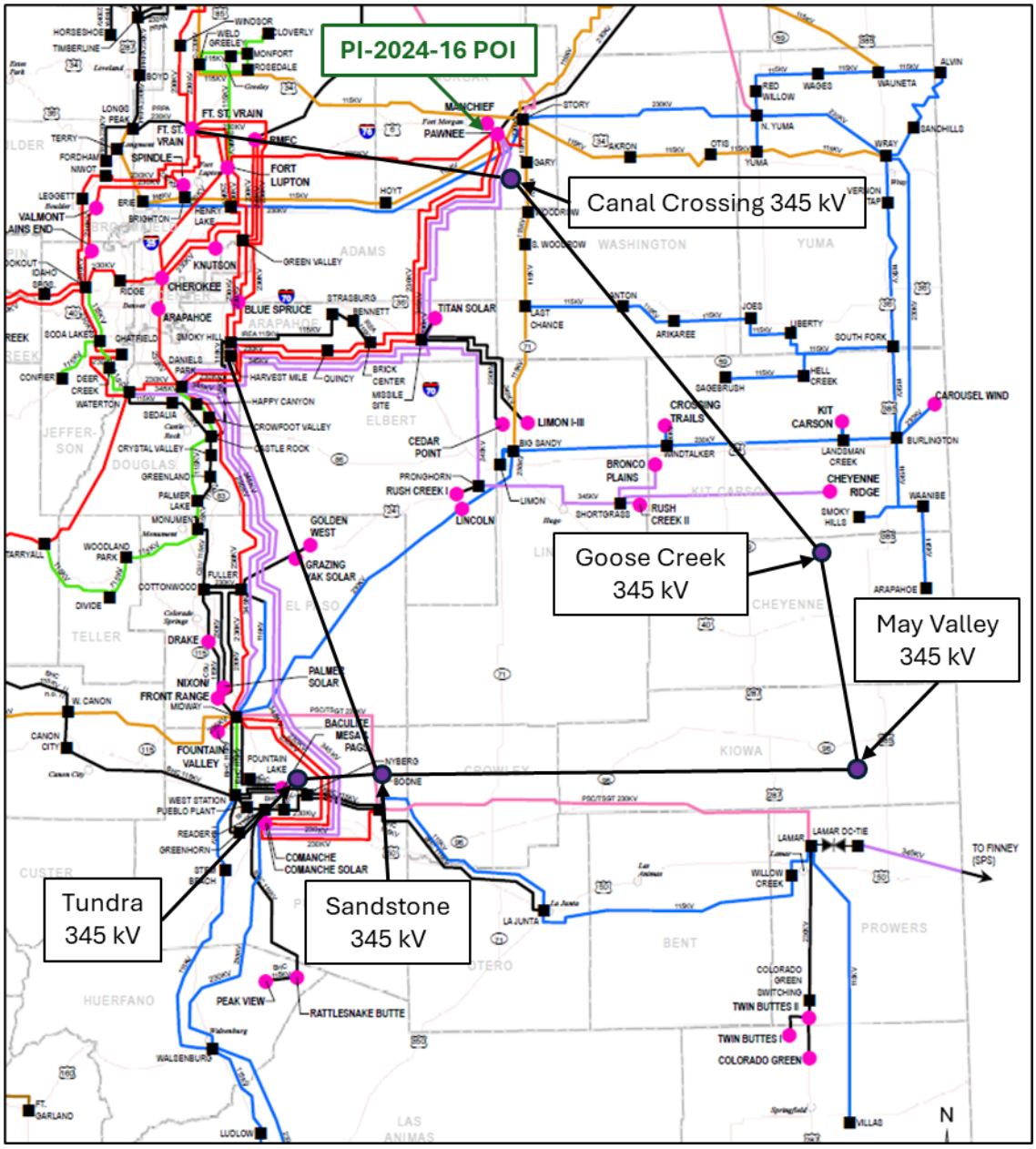

Figure 1: Approximate Point of Interconnection of PI-2024-16

3.0 Study Scope

The purpose of this study is to determine the impacts to the PSCo transmission system and the Affected Systems from interconnecting PI-2024-16 for Provisional Interconnection Service. Consistent with the assumption in the study agreement, PI-2024-16 selected Energy Resource Interconnection Service (ERIS)[4].

The scope of this report includes voltage and reactive capability evaluation, steady state (thermal and voltage) analysis, transient stability analysis, short-circuit analysis, and cost estimates for Interconnection Facilities and Station Network Upgrades. The study also identifies the estimated Security[5] and Contingent Facilities associated with the Provisional Interconnection Service.

3.1 Steady-State Criteria

The following Criteria are used for the reliability analysis of the PSCo system and Affected Systems:

P0—System Intact conditions:

Thermal Loading: <=100% of the normal facility rating

Voltage range: 0.95 to 1.05 per unit

P1 & P2-1—Single Contingencies:

Thermal Loading: <=100% Normal facility rating

Voltage range: 0.90 to 1.10 per unit

Voltage deviation: <=8% of pre-contingency voltage

P2 (except P2-1), P4, P5 & P7—Multiple Contingencies:

Thermal Loading: <=100% Emergency facility rating

Voltage range: 0.90 to 1.10 per unit

Voltage deviation: <=8% of pre-contingency voltage

[4] **Energy Resource Interconnection Service** shall mean an Interconnection Service that allows the Interconnection Customer to connect its Generating Facility to the Transmission Provider's Transmission system to be eligible to deliver the Generating Facility's electric output using the existing firm and non-firm capabilities of the Transmission Provider's Transmission System on an as available basis.

[5] **Security** estimates the risk associated with the Network Upgrades and Interconnection Facilities that could be identified in the corresponding LGIA.

3.2 Transient Stability Criteria

The transient voltage stability criteria are as follows:

a. Following fault clearing, the voltage shall recover to 80% of the pre-contingency voltage within 20 seconds of the initiating event for all P1 through P7 events for each applicable Bulk Electric System (BES) bus serving load.
b. Following fault clearing and voltage recovery above 80%, voltage at each applicable BES bus serving load shall neither dip below 70% of pre-contingency voltage for more than 30 cycles nor remain below 80% of pre-contingency voltage for more than two seconds, for all P1 through P7 events.
c. For Contingencies without a fault (P2.1 category event), voltage dips at each applicable BES bus serving load shall neither dip below 70% of pre-contingency voltage for more than 30 cycles nor remain below 80% of pre-contingency voltage for more than two seconds.

The transient angular stability criteria are as follows:

a. P1—No generating unit shall pull out of synchronism. A generator being disconnected from the system by fault clearing action or by a special Protection System is not considered an angular instability.
b. P2–P7—One or more generators may pull out of synchronism, provided the resulting apparent impedance swings shall not result in the tripping of any other generation facilities.
c. P1–P7—The relative rotor angle (power) oscillations are characterized by positive damping (i.e., amplitude reduction of successive peaks) > 5% within 30 seconds.

3.3 Breaker Duty Analysis Criteria

Fault Current after PI addition should not exceed 100% of the Breaker Duty rating. PSCo can only perform breaker duty analysis on the PSCo system. Before the PI goes in-service the Affected Systems may choose to perform a breaker duty analysis to identify breaker duty violations on their system.

3.4 Study Methodology

For PSCo and non-PSCo owned facilities, thermal violations attributed to the request include all new facility overloads with a thermal loading >100% and increased by 1% or more from the benchmark case overload post the Generator Interconnection Request (GIR) addition.

The voltage violations assigned to the request include new voltage violations which resulted in a further variation of 0.01 per unit.

Since the request is for Provisional Interconnection Service, if thermal or voltage violations are seen, the maximum permissible Provisional Interconnection Service before violations is identified. For voltage violations caused by reactive power deficiency at the POI, voltage upgrades are identified.

The Provisional Interconnection Service request should meet the transient stability criteria stated in Section 3.2. If the addition of the GIR causes any violations, the maximum permissible Provisional Interconnection Service before violations is identified.

3.5 Contingency Analysis

The transmission system on which steady state contingency analysis is run includes the WECC designated Area 70 and selected zones in Area 73, as appropriate. Contingencies performed were provided by PSCo.

The transient stability analysis is performed for the following worst-case contingencies shown in Table 1.

Table 1 – Transient Stability Contingencies

Ref. No.	Fault Location	Fault Category	Outage(s)	Clearing Time (Cycles)
1	-	P0	Flat Run	-
2	Pawnee 345 kV	P1	Canal Crossing – Pawnee 345 kV ckt 1	4
3	Pawnee 345 kV	P1	GI-2023-14 POI – Pawnee 345 kV ckt 1	4
4	Pawnee 345 kV	P1	PI-2024-16 Generation	4
5	Pawnee 345 kV	P1	Pawnee 345/230 kV Transformer T2	4
6	Pawnee 230 kV	P1	Ft Lupton – Pawnee 230 kV ckt 1	5
7	Pawnee 230 kV	P1	Pawnee – Peetz Logan 230 kV ckt 1 Peetz Logan Generation	5
8	Pawnee 230 kV	P1	Pawnee – 5RSC-24-7-1 230 kV ckt 1	5

Ref. No.	Fault Location	Fault Category	Outage(s)	Clearing Time (Cycles)
9	Pawnee 230 kV	P1	Story – Pawnee 230 kV ckt 1	5
10	Pawnee 230 kV	P1	Pawnee Generation	5
11	Pawnee 230 kV (BF_057b)	P4	Ft Lupton – Pawnee 230 kV ckt 1 Ft Lupton – JL Green 230 kV ckt 1	17
12	Canal Crossing 345 kV (P7_159)	P4	Canal Crossing – Pawnee 345 kV ckt 1 Canal Crossing – Pawnee 345 kV ckt 2	4
13	Canal Crossing 345 kV (P7_160)	P7	Canal Crossing – Goose Creek 345 kV ckt 1 Canal Crossing – Goose Creek 345 kV ckt 2	4
14	Canal Crossing 345 kV (P7_161)	P7	Canal Crossing – Ft St Vrain 345 kV ckt 1 Canal Crossing – Ft St Vrain 345 kV ckt 2	4

3.6 Study Area

The East Colorado study area includes WECC designated zone 706. As described in Section 3.11 of the BPM, the East study pocket is comprised of the eastern Colorado transmission system with major generation injecting into the following substations:

- Pawnee: Pawnee Coal, Manchief Gas, Peetz Logan Wind
- Beaver Creek: Brush Gas + Combined Cycle (CC)
- Missile Site: Cedar Point Wind, Limon Wind, Rush Creek Wind

4.0 Base Case Modeling Assumptions

The 2029HS2a WECC case released on May 8, 2023, was selected as the Starting Case. The 2027 Heavy Summer (2027HS) Base Case was created from the Starting Case by including the following modeling changes.

- Shortgrass to Goose Creek uprate to 1439 MVA – ISD TBD
- Poncha – San Luis Valley 115 kV L9811 uprate to 239 MVA – ISD 8/20/2025.
- Daniels Park-Prairie-Greenwood Uprate L5707 to 956 MVA – ISD 6/1/2026.
- Leetsdale-Monroe-Elati line 5283 uprate to 956 MVA – ISD 5/31/2026.
- Uprate Lines 6935/6936 69 kV from Alamosa - Mosca - San Luis Valley to 95 MVA – ISD 5/15/2026.
- Daniels Park-Prairie-Greenwood Uprate L5111 to 956 MVA – ISD 10/21/2026.
- NEW Harvest Mile to Smoky Hill 230 kV Line – ISD 5/14/2027.
- NEW Leetsdale to University Line 9338 – ISD 9/9/2026.
- Tollgate Load Shift – ISD 7/7/2026.
- NEW Arapahoe T6 230/115 kV, 272/319 MVA – ISD 2/10/2027.
- Cherokee-Federal Heights-Broomfield L9558 Line rebuild – ISD 11/18/2026.
- Midway PS 230/115 T1 Transformer Replacement with 280 MVA – ISD 10/7/2026.

Additionally, the following segments of the Colorado's Power Pathway (CPP) were included in the Base Case:

- Segment #1: Fort St. Vrain – Canal Crossing 345 kV Double Circuit
- Segment #2: Canal Crossing – Goose Creek 345 kV Double Circuit
- Segment #3: Goose Creek – May Valley 345 kV Double Circuit
- Segment #4: May Valley – Sandstone – Tundra 345 kV Double Circuit
- Segment #5: Sandstone – Harvest Mile 345 kV Double Circuit

The Base Case model includes the existing PSCo generation resources and all Affected Systems' existing resources. While the higher-queued NRIS requests were dispatched at 100%, the higher-queued ERIS requests were modeled offline.

4.1 Benchmark Case Modeling

The Benchmark Case was created from the Base Case (2027HS) described in Section 4.0 by changing the study pocket generation dispatch to reflect heavy generation in the East study pocket. This was accomplished by adopting the stressed generation dispatch given in Table 2. Additionally, 4050 MW of Native Load Priority (NLP) was modeled, as shown in Table 3. Furthermore, GI-2024-18 (on bus 700402), a unit that shares the same gen-tie as PI-2024-16, has been modeled online such as it injects 150 MW at the POI, Pawnee 345 kV.

Table 2 – Generation Dispatch to Create the Eastern Colorado Benchmark Case for Discharging Scenario (MW is Gross Capacity)

Gen Bus Number	Name	ID	Status	Pgen (MW)
70310	PAWNEE	C1	1	526.00
70314	MANCHEF1	G1	1	118.35
70315	MANCHEF2	G2	1	117.90
70767	RUSHCK1_W1	W1	1	161.60
70770	RUSHCK1_W2	W2	1	142.40
70771	RUSHCK2_W3	W3	1	176.00
70739	CHEYRGW_W1	W1	1	109.12
70742	CHEYRGW_W2	W2	1	105.60
70733	CHEYRGE_W1	W1	1	43.20
70736	CHEYRGE_W2	W2	1	88.00
70775	CHEYRGE_W3	W3	1	52.80
70818	MTNBRZ_W1	W1	1	126.32
70817	MTNBRZ_W2	W2	1	11.04
70670	CEDARPT_W1	W1	1	99.36
70671	CEDARPT_W2	W2	1	100.80
70635	LIMON1_W	W1	1	160.80
70636	LIMON2_W	W2	1	160.80
70637	LIMON3_W	W3	1	160.80
70753	BRONCO_W1	W1	1	117.28
70749	BRONCO_W2	W2	1	128.96
70710	PTZLOGN1	W1	1	160.80
70712	PTZLOGN2	W2	1	96.00
70713	PTZLOGN3	W3	1	63.60
70714	PTZLOGN4	W4	1	140.00
70721	SPRNGCAN1_W1	W1	1	51.84

Gen Bus Number	Name	ID	Status	Pgen (MW)
70715	SPRNGCAN2_W2	W2	1	50.16
70723	RDGCREST	W1	1	23.76
70443	Arriba W1	W1	1	80.04
70442	Arriba W2	W2	1	80.04
700402	GI24_18S GEN 1	1	1	156.48

Table 3 - NLP Generation Included

Generator Bus No.	Name	ID	Status	Pgen (MW)
700043	5RSC_24_10	B	1	253.60
700057	5RSC_24_15	W2	1	130.00
700060	5RSC_24_15	W3	1	130.00
700063	5RSC_24_15	W4	1	110.00
700067	5RSC_24_15	W1	1	130.00
700076	5RSC_24_16	W1	1	144.00
700077	5RSC_24_16	W2	1	162.00
700078	5RSC_24_16	W3	1	144.00
700079	5RSC_24_17	W1	1	153.00
700085	5RSC_24_17	W3	1	135.00
700088	5RSC_24_17	W4	1	153.00
700095	5RSC_24_18	W	1	310.90
999002	NLP_CACR	1	1	882.50
70920	NLP_MAYV	1	1	1212.00

4.2 Grid Charging Benchmark Case Modeling

The Grid Charging Benchmark Case was created from the Base Case (2027HS) described in Section 4.0 by changing the study pocket generation dispatch to reflect a Grid Charging scenario in the East study pocket. This was accomplished by adopting the stressed generation dispatch given in Table 4. Note that unit GI-2024-18 was modeled with 0 power output for the Grid Charging scenario. Additionally, 4050 MW of Native Load Priority (NLP) was modeled, as shown in Table 3.

Table 4 - Generation Dispatch to Create the Eastern Colorado Benchmark Case for Grid Charging Scenario (MW is Gross Capacity)

Gen Bus Number	Name	ID	Status	Pgen (MW)
70310	PAWNEE	C1	1	526.00
70314	MANCHEF1	G1	1	118.35
70315	MANCHEF2	G2	1	117.90
70767	RUSHCK1_W1	W1	1	42.42
70770	RUSHCK1_W2	W2	1	37.38
70771	RUSHCK2_W3	W3	1	46.20
70739	CHEYRGW_W1	W1	1	28.64
70742	CHEYRGW_W2	W2	1	27.72
70733	CHEYRGE_W1	W1	1	11.34
70736	CHEYRGE_W2	W2	1	23.10
70775	CHEYRGE_W3	W3	1	13.86
70818	MTNBRZ_W1	W1	1	33.16
70817	MTNBRZ_W2	W2	1	2.90
70670	CEDARPT_W1	W1	1	26.08
70671	CEDARPT_W2	W2	1	26.46
70635	LIMON1_W	W1	1	42.21
70636	LIMON2_W	W2	1	42.21
70637	LIMON3_W	W3	1	42.21
70753	BRONCO_W1	W1	1	30.79
70749	BRONCO_W2	W2	1	33.85
70710	PTZLOGN1	W1	1	42.21
70712	PTZLOGN2	W2	1	25.20
70713	PTZLOGN3	W3	1	16.70
70714	PTZLOGN4	W4	1	36.75
70721	SPRNGCAN1_W1	W1	1	13.61
70715	SPRNGCAN2_W2	W2	1	13.17
70723	RDGCREST	W1	1	6.24
70443	Arriba W1	W1	1	21.01
70442	Arriba W2	W2	1	21.01
700402	GI24_18S GEN 1	1	1	0.00

4.3 Study Case Modeling

The PI-2024-16 project includes 250 MW of Battery Storage using 78 PE 3.43 MVA inverters connected through 78 two-winding transformers to the 34.5 kV bus. The voltage is stepped up to the POI voltage level via two (2) 34.5/345/13.8 kV transformers, one rated 102/136/170 MVA and one rated 69/92/115 MVA. The high side of the transformers are connected to the POI via a 1-mile generation tie-line. The output at the POI will be limited to 250 MW.

A Study Case was created from the Benchmark Case by turning on the PI-2024-16 generation. The additional 250 MW of net output from PI-2024-16 at the POI was balanced against PSCo generation outside of the East Colorado study pocket.

A Grid Charging Study Case was created from the Benchmark Case by adding the PI-2024-16 BESS modeled as a load (254.28 MW). The additional 254.28 MW of consumption from PI-2024-16 was balanced against PSCo generation outside the East Colorado study pocket.

4.4 Short-Circuit Modeling

This request is for the Interconnection of a 250 MW Battery Energy Storage Systems (BESS) (PI-2024-16) to the Pawnee 345 kV switching station. The net output shall not exceed 250 MW at the POI.

All connected generating facilities were assumed capable of producing maximum fault current. As such, all generation was modeled at full capacity, whether NRIS or ERIS is requested. Generation is modeled as a separate generating resource in CAPE and included at full capacity in the short circuit study, regardless of any limitations to the output that would be imposed otherwise.

5.0 Provisional Interconnection Service Analysis

5.1 Voltage and Reactive Power Capability Evaluation

Per Section 4.1.1.1 of the BPM, the following voltage regulation and reactive power capability requirements are applicable to non-synchronous generators:

- Xcel Energy's OATT requires all non-synchronous generator Interconnection Customers to provide dynamic reactive power within the power factor range of 0.95 leading to 0.95 lagging at the high side of the generator substation. Furthermore, Xcel Energy requires every Generating Facility to have dynamic voltage control capability to assist in maintaining the POI voltage schedule specified by the Transmission Operator.
- It is the responsibility of the Interconnection Customer to determine the type (switched shunt capacitors and/or switched shunt reactors, etc.), the size (MVar), and the locations (on the Interconnection Customer's facility) of any additional static reactive power compensation needed within the generating plant in order to have adequate reactive capability to meet the +/- 0.95 power factor at the high side of the main step-up transformer.
- It is the responsibility of the Interconnection Customer to compensate their generation tie-line to ensure minimal reactive power flow under no load conditions.

All proposed reactive devices in customer provided models are switched favorably to provide appropriate reactive compensation in each test, therefore identified deficiencies are in addition to any proposed reactive compensation.

All summary tables representing GIRs' Voltage and Reactive Power Capability tests adhere to the following color formatting representing the different aspects of the tests:

- Values highlighted in red indicate a failed reactive power requirement.
- Voltages outside of 0.95 – 1.05 p.u. are highlighted in yellow to provide additional information.

The PI-2024-16 GIR is modeled as follows:

- Generator gross capacity: Pmax = 254.28 MW, Pmin = -254.28 MW, Qmax = 83.18 Mvar, Qmin = -83.18 Mvar

The summary for the Voltage and Reactive Power Capability Evaluation for PI-2024-16 is:

- The GIR is capable of meeting ±0.95 pf at the high side of the main step-up transformer while maintaining a normal operating voltage at the POI.
  Note during the 0.95 lagging power factor test the generator terminals bus voltages exceed 1.05 p.u. voltage.
- The GIR is capable of meeting ±0.95 pf at its terminals while meeting the interconnection service request.
- The reactive power exchange and voltage change across the gen-tie are acceptable under no load conditions.

The Voltage and Reactive Power Capability tests performed for PI-2024-16 are summarized in Table 5.

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Table 5 – Reactive Power Capability Evaluation for PI-2024-16

Generator Terminals					High Side of Main Transformer				POI			
Pgen (MW)	Qgen (Mvar)	Qmax (Mvar)	Qmin (Mvar)	V (p.u.)	P (MW)	Q (Mvar)	V (p.u.)	PF	P (MW)	Q (Mvar)	V (p.u.)	PF
254.2	58.3	83.2	-83.2	1.08	250.0	83.2	1.03	0.9488	250.0	83.8	1.03	0.9482
254.2	-34.5	83.2	-83.2	1.04	250.1	-83.6	1.02	-0.9484	250.0	-83.1	1.02	-0.9489
0.0	-1.3	83.2	-83.2	1.03	-1.5	-1.3	1.03	-0.7557	-1.5	-0.4	1.03	-0.9662

5.2 Steady State Analysis – Grid Charging

Contingency analysis was performed on the East study pocket Grid Charging Study Case. The results obtained with the Study Case model, for Grid Charging scenario, are summarized below:

- System Intact analysis showed no thermal or voltage violations attributed to PI-2024-16.
- Single Contingency analysis showed no thermal or voltage violations attributed to PI-2024-16.
- Multiple Contingency analysis showed no thermal or voltage violations attributed to PI-2024-16.

5.3 Steady State Analysis – Discharging

Contingency analysis was performed on the East study pocket Discharging Study Case. The power flow analysis showed that the contingency shown in Table 6 was divergent in the Study Case. As described in Section 7.4 of the BPM, Single Contingency issues should be mitigated using redispatch. Therefore, to resolve the divergence without requiring network upgrades or curtailment of the Study GIR's output, PSCo units located near the Study GIR were re-dispatched until the diverged contingency was resolved. The redispatch to resolve these contingencies is described in Table 7, below. The System Intact and Single Contingency analyses were then performed with this redispatch applied to the Study Case.

Table 6 –Diverged P1 Contingency

Diverged Contingency	Contingency Description	Case
Line_144_SGL_345_001	P1: Smoky Hill - Missile Site #7081	Study

Table 7 – Generation Dispatch to Resolve the Diverged P1 Contingency

Generator Bus Number	Generator Name	ID	Initial Pgen (MW)	Modified Pgen (MW)
70771	RUSHCREEK_W3	W3	176.00	0.00
70120	COMAN_2	C2	0.00	195.00

The results obtained with the Study Case model, for Discharging scenario and after the redispatch was applied, are summarized below:

- System Intact analysis showed no thermal or voltage violations attributed to PI-2024-16.
- Single Contingency analysis showed the thermal overloads in Table 8. No Single Contingency voltage violations attributable to PI-2024-16 were observed.
    - Note all Single Contingency violations are alleviated via redispatch, as shown in the last column of Table 8.
    - Re-dispatched generation is summarized in Table 9.
- Multiple Contingency analysis showed the thermal overloads in Table 10. No Multiple Contingency voltage violations attributable to PI-2024-16 were observed.
    - Per TPL-001-5, Multiple Contingency overloads are mitigated using system adjustments, including generation redispatch (includes GIR under study) and/or operator actions.
    - Five P7 contingencies were divergent as shown in Table 11. All five contingencies were divergent in both Benchmark and Study Cases. Multiple Contingency issues are resolved using system adjustments, including generation redispatch (including GIR under study) and/or operator actions. Therefore, divergences are not attributable to PI-2024-16.

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Table 8 – Single Contingency Overloads

Ref. No.	Monitored Facility	Contingency Name	kVs	Areas	Rate Cont (MVA)	Benchmark Case Loading (%)	Study Case Loading (%)	Loading Difference (%)	Re-dispatched Study Case Loading (%)
1	STORY (73192) – PAWNEE (70311) 230 kV CKT 1	line_144_SGL_345_001	230	73/70	772	103.90	108.29	4.39	99.94
2	B.CK_TRI 115/230 kV (73015/73016) TRANSFORMER T1	line_000_SGL_115_001	115/230	73	224	101.23	103.14	1.91	78.20

Table 9 – Generation Dispatch to Resolve the Single Contingency Overloads

Bus No.	Bus Name	Base kV	ID	Modified Status	Original Pgen (MW)	Modified Pgen (MW)
70500	QF_CPP1T	13.8	G1	1	0.0	24.0
78000	QF_CPP1T	13.8	G2	1	0.0	24.0
70501	QF_CPP3T	13.8	ST	1	0.0	27.0
70556	QF_B4D4T	12.5	ST	1	0.0	22.9
70714	PTZLOGN4	34.5	W4	-	140.0	34.4
71003	BAC_MSA GEN4	13.8	S1	-	24.8	23.0

Table 10 – Multiple Contingency Overloads

Ref. No.	Monitored Facility	Contingency Name	kVs	Areas	Rate Cont (MVA)	Benchmark Case Loading (%)	Study Case Loading (%)	Loading Difference (%)
1	STORY (73192) – PAWNEE (70311) 230 kV CKT 1	P7_135 (Lines: 7081 7109)	230	73/70	772	103.90	108.29	4.39

Ref. No.	Monitored Facility	Contingency Name	kVs	Areas	Rate Cont (MVA)	Benchmark Case Loading (%)	Study Case Loading (%)	Loading Difference (%)
2	BUCKLEY2 (70046) – SMOKY_HL (70396) 230 kV CKT 1	P7_101 (Lines: 5705 5167 5717)	230	70	478	99.83	101.03	1.20

Table 11 – Diverged P7 Contingencies

Diverged Contingency	Contingency Description	BM Case	Study Case
P7_136	Pawnee - Brick Center 230 kV circuit 1 Smoky Hill - Missile Site 345 kV circuit 1	Diverged	Diverged
P7_160	Canal Crossing - Goose Creek 345 kV circuit 1 Canal Crossing - Goose Creek 345 kV circuit 2	Diverged	Diverged
P7_161	Canal Crossing - FSV 345 kV circuit 1 Canal Crossing - FSV 345 kV circuit 2	Diverged	Diverged
P7_166	Tundra - Sandstone 345 kV circuit 1 Tundra - Sandstone 345 kV circuit 2	Diverged	Diverged
P7_167	May Valley - Sandstone 345 kV circuit 1 May Valley - Sandstone 345 kV circuit 2	Diverged	Diverged

5.4 Transient Stability Results

The following observations were made during Discharging scenario (Study Case model):

- Contingency Ref. No. 12 (P7_159) presented large oscillations after fault clearing in the Study case. The oscillations are damped and vanish at t = 13 seconds. This contingency presented a similar response when it was simulated in the Benchmark Case.
- Contingency Ref. No. 13 (P7_160) presented sustained oscillations after fault clearing in the Study case. This contingency did not present sustained oscillations when simulated in the Benchmark case. Please recall that P7_160 diverged in the Power Flow Analysis for both Study and Benchmark Cases.
- Contingency Ref. No. 14 (P7_161) diverged during its simulation in the Study case. This contingency presented a stable result when simulated in the Benchmark case. Please recall that P7_161 diverged in the Power Flow Analysis for both Study and Benchmark Cases.
- Per TPL-001-05, Multiple Contingency issues are resolved using system adjustments, including generation redispatch (including GIR under study) and/or operator actions.

Apart from the contingencies mentioned above, the following results were obtained for the disturbances analyzed for Study Case and the Grid Charging Study Case models:

- ✓ No machines lost synchronism with the system.
- ✓ No transient voltage drop violations were observed.
- ✓ Machine rotor angles displayed positive damping.

The results of the contingency analysis for Study Case and Grid Charging Study Case models are shown in Table 12 and Table 13, respectively. The transient stability plots are shown in Appendix A and B in Section 10.0 of this report.

Table 12 – Transient Stability Analysis Results for Grid Discharging Study Case Model

Ref. No.	Fault Location	Fault Category	Outage(s)	Clearing Time (Cycles)	Post-Fault Voltage Recovery	Angular Stability
1	-	P0	Flat Run	-	Stable	Stable
2	Pawnee 345 kV	P1	Canal Crossing – Pawnee 345 kV ckt 1	4	Stable	Stable
3	Pawnee 345 kV	P1	GI-2023-14 POI – Pawnee 345 kV ckt 1	4	Stable	Stable
4	Pawnee 345 kV	P1	PI-2024-16 Generation	4	Stable	Stable
5	Pawnee 345 kV	P1	Pawnee 345/230 kV Transformer T2	4	Stable	Stable
6	Pawnee 230 kV	P1	Ft Lupton – Pawnee 230 kV ckt 1	5	Stable	Stable
7	Pawnee 230 kV	P1	Pawnee – Peetz Logan 230 kV ckt 1 Peetz Logan Generation	5	Stable	Stable
8	Pawnee 230 kV	P1	Pawnee – 5RSC-24-7-1 230 kV ckt 1	5	Stable	Stable
9	Pawnee 230 kV	P1	Story – Pawnee 230 kV ckt 1	5	Stable	Stable
10	Pawnee 230 kV	P1	Pawnee Generation	5	Stable	Stable
11	Pawnee 230 kV (BF_057b)	P4	Ft Lupton – Pawnee 230 kV ckt 1 Ft Lupton – JL Green 230 kV ckt 1	17	Stable	Stable
12	Canal Crossing 345 kV (P7_159)	P4	Canal Crossing – Pawnee 345 kV ckt 1 Canal Crossing – Pawnee 345 kV ckt 2	4	Stable	Stable
13	Canal Crossing 345 kV (P7_160)	P7	Canal Crossing – Goose Creek 345 kV ckt 1 Canal Crossing – Goose Creek 345 kV ckt 2	4	Unstable	Unstable
14	Canal Crossing 345 kV (P7_161)	P7	Canal Crossing – Ft St Vrain 345 kV ckt 1 Canal Crossing – Ft St Vrain 345 kV ckt 2	4	Diverged	Diverged

Table 13 – Transient Stability Analysis Results for Grid Charging Study Case Model

Ref. No.	Fault Location	Fault Category	Outage(s)	Clearing Time (Cycles)	Post-Fault Voltage Recovery	Angular Stability
1	-	P0	Flat Run	-	Stable	Stable
2	Pawnee 345 kV	P1	Canal Crossing – Pawnee 345 kV ckt 1	4	Stable	Stable
3	Pawnee 345 kV	P1	GI-2023-14 POI – Pawnee 345 kV ckt 1	4	Stable	Stable
4	Pawnee 345 kV	P1	PI-2024-16 Generation	4	Stable	Stable
5	Pawnee 345 kV	P1	Pawnee 345/230 kV Transformer T2	4	Stable	Stable
6	Pawnee 230 kV	P1	Ft Lupton – Pawnee 230 kV ckt 1	5	Stable	Stable
7	Pawnee 230 kV	P1	Pawnee – Peetz Logan 230 kV ckt 1 Peetz Logan Generation	5	Stable	Stable
8	Pawnee 230 kV	P1	Pawnee – 5RSC-24-7-1 230 kV ckt 1	5	Stable	Stable
9	Pawnee 230 kV	P1	Story – Pawnee 230 kV ckt 1	5	Stable	Stable
10	Pawnee 230 kV	P1	Pawnee Generation	5	Stable	Stable
11	Pawnee 230 kV (BF_057b)	P4	Ft Lupton – Pawnee 230 kV ckt 1 Ft Lupton – JL Green 230 kV ckt 1	17	Stable	Stable
12	Canal Crossing 345 kV (P7_159)	P4	Canal Crossing – Pawnee 345 kV ckt 1 Canal Crossing – Pawnee 345 kV ckt 2	4	Stable	Stable
13	Canal Crossing 345 kV (P7_160)	P7	Canal Crossing – Goose Creek 345 kV ckt 1 Canal Crossing – Goose Creek 345 kV ckt 2	4	Stable	Stable
14	Canal Crossing 345 kV (P7_161)	P7	Canal Crossing – Ft St Vrain 345 kV ckt 1 Canal Crossing – Ft St Vrain 345 kV ckt 2	4	Stable	Stable

5.5 Short-Circuit and Breaker Duty Analysis Results

A study was completed to determine whether any over-dutied breakers resulted when several Provisional Interconnections (PIs) were added to the PSCo transmission system in the order of their Commercial Operation Date (COD). If the addition of the interconnection resulted in a requirement that one or more breakers be replaced in the PSCo transmission system, it was considered that that customer would not be able to connect under a provisional interconnection agreement and it was removed from the study.

Taken into consideration were any existing plans for breaker replacement by PSCo. Breakers that had already been assigned to projects were not considered as needing replacement by the interconnection customer.

The Short Circuit study on the PSCo transmission system did not identify any circuit breakers that became over-dutied because of adding the PI-2024-16. The fault currents at the POI for can be made available upon request by the Customer.

5.6 Affected Systems

The study did not identify any impacts to Affected Systems.

5.7 Summary of Provisional Interconnection Analysis

All single contingency thermal violations for Discharging Scenario were alleviated through generation redispatch, therefore, the maximum allowable output of the GIR without requiring any additional System Network Upgrades is 250 MW. Additionally, the requested Grid Charging capacity of 254.28 MW will be permitted as no Network Upgrades were found to be necessary to accommodate the consumption.

No thermal or voltage violations were observed for System Intact condition in Discharging Scenario. All the Single Contingency thermal violations observed for Discharging Scenario were alleviated through generation redispatch. Multiple Contingency analysis showed two thermal violations during Discharging Scenario. Per TPL-001-5, Multiple Contingency overloads are mitigated using system adjustments, including generation redispatch (includes GIRs under study) and/or operator actions.

Five P7 contingencies were divergent as shown in Table 11. All five P7 contingencies were divergent in both Benchmark and Study Cases. Multiple Contingency issues are resolved using

system adjustments, including generation redispatch (including GIR under study) and/or operator actions. Therefore, divergences are not attributable to PI-2024-16.

No thermal or voltage violations were observed during System Intact, Single Contingency, and Multiple Contingency analyses for the Grid Charging Study Case.

During the Transient Stability analysis performed in the Discharging scenario, the following results were observed:

- Contingency Ref. No. 12 (P7_159) presented large oscillations after fault clearing in the Study case. The oscillations are damped and vanish at t = 13 seconds. This contingency presented a similar response when it was simulated in the Benchmark Case.
- Contingency Ref. No. 13 (P7_160) presented sustained oscillations after fault clearing in the Study case. This contingency did not present sustained oscillations when simulated in the Benchmark case. Please recall that P7_160 diverged in the Power Flow Analysis for both Study and Benchmark cases.
- Contingency Ref. No. 14 (P7_161) diverged during its simulation in the Study case. This contingency presented a stable result when simulated in the Benchmark case. Please recall that P7_161 diverged in the Power Flow Analysis for both Study and Benchmark cases.
- Per TPL-001-05, Multiple Contingency issues are resolved using system adjustments, including generation redispatch (including GIR under study) and/or operator actions.

Apart from this, the Study unit presented satisfactory behavior during the Transient Stability analysis for both Discharging and Grid Charging Scenarios. Nine (9) P1, and four (4) Multiple contingencies were tested, and stable results were observed for all tested contingencies.

The initial maximum permissible output of the Provisional Interconnection Service request is 250 MW at the POI. Additionally, the requested Grid Charging capacity of 254.28 MW will be permitted as no Network Upgrades were found to be necessary to accommodate the consumption. The maximum permissible output of the Generating Facility in the PLGIA will be reviewed quarterly and updated if there are changes to the system conditions assumed in this analysis.

6.0 Cost Estimates

The total estimated cost of the required Upgrades for PI-2024-16 to interconnect for Provisional Interconnection Service at Pawnee 345 kV switching station is **$11.015** million.

- **Cost of Transmission Provider's Interconnection Facilities (TPIF) is $4.280 million** (Table 14)
- **Cost of Station Network Upgrades is $6.735 million** (Table 15)
- **Cost of System Network Upgrades is $0**

The list of improvements required to accommodate the Provisional Interconnection Service of PI-2024-16 are given in Table 14, and Table 15.

Table 14 – Transmission Provider's Interconnection Facilities

Element	Description	Cost Est. (Million)
PSCo's Pawnee 345 kV substation	Interconnection of 5RSC-2024-11 (PI-2024-16) at the Pawnee 345 kV substation. The new equipment includes: • (1) 345 kV single bay dead end structure • (1) 345 kV 3-phase arrester • (1) 345 kV 3000 A line disconnect switch • (3) 345 kV 1-phase CT for metering • (1) 345 kV 3-phase CCVT • Yard expansion including grading, ground grid, access road relocation, surfacing and fencing • Dual fiber communication equipment • Associated electrical equipment, bus, wiring and grounding • Associated foundations and structures • Associated transmission line communications, fiber, relaying and testing	$4.030
PSCo's Pawnee 345 kV substation	Transmission Provider's dead-end structure at the Point of Change of Ownership (PCO) outside the switching station fence line and transmission line into new switching station from the PCO. Single span, dead end structure, 3 conductors, insulators, hardware, jumpers and labor	$0.250
Total Cost Estimate for Interconnection Customer-Funded, PSCo-Owned Interconnection Facilities		**$4.280**

Table 15 – Station Network Upgrades

Element	Description	Cost Est. (Million)
PSCo's Pawnee 345 kV substation	Interconnection of 5RSC-2024-11 (PI-2024-16) at Pawnee 345 kV substation. The new equipment includes: • (2) 345 kV dead end structures • (5) 345 kV 3000 A SF6 circuit breakers • (6) 345 kV 3000 A disconnect switches • (2) 345 kV 3-phase CCVTs • Associated electrical equipment, bus, wiring and grounding • Associated foundations and structures	$6.735
Total Cost Estimate for PSCo-Funded, PSCo-Owned Interconnection Facilities		**$6.735**

PSCo has developed cost estimates for Interconnection Facilities and Network/Infrastructure Upgrades required for the interconnection of PI-2024-16 for Provisional Interconnection Service. The estimated costs provided in this report are based upon the following assumptions:

- The estimated costs are in 2025 dollars with escalation and contingencies applied.
- Allowances for Funds Used During Construction (AFUDC) is not included.
- The estimated costs include all applicable labor and overheads associated with the siting, engineering, design, and construction of these new PSCo facilities.
- The estimated costs do not include the cost for any Customer owned equipment and associated design and engineering.
- Labor is estimated for straight time only—no overtime included.
- PSCo (or its Contractor) will perform all construction, wiring, testing, and commissioning for PSCo owned and maintained facilities.

The customer requirements include:

- Customer will install two (2) redundant fiber optic circuits (one primary circuit with a redundant backup) into the Transmission Provider's substation as part of its interconnection facilities construction scope.
- Power Quality Metering (PQM) will be required on the Customer's generation tie-line terminating into the POI.
- The Customer will be required to design, procure, install, own, operate and maintain a Load Frequency/Automated Generation Control (LF/AGC) RTU at

their Customer substation. PSCo will be provided with indications, readings, and data from the LF/AGC RTU.

- The Interconnection Customer will comply with the Interconnection Guidelines for Transmission Interconnected Producer-Owned Generation Greater Than 20 MW, as amended from time to time, and available at: XEL-POL-Transmission Interconnection Guideline Greater 20MW

6.1 Schedule

This section provides proposed milestones for the interconnection of PI-2024-16 to the Transmission Provider's Transmission System. The customer requested back-feed date (In-Service Date for Transmission Provider's Interconnection Facilities and Station Network Upgrades required for interconnection) for the Provisional Interconnection Service is February 1, 2027. This is attainable by the Transmission Provider, based upon the current schedule developed for this interconnection request. The Transmission Provider proposes the milestones provided below in Table 16.

Table 16 – Proposed Milestones for PI-2024-16

Milestone	Responsible Party	Estimated Completion Date
PLGIA Execution	Interconnection Customer and Transmission Provider	August 30, 2025
In-Service Date for Transmission Provider Interconnection Facilities and Station Network Upgrades required for interconnection	Transmission Provider	March 10, 2027
In-Service Date & Energization of Interconnection Customer's Interconnection Facilities	Interconnection Customer	March 10, 2027
Initial Synchronization Date	Interconnection Customer	March 18, 2027
Begin trial operation & testing (90% of Generating Facility available for testing)	Interconnection Customer and Transmission Provider	April 1, 2027
Commercial Operation Date	Interconnection Customer	June 1, 2027

Some schedule elements are outside of the Transmission Provider's control and could impact the overall schedule. The following schedule assumptions provide the basis for the schedule milestones:

- Construction permitting (if required) for new facilities will be completed within 12 months of PLGIA execution.
- The Transmission Provider is currently experiencing continued increases to material lead times which could impact the schedule milestones. The schedule milestones are based upon material lead times known at this time.
- Availability of line outages to interconnect new facilities to the transmission system.
- A Certificate of Public Convenience and Necessity (CPCN) may be required for the construction of the Interconnection Facilities and Station Network Upgrades. The expected time to obtain a CPCN approval is 18 months, which could impact the start of construction for the interconnection facilities.

7.0 Summary of Provisional Interconnection Service Analysis

The total estimated cost of the PSCo transmission system improvements required for PI-2024-16 to qualify for Provisional Interconnection Service would be **$11.015** million.

The initial maximum permissible output of PI-2024-16 Generating Facility is 250 MW at the Point of Interconnection. Additionally, the requested Grid Charging capacity of 254.28 MW will be permitted. The maximum permissible output of the Generating Facility in the PLGIA will be reviewed quarterly and updated if there are changes to the system conditions assumed in this analysis.

During the 0.95 lagging power factor test the generator terminals bus voltages exceed 1.05 p.u. voltage.

Security: PI-2024-16 is a request for Energy Resource Interconnection Service (ERIS). For ERIS requests, security shall estimate the risk associated with the Network Upgrades and the Interconnection Facilities and is assumed to be a minimum of $5 million.

The Provisional Interconnection Service in and of itself does not convey transmission service.

8.0 Contingent Facilities

The Contingent Facilities identified for PI-2024-16 include the TPIF and Station Network Upgrades identified in Table 14 and Table 15, respectively.

9.0 Preliminary One-Line Diagram and General Arrangement for PI-2024-16

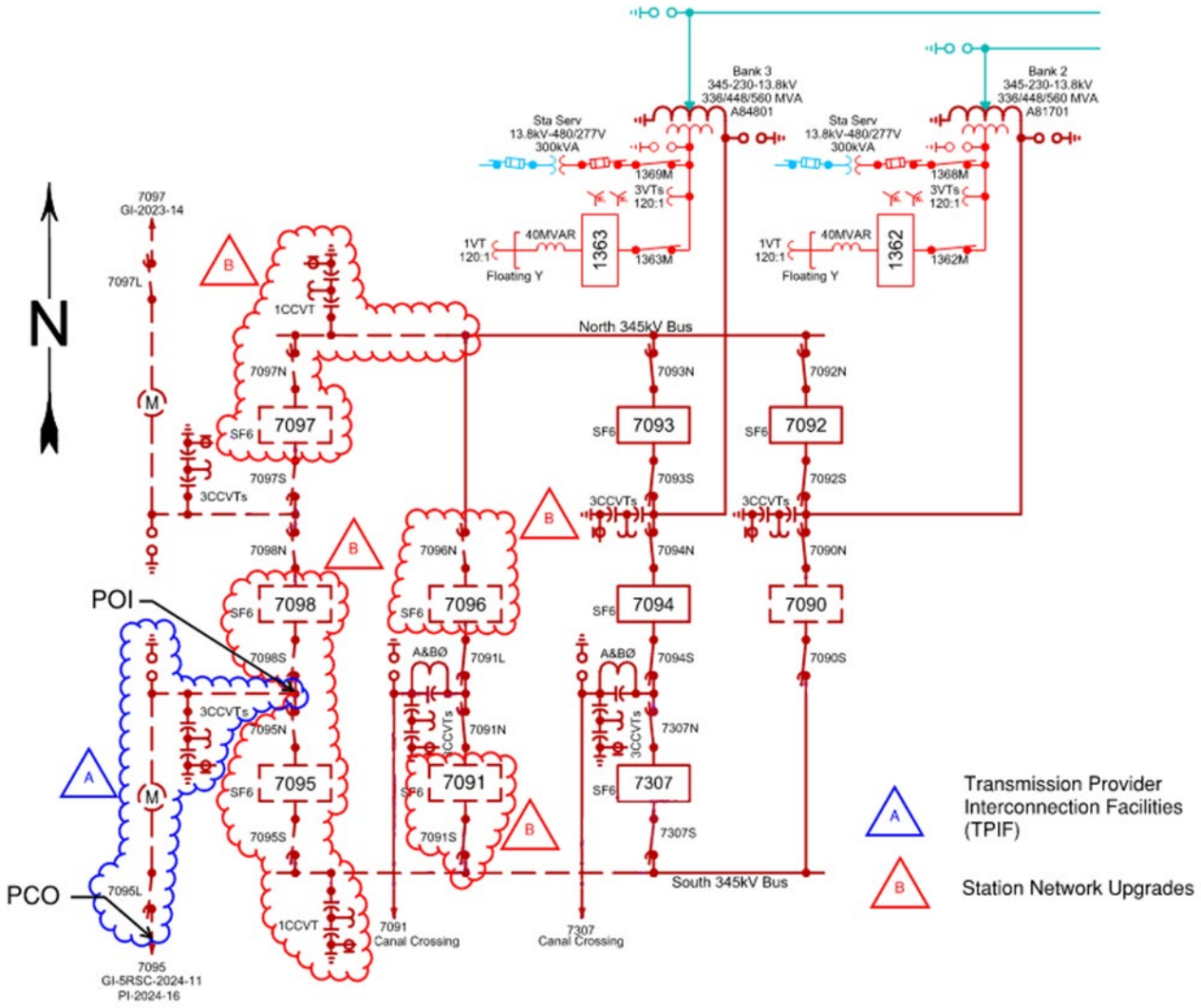


Figure 2: Preliminary One-Line for PI-2024-16 at the Pawnee 345 kV Switching Station

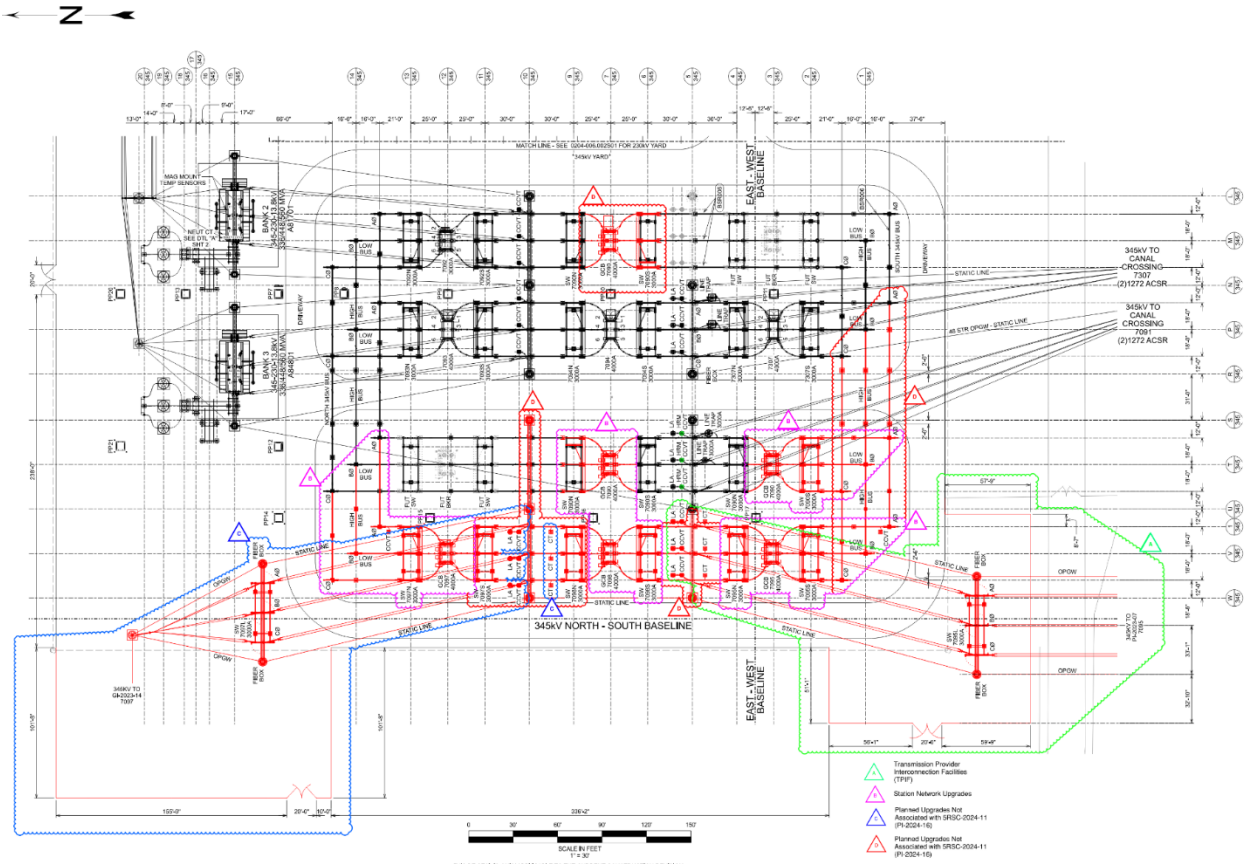
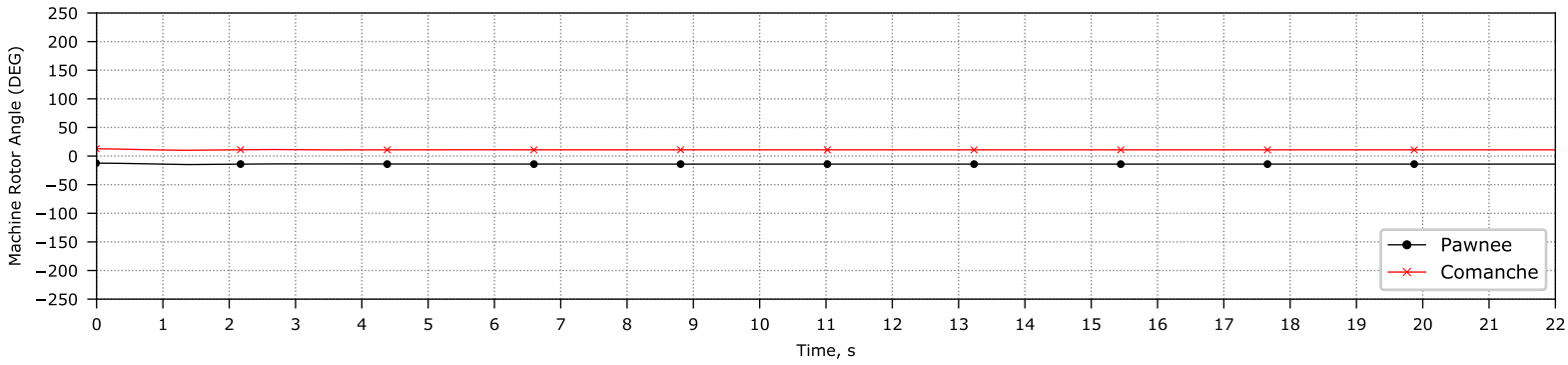


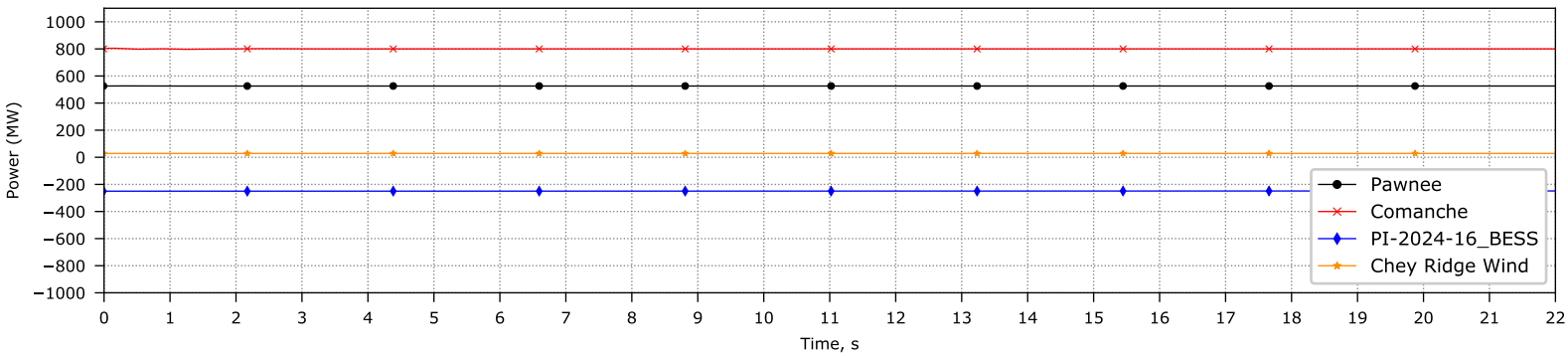
Figure 3: Preliminary General Arrangement for PI-2024-16 at the Pawnee 345 kV Switching Station

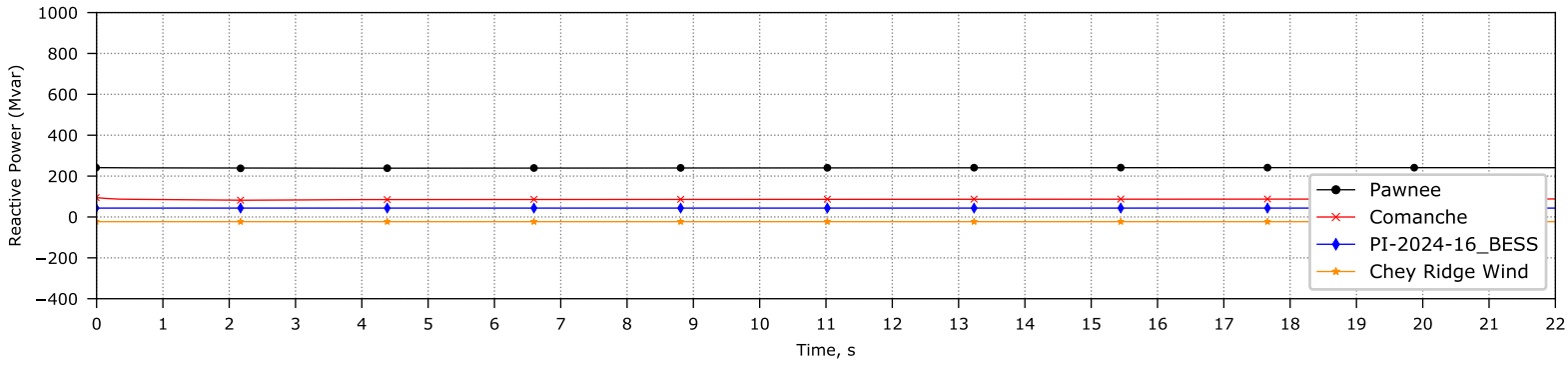
10.0 Appendices

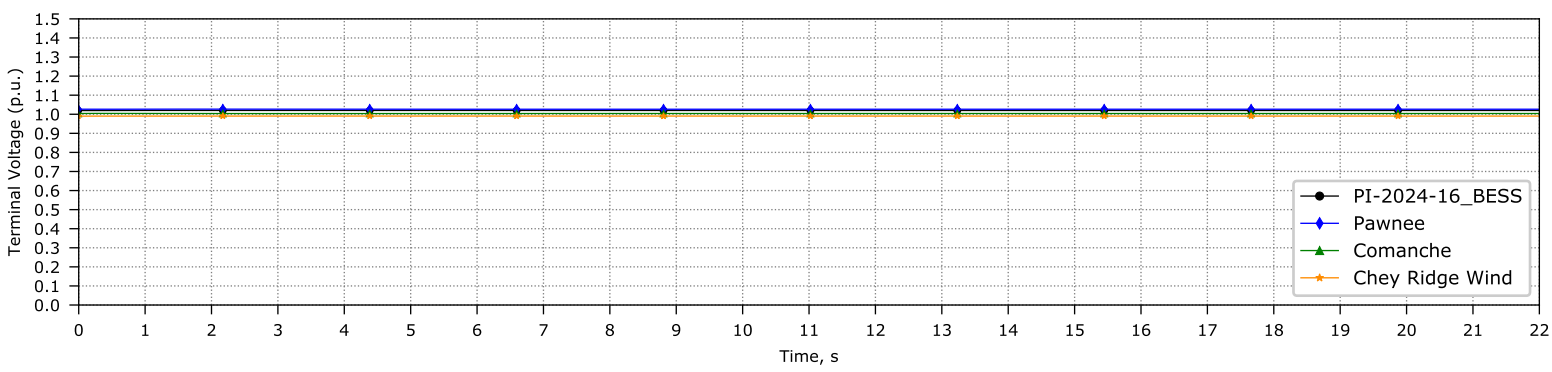
Appendix A: Transient Stability Plots for Discharging Scenario	 PI-2024-16_Transient_Stability_Plots_GD
Appendix B: Transient Stability Plots for Grid Charging Scenario	 PI-2024-16_Transient_Stability_Plots_GC_Res

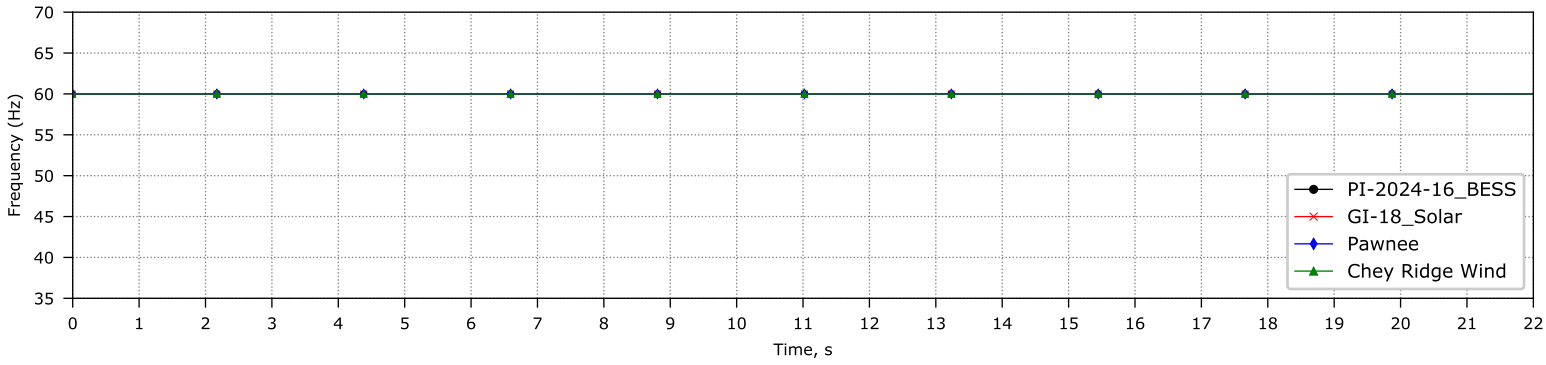
PI-2024-16_Study_East_flatrun

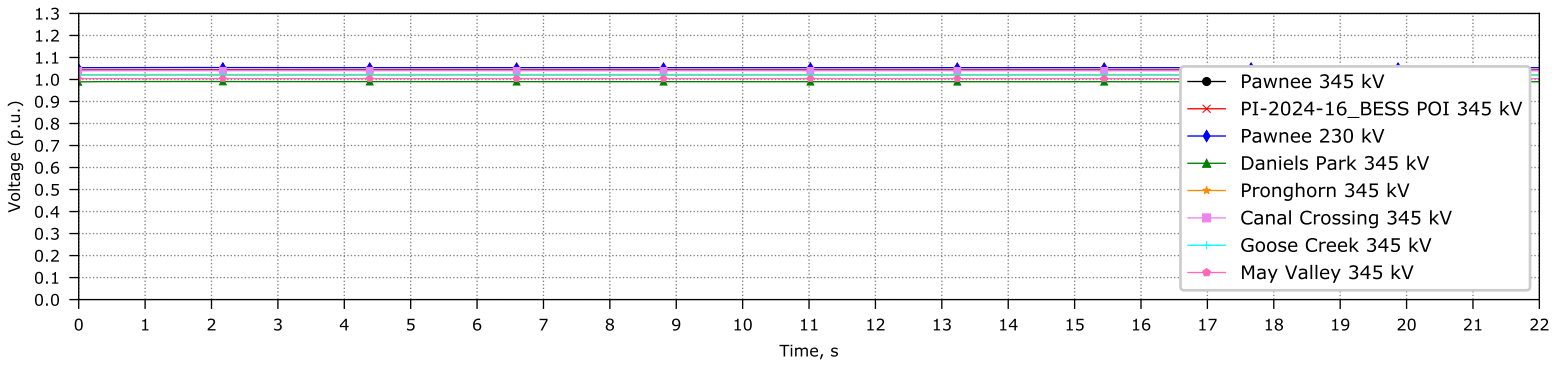




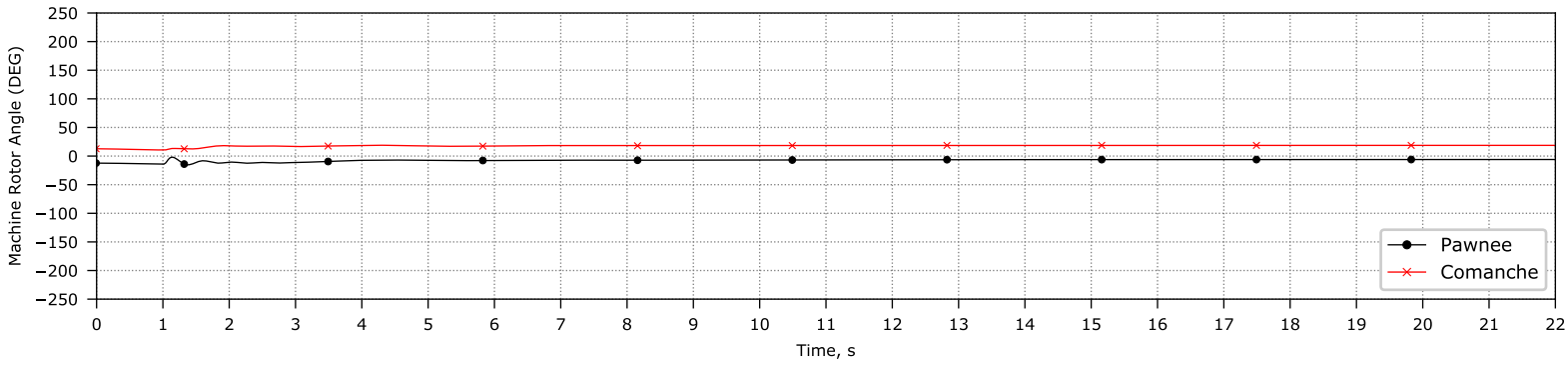


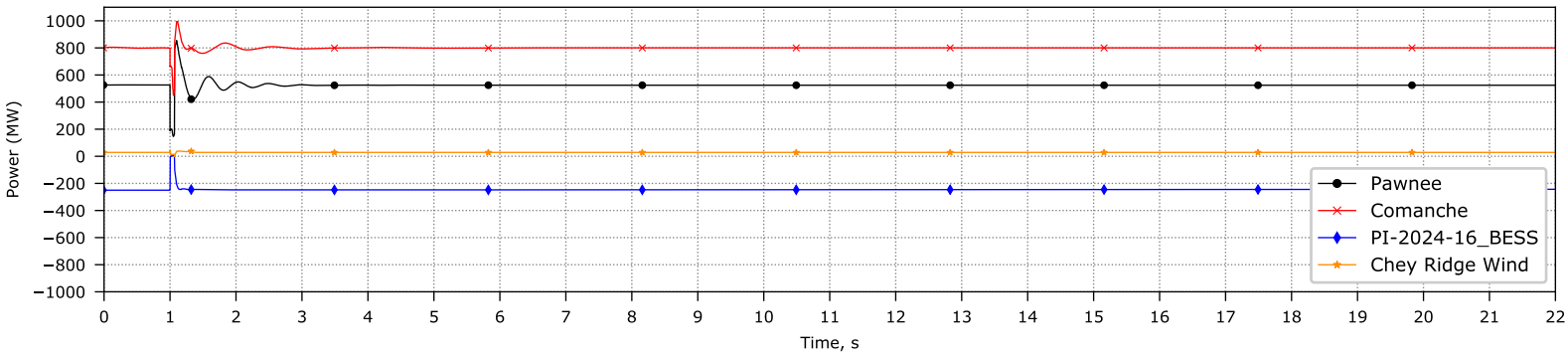


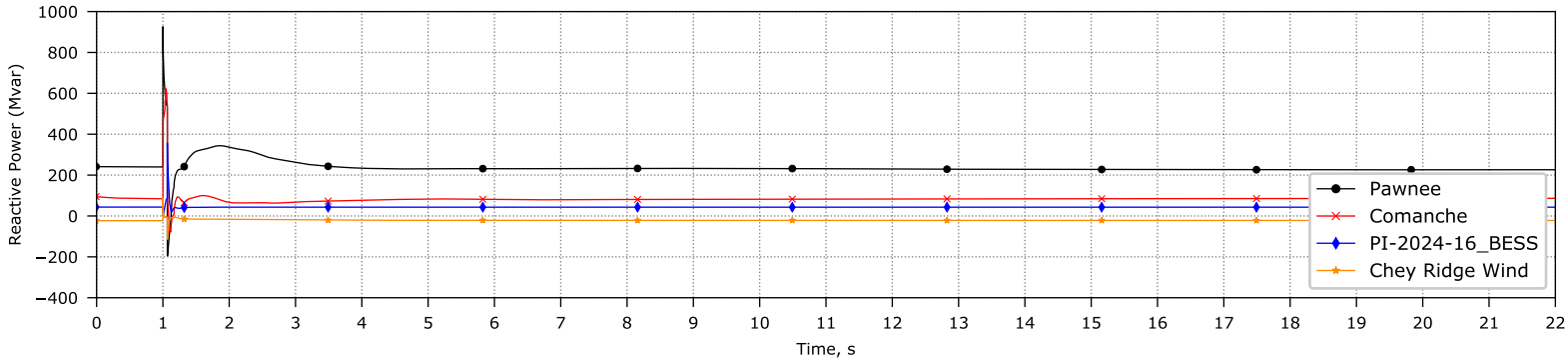


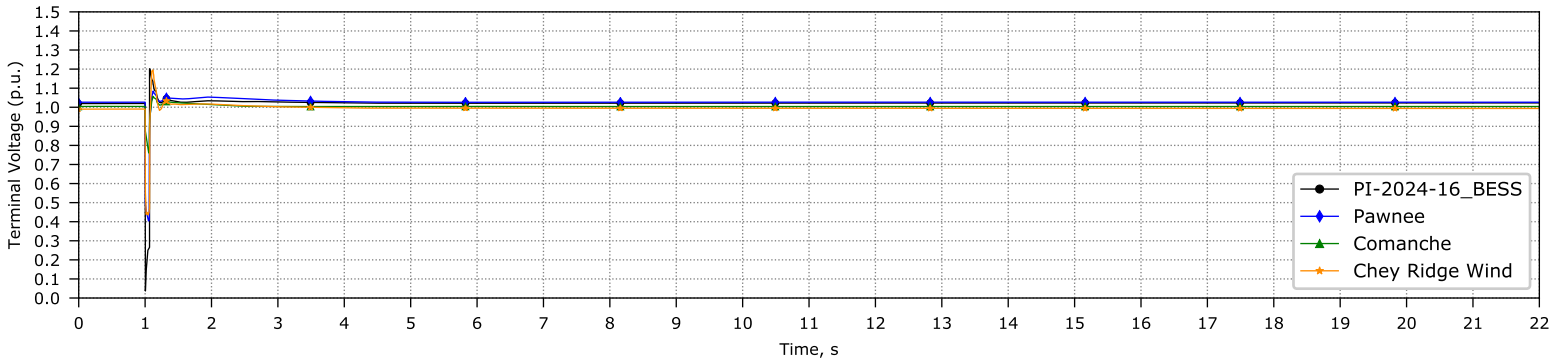


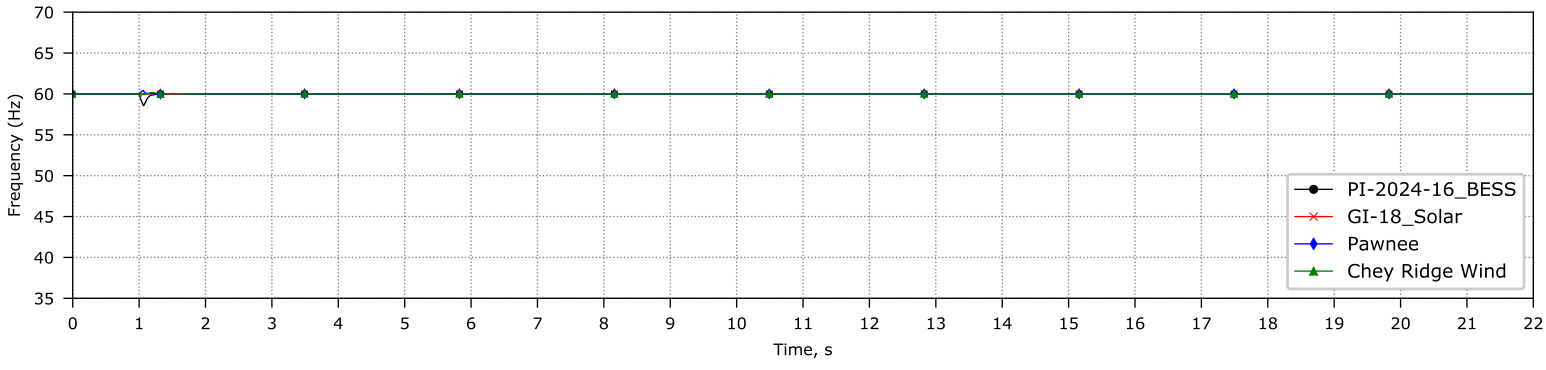
PI-2024-16_Study_East_CanalXing-Pawnee-1_345kV

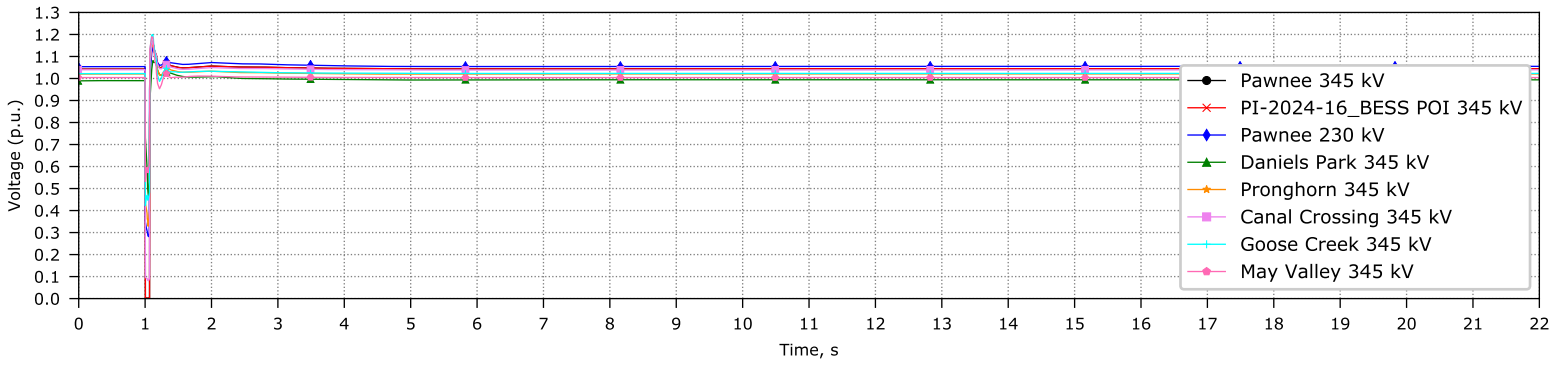




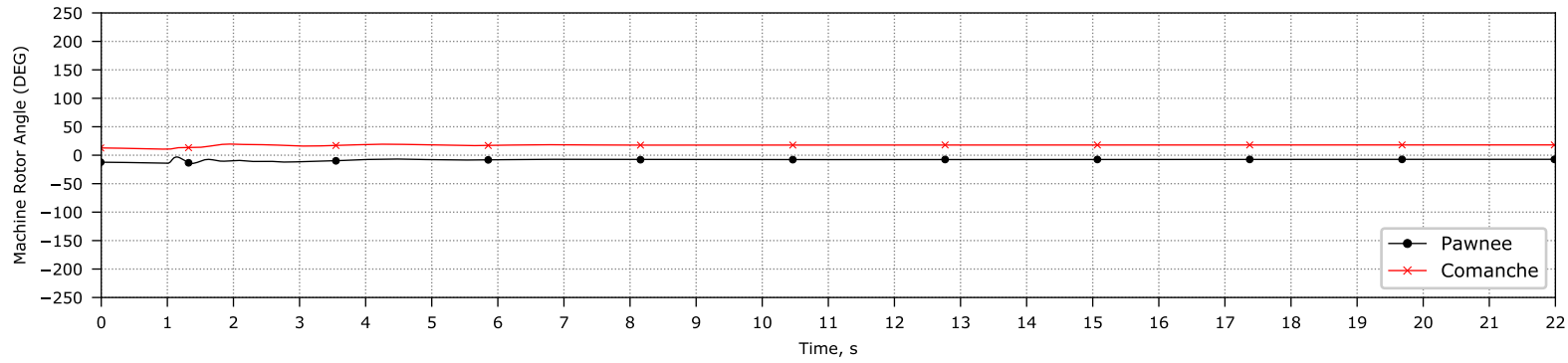


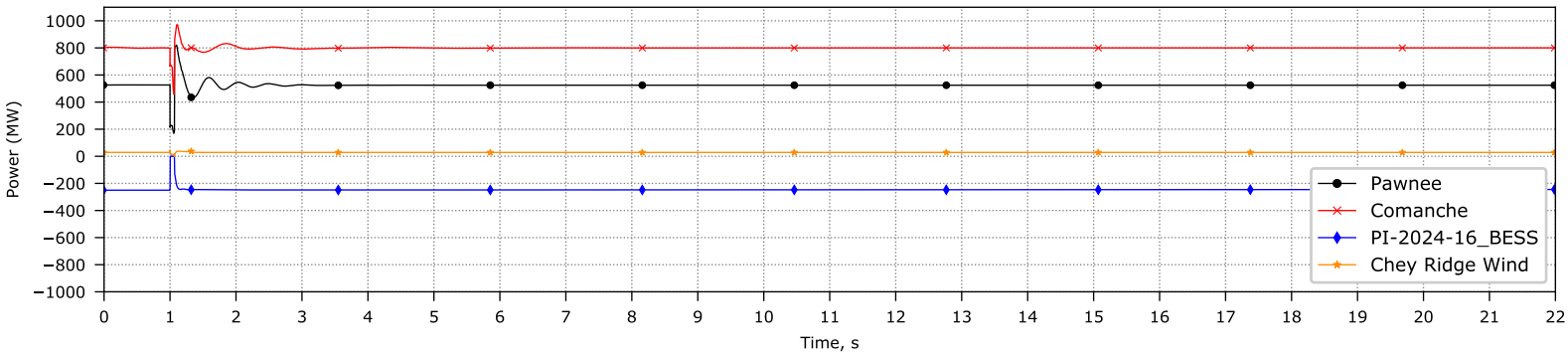


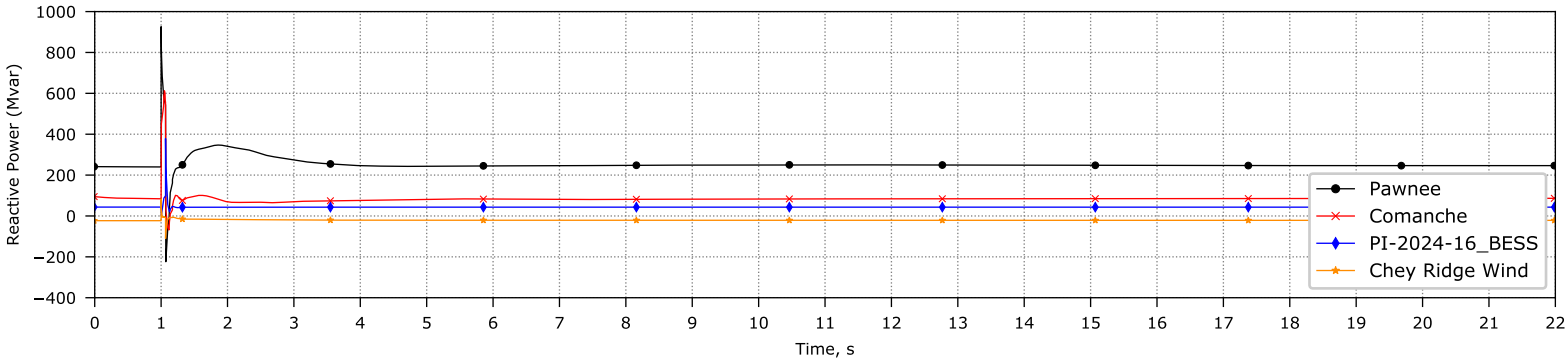


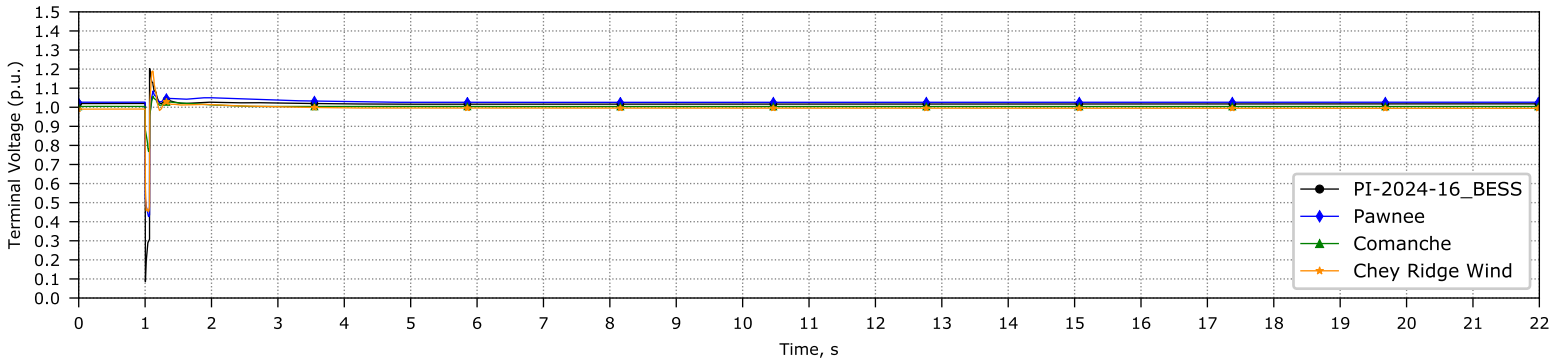


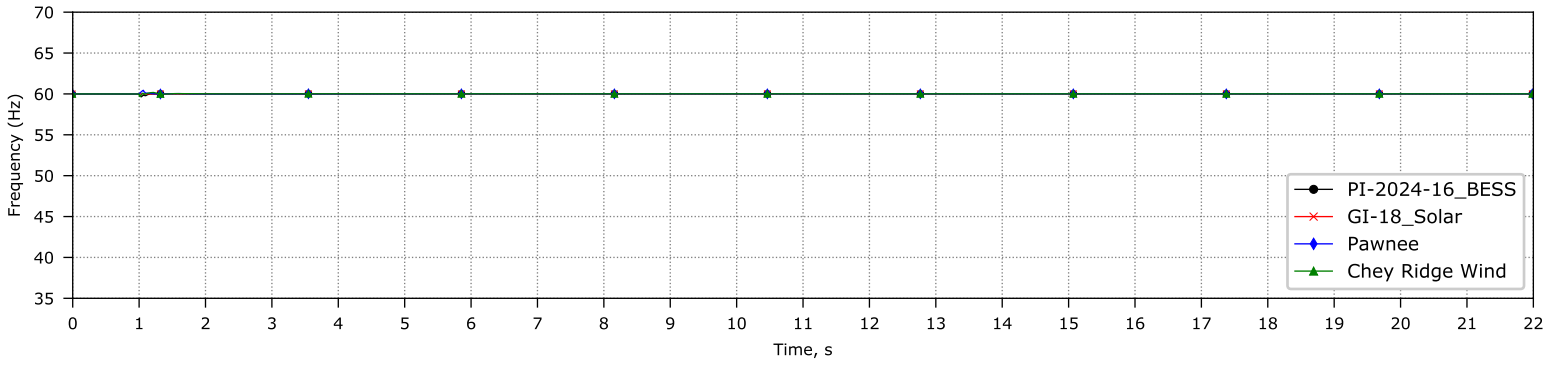
PI-2024-16_Study_East_GI_2023_14-Pawnee-1_345kV

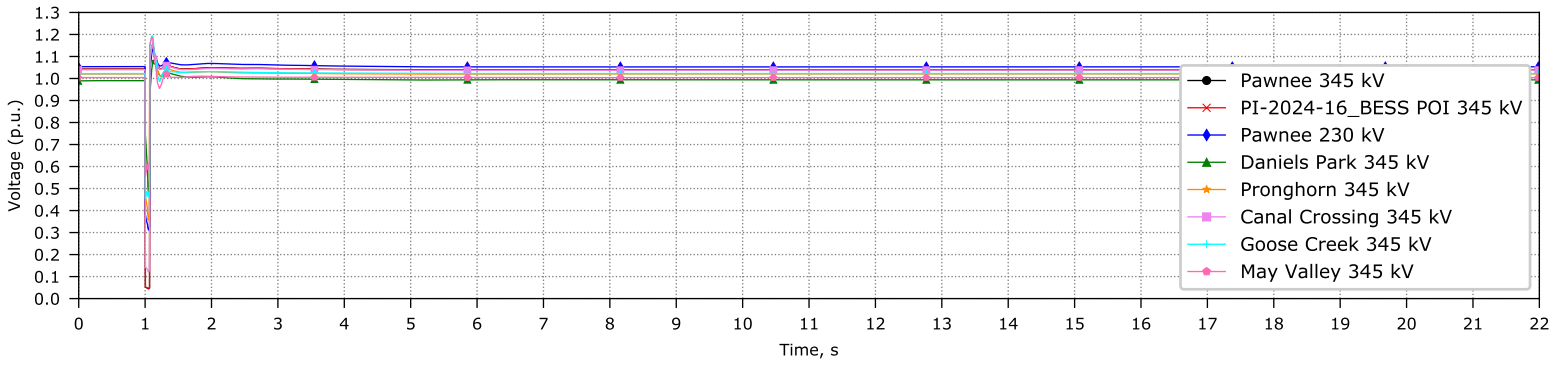




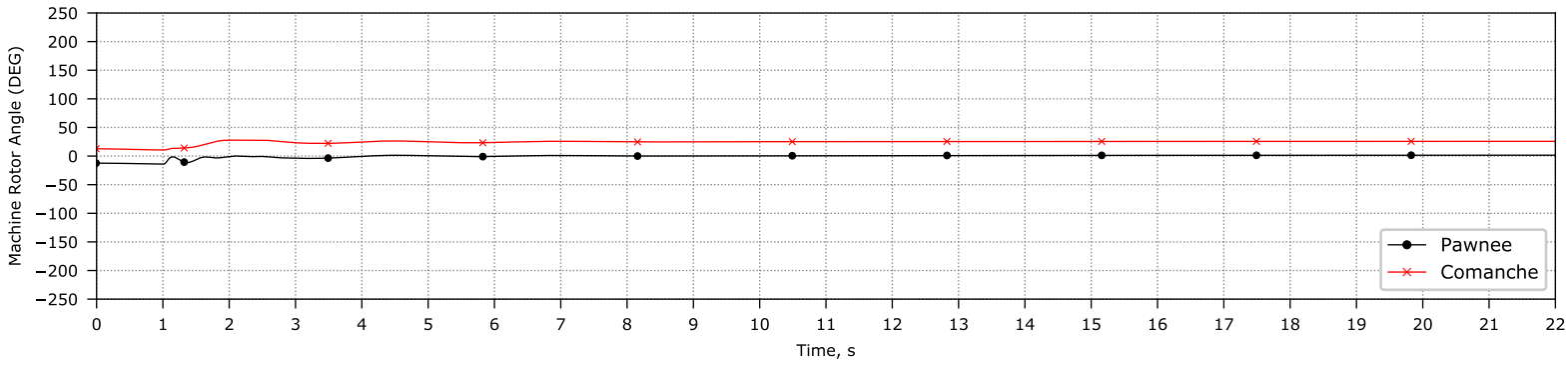


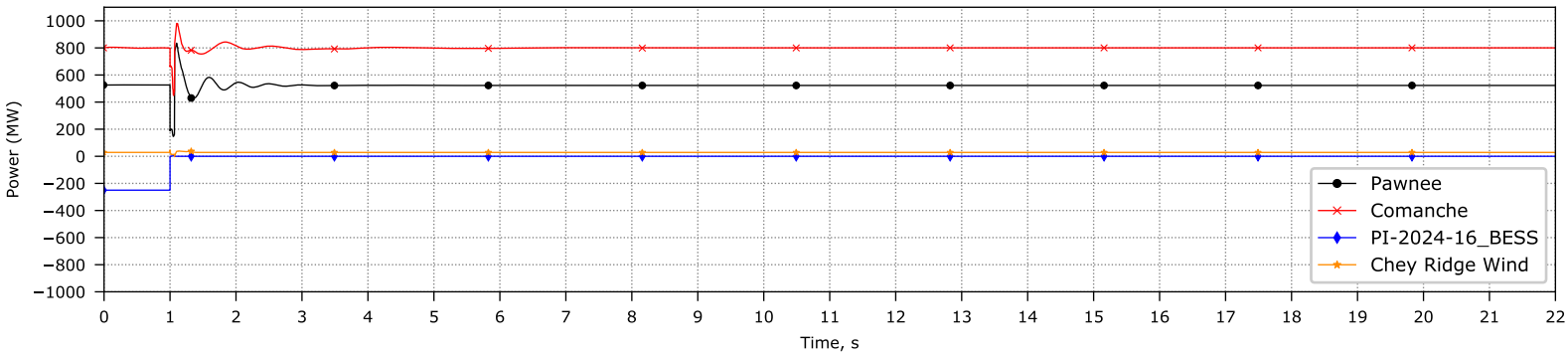


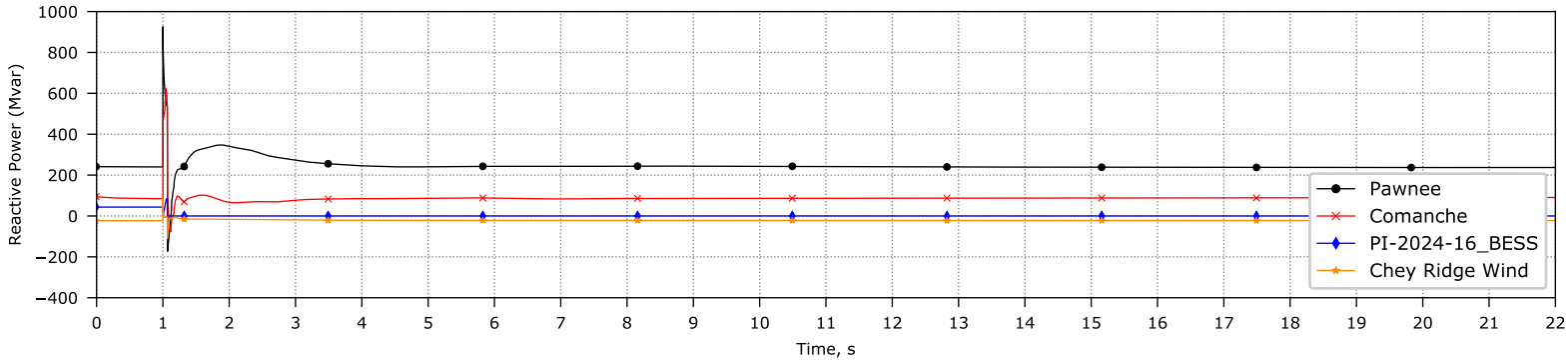


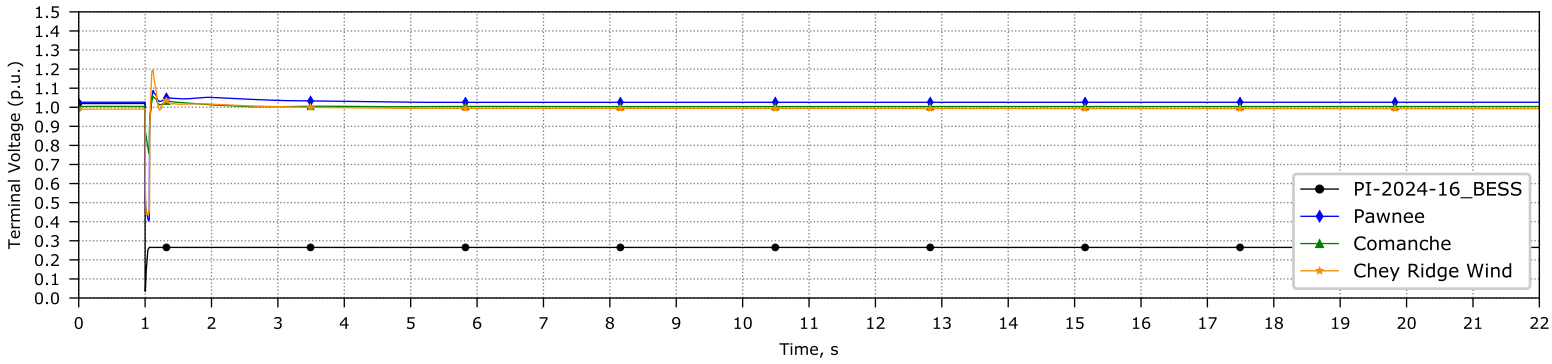


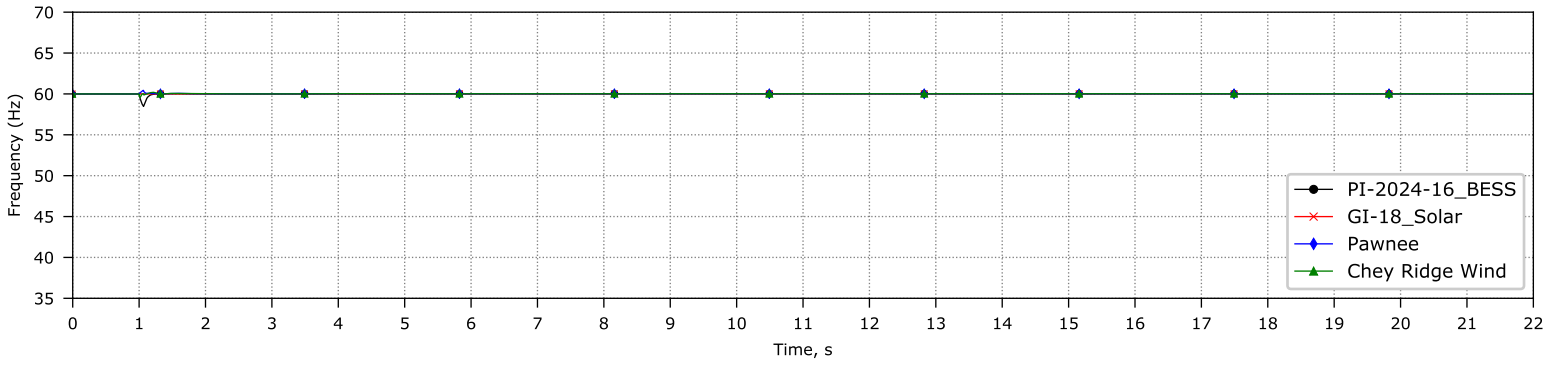
PI-2024-16_Study_East_Pawnee_PI-2024-16_Gen

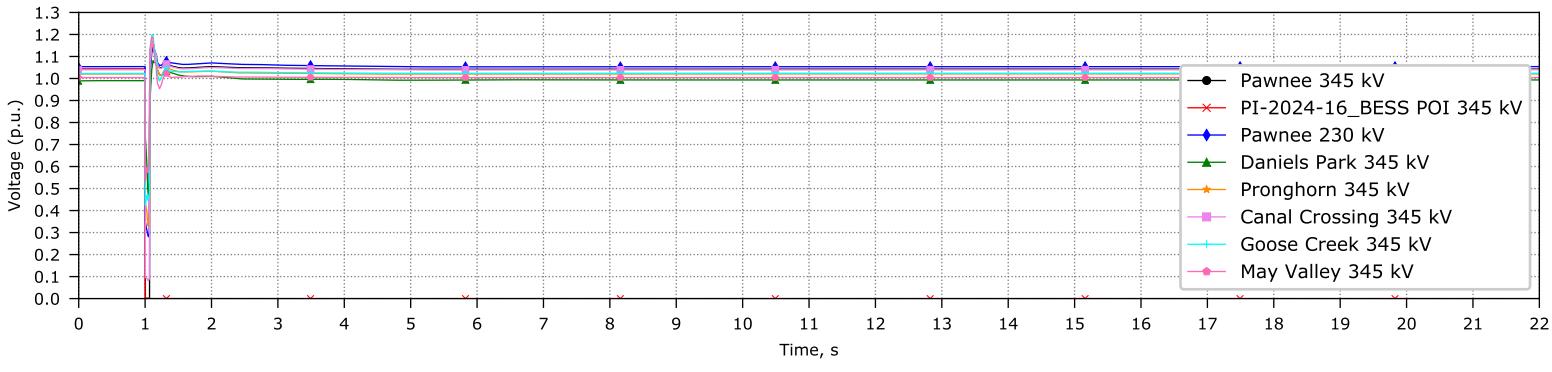




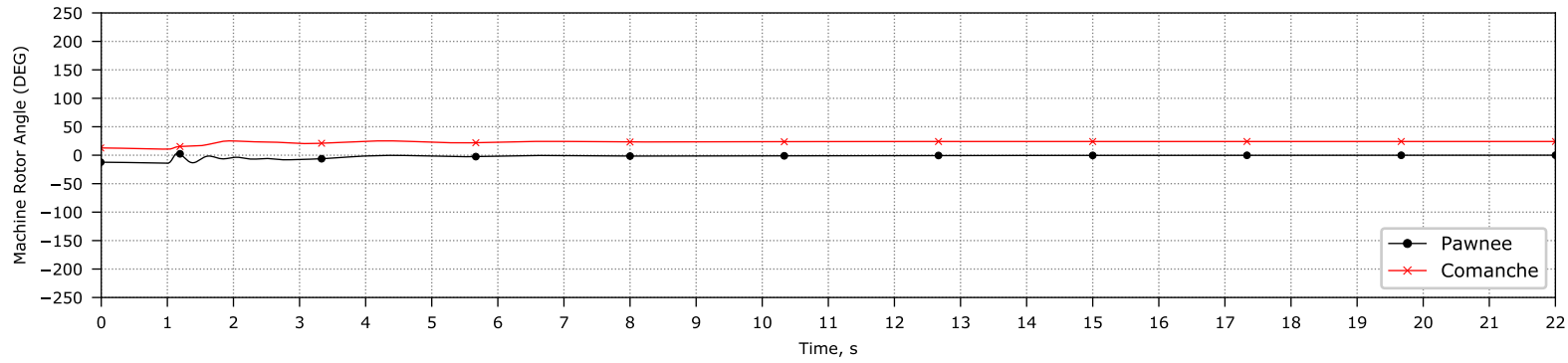


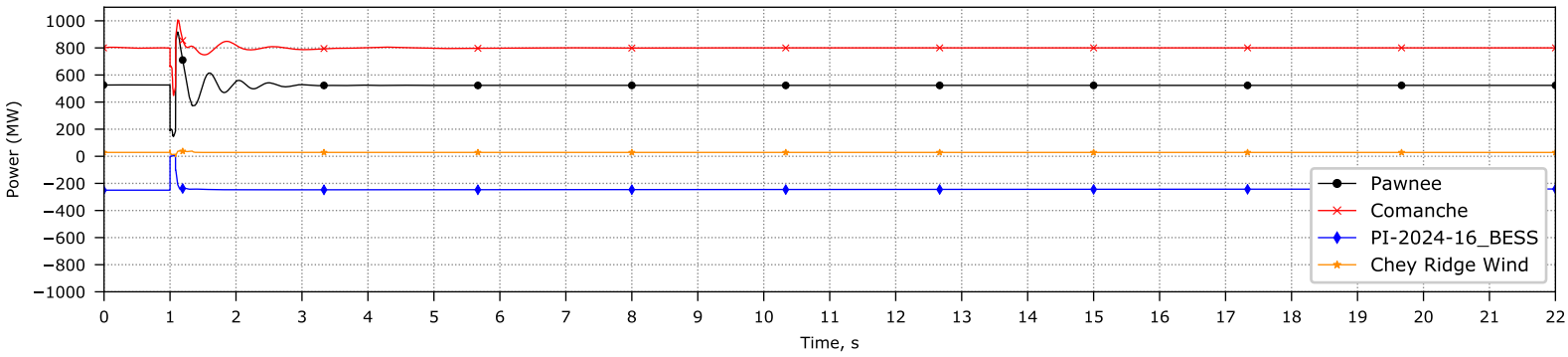


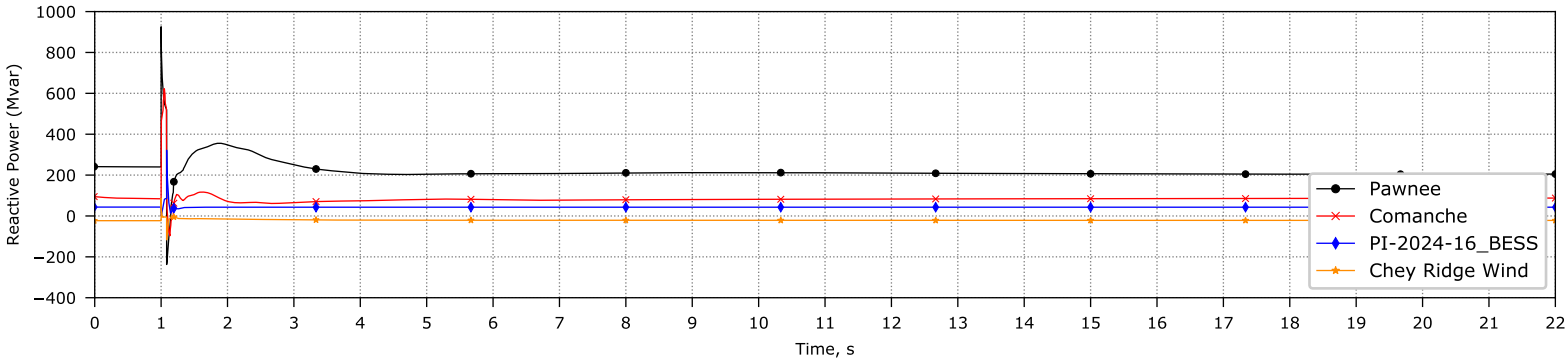


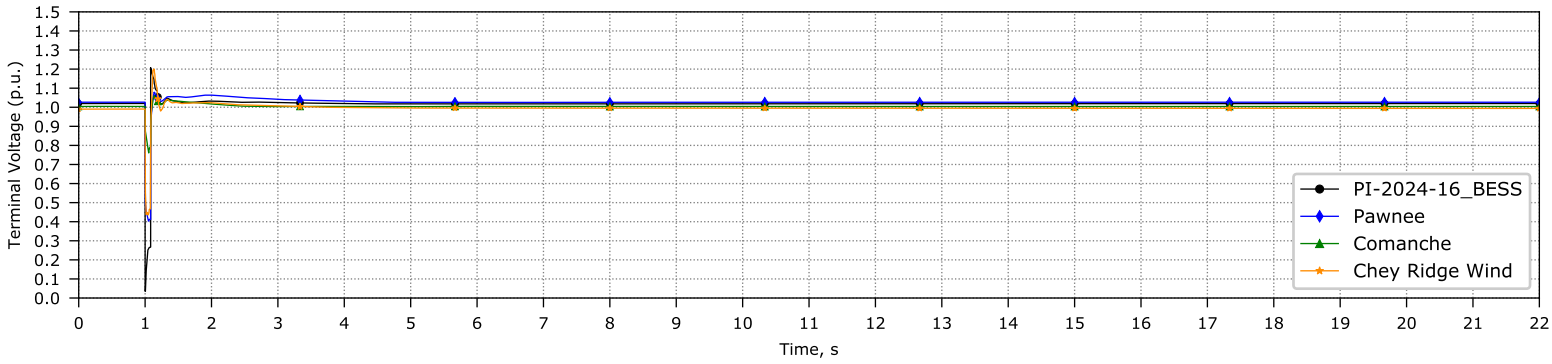


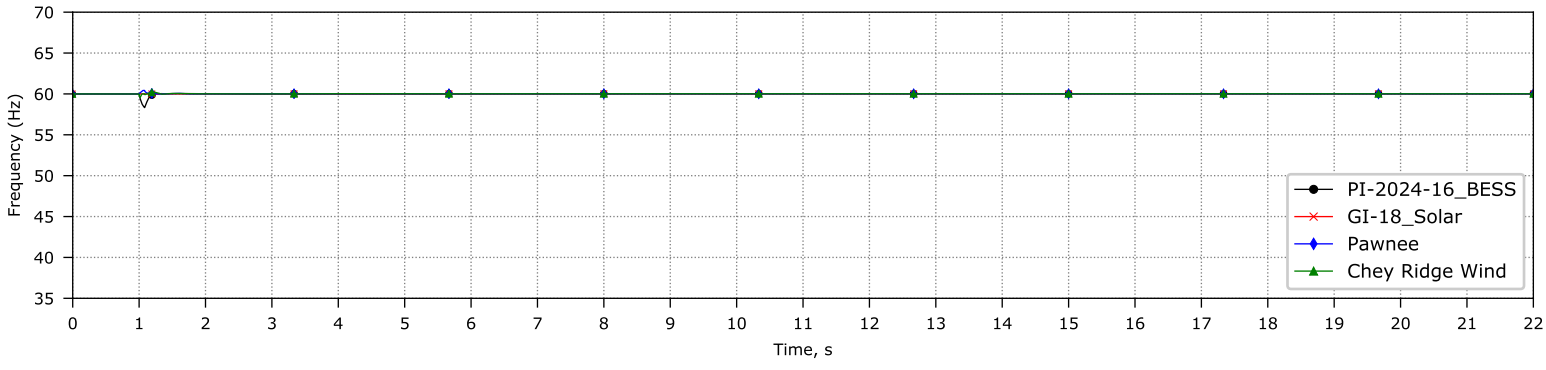
PI-2024-16_Study_East_Pawnee_345kV-Pawnee_230kV_Transformer2

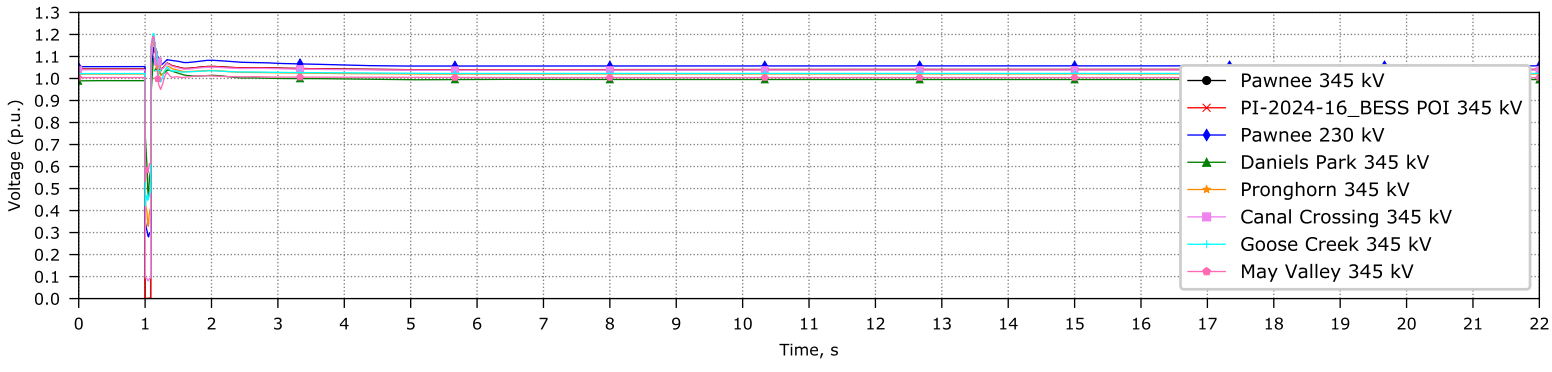




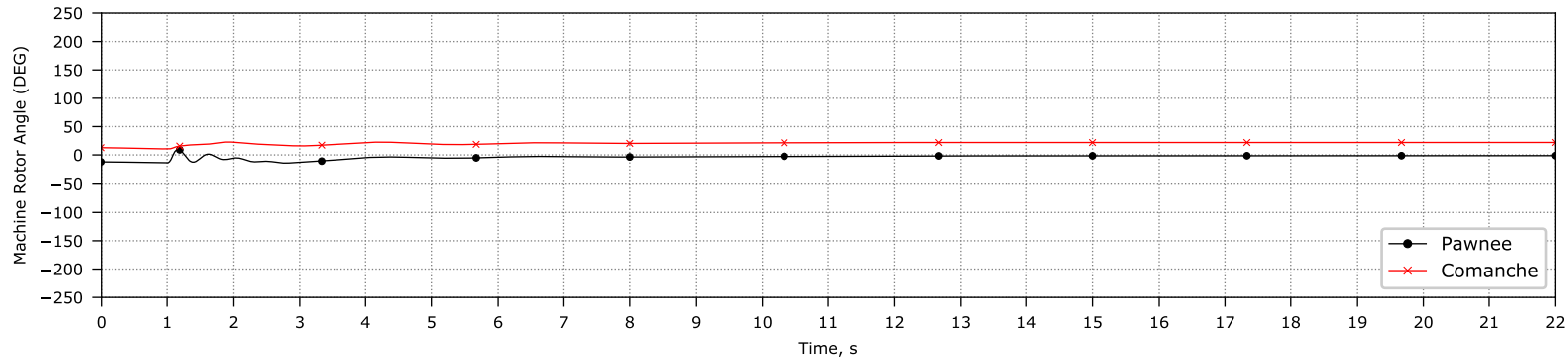


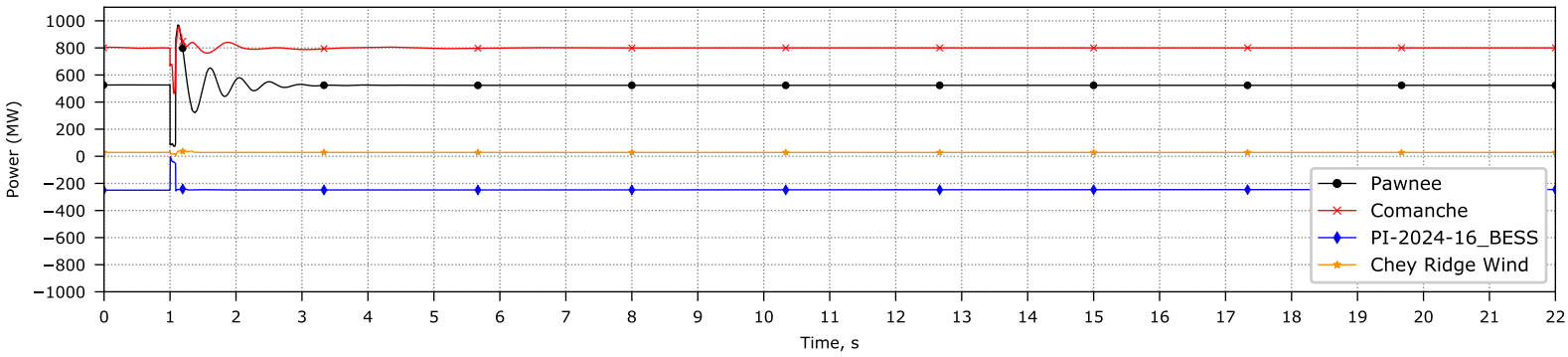


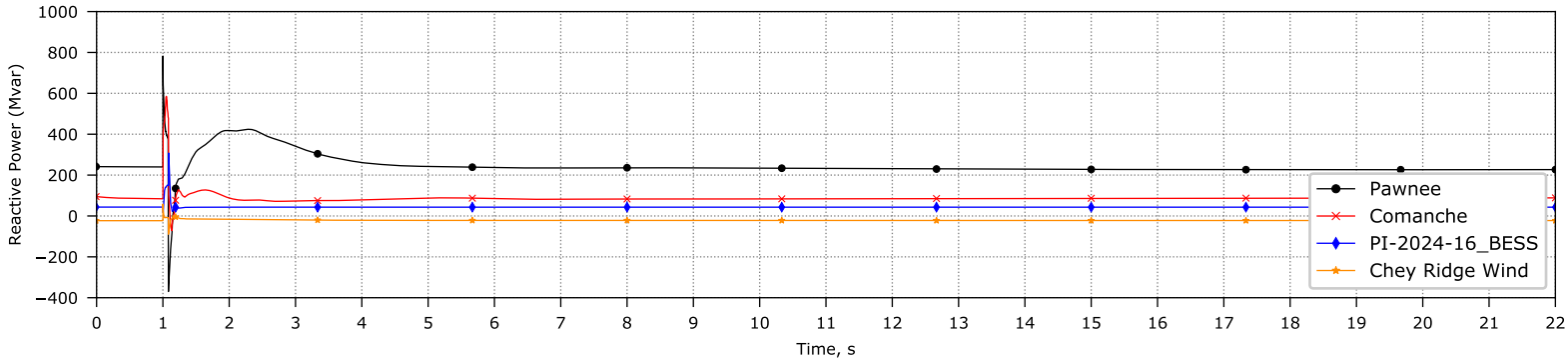


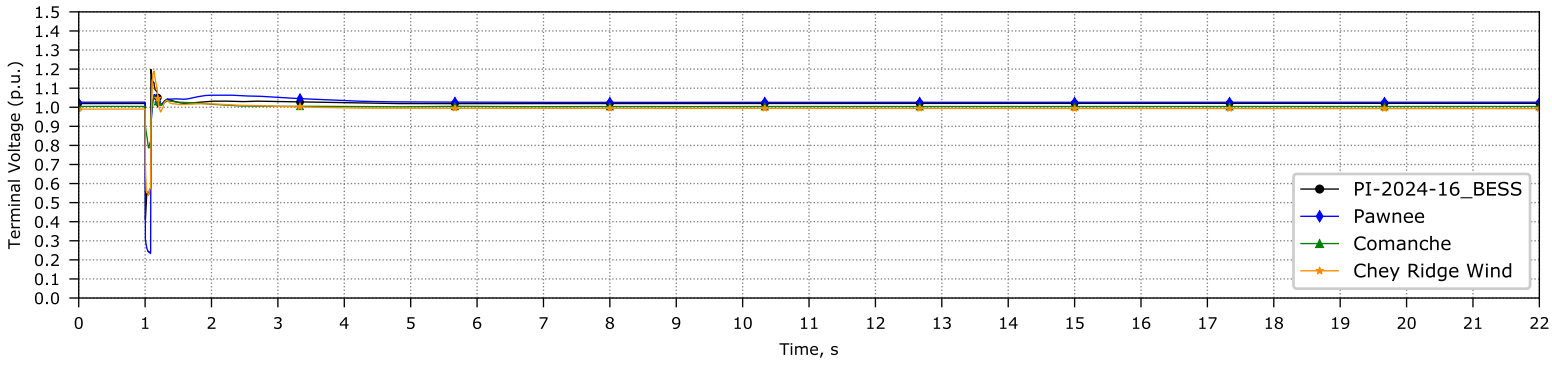


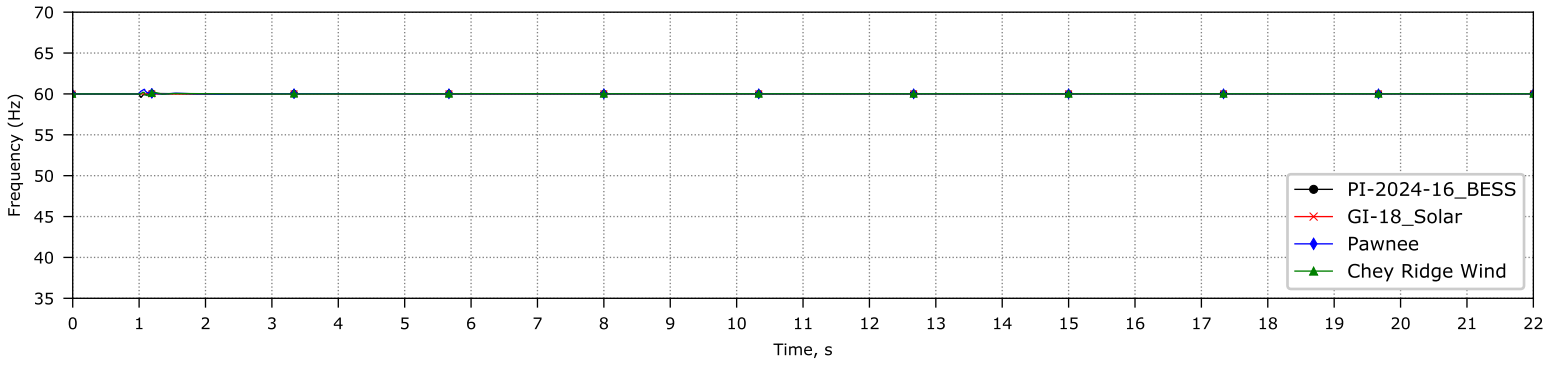
PI-2024-16_Study_East_FT_Lupton-Pawnee-1_230kV

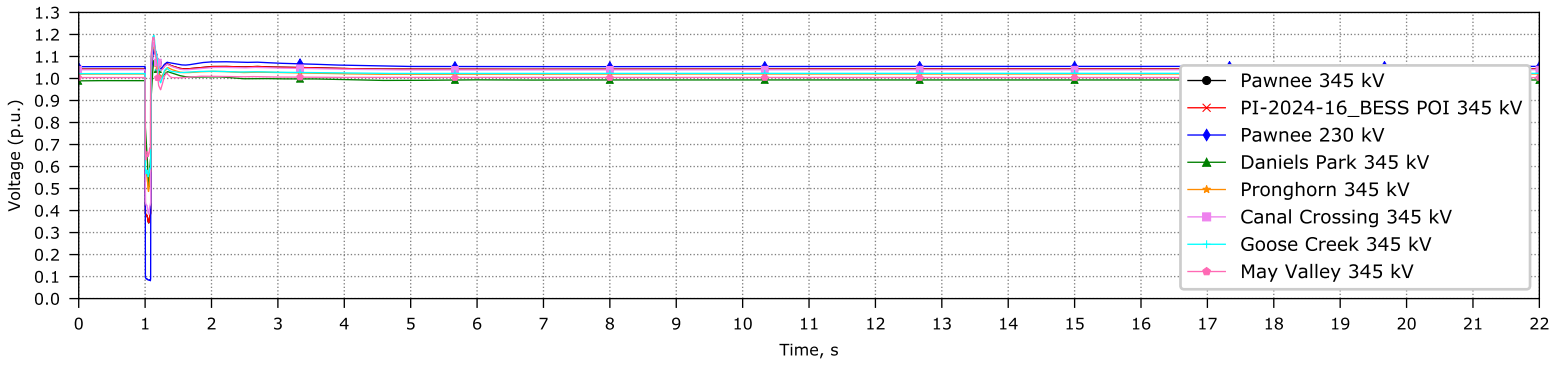




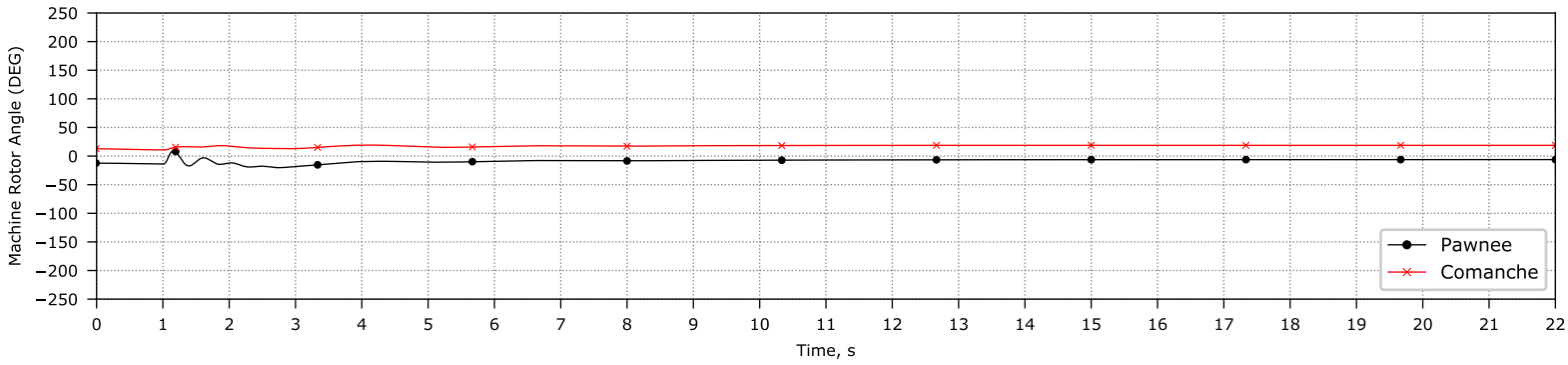


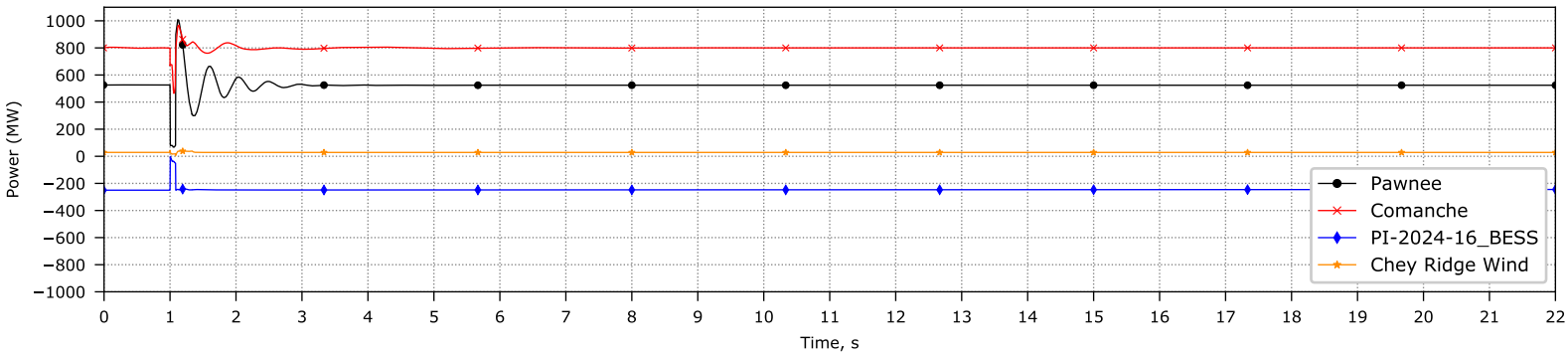


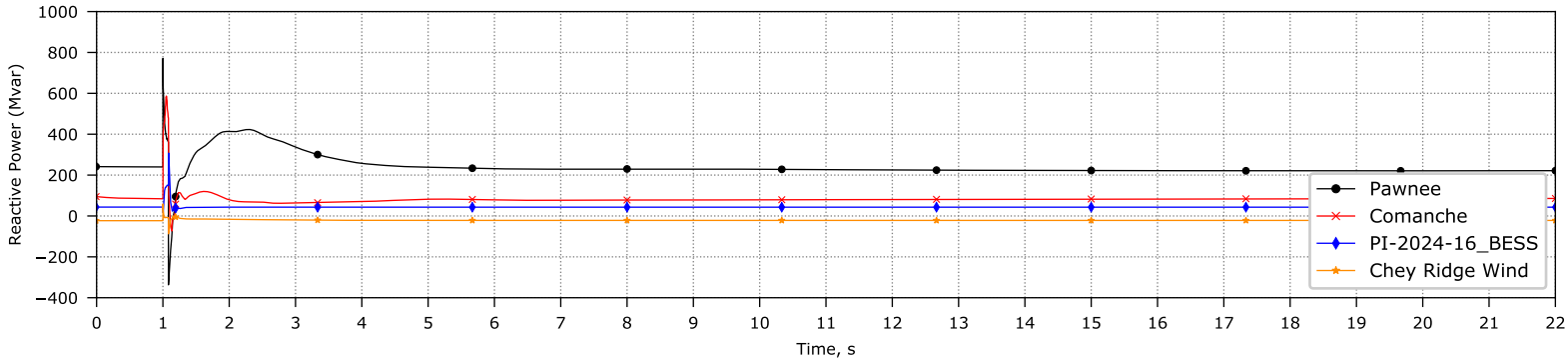


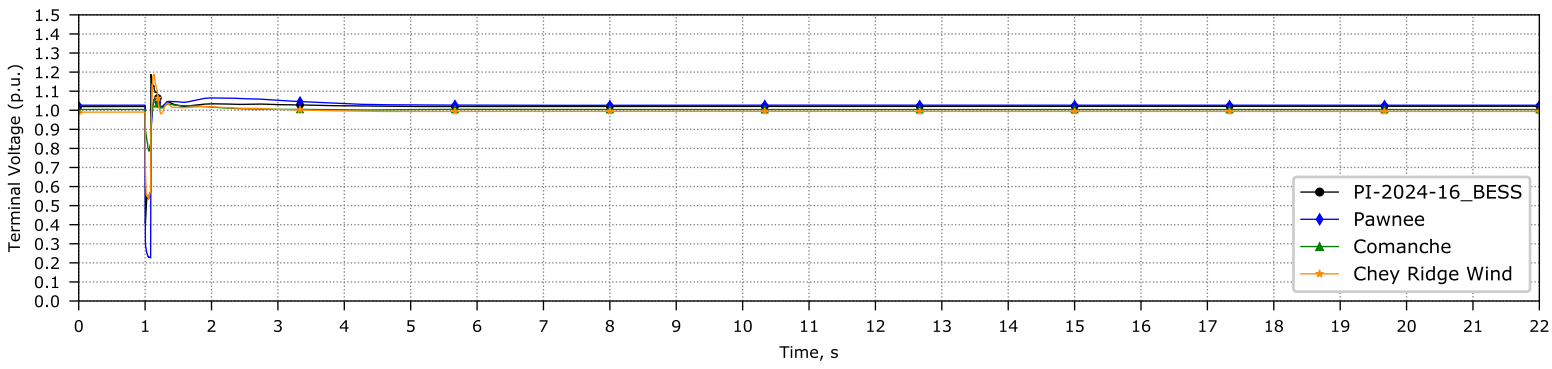


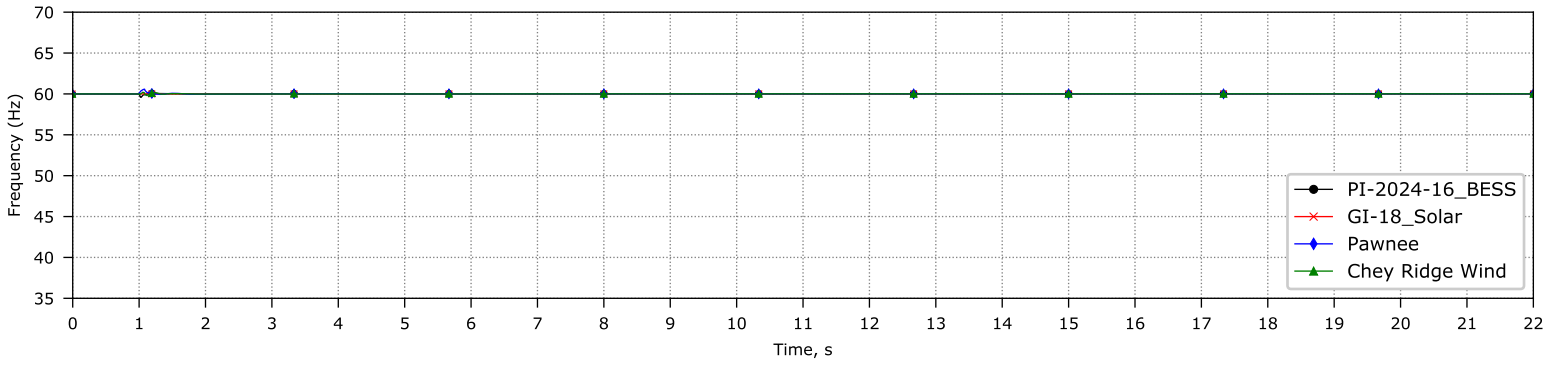
PI-2024-16_Study_East_Pawnee-Ptzlogn-1_230kV

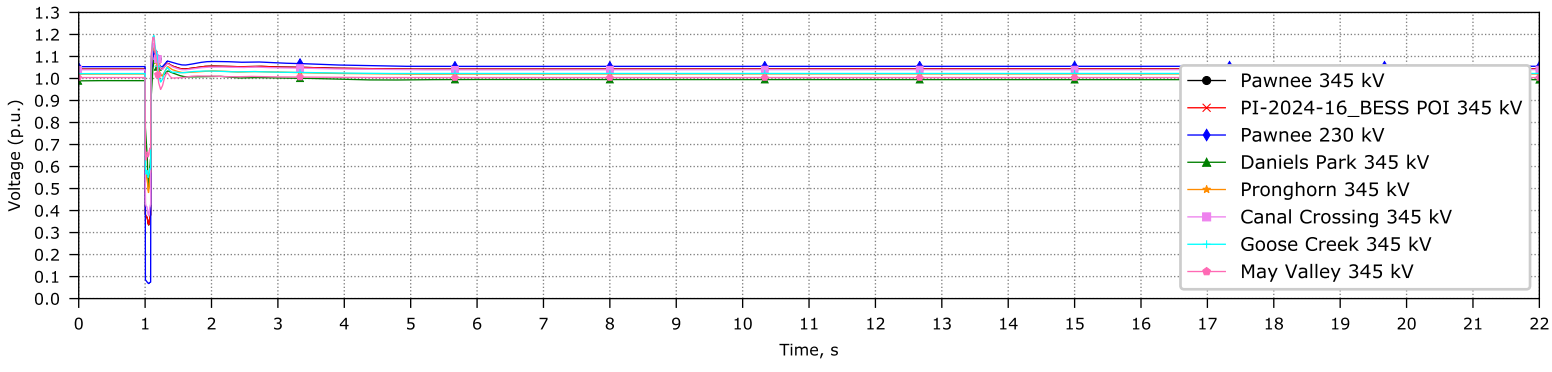




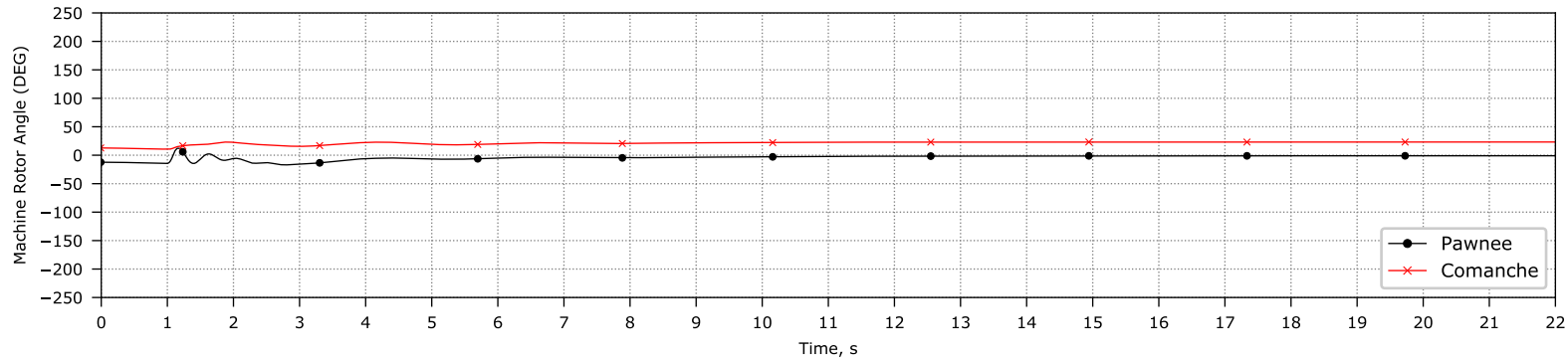


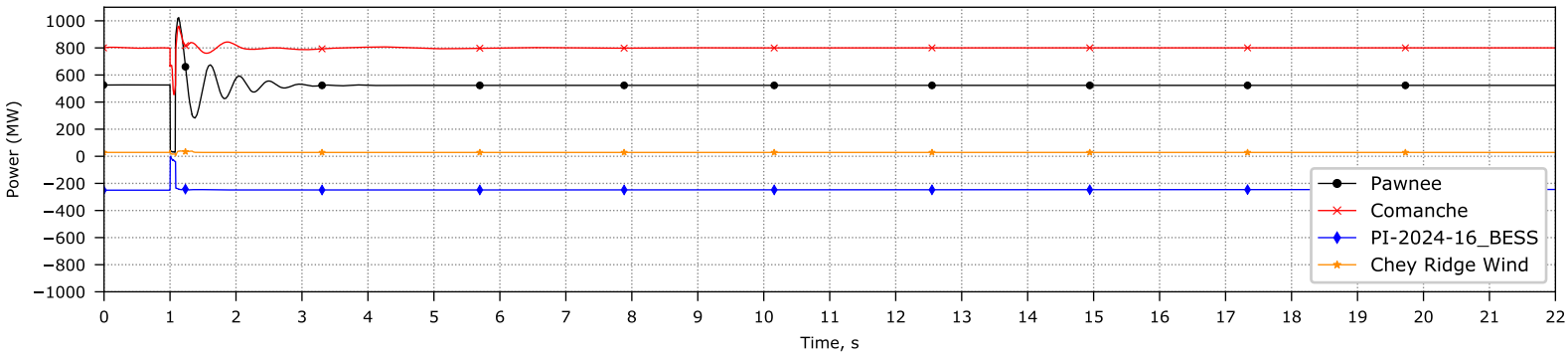


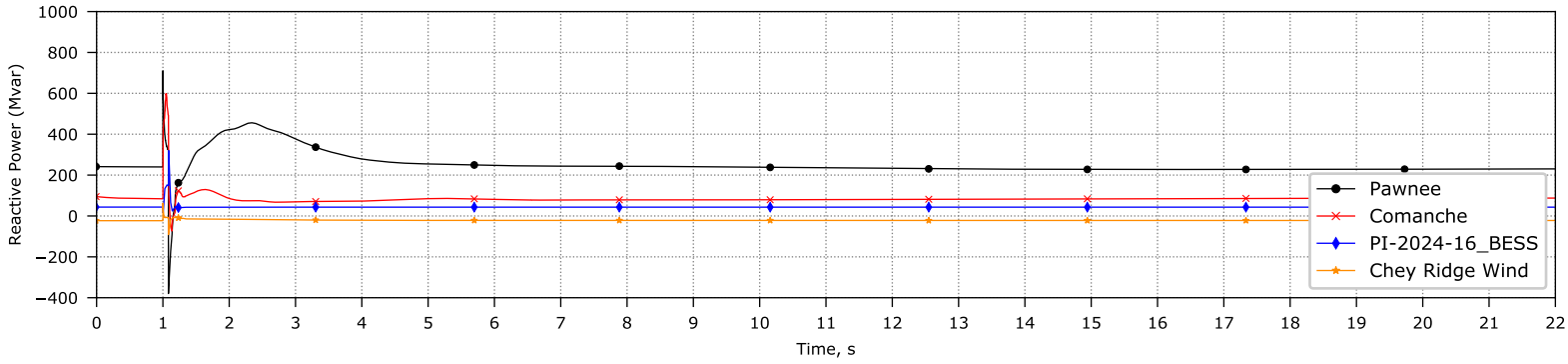


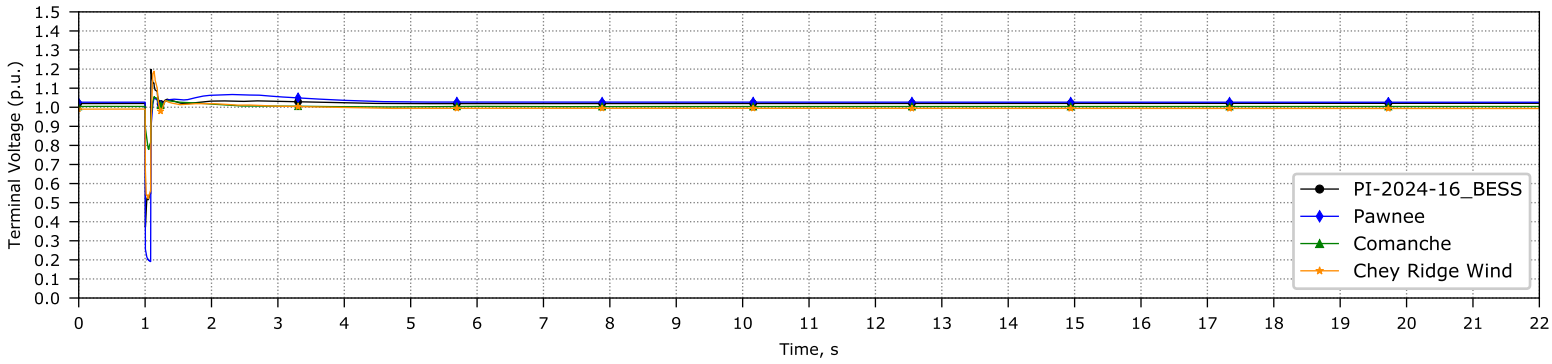


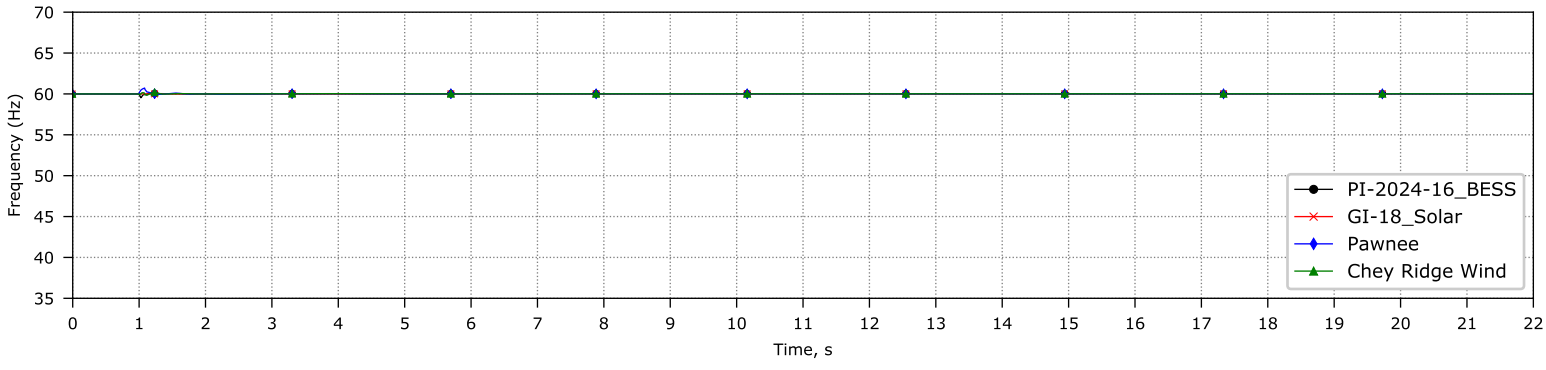
PI-2024-16_Study_East_Pawnee-5RSC_24_7-1_230kV

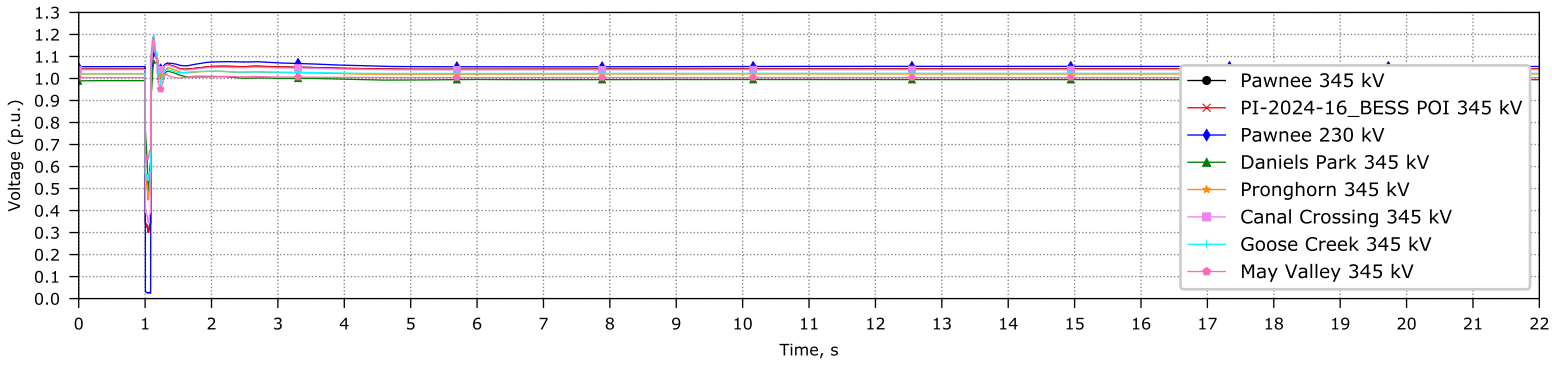




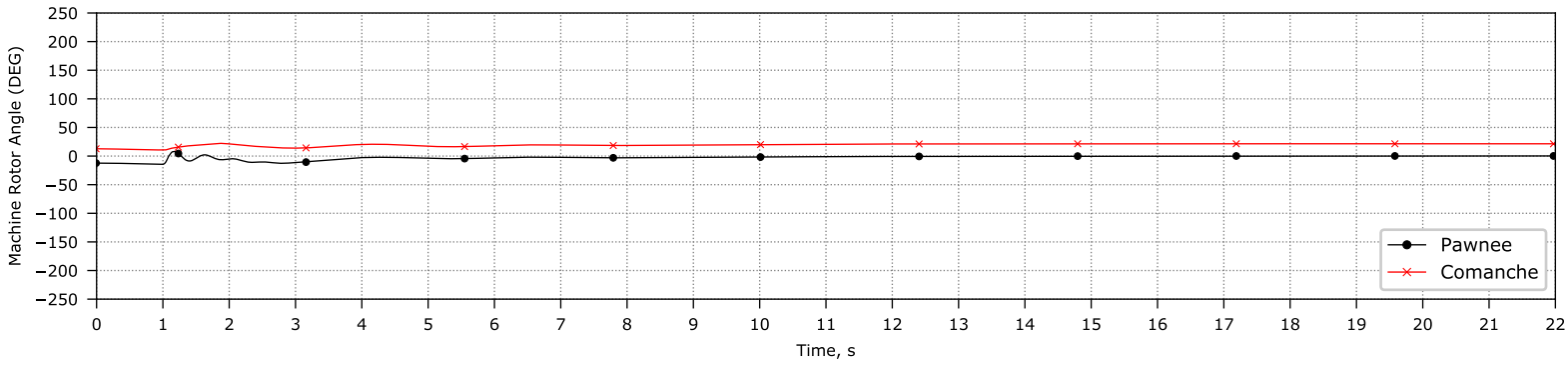


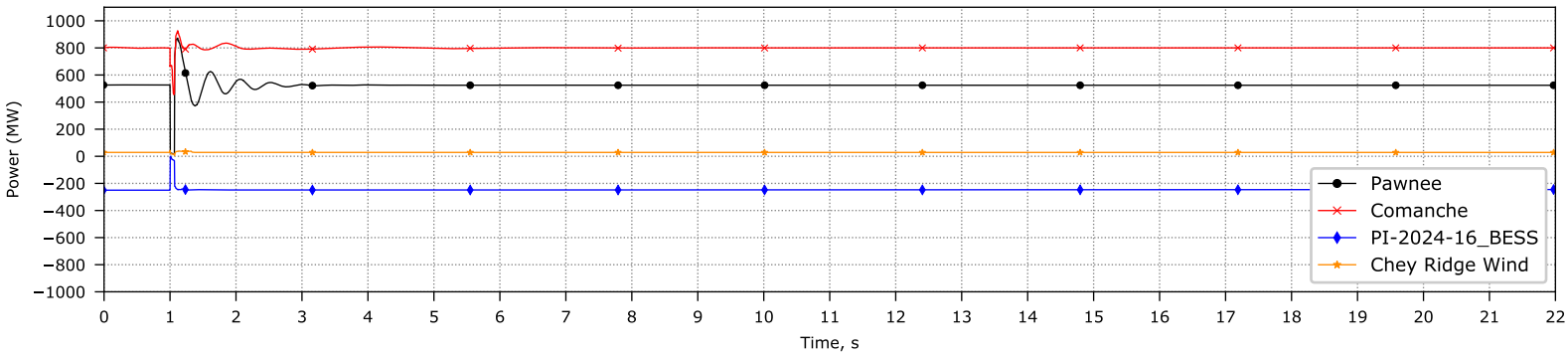


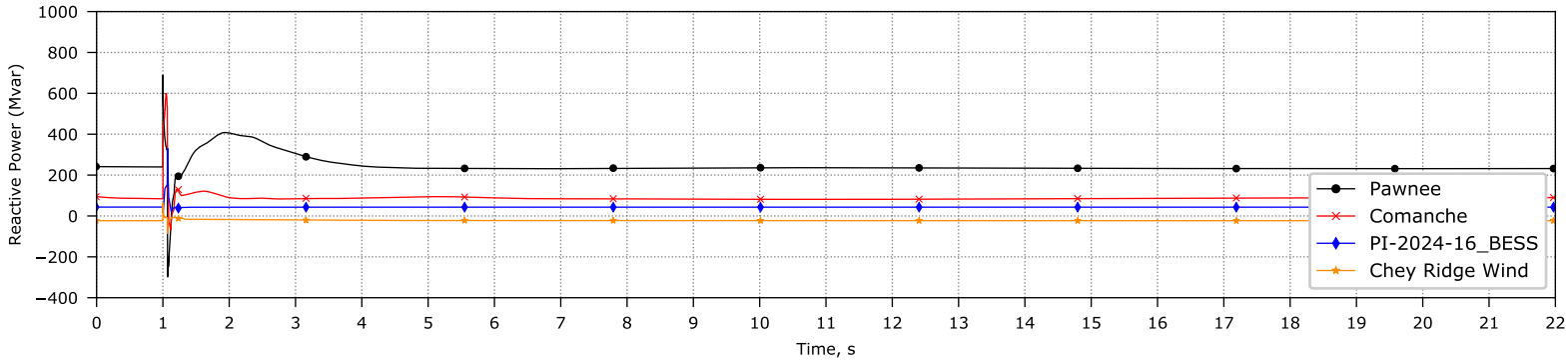


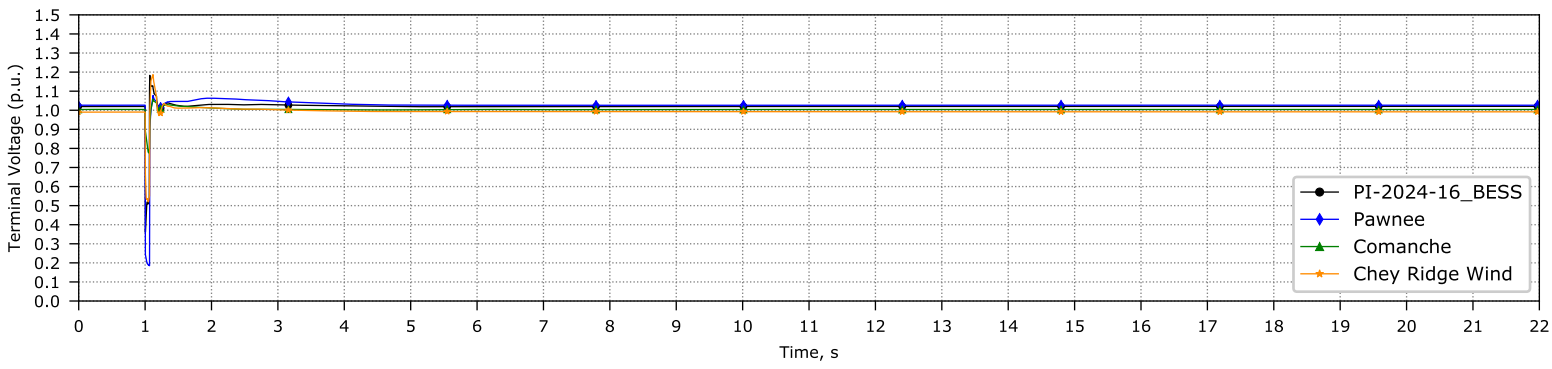


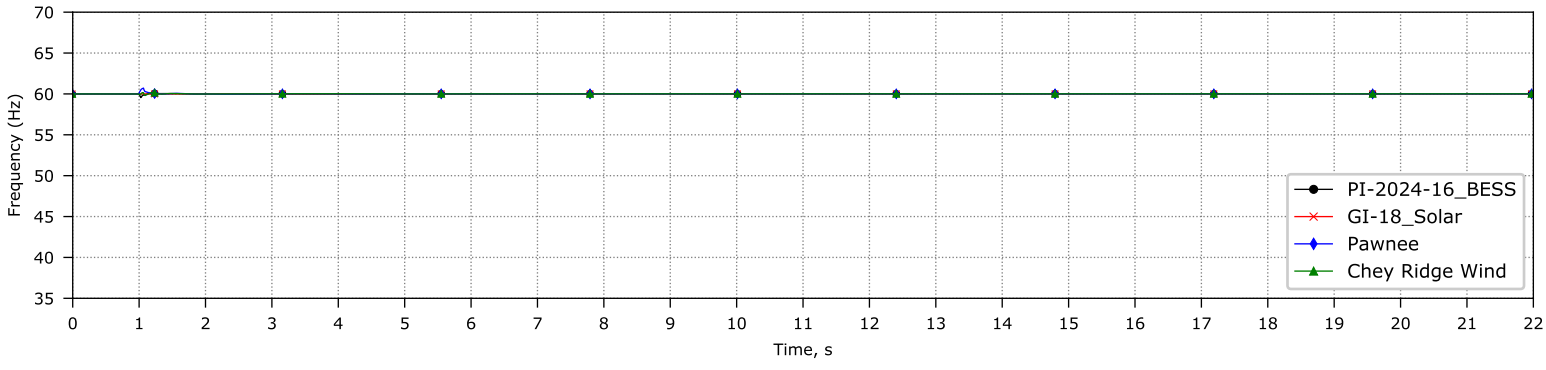
PI-2024-16_Study_East_Story-Pawnee-1_230kV

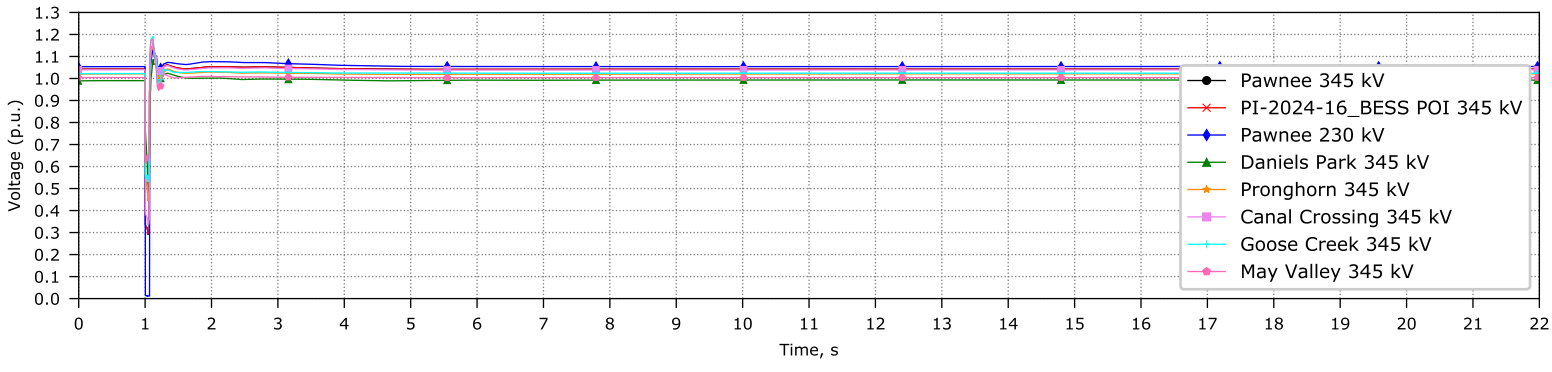




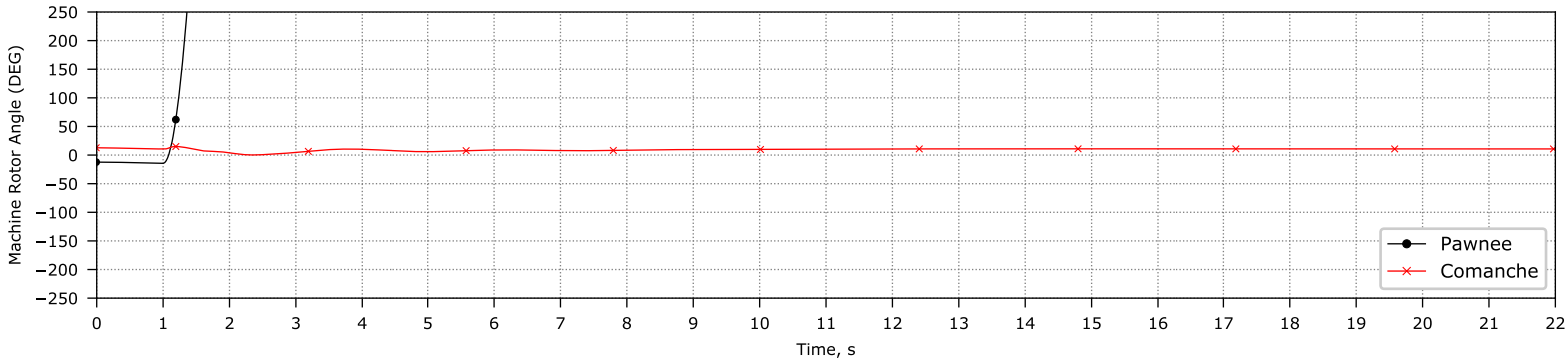


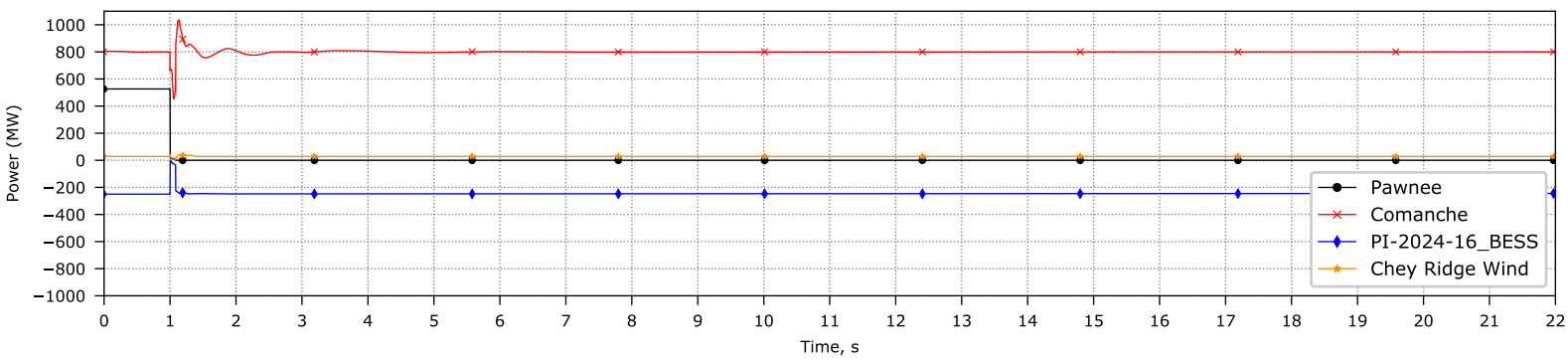


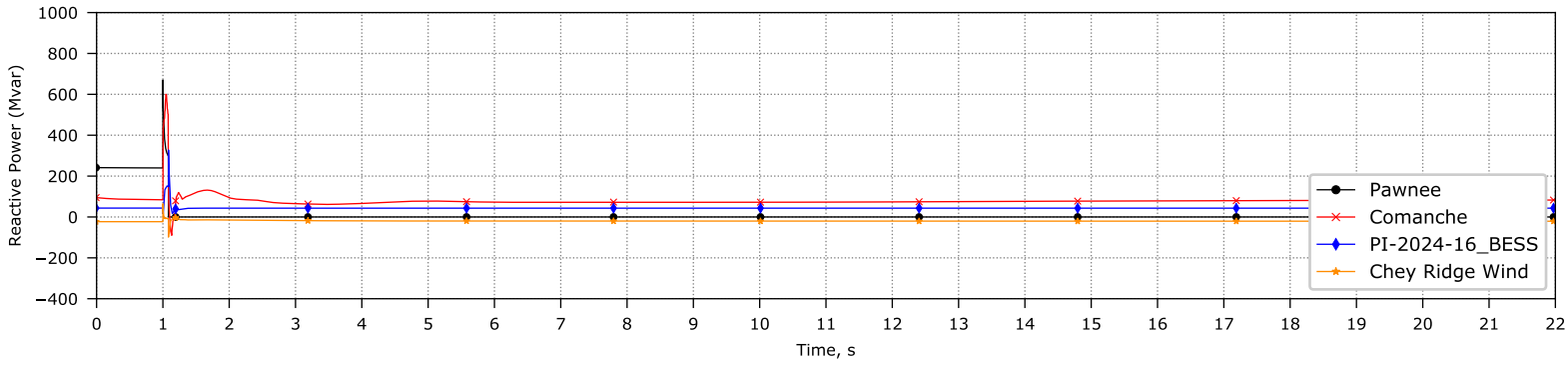


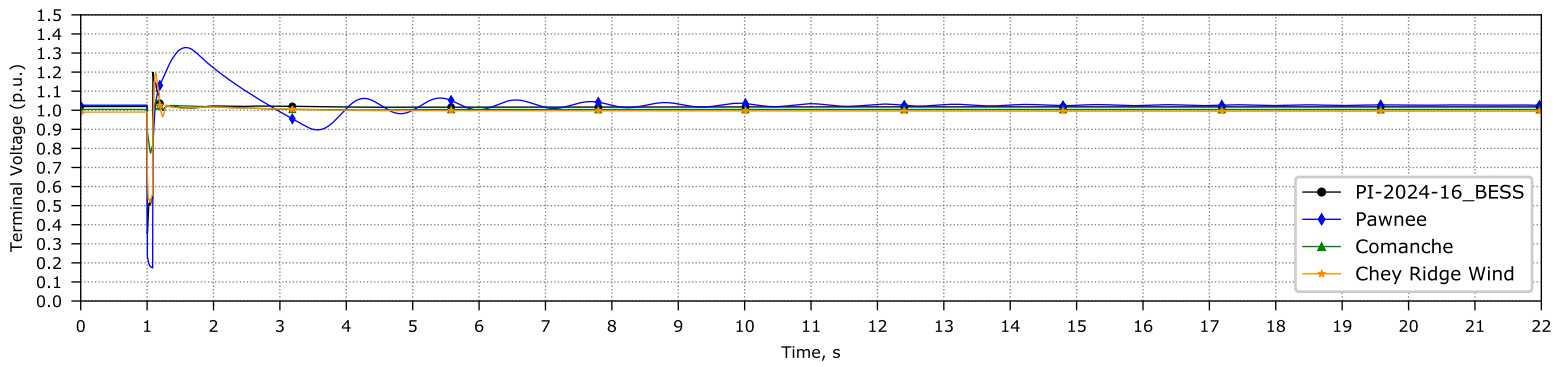


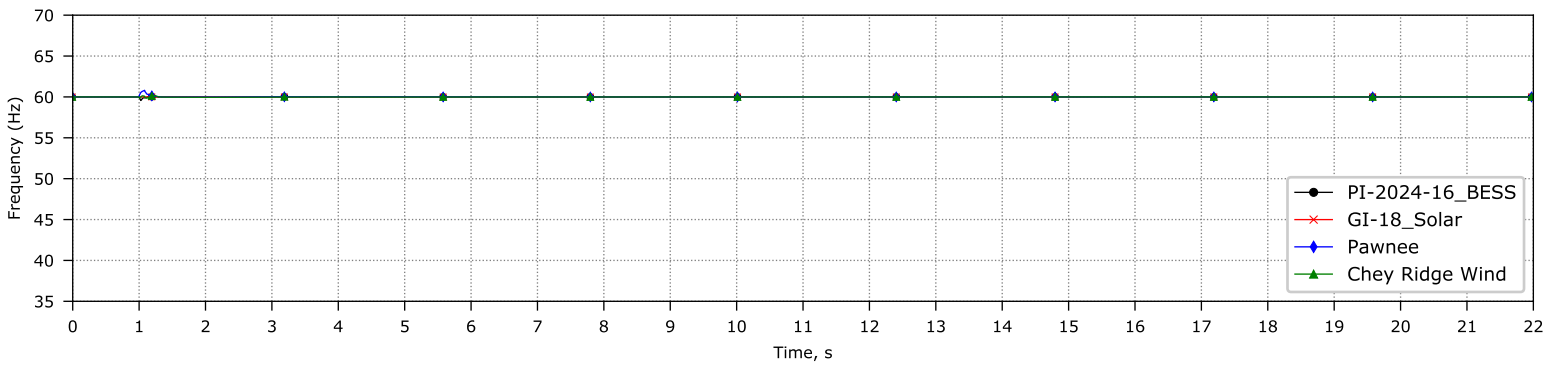
PI-2024-16_Study_East_Pawnee_230kV_Gen

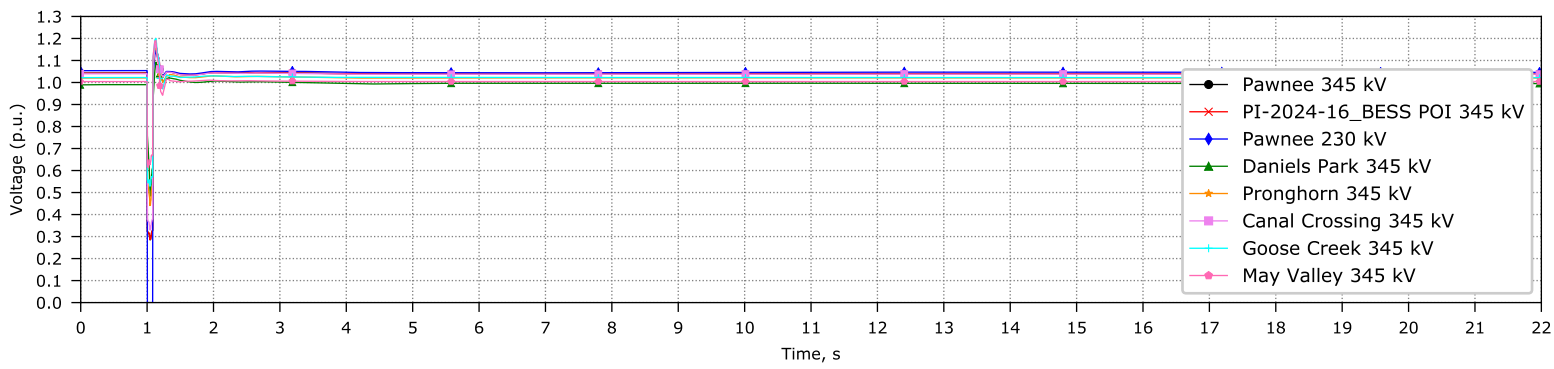




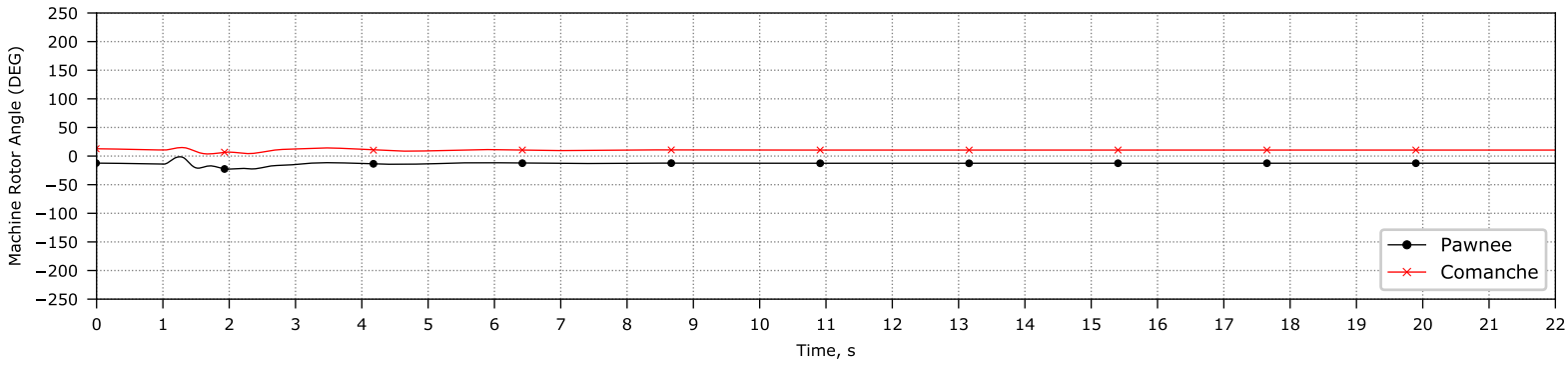


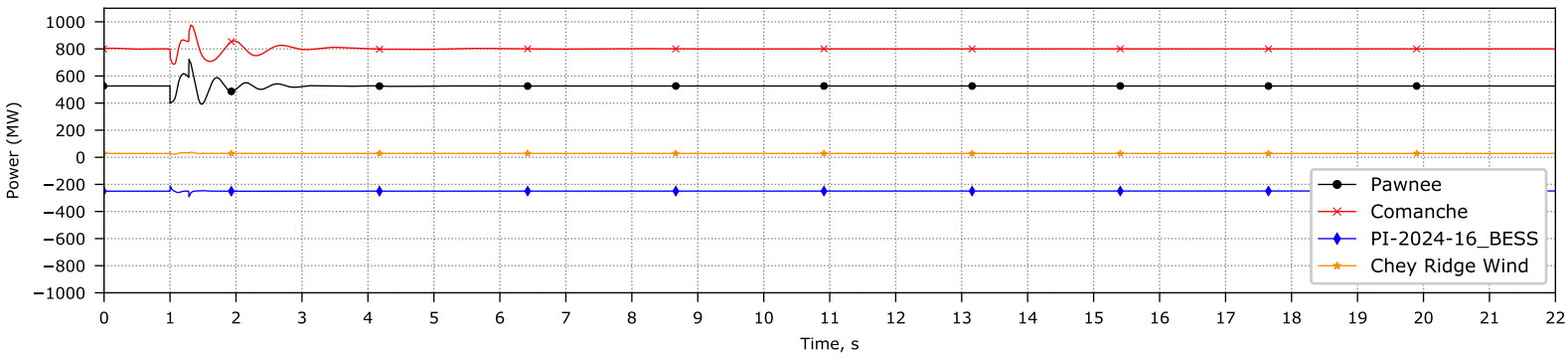


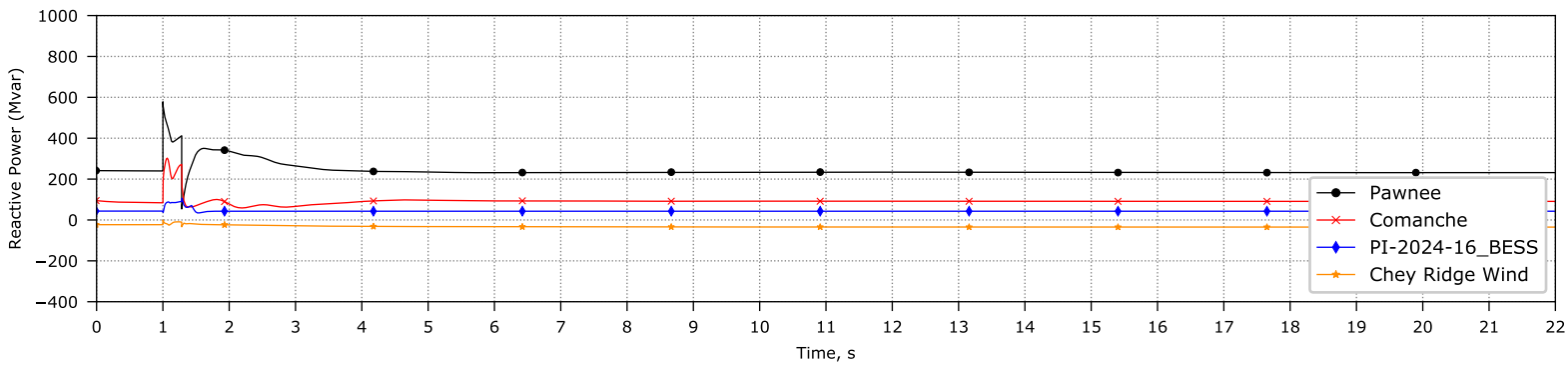


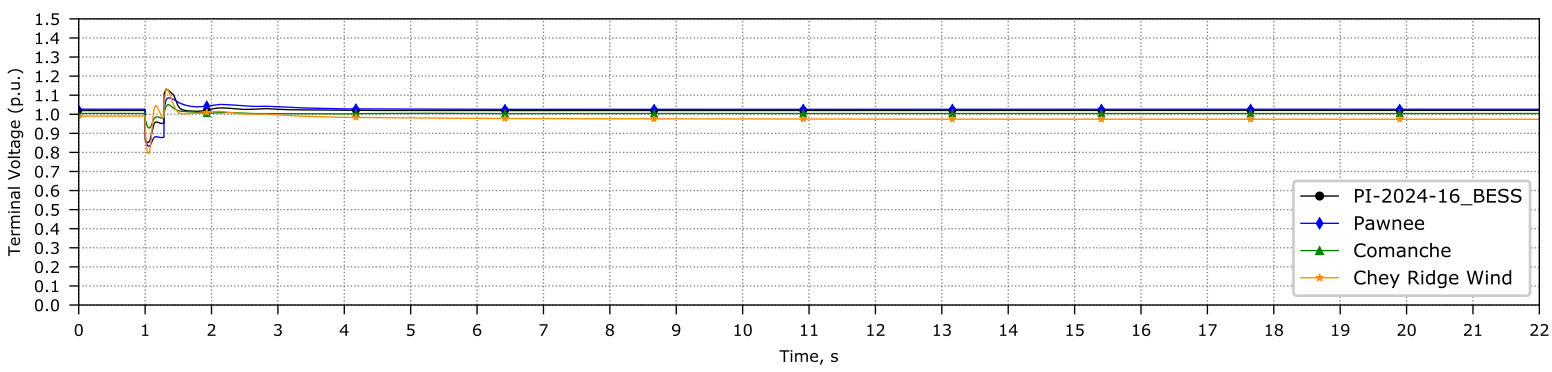


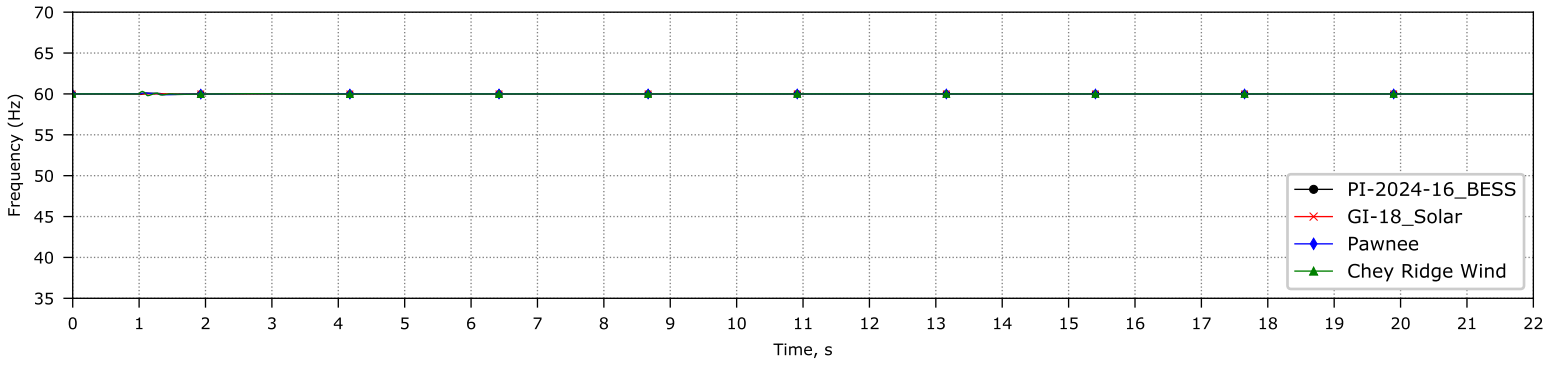
PI-2024-16_Study_East_BF_057b

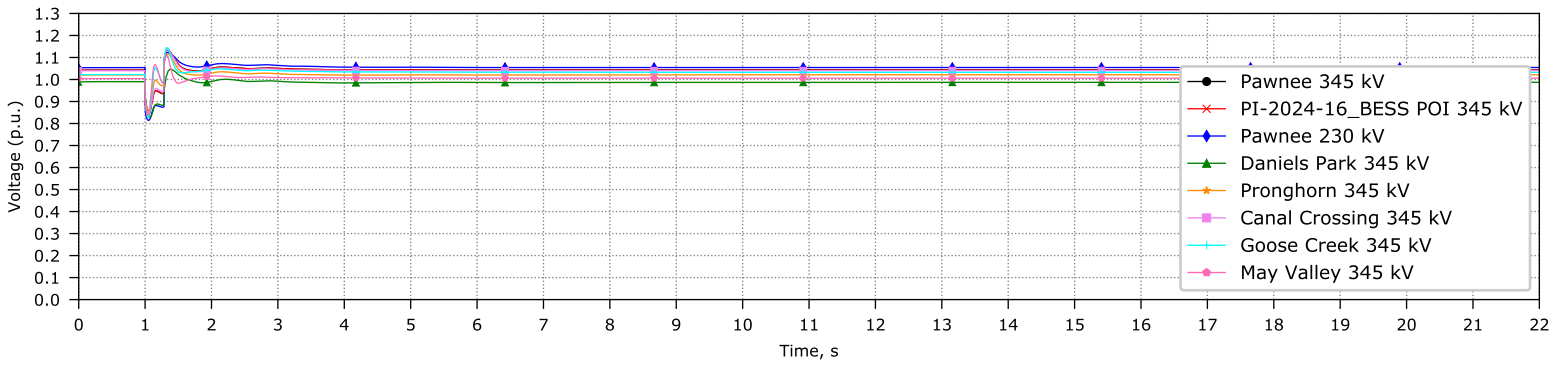




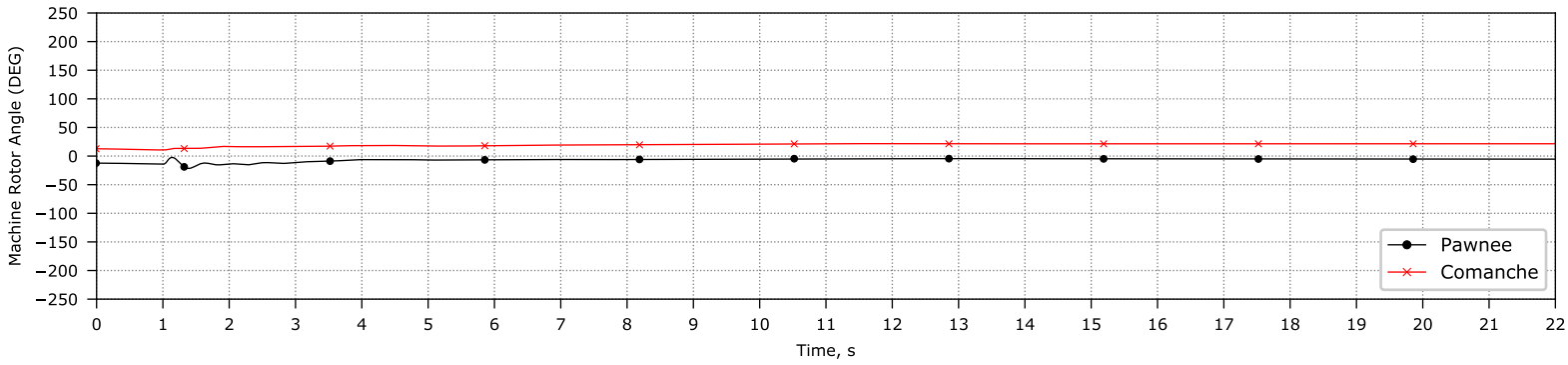


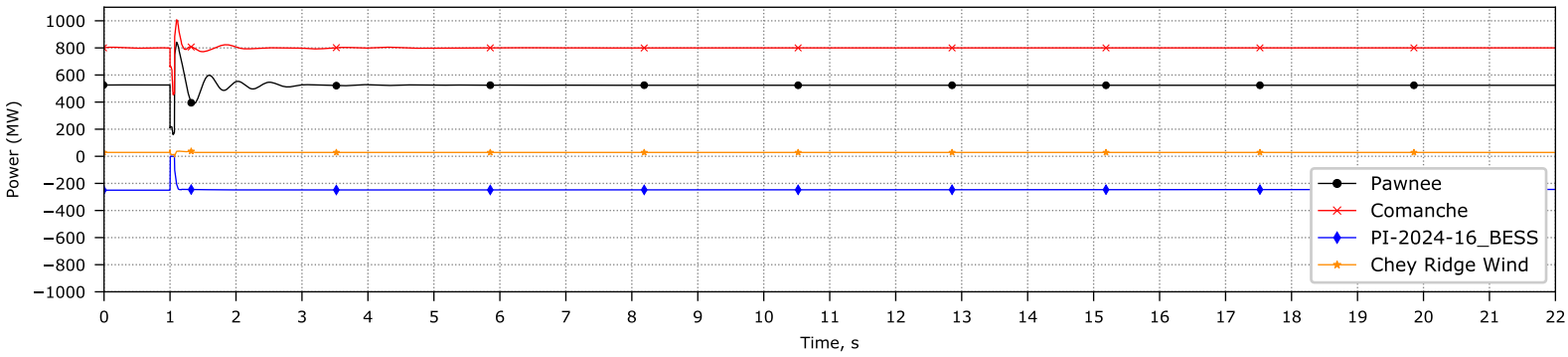


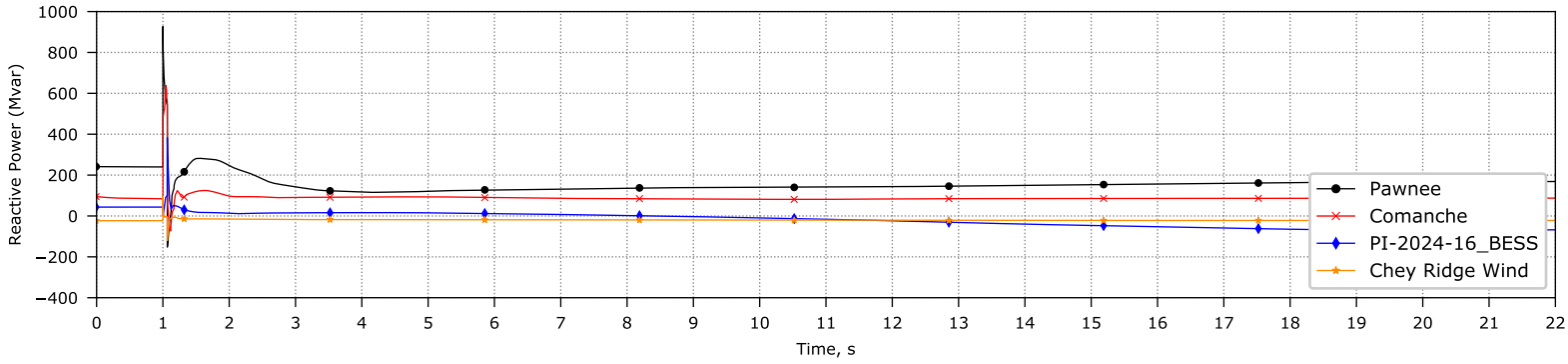


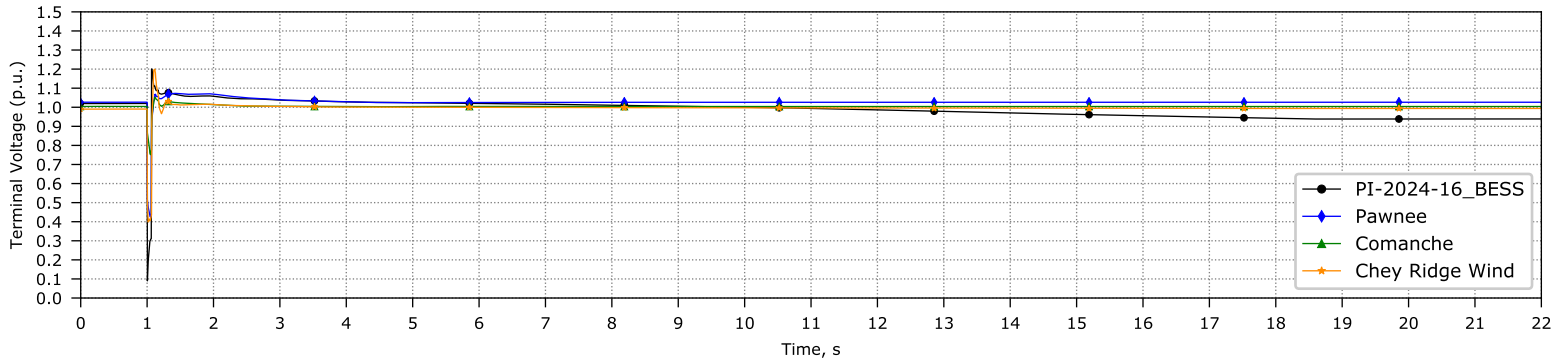


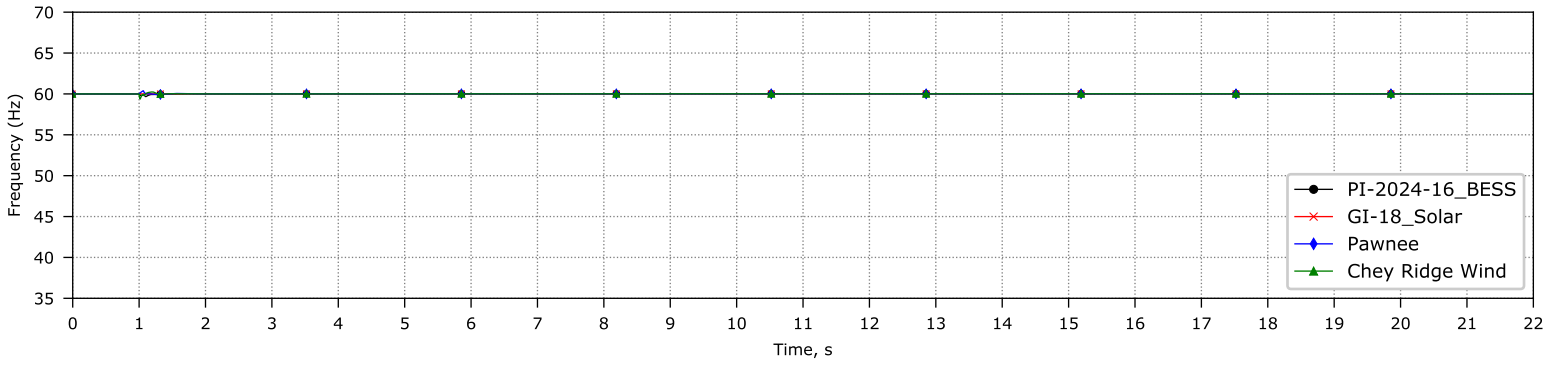
PI-2024-16_Study_East_P7_159

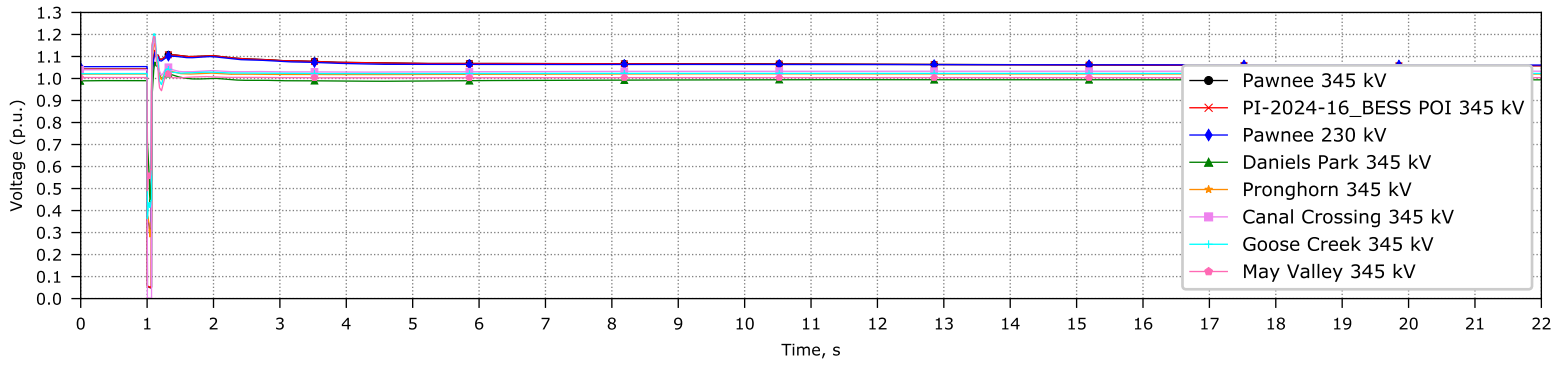




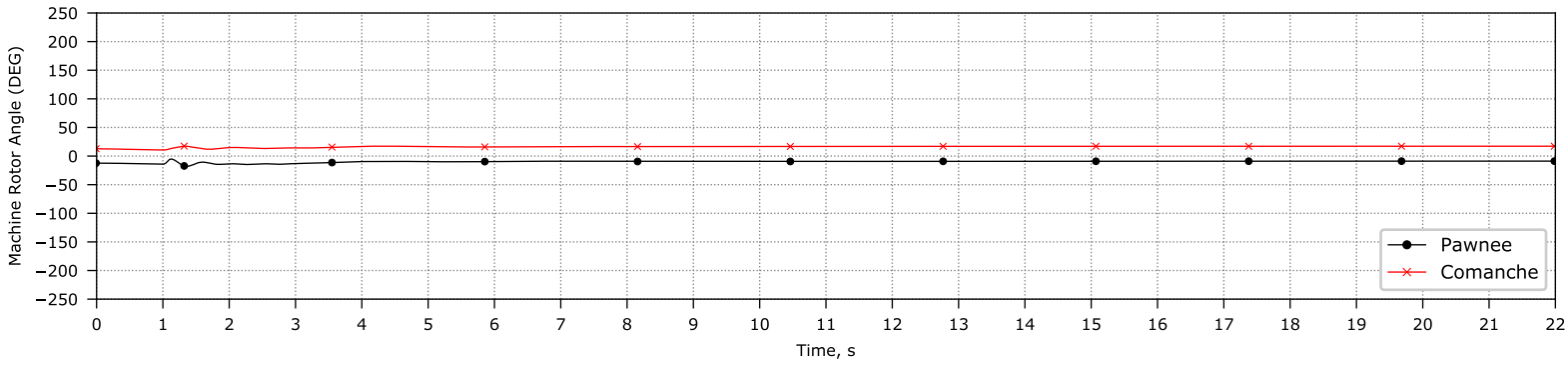


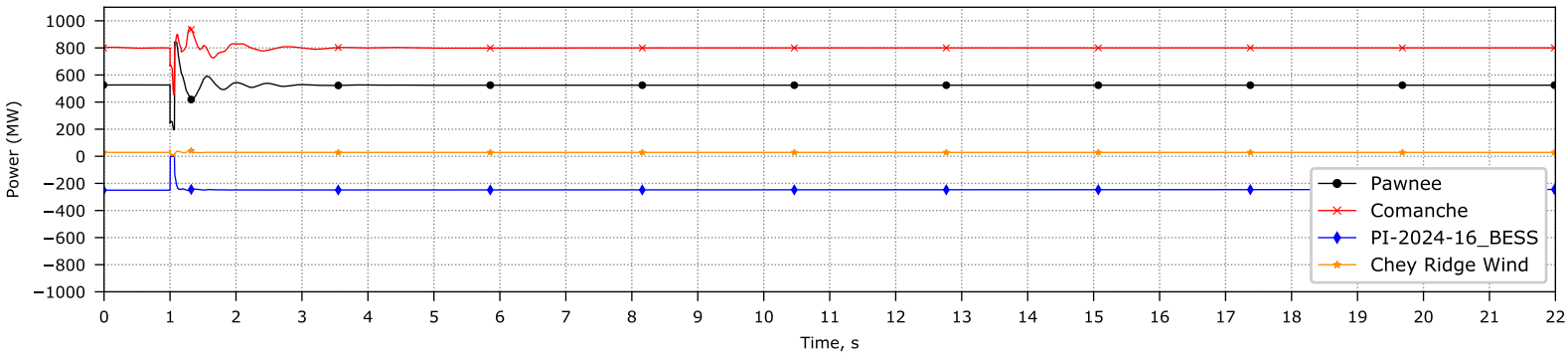


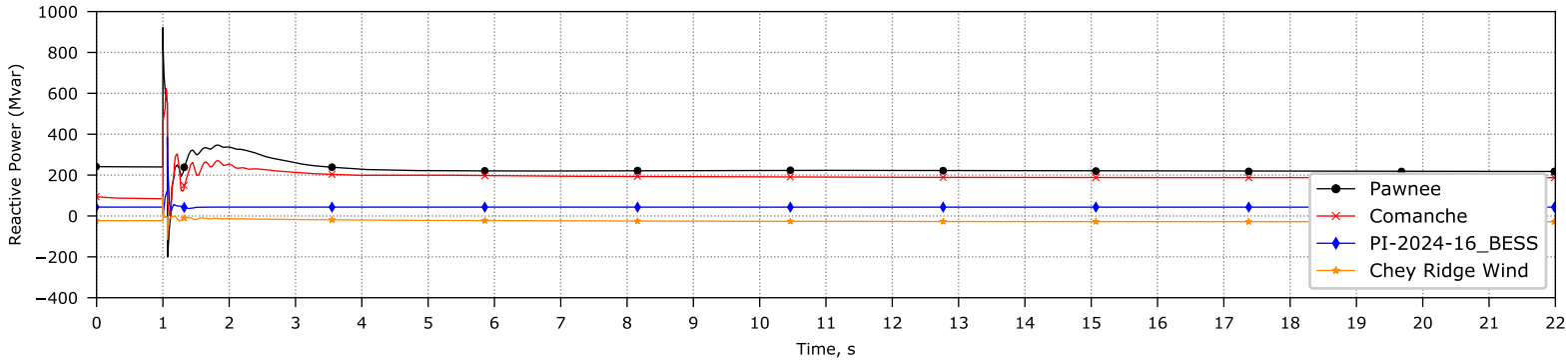


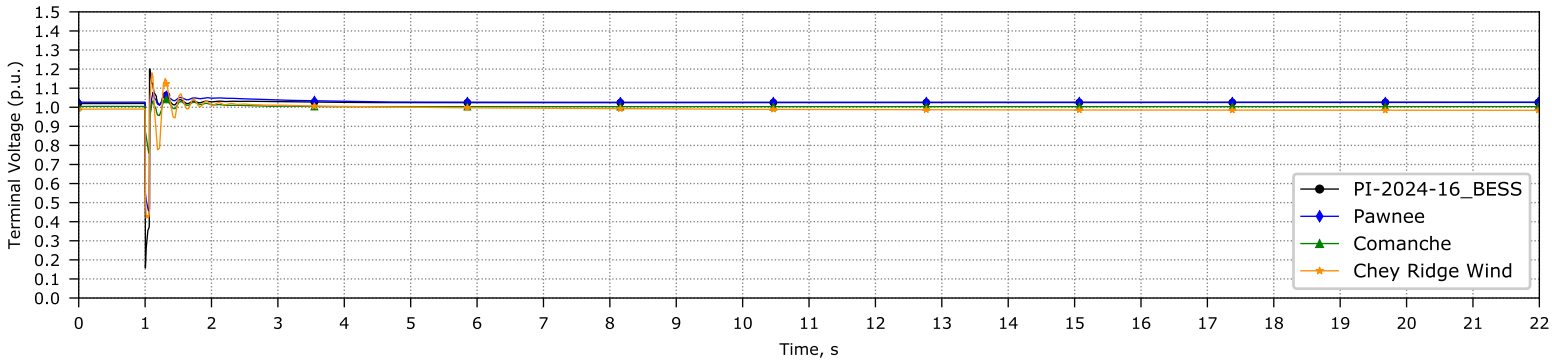


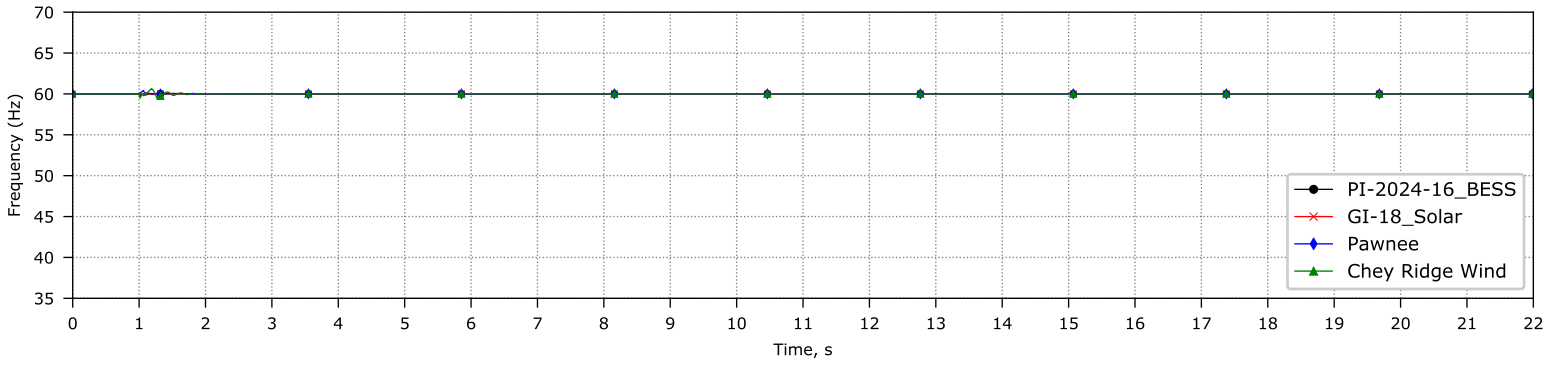
PI-2024-16_Study_East_P7_160

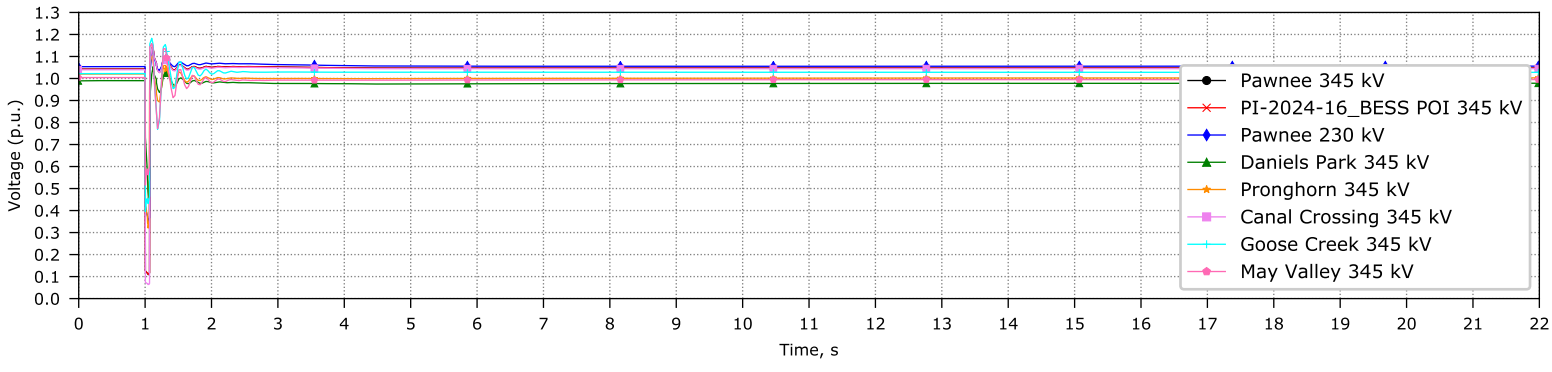




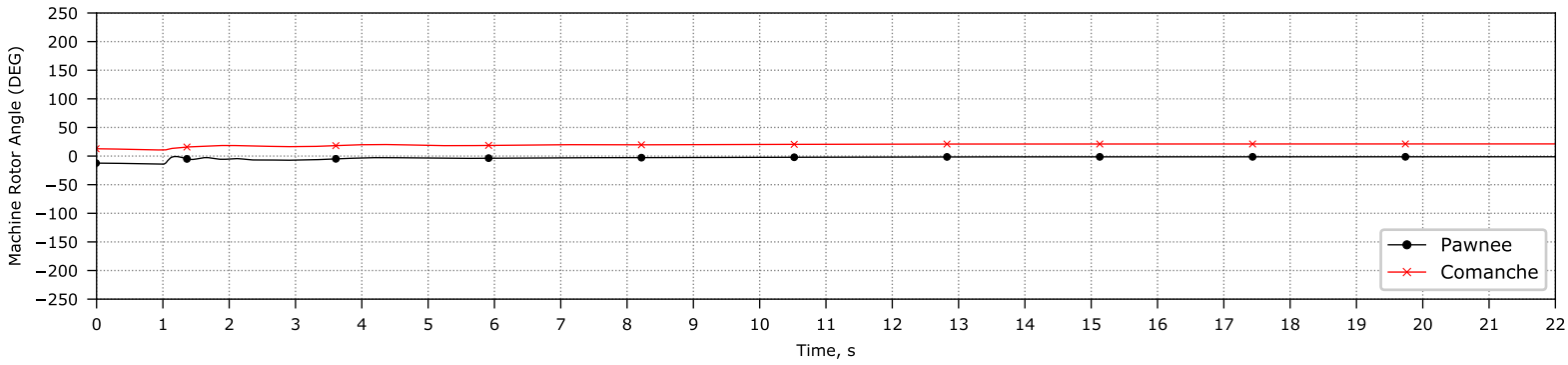


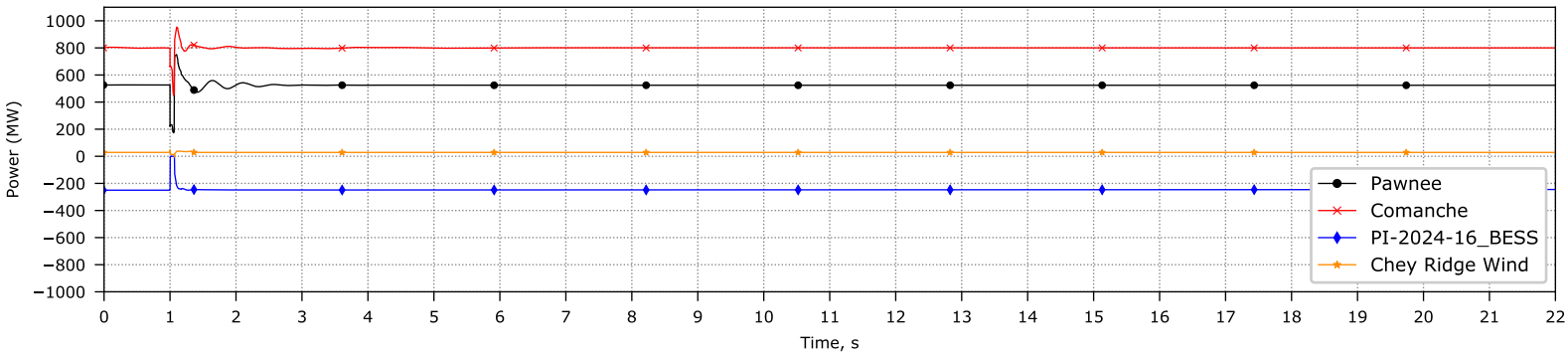


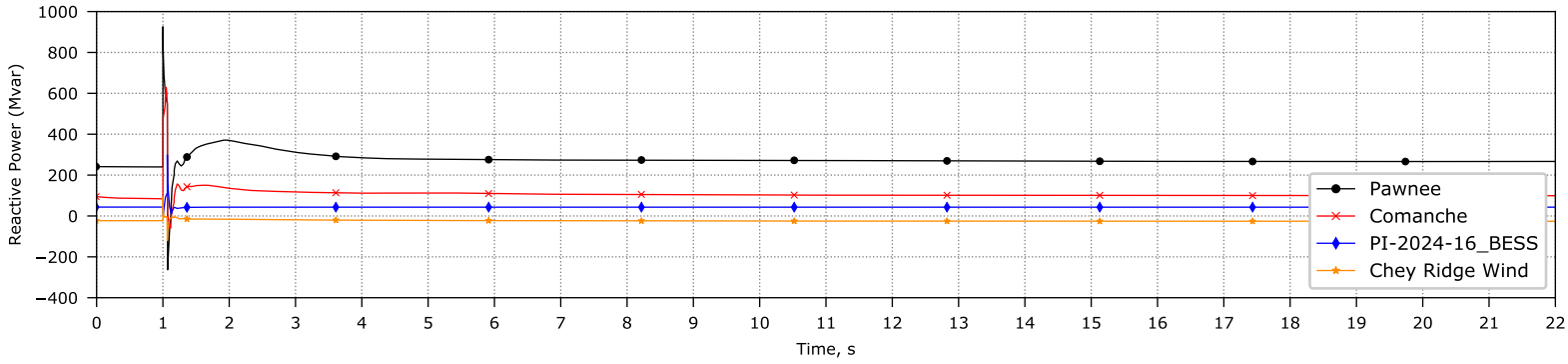


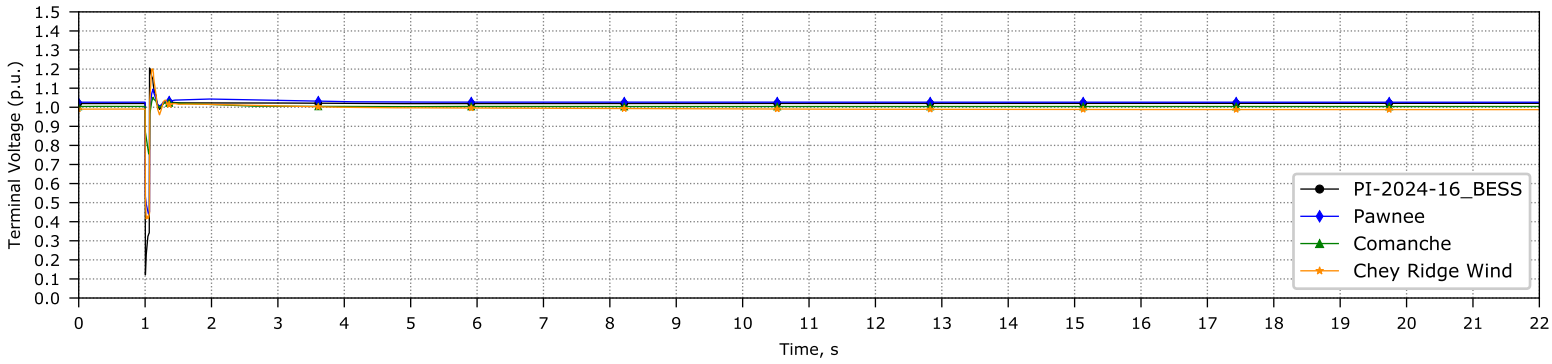


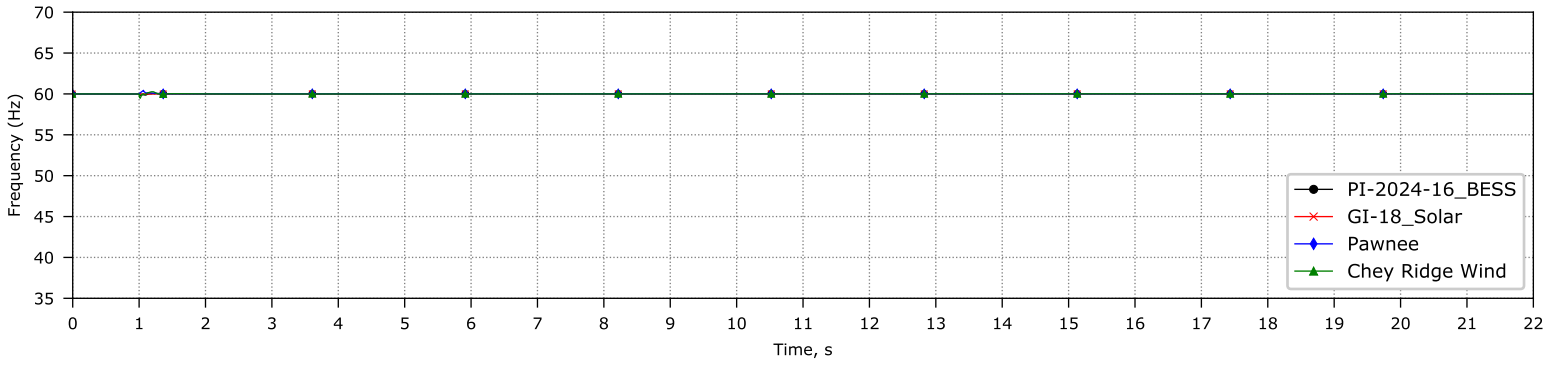
PI-2024-16_Study_East_P7_161

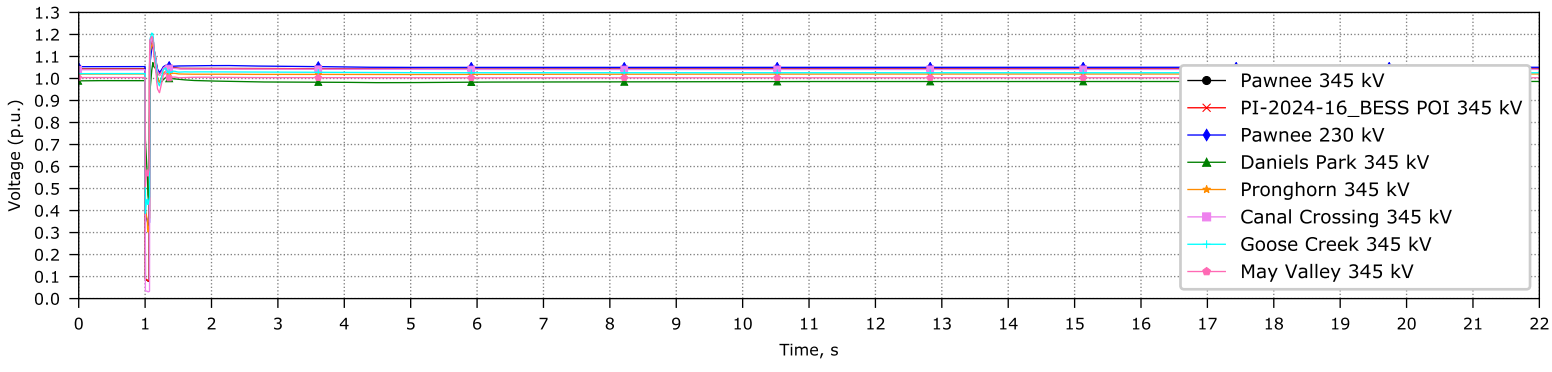




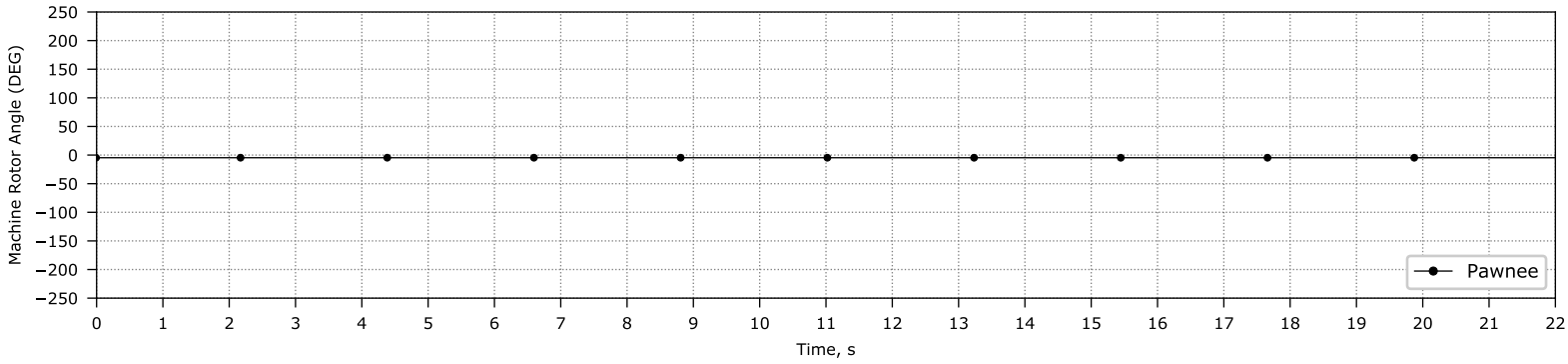


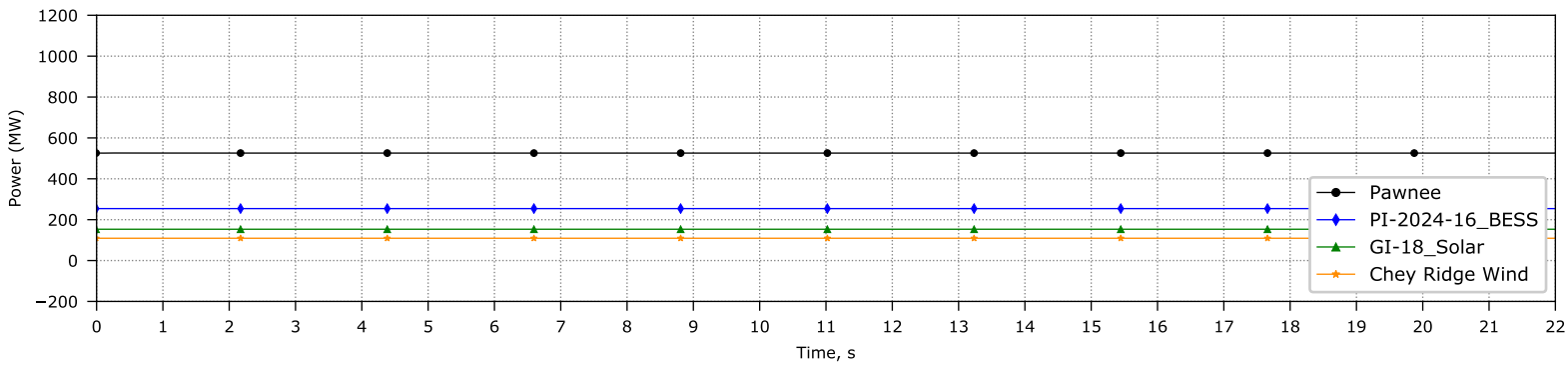


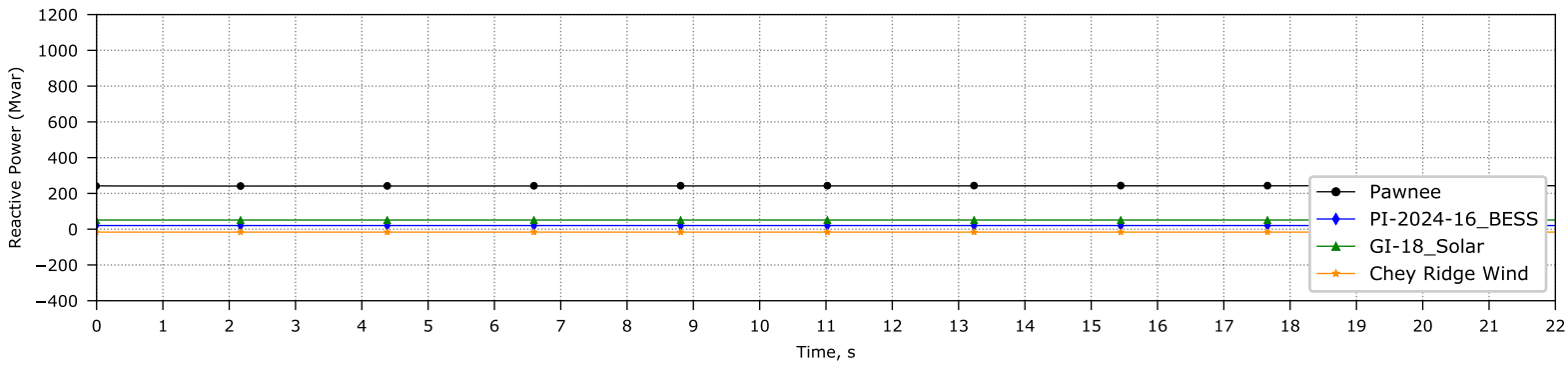


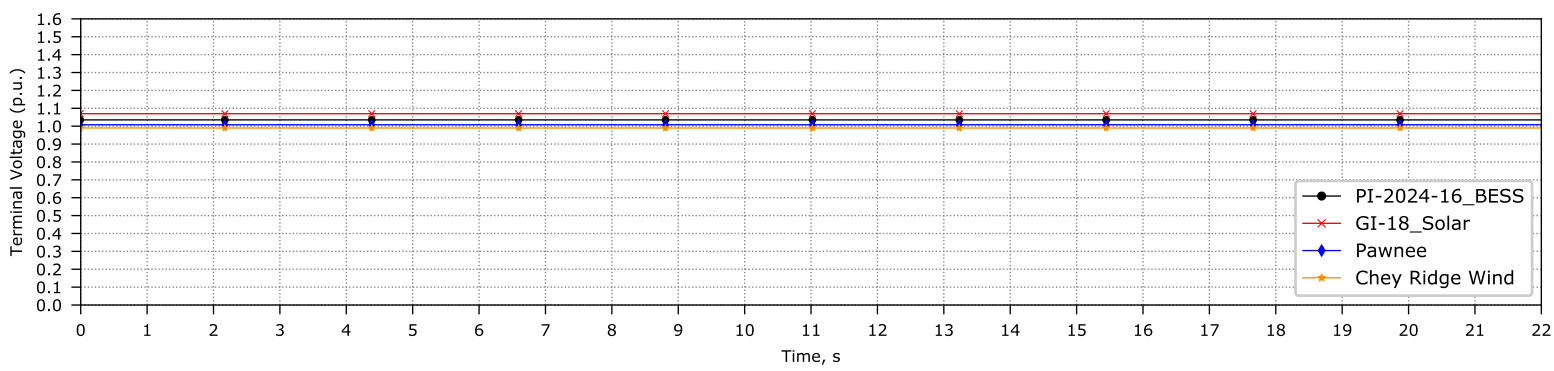


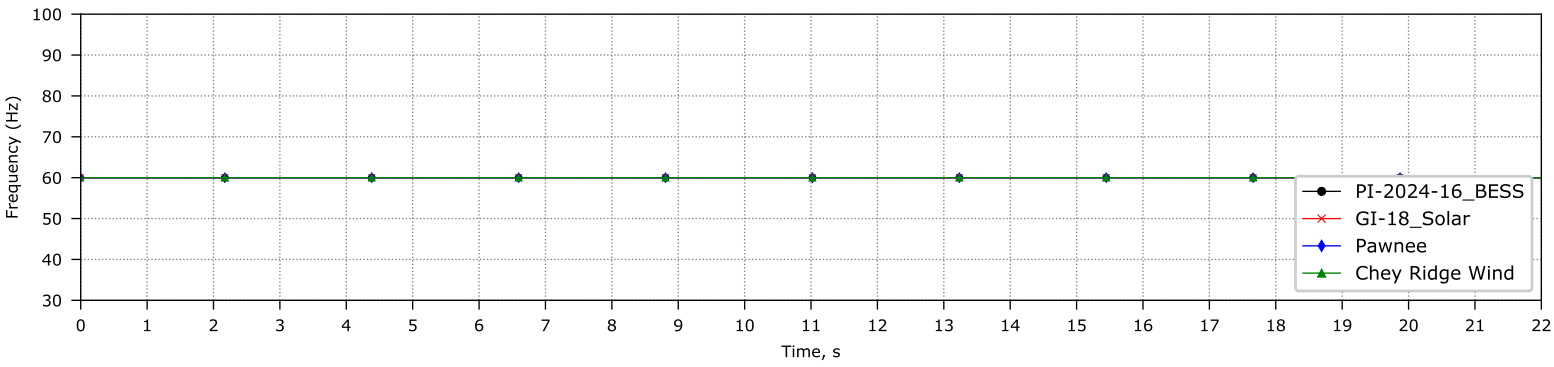
PI-2024-16_Study_East_flatrun

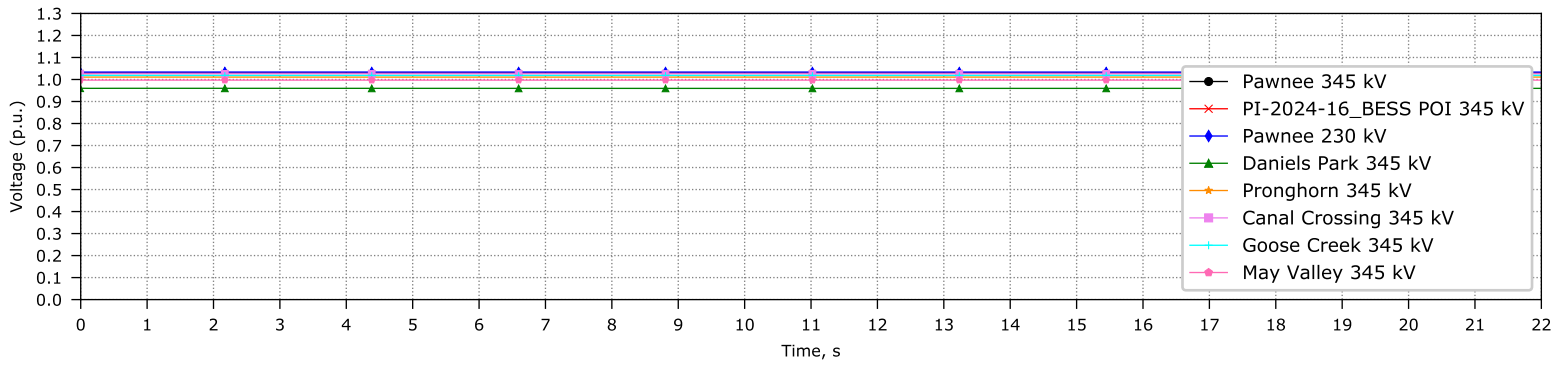




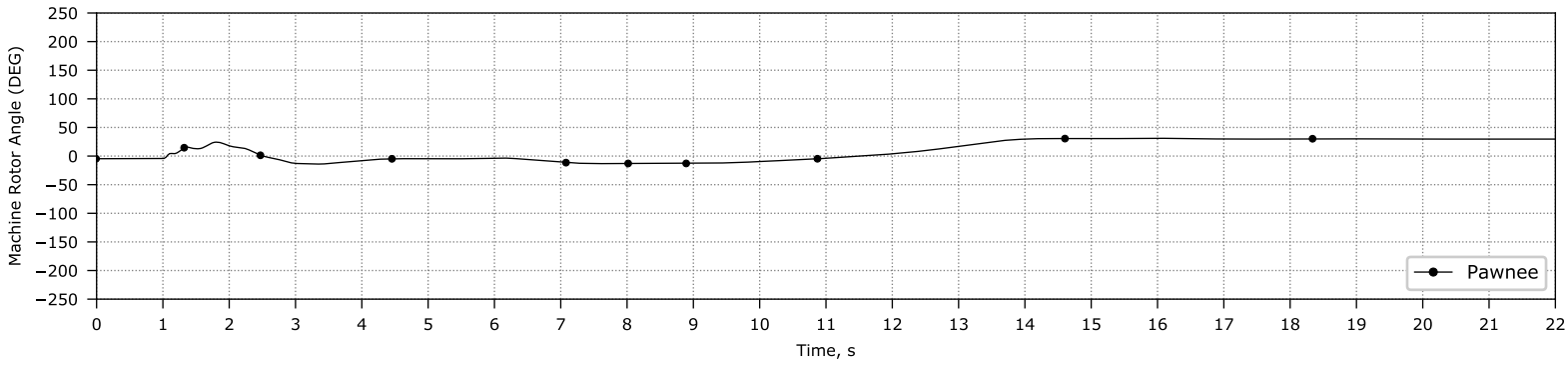


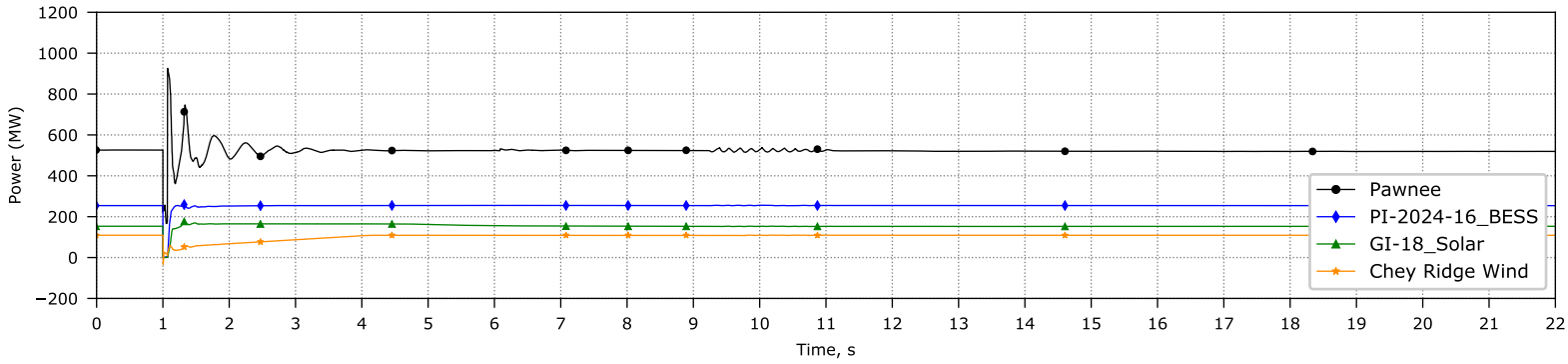


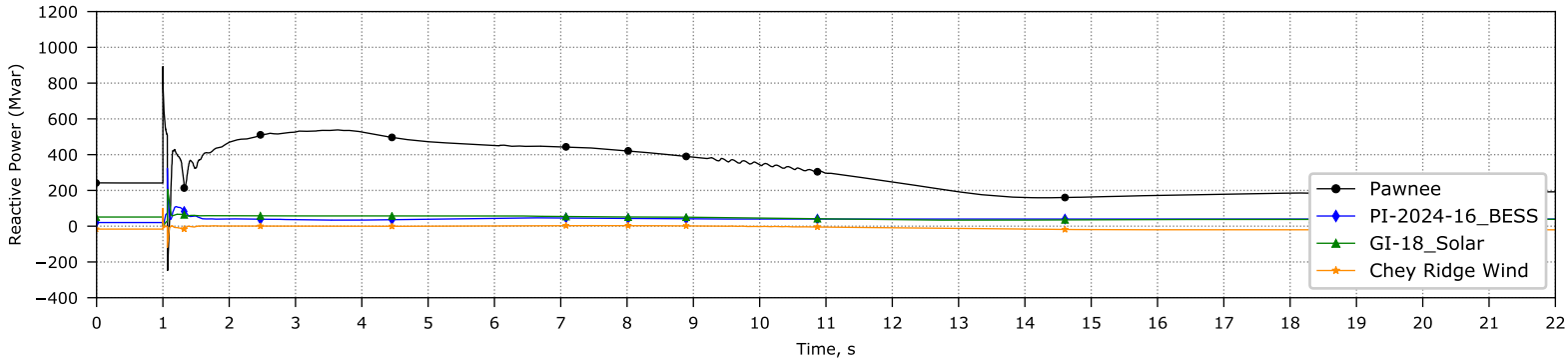


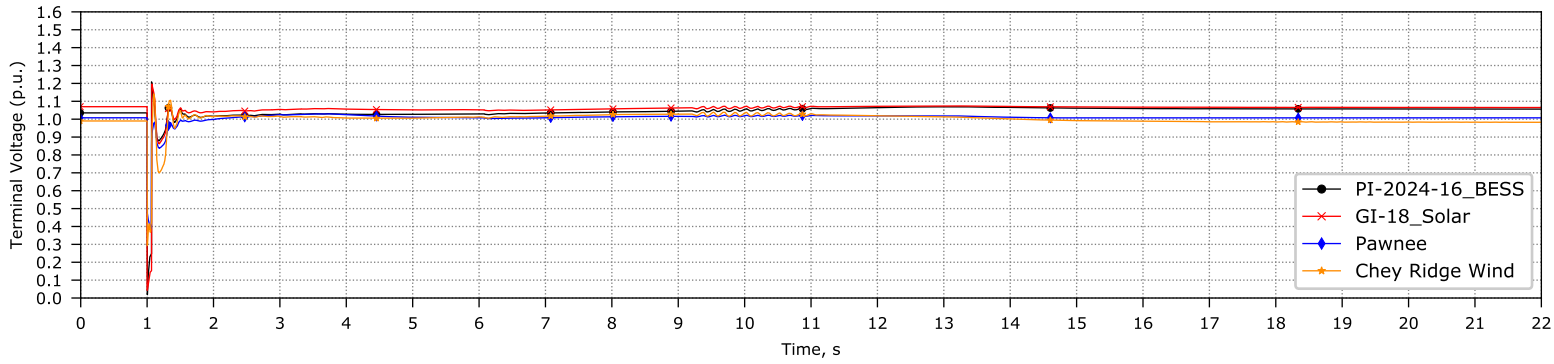


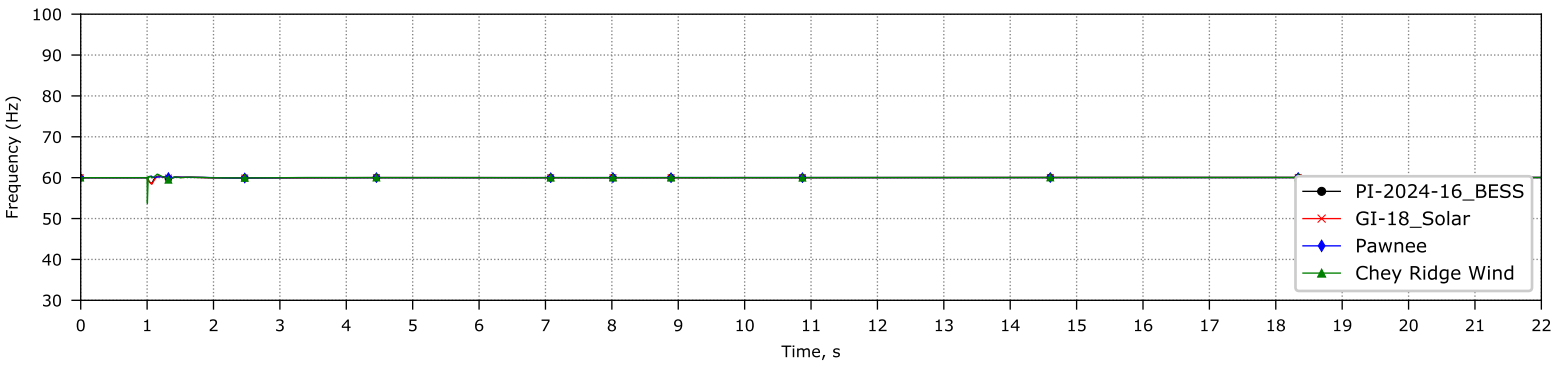
PI-2024-16_Study_East_CanalXing-Pawnee-1_345kV

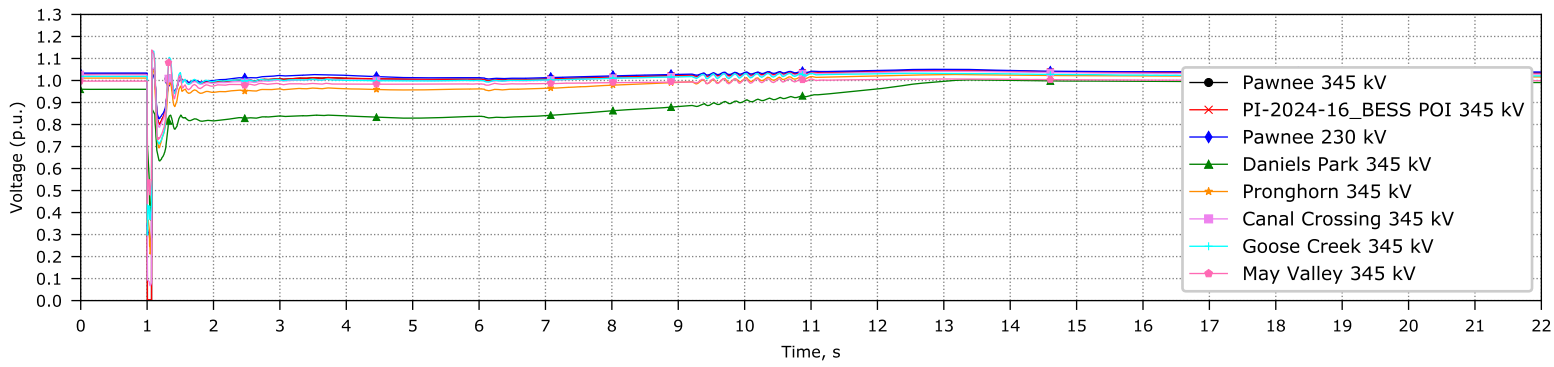




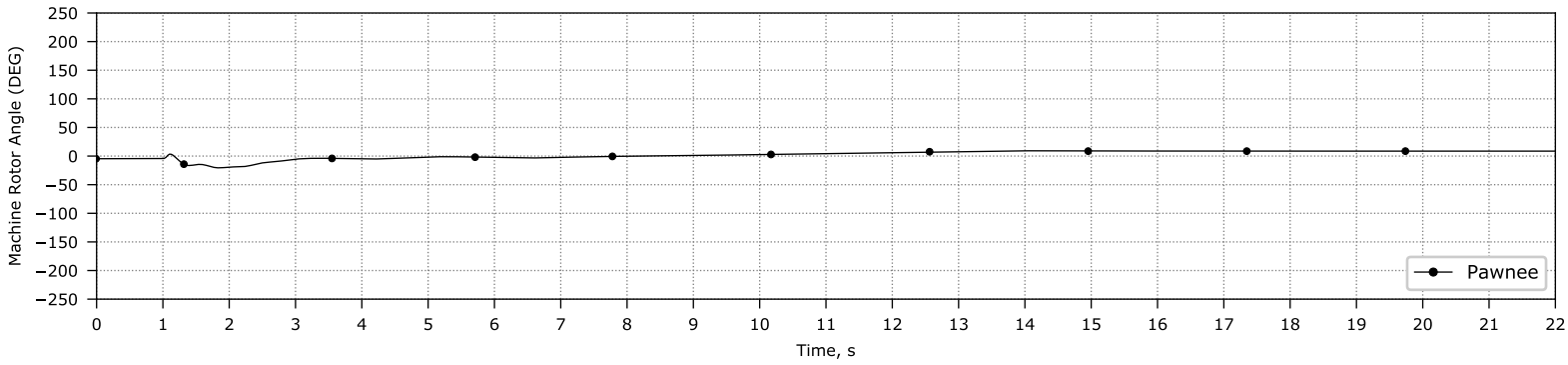


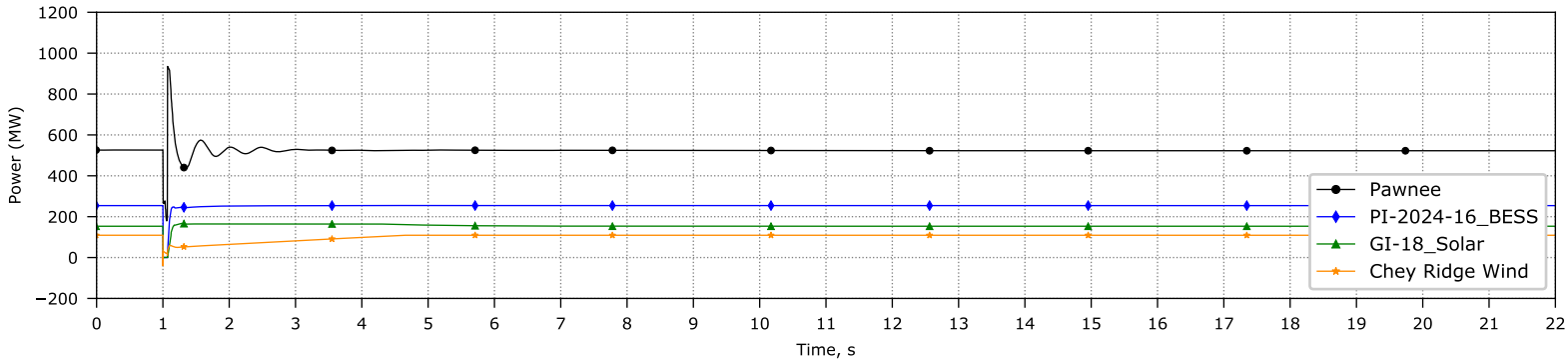


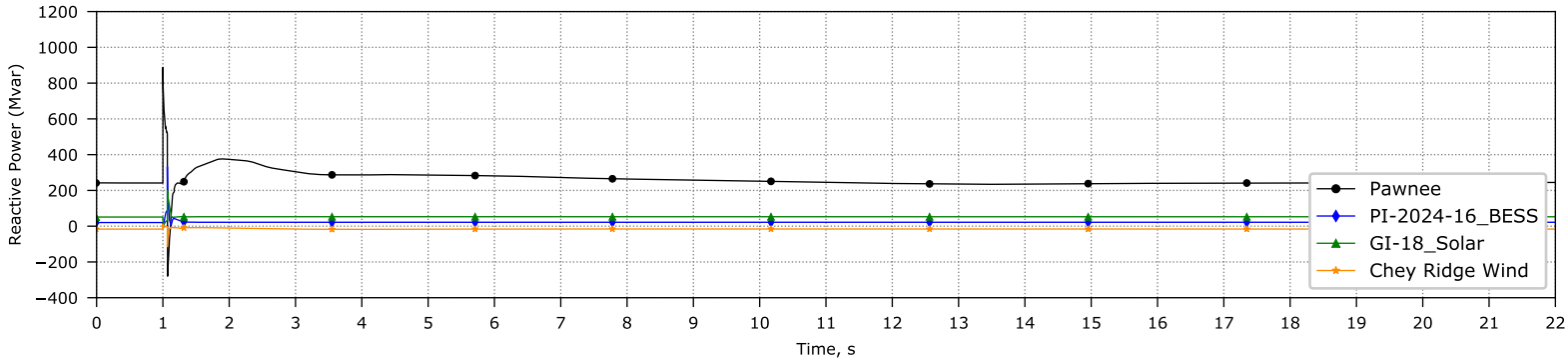


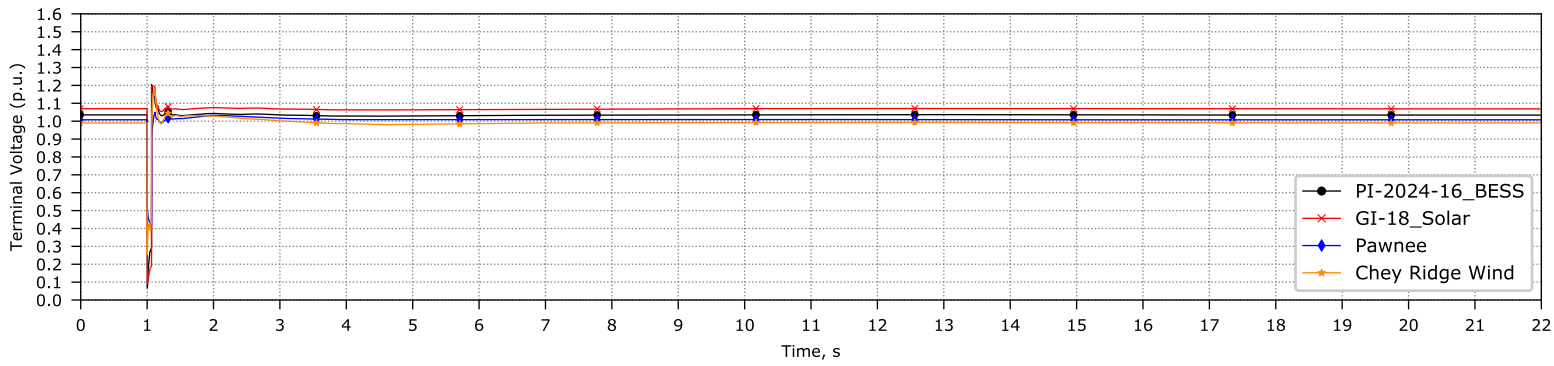


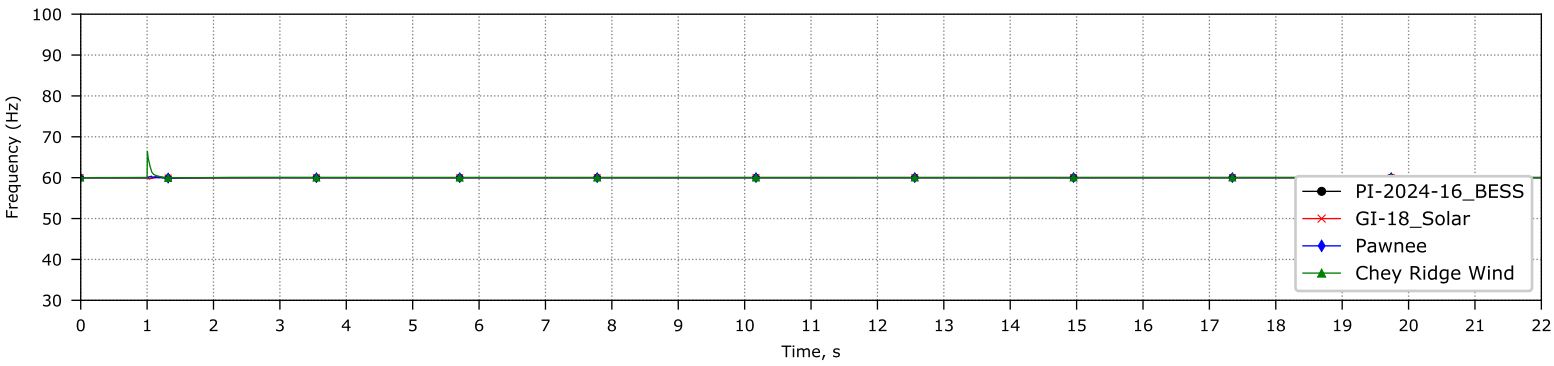
PI-2024-16_Study_East_GI_2023_14-Pawnee-1_345kV

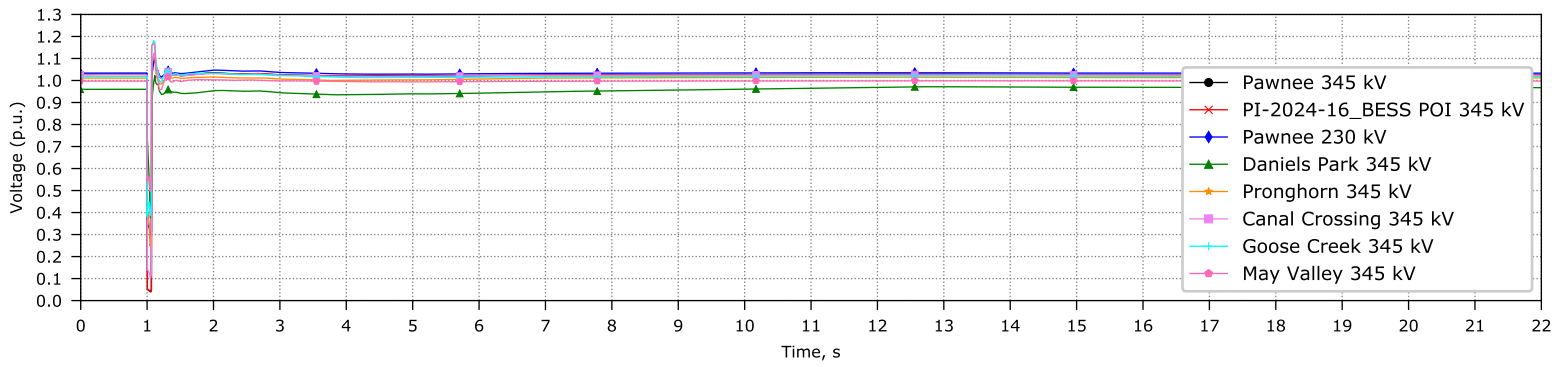




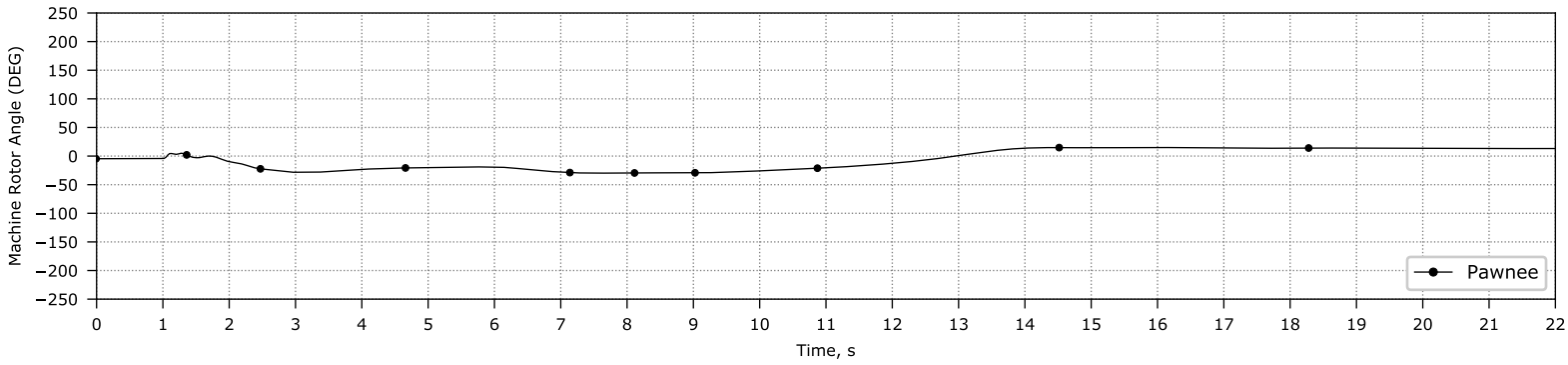


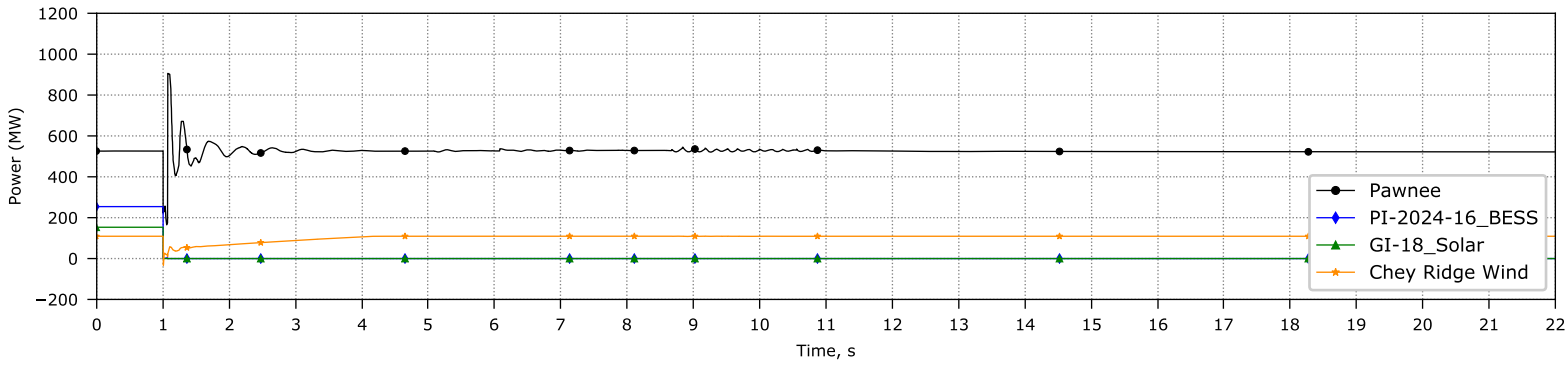


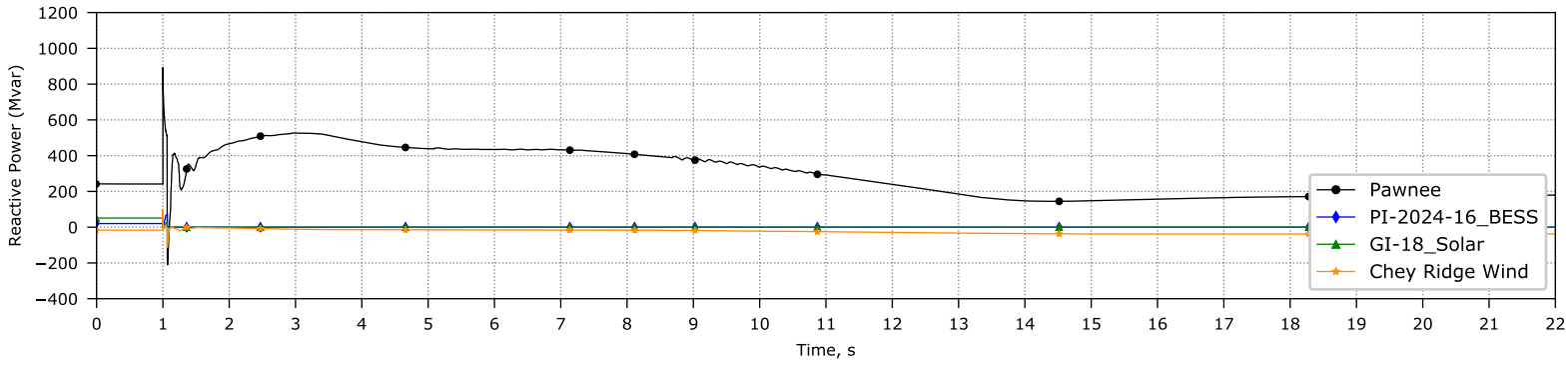


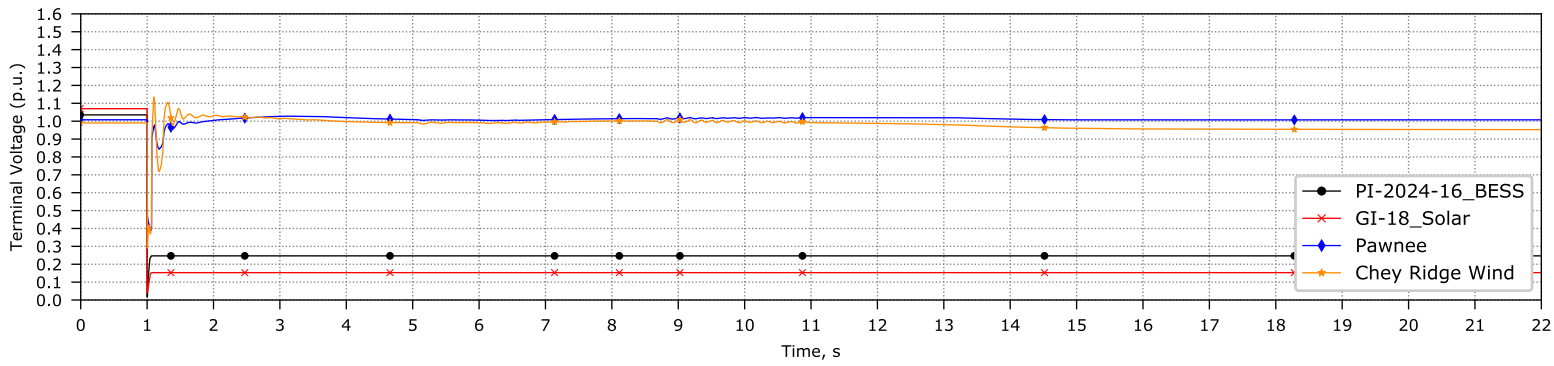


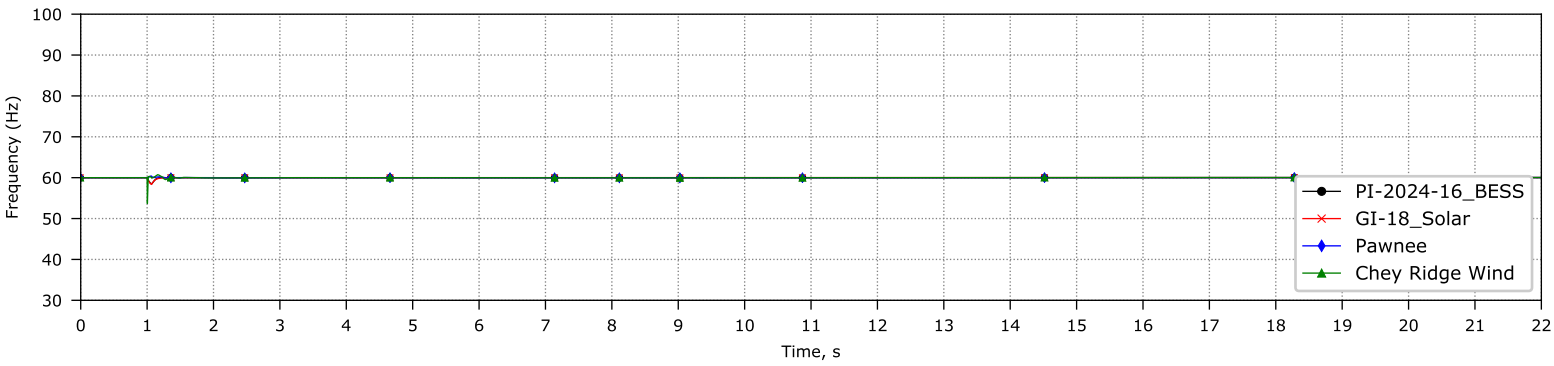
PI-2024-16_Study_East_Pawnee_PI-2024-16_Gen

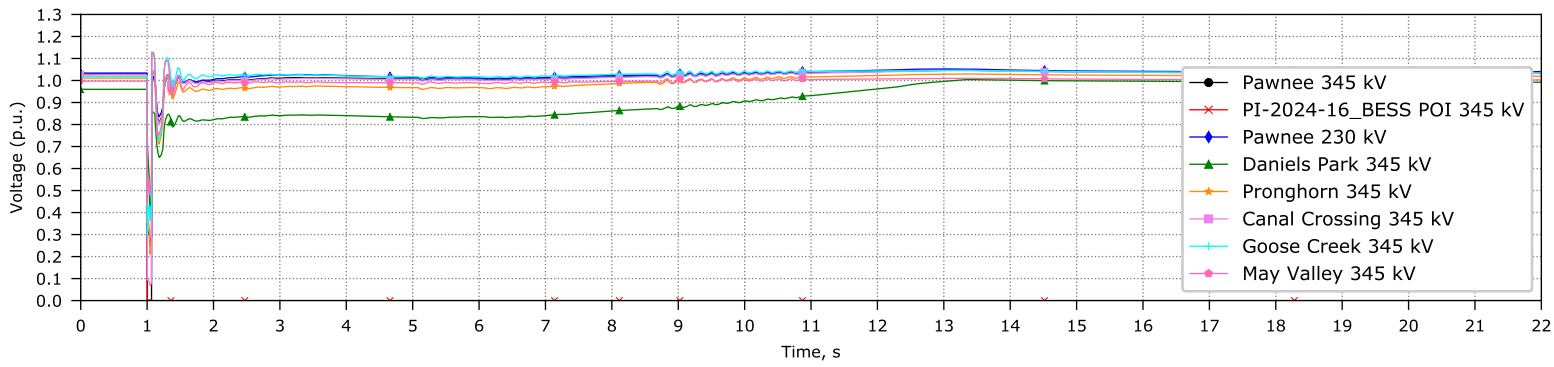




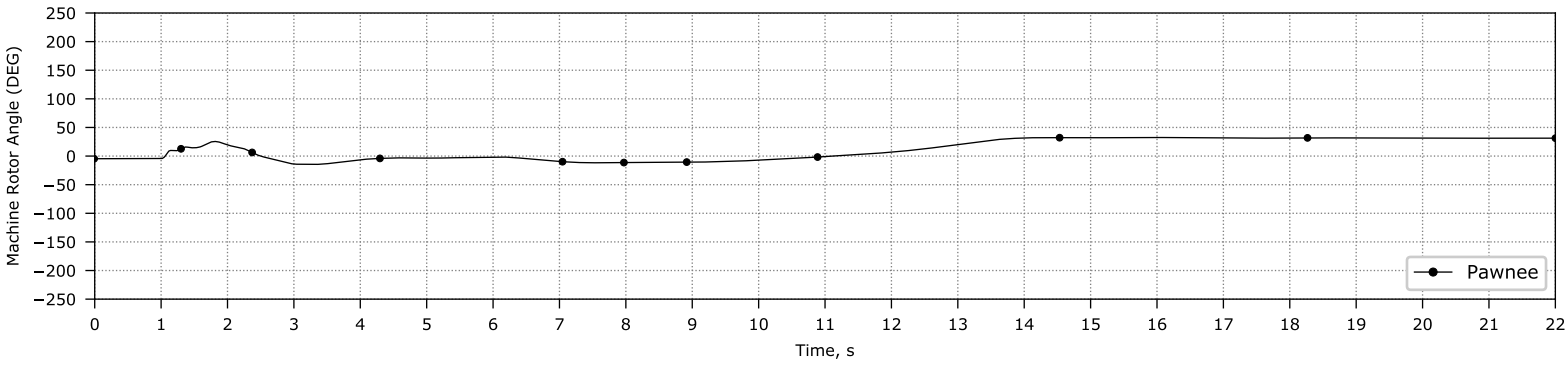


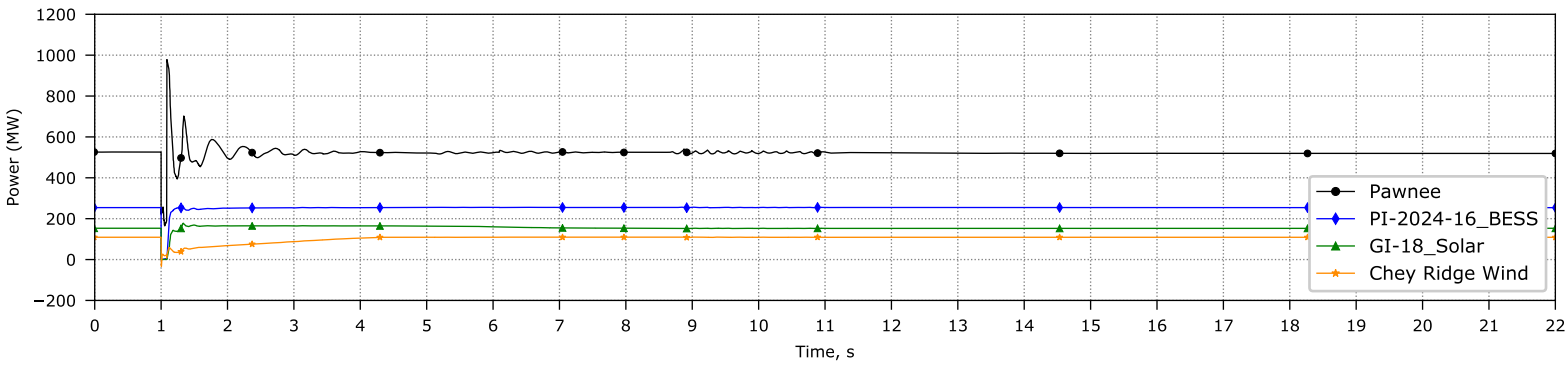


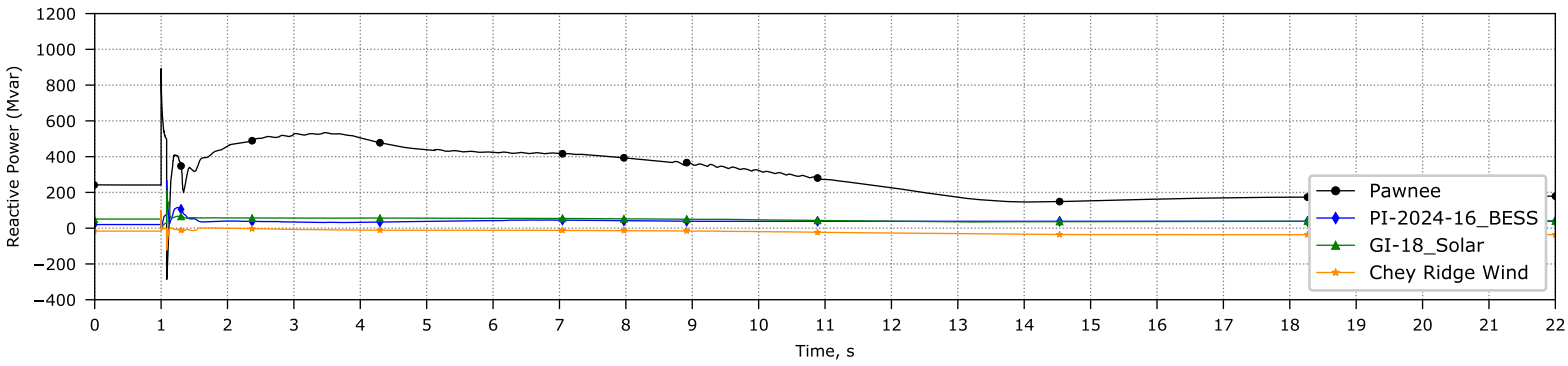


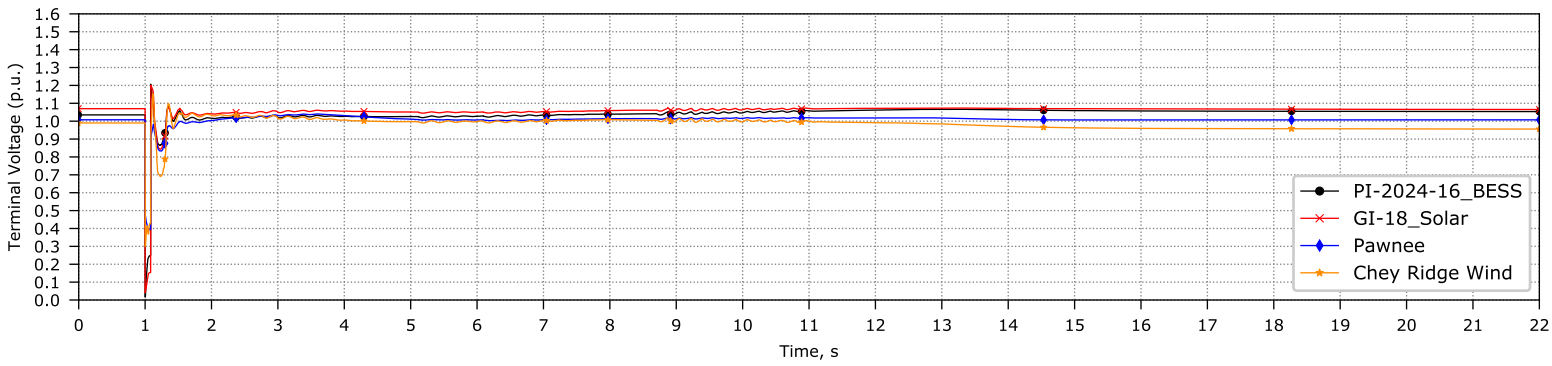


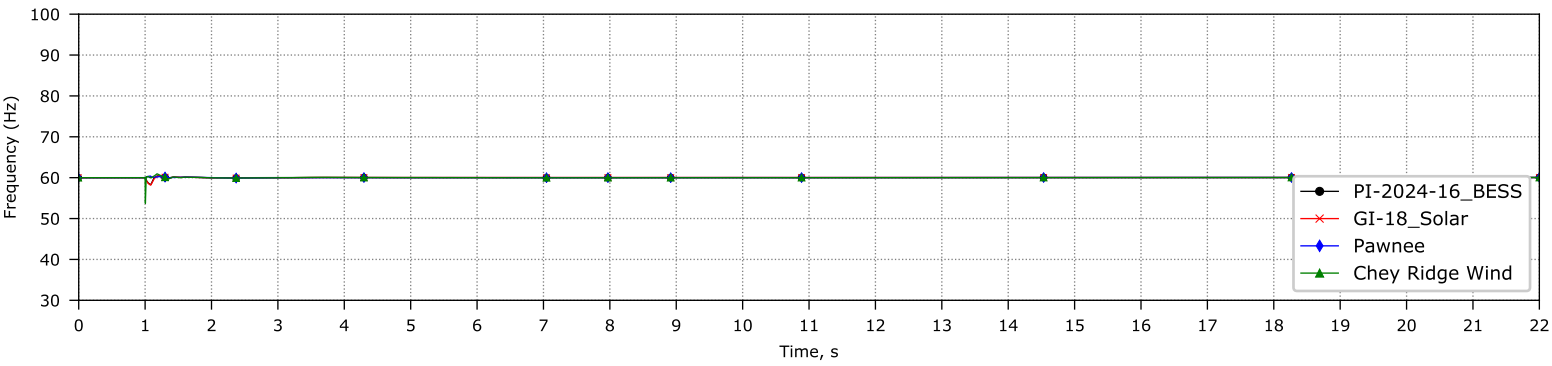
PI-2024-16_Study_East_Pawnee_345kV-Pawnee_230kV_Transformer2

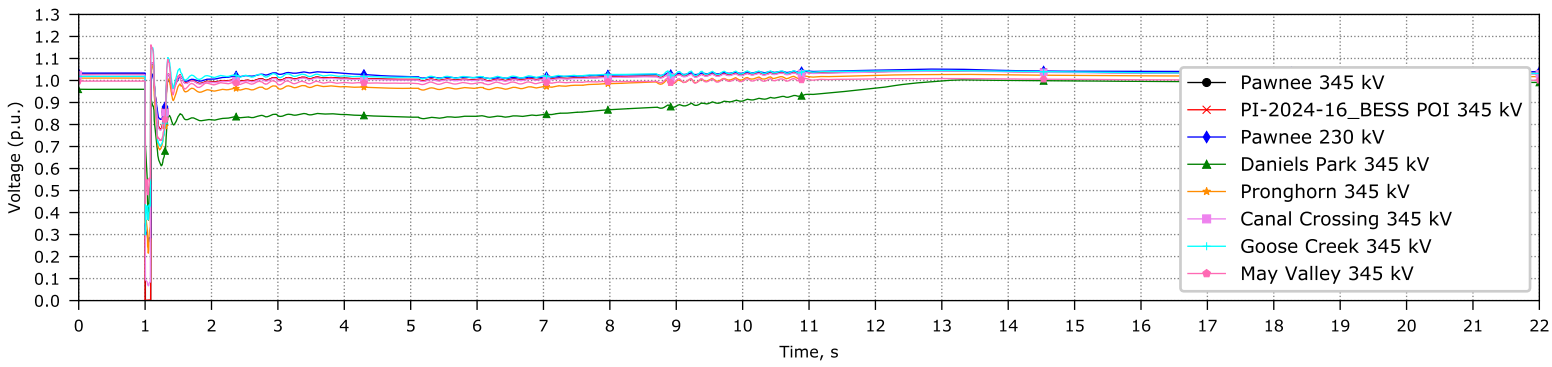




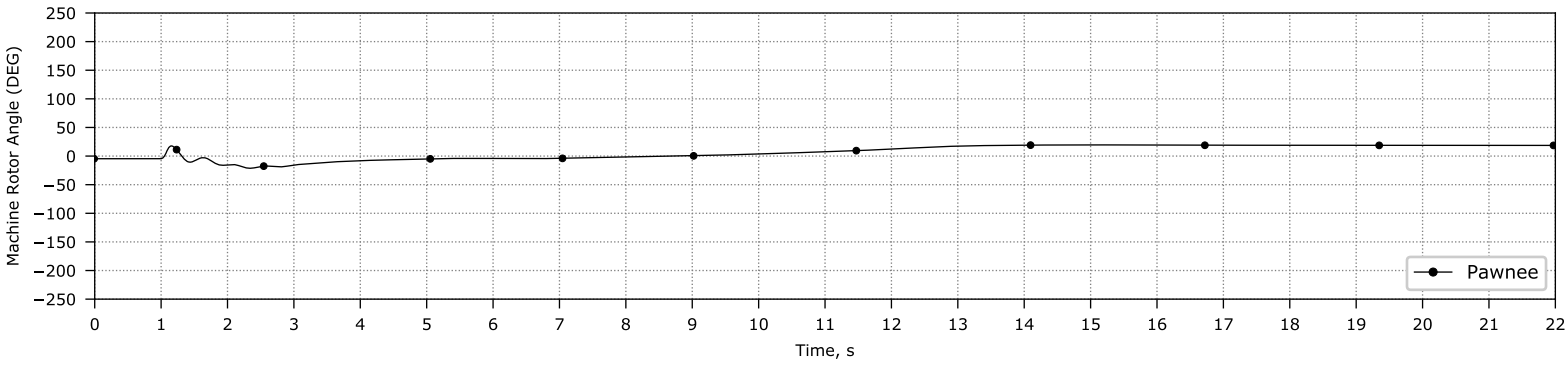


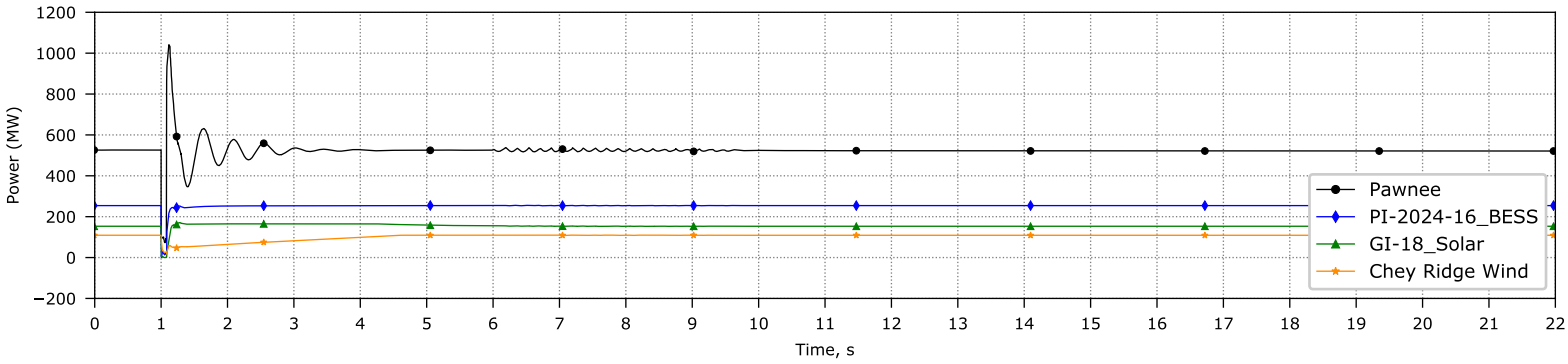


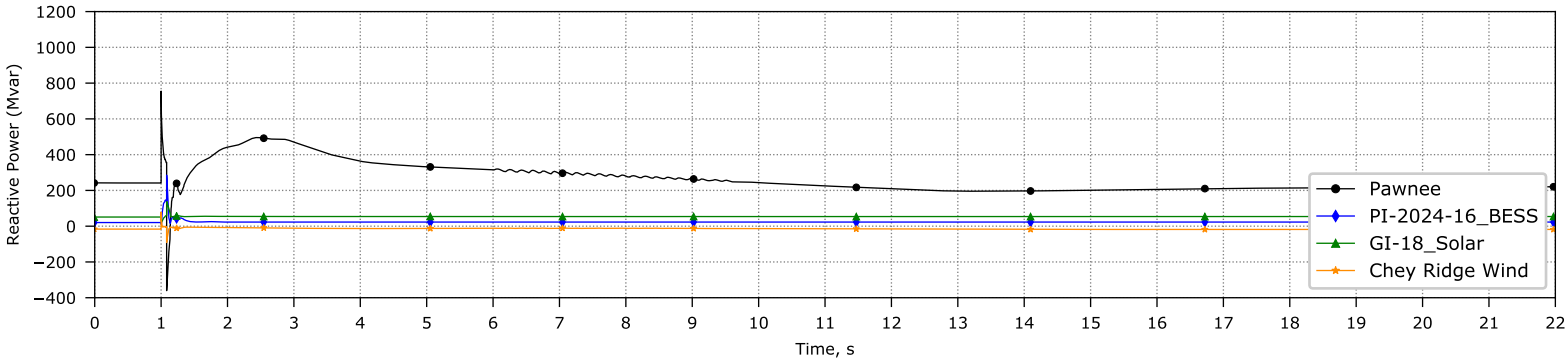


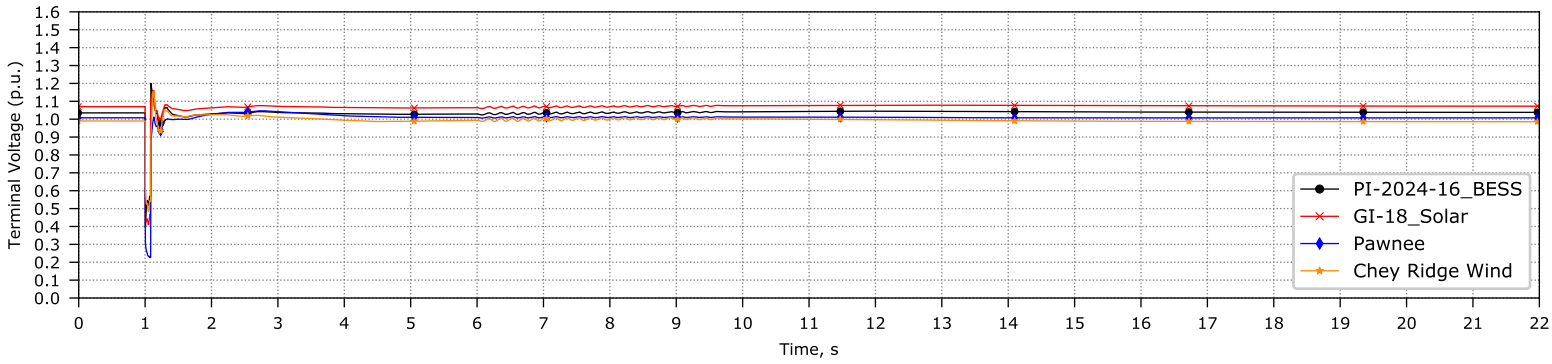


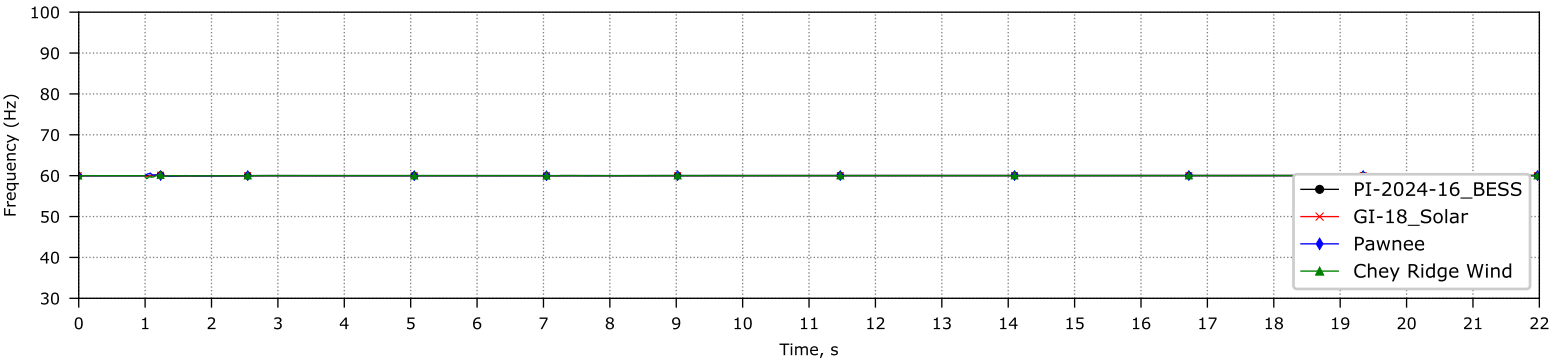
PI-2024-16_Study_East_FT_Lupton-Pawnee-1_230kV

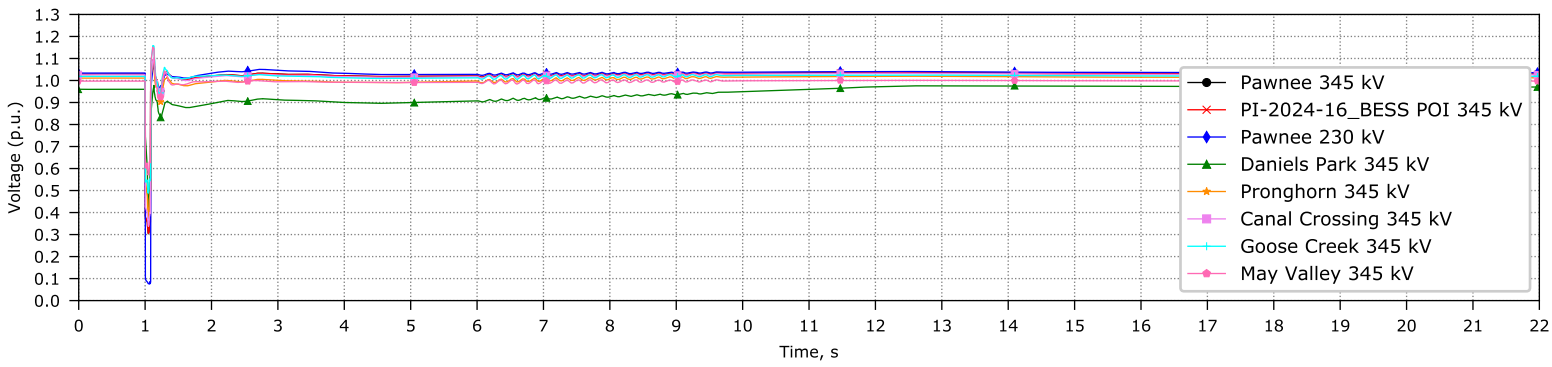




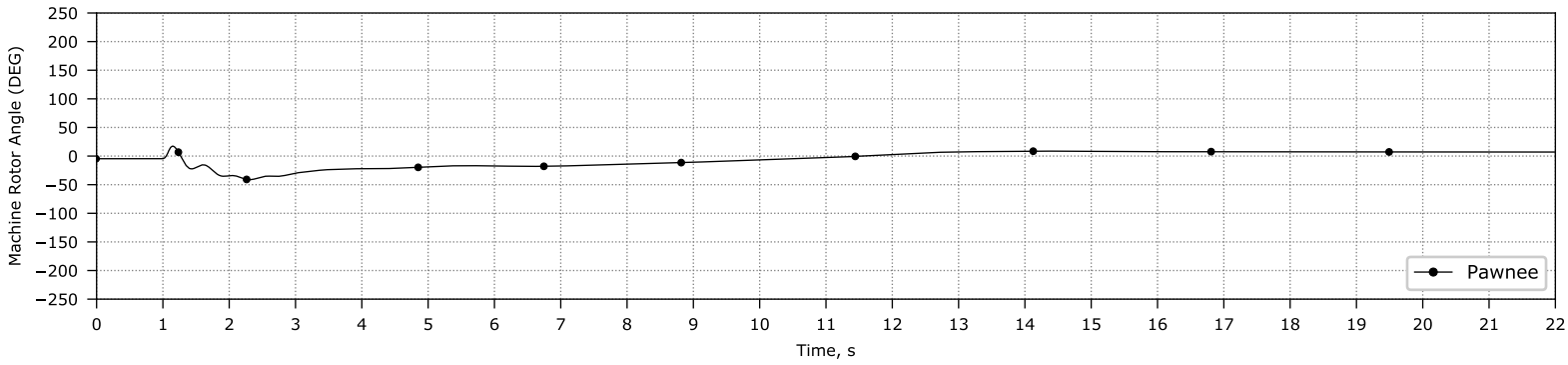


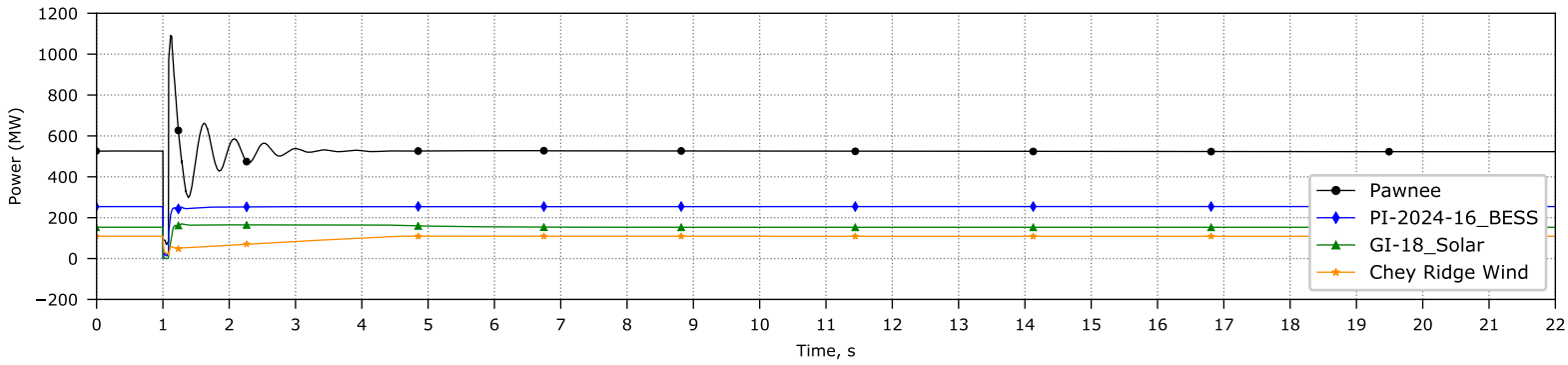


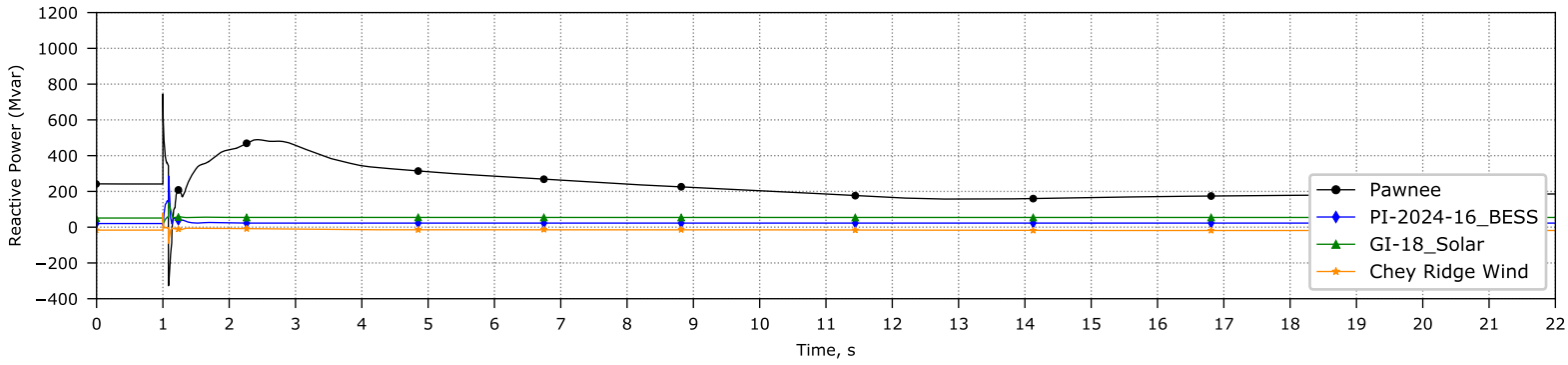


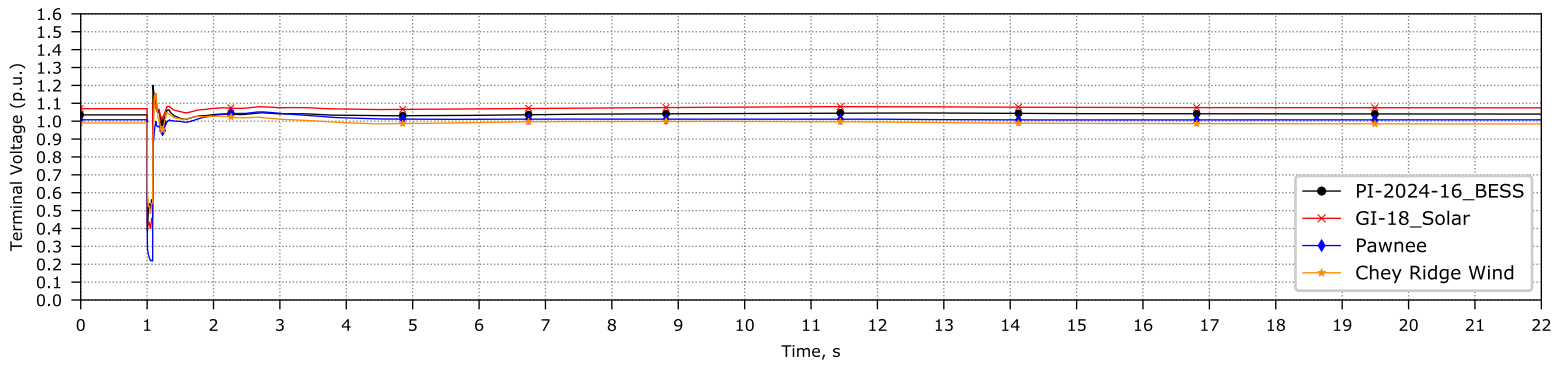


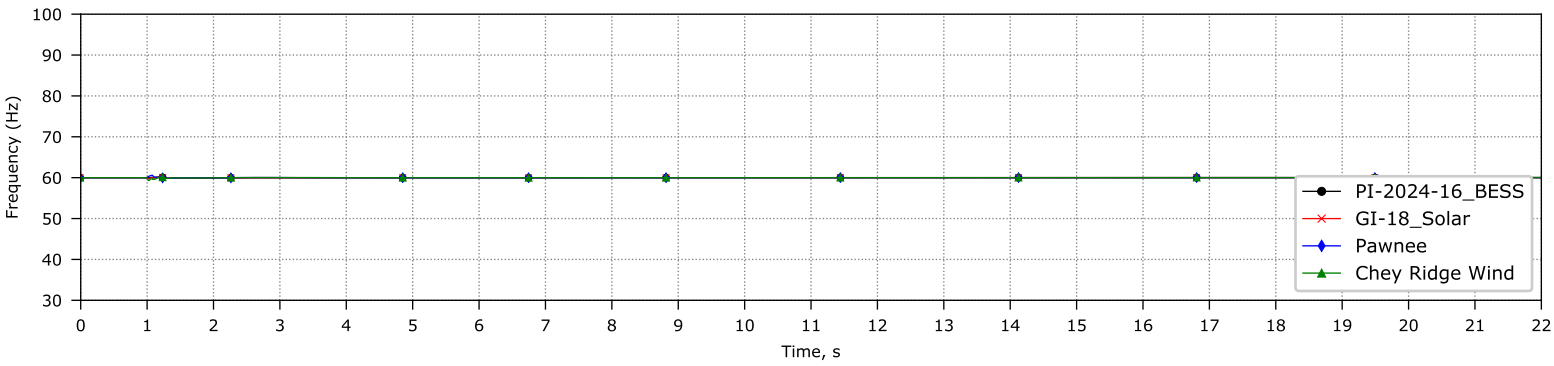
PI-2024-16_Study_East_Pawnee-Ptzlogn-1_230kV

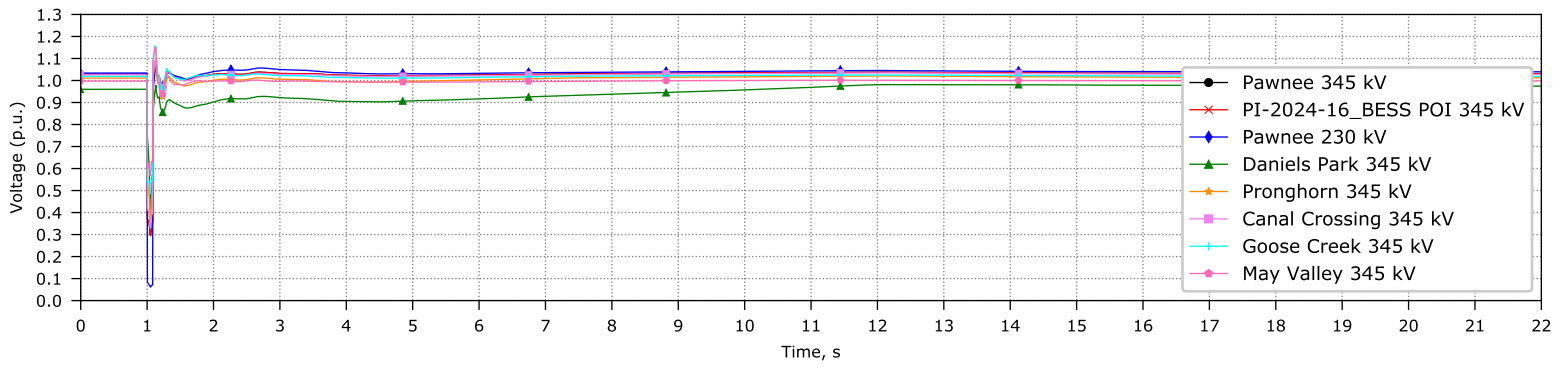




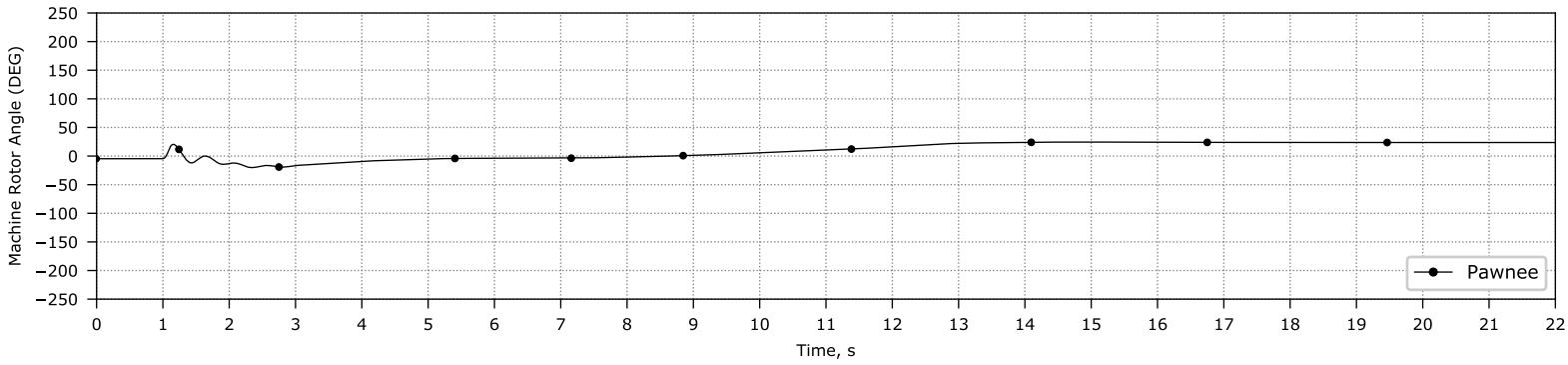


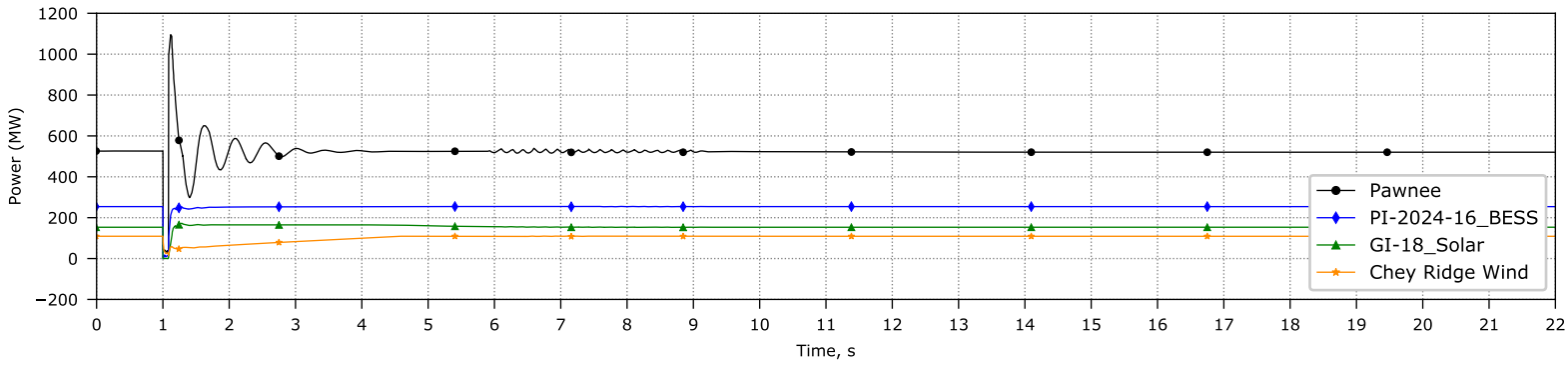


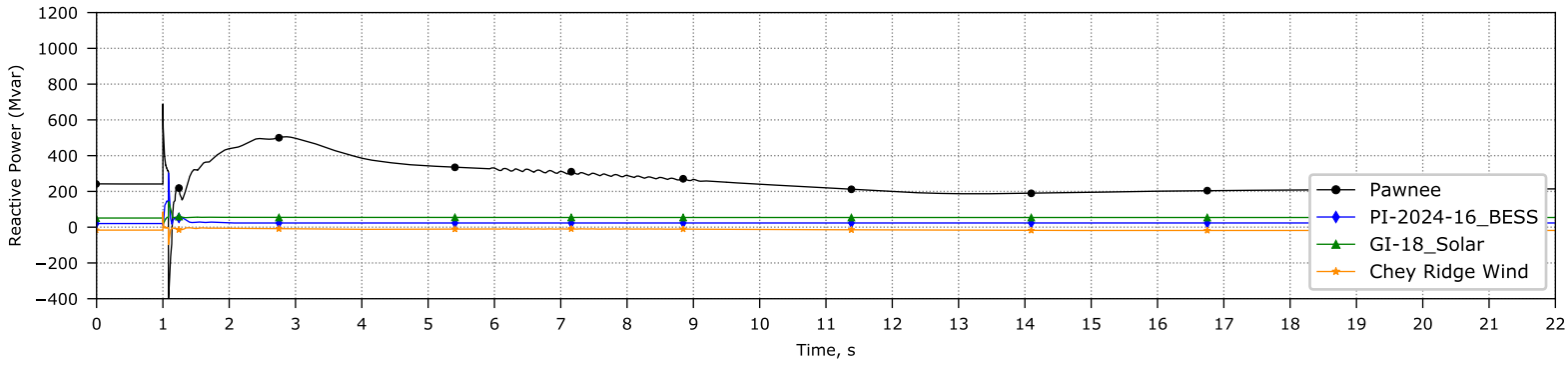


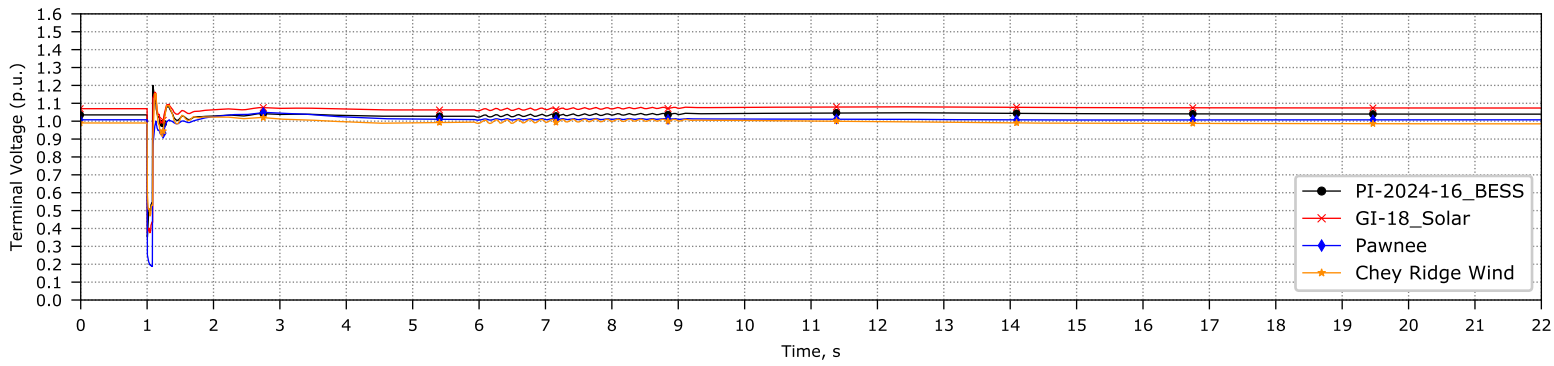


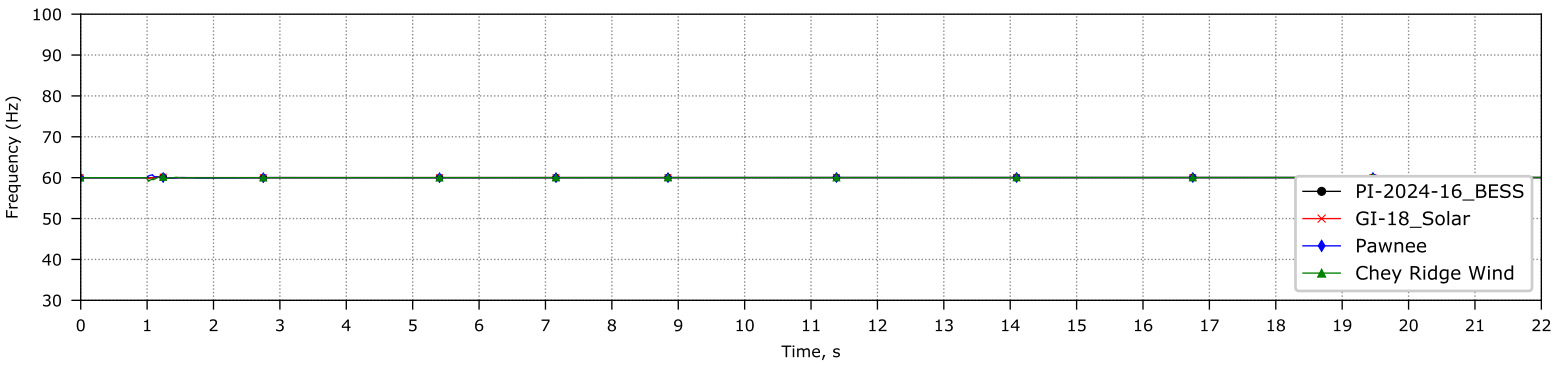
PI-2024-16_Study_East_Pawnee-5RSC_24_7-1_230kV

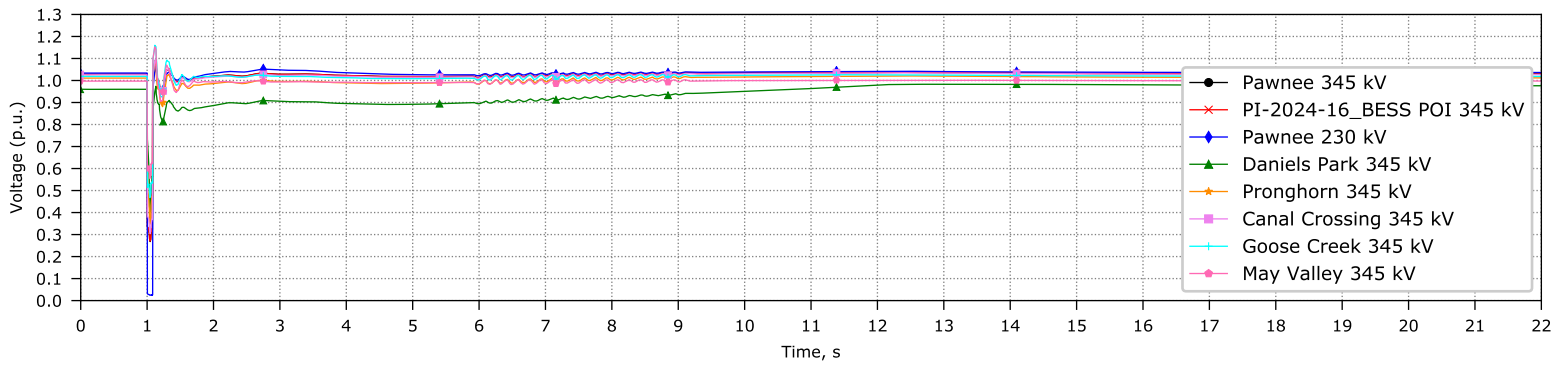




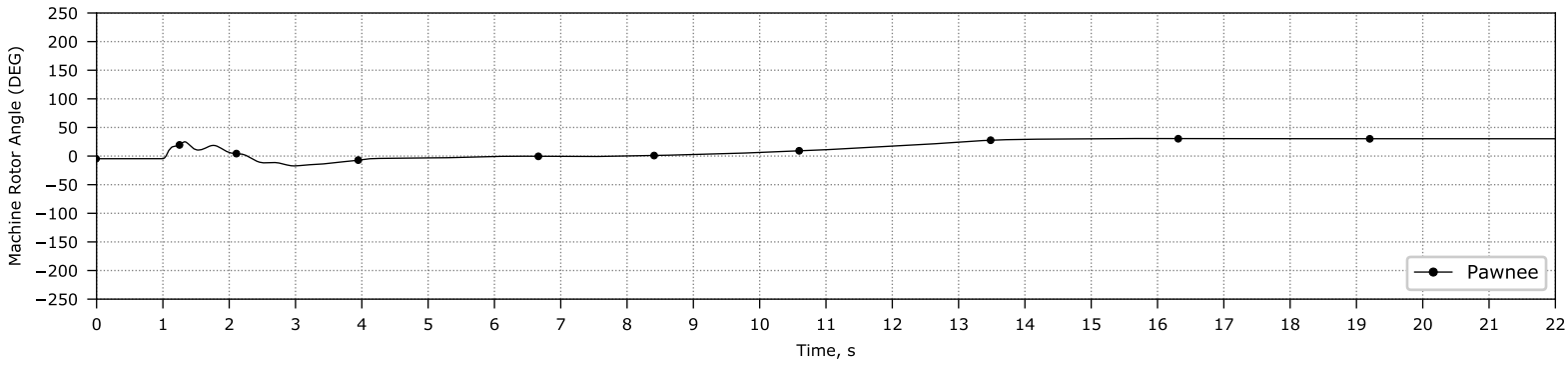


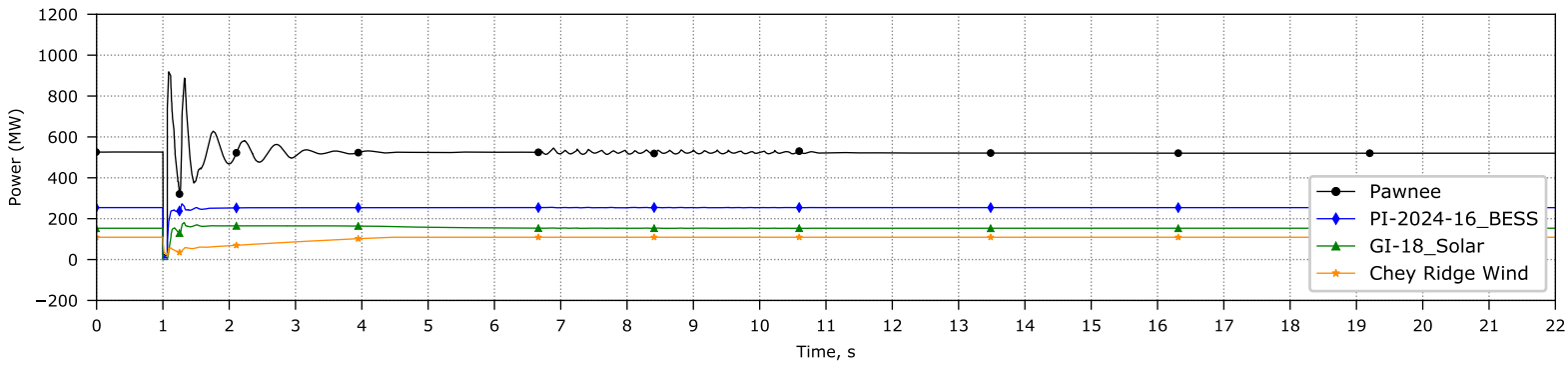


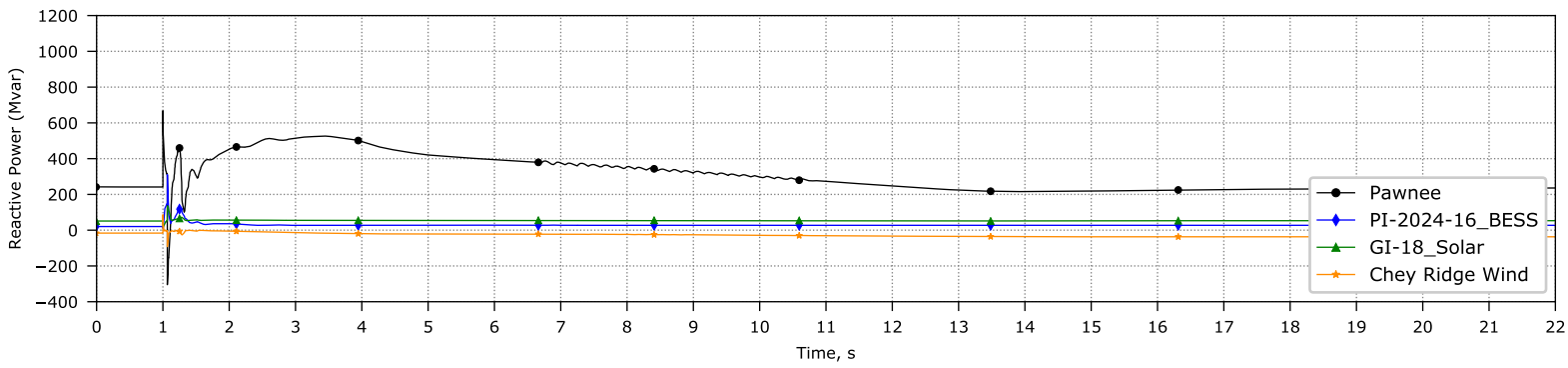


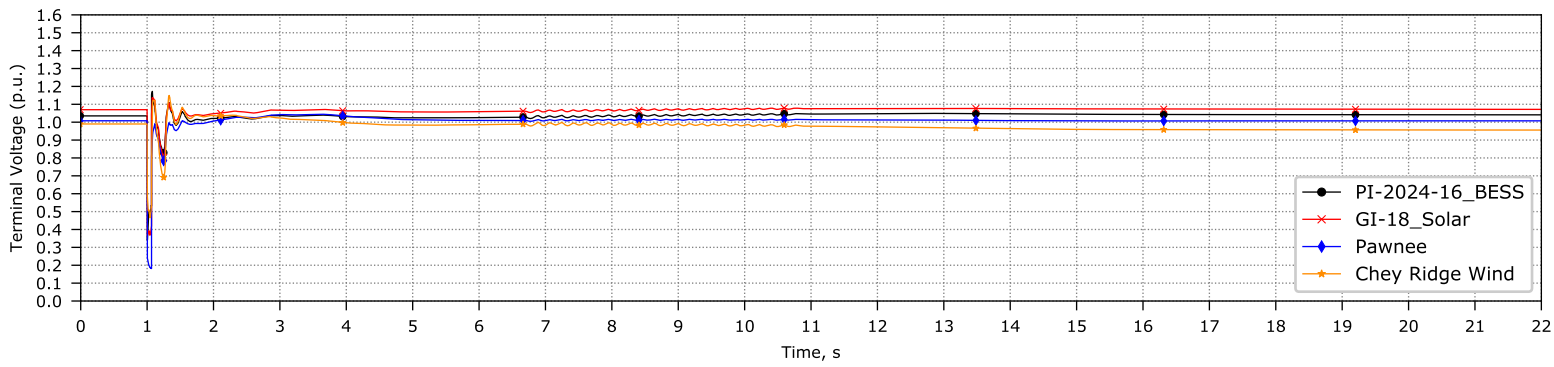


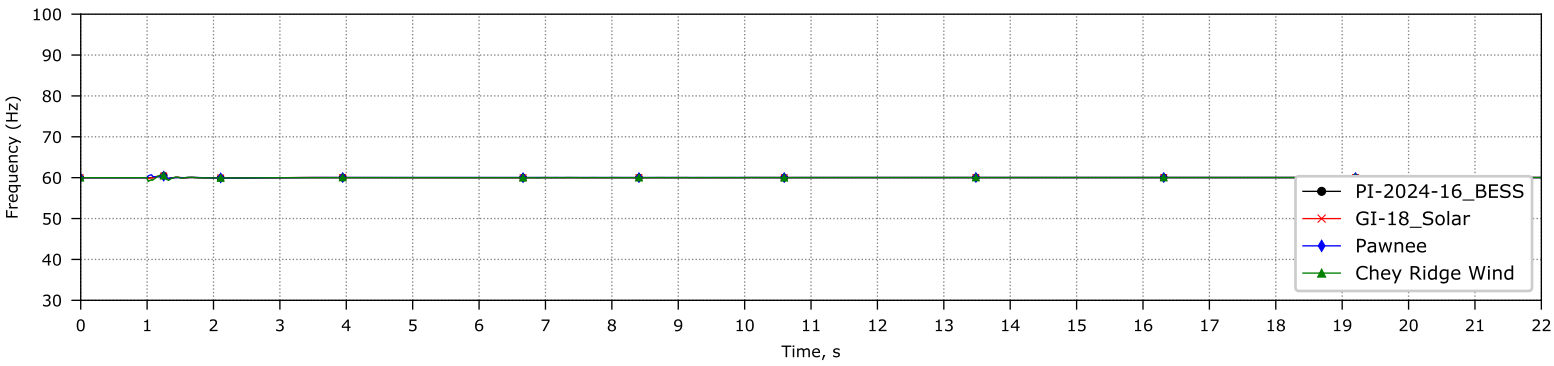
PI-2024-16_Study_East_Story-Pawnee-1_230kV

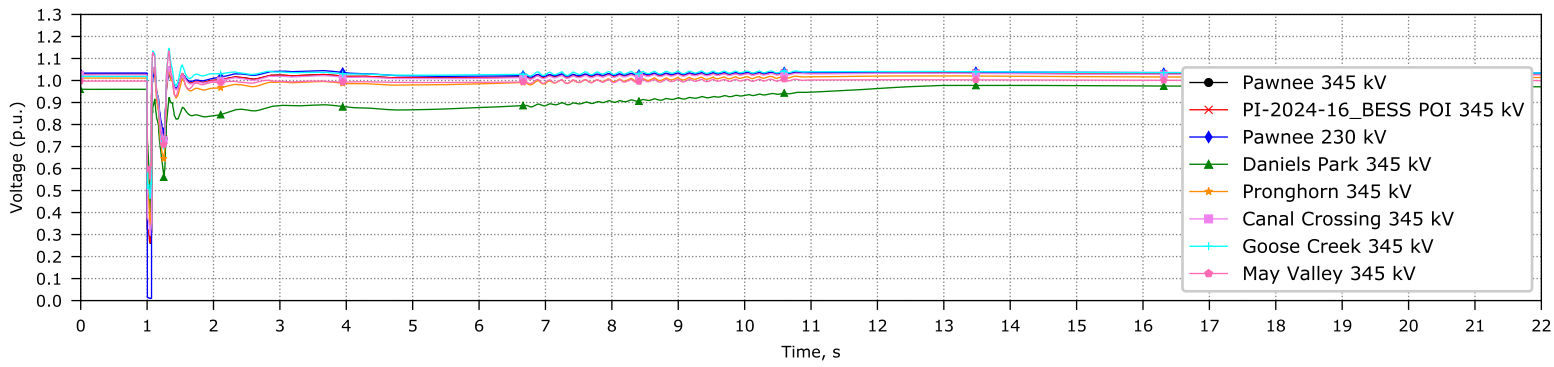




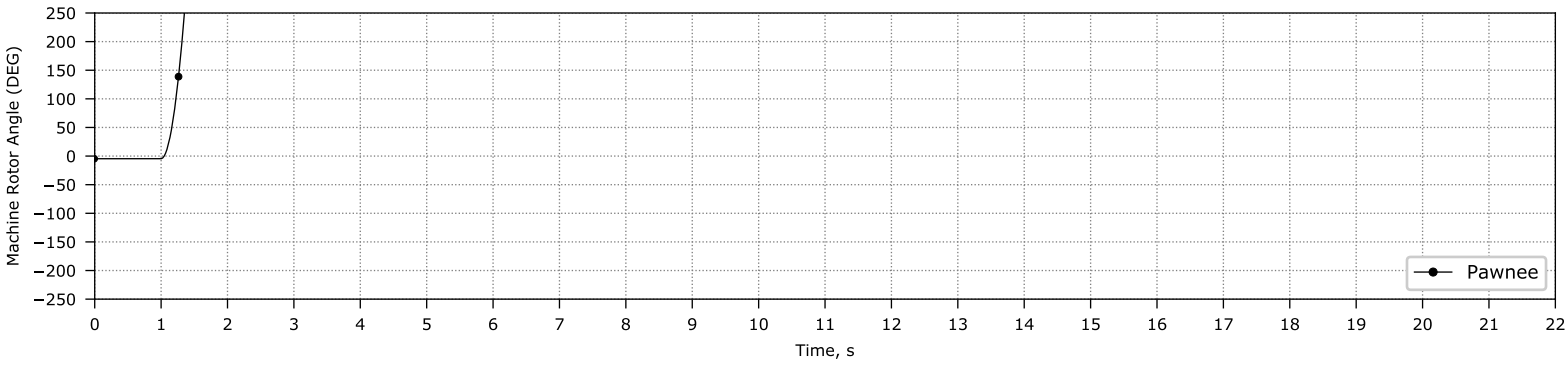


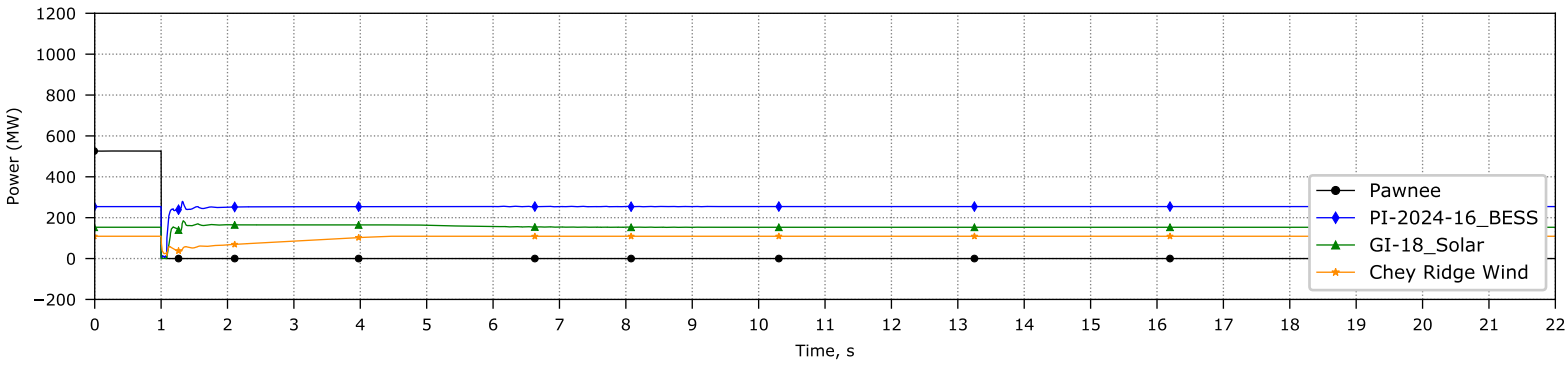


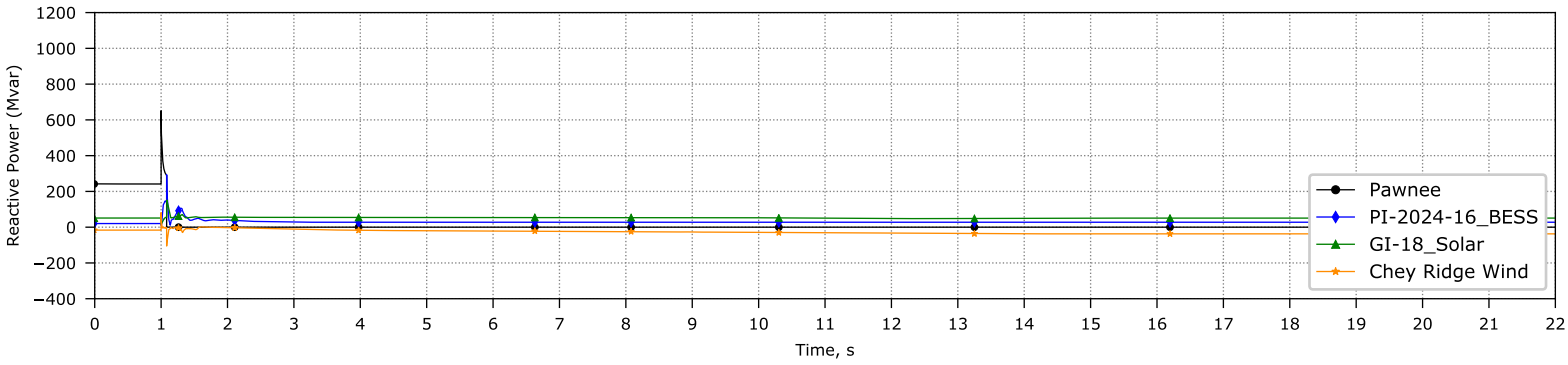


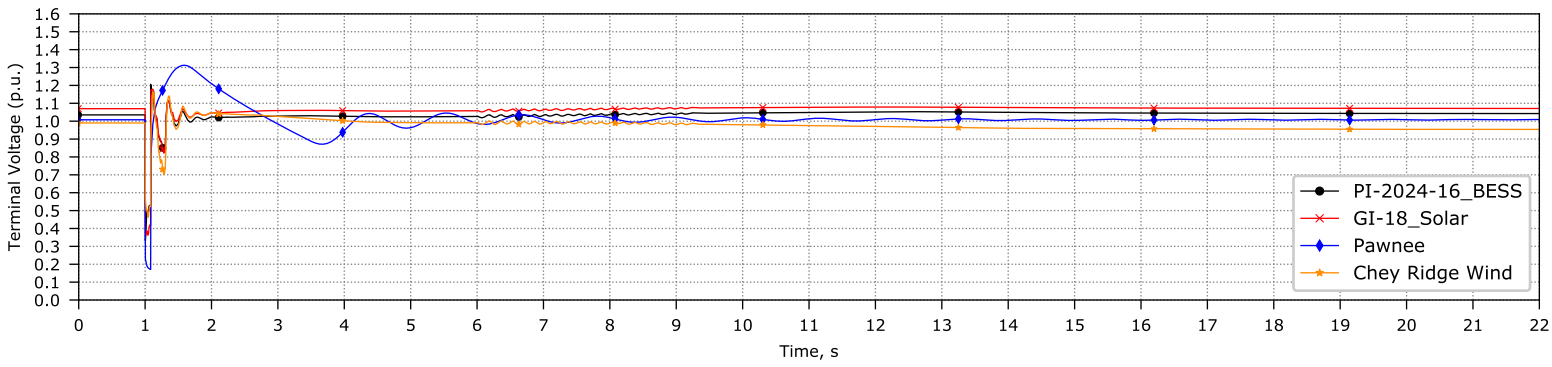


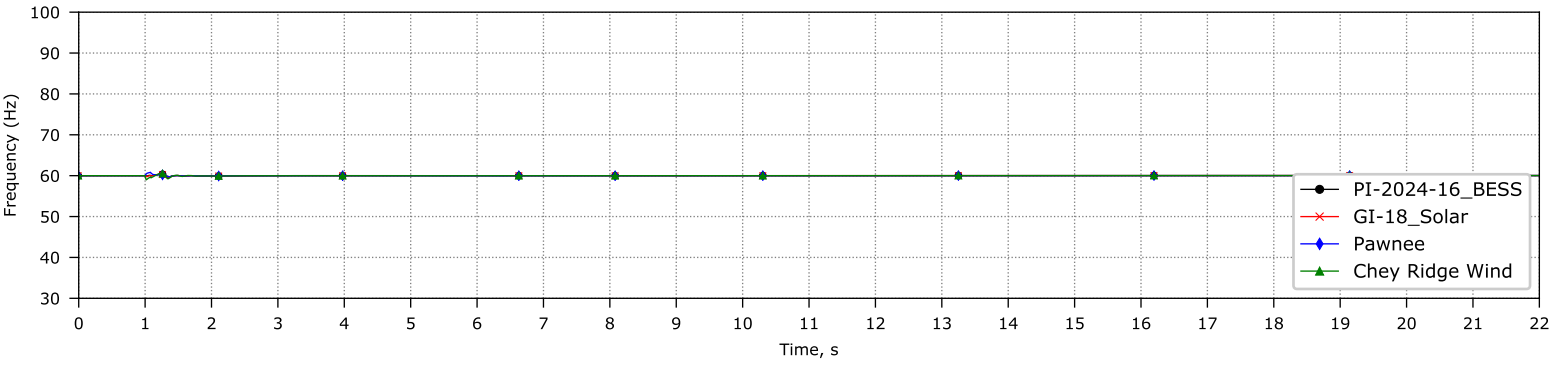
PI-2024-16_Study_East_Pawnee_230kV_Gen

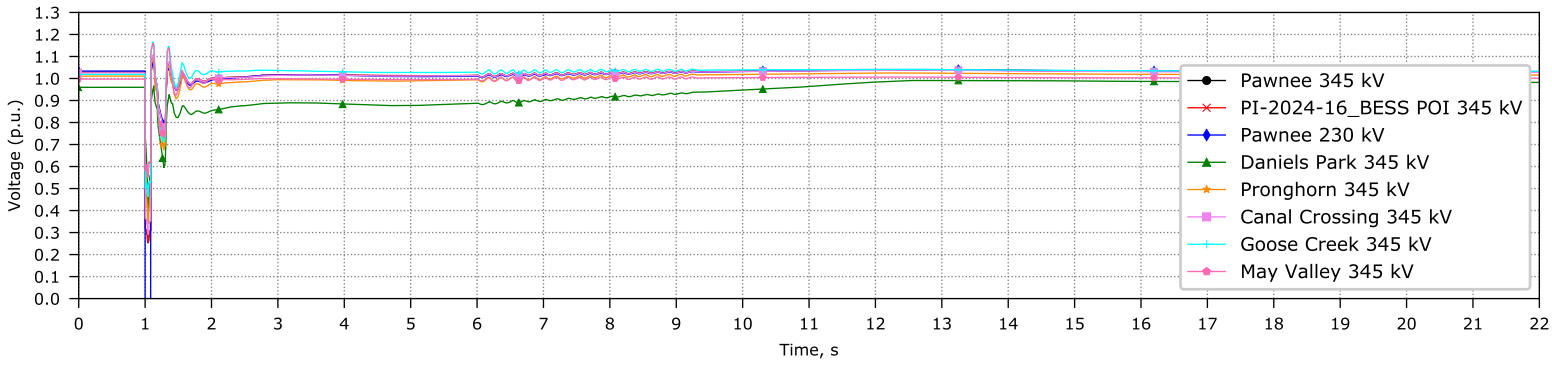




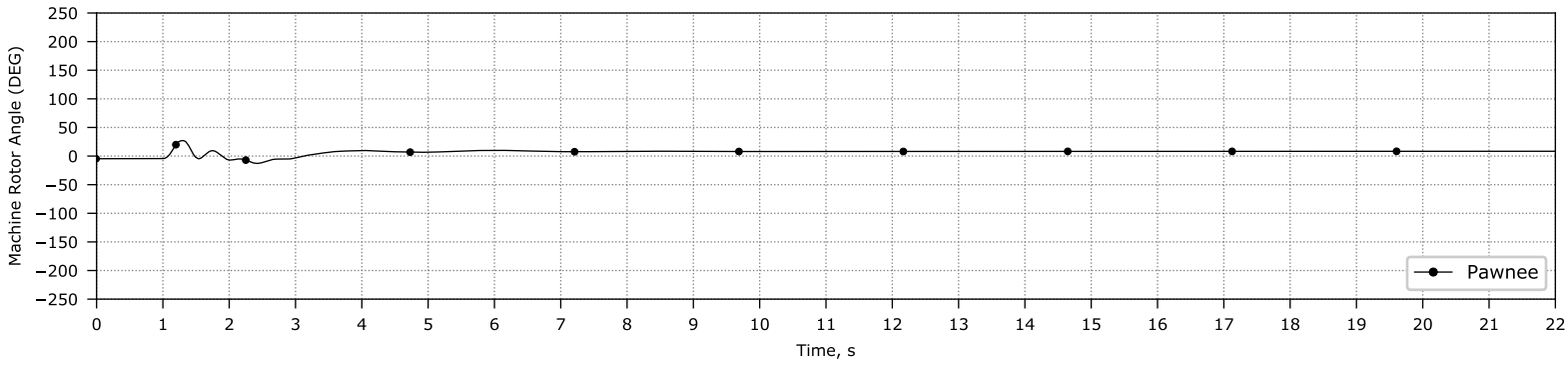


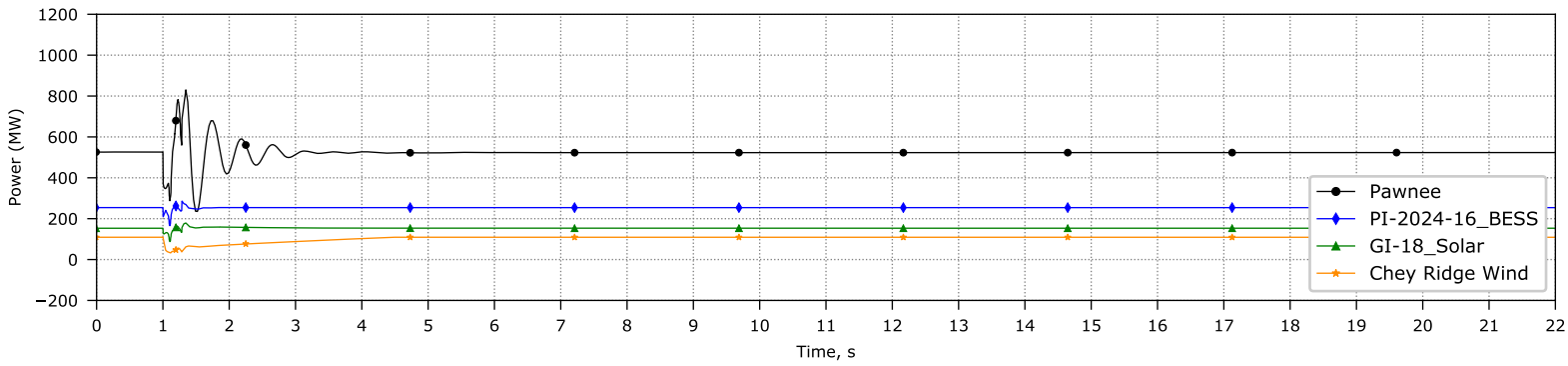


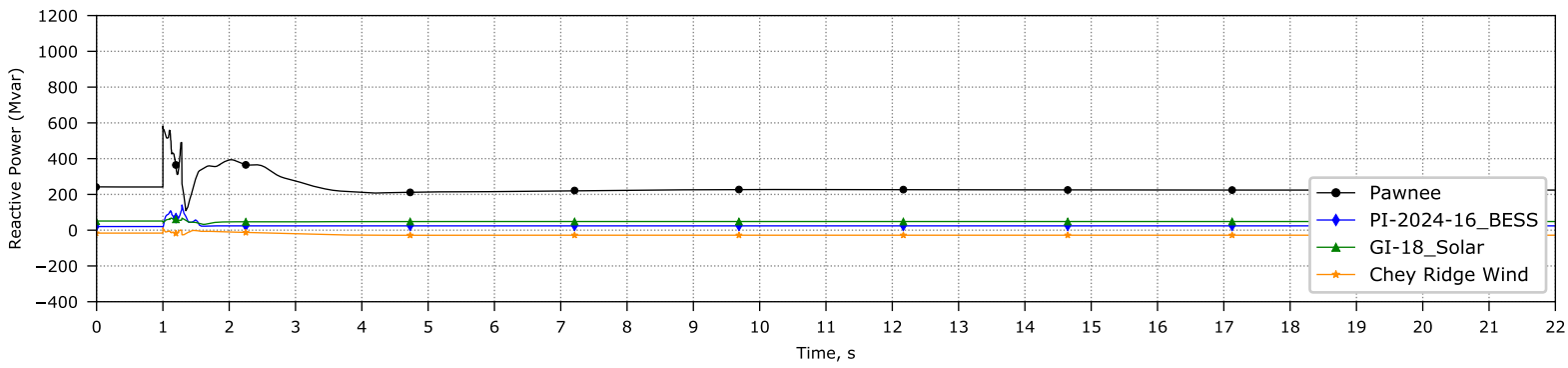


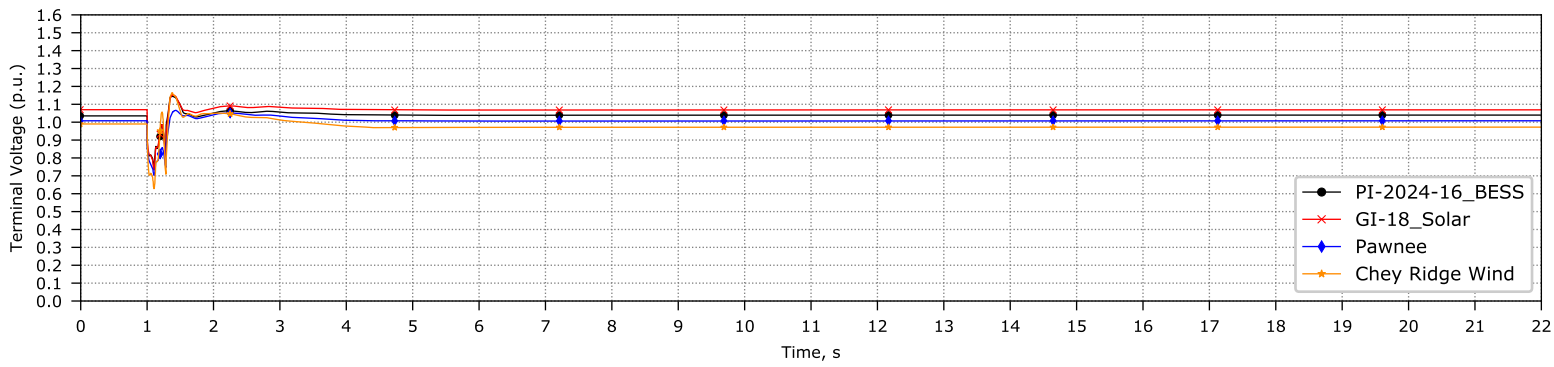


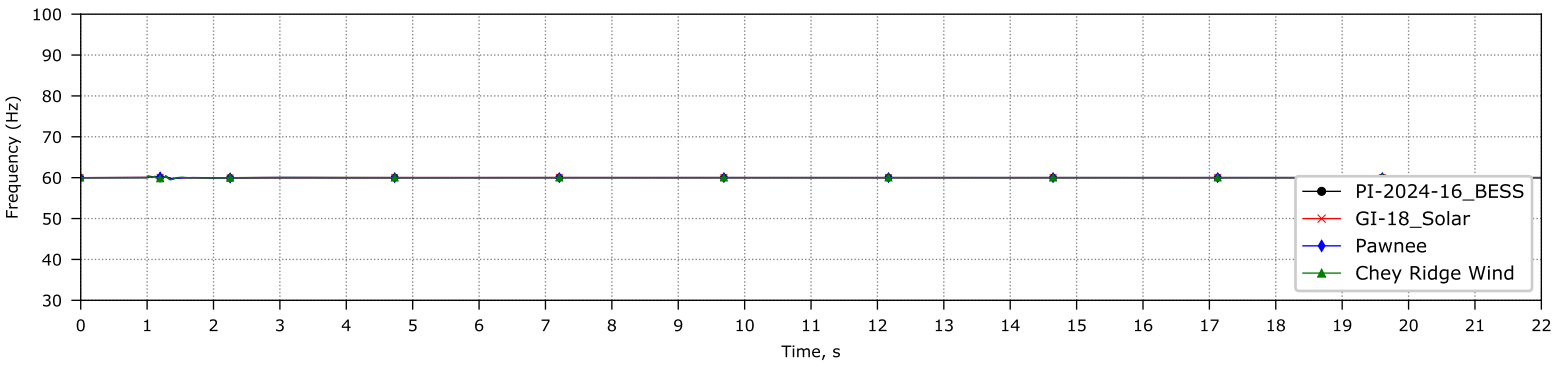
PI-2024-16_Study_East_BF_057b

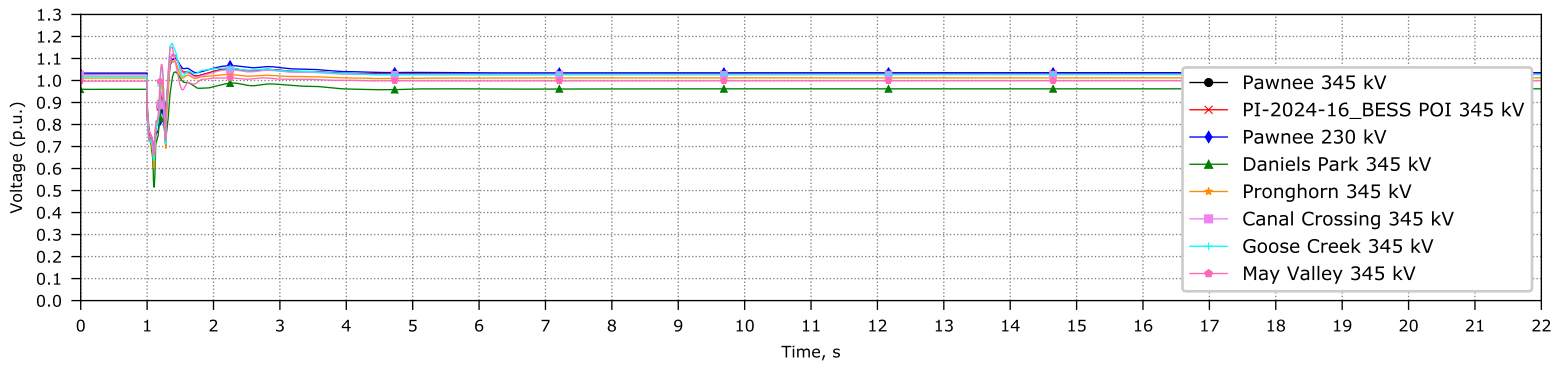












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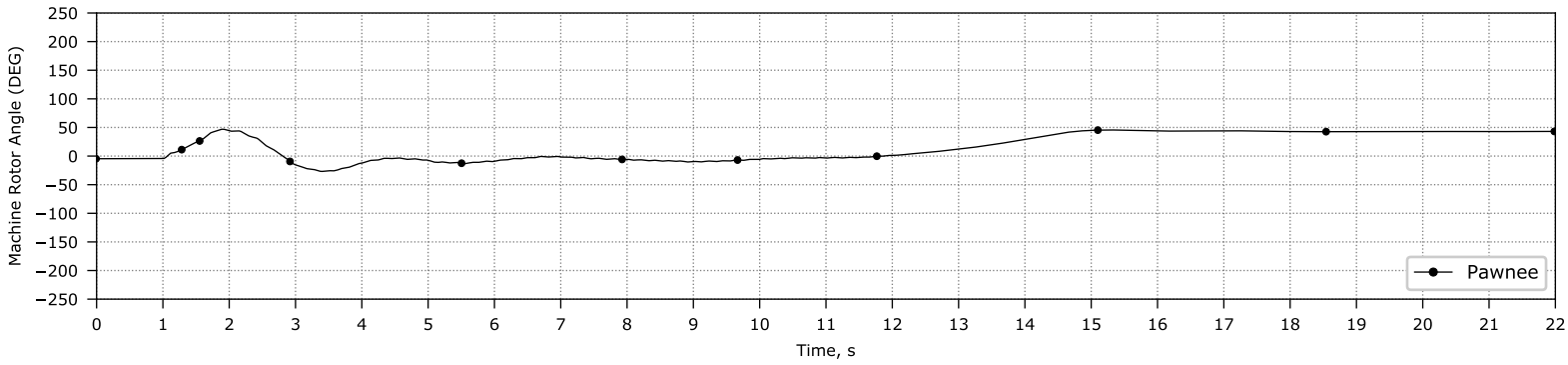
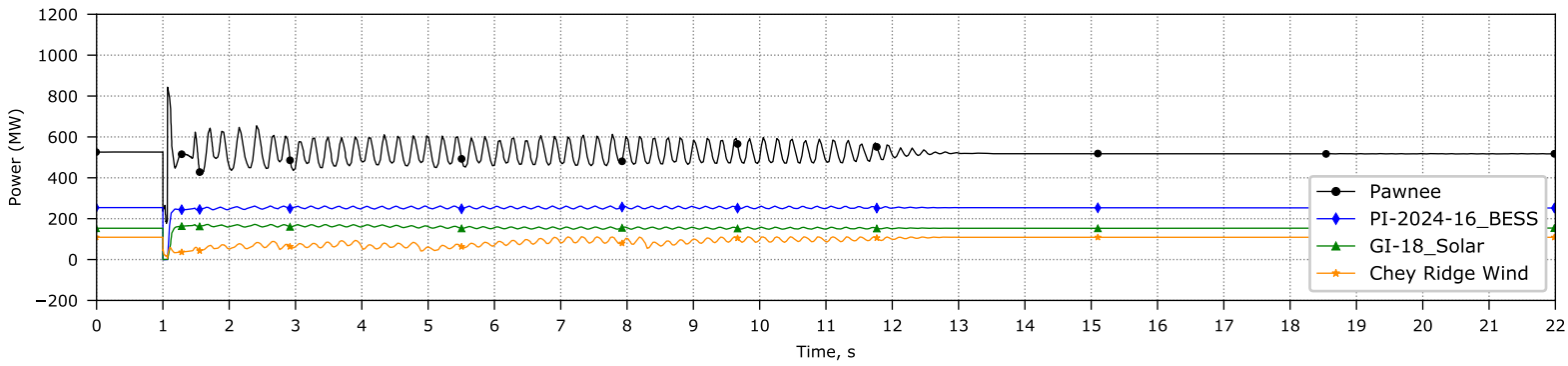
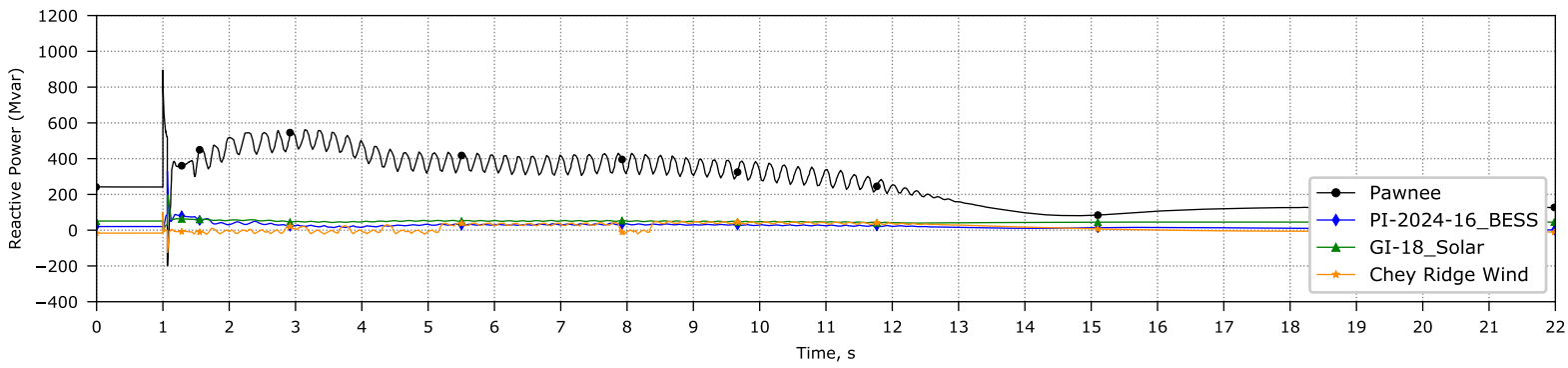
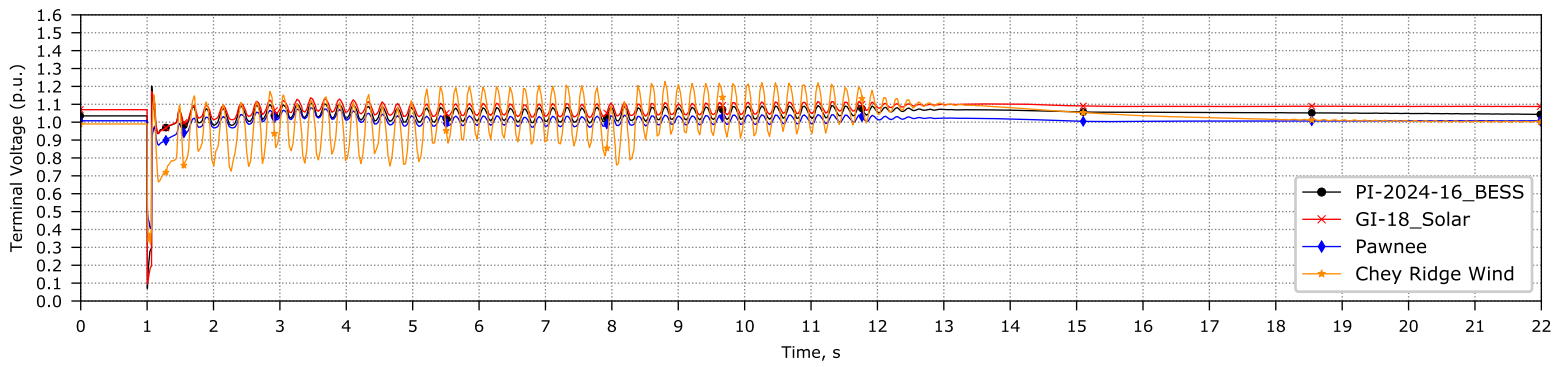
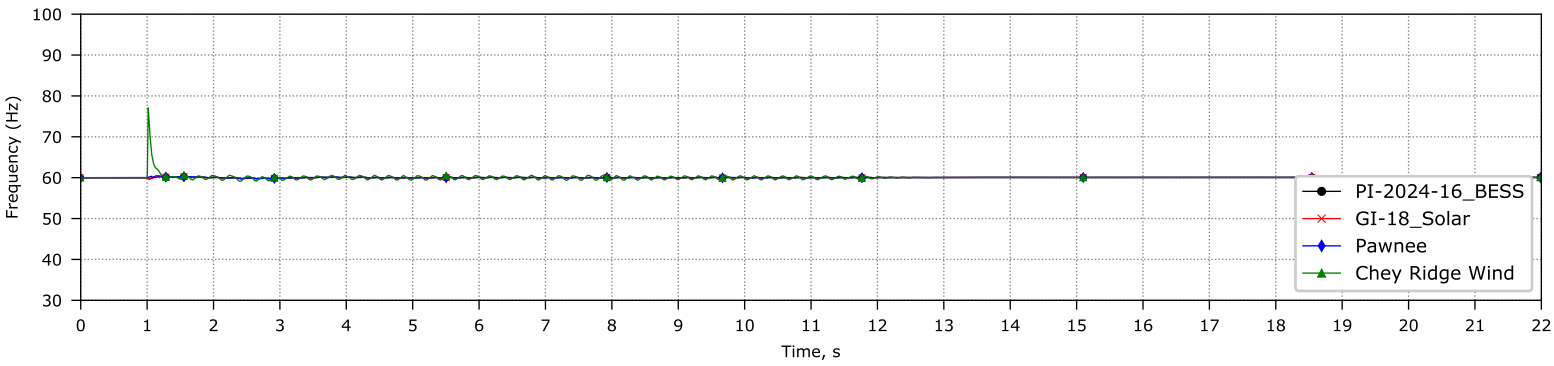
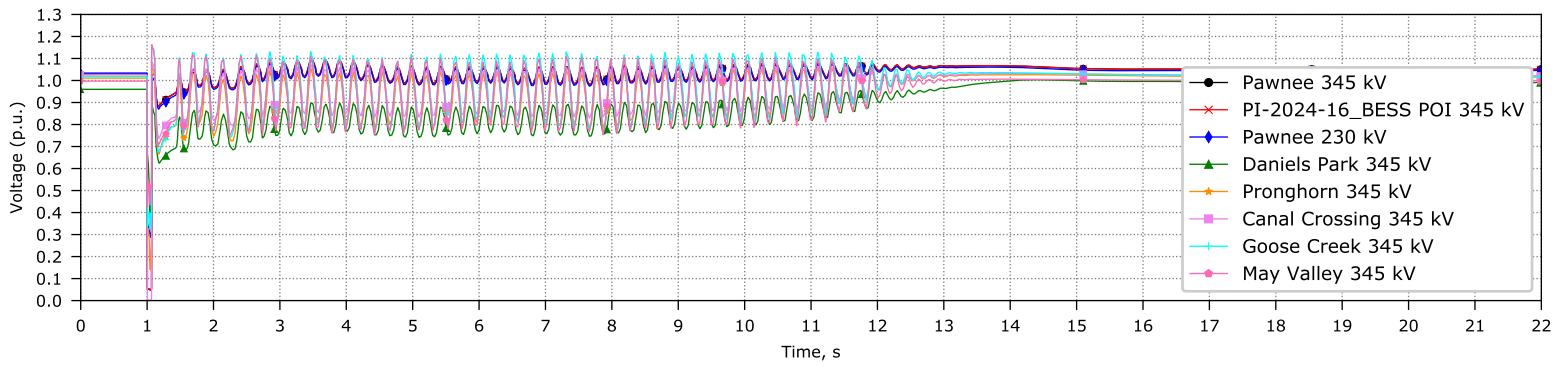




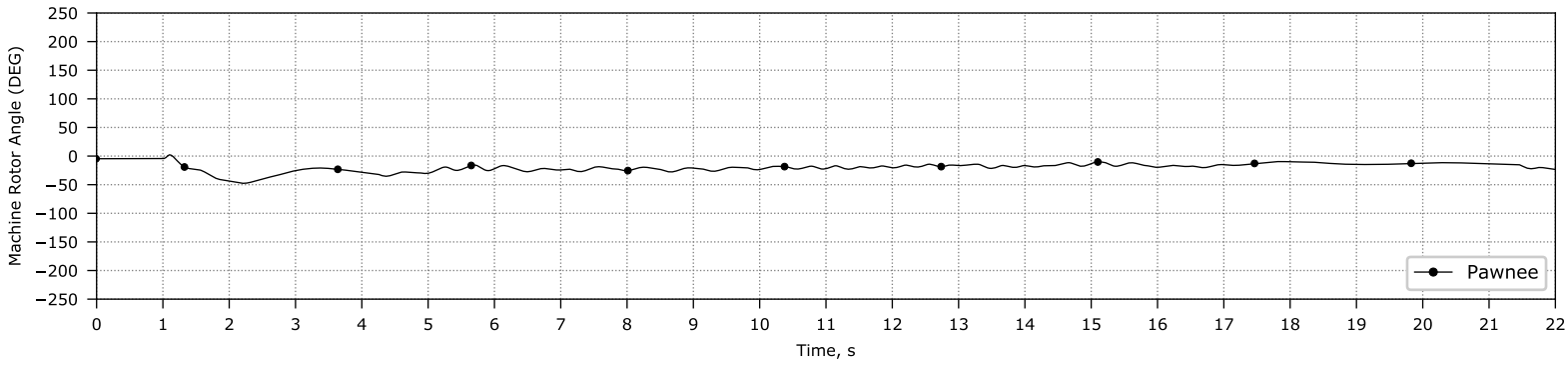


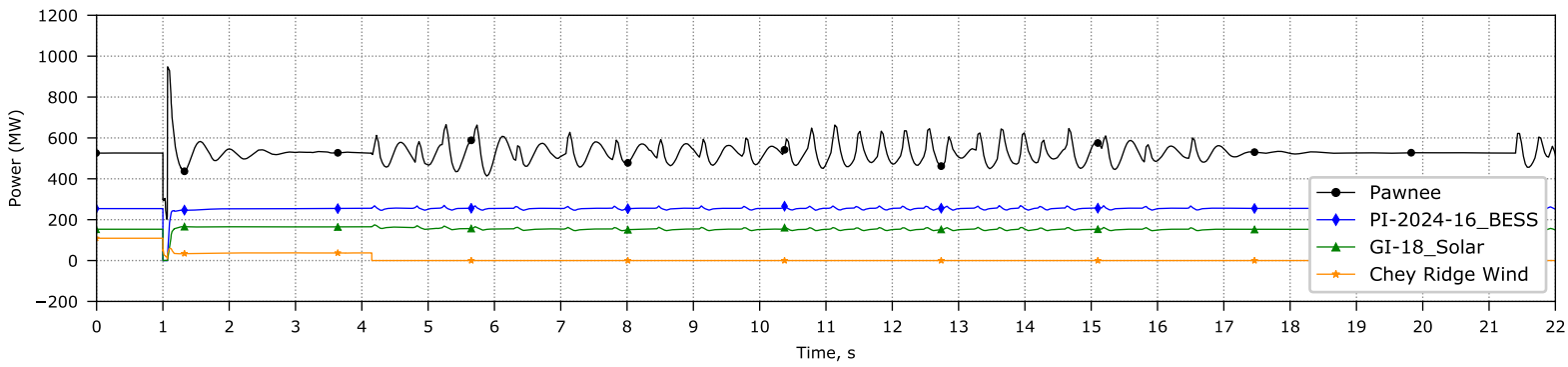


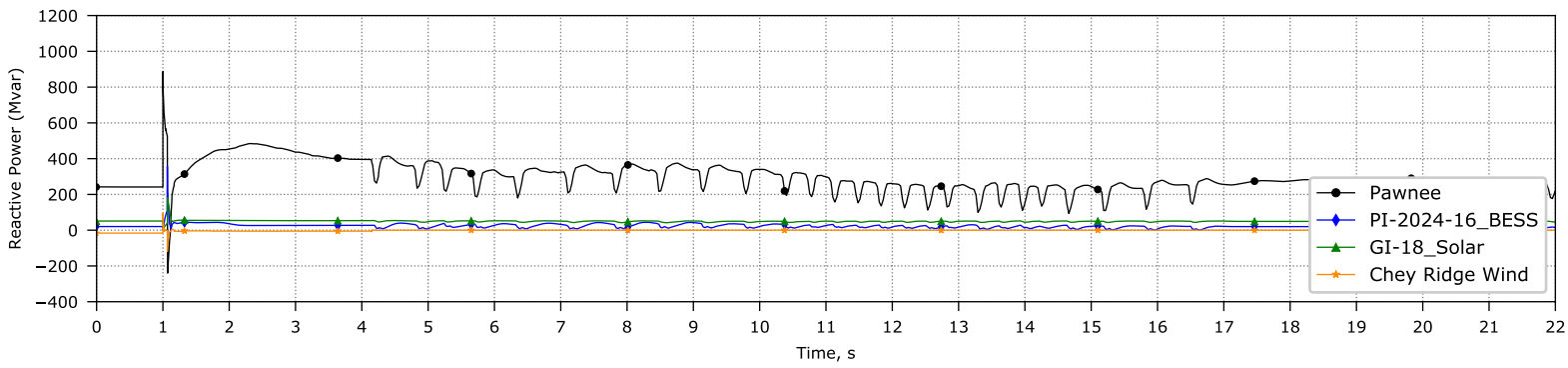


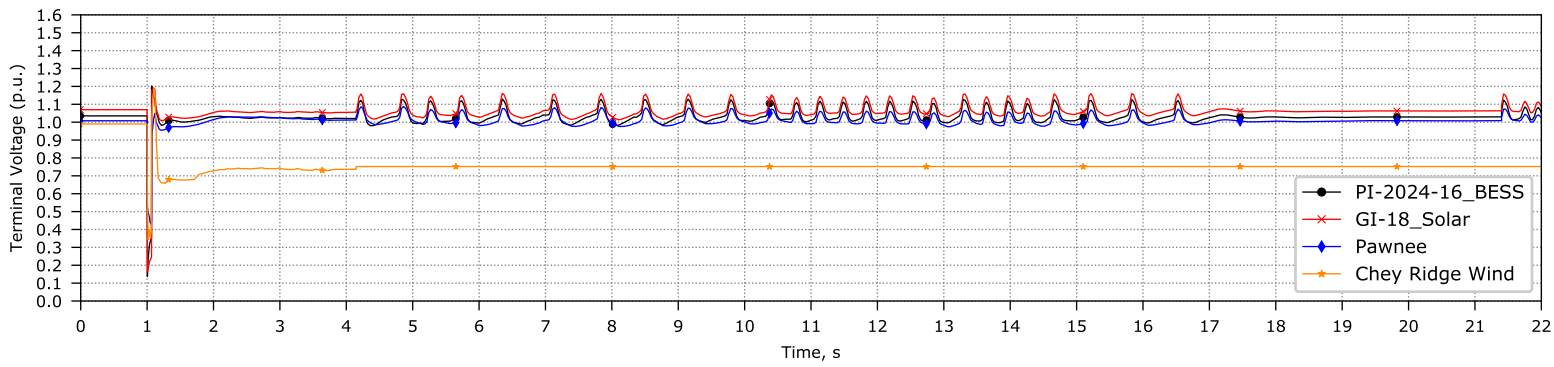


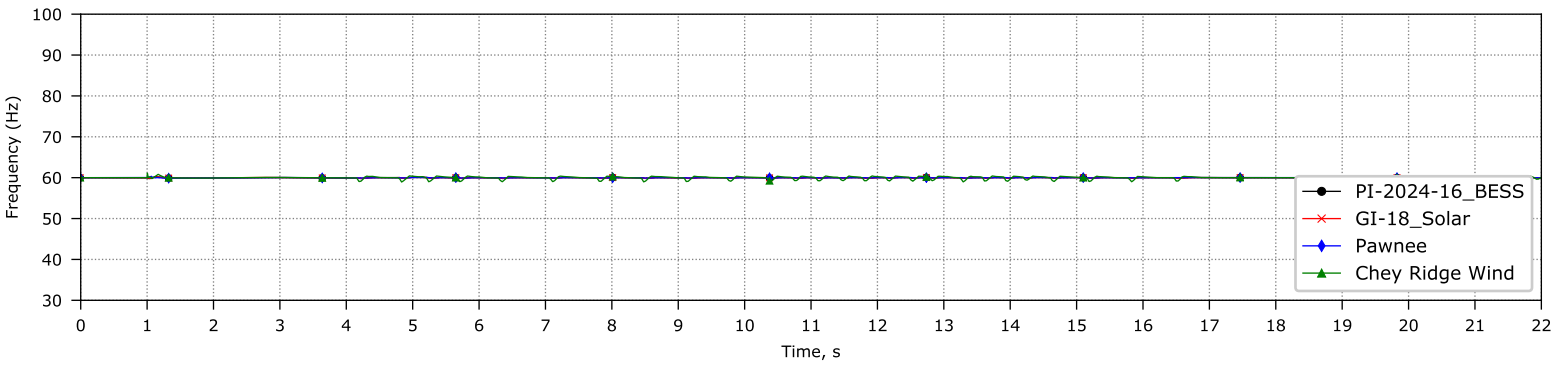
PI-2024-16_Study_East_P7_160

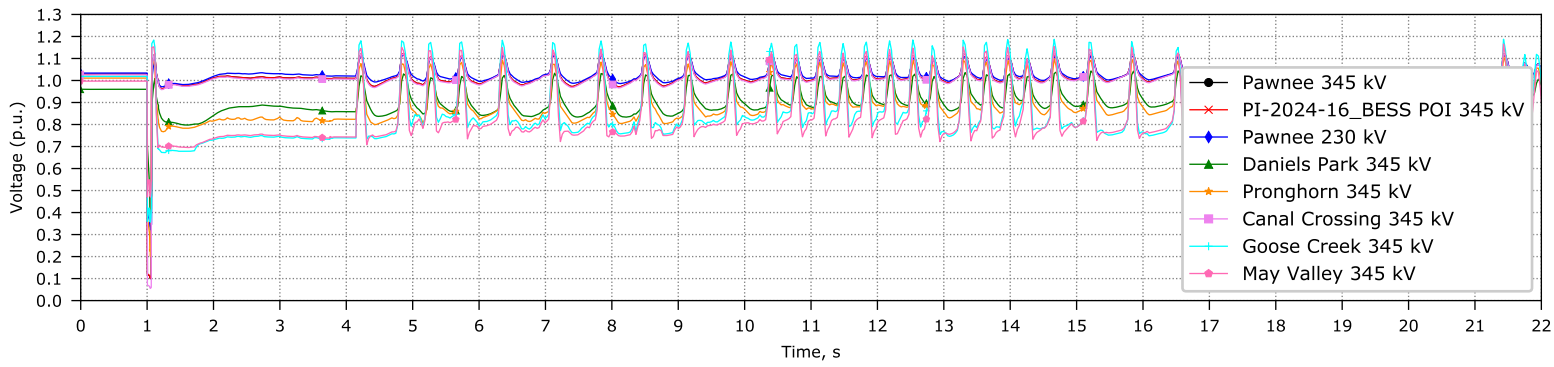












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