Bowmanton 244S Substation Voltage Support Project

Planning Report

AESO Project Number: P7083

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Executive Summary

The AESO performs system planning studies to assess transmission system reliability. This Planning Report describes the planning studies conducted by the AESO to assess the need for transmission system development in the Medicine Hat (Area 4) planning area and the Preferred Transmission Development which will enhance the 240 kilovolt (kV) transmission system allowing for the reliable connection of generation.

The Study Area consists of the 240 kV double-circuit path from the Cassils 324S and Newell 2075S substations located in the Brooks (Area 47) planning area to the Bowmanton 244S and Whitla 251S substations located in the Medicine Hat (Area 4) planning area. This 240 kV double-circuit path is also called the Cassils - Bowmanton - Whitla (CBW) path and consists of the 240 kV transmission lines 1034L, 1035L, 964L and 983L. For the purposes of the planning studies, the bus-tie breaker[1] at Bowmanton 244S substation is assumed to be open. With the bus-tie breaker open, the 138 kV transmission lines 675L, 676L, 880L and 600L remain connected to the CBW path through 240/138 kV transformers at Bowmanton 244S substation. Therefore, the Study Area includes the 138 kV transmission lines 675L, 676L, 880L and 600L as well. The AESO has received interest from generation developers in the Study Area, resulting in more than 6,000 MW[2] of generation projects seeking to connect to the CBW path. As of February 2023, there is 795 MW of existing wind generation on the CBW path and 984 MW of new generation projects meeting the AESO's project inclusion criteria[3] anticipated to connect to the CBW path over the next two years. With existing generation and connection of new generation projects meeting the AESO's project inclusion criteria, the AESO anticipates congestion (curtailment of in-merit energy) is likely to occur due to potential voltage criteria violations under certain conditions of high generation dispatch on the CBW path.

To evaluate transmission system reliability as generation continues to connect to the CBW path, the AESO carried out planning studies based on Power-Voltage (P-V) analysis. The planning studies carried out in this report were used to establish the need for transmission development, evaluate the merits of Transmission Development Options and to select the Preferred Transmission Development. The AESO conducted further assessments (e.g., short-circuit analysis and transient stability analysis) with the Preferred Transmission Development modeled to re-affirm the planning recommendation made in this Planning Report.

Need Assessment

The AESO conducted Category A generation integration capability studies to assess the performance of the transmission system without transmission development (pre-development) in the Study Area. With

[1] The bus-tie breaker is the 138 kV breaker 244S3752 at Bowmanton 244S substation, which is used to isolate the 138 kV transmission lines 674L, 879L and 892L from the 240 kV CBW path during conditions of high renewable generation dispatch.

[2] This is the total capacity of existing generation, generation projects meeting the AESO's project inclusion criteria and other less certain generation projects in the AESO's connection project list.

[3] The AESO's project inclusion criteria are available in *ID #2018-018T Provision of System Access Service and the AESO Connection Process*, on the AESO website. For connection projects, the project inclusion criteria are met when system access service agreement is effective; or if there is no system access service agreement, when permit and license is issued by the Alberta Utilities Commission. For behind the fence projects, the project inclusion criteria are met when system access service agreement is effective; or if there is no system access service agreement, when the generating unit owner's contribution is paid; or if there is no system access service agreement and payment of the generating unit owner's contribution is not required, when gate 3/4 is passed.

existing generation and the connection and dispatch of new generation projects that meet the AESO's project inclusion criteria in the Study Area, Category A voltage criteria violations were observed on the CBW path. Generation curtailment will be required to mitigate the voltage criteria violations. Therefore, there is a need for transmission development in the Study Area to alleviate the anticipated near-term Category A voltage criteria violations and allow for transmission of in-merit electric energy[4]. Prior to transmission development in the Study Area, Category A voltage criteria violations can be managed by operational measures in accordance with the procedures set out in Section 302.1 of the ISO rules, *Real Time Transmission Constraint Management* (TCM Rule).

Transmission Development Options and Comparative Assessment

To help alleviate the identified constraints in the Study Area, the AESO investigated two Transmission Development Options[5], taking into consideration the cost, additional generation integration capability and land use and environmental effects. The Transmission Development Options are presented in Table A-1.

Table A-1: Transmission Development Options

Option	Description	Total Project Cost (+/- 30%)
1	Add 300 MVAr of Shunt Capacitor Banks on the 240 kV Bus at Bowmanton 244S Substation	$11,214,291
2	Add 50% Series Compensation on 240 kV Transmission Lines 1034L and 1035L	$55,162,680

Based on the planning study results, Options 1 and 2 provide technically similar improvement in the Category A generation integration capability. However, Option 1 results in a significantly lower cost than Option 2.

AltaLink reviewed Option 1 and confirmed that the proposed 300 MVAr of shunt capacitor banks fit within the existing fence line of Bowmanton 244S substation without requiring site expansion. However, Option 2 would require the development of a new substation to contain the series compensation and therefore, Option 1 has lower environmental and land use effects compared to Option 2.

Option 1 was selected as the Preferred Transmission Development due to comparable technical performance, substantially lower cost and lower environmental and land use effects compared to Option 2.

The Preferred Transmission Development involves the following:

- Add three (3) 100 MVAr shunt capacitor banks on the 240 kV bus at Bowmanton 244S substation;
- Add three (3) 240 kV circuit breakers and associated disconnect switches; and
- Add or modify any associated equipment as required.

[4] Refer to Part 3 Transmission System Criteria and Reliability Standards, section 15(1)(e)(i) of Alberta's *Transmission Regulation*.

[5] The Transmission Development Options proposed in this Planning Report were not identified in the AESO's 2022 Long-term Transmission Plan (2022 LTP). The 2022 LTP identified the need for new 240 kV transmission lines in the Southeast sub-region to provide additional generation integration capability. However, given the fast pace of generation developments in the Medicine Hat (Area 4) planning area, congestion on the CBW path is anticipated to occur in the near term. The Transmission Development Options proposed in this Planning Report help reduce the anticipated congestion in the near term before the significant infrastructure identified in the 2022 LTP is in place.

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Abbreviations

AESO	Alberta Electric System Operator
AC	alternating current
AIES	Alberta interconnected electric system
APS	Automatic protection scheme
BC	British Columbia
CBW	Cassils - Bowmanton - Whitla
DC	direct current
EATL	Eastern Alberta Transmission Line
GSU	Generator step-up transformer
km	kilometer
kV	kilovolt
LTO	AESO's Long-term Outlook
LTP	AESO's Long-term Transmission Plan
MSSC	Most Severe Single Contingency
MVA	megavolt ampere
MVAr	megavolt ampere reactive
MW	megawatt
NID	Needs Identification Document
P-V	Power-Voltage
RAS	Remedial action scheme
TFO	legal owner of a transmission facility
TPL	Transmission Planning Standards (part of the Alberta Reliability Standards)
VAr	volt ampere reactive
WATL	Western Alberta Transmission Line
WECC	Western Electricity Coordinating Council

1 Introduction

The AESO performs system planning studies to assess transmission system reliability. This Planning Report describes the planning studies conducted by the AESO to assess the need for transmission system development in the Medicine Hat (Area 4) planning area and the Preferred Transmission Development which will enhance the 240 kilovolt (kV) transmission system allowing for the reliable connection of generation.

The Study Area consists of the 240 kV double-circuit path from the Cassils 324S and Newell 2075S substations located in the Brooks (Area 47) planning area to the Bowmanton 244S and Whitla 251S substations located in the Medicine Hat (Area 4) planning area. This 240 kV double-circuit path is also called the Cassils - Bowmanton - Whitla (CBW) path and consists of the 240 kV transmission lines 1034L, 1035L, 964L and 983L. For the purposes of the planning studies, the bus-tie breaker at Bowmanton 244S substation is assumed to be open. With the bus-tie breaker open, the 138 kV transmission lines 675L, 676L, 880L and 600L remain connected to the CBW path through 240/138 kV transformers at Bowmanton 244S substation. Therefore, the Study Area includes the 138 kV transmission lines 675L, 676L, 880L and 600L as well. The AESO has received interest from generation developers in the Study Area, resulting in more than 6,000 MW[6] of generation projects seeking to connect to the CBW path. As of February 2023, there is 795 MW of existing wind generation on the CBW path and 984 MW of new generation projects meeting the AESO's project inclusion criteria anticipated to connect to the CBW path over the next two years. With existing generation and connection of new generation projects meeting the AESO's project inclusion criteria, the AESO anticipates congestion (curtailment of in-merit energy) is likely to occur due to potential voltage criteria violations under certain conditions of high generation dispatch on the CBW path.

To evaluate transmission system reliability as generation continues to connect to the CBW path, the AESO carried out planning studies based on Power-Voltage (P-V) analysis. The planning studies carried out in this report were used to establish the need for transmission development, evaluate the merits of Transmission Development Options and to select the Preferred Transmission Development. The AESO conducted further assessments (e.g., short-circuit analysis and transient stability analysis) with the Preferred Transmission Development modeled to re-affirm the planning recommendation made in this Planning Report.

1.1 Study Area Definitions

The Study Area consists of the 240 kV double-circuit path from the Cassils 324S and Newell 2075S substations located in the Brooks (Area 47) planning area to the Bowmanton 244S and Whitla 251S substations located in the Medicine Hat (Area 4) planning area. This 240 kV double-circuit path is also called the Cassils – Bowmanton – Whitla (CBW) path and consists of the 240 kV transmission lines 1034L, 1035L, 964L and 983L. For the purposes of the planning studies, the bus-tie breaker at Bowmanton 244S substation is assumed to be open. With the bus-tie breaker open, the 138 kV transmission lines 675L, 676L, 880L and 600L remain connected to the CBW path through 240/138 kV transformers at Bowmanton 244S

[6] This is the total capacity of existing generation, generation projects meeting the AESO's project inclusion criteria and other less certain generation projects in the AESO's connection project list.

substation. Therefore, the Study Area includes the 138 kV transmission lines 675L, 676L, 880L and 600L as well.

1.2 Transmission System in the Study Area

The Pre-Development[7] transmission system in and near the Study Area is shown in Figure 1-1. The CBW path acts as a transfer-out path for the power produced from the existing generating units and the influx of generation projects seeking system access in the Study Area. During conditions of high generation dispatch, the bus-tie breaker at Bowmanton 244S substation is open.

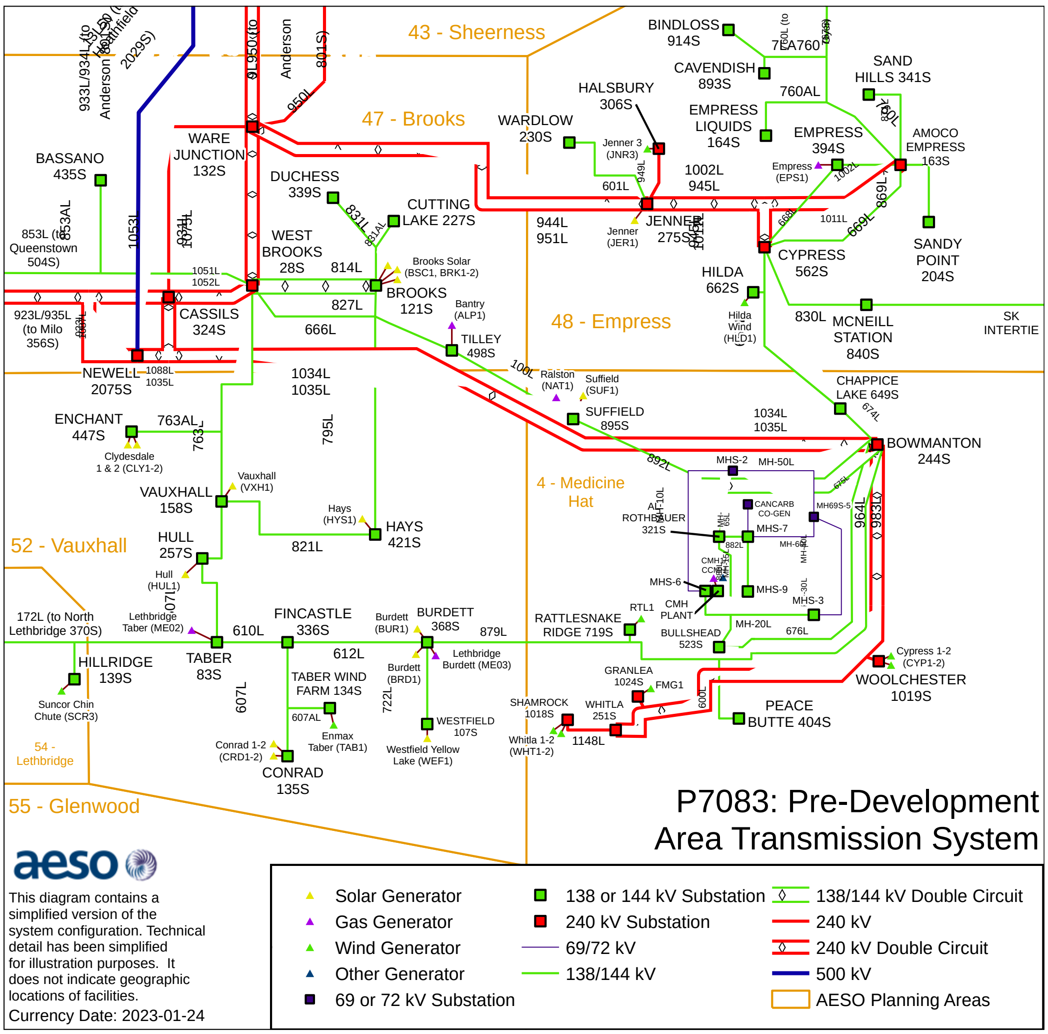

Figure 1-1: Pre-Development Transmission System in and near the Study Area

[7] The Pre-Development transmission system is the existing transmission system with system and connection projects in-service as of February 2023.

1.3 Study Objectives

The study objectives are summarized below.

- Assess the need for transmission development in the Study Area.
- Develop Transmission Development Options to address the identified transmission constraints.
- Assess Transmission Development Options and compare performance of these options.
- Select the Preferred Transmission Development.

1.4 Study Scope

The following planning studies were performed in the Study Area:

- **Need Assessment**

  The AESO conducted Power-Voltage (P-V) analysis to assess transmission system performance. The P-V analysis was used to obtain P-V curves that show the relationship between generation dispatch and bus voltages in the Study Area. The obtained P-V curves were then used to identify the maximum generation dispatch levels before observing Category A voltage criteria violations.

  The P-V analysis was carried out for year 2023 base cases for the Pre-Development transmission system. The year 2023 was selected based on anticipated need. The transmission system performance was compared against the requirements of the Reliability Criteria (see Section 2.1) to identify the transmission constraints.

- **Transmission Development Options**

  Two Transmission Development Options were considered to alleviate the identified constraints and to allow for the integration of more generation projects in the Study Area.

- **Technical Assessment of the Transmission Development Options**

  The performance of each of the Transmission Development Options was evaluated by assessing the Category A generation integration capability provided by each of the options.

- **Selection of the Preferred Transmission Development**

  Different factors were considered when selecting the Preferred Transmission Development including a comparison of generation integration capability, cost, and environmental and land use effects.

- **Validation of Performance of the Preferred Transmission Development**

  The performance of the transmission system with the Preferred Transmission Development (Post-Development) included was further evaluated through Category B P-V analysis and transient stability studies to ensure its performance fully complies with the Reliability Criteria as described in Section 2.1. Siting and sizing analyses were also performed to confirm the location and size of the Preferred Transmission Development. In addition, short circuit analysis of the transmission system was performed both before and after the Preferred Transmission Development is in-service in different timeframes.

2 Reliability Standards, Criteria, Study Assumptions and System Model

This section discusses the applicable reliability standards, criteria, study assumptions and system model that were applied in the planning studies. The information used to create study cases, load and generation assumptions and system configuration reflects the most current information available to the AESO. While the AESO makes assumptions based on the latest available information, it is acknowledged that assumptions are subject to change over time. The AESO addresses the possible impact of changes in assumptions by monitoring active system and customer connection projects and performing regular system planning studies as part of its long-term planning process.

2.1 Transmission Reliability Standards and Criteria

The TPL reliability standards, which are part of the Alberta reliability standards[8], and *Transmission Planning Criteria – Basis and Assumptions*[9] (collectively, the Reliability Criteria) will be applied to evaluate system performance under Category A system condition (i.e., all elements in-service) and following Category B contingencies (i.e., single element outage), and Category C contingencies (i.e., multiple element outage).

Category A, often referred to as the N-0 condition, represents a normal system condition with all elements in-service. All equipment must be within its applicable rating, voltages must be within their applicable range and the system must be stable with no cascading outages. Under Category A system condition, electric supply to load cannot be interrupted and generating units cannot be removed from service.

Category B events, often referred to as the N-1 conditions, results in the loss of any single element under specified fault conditions with normal clearing. The specified elements are a generating unit, a transmission circuit, a transformer, or a single pole of a direct current transmission line. The acceptable impact on the system is the same as Category A with the exception that radial customers or some local network customers, including loads or generating units, are allowed to be disconnected from the system if they are connected through the faulted element. The loss of opportunity load or opportunity interchanges is allowed. No cascading can occur.

Category C5 events results in loss of two circuits of a multiple circuit tower. All equipment must operate within its applicable rating, voltages must be within their applicable range, and the system must be stable with no cascading outages. For Category C5, the controlled interruption of electric supply to customers (load shedding), the planned removal from service of certain generators, and/or the curtailment of contracted firm (non-recallable reserved) transmission service electric power transfers may be necessary to maintain the overall reliability of the interconnected electric system.

Category C3 events referred to as a Category B contingency, followed by manual system adjustments, followed by another Category B contingency. All equipment must operate within its applicable rating, voltages must be within their applicable range, and the system must be stable with no cascading outages. The controlled interruption of electric supply to customers (load shedding), the removal from service of

[8] A complete description of the Alberta reliability standards can be found on the AESO website.

[9] A complete description of the transmission planning criteria can be found in Attachment A.

certain generators, and/or the curtailment of contracted firm (non-recallable reserved) transmission service electric power transfers is allowed both as a system adjustment and as a corrective action.

The TPL reliability standards, TPL-001-AB-0, TPL-002-AB1-0, and TPL-003-AB-0, have referenced Applicable Ratings when specifying the required transmission system performance under Category A, Category B, and Category C events. For the purpose of applying the TPL reliability standards to the studies documented in this report, Applicable Ratings are defined as follows:

- Normal thermal rating of the transmission line's loading limits for each season.
- The highest specified loading limits for transformers.
- For Category A conditions: Voltage range under normal operating conditions per AESO Information Document #2010-007RS, *General Operating Practices – Voltage Control* (ID #2010-007RS). For the busses not listed in ID #2010-007RS, Table 2-1 in the *Transmission Planning Criteria – Basis and Assumptions* applies.
- For Category B and Category C contingency conditions: The extreme voltage range values per Table 2-1 in the *Transmission Planning Criteria – Basis and Assumptions.*

2.2 Study Years

The planning studies were carried out for year 2023. The year 2023 was selected based on anticipated need.

2.3 Load Forecast

The *AESO 2021 Long-term Outlook*[10] (2021 LTO) Reference Case load forecast was used for the studies in this Planning Report.

With the bus-tie breaker at Bowmanton 244S substation open, the only loads connected to the CBW path are the loads fed through the 138 kV transmission lines 675L, 676L, 880L and 600L (i.e., City of Medicine Hat loads as well as loads at Bullshead 523S and Peace Butte 404S substations). These loads are expected to grow over the next 10 years at a pace that is consistent with the 2021 LTO. As the congestion on the CBW path is a generation-driven outflow issue, this load growth will have a positive impact on the CBW path by consuming generation locally and reducing the power flow on the CBW path. With increased generation development interests in the Study Area, the addition of generation capacity is anticipated to outpace the load growth in the Study Area and the need for additional transmission capability will continue to remain in the future. Therefore, a detailed load forecast is not included in this Planning Report.

[10] The AESO 2021 LTO is available on the AESO website.

2.4 Generation Assumptions

2.4.1 Existing Generation

As of February 2023, there is 795 MW of wind generation and 341 MW of other types of generation in the Study Area. Table 2-1 details the existing generation in the Study Area.

Table 2-1: Existing Generation in the Study Area

Asset	Type	Maximum Capability (MW)	Planning Area	Total (MW)
Whitla 1 (WHT1)	Wind	202	04 - Medicine Hat	795
Whitla 2 (WHT2)	Wind	151	04 - Medicine Hat	
Forty Mile Granlea (FMG1)	Wind	200	04 - Medicine Hat	
Cypress 1 (CYP1)	Wind	196	04 - Medicine Hat	
Cypress 2 (CYP2)	Wind	46	04 - Medicine Hat	
Medicine Hat #1 (CMH1) *	Combined Cycle	299	04 - Medicine Hat	341
Cancarb Medicine Hat (CCMH) *	Other	42	04 - Medicine Hat	
Total Capacity (MW)		**1136**		

* CMH1 and CCMH generation facilities are connected to the 138 kV transmission system in the service territory of the City of Medicine Hat (i.e., they are not directly connected to the 240 kV CBW path). In the planning studies, these two generation facilities were dispatched to only offset the loads fed through the 138 kV transmission lines 675L, 676L, 880L and 600L (i.e., City of Medicine Hat loads as well as loads at Bullshead 523S and Peace Butte 404S substations), while the bus-tie breaker at Bowmanton 244S substation was assumed to be open. Therefore, CMH1 and CCMH generation facilities did not contribute to the net outflow on the 240 kV CBW path in the planning studies.

2.4.2 New Generation

As of February 2023, several generation projects in the Study Area meet the AESO's project inclusion criteria and are anticipated to energize over the next two years. Table 2-2 details the new generation projects in the Study Area that meet the AESO's project inclusion criteria.

Table 2-2: New Generation Connection Projects Included

Category	Project Name	Type	Maximum Capacity (MW)	Planning Area	Total (MW)
Met AESO's Project Inclusion Criteria (**as of the end of October 2022**)	P0693 - Wild Rose 2 Wind Farm	Wind	192	04 - Medicine Hat	984
	P2347 - Forty Mile Granlea Solar Phase 2	Solar	220	04 - Medicine Hat	
	P2337 - Dunmore Solar **	Solar	216	04 - Medicine Hat	
Met AESO's Project Inclusion Criteria (**after October 2022**)	P2237 - RESC Forty Mile MPC Wind *	Wind	266	04 - Medicine Hat	
	P2137 - Enerfin Winnifred MPC Wind *, **	Wind	90	04 - Medicine Hat	

* P2237 and P2137 generation projects met the AESO's project inclusion criteria after completing the planning studies in October 2022. Therefore, these two projects were not included in the planning studies. The additional generations are expected to exacerbate the need for transmission development.

** P2337 and P2137 generation projects will be connected to the 138 kV transmission lines in the Medicine Hat planning area (i.e., they will not be directly connected to the 240 kV CBW path). However, when the bus-tie breaker at Bowmanton 244S substation is open, the power generation from these projects will be injected into the 240 kV CBW path.

2.5 Transmission Developments

There are no transmission development projects near the Study Area that are expected to influence the results of this planning study.

2.6 Interties

The AIES is presently connected to British Columbia via WECC Path 1, which is the Alberta-British Columbia Intertie (AB-BC); to Saskatchewan via WECC Path 2 (AB-SK); and to Montana via the Montana Alberta Tie-Line (MATL) (WECC Path 83). Different import and export flows were assumed in the base cases, see section 3.1 for intertie flows.

2.7 Voltage Profile Assumptions

ID #2010-007RS was used to establish system normal (i.e., pre-contingency) voltage profiles for key area buses prior to commencing any of the planning studies. For the buses not included in ID #2010-007RS, Table 2-1 of the *Transmission Planning Criteria – Basis and Assumptions* applies. These voltages were used to set the voltage profile for the study base cases prior to the planning studies.

2.8 Transmission Facility Ratings

Table 2-3 summarizes the assumed facility ratings of key transmission facilities in the Study Area. Table 2-4 summarizes the ratings of existing transformers in the Study Area. The details of shunt elements in the Study Area are provided in Table 2-5.

Table 2-3: Key Transmission Line Ratings in the Study Area

Base Voltage (kV)	Transmission Line	From Substation	To Substation	Normal Rating	
				Summer (MVA)	Winter (MVA)
240	1034L	BOWMANTON 244S	CASSILS 324S	931	1,117
240	1035L	BOWMANTON 244S	NEWELL 2075S	952	1,142
240	964L	BOWMANTON 244S	WHITLA 251S	952	1,142
240	983L	BOWMANTON 244S	WHITLA 251S	952	1,142

Table 2-4: Key Transformer Ratings in the Study Area

Substation Name and Number	Transformer ID	Transformer Voltages (kV)	MVA Rating
244S BOWMANTON	T1	240/138	200
244S BOWMANTON	T2	240/138	200

Table 2-5: Key Shunt Elements in the Study Area

Substation Name and Number	Base Voltage (kV)	Capacitors		Reactors	
		Number of Switched Shunt Blocks	Total at Nominal Voltage (MVAr)	Number of Switched Shunt Blocks	Total at Nominal Voltage (MVAr)
WHITLA 251S	240	-	-	2 x 75	150
SHAMROCK 1018S	34.5	2 x16 + 1 x 8	24	-	-

2.9 Dynamic Data and Assumptions

In the planning studies, validated dynamic data was used for existing equipment in the AIES such as generators, wind farm turbines, motor loads, and static VAr compensators when available. If validated data was not available, generic dynamic models were adopted for existing equipment and for facilities planned to be in-service within the timeline of the planning studies.

2.10 Protection Fault Clearing Times

The transient stability studies were performed using the protection fault clearing times provided by the TFOs. If the TFO did not specify the fault clearing times (e.g., for new transmission lines) for a selected contingency, then the studies for that contingency were performed using the standard fault clearing times that are specified in Table 2-3 of the AESO's *Transmission Planning Criteria – Basis and Assumptions*.

2.11 HVDC Power Order Assumptions

The Western Alberta Transmission Line (WATL) was dispatched to minimize system losses in the base cases. The Eastern Alberta Transmission Line (EATL) was dispatched to its maximum capacity (1,000 MW) from south terminal to north terminal. The EATL dispatch was selected to stress the base cases given the proximity of this HVDC line to the Study Area.

The reactive power limits of the MVAr exchanges between the HVDC terminals (WATL and EATL) and the connected AC transmission systems are shown in Table 2-6. These limits were maintained when performing the planning studies.

Table 2-6: HVDC to Adjacent AC System MVAr Exchange Limits

HVDC Facility	North Terminal Reactive Power Limit (MVAr)	South Terminal Reactive Power Limit (MVAr)
EATL	-85 to 75	-35 to 35
WATL	-75 to 75	-35 to 35

2.12 Existing RAS in Study Area

The existing transmission system in the Study Area is being operated with the help of remedial action schemes (RAS) and automatic protection schemes (APS) that result in automatic tripping of generation to avoid thermal criteria violations and/or voltage criteria violations in post-contingency conditions. Table 2-7 lists the existing and planned RAS and APS in the Study Area that are designed to operate automatically in real-time to protect the transmission system from Reliability Criteria violations.

RAS 164 is an existing RAS designed to trip generation in response to specified contingencies in the Study Area (e.g., loss of 1034L or 1035L) to ensure the system remains reliable after contingencies. When the flow on the CBW path goes beyond a certain threshold, all the generation assigned to the RAS will be automatically armed to be ready for tripping of generation in the event of specific contingencies. Since the majority of generation in the Study Area will be assigned to RAS 164, the real-time output of the armed generation can exceed the Most Severe Single Contingency (MSSC). In these situations, pre-contingency curtailments to these generating facilities, via TCM Rule, will be required to reduce the real-time generation output of the armed generation to respect the MSSC. Therefore, the current RAS 164 design may limit the maximum amount of generation that can be dispatched in the Study Area under Category A system condition. The AESO is exploring solutions, under a separate effort, to optimize RAS 164 to minimize pre-contingency generation curtailments. This Planning Report focuses on addressing voltage-related limits in the Study Area.

Table 2-7: Existing and Planned RAS and APS in the Study Area

RAS and APS No.	Scheme Name	Status
164	CBW Area 240 kV Contingency Mitigation	Existing

3 Planning Methodology

The methodology used to conduct the planning studies included the following:

- Develop reliable study cases that include updated generation forecast for the Study Area.
- Conduct need assessment studies by evaluating the generation integration capability of the transmission system prior to transmission development and identify potential transmission system constraints in the Study Area.
- Develop Transmission Development Options to address the identified transmission system constraints.
- Evaluate the Category A performance of the proposed Transmission Development Options and select the Preferred Transmission Development.
- Verify the performance of the Preferred Transmission Development through Category B P-V analysis and transient stability studies as well as siting/sizing analysis and short-circuit studies.

3.1 Study Cases

Study cases represent various combinations of key factors such as load and generation that would result in reasonably stressed transmission system conditions. The planning studies were carried out using the following two base cases:

1) 2023 summer peak (SP) case with high wind generation in the South Planning Region
2) 2023 summer light (SL) case with high wind generation in the South Planning Region

Table 3-1 shows the operating conditions of the base cases.

For each base case, various dispatch scenarios were created for the generation facilities in the Study Area to evaluate the generation integration capabilities and identify the transmission system constraints. In this regard, the total generation dispatch in the Study Area was changed within the range of 600 MW to 1,400 MW for different studies (e.g., P-V analysis and transient stability studies).

Table 3-2 shows an example of dispatch conditions of generation facilities in the Study Area for various dispatch scenarios. Power flow single line diagrams (SLD) of the Pre-Development transmission system in the Study Area for different study cases are provided in Attachment B.

Table 3-1: Base Case Operating Conditions

Operating Conditions	Base Case	
	2023 SP	2023 SL
Alberta Internal Load w/o Losses (MW)	10,825	7,738
Total Generation Dispatch in the Study Area (MW)	600	600
Outflow on 1034L and 1035L Transmission Lines (MW)	589	589
Bus-Tie Breaker at Bowmanton 244S Substation	Open	Open
EATL Dispatch (+ North to South) (MW)	- 1,000	-1,000
WATL Dispatch (+ North to South) (MW)	- 250	-450
AB-BC Exchange (+ Export) (MW)	-253	-239

MATL Exchange (+ Export) (MW)	0	0
AB-SK Exchange (+ Export) (MW)	0	0

Table 3-2: Dispatch Conditions of Generation Facilities in the Study Area for Various Dispatch Scenarios

Total Generation Dispatch in the Study Area (MW)	Dispatch Conditions of Generation Facilities (MW)							
	WHT1	WHT2	FMG1	P2122	P2413	P2337	P0693	P2347
600 MW	84	64	85	84	21	90	80	92
700 MW	98	74	99	98	24	106	94	107
800 MW	112	85	113	112	28	120	107	123
900 MW	127	95	127	126	31	136	120	138
1000 MW	140	106	141	140	35	151	134	153
1100 MW	154	117	169	155	38	165	147	155
1200 MW	169	127	169	169	42	180	160	184
1300 MW	183	138	183	183	45	195	174	199
1400MW	197	148	197	197	49	210	187	215
Maximum Capability (MW)	**202**	**151**	**200**	**202**	**50**	**216**	**192**	**220**

3.2 P-V Analysis

For P-V analysis, the total active power generation in the Study Area was increased in small increments and the voltages at buses of interest were monitored. This analysis resulted in the development of P-V curves that show the relationship between generation dispatch and bus voltages in the Study Area. Figure 3-1 shows an example of typical P-V curves.

The WECC voltage stability assessment methodology was used to identify the static voltage stability limits. This methodology requires at least 5% margin with respect to the knee of the P-V curves for Category A and Category B contingencies.

Category A P-V analysis was conducted for the 2023 study year to identify voltage criteria violations on the transmission system in the Study Area. This analysis was performed for the need assessment prior to any new transmission development to identify reliability standards violations. Category A P-V analysis was conducted again for the proposed Transmission Development Options to identify the generation integration capability provided by each of the options. Also, Category B P-V analysis was performed with the Preferred Transmission Development in-service for the 2023 study year to validate its performance.

It should be noted that P-V analysis was performed with the following assumptions in the Study Area:

- Generators were controlling their terminal voltage
- Generator scheduled voltages were set to 1.0 p.u.
- Generator step-up transformer (GSU) taps were set to 1.0
- Bus-tie breaker at Bowmanton 244S substation was open

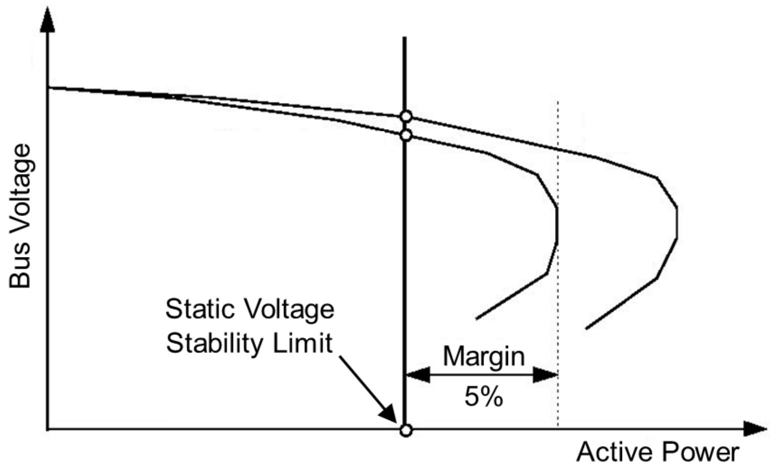

Figure 3-1: Typical P-V Curves

3.3 Short-circuit Analysis

The objective of short-circuit analysis was to assess whether the maximum fault current levels exceed the capability of the circuit breakers to clear faults and to ensure equipment in the Study Area can carry the anticipated short-circuit flow. Short-circuit levels were analyzed under three-phase-to-ground faults and single-line-to-ground faults with all the generators in the Study Area dispatched.

The short-circuit analysis was carried out both before and after the Preferred Transmission Development is in-service for the 2023 study year. The short-circuit analysis was also carried out for a 2031 study year with the Preferred Transmission Development in-service.

3.4 Transient Stability Analysis

Transient stability studies were conducted for the 2023 study year with the Preferred Transmission Development in-service. The transient stability studies utilized actual fault clearing times for the existing transmission system where available and followed standard clearing times for the remaining existing transmission lines and new transmission lines as outlined in the AESO's *Transmission Planning Criteria – Basis and Assumptions*. Terminal voltages and MW/MVAR outputs of generators as well as voltage magnitudes of key buses in the Study Area were monitored. The transient stability analysis results were used to assess the dynamic behavior of the system and identify any potential stability issues.

3.5 Siting and Sizing Analyses

Siting and sizing analyses were performed to confirm the location and size of the Preferred Transmission Development. The objective of the siting analysis was to identify the most effective location for the Preferred Transmission Development to improve voltage-related limits in the Study Area. The objective of the sizing analysis was to identify the optimal step size of shunt capacitor banks in the Preferred Transmission Development to ensure that voltage step change due to capacitor bank switching meets the requirements set out in the ISO Rules.

4 Need Assessment

Using the study cases described in Section 3.1, the need assessment was conducted based on P-V analysis to identify voltage criteria violations in the Study Area under Category A system conditions. The assumptions made for P-V Analysis were described in Section 3.2.

4.1 Need Assessment Results

The following sections present a summary of the need assessment results for the 2023 study year.

4.1.1 Category A Analysis

Figure 4-1 and Figure 4-2 show Category A P-V curves for 2023 summer peak and 2023 summer light cases, respectively. These figures illustrate the 240 kV bus voltage magnitudes at Bowmanton 244S, planned Elkwater 264S and Whitla 251S substations versus the total generation dispatch in the Study Area. As can be seen, the 240 kV bus at Bowmanton 244S substation experiences the lowest voltage magnitude compared to the other two buses.

Applying a 5% margin with respect to the knee of the P-V curves leads to static voltage stability limits of 1,232 MW for the summer peak case and 1,250 MW for the summer light case. However, increasing the total generation dispatch in the Study Area to 1,232 MW or 1,250 MW would cause voltage criteria violations as the 240 kV bus voltages could get as low as 0.875 p.u.

As per the AESO's *Transmission Planning Criteria – Basis and Assumptions*, the Category A minimum voltage limit for 240 kV buses is 0.975 p.u. (or 234 kV). Applying a 0.975 p.u. minimum voltage to the P-V curves leads to minimum voltage requirement limits of 860 MW for the summer peak case and 887 MW for the summer light case.

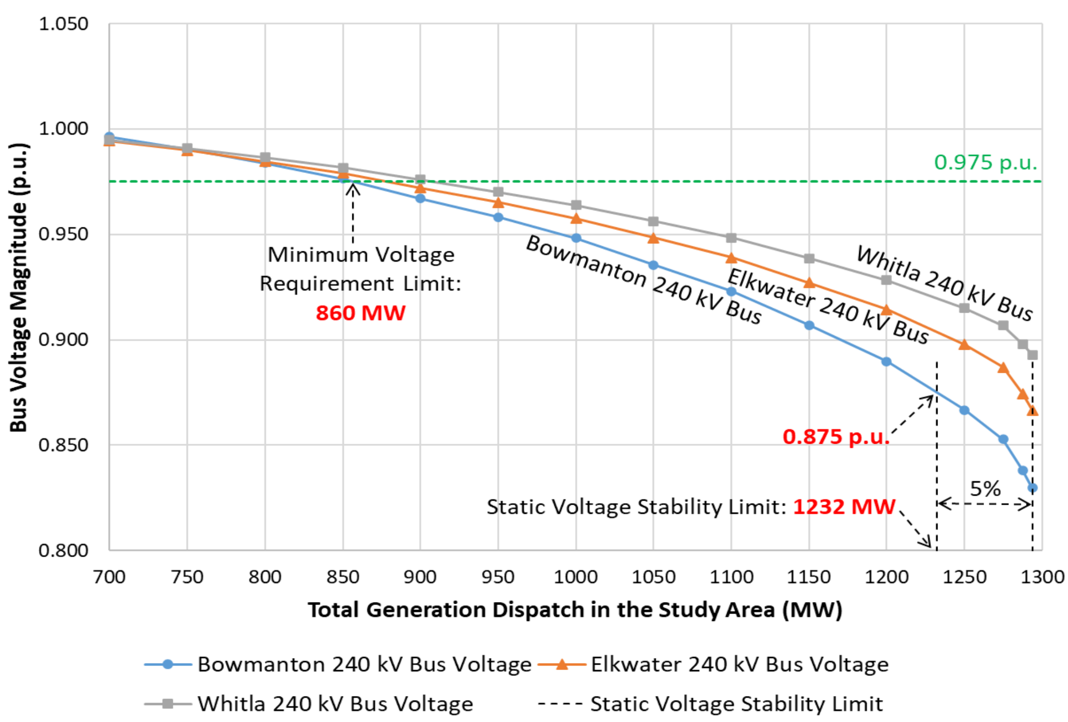

Figure 4-1: Category A P-V Curves for 2023 Summer Peak Case

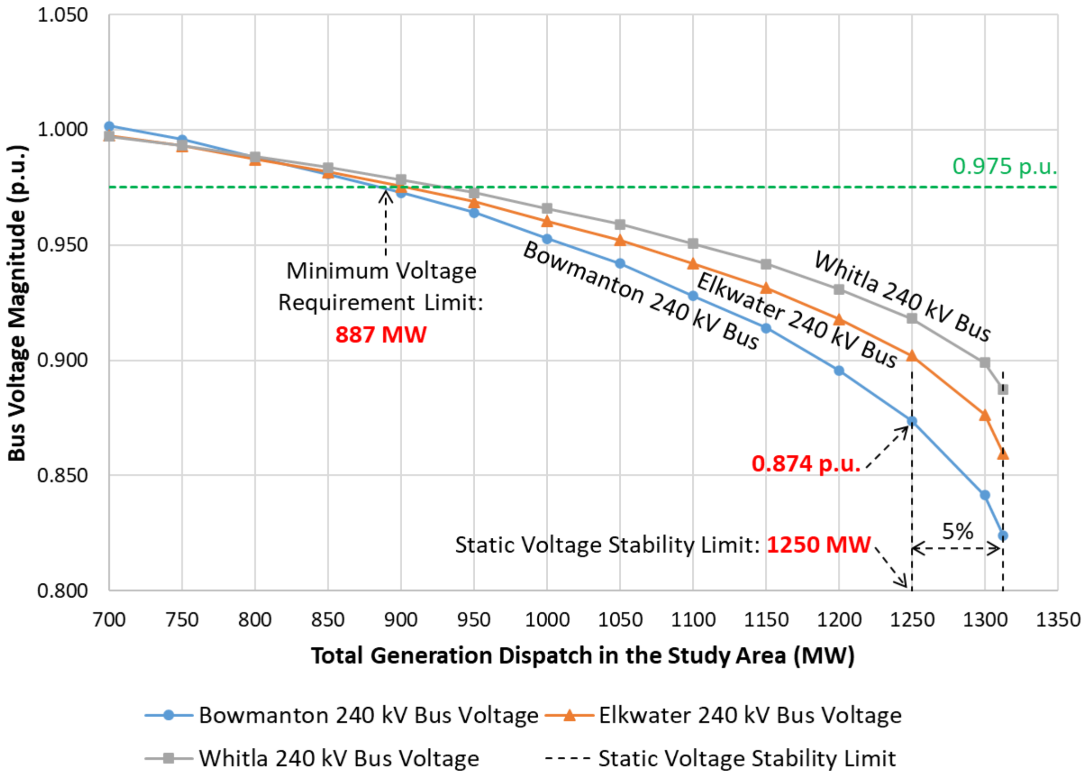

Figure 4-2: Category A P-V Curves for 2023 Summer Light Case

Table 4-1 shows a summary of voltage-related limits in the Study Area, identified by conducting P-V analysis under Category A system conditions. This table indicates that the maximum amount of generation that can be dispatched in the Study Area before causing Category A voltage criteria violations is 860 MW. When the dispatched generation connected to the CBW path goes beyond 860 MW, Category A congestion will start to occur due to voltage criteria violations. Therefore, the existing transmission system in the Study Area (i.e., the CBW path) does not have the capability to accommodate a large portion of the new generation projects meeting the AESO's project inclusion criteria.

Table 4-1: Summary of Category A Voltage-Related Limits in the Study Area

Type of Voltage-Related Limit	Base Case 2023 SP	Base Case 2023 SL	Lowest Limit
Static Voltage Stability Limit (MW)	1,232	1,250	1,232
Minimum Voltage Requirement limit (MW)	860	887	860
Lowest Voltage-Related Limit (MW)			**860 MW**

4.2 Summary of Need Assessment

With existing generation and the connection and dispatch of new generation projects meeting the AESO's project inclusion criteria in the Study Area, Category A voltage criteria violations were observed at different substations along the CBW path (i.e., Bowmanton 244S, planned Elkwater 264S and Whitla 251S substations). Without any transmission development, generation curtailments will be required in the Study Area.

Therefore, there is an immediate need for transmission development in the Study Area to help alleviate the anticipated near-term Category A voltage criteria violations and allow for transmission of more in-merit electric energy. Prior to transmission development in the Study Area, Category A voltage criteria violations can be managed by operational measures in accordance with the procedures set out in Section 302.1 of the ISO rules, *Real Time Transmission Constraint Management* (TCM Rule).

5 Transmission Development Options

This section presents the two Transmission Development Options considered to address the need identified in Section 4. Based on the Need Assessment, voltage support devices need to be added to increase the transfer capability of the CBW path which acts as a transfer-out path for the power produced from generating facilities in the Study Area.

5.1 Option 1: Add 300 MVAr of Shunt Capacitor Banks on the 240 kV Bus at Bowmanton 244S Substation

Option 1 involves the following components:

- Add three (3) 100 MVAr shunt capacitor banks on the 240 kV bus at Bowmanton 244S substation;
- Add three (3) 240 kV circuit breakers and associated disconnect switches; and
- Add or modify any associated equipment as required.

Figure 5-1 shows a simplified schematic diagram for Option 1.

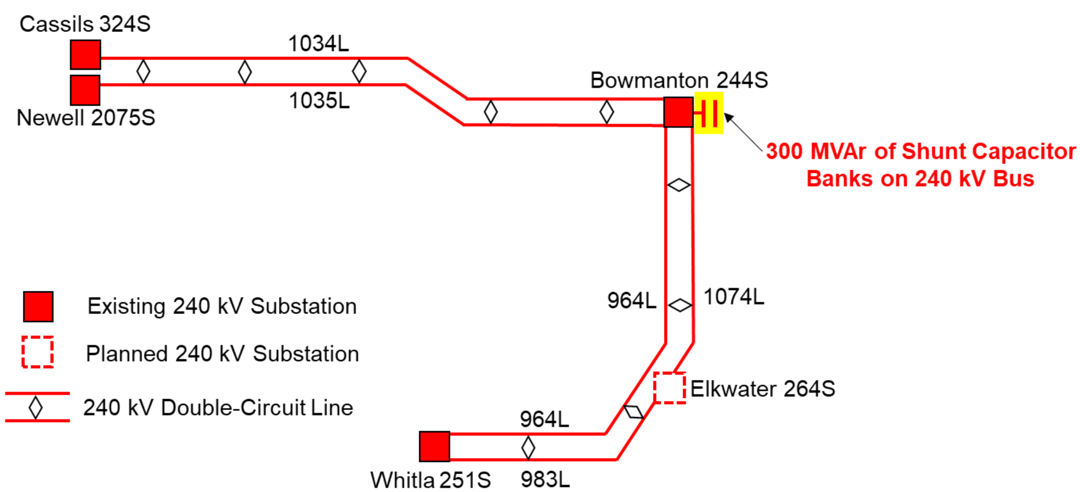

Figure 5-1: Option 1 - Add 300 MVAr of Shunt Capacitor Banks on the 240 kV Bus at Bowmanton 244S Substation

5.2 Option 2: Add 50% Series Compensation on 240 kV Transmission Lines 1034L and 1035L

Option 2 involves the following components:

- Add 50% series compensation on the 240 kV transmission lines 1034L and 1035L;
- Add a new substation to house the series compensation (including fixed series capacitor banks, 240 kV bypass circuit breakers and disconnect switches); and
- Add or modify any associated equipment as required.

Figure 5-2 shows a simplified schematic diagram for Option 2.

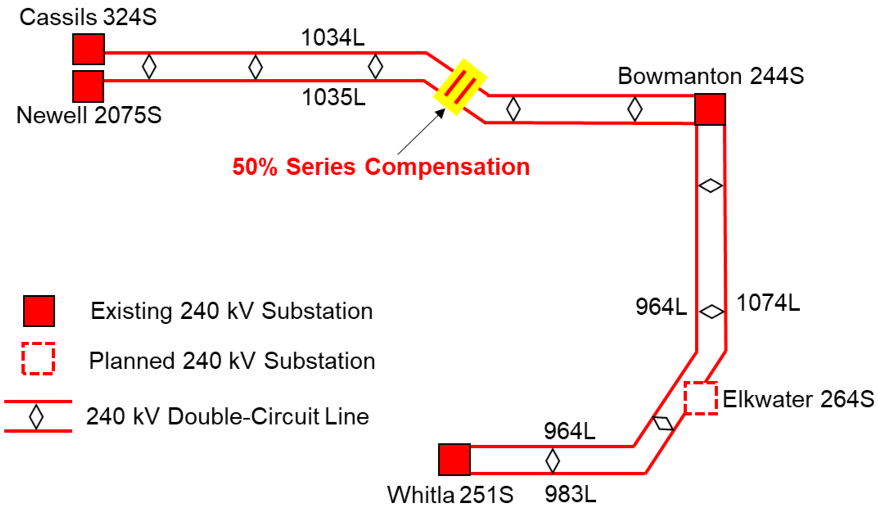

Figure 5-2: Option 2 - Add 50% Series Compensation on the 240 kV Transmission Lines 1034L and 1035L

6 Selection of the Preferred Transmission Development

This section presents the evaluation and comparison of the technical performance, cost estimates and environmental and land use effects of the Transmission Development Options described in Section 5.

6.1 Technical Assessment of the Transmission Development Options

Category A P-V analysis was performed for the Transmission Development Options to identify the generation integration capability provided by each of them. The assumptions made for P-V Analysis were described in Section 3.2.

6.1.1 Category A Analysis for Option 1

Figure 6-1 shows Category A P-V curves for 2023 summer peak and 2023 summer light cases with Option 1 included. This figure illustrates the 240 kV bus voltage magnitude at Bowmanton 244S substation versus the total generation dispatch in the Study Area.

Applying a 5% margin with respect to the knee of the P-V curves leads to a static voltage stability limit of 1,333 MW for both summer peak and summer light cases. However, increasing the total generation dispatch in the Study Area to 1,333 MW would cause voltage criteria violations as the 240 kV bus voltages could get as low as 0.916 p.u.

As per the AESO's *Transmission Planning Criteria – Basis and Assumptions*, the Category A minimum voltage limit for 240 kV buses is 0.975 p.u. (or 234 kV). Applying a 0.975 p.u. minimum voltage to the P-V curves leads to minimum voltage requirement limits of 1,180 MW for the summer peak case and 1,203 MW for the summer light case.

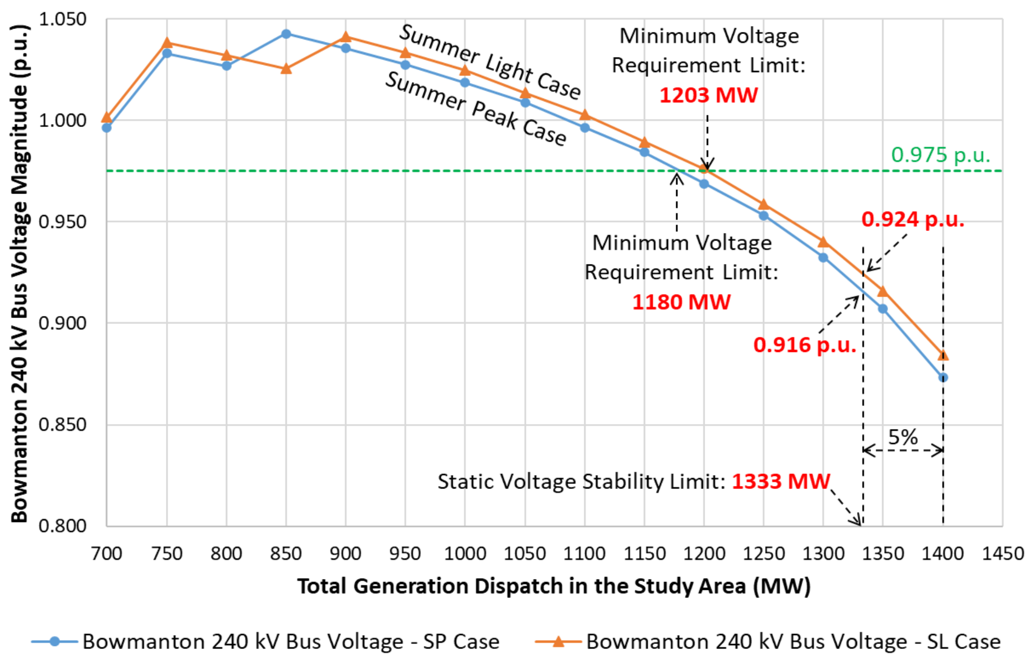

Figure 6-1: Option 1 - Category A P-V Curves for 2023 Summer Peak and 2023 Summer Light Cases

Table 6-1 shows a summary of Category A voltage-related limits in the Study Area with Option 1 included. This table indicates that after addition of 300 MVAr of shunt capacitor banks at Bowmanton 244S substation, 1,180 MW of generation can be dispatched in the Study Area without causing Category A voltage criteria violations. Option 1 can provide 320 MW of additional transfer capability for the transmission system in the Study Area.

Table 6-1: Option 1 - Summary of Category A Voltage-Related Limits in the Study Area

Type of Voltage-Related Limit	Base Case 2023 SP	Base Case 2023 SL	Lowest Limit
Static Voltage Stability Limit (MW)	1,333	1,333	1,333
Minimum Voltage Requirement limit (MW)	1,180	1,203	1,180
Lowest Voltage-Related Limit (MW)			**1,180**

6.1.2 Category A Analysis for Option 2

Figure 6-2 shows Category A P-V curves for 2023 summer peak and 2023 summer light cases with Option 2 included. This figure illustrates the 240 kV bus voltage magnitude at Bowmanton 244S substation versus the total generation dispatch in the Study Area.

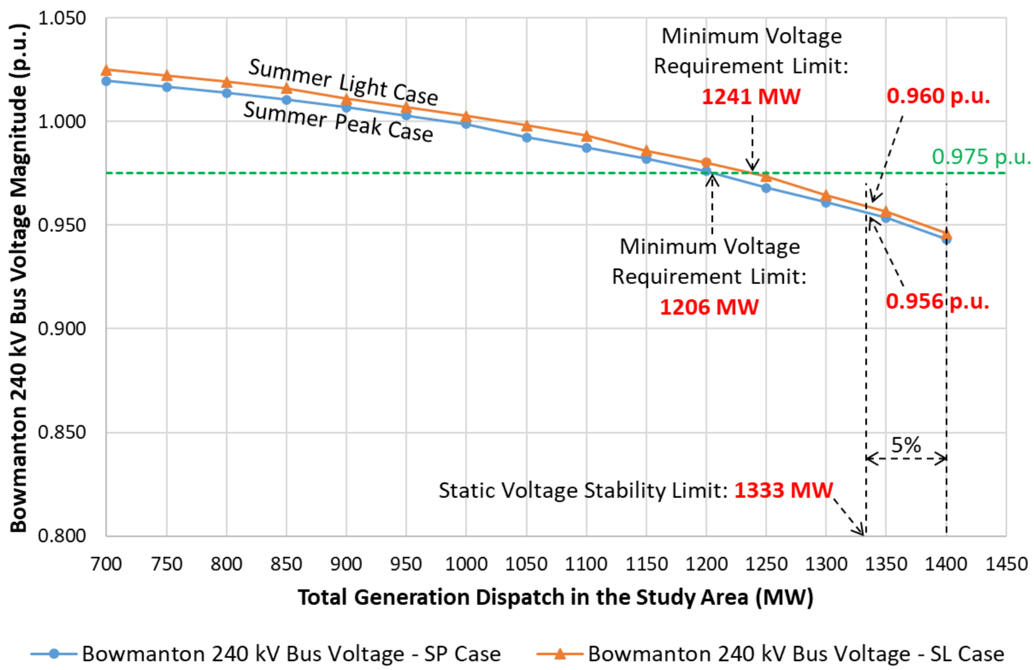

Figure 6-2: Option 2 - Category A P-V Curves for 2023 Summer Peak and 2023 Summer Light Cases

Applying a 5% margin with respect to the knee of the P-V curves leads to a static voltage stability limit of 1,333 MW for both summer peak and summer light cases. However, increasing the total generation dispatch in the Study Area to 1,333 MW would cause voltage criteria violations as the 240 kV bus voltages could get as low as 0.956 p.u.

As per the AESO's *Transmission Planning Criteria – Basis and Assumptions*, the Category A minimum voltage limit for 240 kV buses is 0.975 p.u. (or 234 kV). Applying a 0.975 p.u. minimum voltage to the P-V curves leads to minimum voltage requirement limits of 1,206 MW for the summer peak case and 1,241 MW for the summer light case.

Table 6-2 shows a summary of Category A voltage-related limits in the Study Area with Option 2 included. This table indicates that after addition of 50% series compensation on the 240 kV transmission lines 1034L and 1035L, 1,206 MW of generation can be dispatched in the Study Area without causing Category A voltage criteria violations. In other words, Option 2 can provide 346 MW of additional transfer capability for the transmission system in the Study Area.

Table 6-2: Option 2 - Summary of Category A Voltage-Related Limits in the Study Area

Type of Voltage-Related Limit	Base Case		Lowest Limit
	2023 SP	2023 SL	
Static Voltage Stability Limit (MW)	1,333	1,333	1,333
Minimum Voltage Requirement limit (MW)	1,206	1,241	1,206
Lowest Voltage-Related Limit (MW)			**1,206**

6.1.3 Technical Assessment Summary

Technical assessments based on Category A P-V analysis were performed for the Transmission Development Options outlined in Section 5. The results indicated that:

- Option 1 provides 320 MW of additional generation integration capability for the transmission system in the Study Area and improves the Category A generation integration capability to 1,180 MW.
- Option 2 provides 346 MW of additional generation integration capability for the transmission system in the Study Area and improves the Category A generation integration capability to 1,206 MW.

Table 6-3 shows the summary of technical assessment results for Options 1 and 2. Both options provide similar improvement in the Category A generation integration capability.

Table 6-3: Summary of Technical Assessment Results for the Transmission Development Options

Transmission Development Option	Additional Transfer Capability Provided (MW)	Post-Development Category A Generation Integration Capability (MW)
Option 1	320	**1,180**
Option 2	346	**1,206**

6.2 Cost Estimate

To further assist with its evaluation of the Transmission Development Options, the AESO prepared a NID class cost estimate, being an AACEi class 4 estimate, in an accuracy range of +30%/-30%[11]. Table *6-4* provides a summary of the cost estimates completed for each Transmission Development Option.

Table 6-4: NID Class Cost Estimate Summary

Transmission Development Option	Total Project Cost (+/- 30%)
Option 1	$11,214,291
Option 2	$55,162,680

6.3 Environmental and Land Use Effects

The legal owner of the transmission facilities (TFO) in the Study Area, in this case, AltaLink Management Ltd., in its capacity as general partner of AltaLink, L.P. (AltaLink), reviewed Option 1 and confirmed that the proposed 300 MVAr of shunt capacitor banks fit within the existing fence line of the Bowmanton 244S substation without requiring site expansion. However, Option 2 would require the development of a new substation to house the series compensation. As a result, Option 1 has lower environmental and land use effects compared to Option 2.

6.4 Selection of the Preferred Transmission Development Option

Based on the technical performance, cost estimates and environmental and land use effects, the AESO selected Option 1 as the Preferred Transmission Development.

Power flow single line diagrams (SLD) of the Post-Development transmission system in the Study Area for different study cases are provided in Attachment C.

[11] The cost estimates are in nominal dollars using a base year of 2022 with escalation considered and an accuracy level of +30%/-30%.

7 Additional Assessments for the Preferred Transmission Development

7.1 Siting Analysis

Siting analysis was performed to confirm the most effective location for the Preferred Transmission Development in the Study Area. The proposed shunt capacitor banks were added at different substations along the CBW path (Bowmanton 244S, planned Elkwater 264S or Whitla 251S substations) and then Category A P-V analysis was conducted to determine which location provides the greatest improvement in voltage-related limits.

Figure 7-1 and Figure 7-2 show the obtained Category A P-V curves for 2023 summer peak and 2023 summer light cases. These figures illustrate the 240 kV bus voltage magnitude at Bowmanton 244S substation versus the total generation dispatch in the Study Area after the addition of shunt capacitor banks at different substations along the CBW path.

Static voltage stability limits are identified by applying a 5% margin with respect to the knee of the P-V curves. As can be observed, when the total generation dispatch in the Study Area is at the identified static voltage stability limits, the 240 kV bus voltages are lower than the Category A minimum voltage limit of 0.975 p.u. (or 234 kV) specified in the *AESO's Transmission Planning Criteria – Basis and Assumptions*. Therefore, a 0.975 p.u. minimum voltage is applied to the P-V curves.

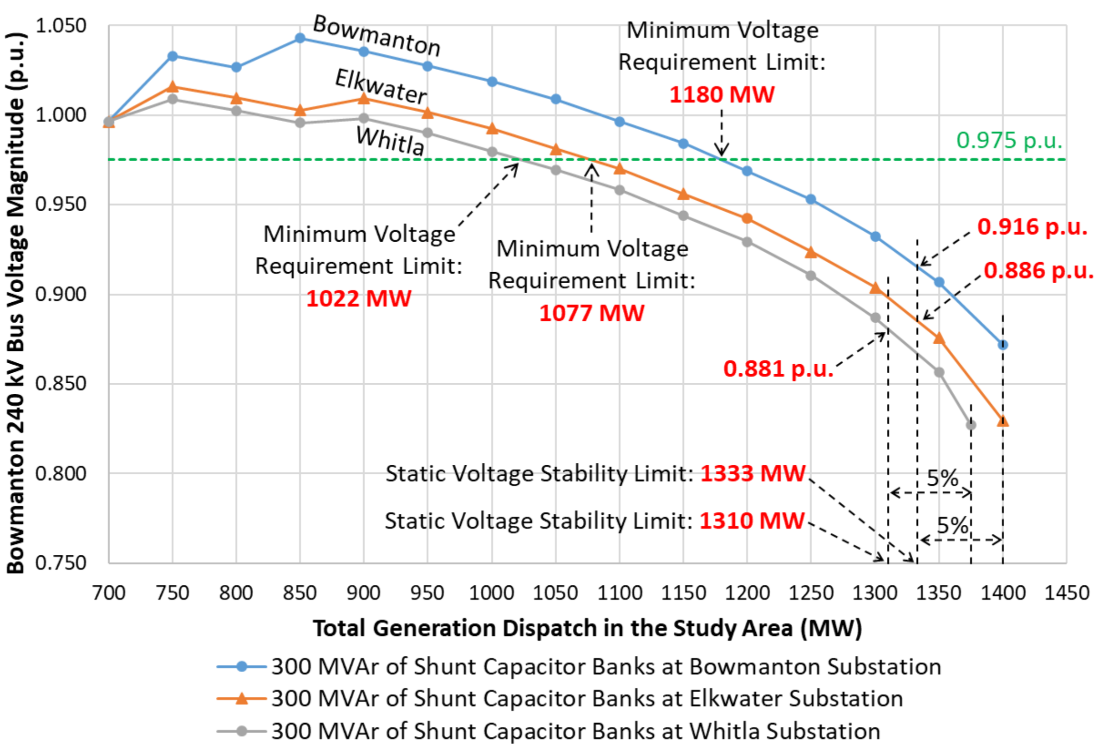

Figure 7-1: Category A P-V Curves for 2023 Summer Peak Case with Shunt Capacitor Banks Added at Different Substations

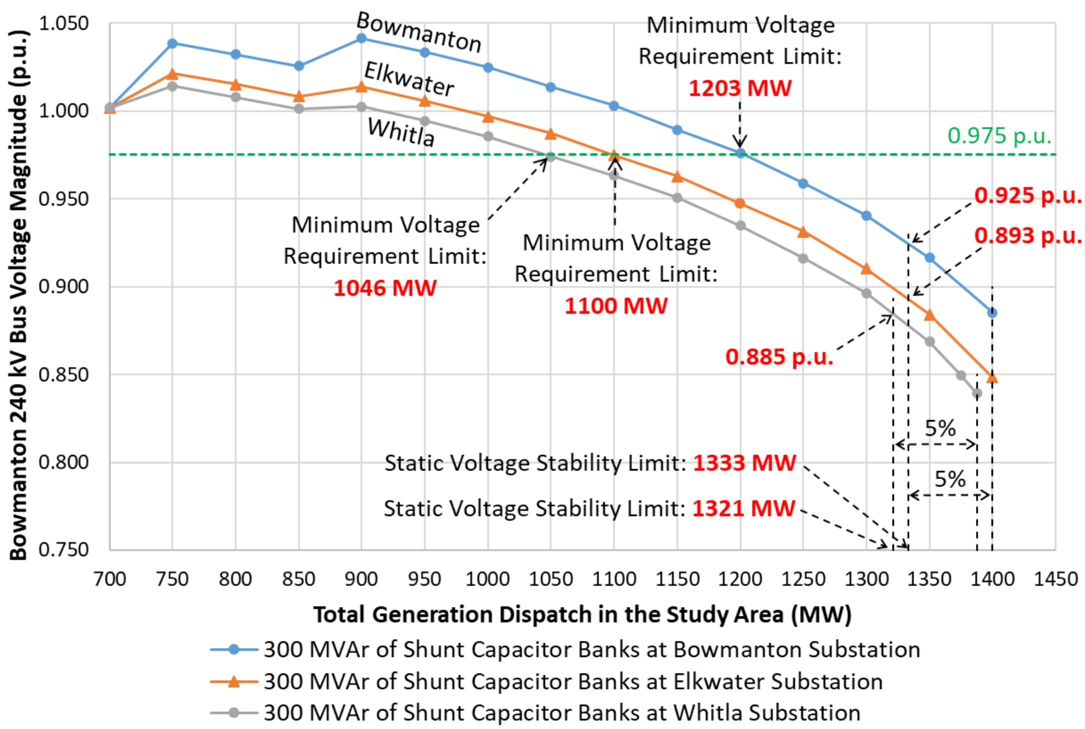

Figure 7-2: Category A P-V Curves for 2023 Summer Light Case with Shunt Capacitor Banks Added at Different Substations

Table 7-1 shows a summary of the identified static voltage stability limits and minimum voltage requirement limits. Adding the proposed shunt capacitor banks at Bowmanton 244S substation provides a greater improvement in voltage-related limits and leads to a higher generation integration capability in the Study Area. Therefore, Bowmanton 244S substation is the most effective location for the Preferred Transmission Development.

Table 7-1: Summary of Category A Voltage-Related Limits in the Study Area with Shunt Capacitor Banks Added at Different Substations

Location of Shunt Capacitor Banks	Type of Voltage-Related Limit	Base Case		Lowest Limit
		2023 SP	2023 SL	
Bowmanton 244S	Static Voltage Stability Limit (MW)	1333	1333	**1180**
	Minimum Voltage Requirement limit (MW)	1180	1203	
Elkwater 264S	Static Voltage Stability Limit (MW)	1333	1333	**1077**
	Minimum Voltage Requirement limit (MW)	1077	1100	
Whitla 251S	Static Voltage Stability Limit (MW)	1310	1321	**1022**
	Minimum Voltage Requirement limit (MW)	1022	1046	

7.2 Sizing Analysis

Sizing analysis was performed to confirm the optimal step size of shunt capacitor banks in the Preferred Transmission Development to ensure that voltage step change due to the capacitor bank does not lead to power quality concerns. Section 502.7 of the ISO Rules was used to determine the boundary for maximum voltage step change limits. Table 7-2 below, taken from Section 502.7 of the ISO Rules, shows the maximum allowable limits for rapid voltage changes caused by any change of load. The proposed shunt capacitor banks are expected to be switched more than 4 times a day, but not more than 2 times per hour. Therefore, the maximum voltage step change limit of 3% was used as the criteria to determine the step size of shunt capacitor banks.

Table 7-2: Maximum Rapid Voltage Change Limits Specified in Section 502.7 of the ISO Rules

Number of Changes (n)	≤ 25kV	> 25kV
n ≤ 4 per day	5%	4%
n ≤ 2 per hour and > 4 per day	4%	3%
2 < n ≤ 10 per hour	3%	2.5%

The sizing analysis was performed for two different sizes of shunt capacitor banks: three 100 MVAr steps and two 150 MVAr steps. Table 7-3 and Table 7-4 show the voltage step changes at different substations along the CBW path (Bowmanton 244S, planned Elkwater 264S or Whitla 251S substations), caused by capacitor bank switching at different levels of generation dispatch in the Study Area. As can be seen, with three 100 MVAr steps, the voltage step changes at monitored buses are less than 3%. However, using two 150 MVAr steps causes the bus voltages at Bowmanton 244S substation to change more than 3%. Therefore, the 100 MVAr step size is selected for shunt capacitor banks in the Preferred Transmission Development.

Table 7-3: Voltage Step Change at Monitored Buses for 3x100 MVAr Shunt Capacitor Banks

Total Generation Dispatch in the Study Area (MW)	Capacitor Bank Step Switched On (MVAr)	Voltage Step Change at Monitored Buses (%)			
		Bowmanton 240kV	Bowmanton 138kV	Whitla	Elkwater
500	1st	2.1	1.7	0.7	1.1
	2nd	2.2	1.8	0.7	1.2
	3rd	2.1	1.8	0.7	1.2
600	1st	2.1	1.7	0.7	1.2
	2nd	2.2	1.8	0.7	1.2
	3rd	2.3	1.9	0.8	1.3
700	1st	2.2	1.8	0.7	1.2
	2nd	2.2	1.8	0.7	1.3
	3rd	2.4	2.0	0.8	1.4
800	1st	2.2	1.8	0.7	1.3
	2nd	2.4	2.0	0.8	1.4
	3rd	2.3	1.9	0.8	1.3

Total Generation Dispatch in the Study Area (MW)	Capacitor Bank Step Switched On (MVAr)	Voltage Step Change at Monitored Buses (%)			
		Bowmanton 240kV	Bowmanton 138kV	Whitla	Elkwater
900	1st	2.5	2.0	0.8	1.4
	2nd	2.4	1.9	0.8	1.3
	3rd	2.5	2.1	0.8	1.5
1,000	1st	2.5	2.0	0.8	1.4
	2nd	2.7	2.2	0.9	1.5
	3rd	2.5	2.1	0.8	1.5

Table 7-4: Voltage Step Change at Monitored Buses for 2x150 MVAr Shunt Capacitor Banks

Total Generation Dispatch in the Study Area (MW)	Capacitor Bank Step Switched On (MVAr)	Voltage Step Change at Monitored Buses (%)			
		Bowmanton 240kV	Bowmanton 138kV	Whitla	Elkwater
500	1st	3.3	2.7	1.0	1.8
	2nd	3.2	2.6	1.0	1.8
600	1st	3.2	2.6	1.0	1.8
	2nd	3.4	2.8	1.1	1.9
700	1st	3.3	2.7	1.1	1.9
	2nd	3.5	2.9	1.2	2.0
800	1st	3.4	2.8	1.1	1.9
	2nd	3.6	3.0	1.2	2.1
900	1st	3.7	3.0	1.2	2.1
	2nd	3.7	3.1	1.2	2.1
1,000	1st	3.8	3.1	1.2	2.1
	2nd	4.0	3.3	1.3	2.3

7.3 Category B P-V Analysis

Category B P-V analysis was performed with the Preferred Transmission Development in-service. The assumptions made for P-V Analysis were described in Section 3.2.

Figure 7-3 shows post-development Category B P-V curves for 2023 summer peak and 2023 summer light cases. This figure illustrates the 240 kV bus voltage magnitude at Bowmanton 244S substation versus the total generation dispatch in the Study Area for the worst Category B contingency (i.e., outage of 240 kV transmission lines 1034L or 1035L).

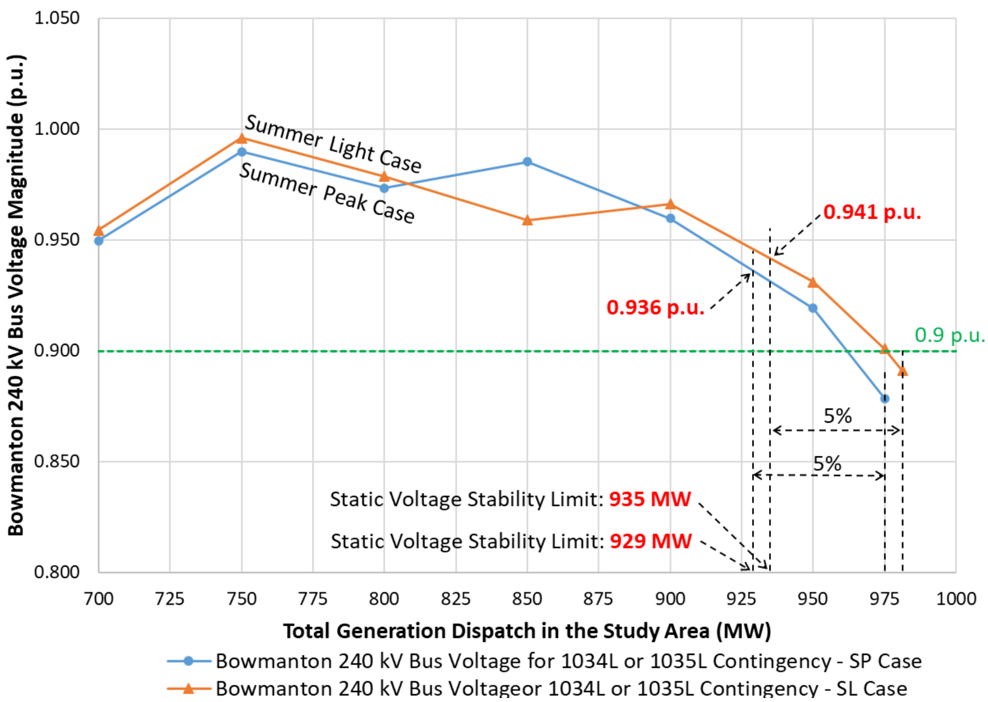

Figure 7-3 Post-Development Category B P-V Curves for 2023 Summer Peak and 2023 Summer Light Cases (1034L or 1035L Contingency)

Applying a 5% margin with respect to the knee of the P-V curves leads to static voltage stability limits of 929 MW for the summer peak case and 935 MW for the summer light case. As can be seen, when the total generation dispatch in the Study Area is at these static voltage stability limits, the 240 kV bus voltages are higher than the Category B minimum voltage limit of 0.9 p.u. (or 216 kV) specified in the AESO's *Transmission Planning Criteria – Basis and Assumptions*.

Table 7-5 shows a summary of post-development Category B voltage-related limits in the Study Area. This table indicates that, with the Preferred Transmission Development in-service, the maximum amount of generation that can be dispatched in the Study Area under Category B system conditions is 929 MW. To avoid voltage criteria violations, the existing and planned RAS in the Study Area will need to disconnect enough amount of generation under Category B system conditions.

Table 7-5 Summary of Post-Development Category B Voltage-Related Limits in the Study Area

Type of Voltage-Related Limit	Base Case		Lowest Limit
	2023 SP	2023 SL	
Static Voltage Stability Limit (MW)	929	935	929
Lowest Voltage-Related Limit (MW)			**929**

7.4 Short-Circuit Analysis

Short-circuit analysis was performed for the pre- and post-Preferred Transmission Development for the 2023 study year and only for the post-Preferred Transmission Development for a 2031 study year. The objective of the analysis was to determine the maximum fault current levels in the Study Area. All existing generation and new generation projects meeting the AESO's project inclusion criteria in the Medicine Hat

(Area 4), Empress (Area 48), Brooks (Area 47) and Vauxhall (Area 52) planning areas were turned on. The bus-tie breaker at Bowmanton 244S substation was closed.

The maximum fault current levels were calculated for the substations in the vicinity of the Preferred Transmission Development (i.e., Bowmanton 244S, planned Elkwater 264S and Whitla 251S substations) assuming normal system operation with all transmission elements in-service. Three-phase faults and single line-to-ground faults were simulated.

The results are summarized in Table 7-6, Table 7-7 and Table 7-8. The Preferred Transmission Development does not have a significant impact on the fault current levels. The fault current levels for the post-Preferred Transmission Development remain within the designed capabilities of the nearby facilities.

Table 7-6: Pre-Development Maximum Fault Current Levels for the 2023 Study Year

Substation	Base Voltage (kV)	Pre-Fault Voltage (p.u.)	3-Phase Fault Current (kA)	Positive Sequence Thevenin Source Impedance (R1+jX1) (p.u.)	1-Phase Fault Current (kA)	Zero Sequence Thevenin Source Impedance (R0+jX0) (p.u.)
Bowmanton 244S	240	1.04	7.5	0.005+0.033j	7.1	0.009+0.041j
Bowmanton 244S	138	1.01	11.9	0.006+0.035j	10.3	0.009+0.050j
Whitla 251S	240	1.01	5.3	0.007+0.045j	3.7	0.025+0.104j
Elkwater 264S	240	1.02	5	0.006+0.049j	6.6	0.003+0.019j

Table 7-7: Post-Development Maximum Fault Current Levels for the 2023 Study Year

Substation	Base Voltage (kV)	Pre-Fault Voltage (p.u.)	3-Phase Fault Current (kA)	Positive Sequence Thevenin Source Impedance (R1+jX1) (p.u.)	1-Phase Fault Current (kA)	Zero Sequence Thevenin Source Impedance (R0+jX0) (p.u.)
Bowmanton 244S	240	1.09	7.3	0.006+0.036j	7.1	0.009+0.040j
Bowmanton 244S	138	1.03	11.8	0.007+0.036j	10.4	0.008+0.050j
Whitla 251S	240	1.01	5.4	0.007+0.044j	4.1	0.019+0.091j
Elkwater 264S	240	1.04	5	0.007+0.050j	6.6	0.003+0.018j

Table 7-8: Post-Development Maximum Fault Current Levels for the 2031 Study Year

Substation	Base Voltage (kV)	Pre-Fault Voltage (p.u.)	3-Phase Fault Current (kA)	Positive Sequence Thevenin Source Impedance (R1+jX1) (p.u.)	1-Phase Fault Current (kA)	Zero Sequence Thevenin Source Impedance (R0+jX0) (p.u.)
Bowmanton 244S	240	1.07	7.3	0.005+0.036j	8	0.005+0.029j
Bowmanton 244S	138	1.02	11.3	0.007+0.038j	11	0.006+0.043j
Whitla 251S	240	1	5.2	0.004+0.047j	5	0.009+0.055j
Elkwater 264S	240	1.03	4.9	0.005+0.052j	6.7	0.002+0.017j

7.5 Transient Stability Analysis

Comprehensive transient stability studies were performed for the post-Preferred Transmission Development using 2023 summer peak and 2023 summer light cases. The total generation dispatch in the Study Area was changed within the range of 600 MW to 1,180 MW for each study case and transient stability analysis was conducted for selected Category B contingencies.

The study results indicate that when the total generation dispatch in the Study Area is less than 720 MW, the transmission system shows acceptable dynamic voltage behavior[12] for all Category B contingencies, without the need for a RAS to disconnect generation. As an example, Figure 7-4 shows the key 240 kV bus voltages for the 240 kV transmission lines 1034L and 1035L Category B contingencies for a 2023 summer peak case with 700 MW of dispatched generation in the Study Area.

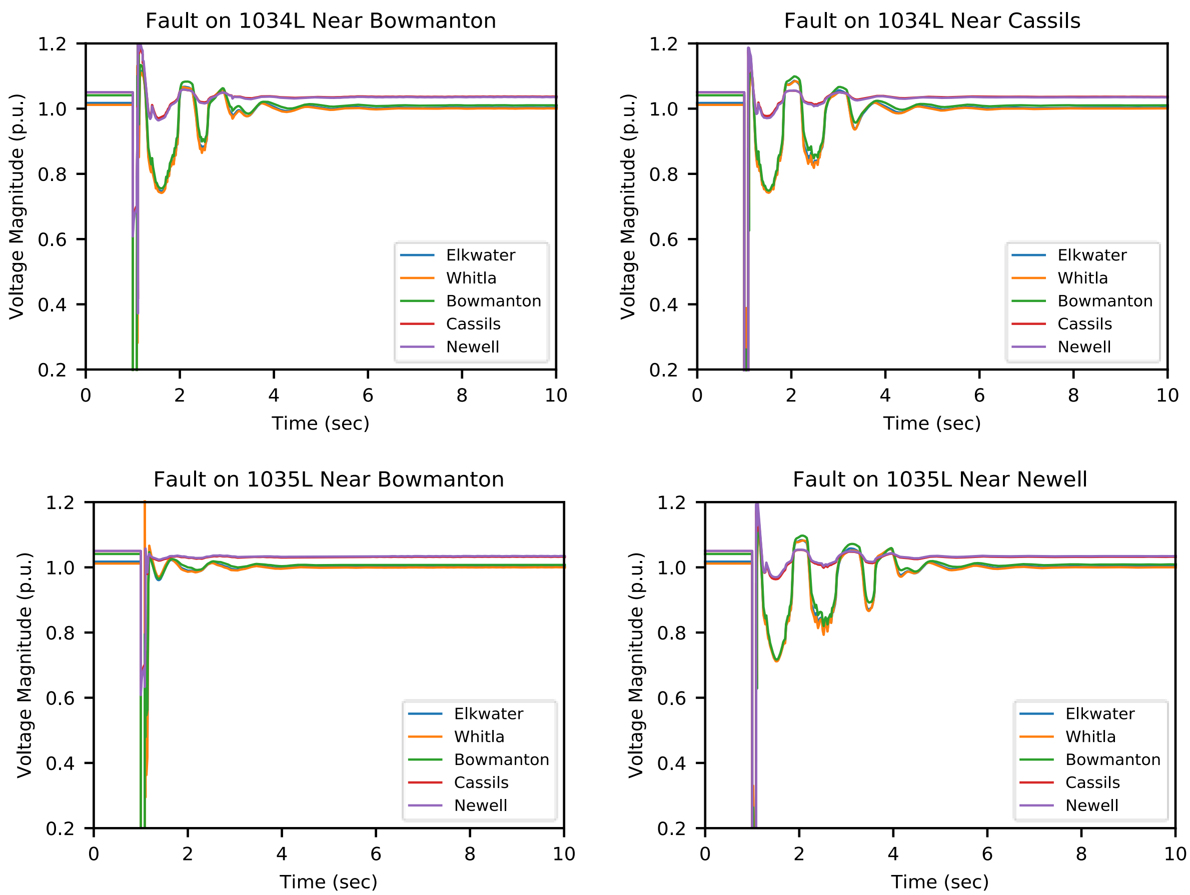

Figure 7-4: Key 240 kV Bus Voltages for 240 kV Transmission Lines 1034L and 1035L Category B Contingencies for a 2023 Summer Peak Case with 700 MW of Dispatched Generation in the Study Area

[12] The voltage ride-through requirements for aggregated generating facilities specified in Section 502.1 of the ISO Rules were used as the criteria for evaluating the dynamic voltage behavior of the system.

When the total generation dispatch in the Study Area is higher than 720 MW, the transmission system shows unacceptable dynamic voltage behavior for Category B contingencies. As an example, Figure 7-5 shows the key 240 kV bus voltages for the 240 kV transmission lines 1034L and 1035L Category B contingencies for a 2023 summer peak case with 900 MW of dispatched generation in the Study Area.

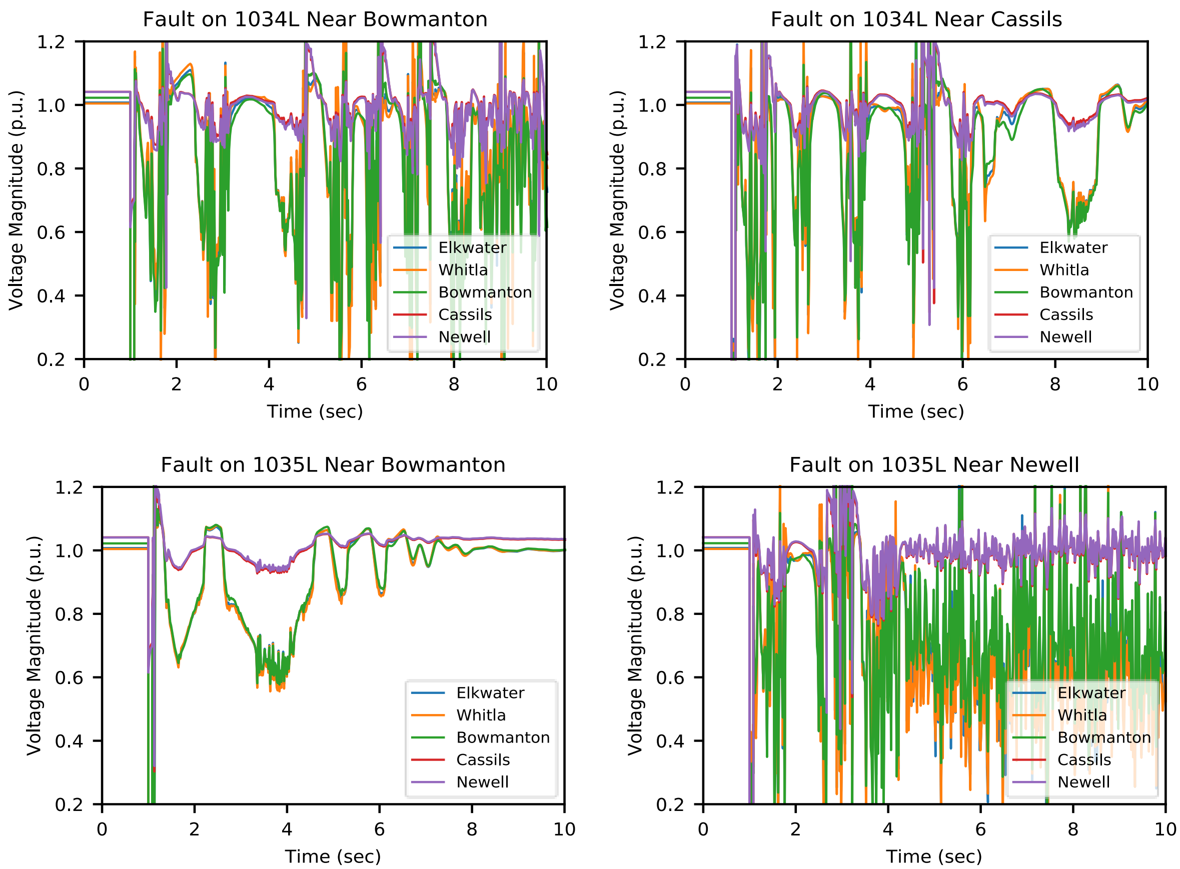

Figure 7-5: Key 240 kV Bus Voltages for 1034L and 1035L Category B Contingencies for a 2023 Summer Peak Case with 900 MW of Dispatched Generation in the Study Area

Therefore, the existing and planned RAS in the Study Area will need to disconnect enough amount of generation for Category B contingencies to avoid transient stability issues. Figure 7-6 shows an example of the key 240 kV bus voltages for the 240 kV transmission lines 1034L and 1035L Category B contingencies for a 2023 summer peak case with 1,180 MW of dispatched generation in the Study Area, while a RAS is used to disconnect 460 MW of generation after contingencies.

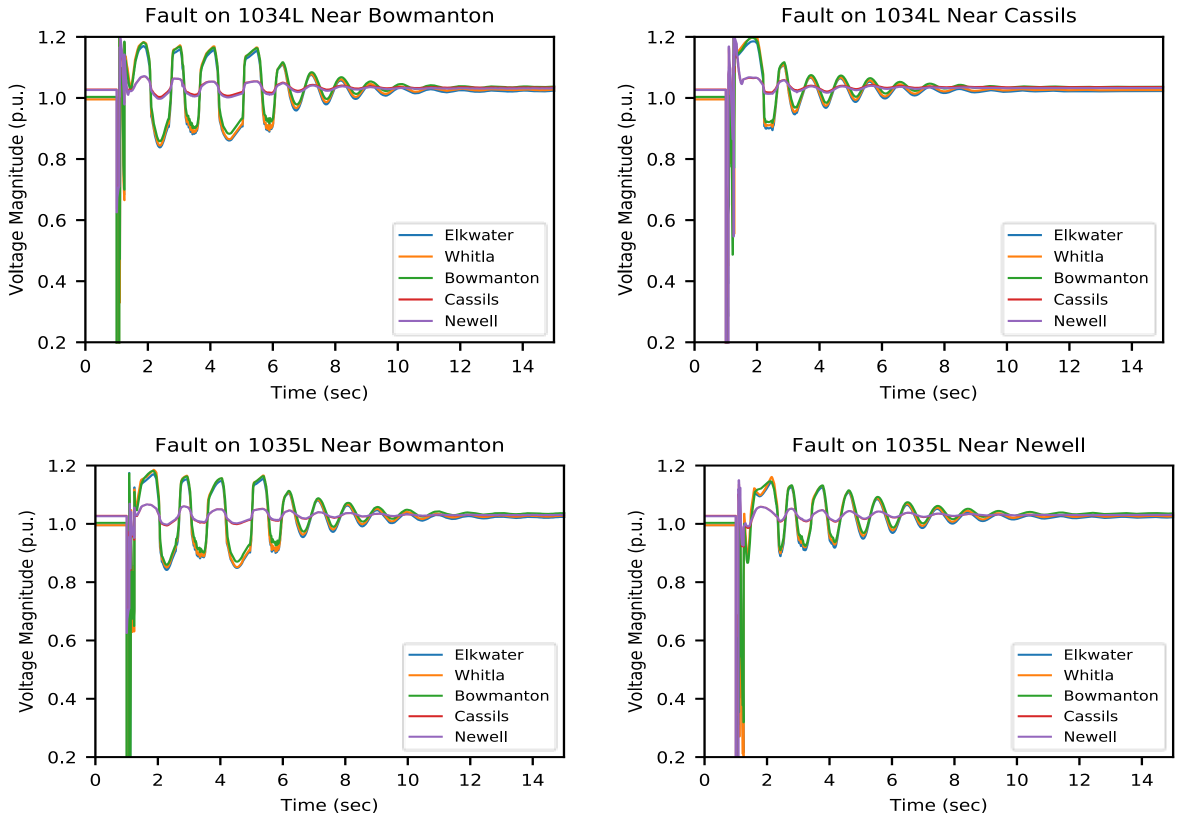

Figure 7-6: Key 240 kV Bus Voltages for 240 kV Transmission Lines 1034L and 1035L Category B Contingencies for a 2023 Summer Peak Case with 1,180 MW of Dispatched Generation in the Study Area with RAS to Disconnect Generation

In summary, the study results show that:

- Without using a RAS to disconnect generation, the system shows acceptable dynamic voltage behavior for the studied Category B contingencies for up to 720 MW of dispatched generation in the Study Area.
- When a RAS is used to disconnect generation, the system remains stable for the studied Category B contingencies for up to 1,180 MW of dispatched generation in the Study Area.

Detailed transient stability study results are provided in Attachment D.

8 Summary of Voltage-Related Limits in the Study Area for Post-Preferred Transmission Development

Table 8-1 provides a summary of Category A and Category B voltage-related limits in the Study Area for post-Preferred Transmission Development. This table indicates that with the Preferred Transmission Development in-service:

- Up to 1,180 MW of generation can be dispatched in the Study Area under Category A system conditions.
- If a Category B contingency happens, a RAS to disconnect generation will be needed to ensure that the total generation dispatch in the Study Area remains below 720 MW. This indicates a pre-contingency dispatch of 1,180 MW (720 + 460) can be accommodated.

Table 8-1: Summary of Post-Development Category A and Category B Voltage-Related Limits in the Study Area

Type of Voltage-Related Limit	System Condition	
	Category A	Category B
Static Voltage Stability Limit (MW)	1,333	929 (up to 929 + 466 = 1,395 MW before contingency)
Minimum Voltage Requirement limit (MW)	1,180	929 (up to 929 + 466 = 1,395 MW before contingency)
Dynamic Voltage Stability Limit (MW)	N/A	720 (up to 720 + 466 = 1,186 MW before contingency)
Lowest Limit (MW)	**1,180**	**720 (up to 720 + 466 = 1,186 MW before contingency)**

9 Alignment with AESO's Long Term Plan

The AESO's long-term transmission system plans are high-level assessments of transmission capability and required transmission system development in Alberta focusing on broad technical aspects. More detailed studies are performed in preparation of a needs identification document application to ensure that the AESO's Preferred Transmission Development will address the identified reliability violations in the most efficient manner.

The Preferred Transmission Development proposed in this Planning Report was not identified in the AESO's 2022 Long-term Transmission Plan (2022 LTP). The 2022 LTP identified the need for new 240 kV transmission lines in the Southeast sub-region to provide additional generation integration capability. However, given the fast pace of generation developments in the Medicine Hat (Area 4) planning area, congestion on the CBW path is anticipated to occur in the near term. The Preferred Transmission Development proposed in this Planning Report will help reduce the anticipated congestion in the near term before the significant infrastructure identified in the 2022 LTP is in place.

10 Project Interdependencies

The Preferred Transmission Development is not dependent on other transmission developments that are currently planned within the AIES in this timeframe.

11 Summary and Conclusions

The AESO conducted planning studies to assess the need for transmission development in the Medicine Hat (Area 4) planning area, specifically the 240 kV double-circuit CBW path. Planning study results demonstrate that the Pre-Development transmission system in the Study Area does not have the capability to integrate a large portion of the future generation projects meeting the AESO's project inclusion criteria due to Category A voltage criteria violations. Therefore, there is a need for transmission development in the Study Area to alleviate the anticipated voltage criteria violations.

Transmission Development Options and Performance Assessment

To alleviate the identified constraints in the Study Area, the AESO investigated two Transmission Development Options as shown in Table 11-1. Based on the planning study results, Options 1 and 2 provide similar improvement in the Category A generation integration capability. However, Option 1 results in a significantly lower cost than Option 2. Option 1 also has lower environmental and land use effects compared to Option 2. Therefore, Option 1 was selected as the Preferred Transmission Development.

Table 11-1: Transmission Development Options

Option	Description	Total Project Cost (+/- 30%)
1	Add 300 MVAr of Shunt Capacitor Banks on the 240 kV Bus at Bowmanton 244S Substation	$11,214,291
2	Add 50% Series Compensation on 240 kV Transmission Lines 1034L and 1035L	$55,162,680

The Preferred Transmission Development involves adding three (3) 100 MVAr shunt capacitor banks on the 240 kV bus at Bowmanton 244S substation, adding three (3) 240 kV circuit breakers and associated disconnect switches, and adding or modifying any associated equipment as required.

With energization of the Preferred Transmission Development, 1,180 MW of generation can be dispatched in the Study Area without causing Category A voltage criteria violations. The Preferred Transmission Development provides 320 MW of additional transfer capability for the transmission system in the Study Area.

Attachment A: Transmission Planning Criteria – Basis and Assumptions

Transmission Planning Criteria - Basis and Assumptions

Version 1.0

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www.aeso.ca www.poweringalberta.com

1. Introduction

This document presents the reliability standards, criteria, and assumptions to be used as the basis for planning the Alberta Transmission System. The criteria, standards and assumptions identified in this document supersede those previously established.

2. Transmission Reliability Standards and Criteria[1]

The AESO applies the following Alberta Reliability Standards to ensure that the transmission system is planned to meet applicable performance requirements under a defined set of system conditions and contingencies. A brief description of each of these standards is given below:

1. **TPL-001-AB-0: System Performance Under Normal Conditions**
   Category A represents a normal system condition with all elements in service (N-0). All equipment must be within its applicable rating, voltages must be within their applicable ratings and the system must be stable with no cascading outages. Under Category A, electric supply to load cannot be interrupted and generating units cannot be removed from service.

2. **TPL-002-AB-0: System Performance Following Loss of a Single BES Element**
   Category B events result in the loss of any single element (N-1) under specified fault conditions with normal clearing. The specified elements are a generating unit, a transmission circuit, a transformer or a single pole of a direct current transmission line. The acceptable impact on the system is the same as Category A with the exception that radial customers or some local network customers, including loads or generating units, are allowed to be disconnected from the system if they are connected through the faulted element. The loss of opportunity load or opportunity interchanges is allowed. No cascading can occur.

3. **TPL-003-AB-0: System Performance Following Loss of Two or More BES Elements**
   Category C events result in the loss of two or more bulk electric system elements (sequential, N-1-1 or concurrent, N-2) under specified fault conditions and include both normal and delayed fault clearing. All of the system limits for Category A and B events apply with the exception that planned and controlled loss of firm load, firm transfers and/or generation is acceptable provided there is no cascading.

4. **TPL-004-AB-0: System Performance Following Extreme BES Events**
   Category D represents a wide variety of extreme, rare and unpredictable events, which may result in the loss of load and generation in widespread areas. The system may not be able to reach a new stable steady state, which means a blackout is a possible outcome. The AESO needs to evaluate these events, at its discretion, for risks and consequences prior to creating mitigation plans.

5. **FAC-014-AB-2: Establishing and Communicating System Operating Limits**
   The AESO is required to establish system operating limits where a contingency is not mitigated through construction of transmission facilities.

[1] A complete description of these standards are given in: AESO. *Alberta Reliability Standards*. Available from http://www.aeso.ca/rulesprocedures/17004.html

2.1 Thermal Loading Criteria

The AESO Thermal Loading Criteria require that the continuous thermal rating of any transmission element is not exceeded under normal and post-contingency operating conditions. Thermal limits are assumed to be 100% of the respective normal summer and winter ratings. Emergency limits are not considered in the planning evaluations.

2.2 Voltage Range and Voltage Stability Criteria

The normal minimum and maximum voltage limits as specified in the following table are used to identify Category A system voltage violations, while the extreme minimum and maximum limits are used to identify Category B and C system violations. Table 2-1 presents the acceptable steady state and contingency state voltage ranges for the AIES. Table 2-2 provides voltage stability criteria used to test the system performance.

Table 2-1: Acceptable Range of Steady State Voltage (kV)

Nominal Voltage	Extreme Minimum	Normal Minimum	Normal Maximum	Extreme Maximum
500	475	500	525	550
240	216	234	252	264
260 (Northeast & Northwest)*	234	247	266	275
144	130	137	151	155
138	124	135	145	152
72	65	68.5	75.5	79
69	62	65.5	72.5	76

Table 2-2: Voltage Stability Criteria

Performance Level	Disturbance (1)(2)(3)(4) Initiated by: Fault or No fault DC Disturbance	MW Margin (P-V method) (5)(6)(7)	MVAr Margin (V-Q method) (6)(7)
A	Any element such as: One Generator One Circuit One Transformer One Reactive Power Source One DC Monopole	$\geq$ 5%	Worst Case Scenario(8)
B	Bus Section	$\geq$ 5%	50% of Margin Requirement in Level A

Performance Level	Disturbance (1)(2)(3)(4) Initiated by: Fault or No fault DC Disturbance	MW Margin (P-V method) (5)(6)(7)	MVAr Margin (V-Q method) (6)(7)
C	Any combination of two elements such as: A Line and a Generator A Line and a Reactive Power Source Two Generators Two Circuits Two Transformers Two Reactive Power Sources DC Bipole	≥ 2.5%	50% of Margin Requirement in Level A
D	Any combination of three or more elements. i.e.: Three or More Circuits on ROW Entire Substation Entire Plant Including Switchyard	> 0	> 0

2.3 Transient Stability Analysis Assumptions

Standard fault clearing times as shown in Table 2-3 are used for the new facilities or when the actual clearing times are not available for the existing facilities. Double line-to-ground faults are applied for the Category C5 events with normal clearing times. Single line-to-ground faults are applied for Category C6 to C9 events with delayed clearing times as depicted in Table 2-4 and Table 2-5.

Table 2-3: Fault Clearing Times

Nominal	Near End	Far End
kV	**Cycles**	**Cycles**
500	4	5
240	5	6
144/138 with telecommunications	6	8
144/138 without telecommunications	6	30

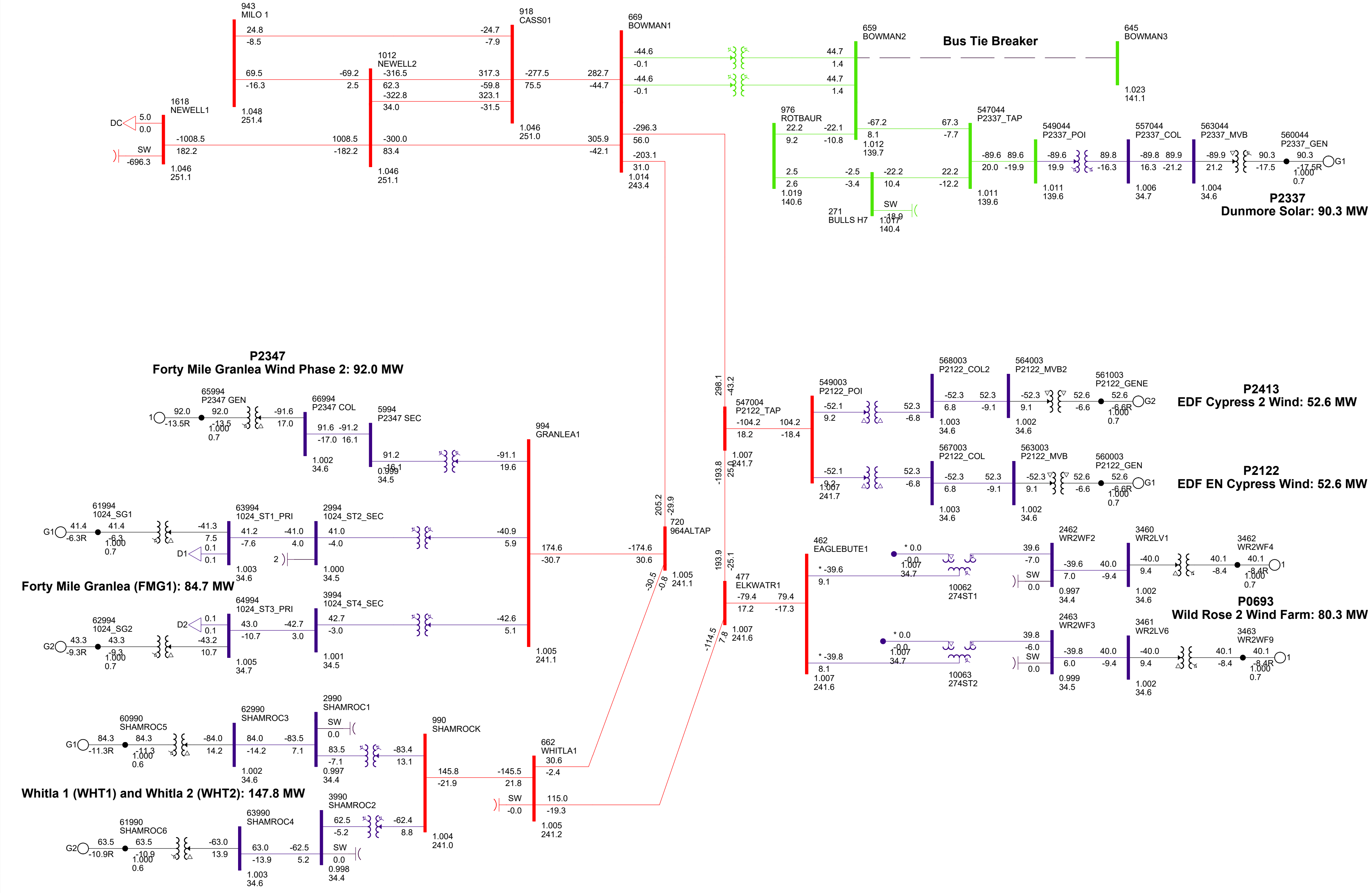
Table 2-4: Stuck Breaker Clearing Times for Lines

Fault Clearing Time			Fault Clearing Time			Fault Clearing Time		
138/144 kV			240 kV			500 kV		
Near End	Far End	2nd Ckt (for C5 and C7 Only)	Near End	Far End	2nd Ckt (for C5 and C7 Only)	Near End	Far End	2nd Ckt (for C5 and C7 Only)
15	24	24	12	6	14	9	5	11

Table 2-5: Stuck Breaker Clearing Times for Transformers

Fault Clearing Time (Cycles)						Fault Clearing Time (Cycles)					
240/138 kV						500/240 kV					
Fault on 240 kV Side			Fault on 138 kV Side			Fault on 500 kV Side			Fault on 240 kV Side		
240 kV Side	138 kV Side	2nd Ckt (for Breaker Fail)	138 kV Side	240 kV Side	2nd Ckt (for Breaker Fail)	500 kV Side	240 kV Side	2nd Ckt (for Breaker Fail)	240 kV Side	500 kV Side	2nd Ckt (for Breaker Fail)
12	6	14	15	5	24	9	5	11	12	4	14

Attachment B: Power Flow SLDs of the Pre-Development Transmission System in the Study Area



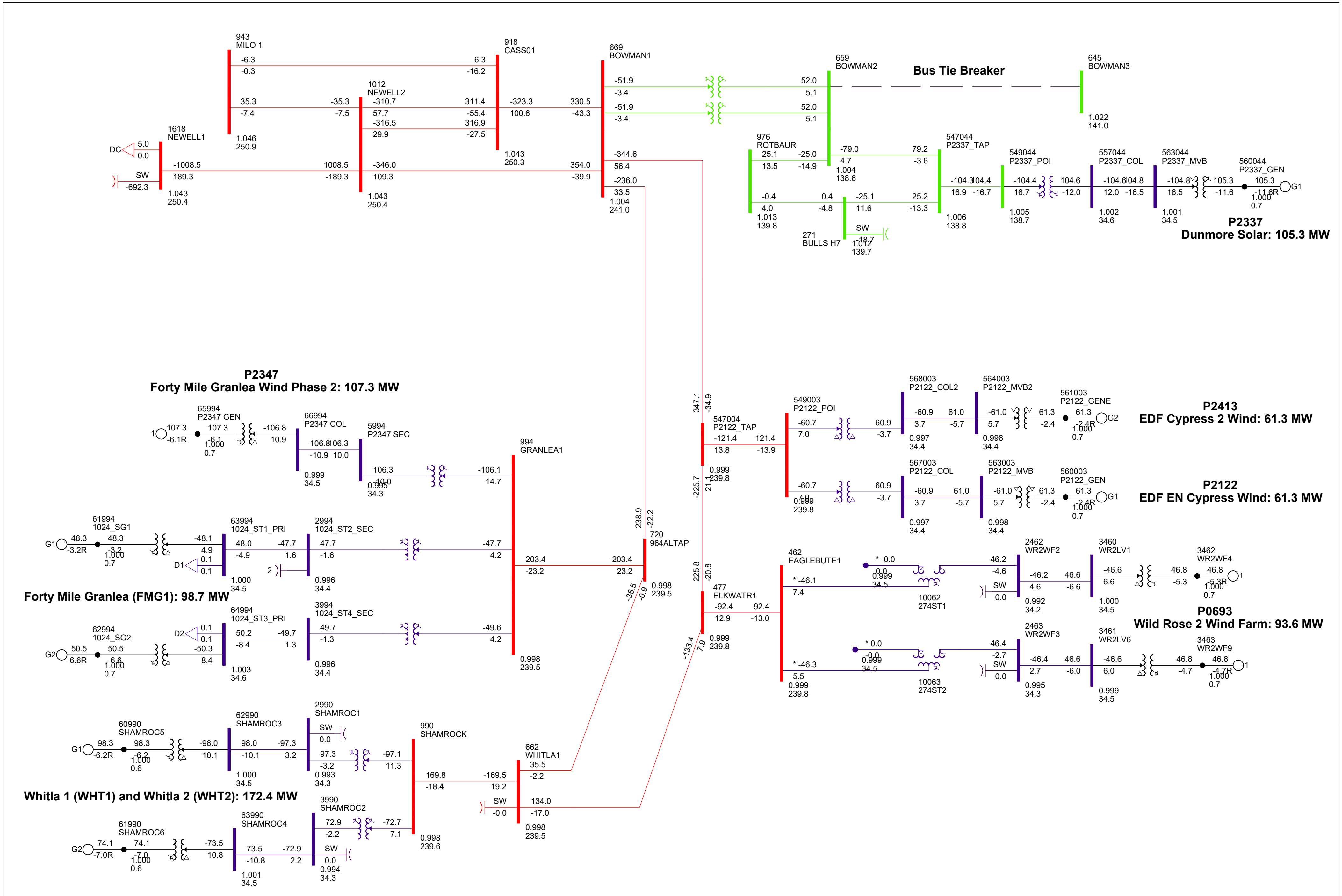
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Peak Case

Total Generation Dispatched
in Study Area: 600.2 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



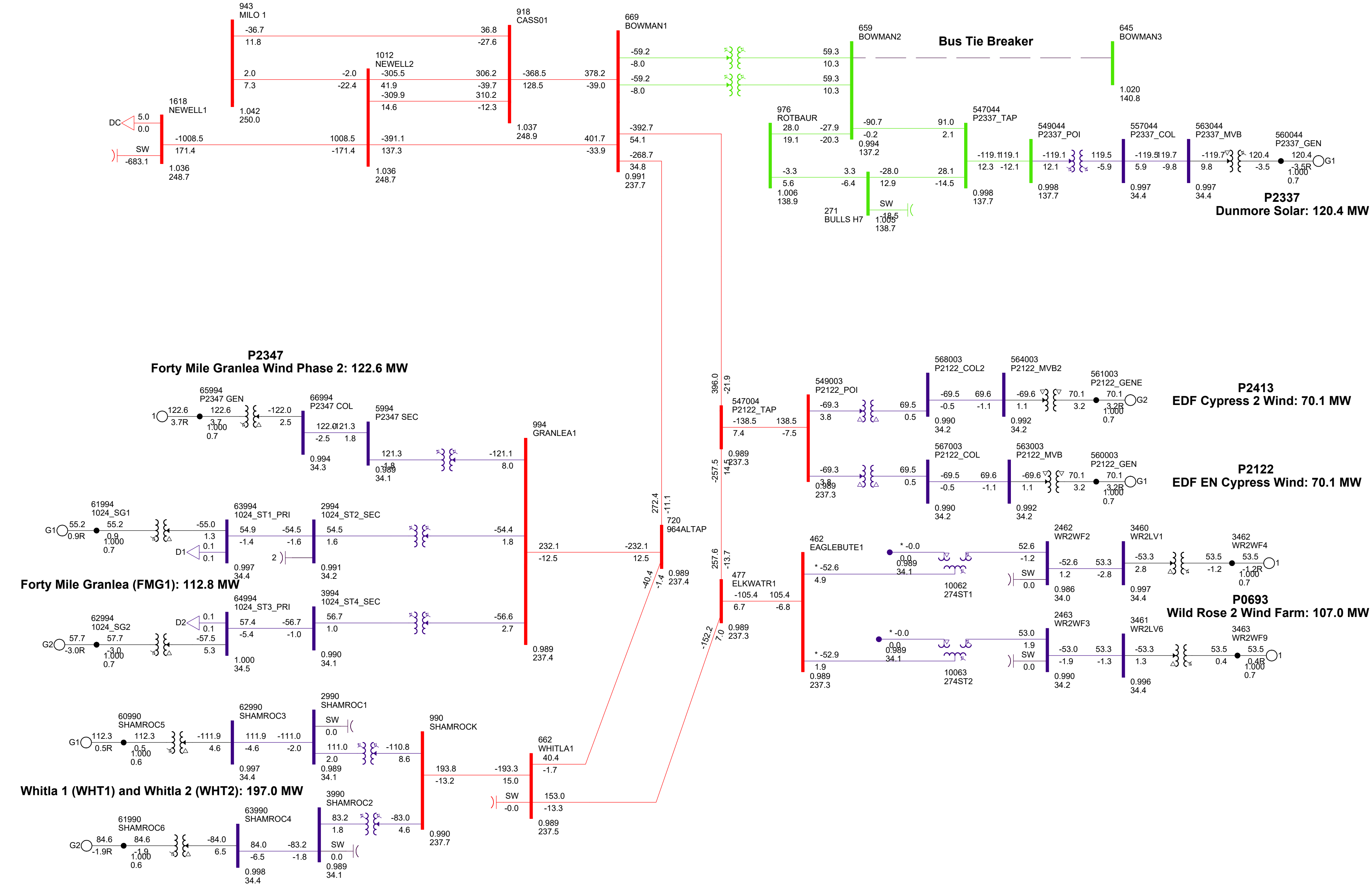
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Peak Case

Total Generation Dispatched
in Study Area: 700.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



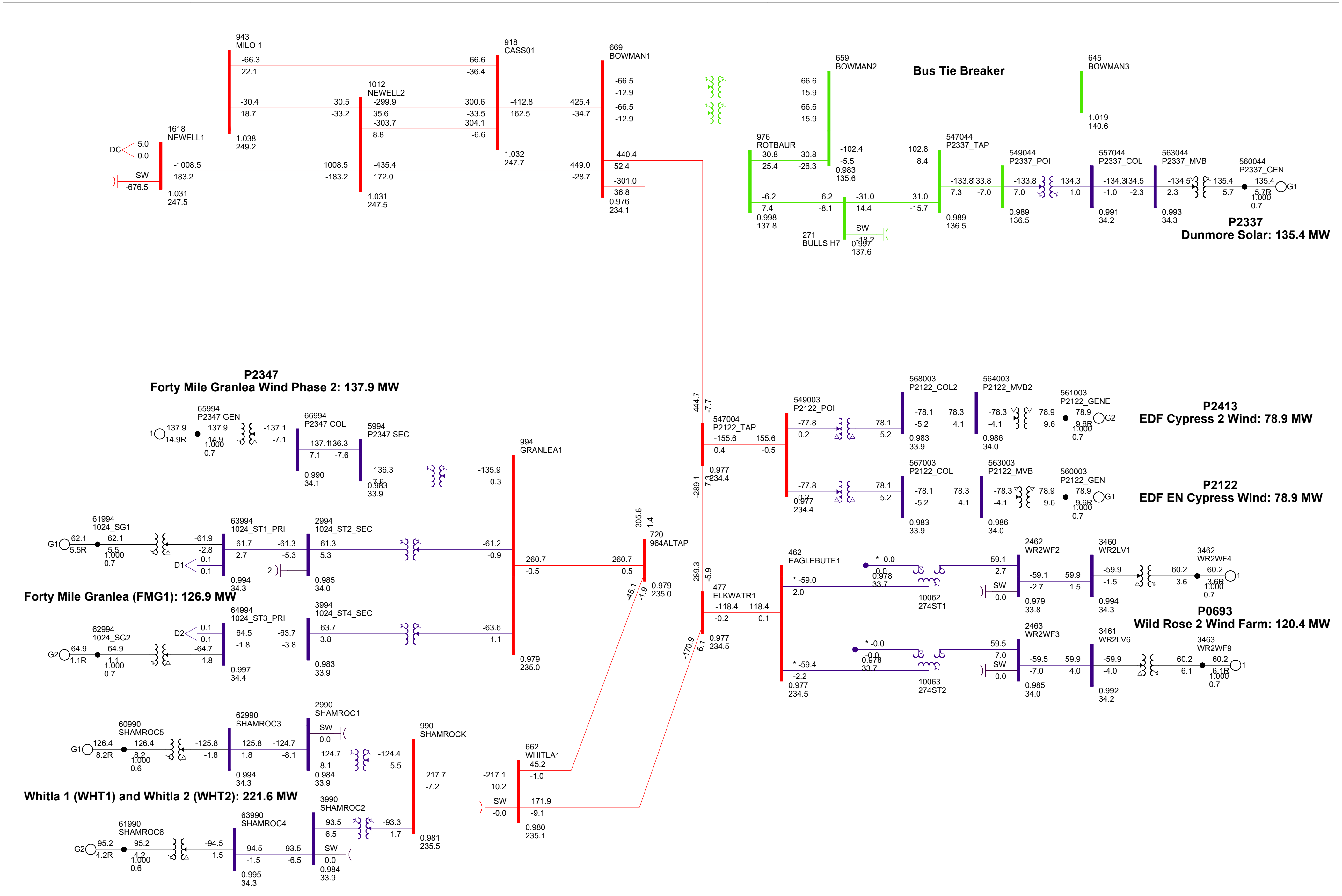
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Peak Case

Total Generation Dispatched
in Study Area: 800.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



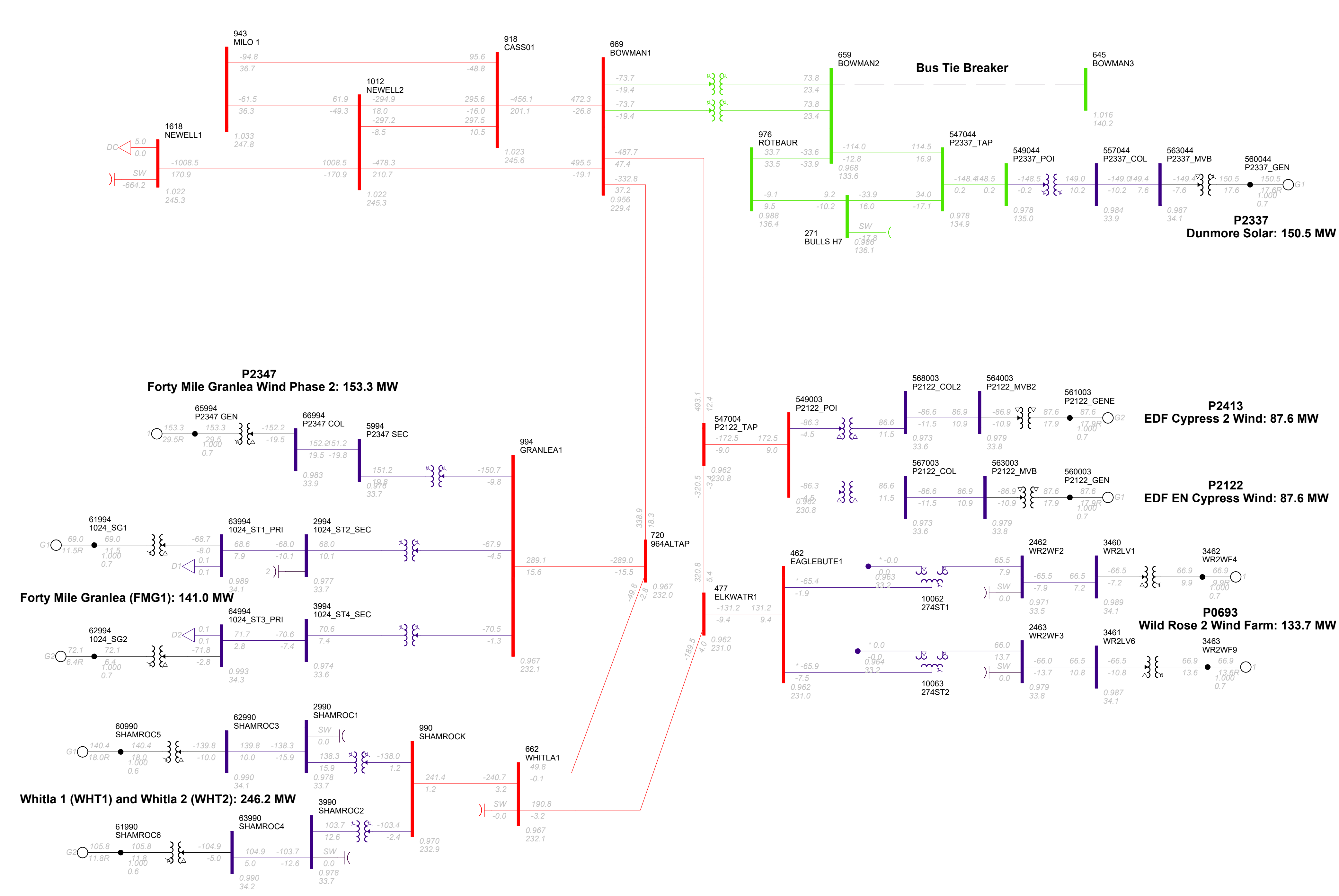
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Peak Case

Total Generation Dispatched
in Study Area: 900.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



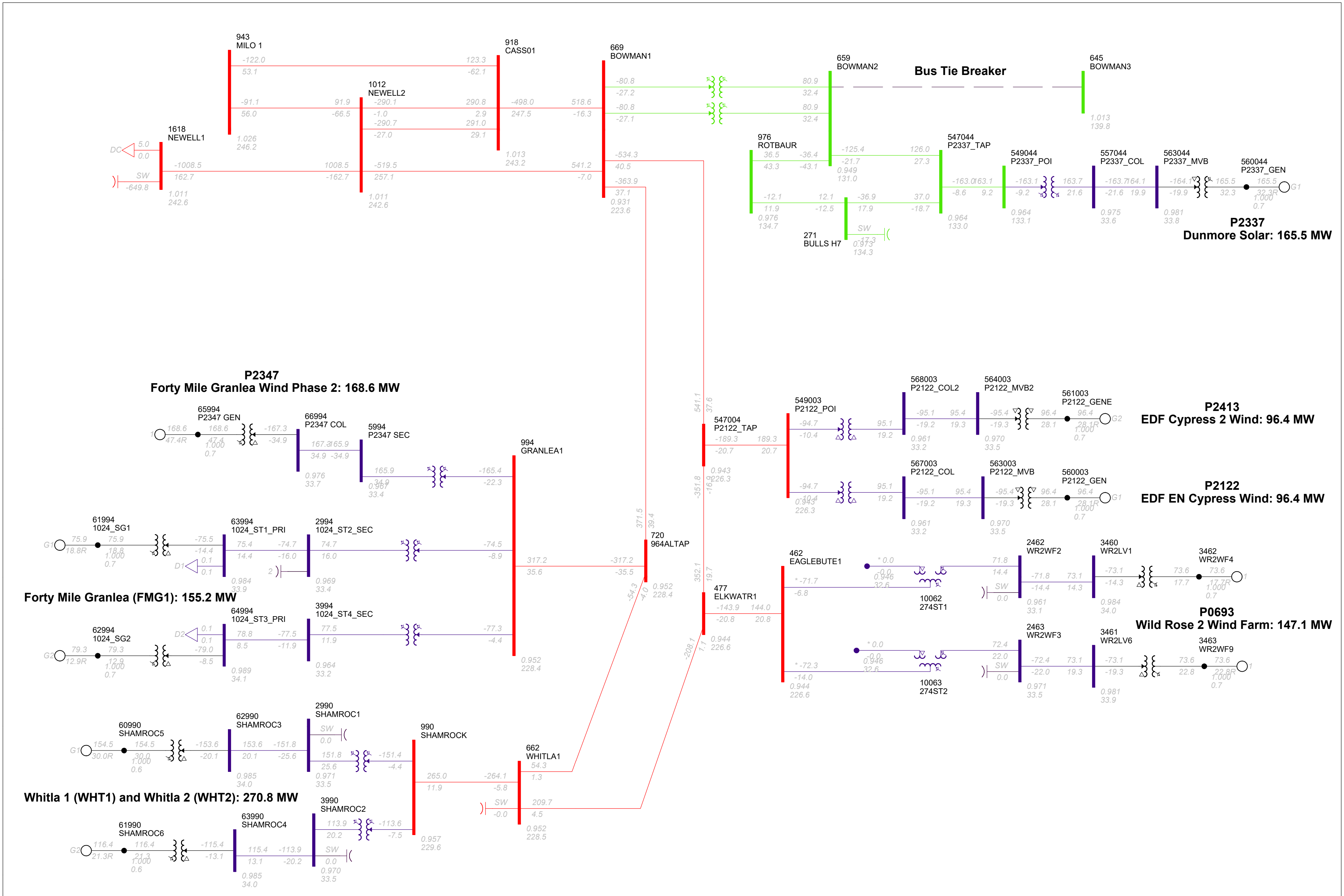
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

2023 Summer Peak Case

Total Generation Dispatched
in Study Area: 1000.0 MW



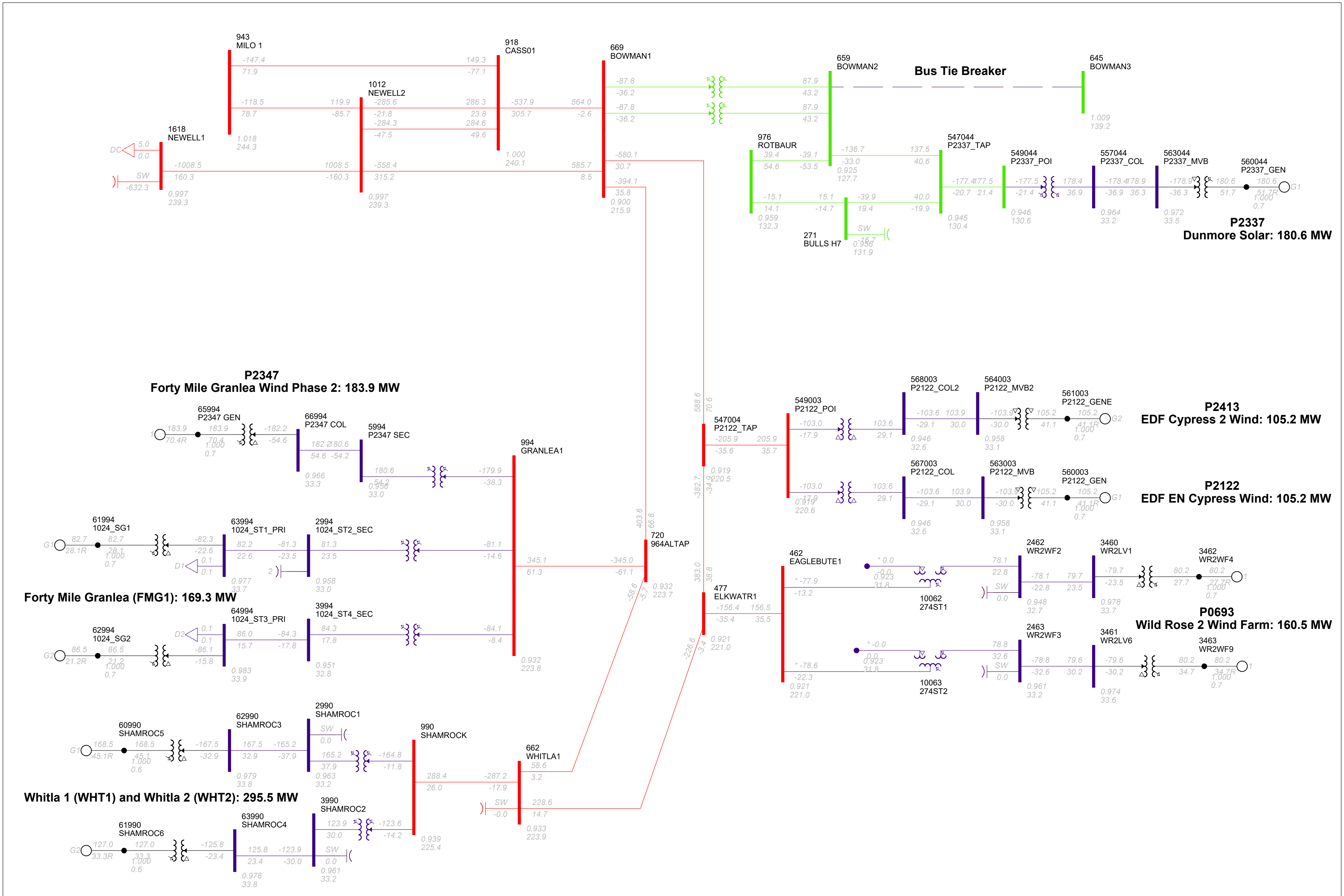
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Peak Case

Total Generation Dispatched
in Study Area: 1100.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



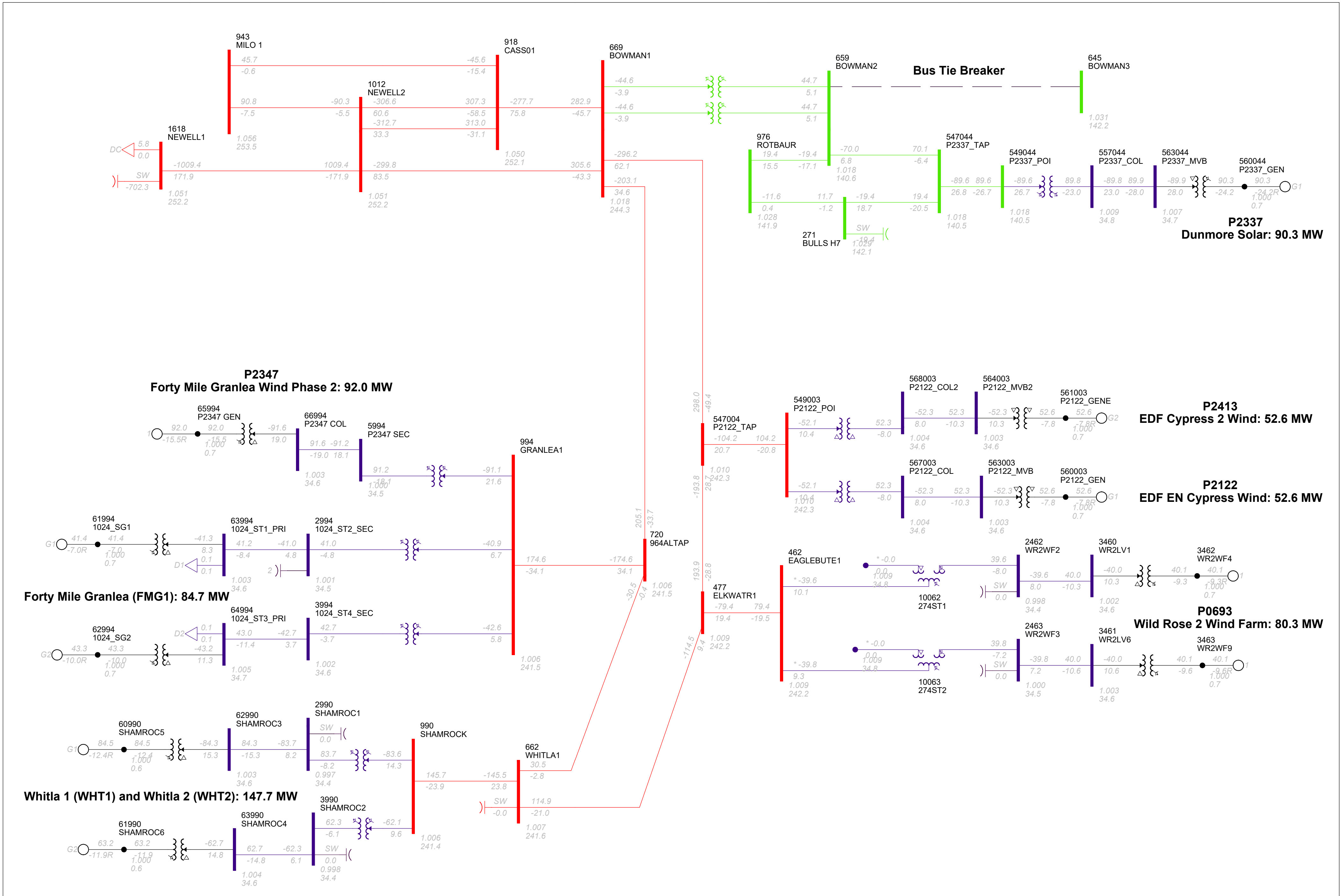
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Peak Case

Total Generation Dispatched
in Study Area: 1200.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



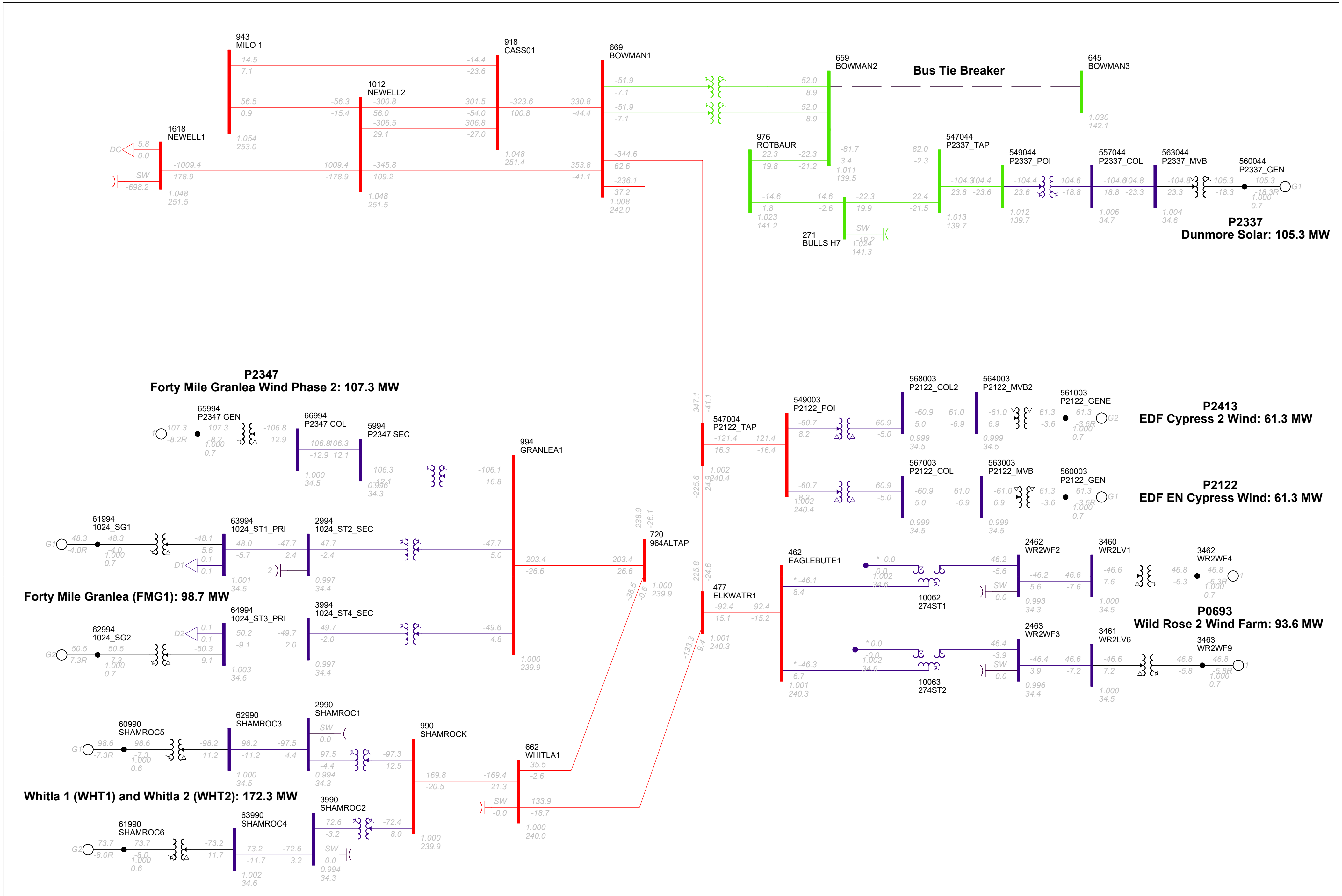
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Light Case

Total Generation Dispatched
in Study Area: 600.2 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



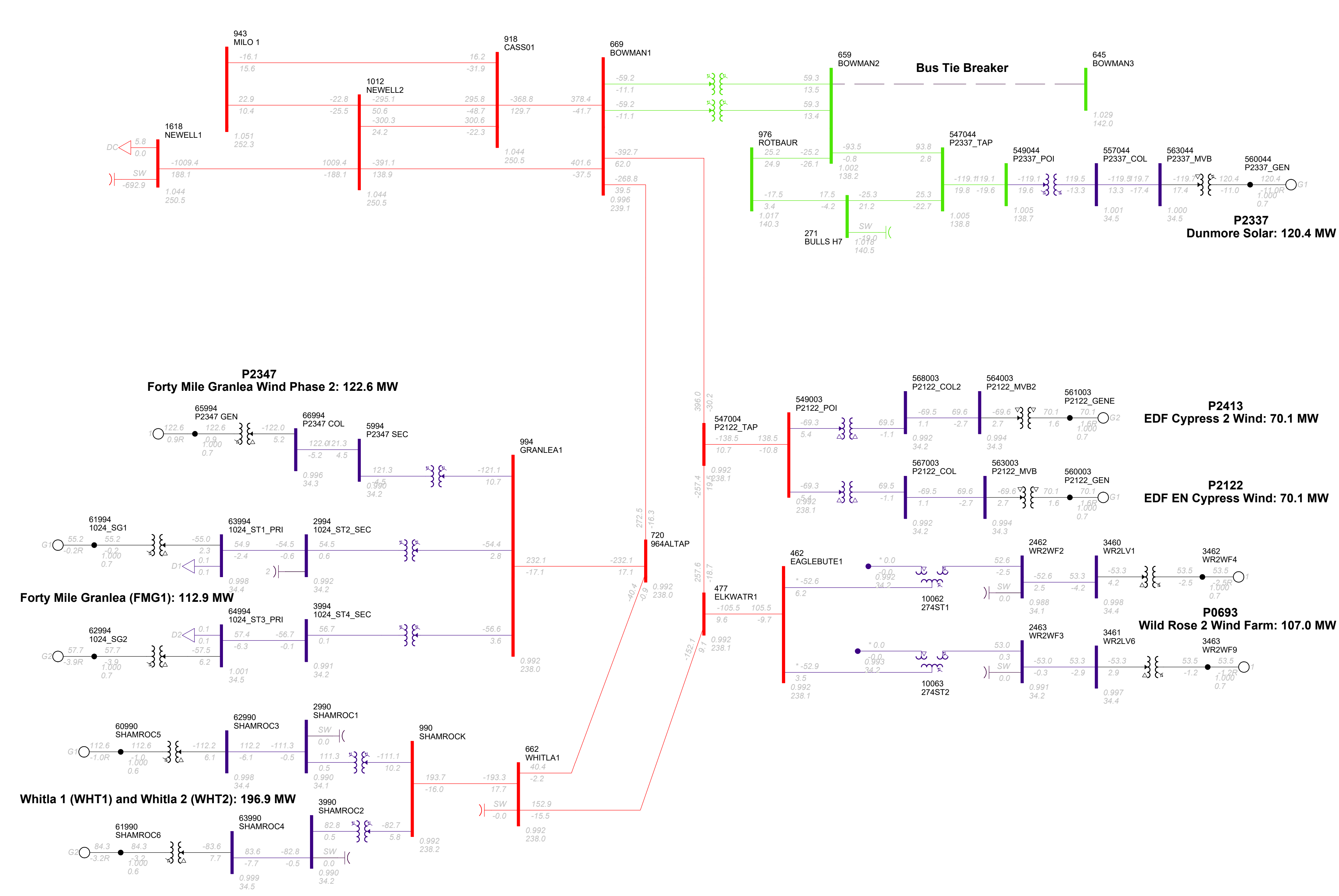
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Light Case

Total Generation Dispatched
in Study Area: 700.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



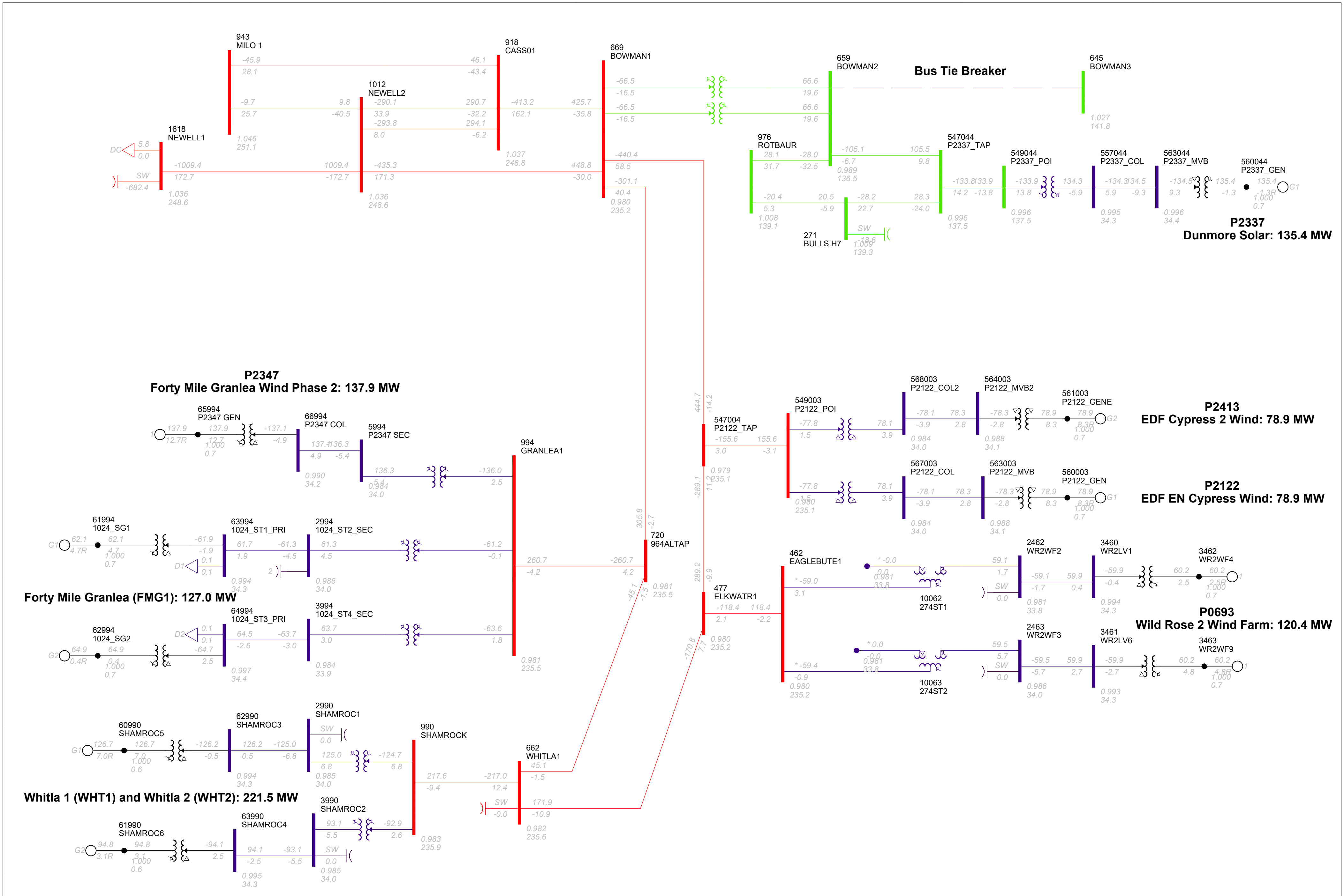
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

2023 Summer Light Case

Total Generation Dispatched in Study Area: 800.0 MW



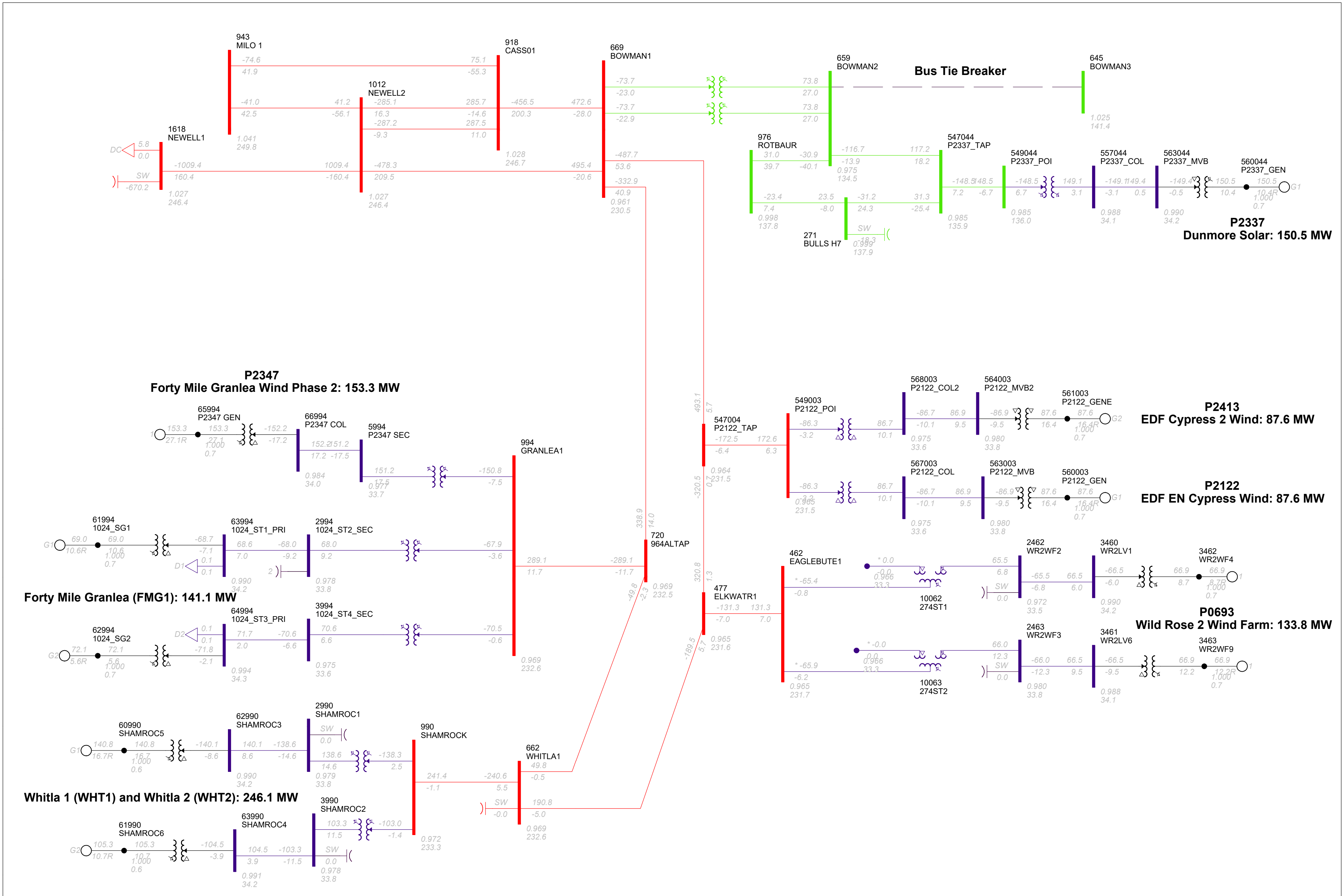
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

2023 Summer Light Case

Total Generation Dispatched
in Study Area: 900.0 MW



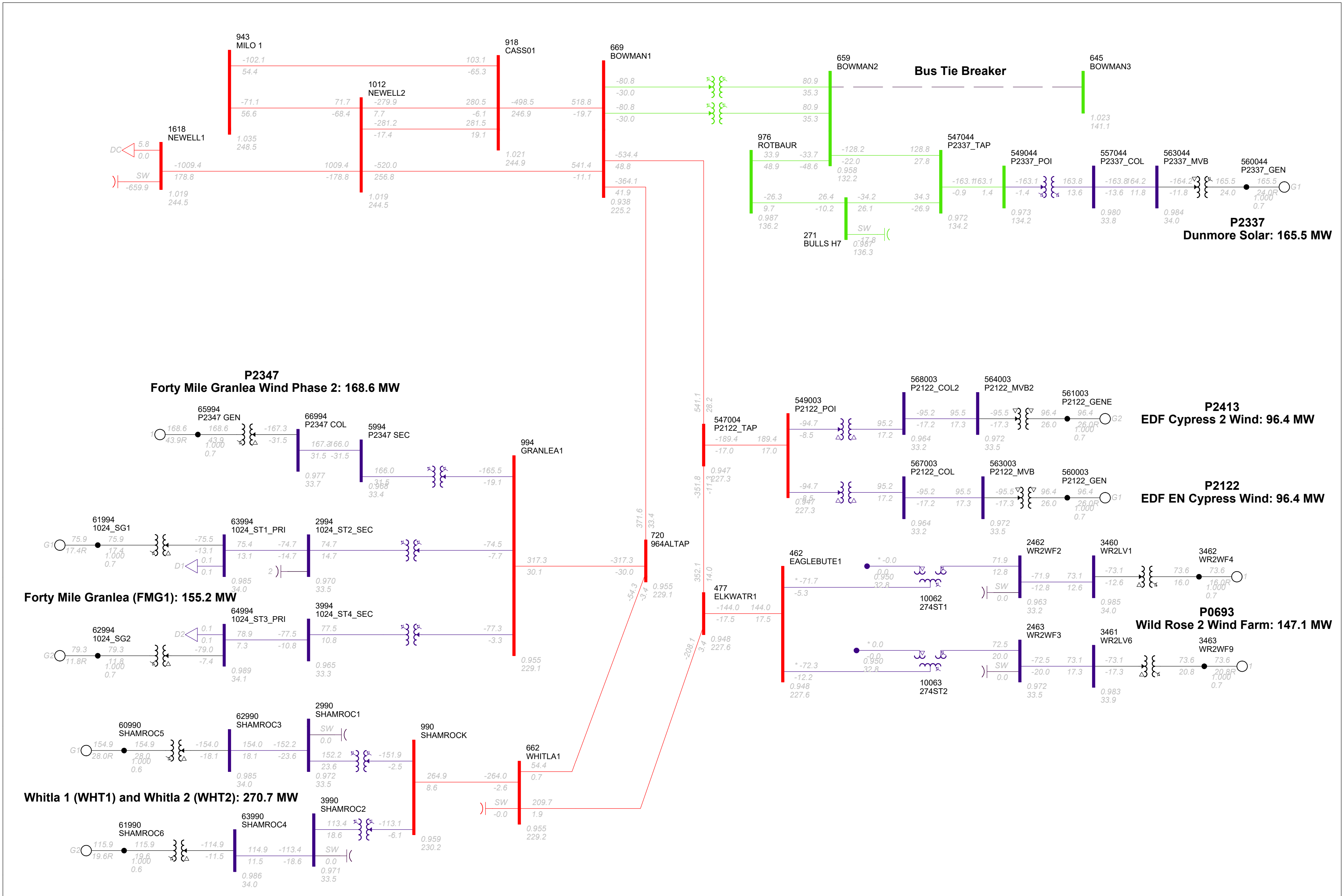
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Light Case

Total Generation Dispatched
in Study Area: 1000.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



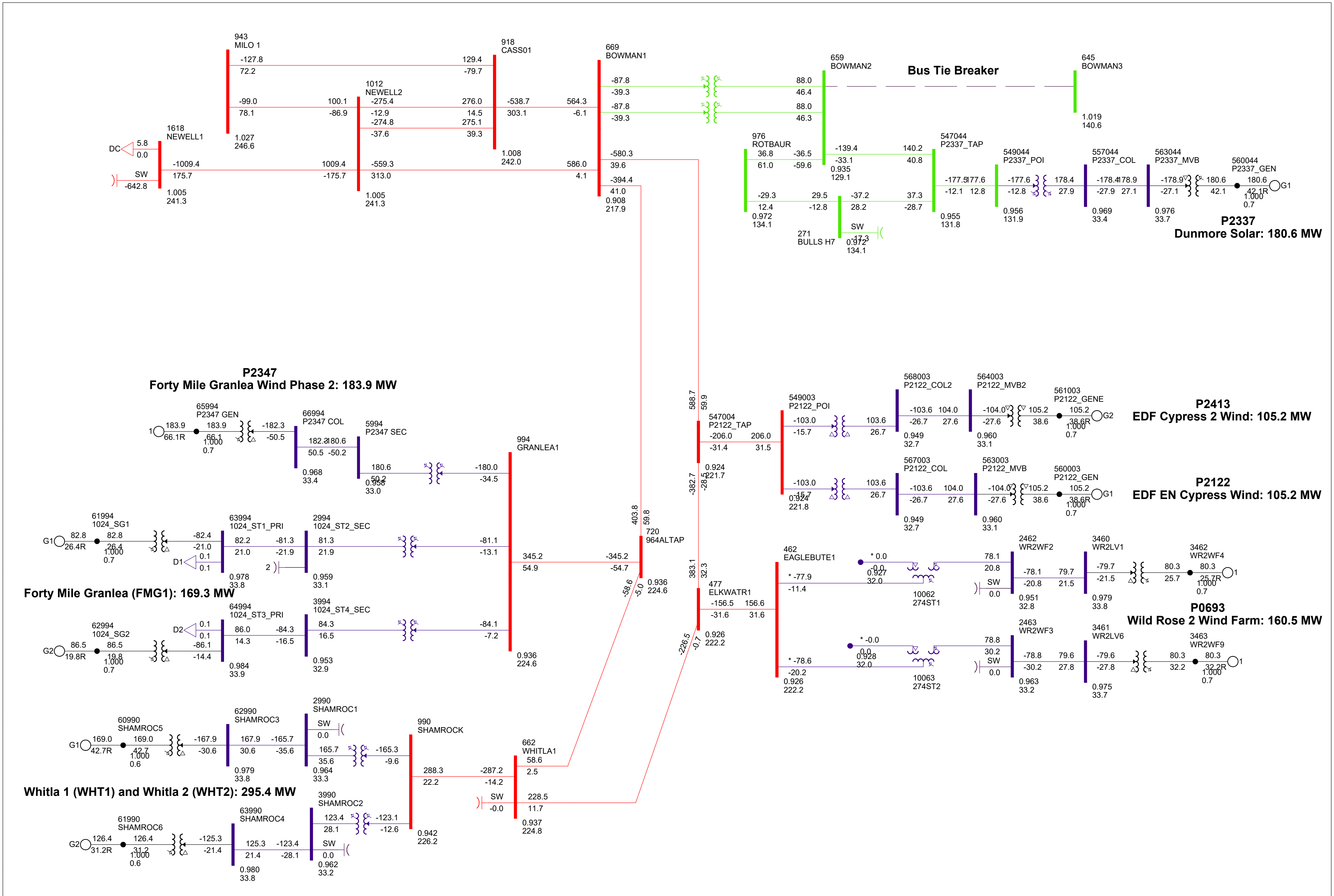
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Light Case

Total Generation Dispatched
in Study Area: 1100.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



P7083 Bowmanton 244S Substation Voltage Support Project

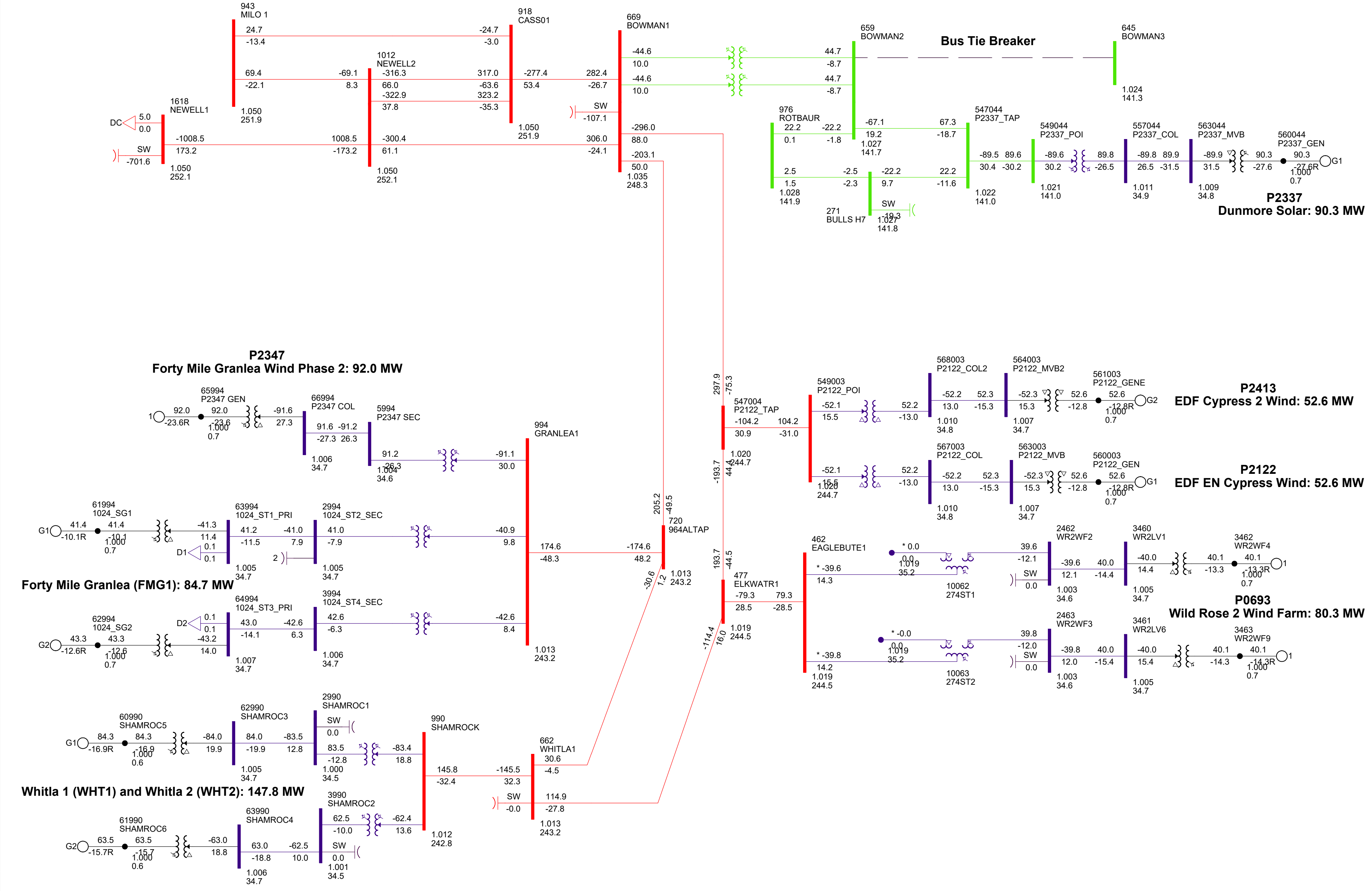
Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Light Case

Total Generation Dispatched
in Study Area: 1200.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

Attachment C: Power Flow SLDs of the Post-Development Transmission System in the Study Area



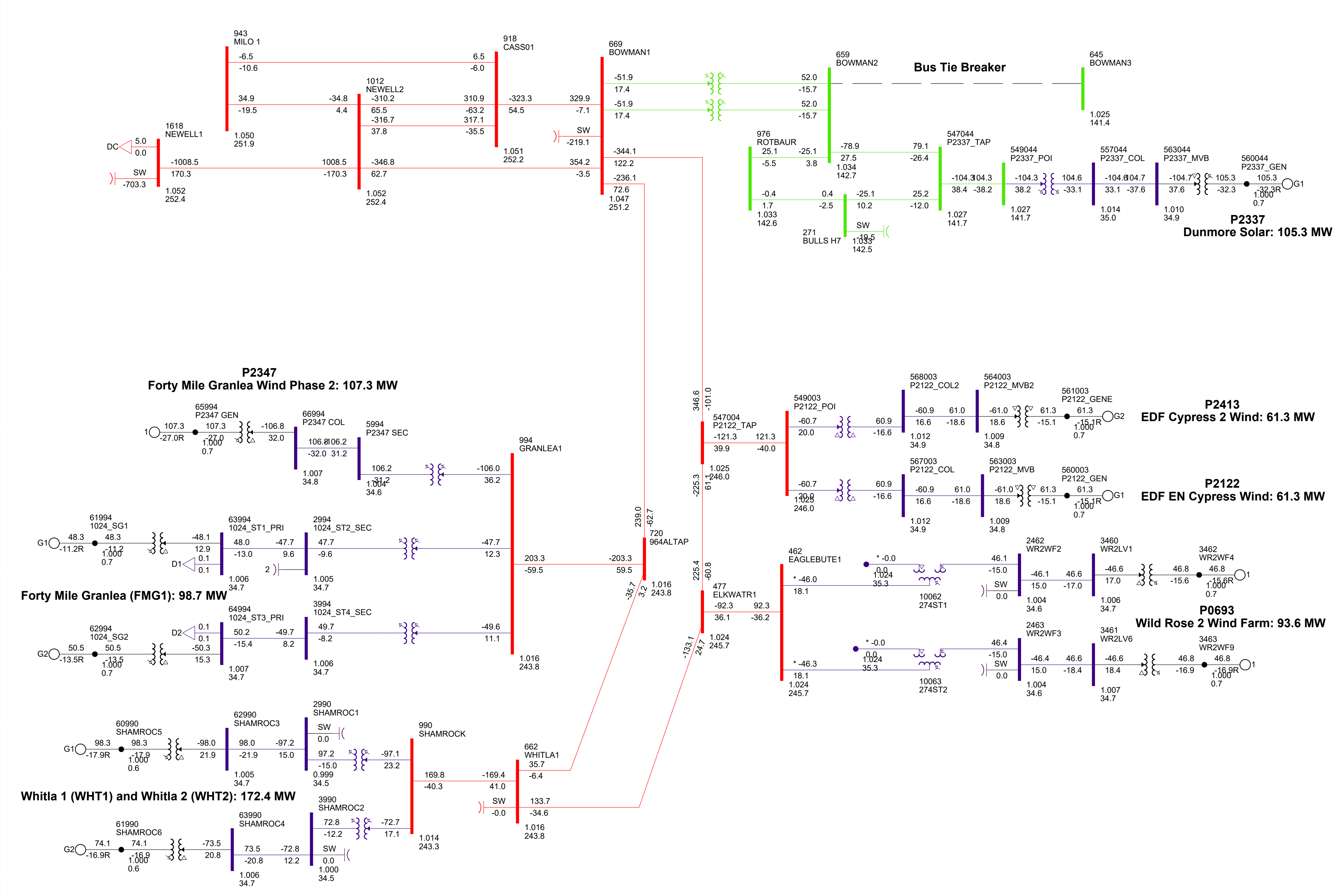
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Peak Case

Total Generation Dispatched
in Study Area: 600.2 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



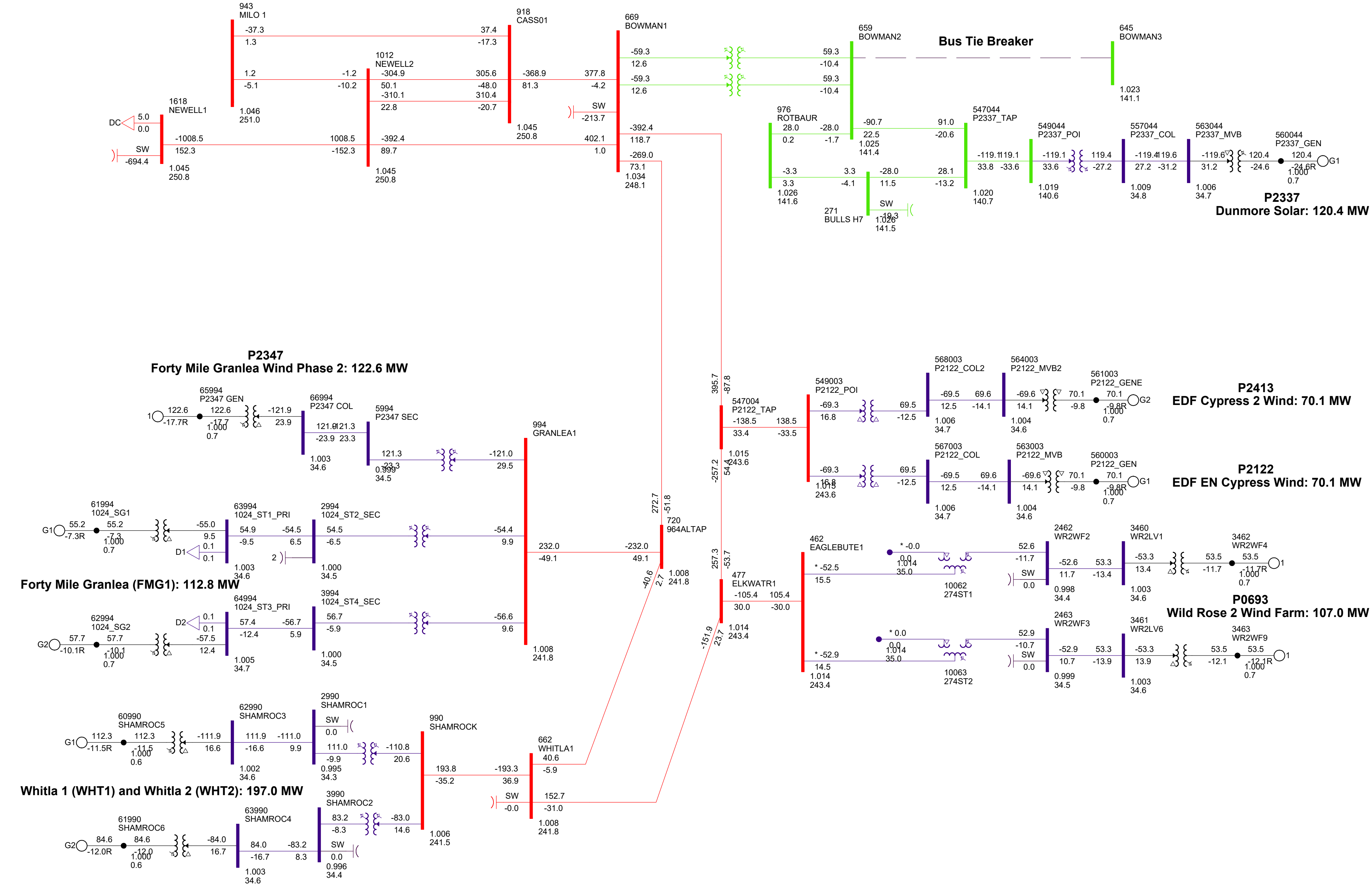
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Peak Case

Total Generation Dispatched
in Study Area: 700.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



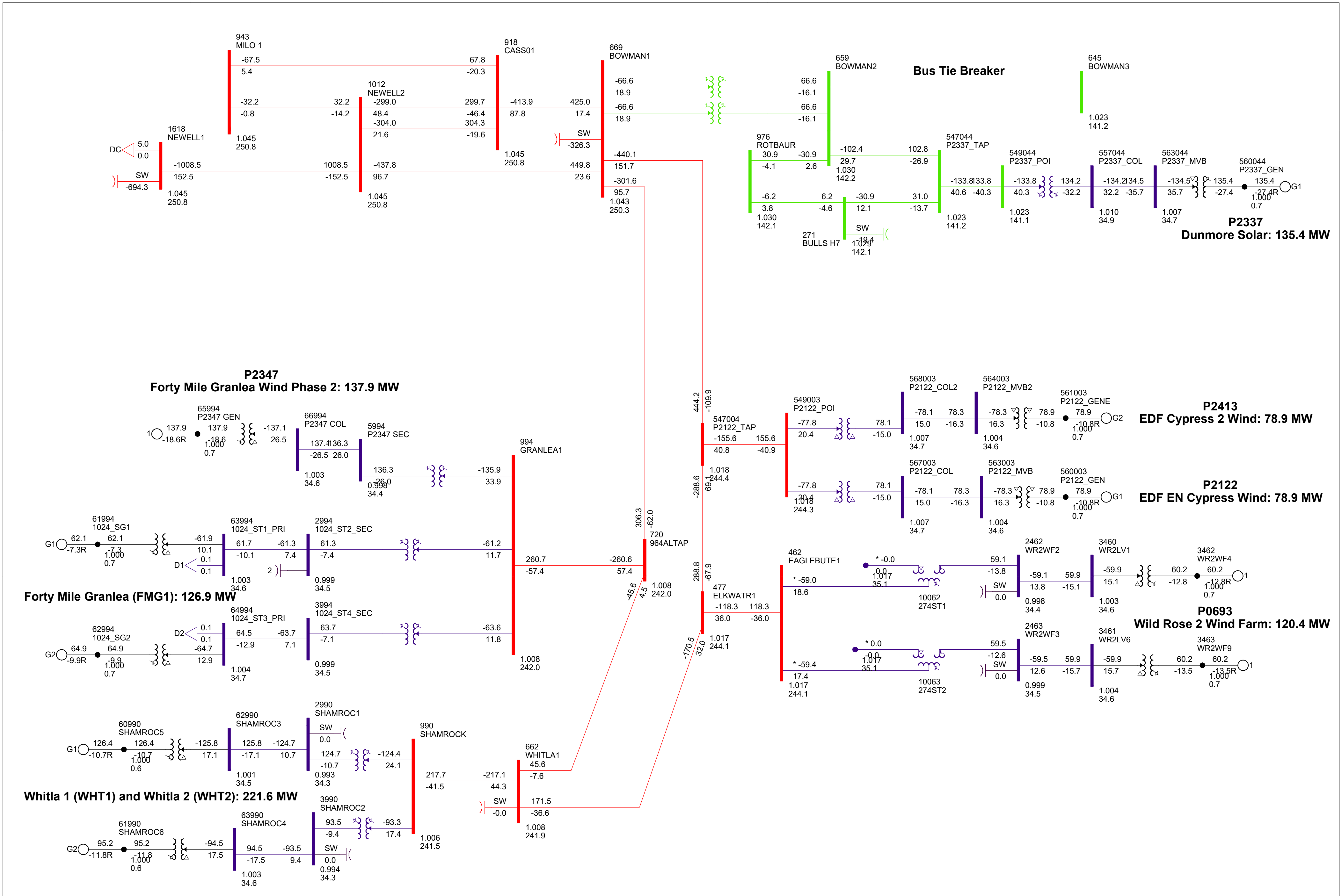
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Peak Case

Total Generation Dispatched
in Study Area: 800.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



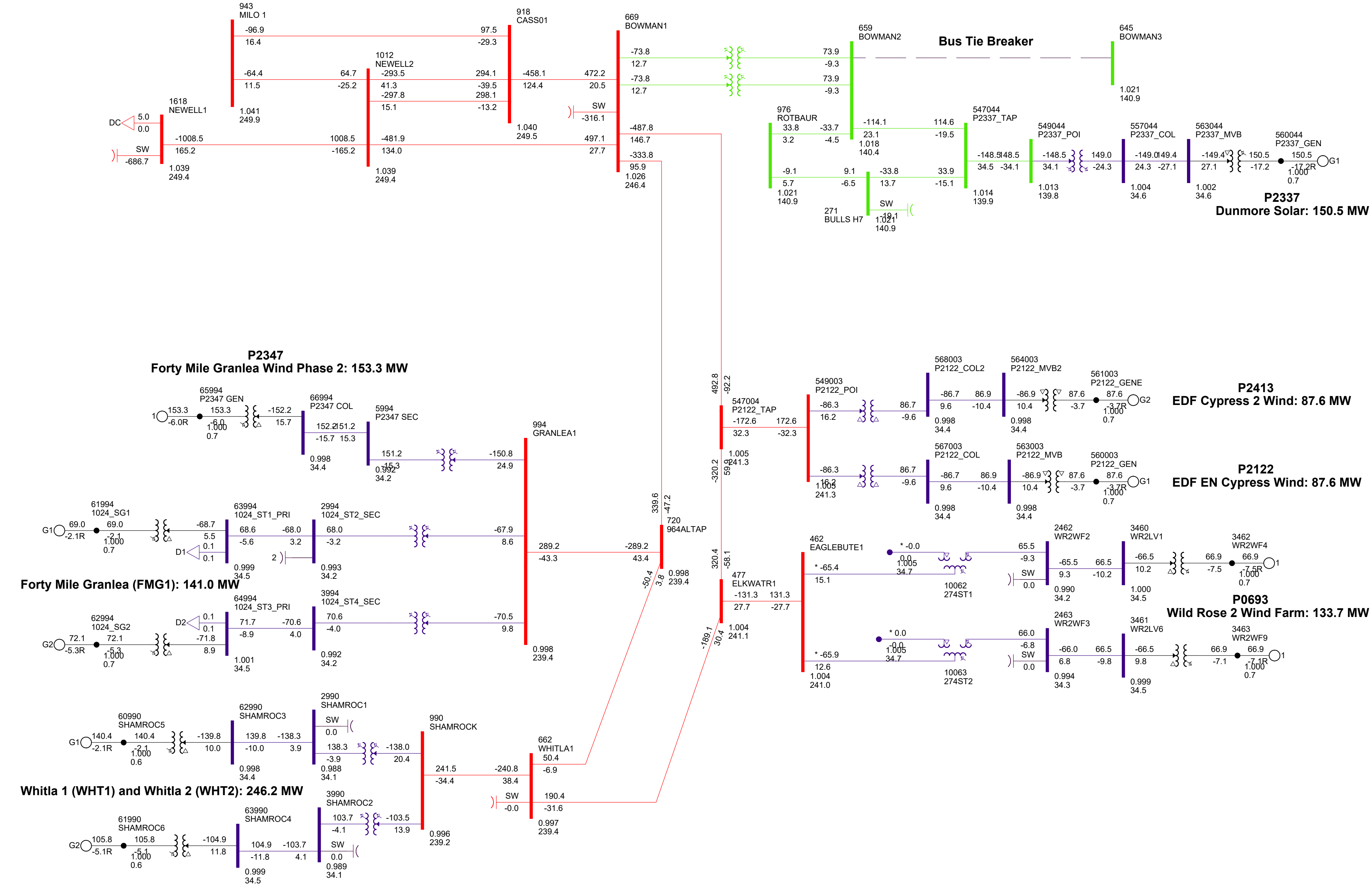
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

2023 Summer Peak Case

Total Generation Dispatched in Study Area: 900.0 MW



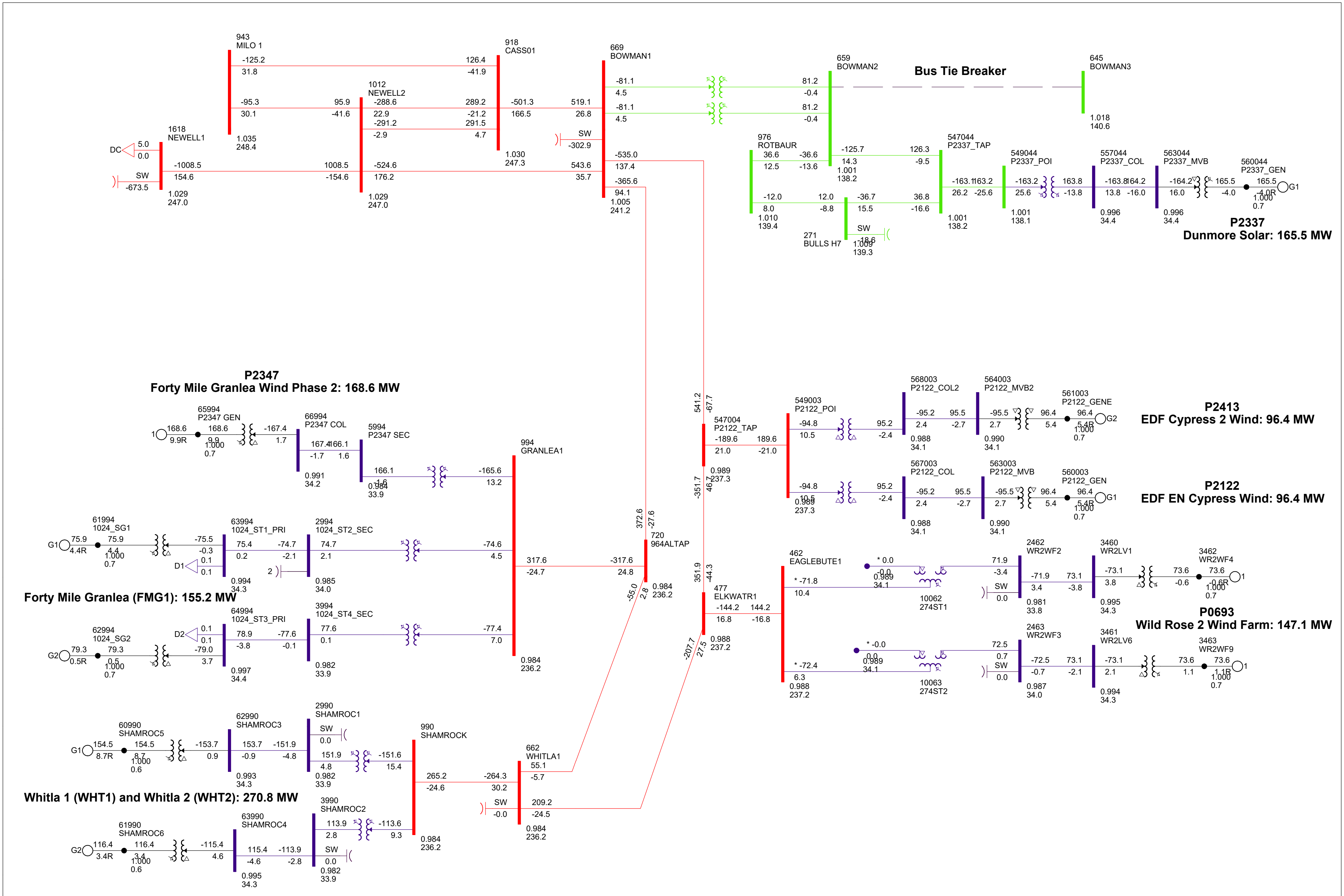
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Peak Case

Total Generation Dispatched
in Study Area: 1000.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



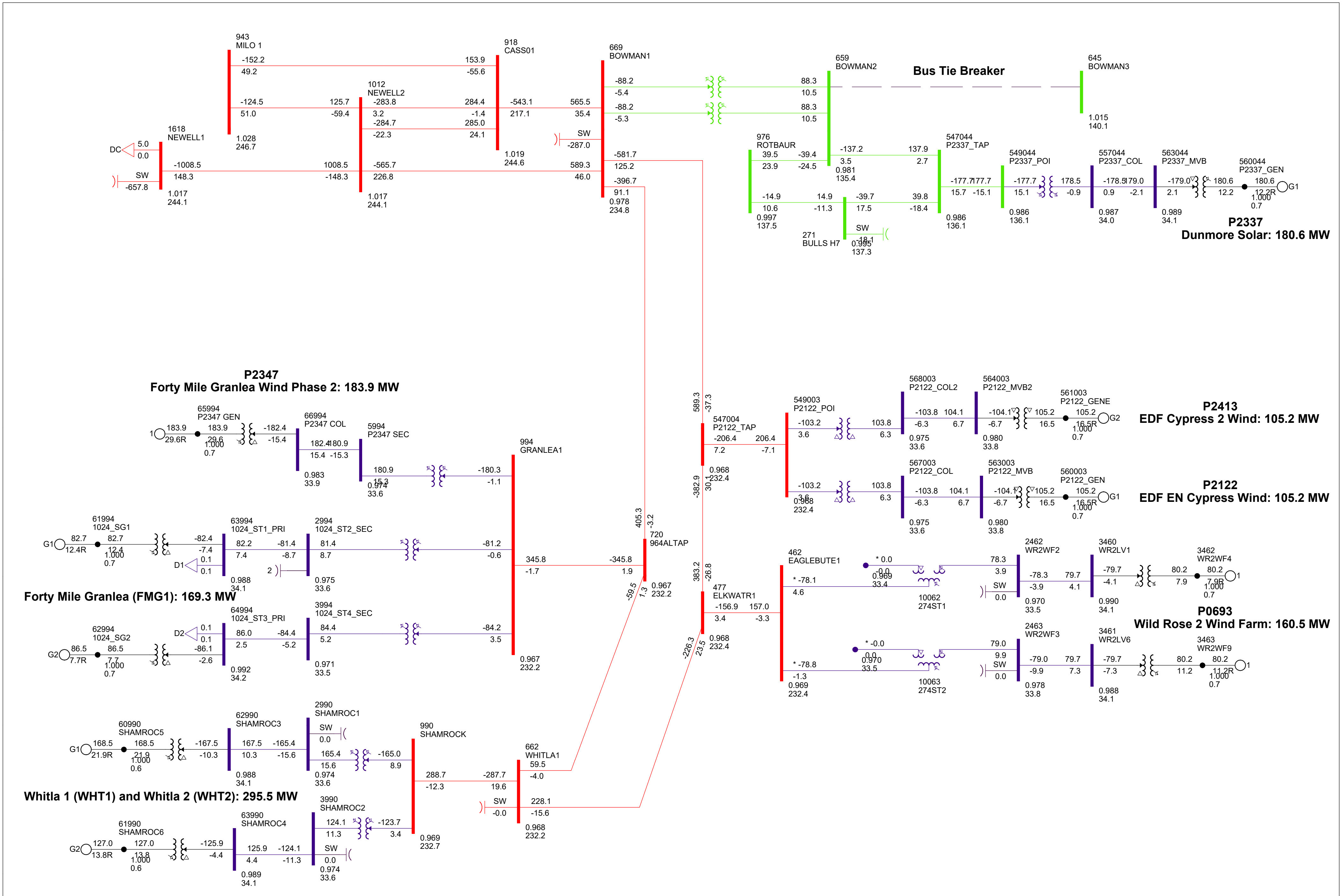
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Peak Case

Total Generation Dispatched
in Study Area: 1100.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



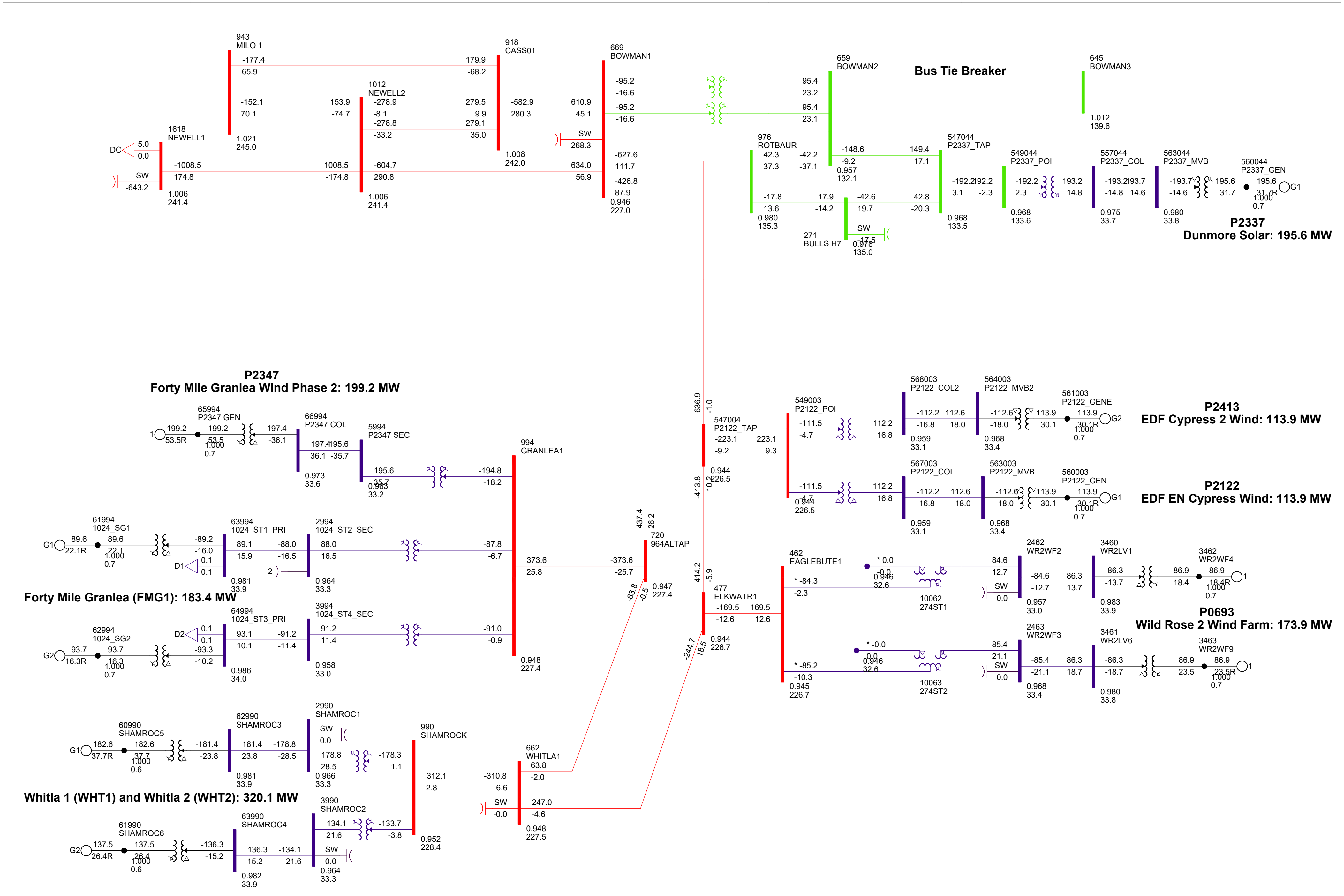
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Peak Case

Total Generation Dispatched
in Study Area: 1200.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



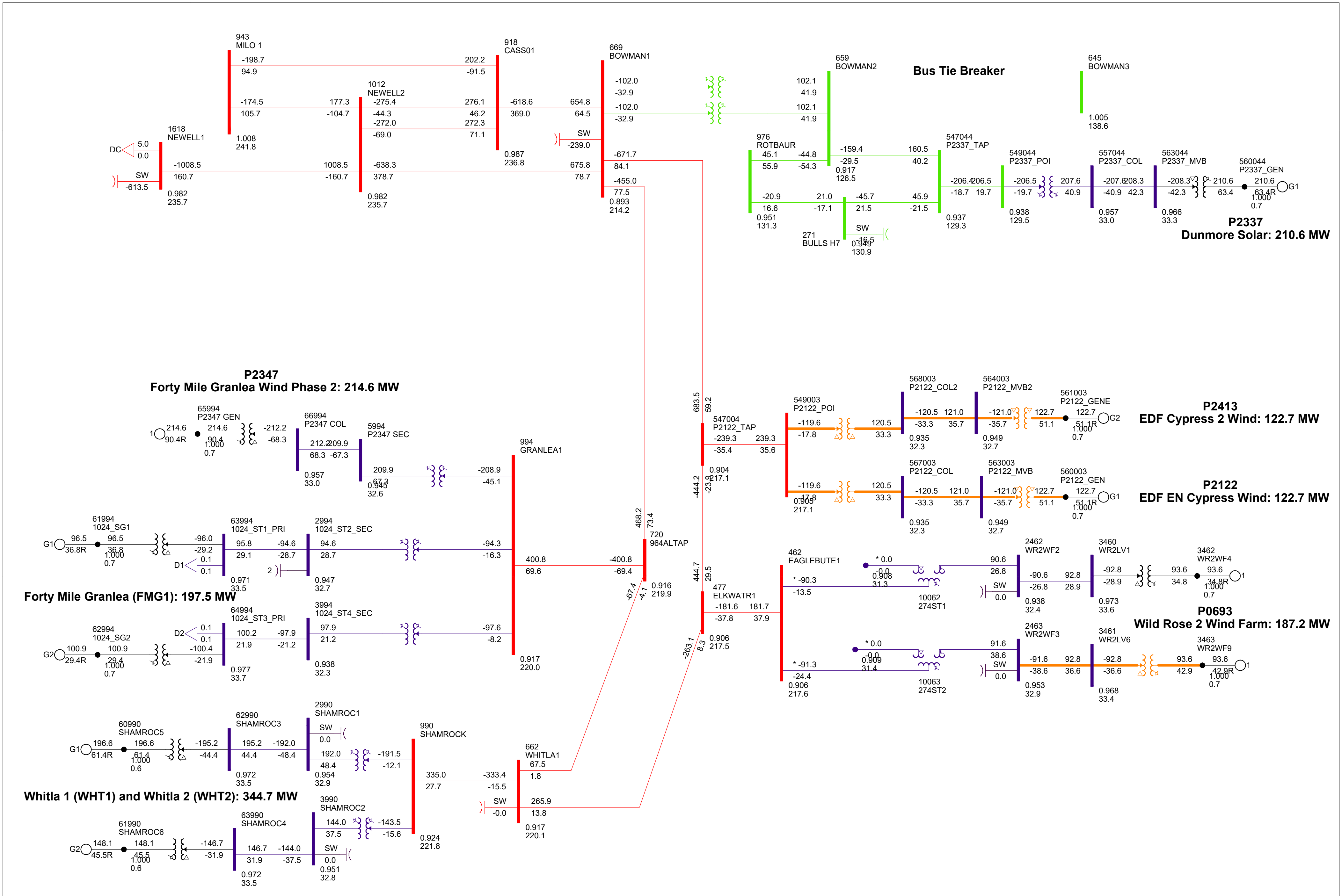
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Peak Case

Total Generation Dispatched
in Study Area: 1300.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



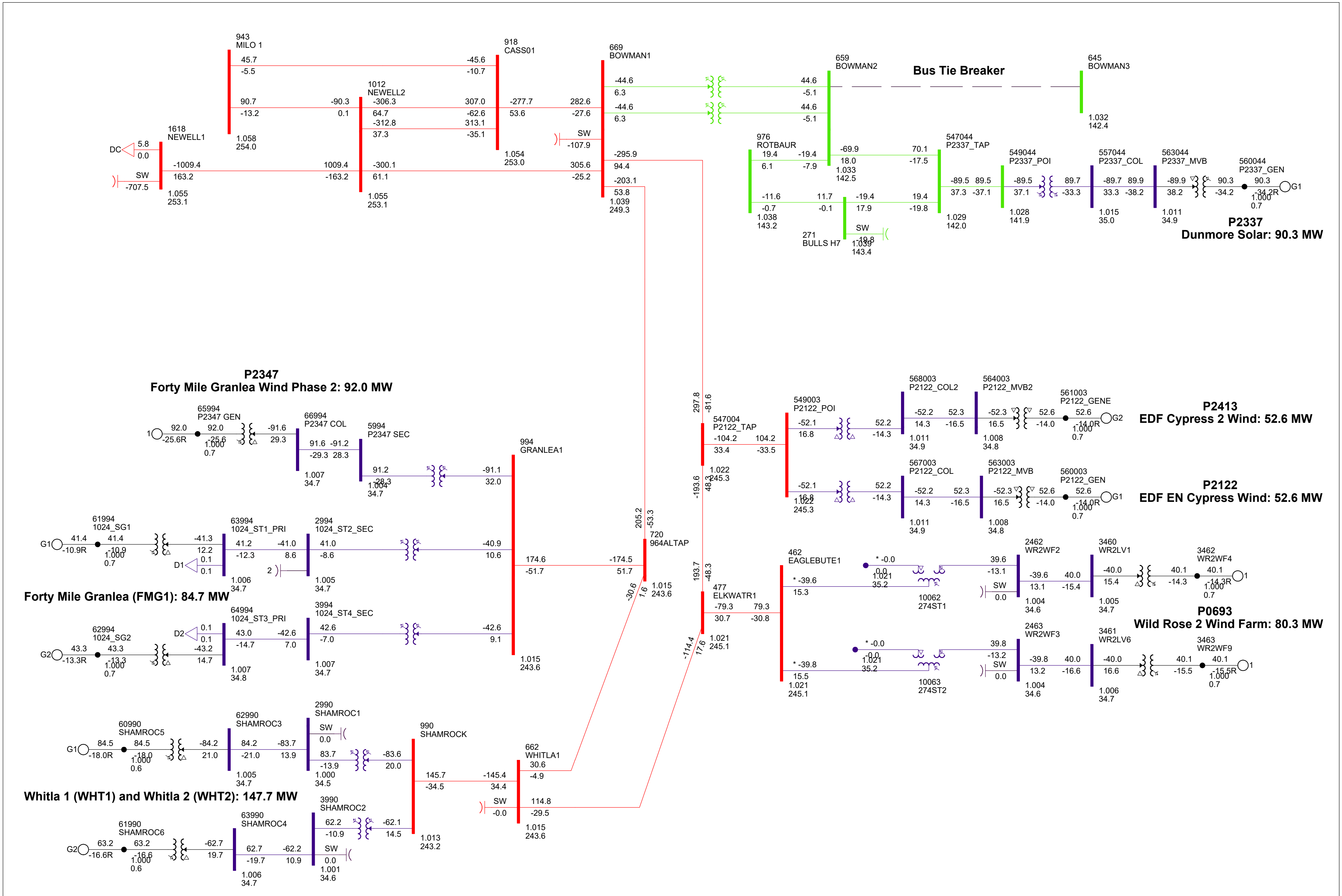
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Peak Case

Total Generation Dispatched
in Study Area: 1400.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



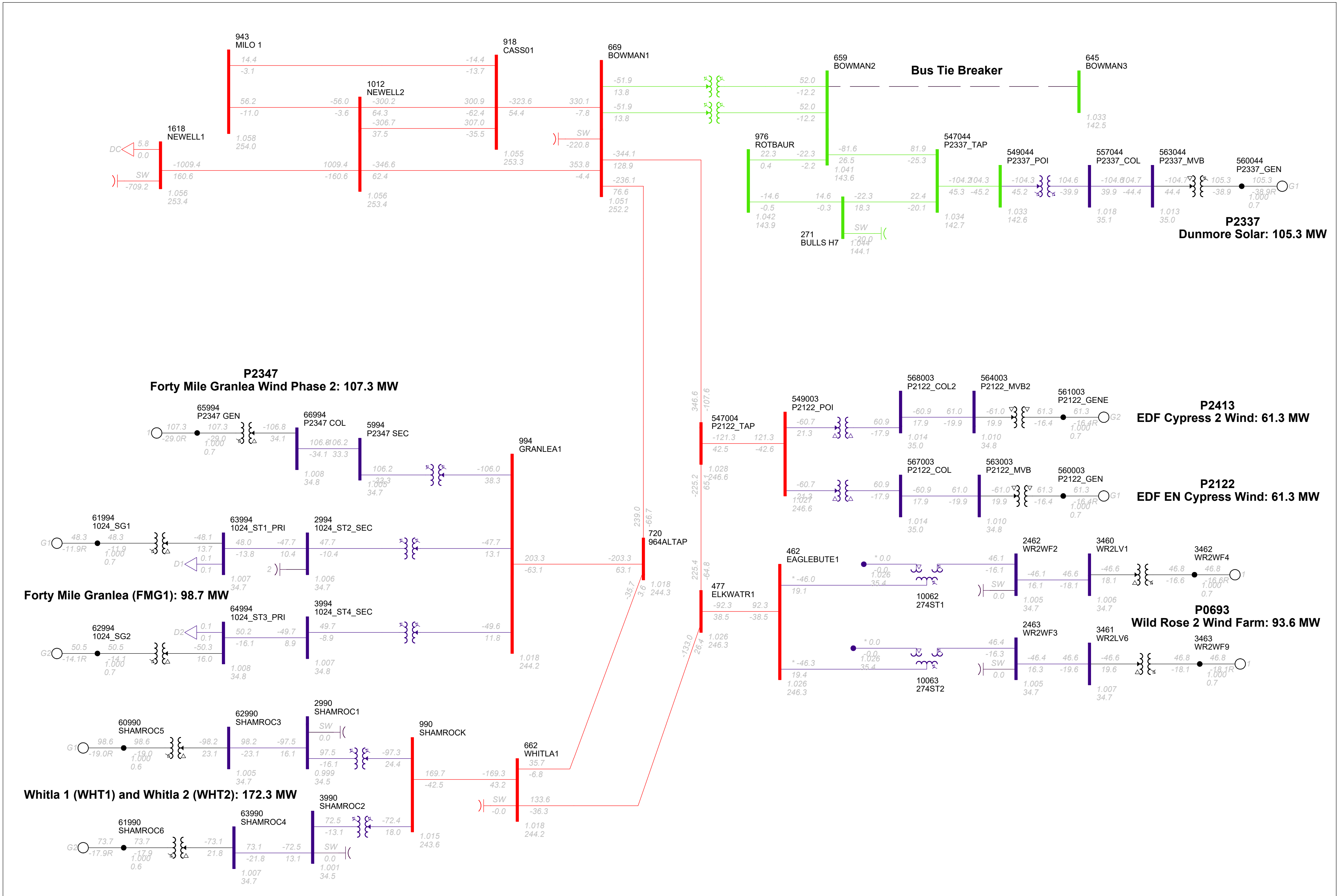
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Light Case

Total Generation Dispatched
in Study Area: 600.2 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



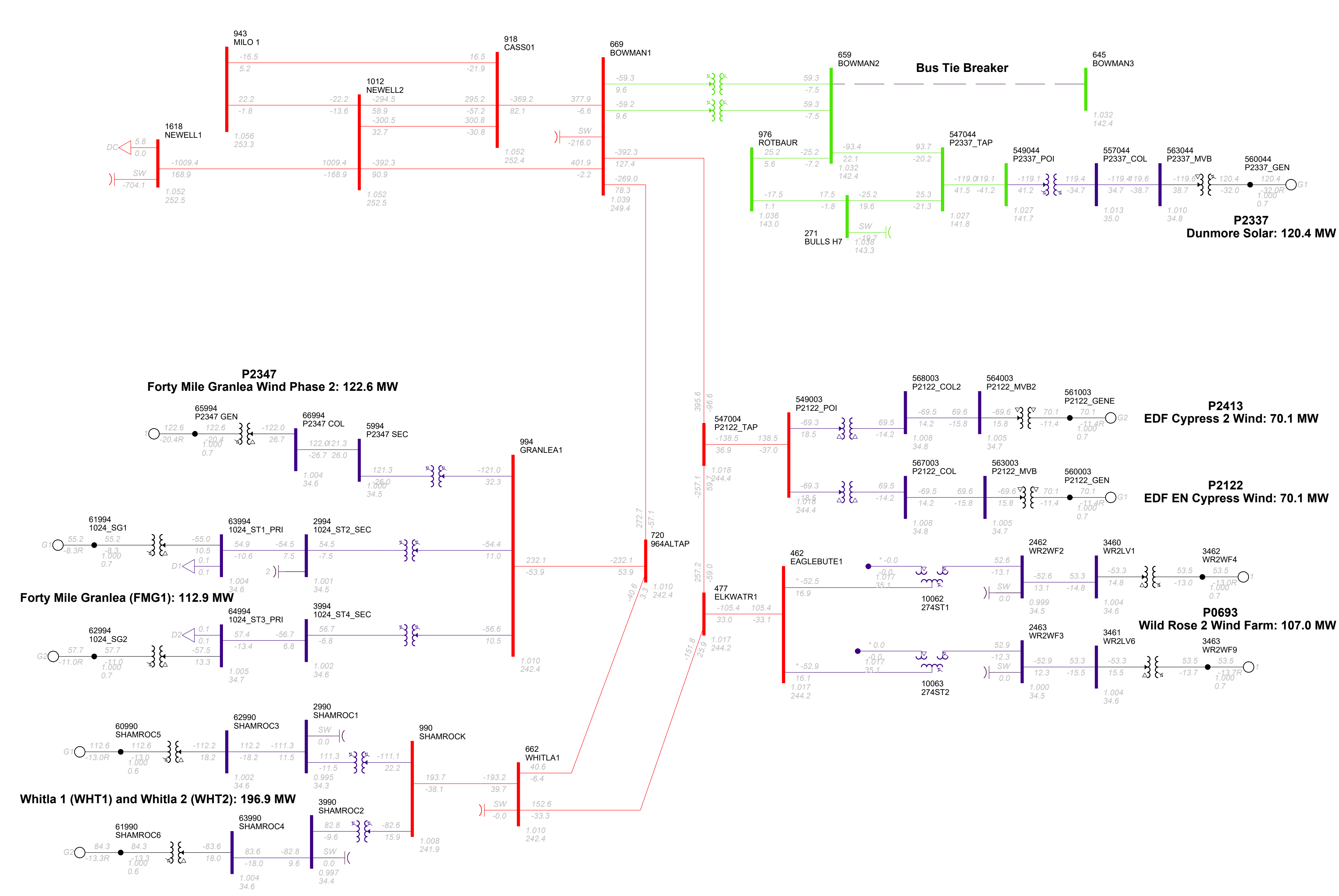
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Light Case

Total Generation Dispatched in Study Area: 700.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



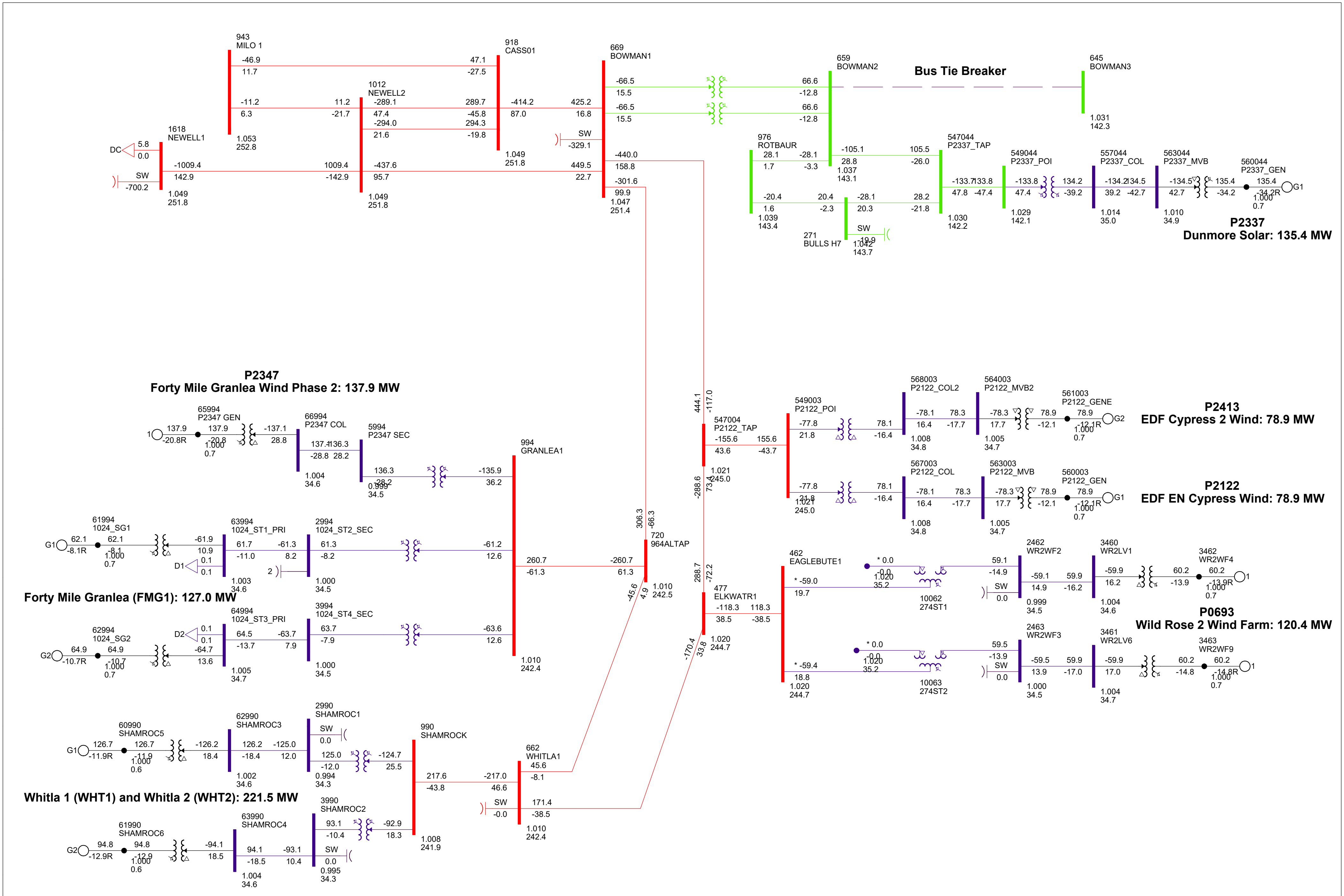
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Light Case

Total Generation Dispatched
in Study Area: 800.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



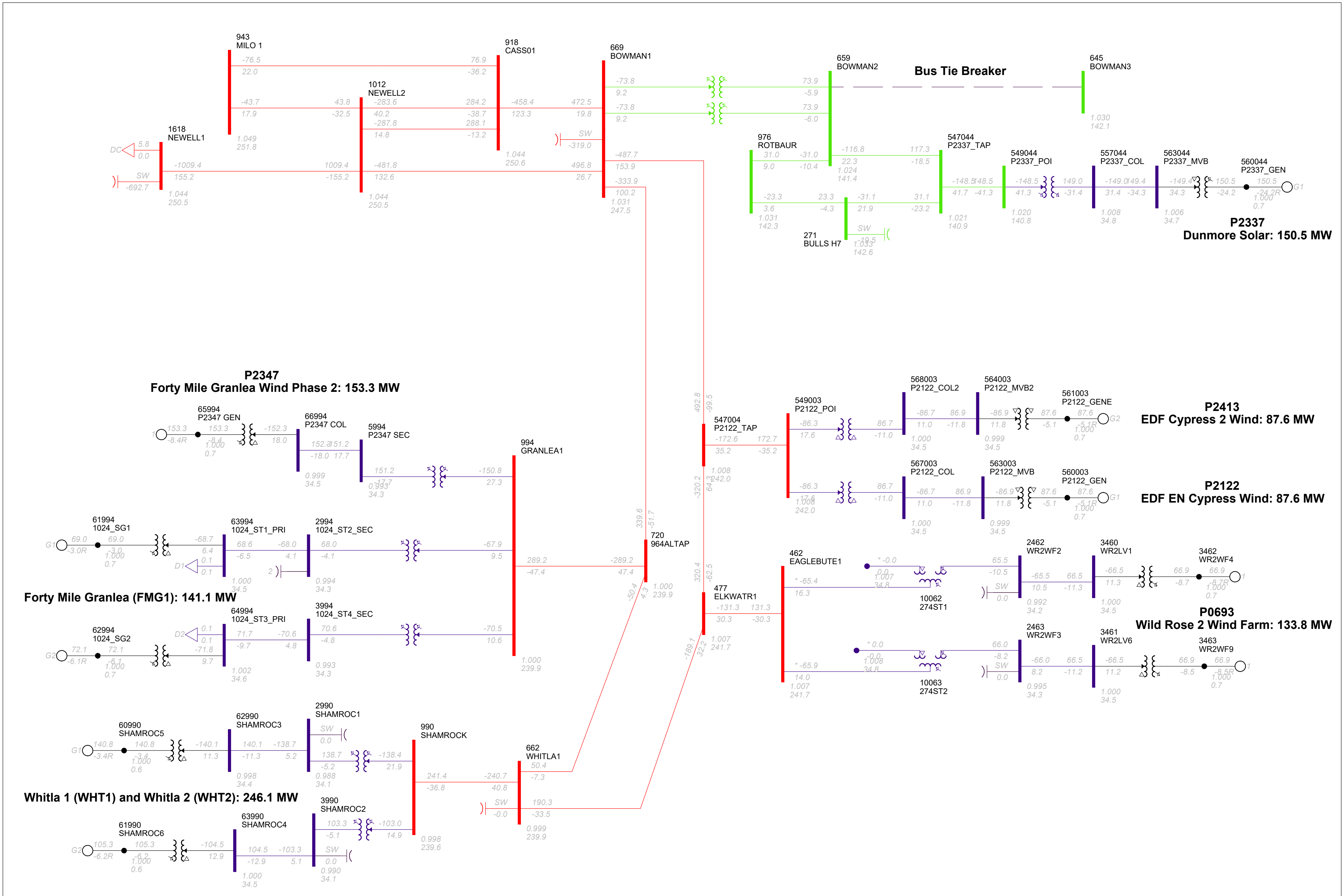
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Light Case

Total Generation Dispatched in Study Area: 900.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



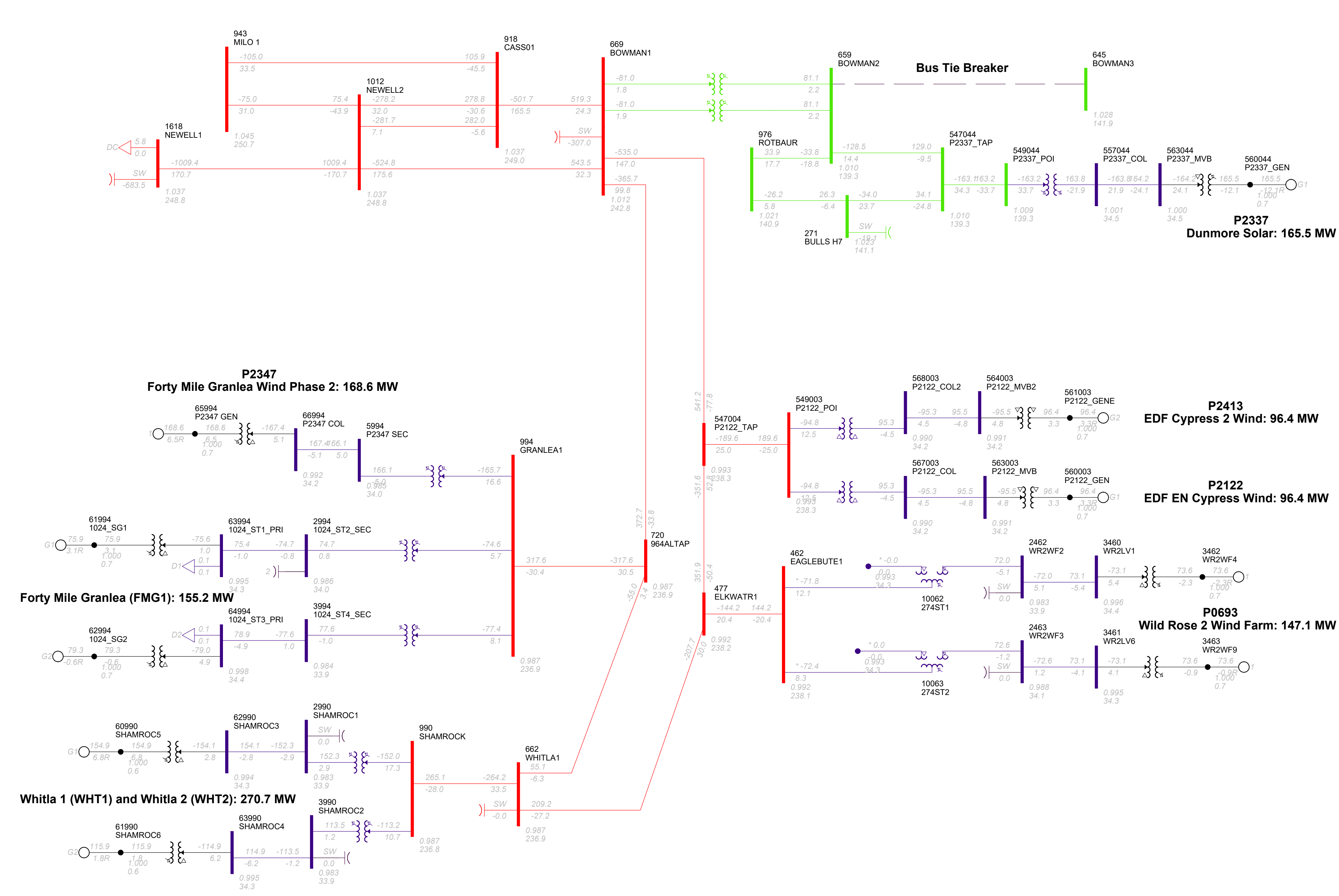
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Light Case

Total Generation Dispatched
in Study Area: 1000.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



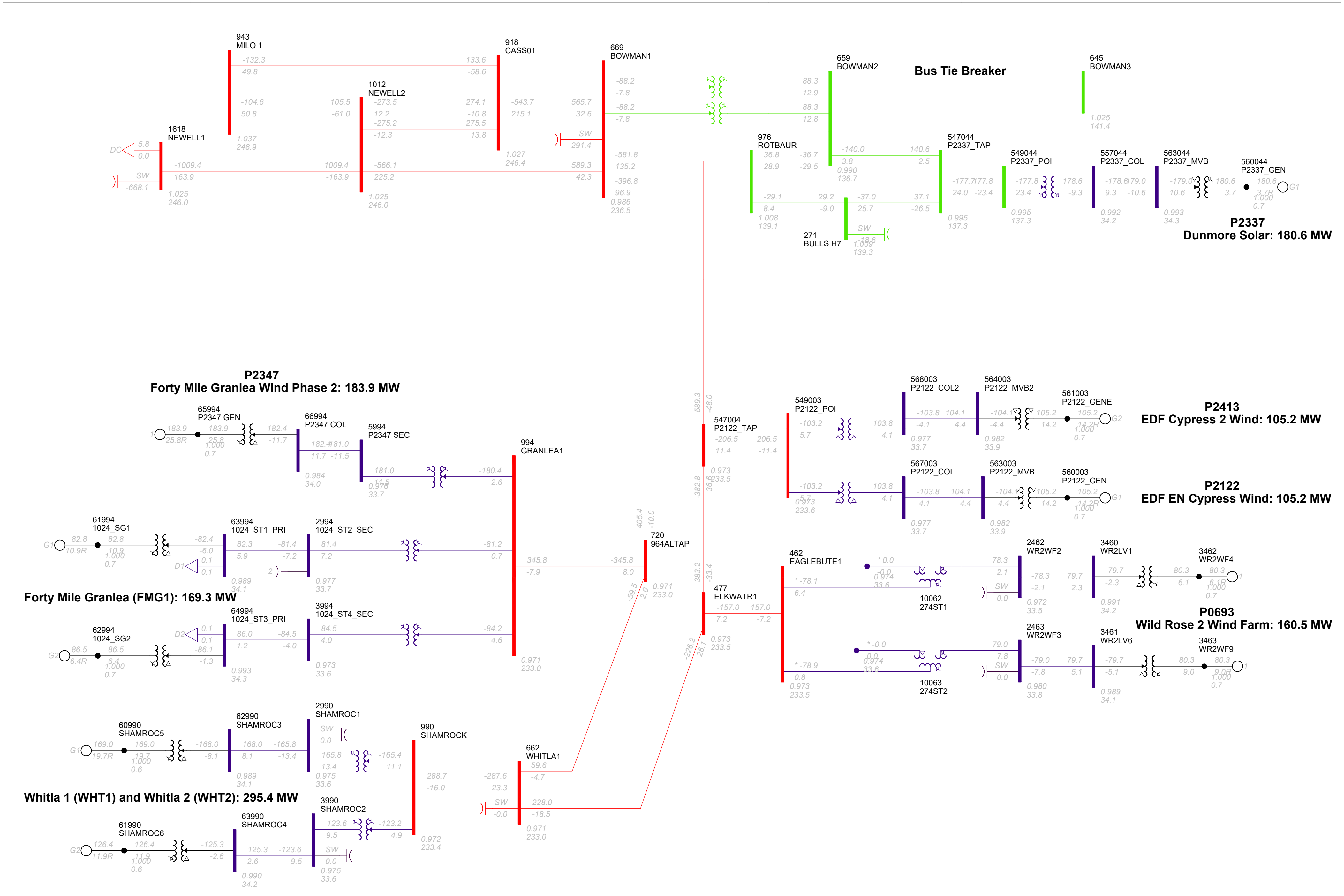
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Light Case

Total Generation Dispatched
in Study Area: 1100.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



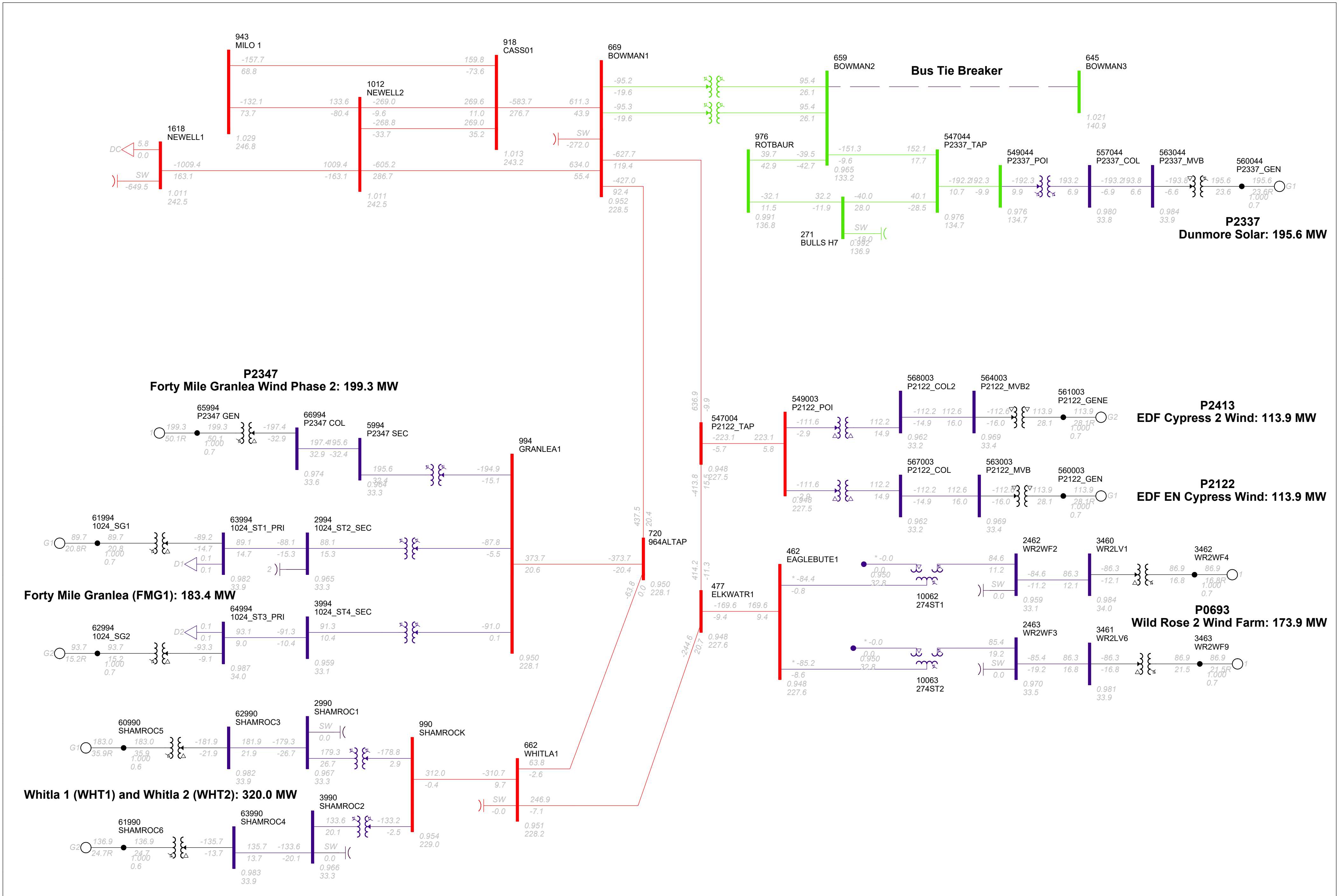
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Light Case

Total Generation Dispatched
in Study Area: 1200.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



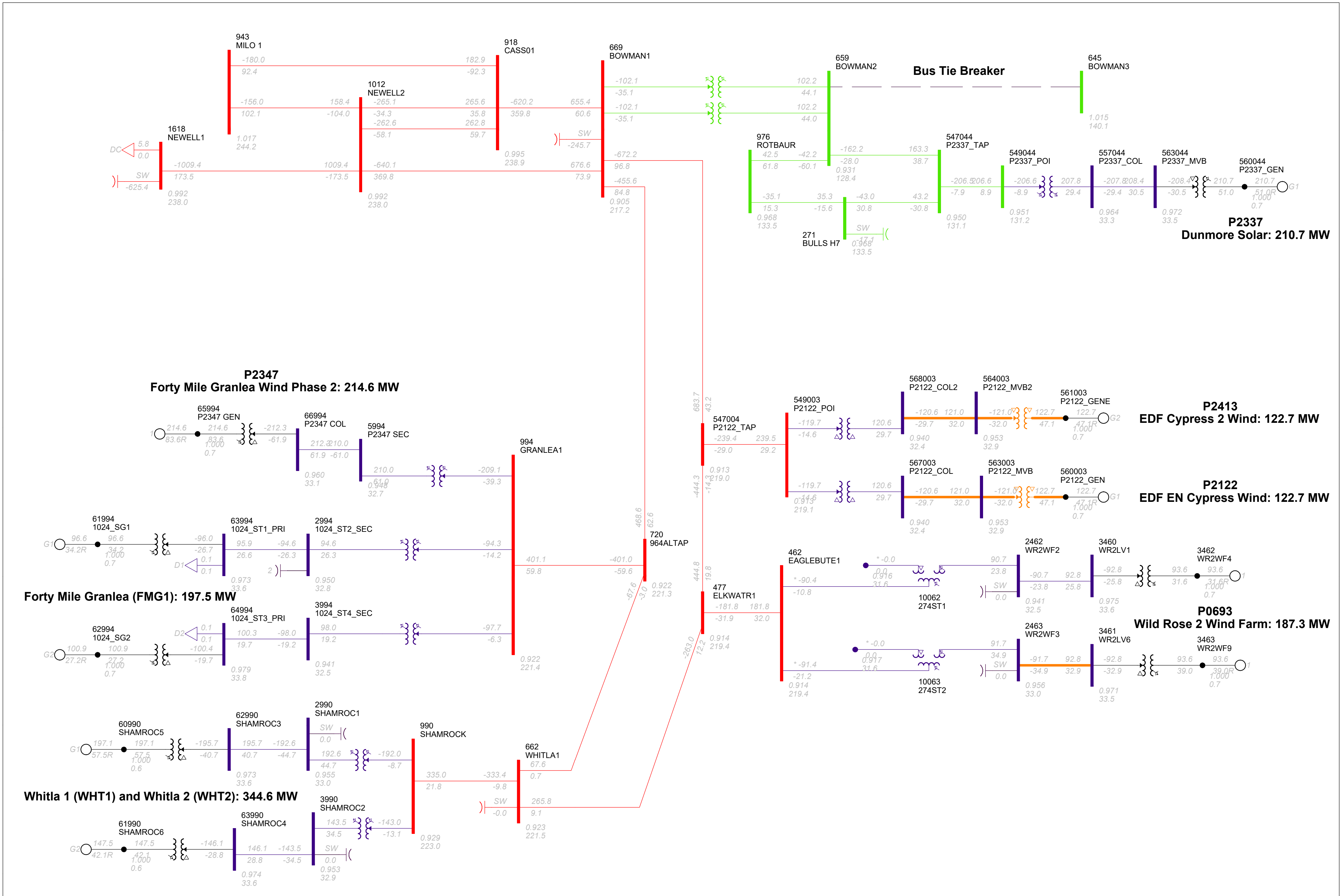
P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Light Case

Total Generation Dispatched
in Study Area: 1300.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000



P7083 Bowmanton 244S Substation Voltage Support Project

Bus - Voltage (kV/pu)
Branch - MW/Mvar
Equipment - MW/Mvar
100.0%Rate A

2023 Summer Light Case

Total Generation Dispatched
in Study Area: 1400.0 MW

kV: <=25.000 <=69.000 <=138.000 <=240.000 <=500.000 >500.000

Attachment D: Transient Stability Analysis Results

Table 1: Category B Contingencies and Fault Clearing Times

Contingency	Fault Location	Clearing Time (Cycles)	
		Near End	Far End
1034L (Bowmanton 244S to Cassils 324S)	Bowmanton 244S	5	6
	Cassils 324S	5	6
1035L (Bowmanton 244S to Newell 2075S)	Bowmanton 244S	5	6
	Newell 2075S	5	6
964L (Bowmanton 244S to Whitla 251S)	Bowmanton 244S	5	6
	Whitla 251S	5	6
983L (Whitla 251S to Elkwater 264S)	Whitla 251S	5	6
	Elkwater 264S	5	6
1074L (Bowmanton 244S to Elkwater 264S)	Bowmanton 244S	5	6
	Elkwater 264S	5	6

Table 2: Transient Stability Analysis Results Summary

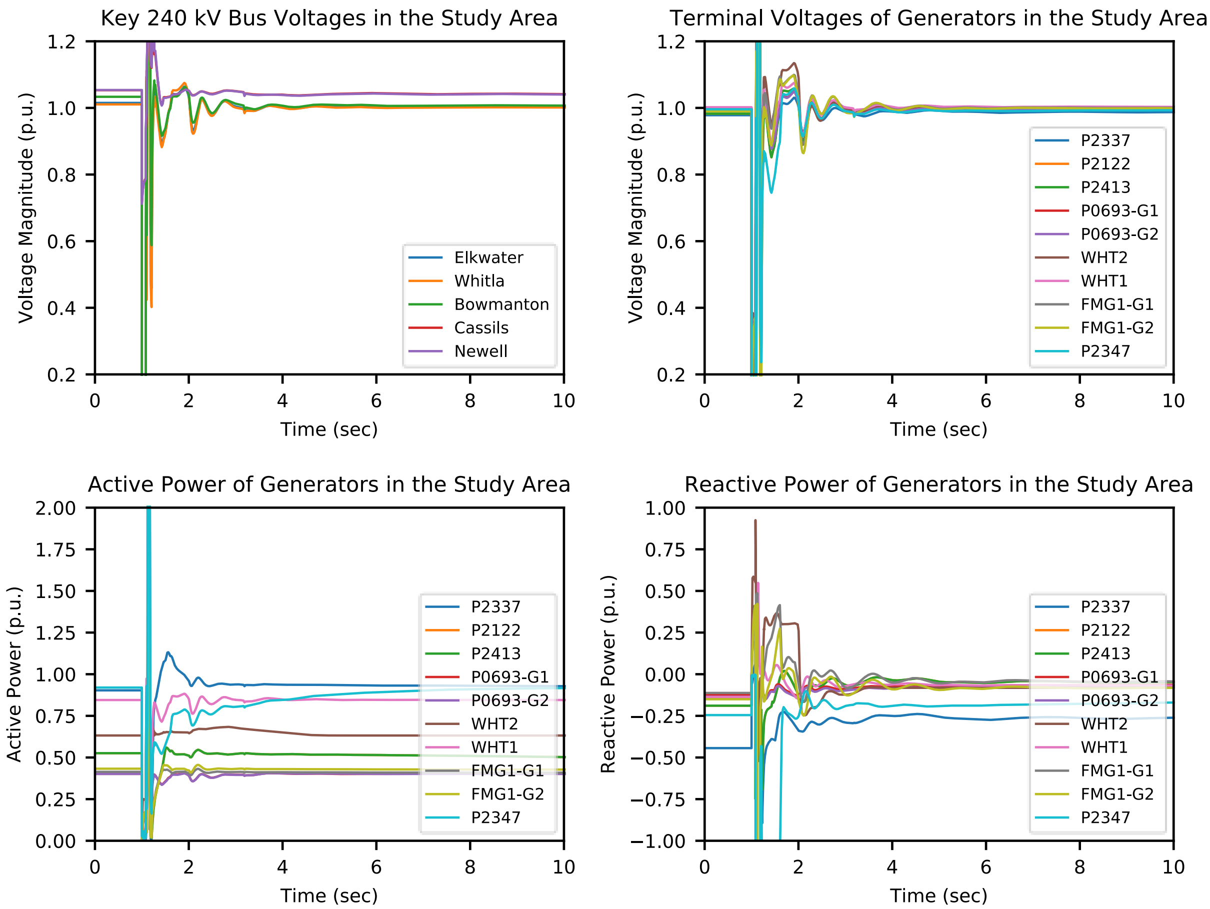
Study Case	Contingency	Fault Location	Fault Type	RAS to Disconnect Gen Needed	Transient Stability
- 2023 Summer Light - 600 MW Generation in the Study Area	1034L	Bowmanton 244S	3-ph to G	No	Stable
		Cassils 324S	3-ph to G	No	Stable
	1035L	Bowmanton 244S	3-ph to G	No	Stable
		Newell 2075S	3-ph to G	No	Stable
	964L	Bowmanton 244S	3-ph to G	No	Stable
		Whitla 251S	3-ph to G	No	Stable
	983L	Whitla 251S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
	1074L	Bowmanton 244S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
- 2023 Summer Light - 700 MW Generation in the Study Area	1034L	Bowmanton 244S	3-ph to G	No	Stable
		Cassils 324S	3-ph to G	No	Stable
	1035L	Bowmanton 244S	3-ph to G	No	Stable
		Newell 2075S	3-ph to G	No	Stable
	964L	Bowmanton 244S	3-ph to G	No	Stable
		Whitla 251S	3-ph to G	No	Stable
	983L	Whitla 251S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
	1074L	Bowmanton 244S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
- 2023 Summer Light - 800 MW Generation in the Study Area	1034L	Bowmanton 244S	3-ph to G	Yes	Stable
		Cassils 324S	3-ph to G	Yes	Stable
	1035L	Bowmanton 244S	3-ph to G	Yes	Stable
		Newell 2075S	3-ph to G	Yes	Stable
	964L	Bowmanton 244S	3-ph to G	No	Stable
		Whitla 251S	3-ph to G	No	Stable
	983L	Whitla 251S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
	1074L	Bowmanton 244S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
- 2023 Summer Light	1034L	Bowmanton 244S	3-ph to G	Yes	Stable
		Cassils 324S	3-ph to G	Yes	Stable

Study Case	Contingency	Fault Location	Fault Type	RAS to Disconnect Gen Needed	Transient Stability
- 900 MW Generation in the Study Area	1035L	Bowmanton 244S	3-ph to G	Yes	Stable
		Newell 2075S	3-ph to G	Yes	Stable
	964L	Bowmanton 244S	3-ph to G	No	Stable
		Whitla 251S	3-ph to G	No	Stable
	983L	Whitla 251S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
	1074L	Bowmanton 244S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
- 2023 Summer Light - 1000 MW Generation in the Study Area	1034L	Bowmanton 244S	3-ph to G	Yes	Stable
		Cassils 324S	3-ph to G	Yes	Stable
	1035L	Bowmanton 244S	3-ph to G	Yes	Stable
		Newell 2075S	3-ph to G	Yes	Stable
	964L	Bowmanton 244S	3-ph to G	No	Stable
		Whitla 251S	3-ph to G	No	Stable
	983L	Whitla 251S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
	1074L	Bowmanton 244S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
- 2023 Summer Light - 1100 MW Generation in the Study Area	1034L	Bowmanton 244S	3-ph to G	Yes	Stable
		Cassils 324S	3-ph to G	Yes	Stable
	1035L	Bowmanton 244S	3-ph to G	Yes	Stable
		Newell 2075S	3-ph to G	Yes	Stable
	964L	Bowmanton 244S	3-ph to G	No	Stable
		Whitla 251S	3-ph to G	No	Stable
	983L	Whitla 251S	3-ph to G	Yes	Stable
		Elkwater 264S	3-ph to G	Yes	Stable
	1074L	Bowmanton 244S	3-ph to G	Yes	Stable
		Elkwater 264S	3-ph to G	Yes	Stable
- 2023 Summer Light - 1180 MW Generation in the Study Area	1034L	Bowmanton 244S	3-ph to G	Yes	Stable
		Cassils 324S	3-ph to G	Yes	Stable
	1035L	Bowmanton 244S	3-ph to G	Yes	Stable
		Newell 2075S	3-ph to G	Yes	Stable
	964L	Bowmanton 244S	3-ph to G	No	Stable
		Whitla 251S	3-ph to G	No	Stable
	983L	Whitla 251S	3-ph to G	Yes	Stable
		Elkwater 264S	3-ph to G	Yes	Stable
	1074L	Bowmanton 244S	3-ph to G	Yes	Stable
		Elkwater 264S	3-ph to G	Yes	Stable
- 2023 Summer Peak - 600 MW Generation in the Study Area	1034L	Bowmanton 244S	3-ph to G	No	Stable
		Cassils 324S	3-ph to G	No	Stable
	1035L	Bowmanton 244S	3-ph to G	No	Stable
		Newell 2075S	3-ph to G	No	Stable
	964L	Bowmanton 244S	3-ph to G	No	Stable
		Whitla 251S	3-ph to G	No	Stable
	983L	Whitla 251S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
	1074L	Bowmanton 244S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
- 2023 Summer Peak - 700 MW Generation in the Study Area	1034L	Bowmanton 244S	3-ph to G	No	Stable
		Cassils 324S	3-ph to G	No	Stable
	1035L	Bowmanton 244S	3-ph to G	No	Stable
		Newell 2075S	3-ph to G	No	Stable

Study Case	Contingency	Fault Location	Fault Type	RAS to Disconnect Gen Needed	Transient Stability
	964L	Bowmanton 244S	3-ph to G	No	Stable
		Whitla 251S	3-ph to G	No	Stable
	983L	Whitla 251S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
	1074L	Bowmanton 244S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
- 2023 Summer Peak - 800 MW Generation in the Study Area	1034L	Bowmanton 244S	3-ph to G	Yes	Stable
		Cassils 324S	3-ph to G	Yes	Stable
	1035L	Bowmanton 244S	3-ph to G	Yes	Stable
		Newell 2075S	3-ph to G	Yes	Stable
	964L	Bowmanton 244S	3-ph to G	No	Stable
		Whitla 251S	3-ph to G	No	Stable
	983L	Whitla 251S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
	1074L	Bowmanton 244S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
- 2023 Summer Peak - 900 MW Generation in the Study Area	1034L	Bowmanton 244S	3-ph to G	Yes	Stable
		Cassils 324S	3-ph to G	Yes	Stable
	1035L	Bowmanton 244S	3-ph to G	Yes	Stable
		Newell 2075S	3-ph to G	Yes	Stable
	964L	Bowmanton 244S	3-ph to G	No	Stable
		Whitla 251S	3-ph to G	No	Stable
	983L	Whitla 251S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
	1074L	Bowmanton 244S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
- 2023 Summer Peak - 1000 MW Generation in the Study Area	1034L	Bowmanton 244S	3-ph to G	Yes	Stable
		Cassils 324S	3-ph to G	Yes	Stable
	1035L	Bowmanton 244S	3-ph to G	Yes	Stable
		Newell 2075S	3-ph to G	Yes	Stable
	964L	Bowmanton 244S	3-ph to G	No	Stable
		Whitla 251S	3-ph to G	No	Stable
	983L	Whitla 251S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
	1074L	Bowmanton 244S	3-ph to G	No	Stable
		Elkwater 264S	3-ph to G	No	Stable
- 2023 Summer Peak - 1100 MW Generation in the Study Area	1034L	Bowmanton 244S	3-ph to G	Yes	Stable
		Cassils 324S	3-ph to G	Yes	Stable
	1035L	Bowmanton 244S	3-ph to G	Yes	Stable
		Newell 2075S	3-ph to G	Yes	Stable
	964L	Bowmanton 244S	3-ph to G	No	Stable
		Whitla 251S	3-ph to G	No	Stable
	983L	Whitla 251S	3-ph to G	Yes	Stable
		Elkwater 264S	3-ph to G	Yes	Stable
	1074L	Bowmanton 244S	3-ph to G	Yes	Stable
		Elkwater 264S	3-ph to G	Yes	Stable
- 2023 Summer Peak - 1180 MW Generation in the Study Area	1034L	Bowmanton 244S	3-ph to G	Yes	Stable
		Cassils 324S	3-ph to G	Yes	Stable
	1035L	Bowmanton 244S	3-ph to G	Yes	Stable
		Newell 2075S	3-ph to G	Yes	Stable
	964L	Bowmanton 244S	3-ph to G	No	Stable
		Whitla 251S	3-ph to G	No	Stable

Study Case	Contingency	Fault Location	Fault Type	RAS to Disconnect Gen Needed	Transient Stability
	983L	Whitla 251S	3-ph to G	Yes	Stable
		Elkwater 264S	3-ph to G	Yes	Stable
	1074L	Bowmanton 244S	3-ph to G	Yes	Stable
		Elkwater 264S	3-ph to G	Yes	Stable

Figure 1



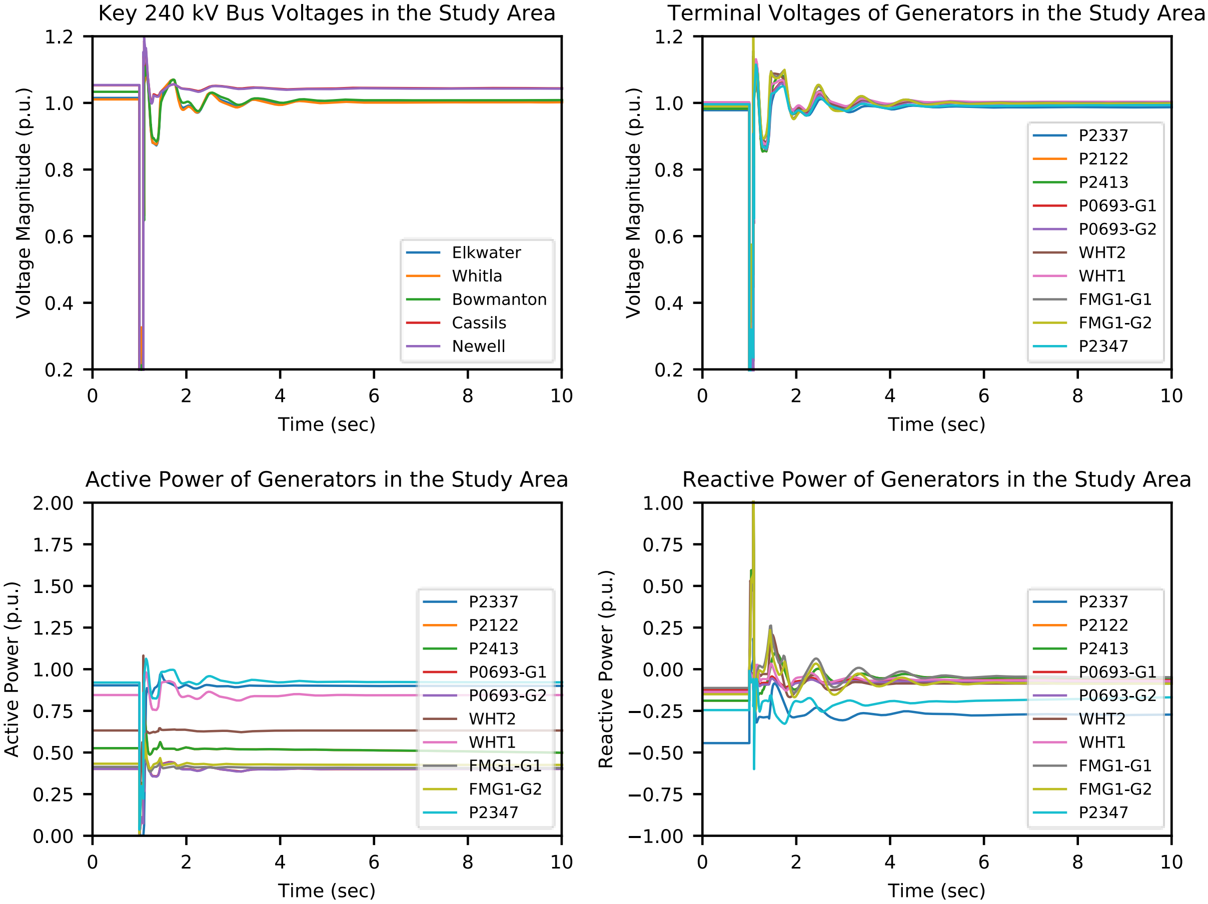
Case Description:

- Post-development 2023 summer light case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 2



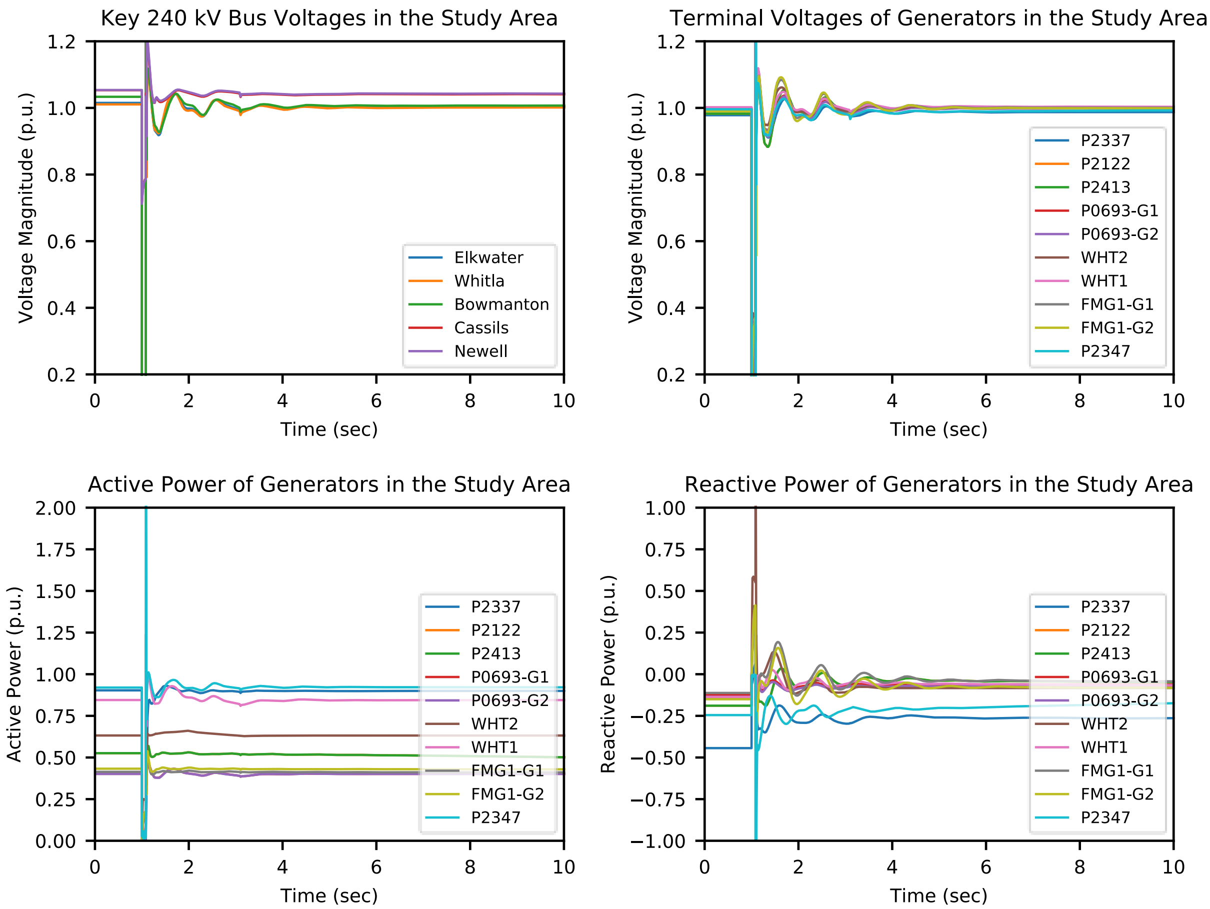
Case Description:

- Post-development 2023 summer light case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Cassils 324S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 3



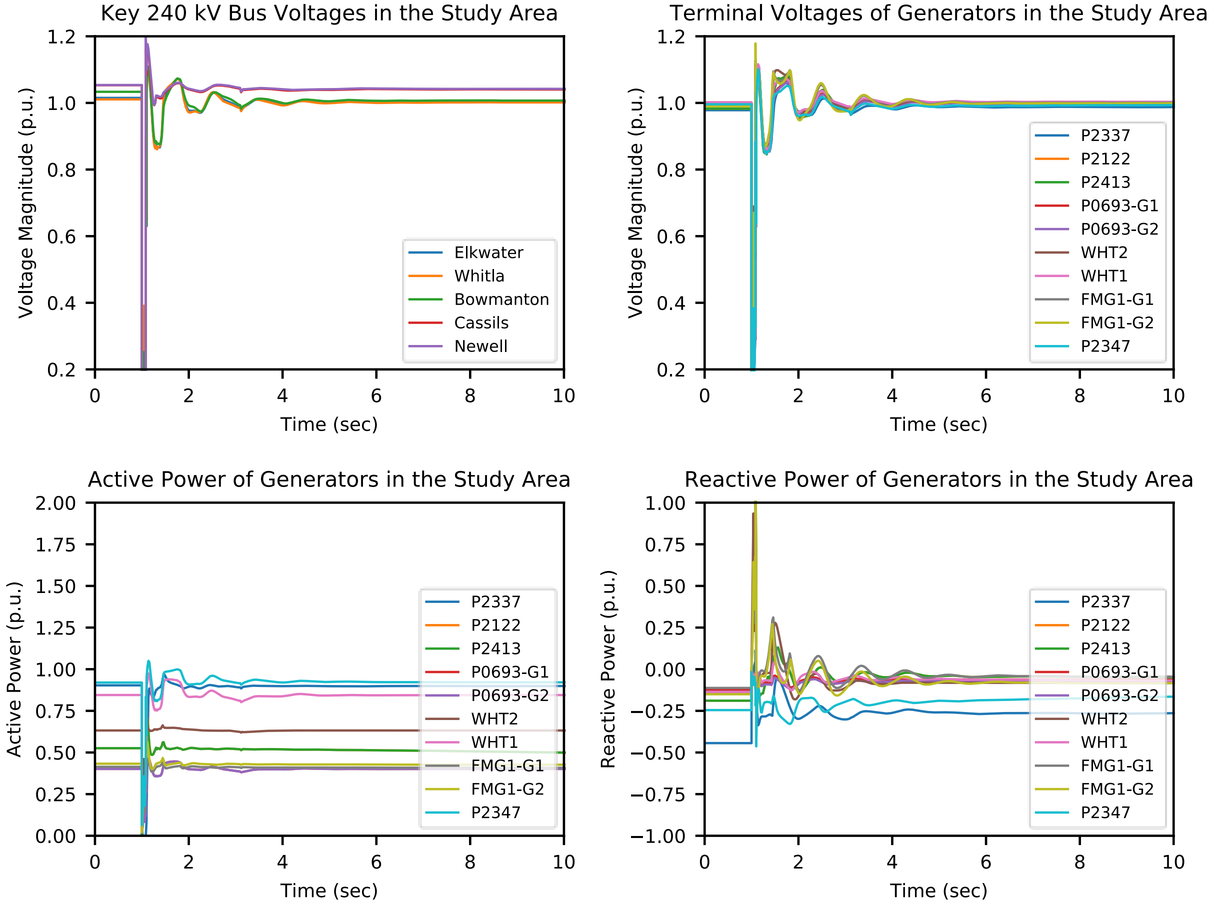
Case Description:

- Post-development 2023 summer light case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 4



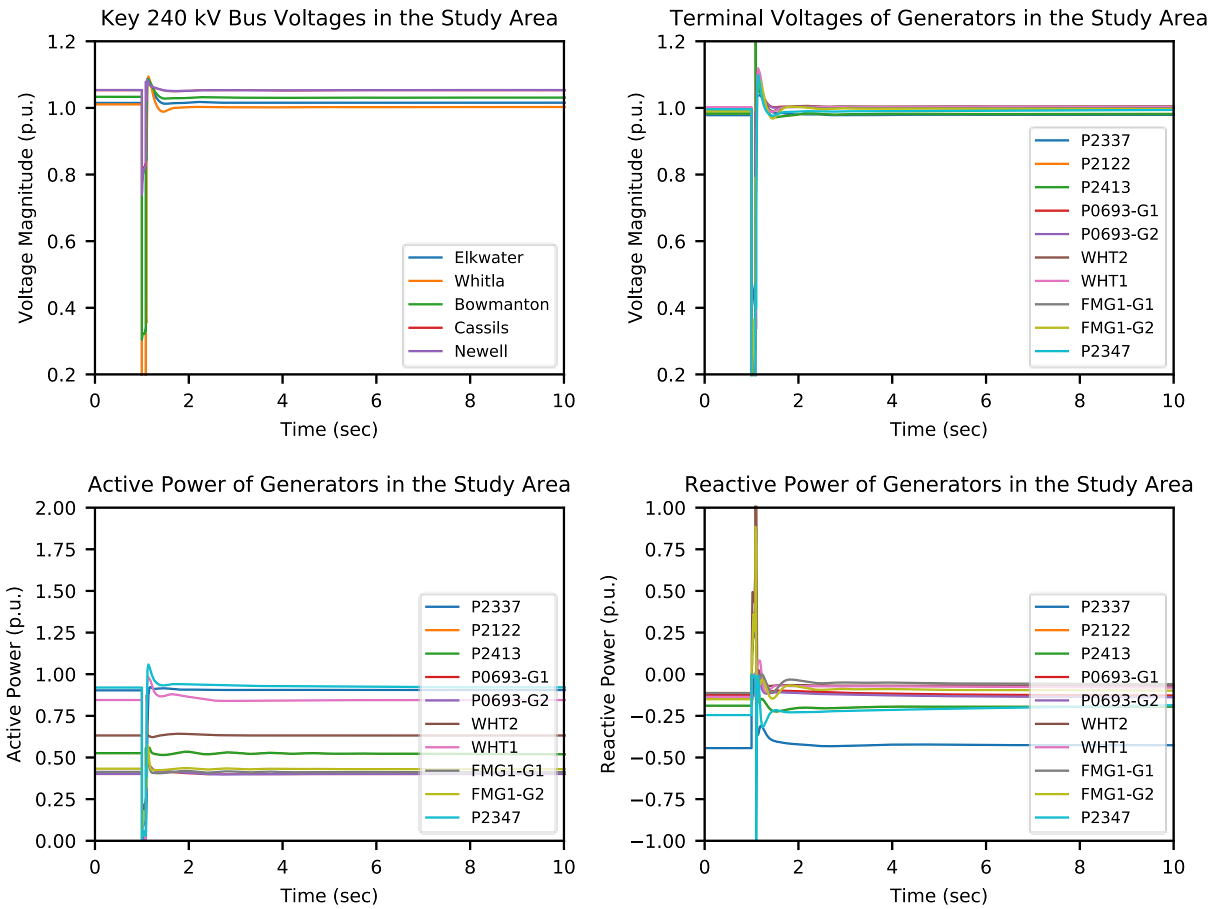
Case Description:

- Post-development 2023 summer light case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Newell 2075S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 5



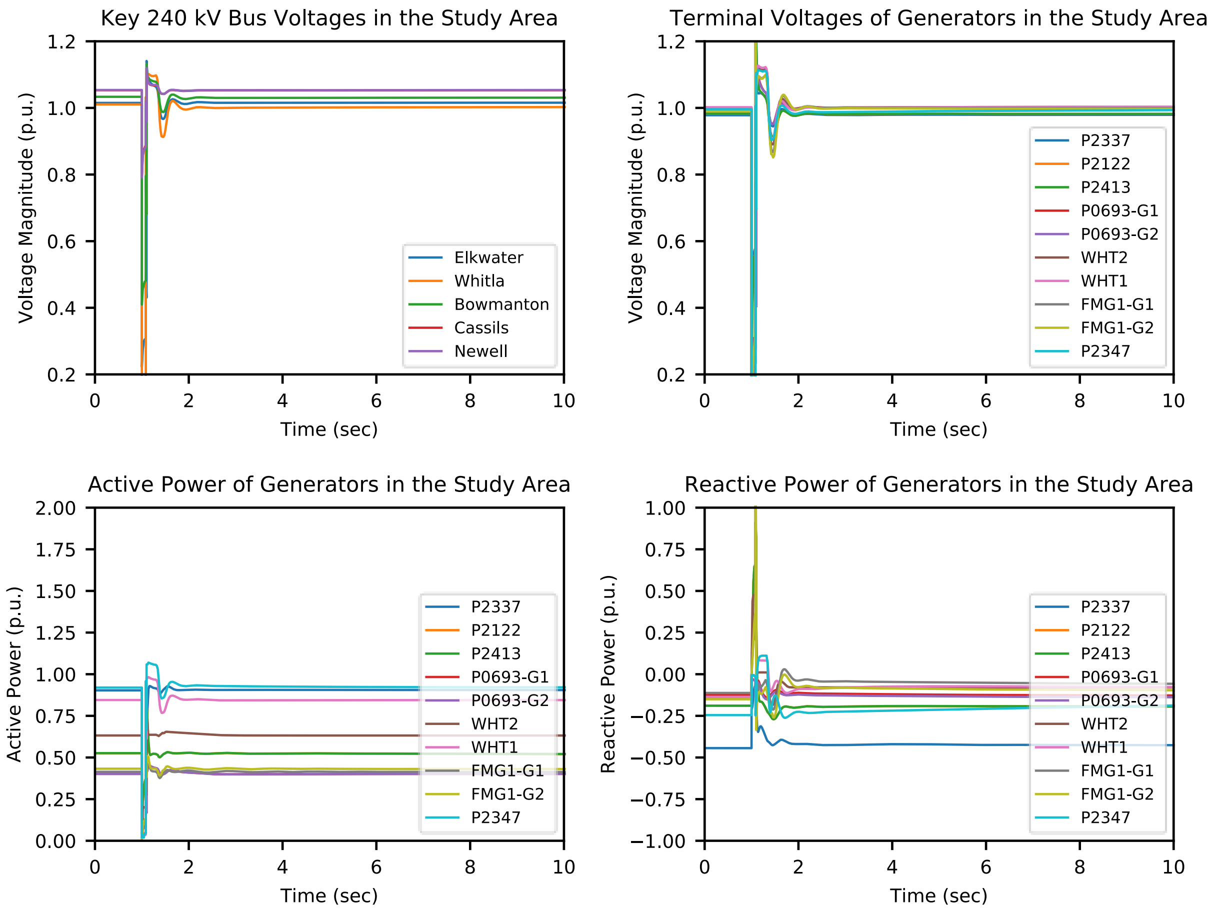
Case Description:

- Post-development 2023 summer light case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 6



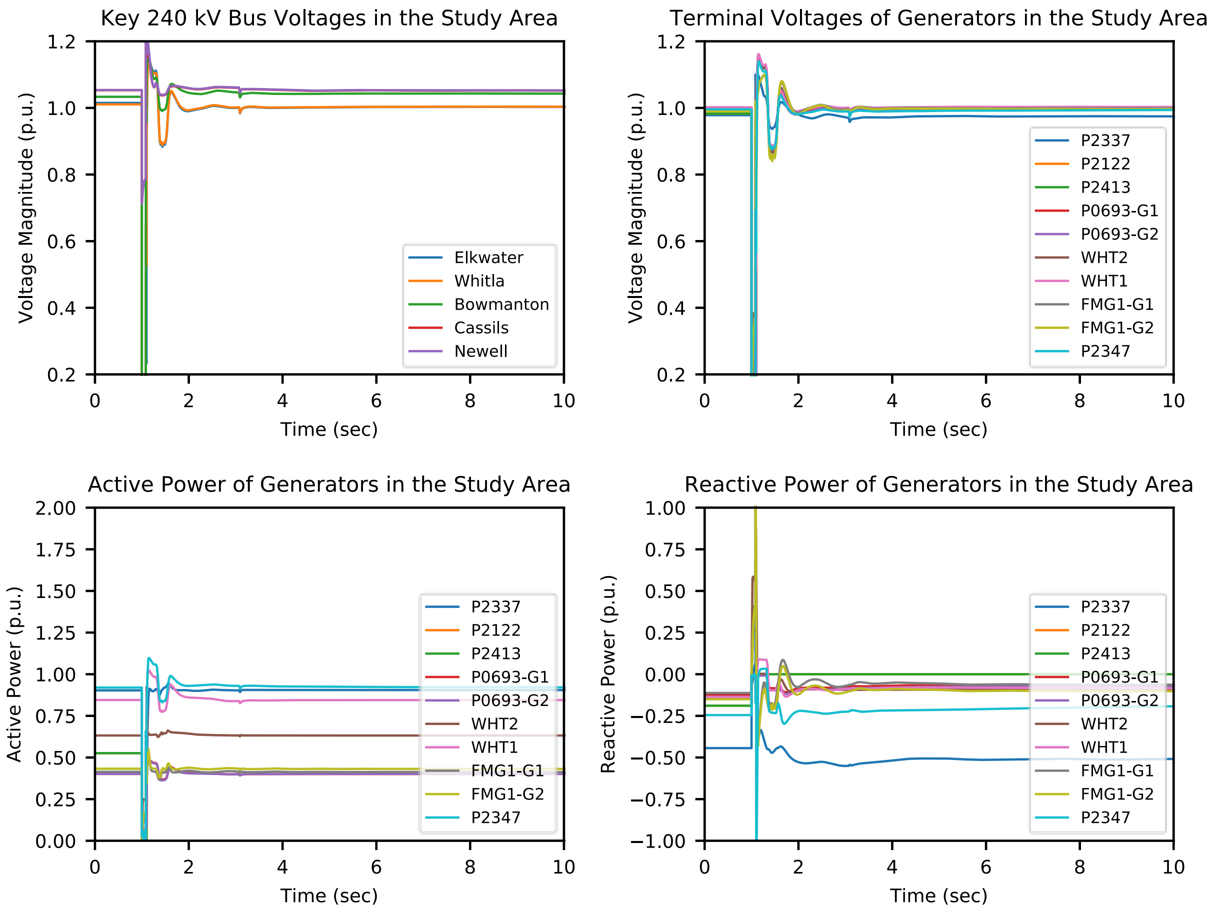
Case Description:

- Post-development 2023 summer light case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 7



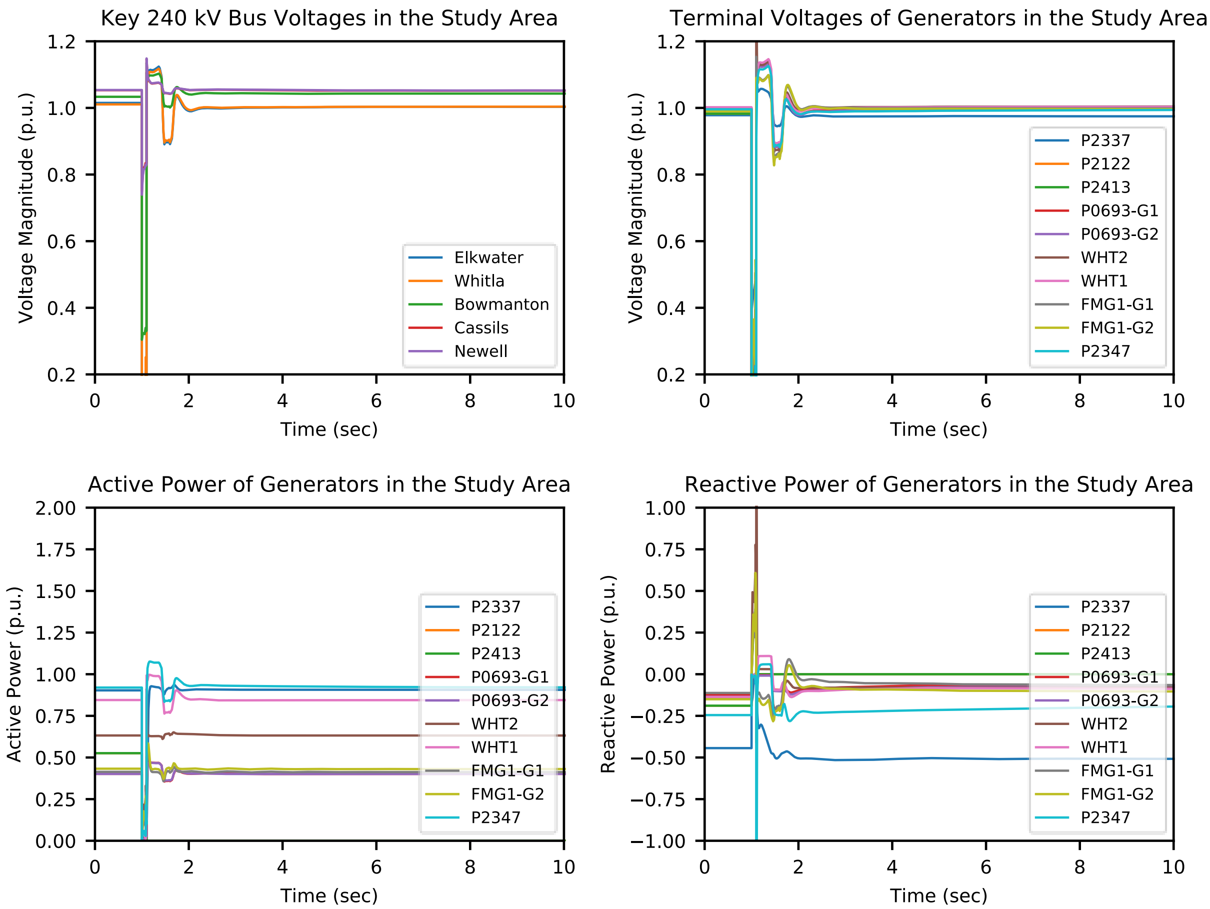
Case Description:

- Post-development 2023 summer light case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 8



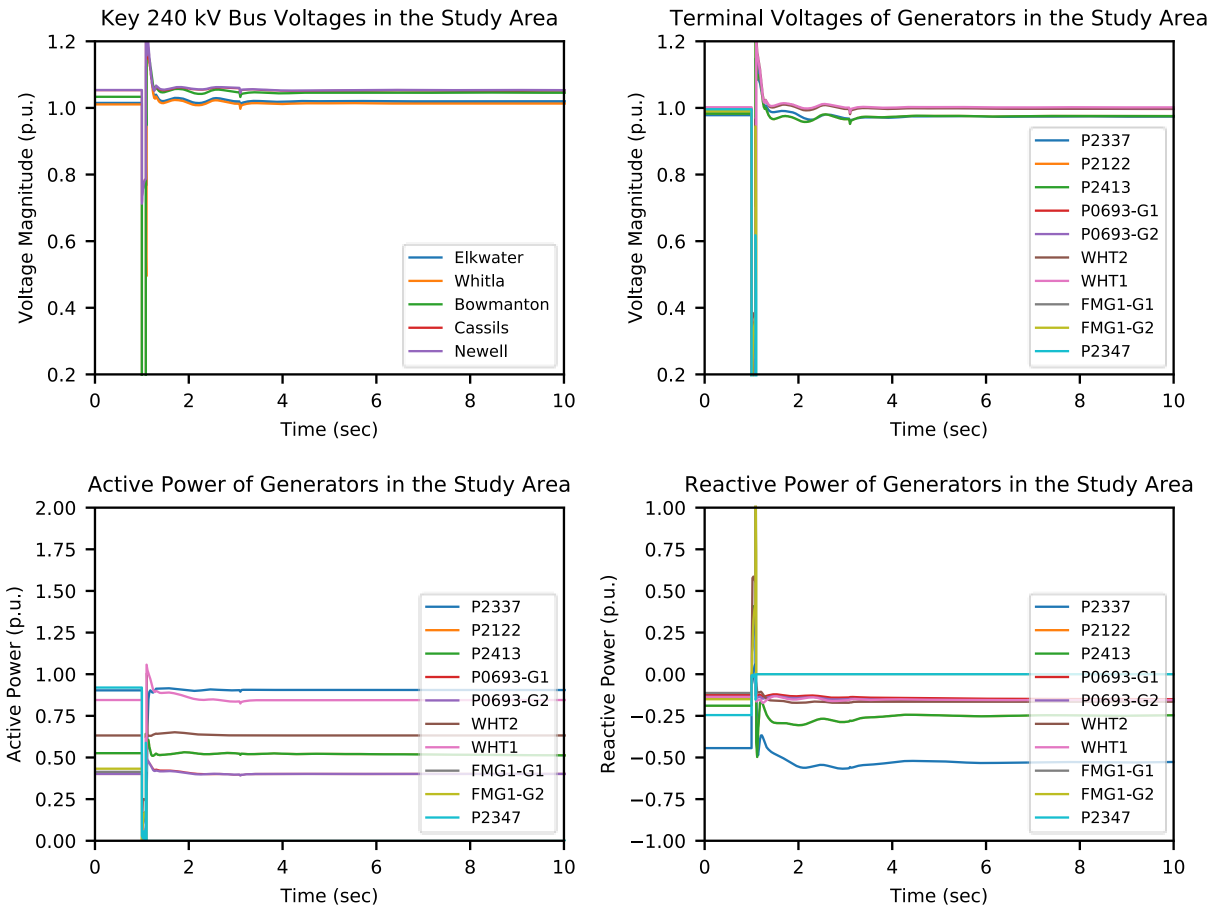
Case Description:

- Post-development 2023 summer light case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 9



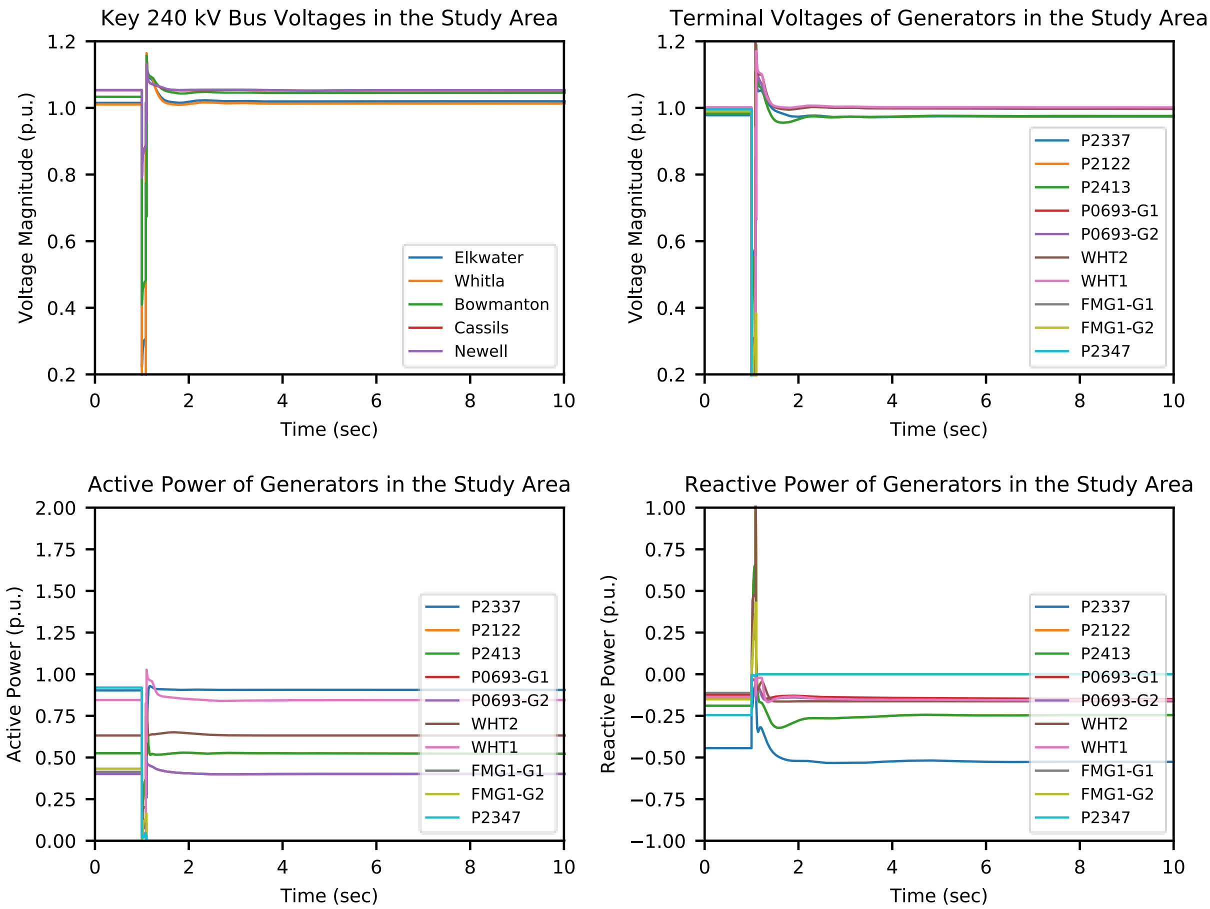
Case Description:

- Post-development 2023 summer light case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 10



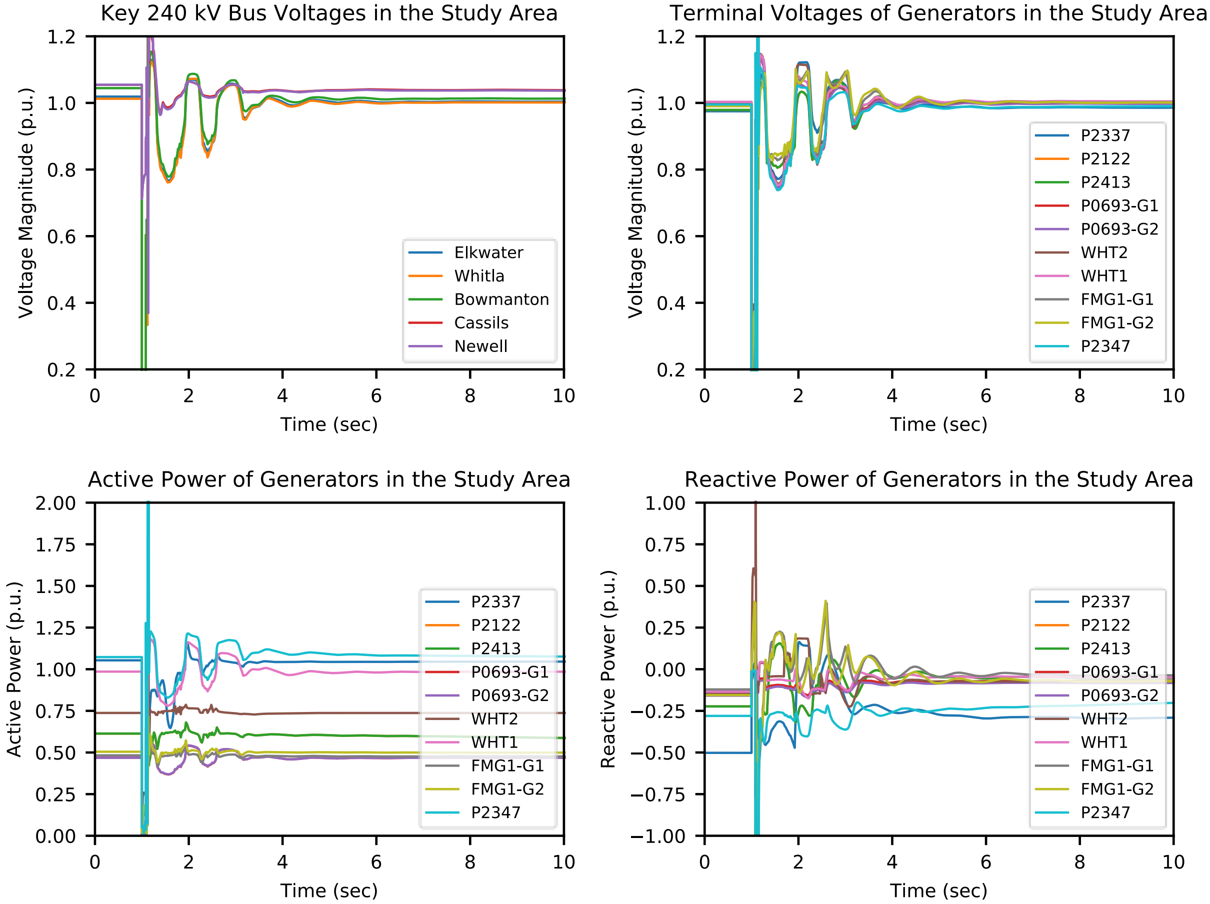
Case Description:

- Post-development 2023 summer light case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 11



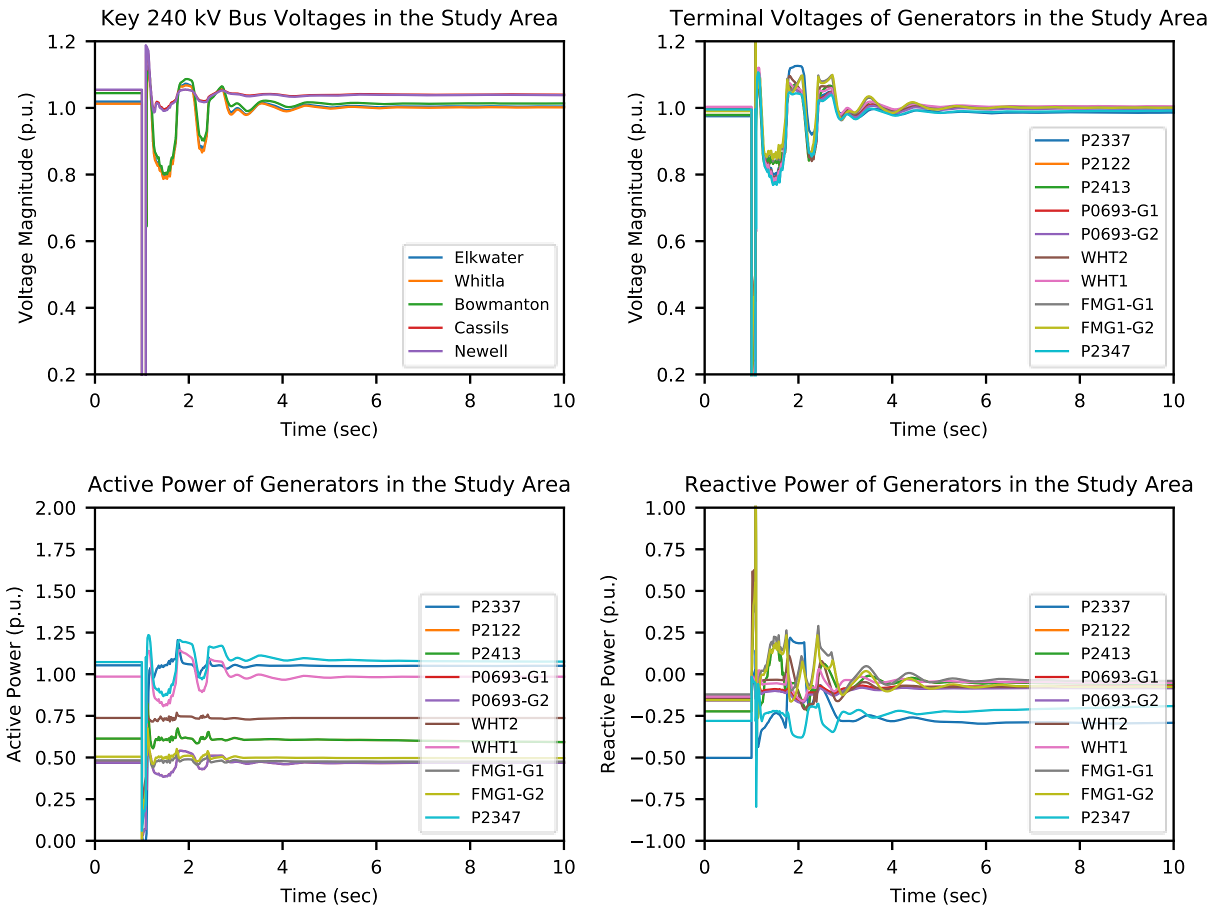
Case Description:

- Post-development 2023 summer light case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 12



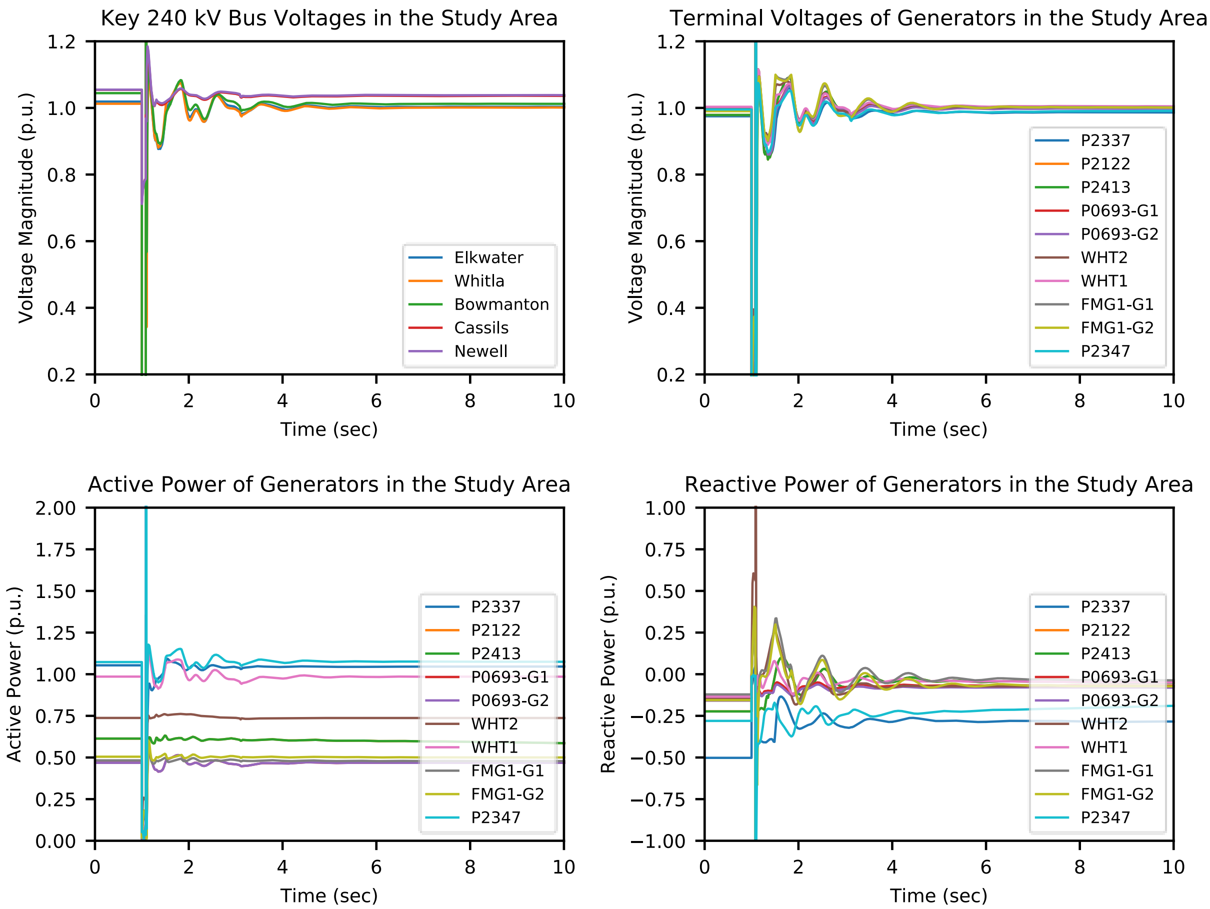
Case Description:

- Post-development 2023 summer light case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Cassils 324S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 13



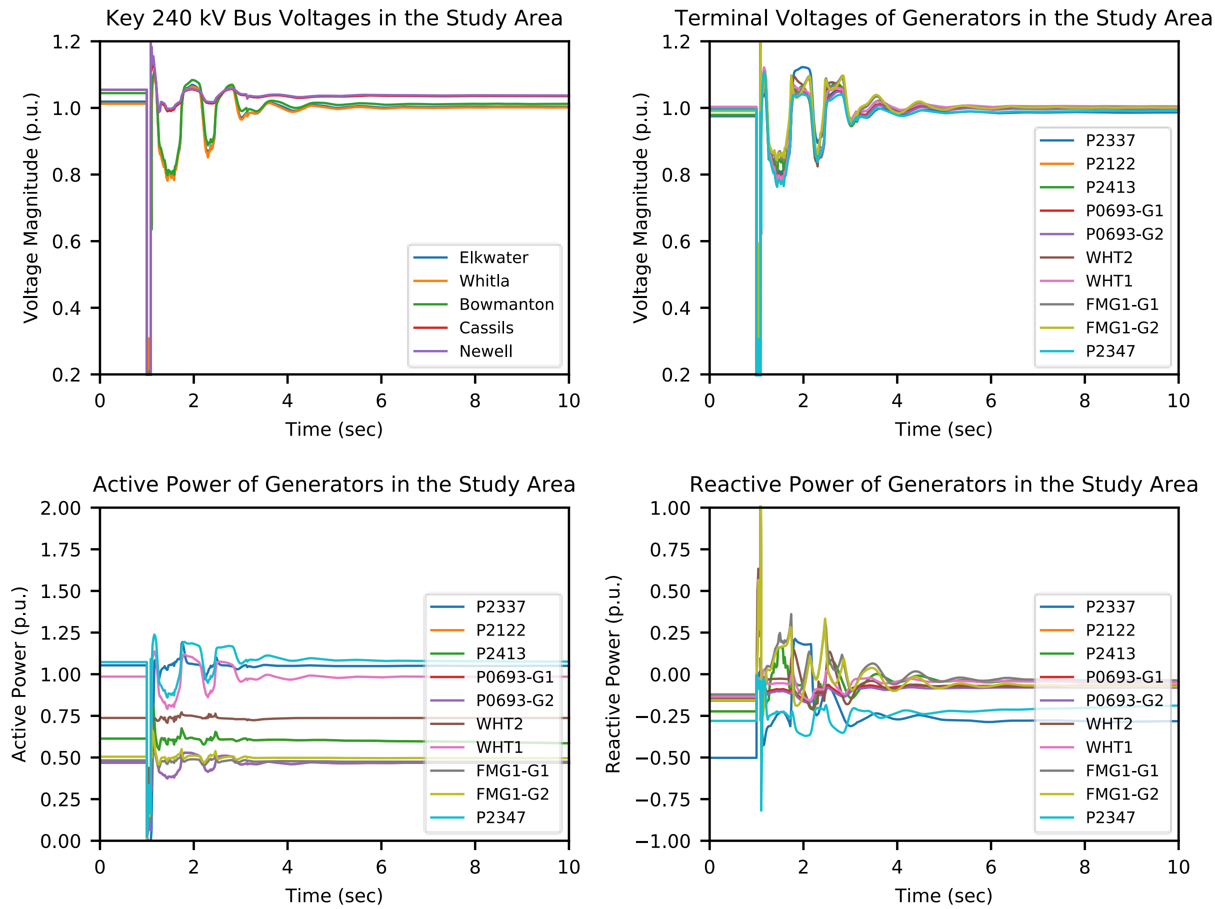
Case Description:

- Post-development 2023 summer light case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 14



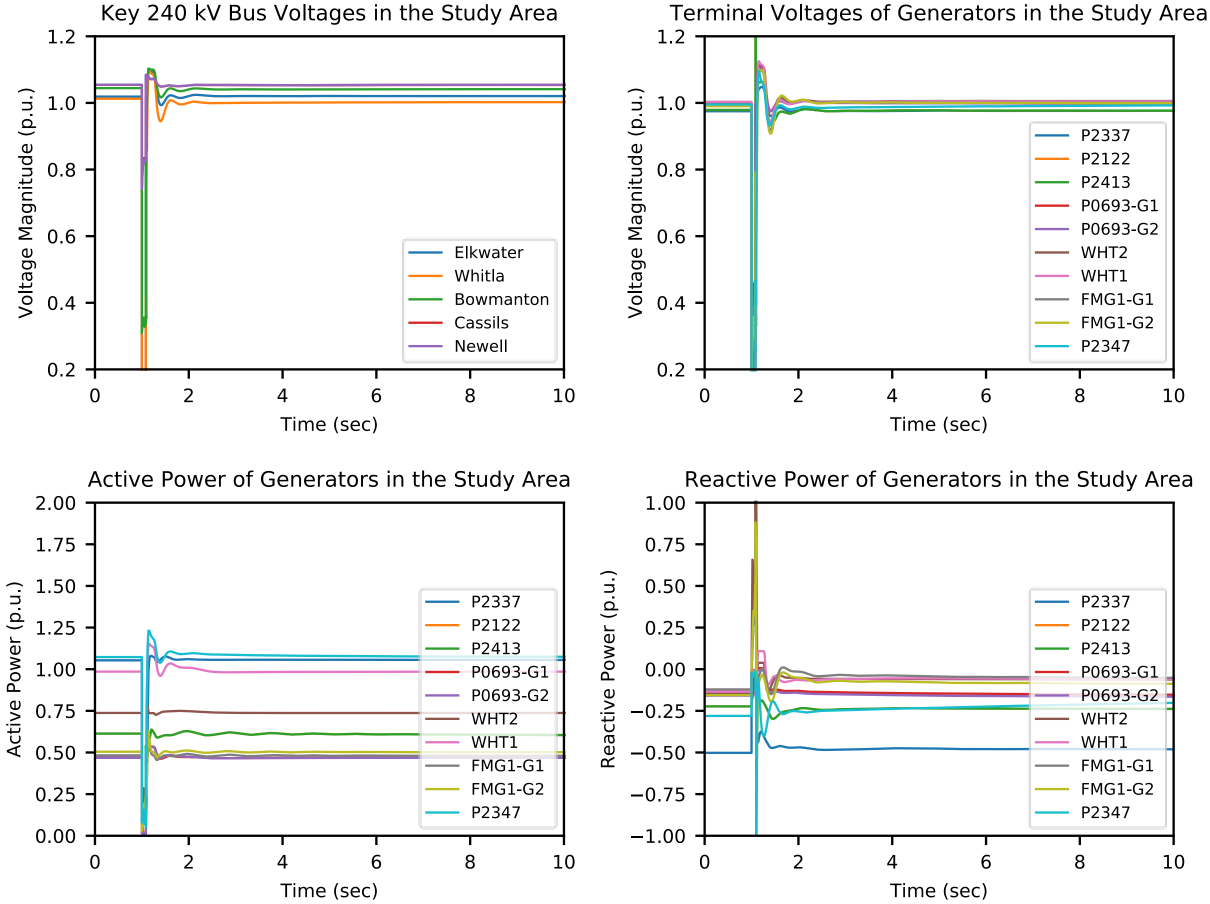
Case Description:

- Post-development 2023 summer light case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Newell 2075S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 15



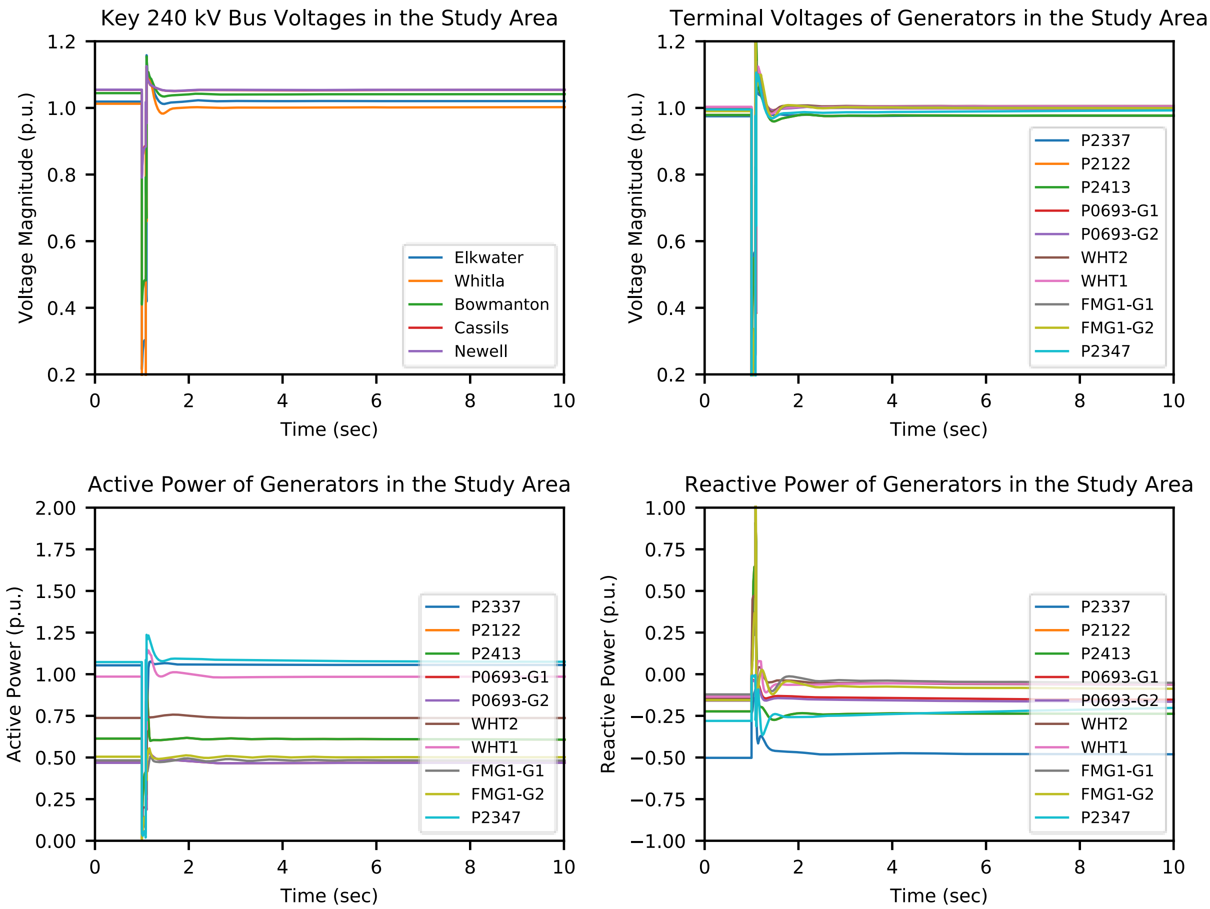
Case Description:

- Post-development 2023 summer light case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 16



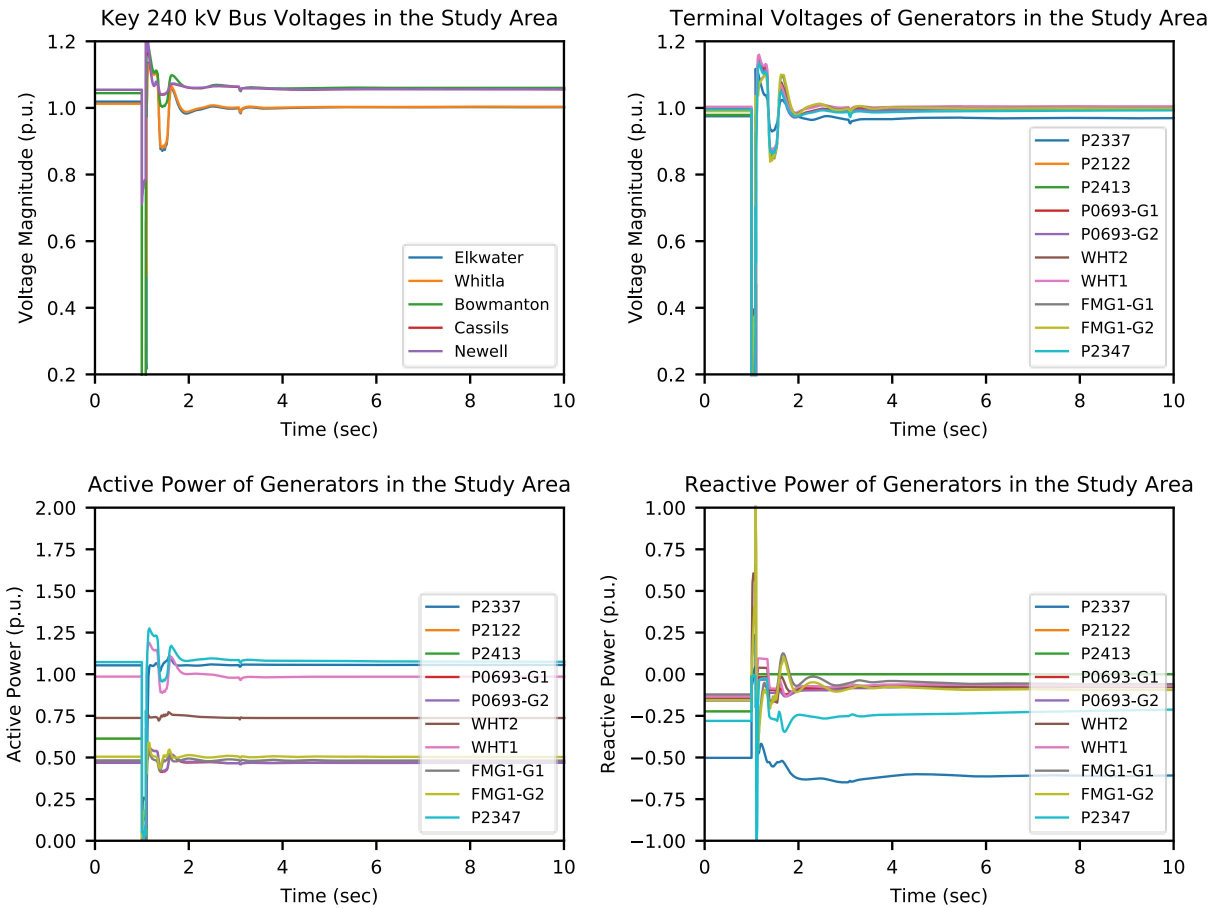
Case Description:

- Post-development 2023 summer light case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 17



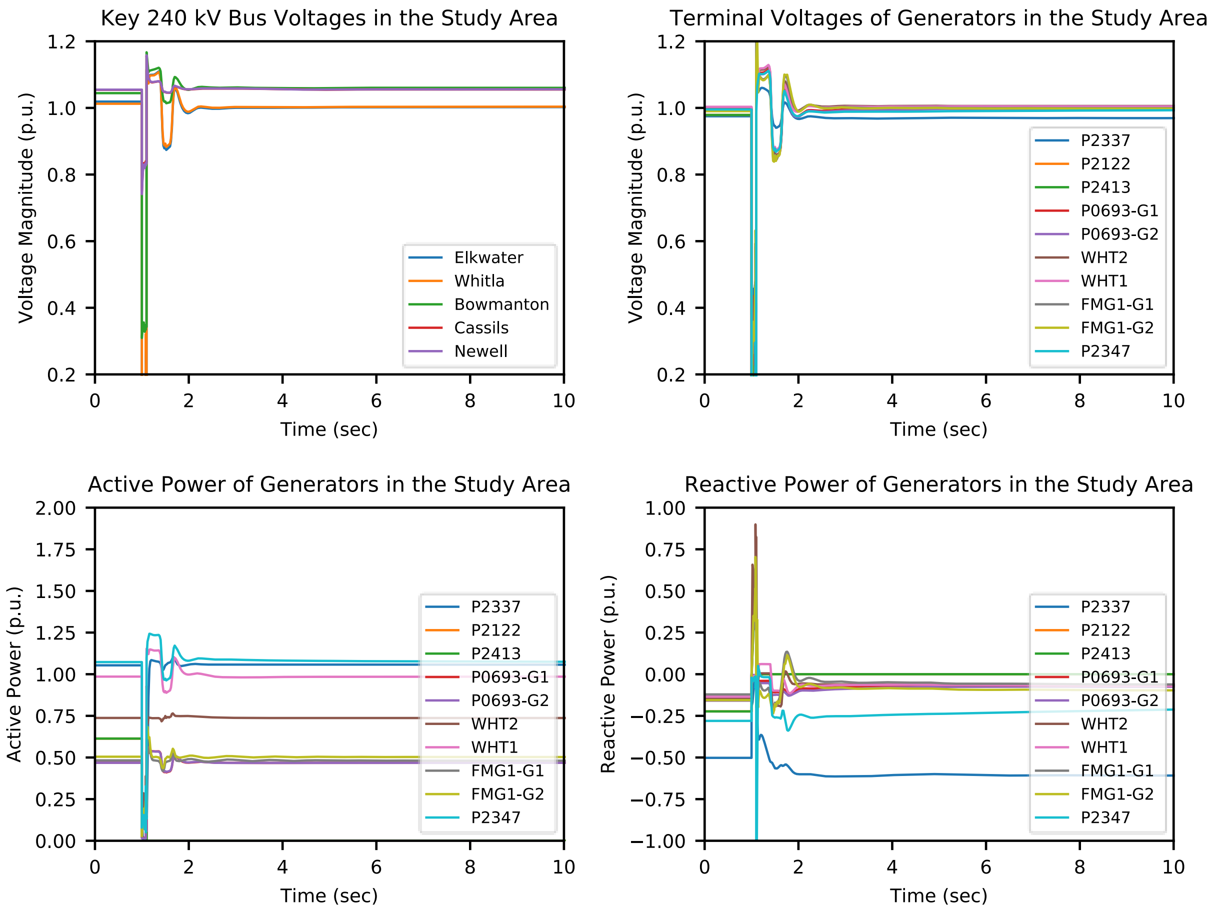
Case Description:

- Post-development 2023 summer light case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 18



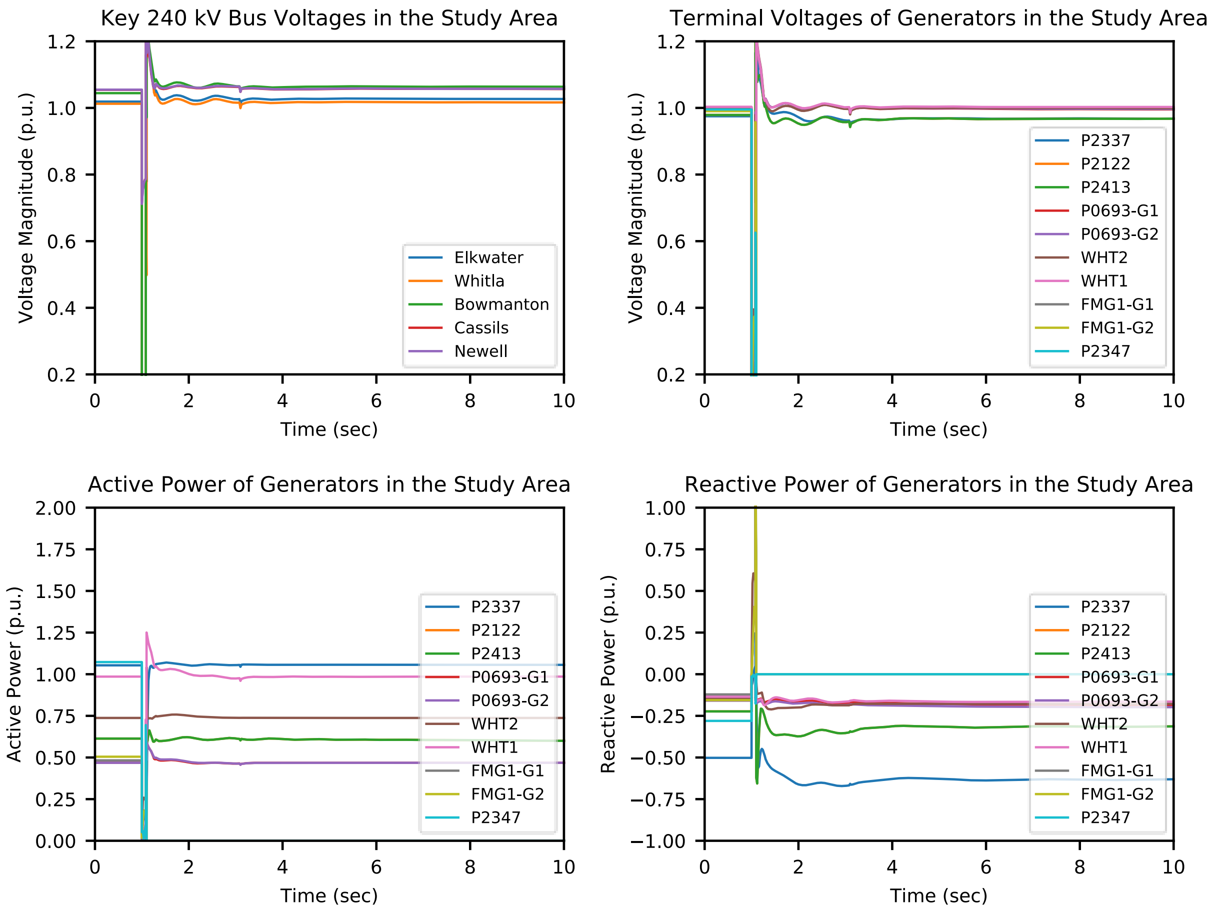
Case Description:

- Post-development 2023 summer light case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 19



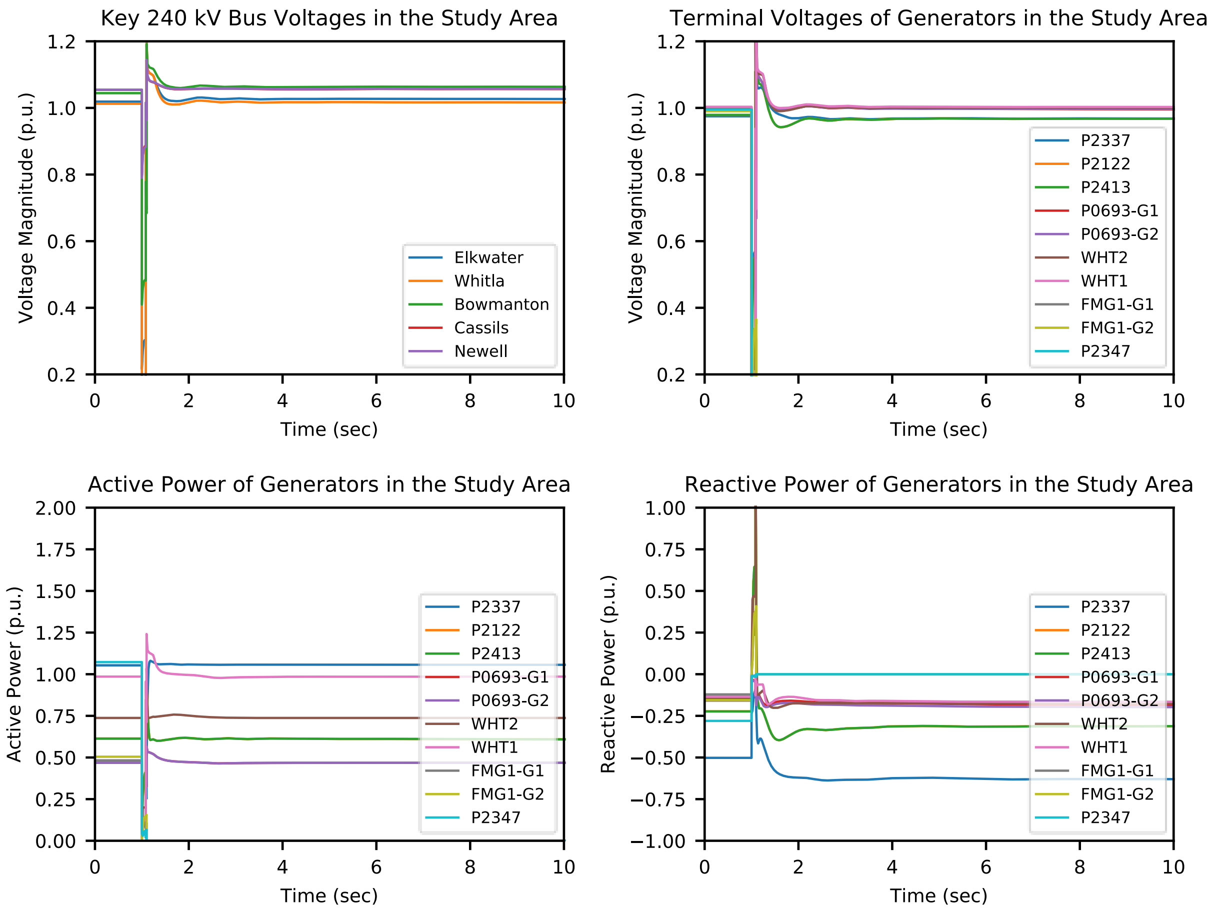
Case Description:

- Post-development 2023 summer light case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 20



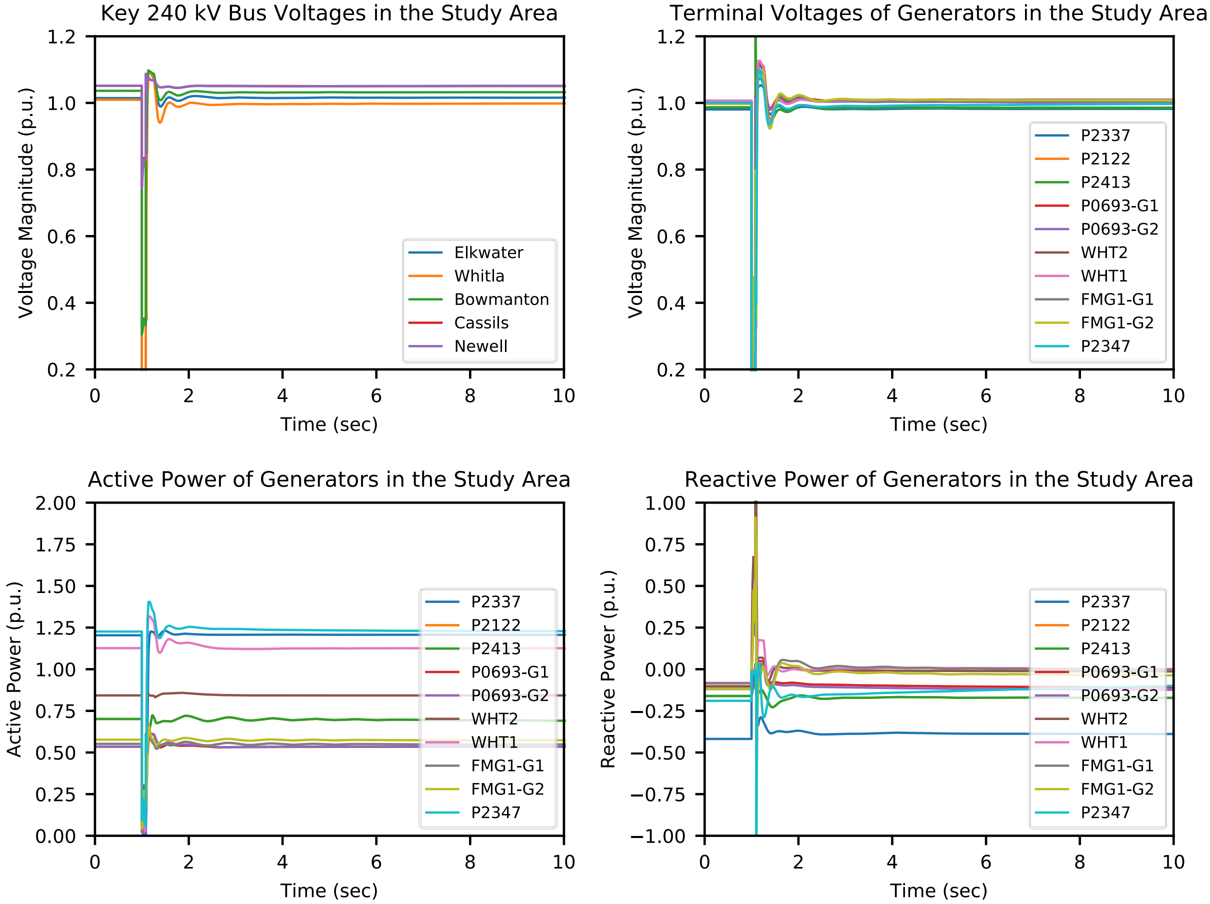
Case Description:

- Post-development 2023 summer light case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 21



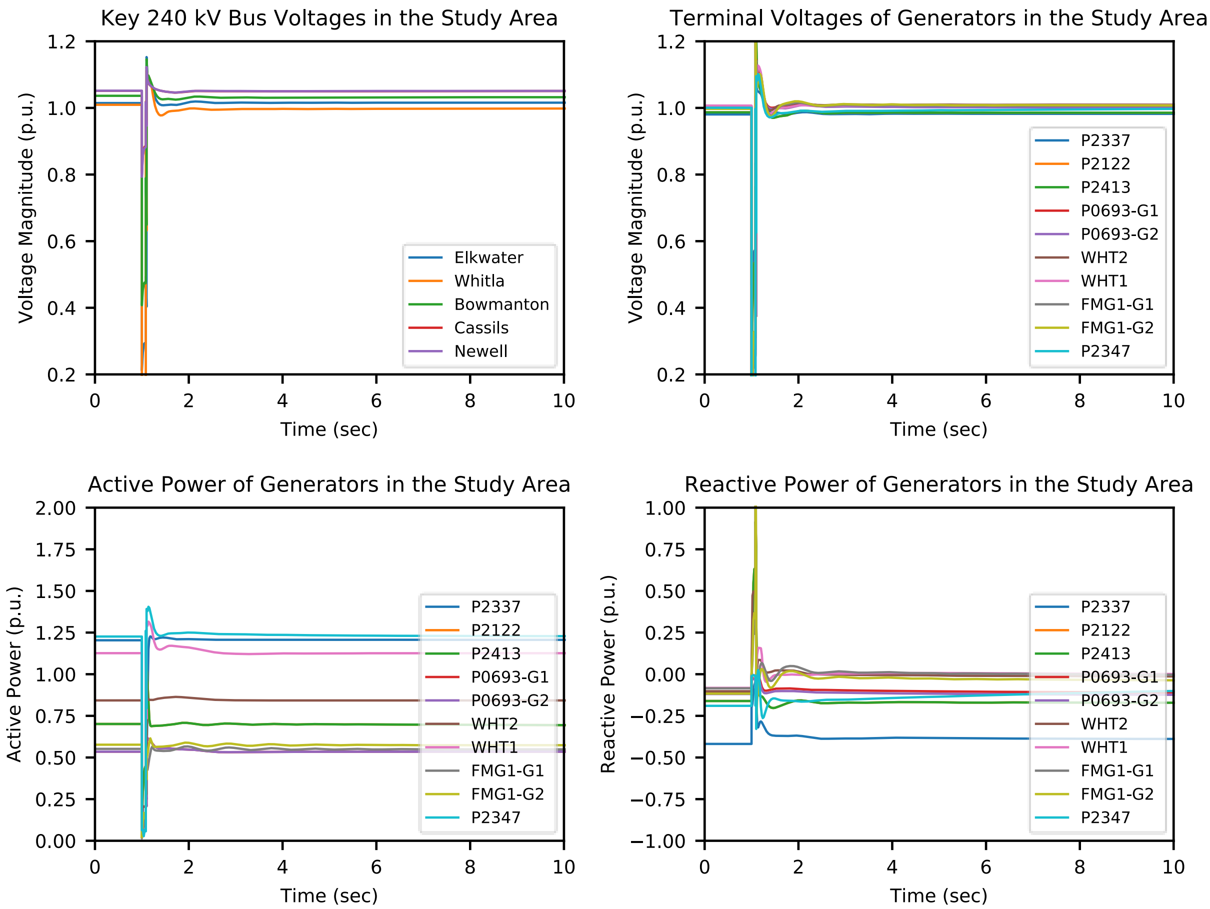
Case Description:

- Post-development 2023 summer light case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 22



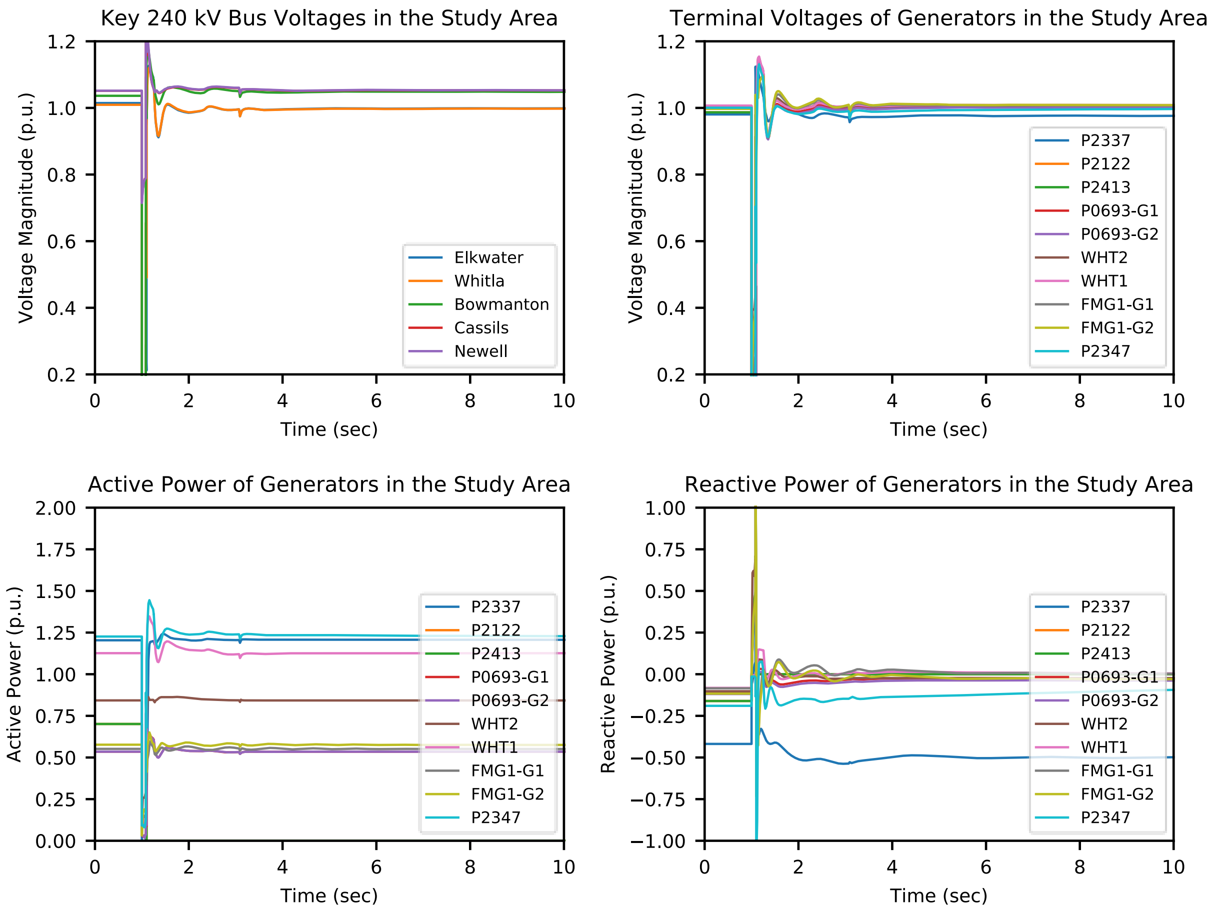
Case Description:

- Post-development 2023 summer light case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 23



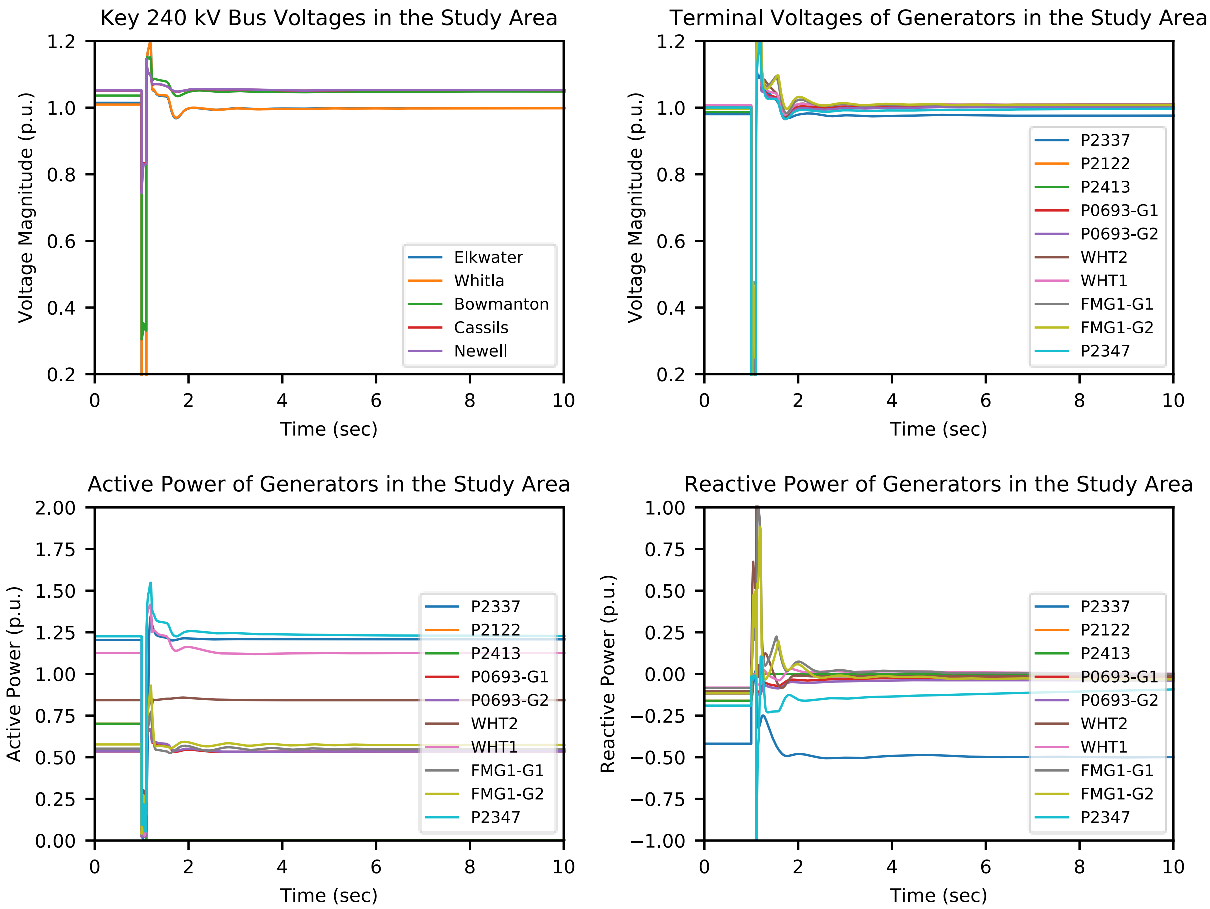
Case Description:

- Post-development 2023 summer light case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 24



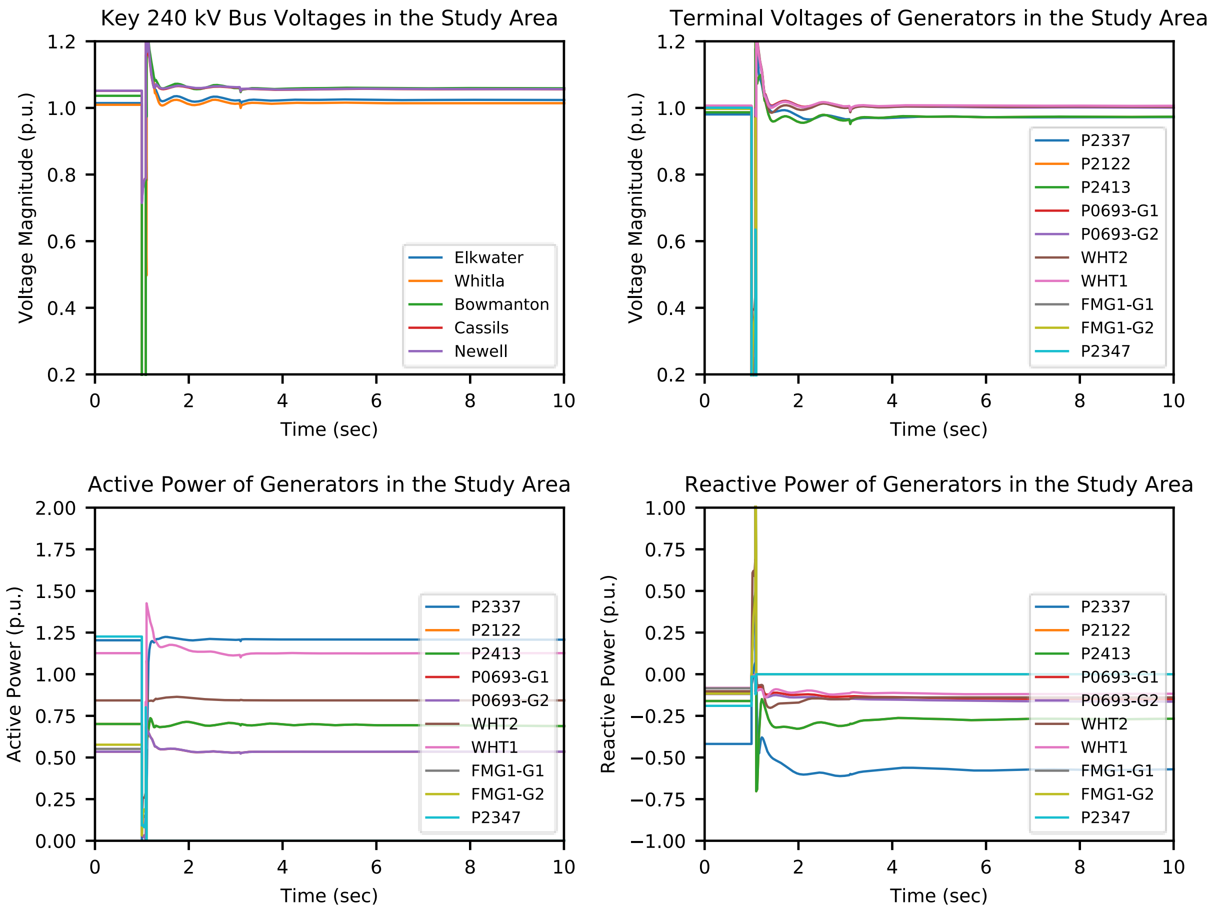
Case Description:

- Post-development 2023 summer light case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 25



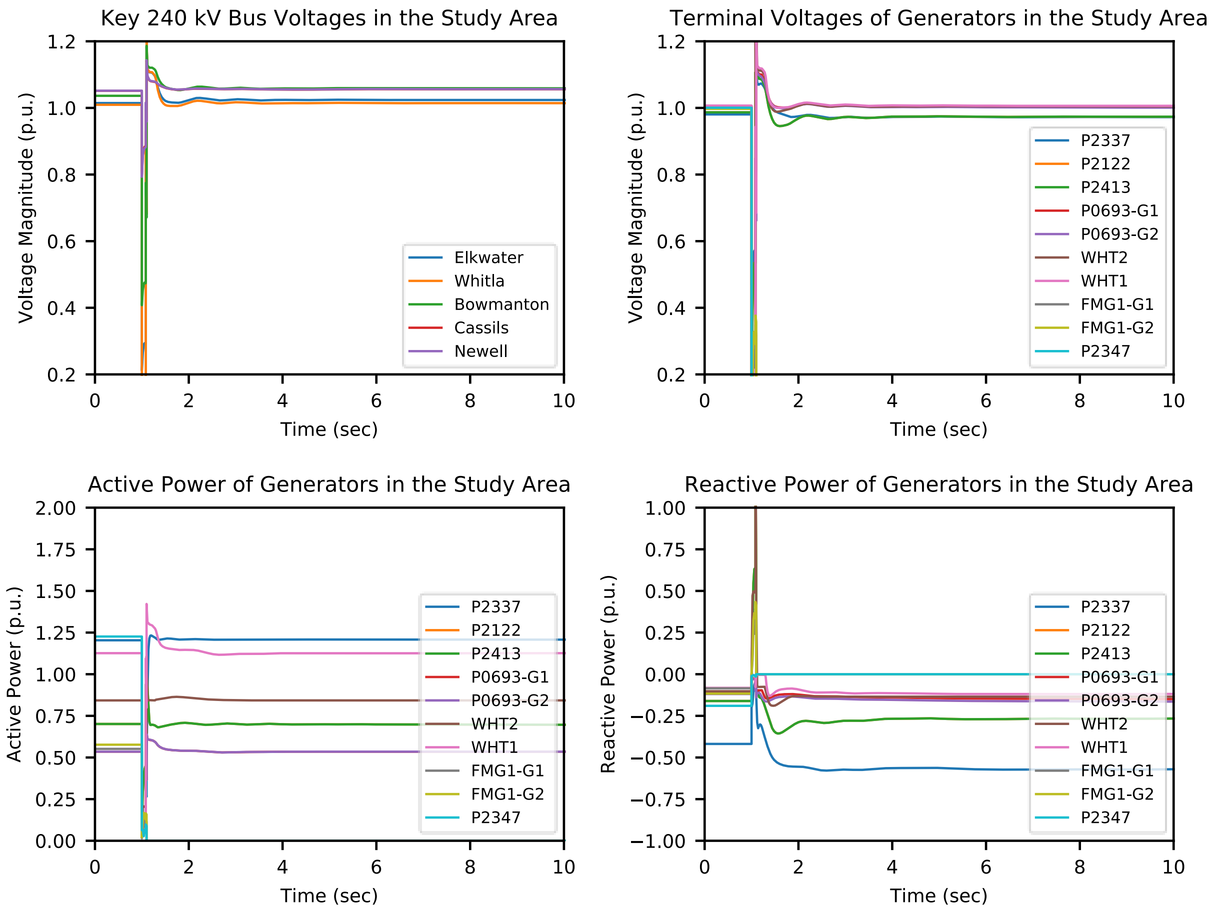
Case Description:

- Post-development 2023 summer light case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 26



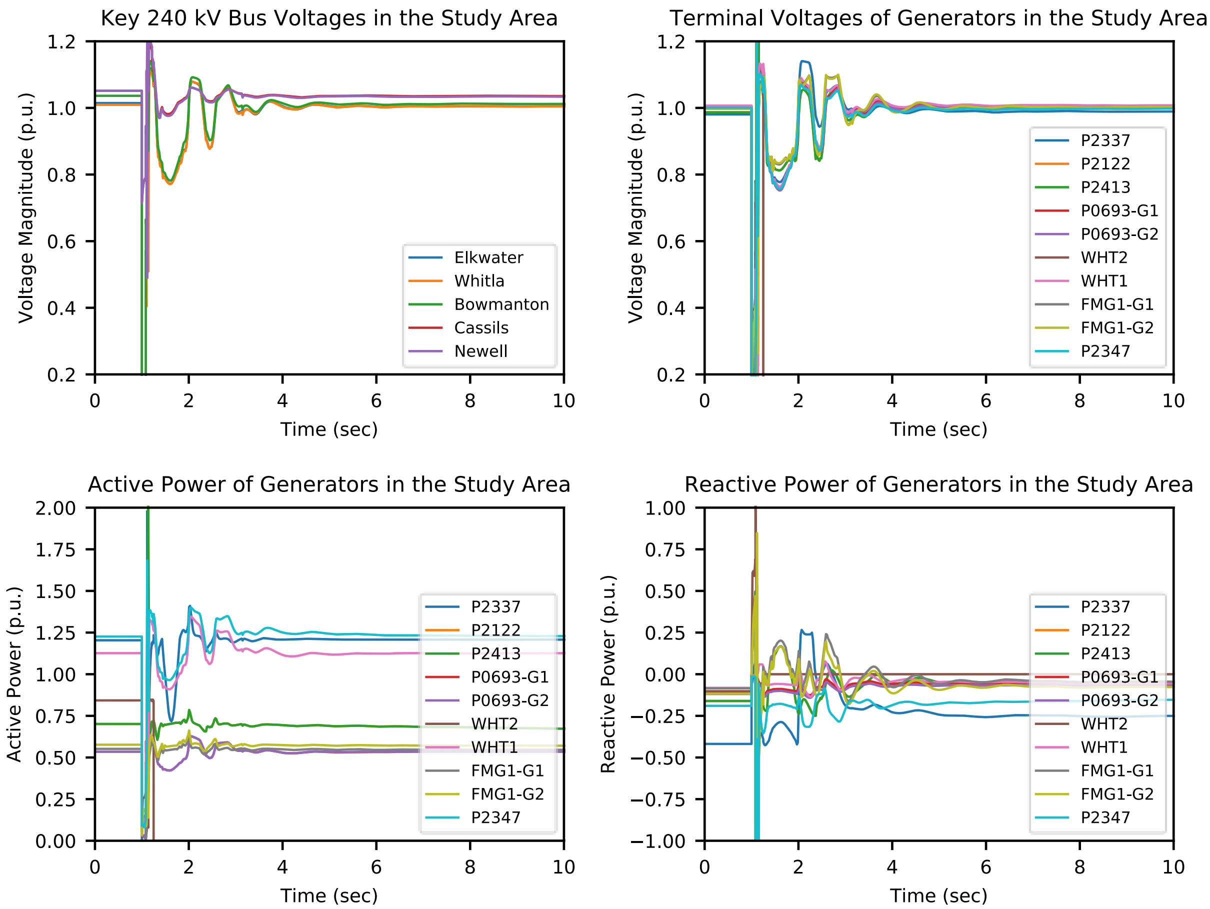
Case Description:

- Post-development 2023 summer light case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 27



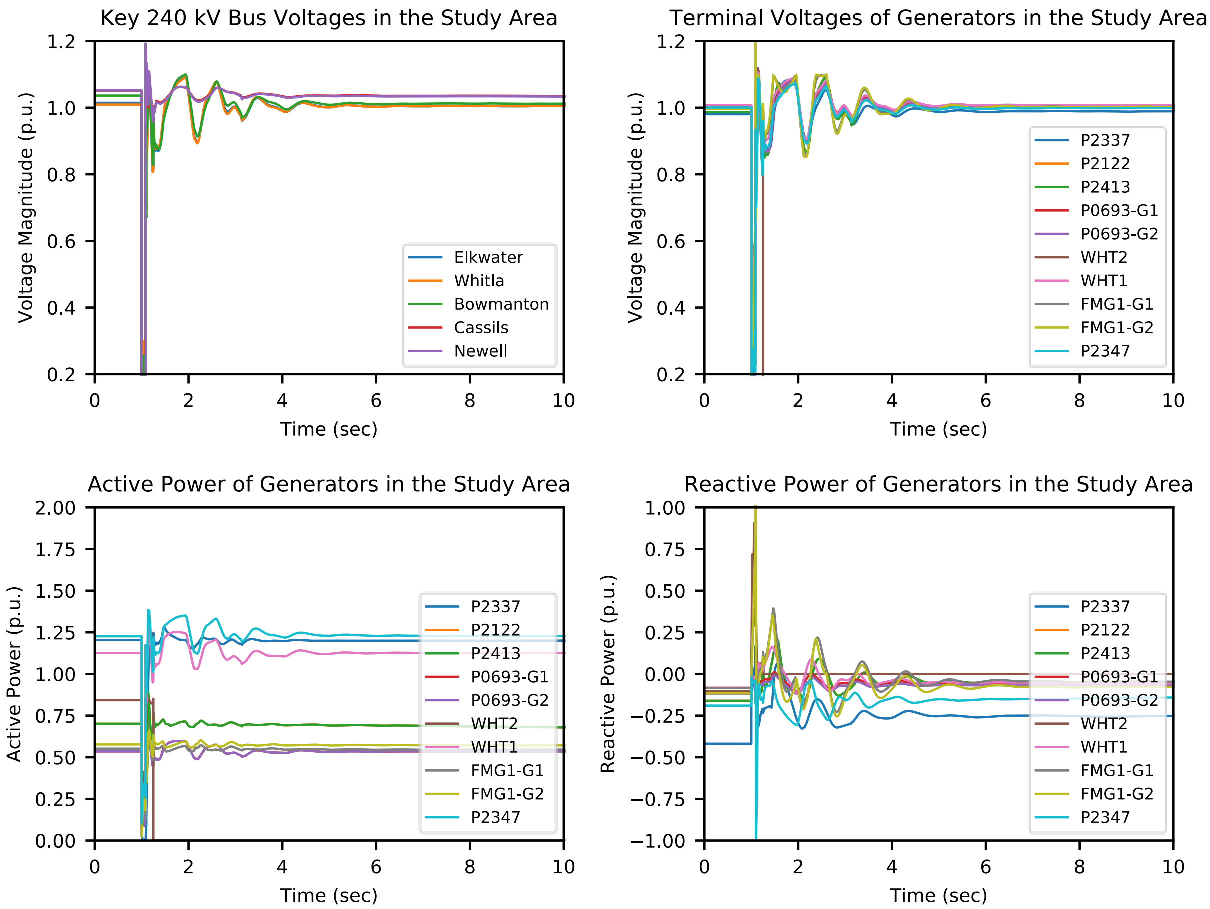
Case Description:

- Post-development 2023 summer light case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 28



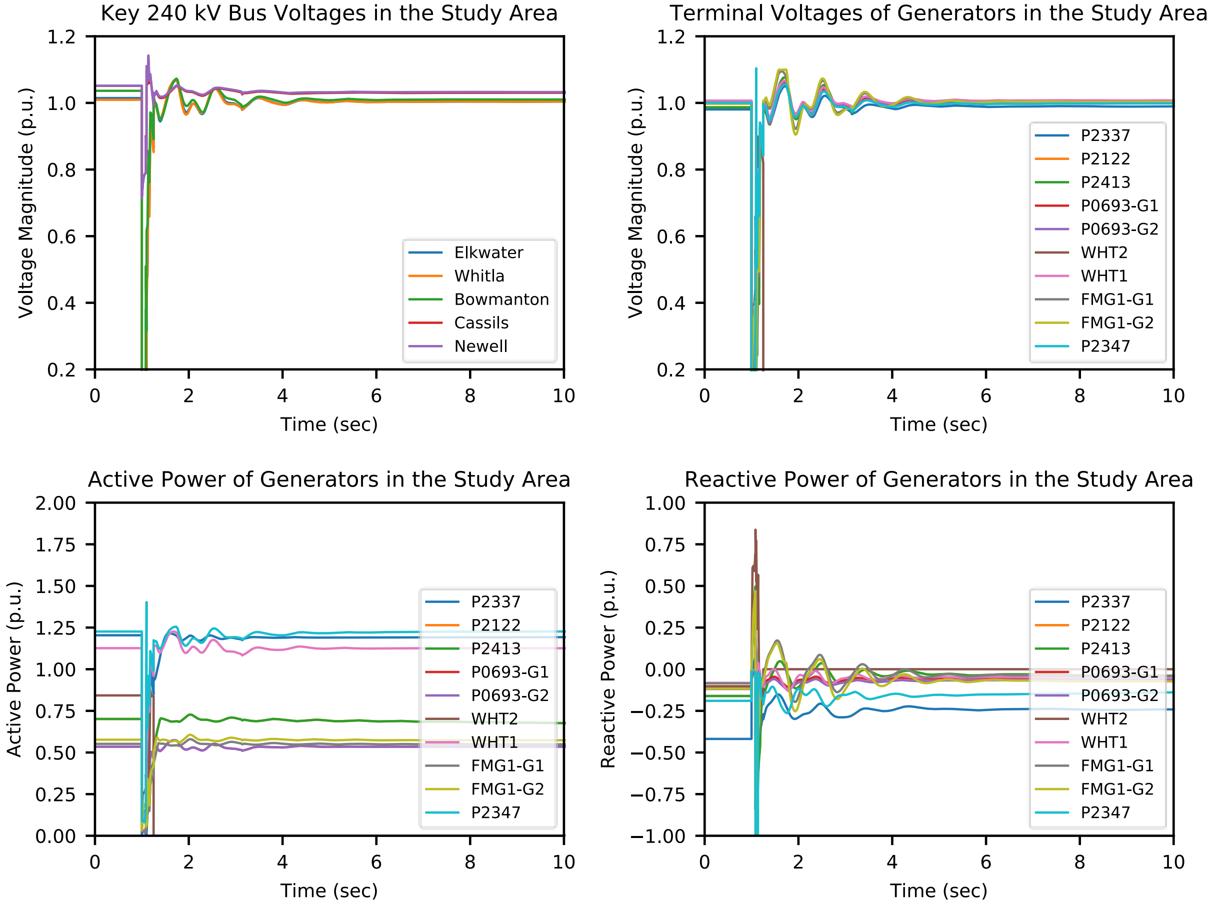
Case Description:

- Post-development 2023 summer light case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Cassils 324S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 29



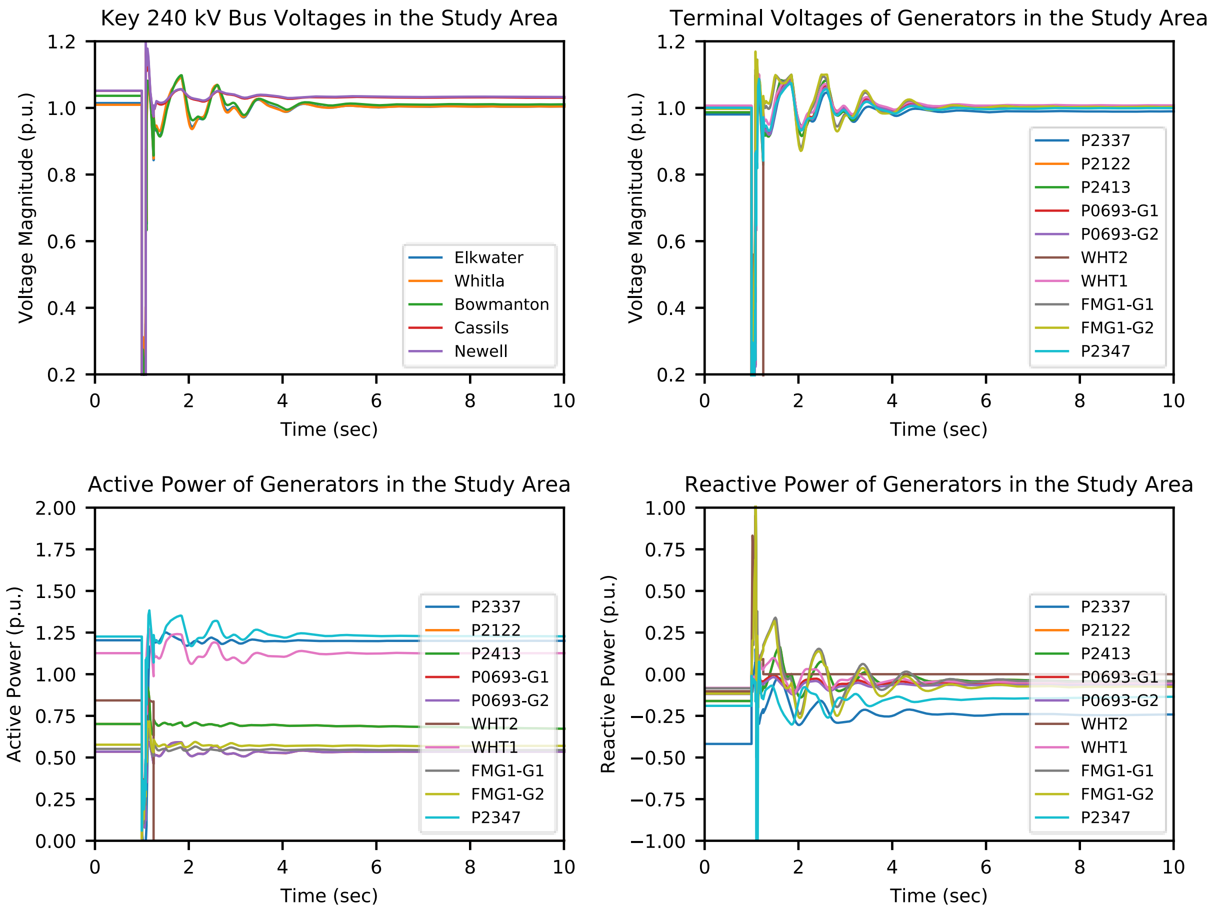
Case Description:

- Post-development 2023 summer light case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 30



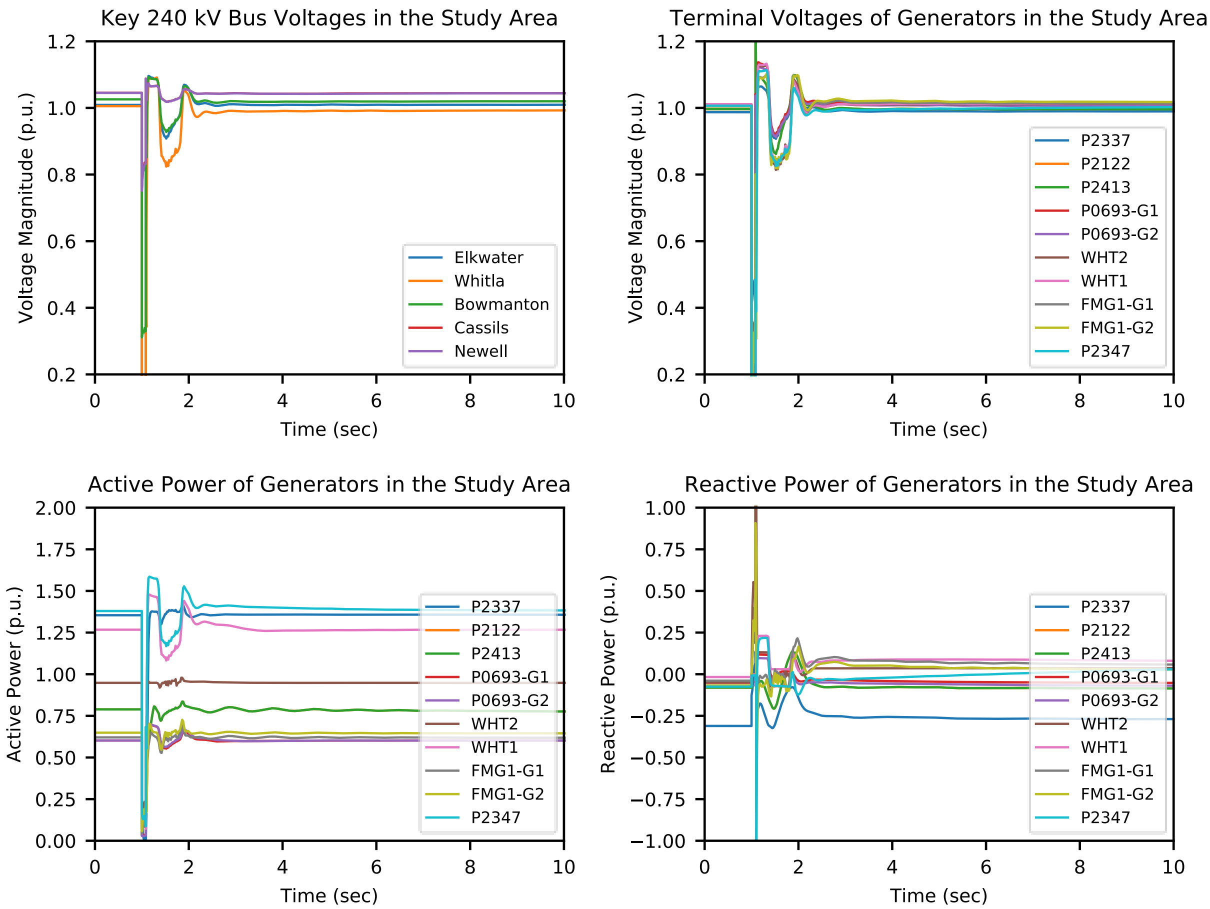
Case Description:

- Post-development 2023 summer light case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Newell 2075S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 31



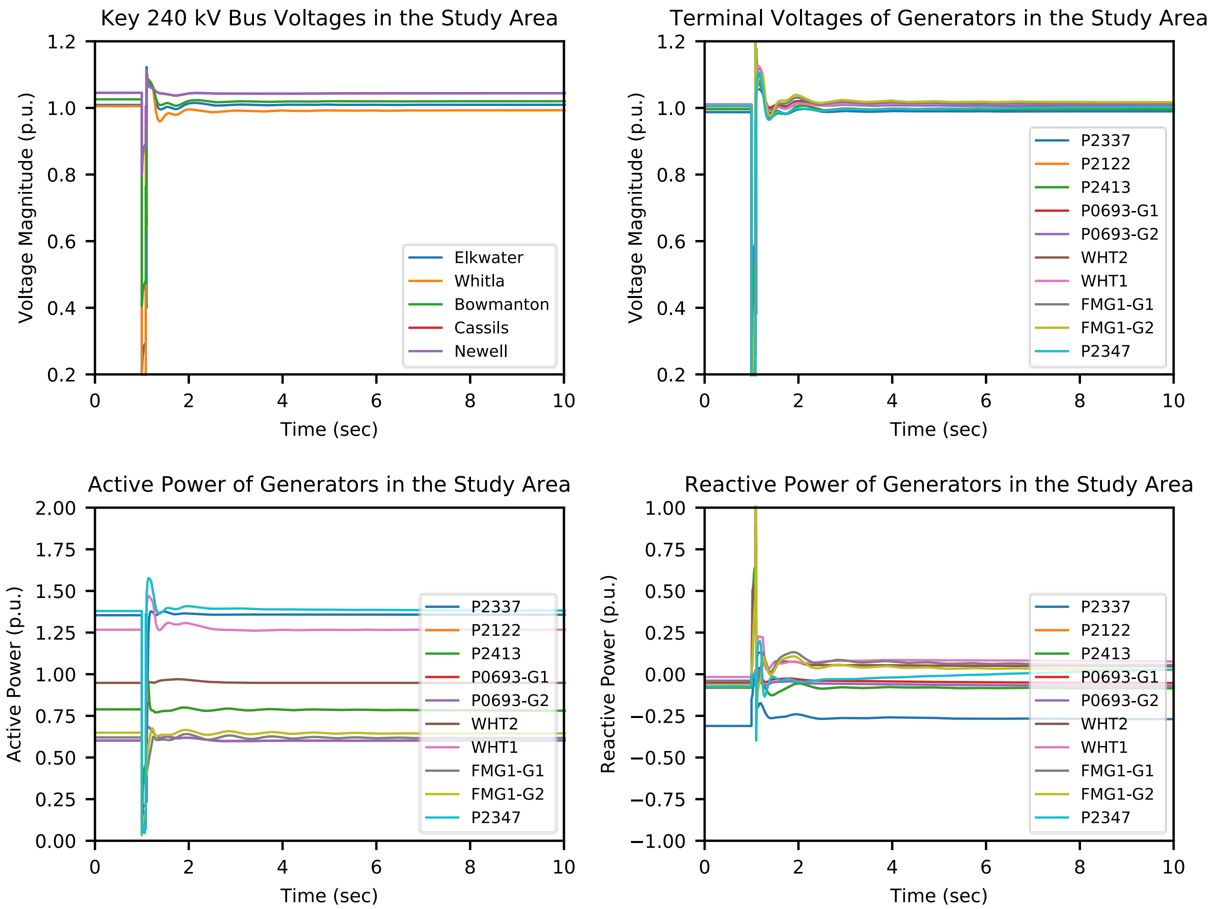
Case Description:

- Post-development 2023 summer light case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 32



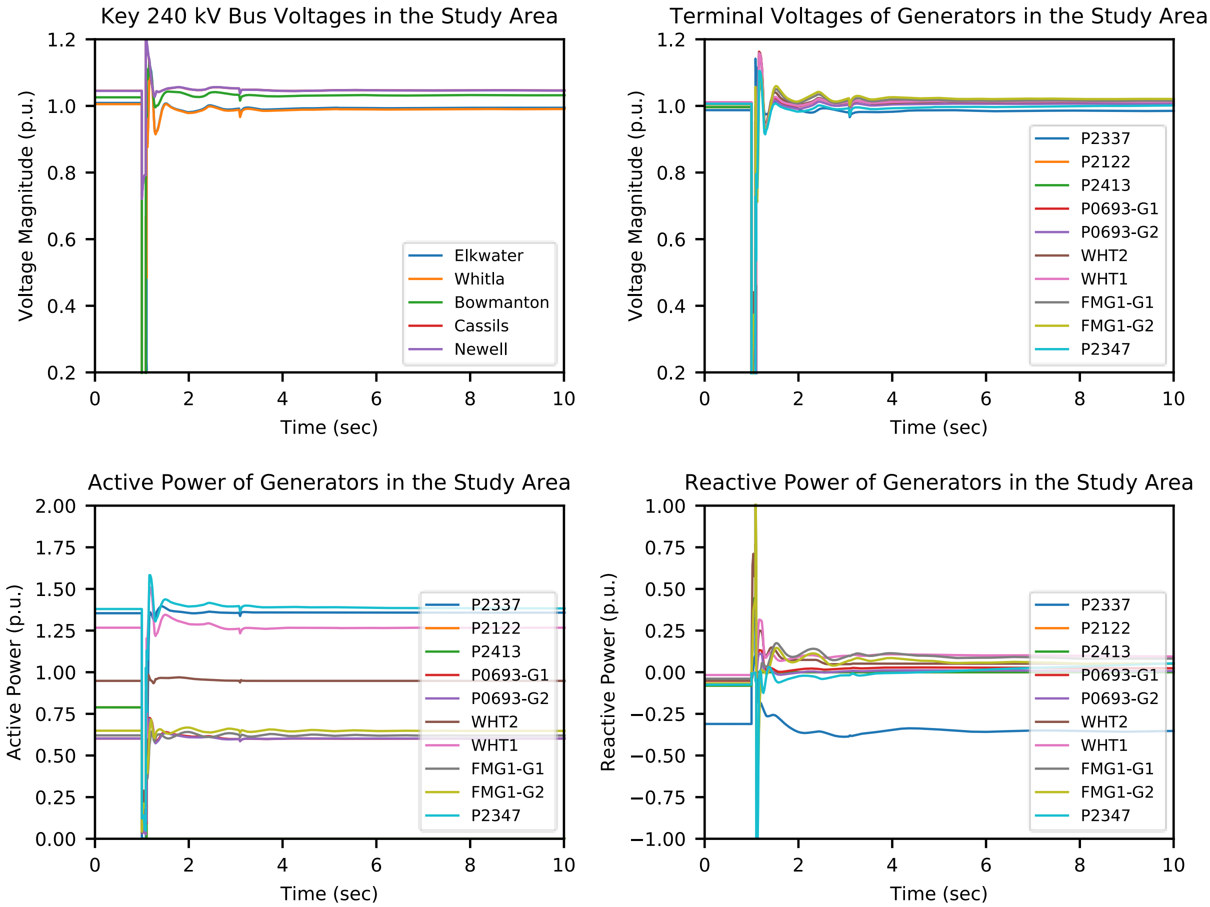
Case Description:

- Post-development 2023 summer light case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 33



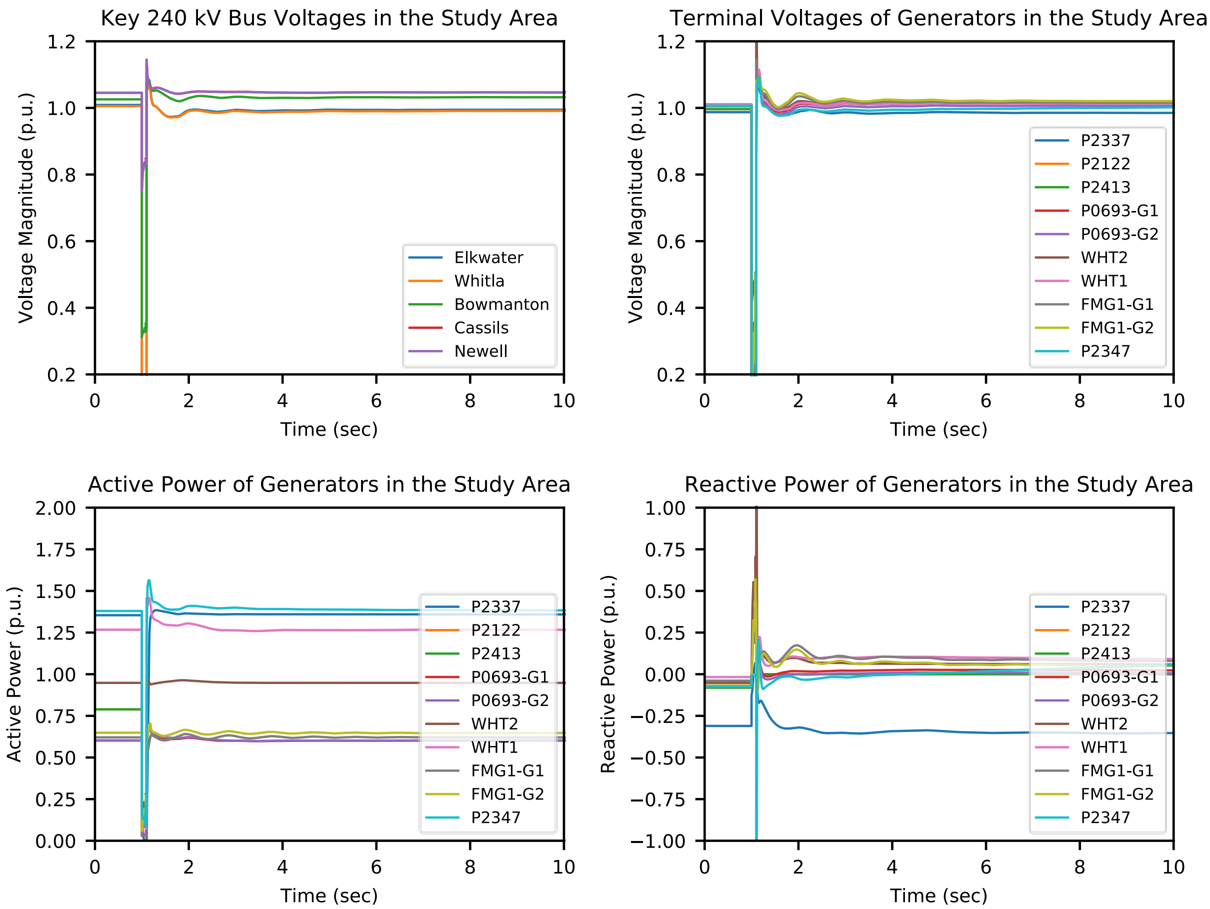
Case Description:

- Post-development 2023 summer light case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 34



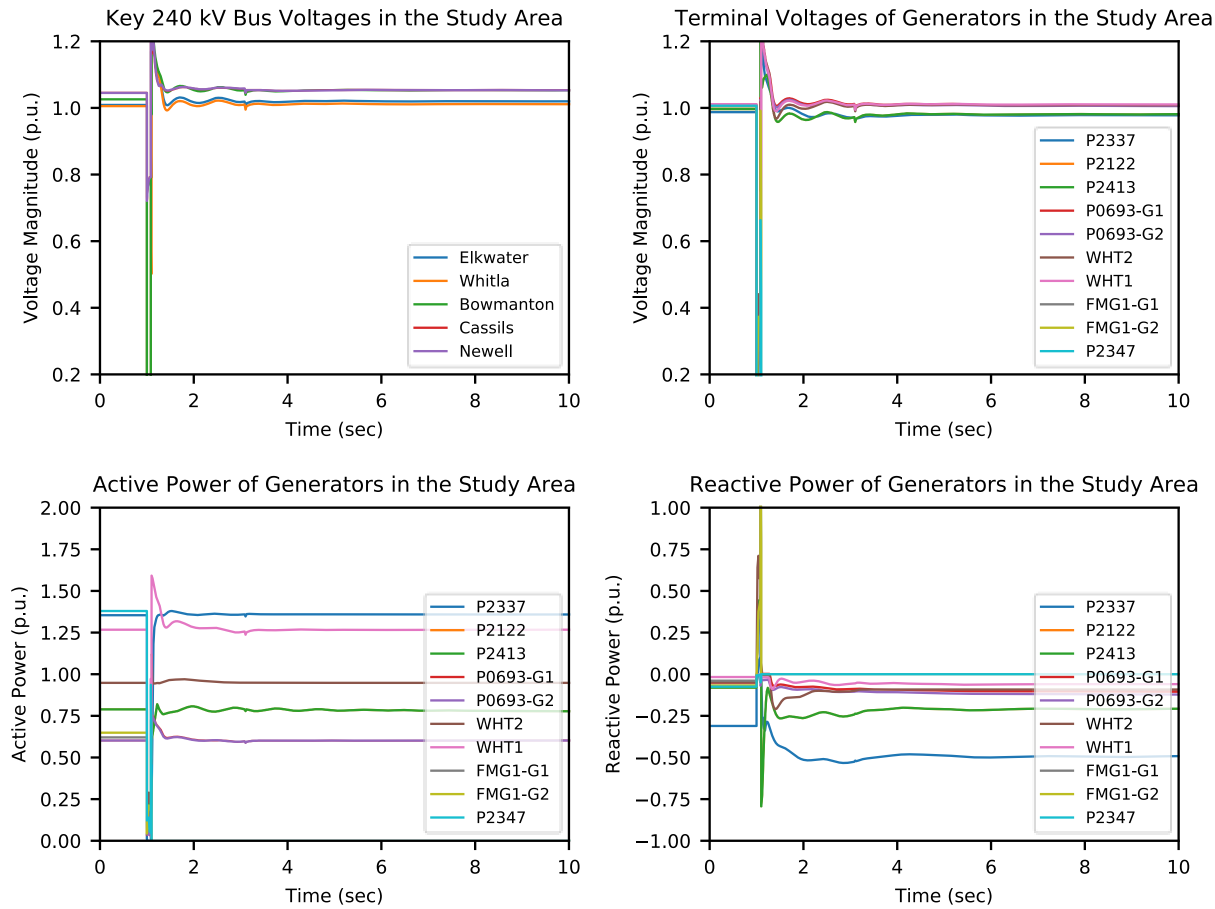
Case Description:

- Post-development 2023 summer light case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 35



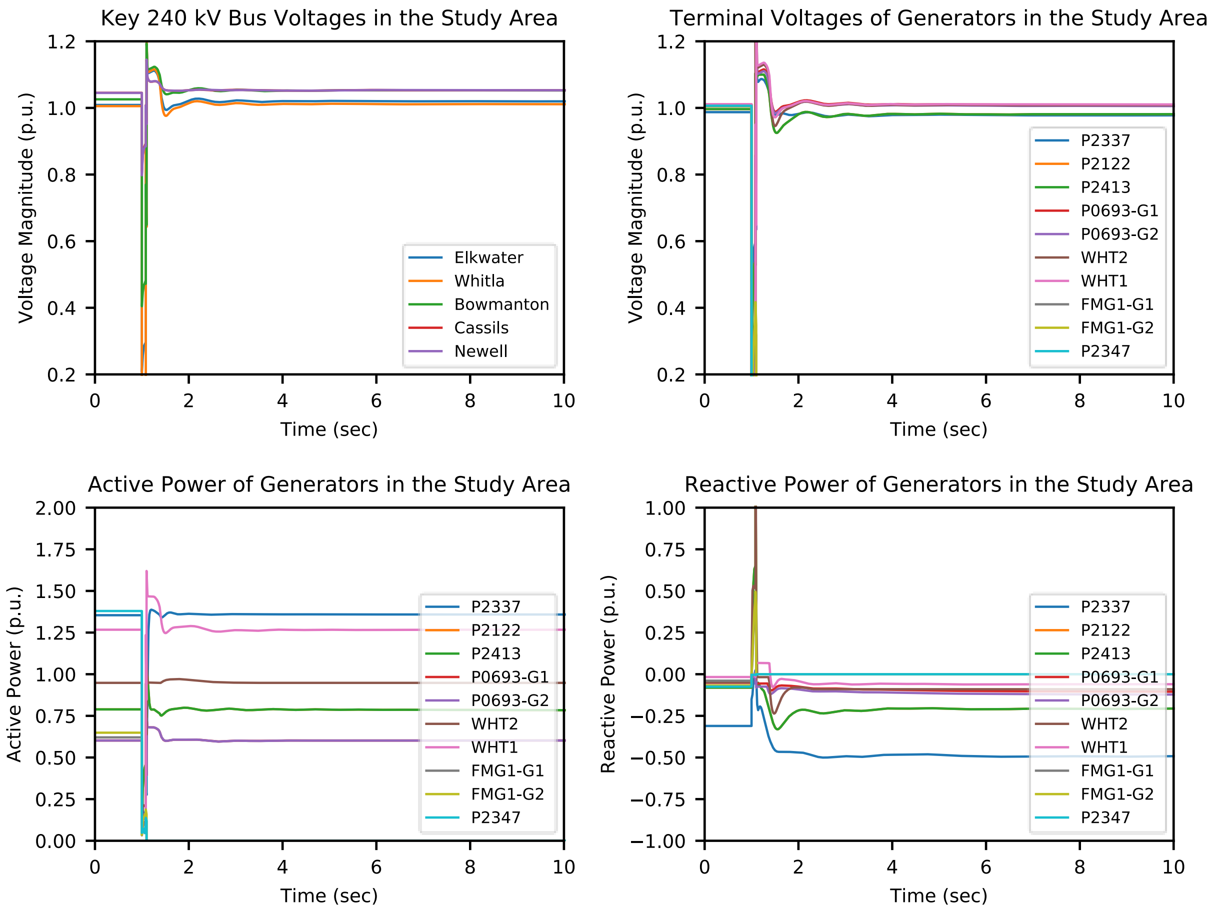
Case Description:

- Post-development 2023 summer light case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 36



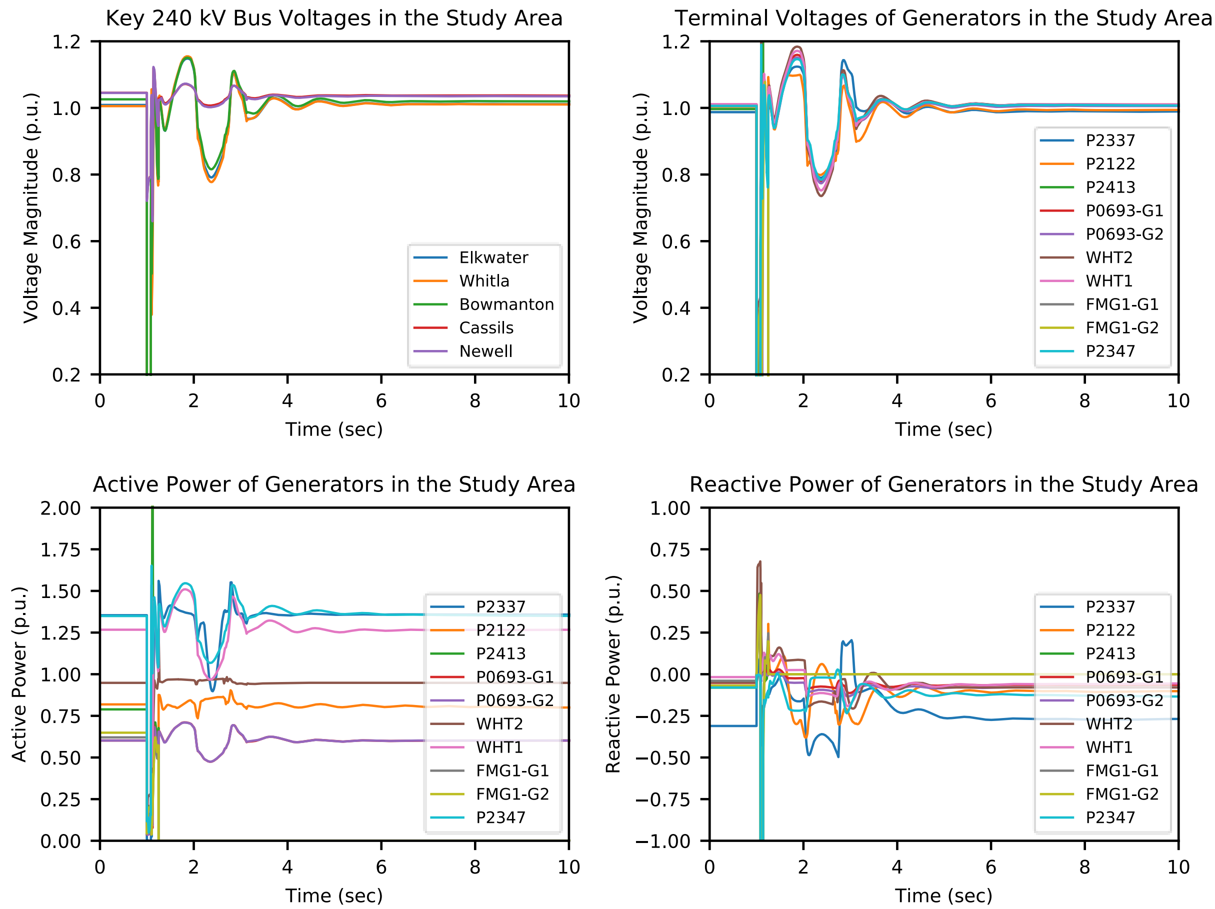
Case Description:

- Post-development 2023 summer light case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 37



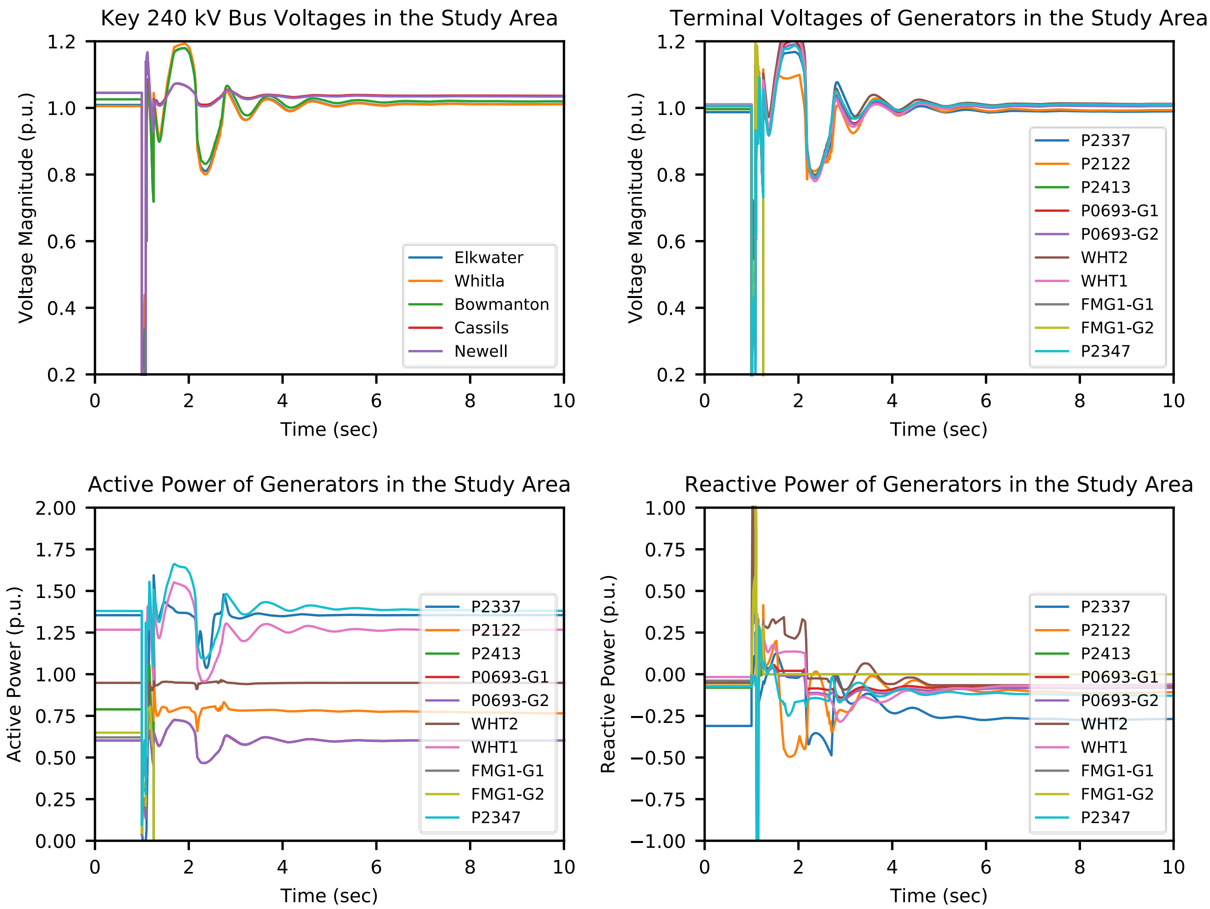
Case Description:

- Post-development 2023 summer light case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 38



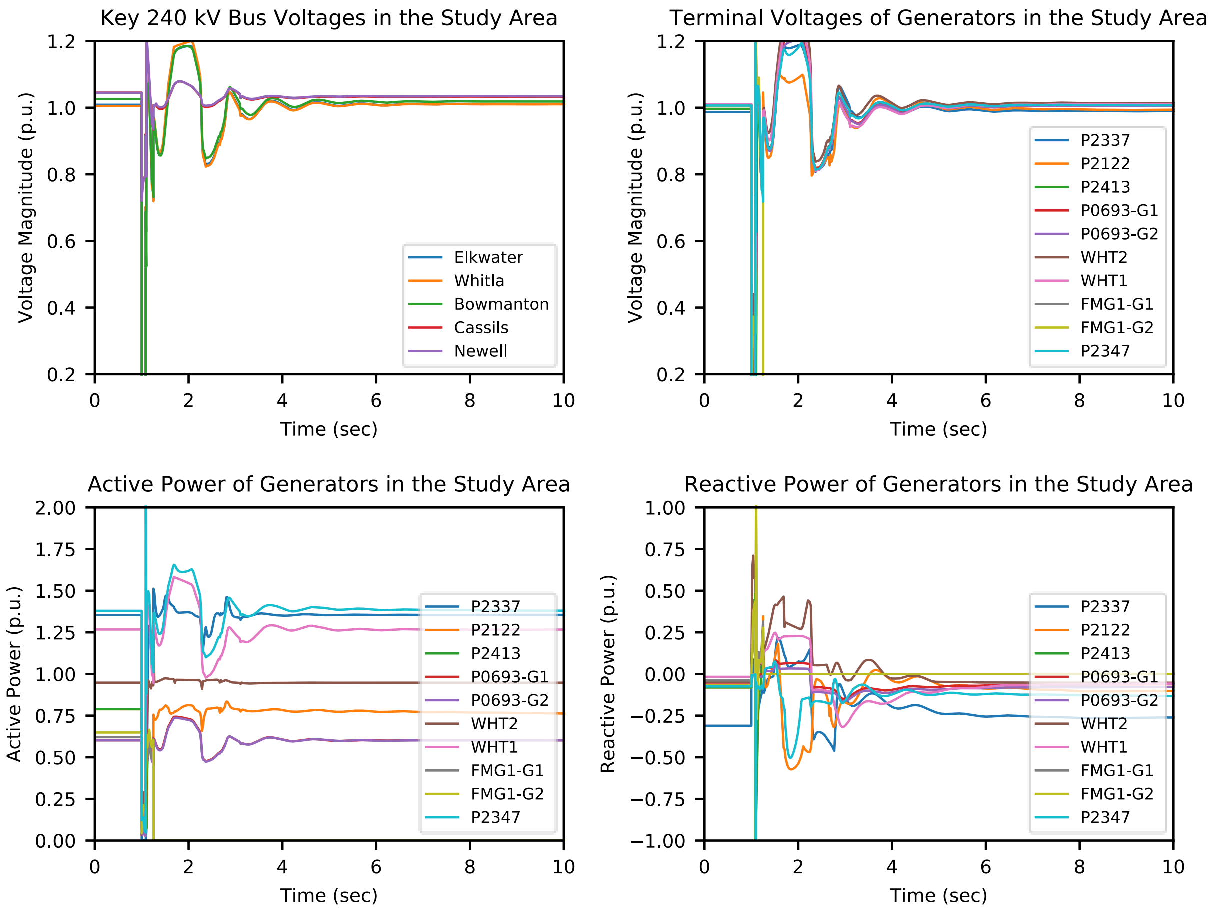
Case Description:

- Post-development 2023 summer light case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Cassils 324S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 39



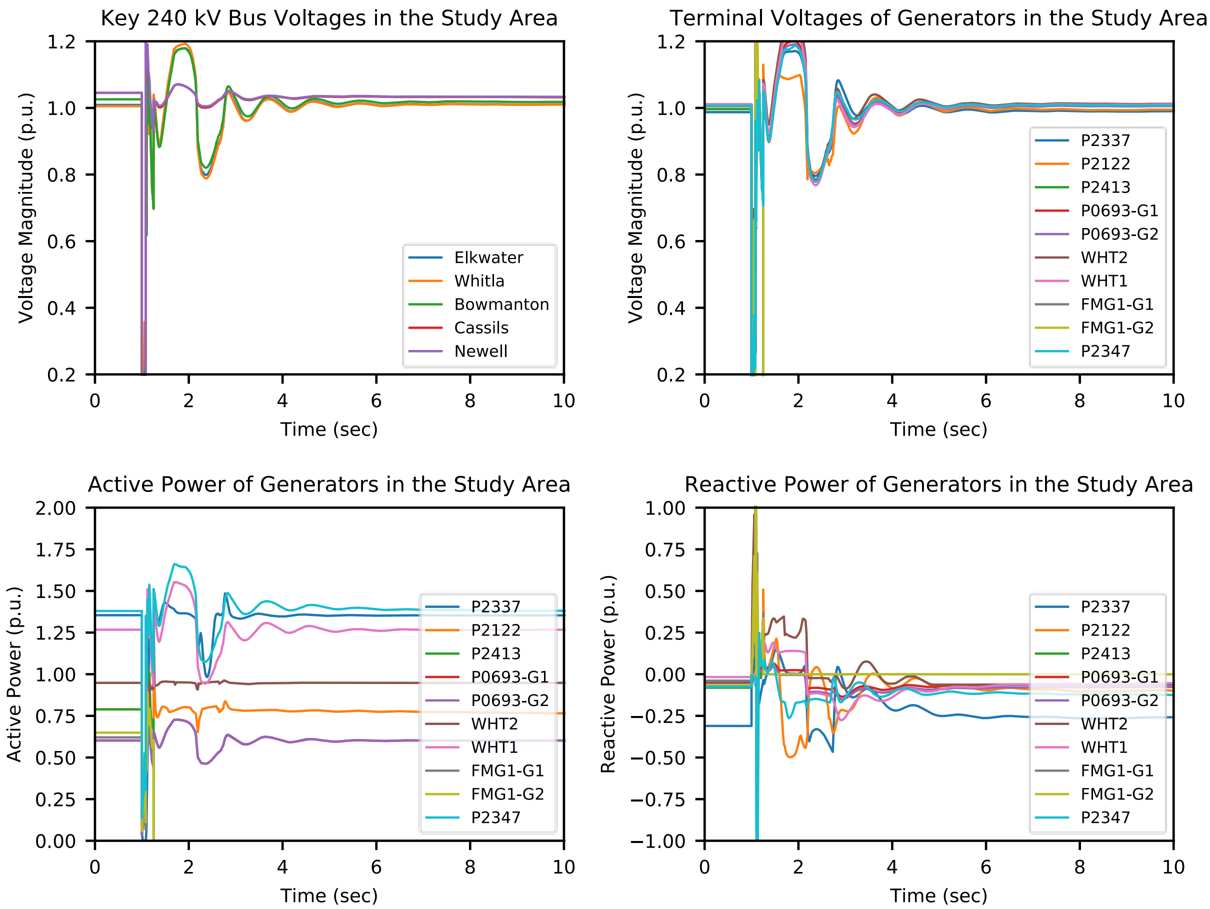
Case Description:

- Post-development 2023 summer light case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 40



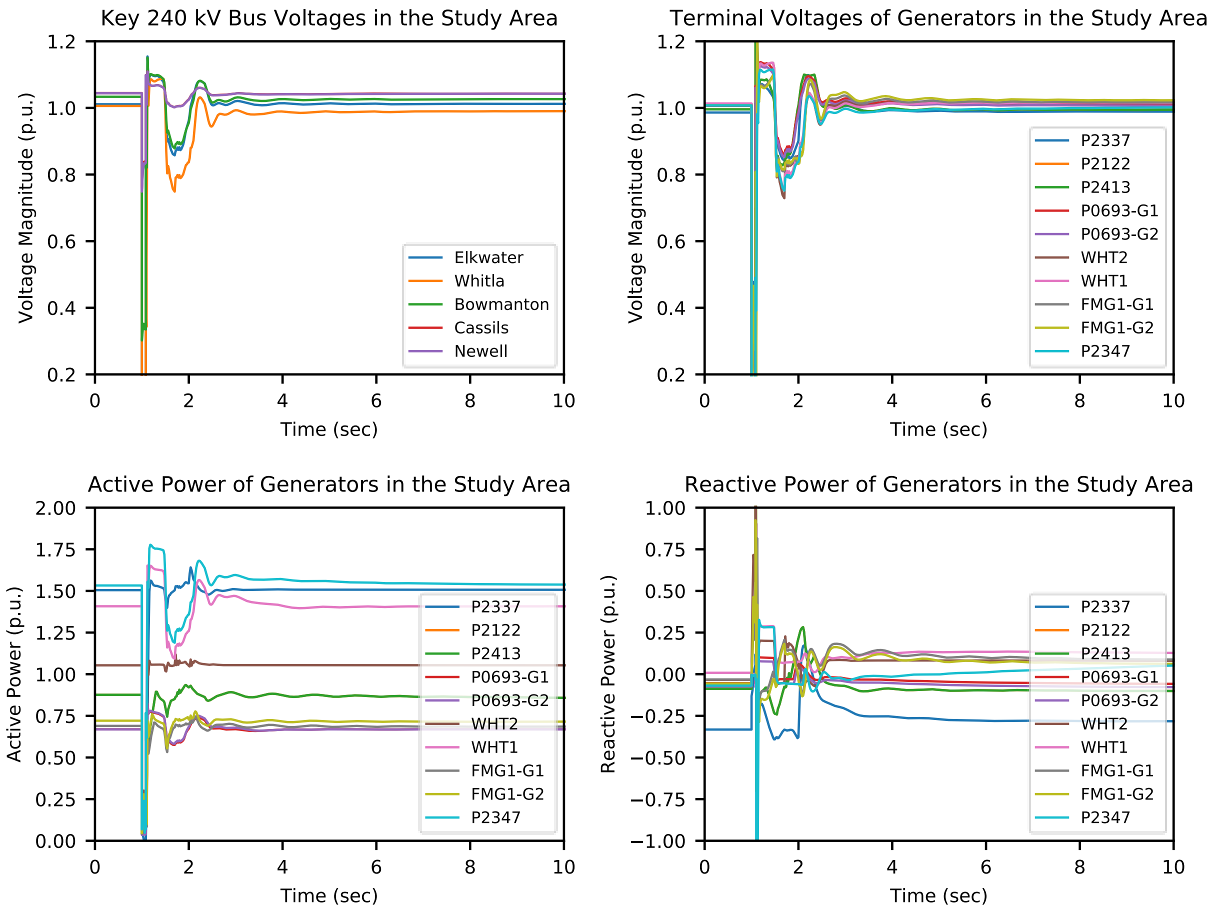
Case Description:

- Post-development 2023 summer light case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Newell 2075S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 41



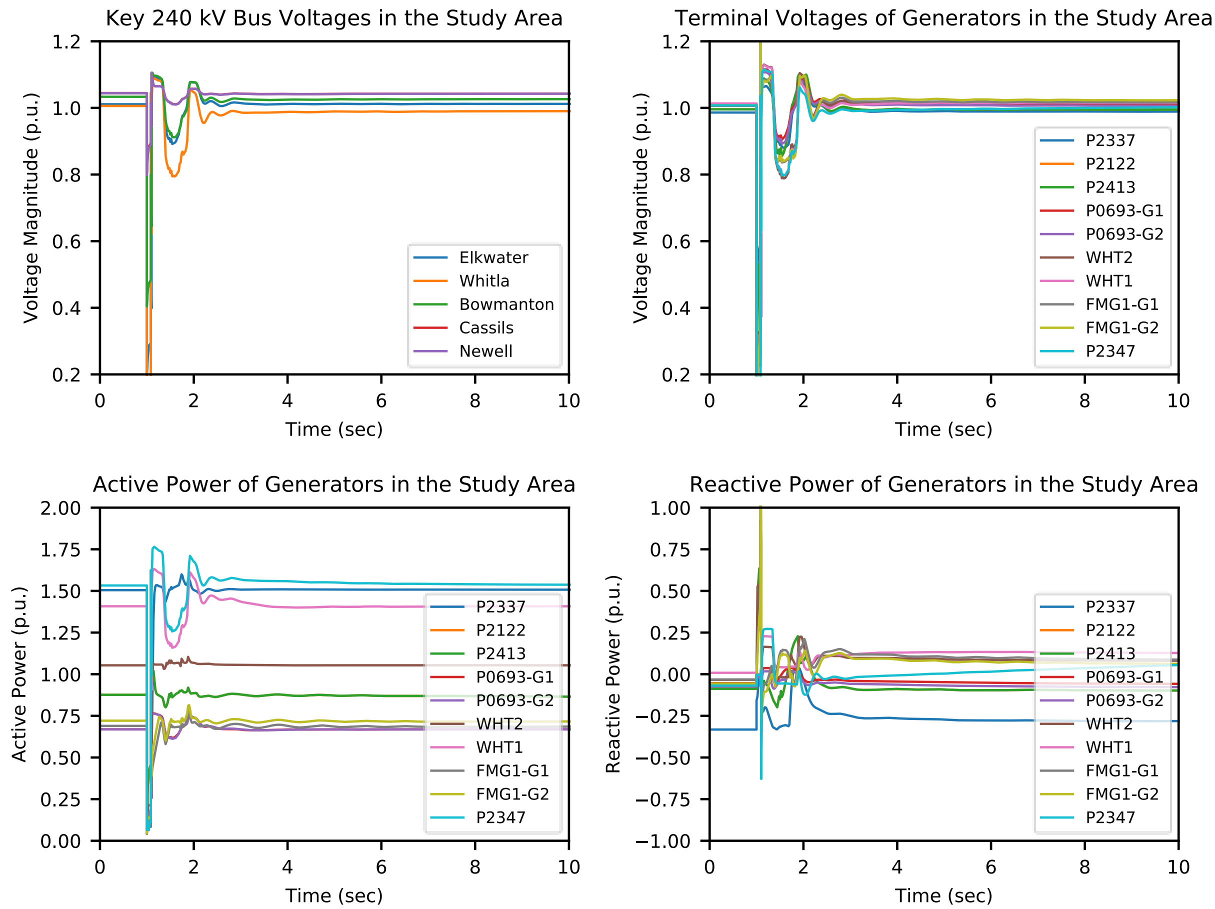
Case Description:

- Post-development 2023 summer light case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 42



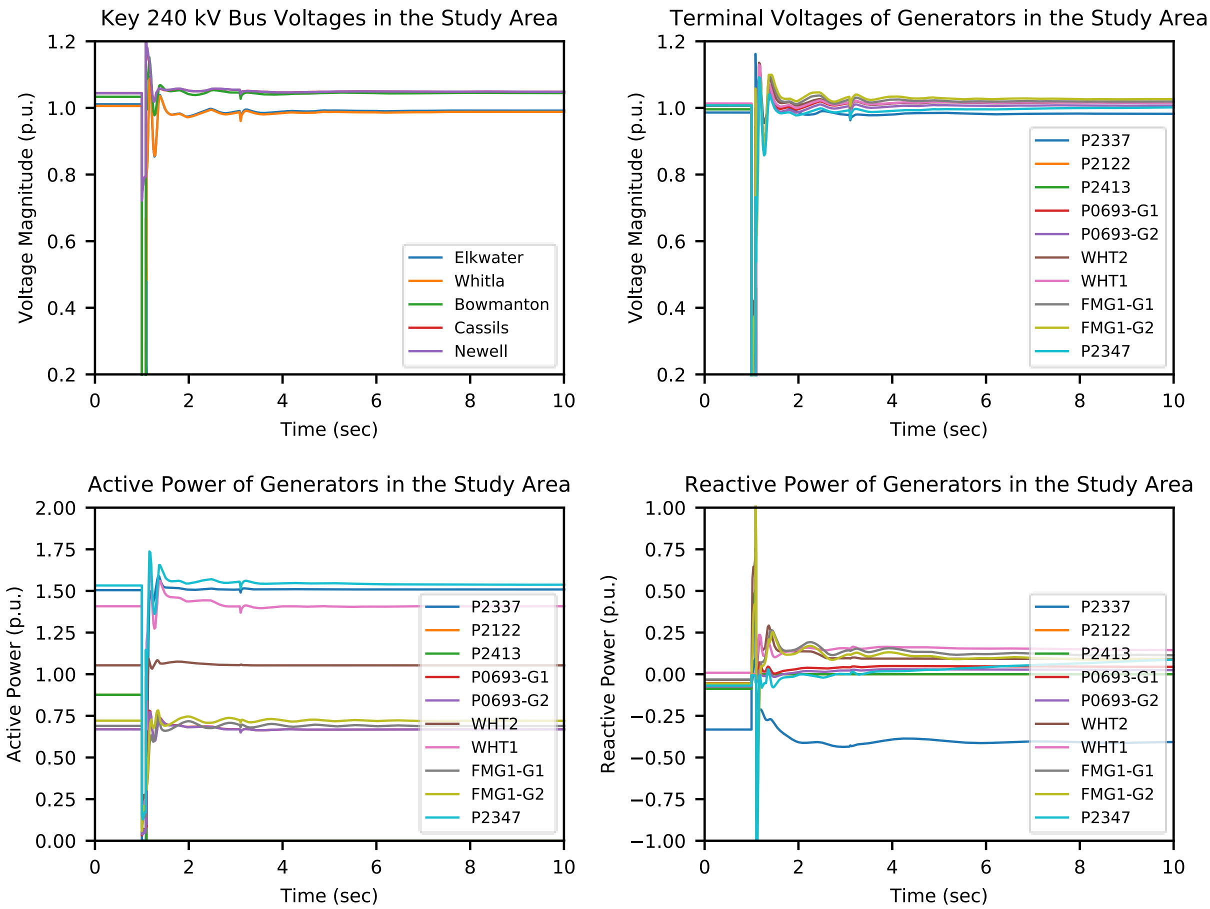
Case Description:

- Post-development 2023 summer light case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 43



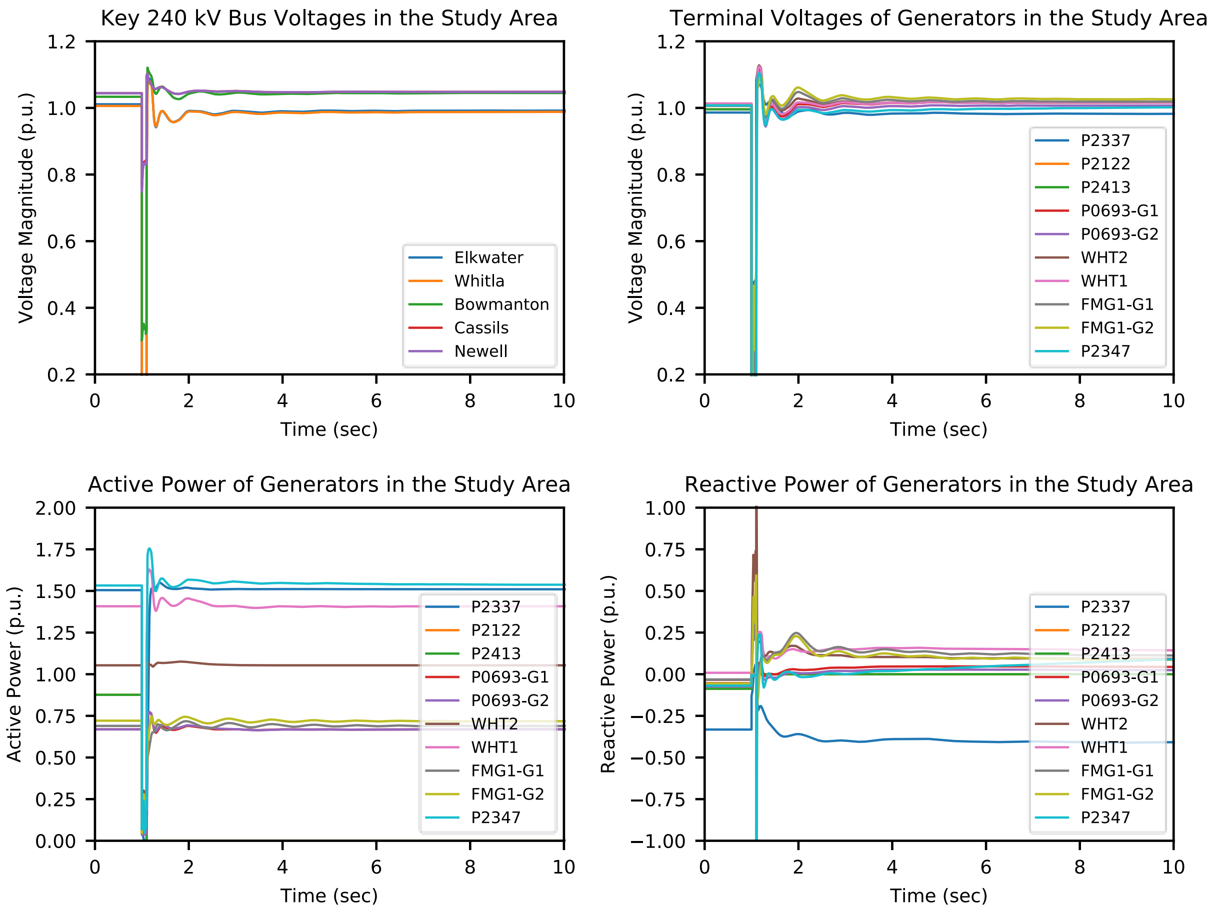
Case Description:

- Post-development 2023 summer light case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 44



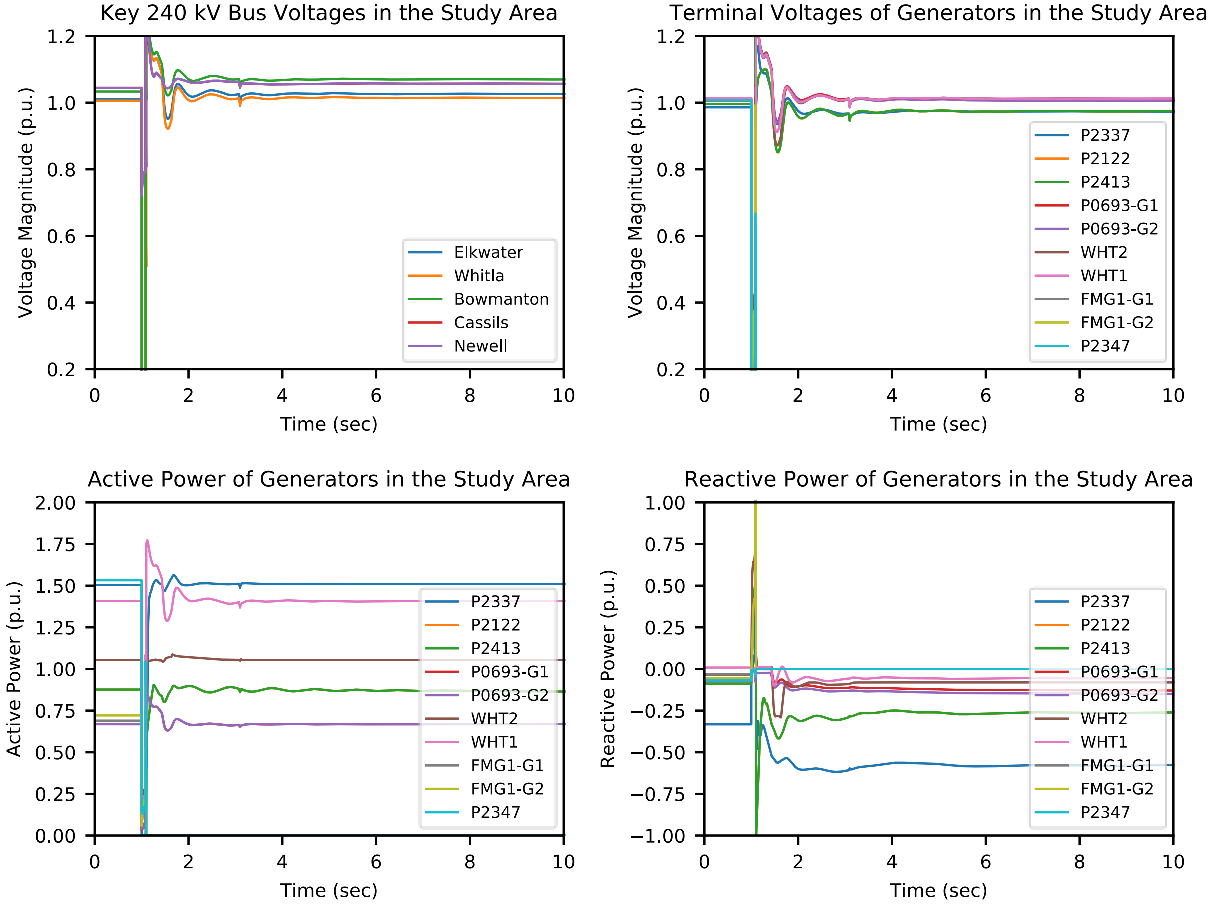
Case Description:

- Post-development 2023 summer light case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 45



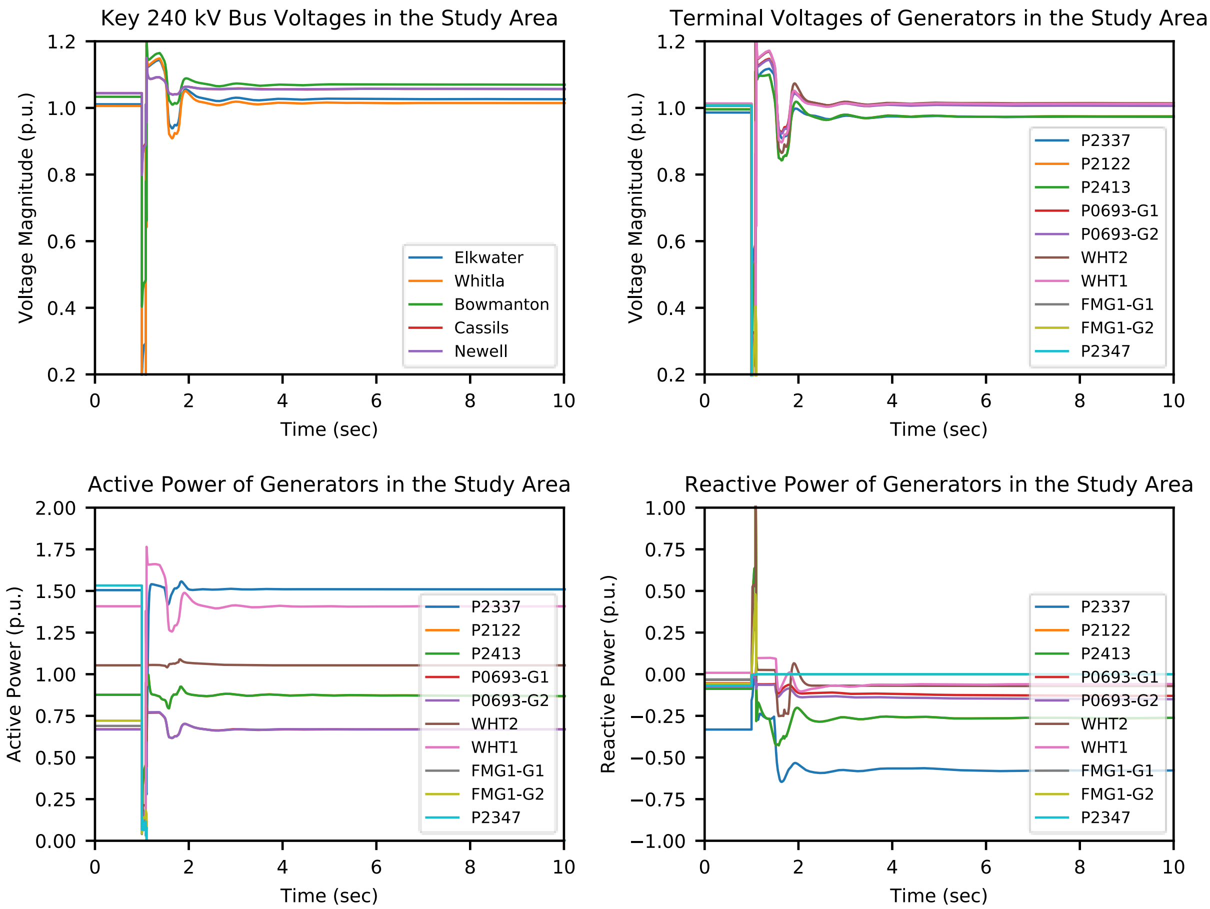
Case Description:

- Post-development 2023 summer light case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 46



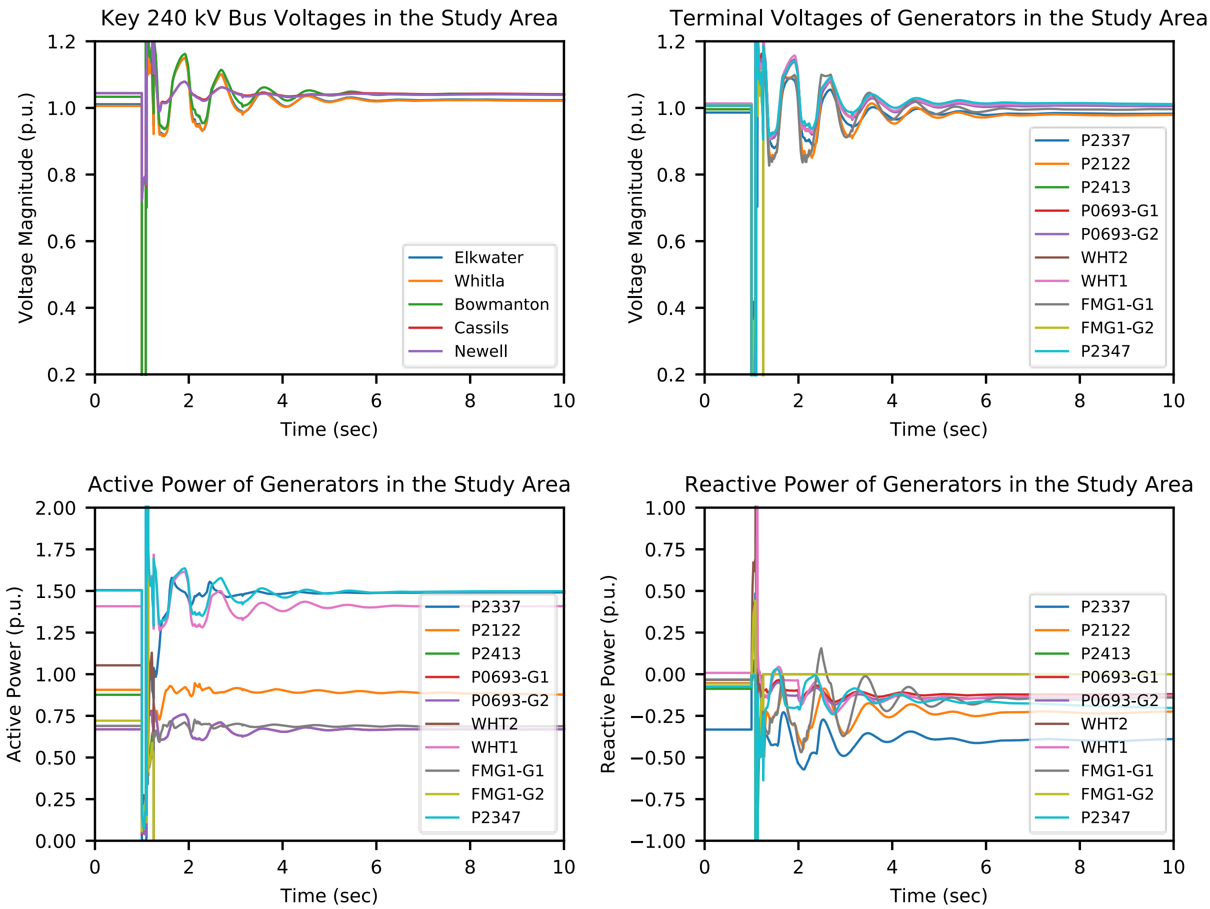
Case Description:

- Post-development 2023 summer light case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 47



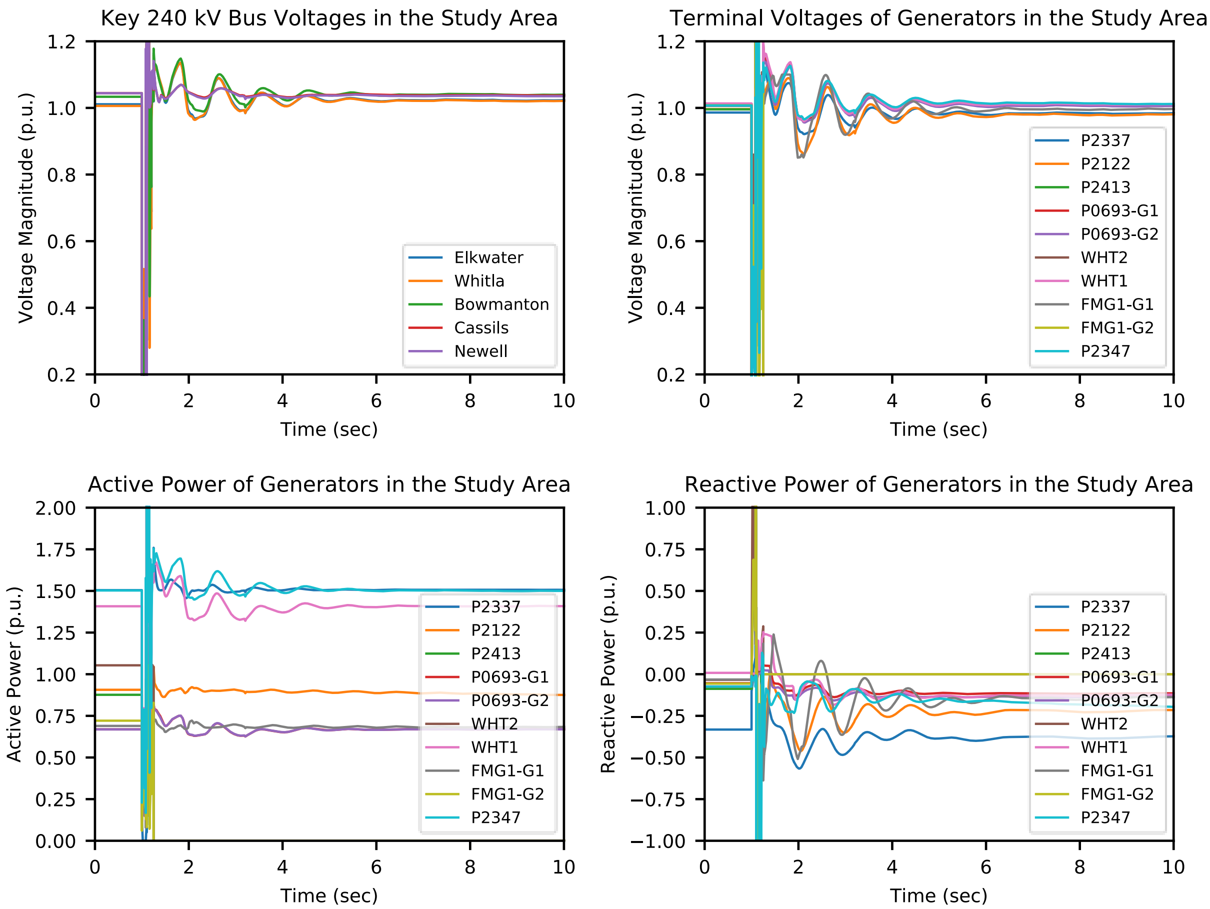
Case Description:

- Post-development 2023 summer light case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 48



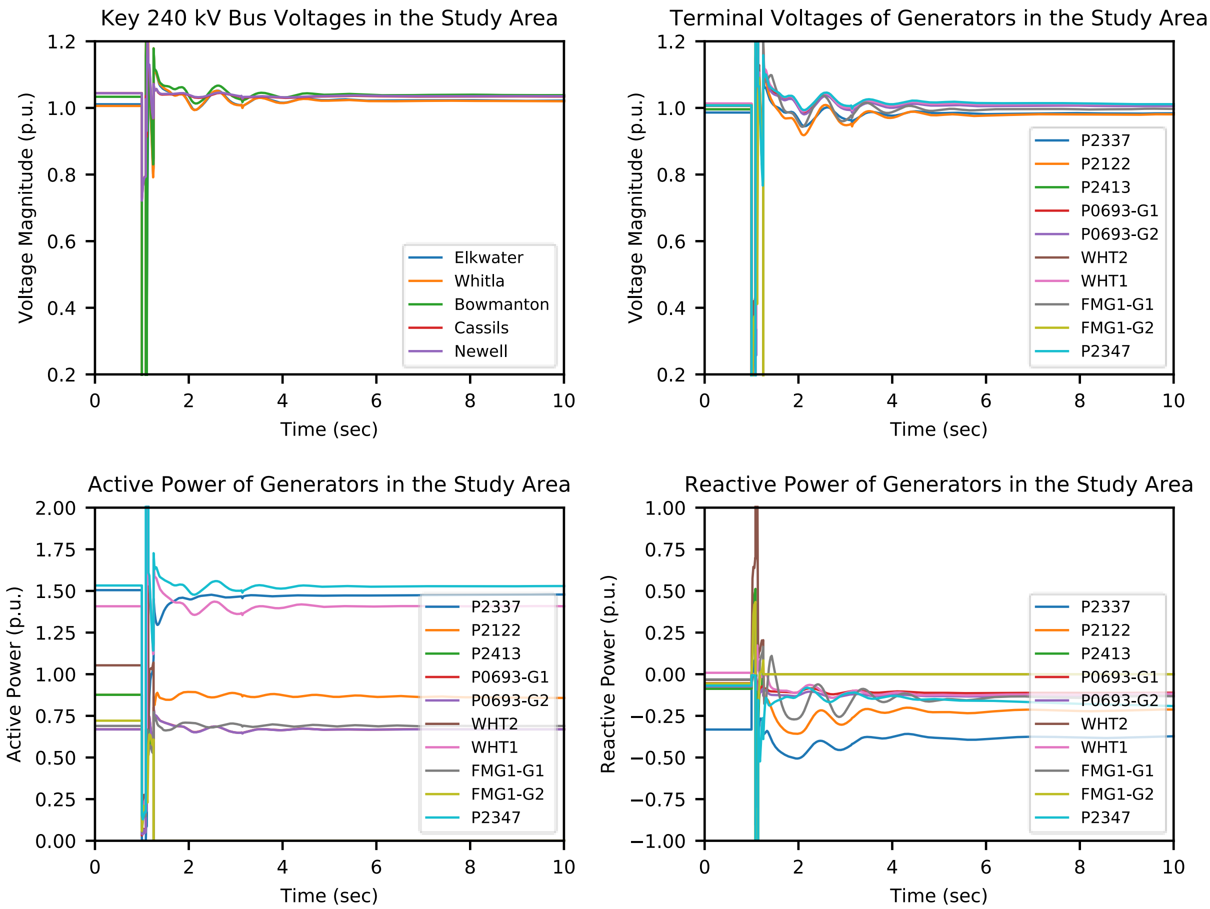
Case Description:

- Post-development 2023 summer light case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Cassils 324S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 49



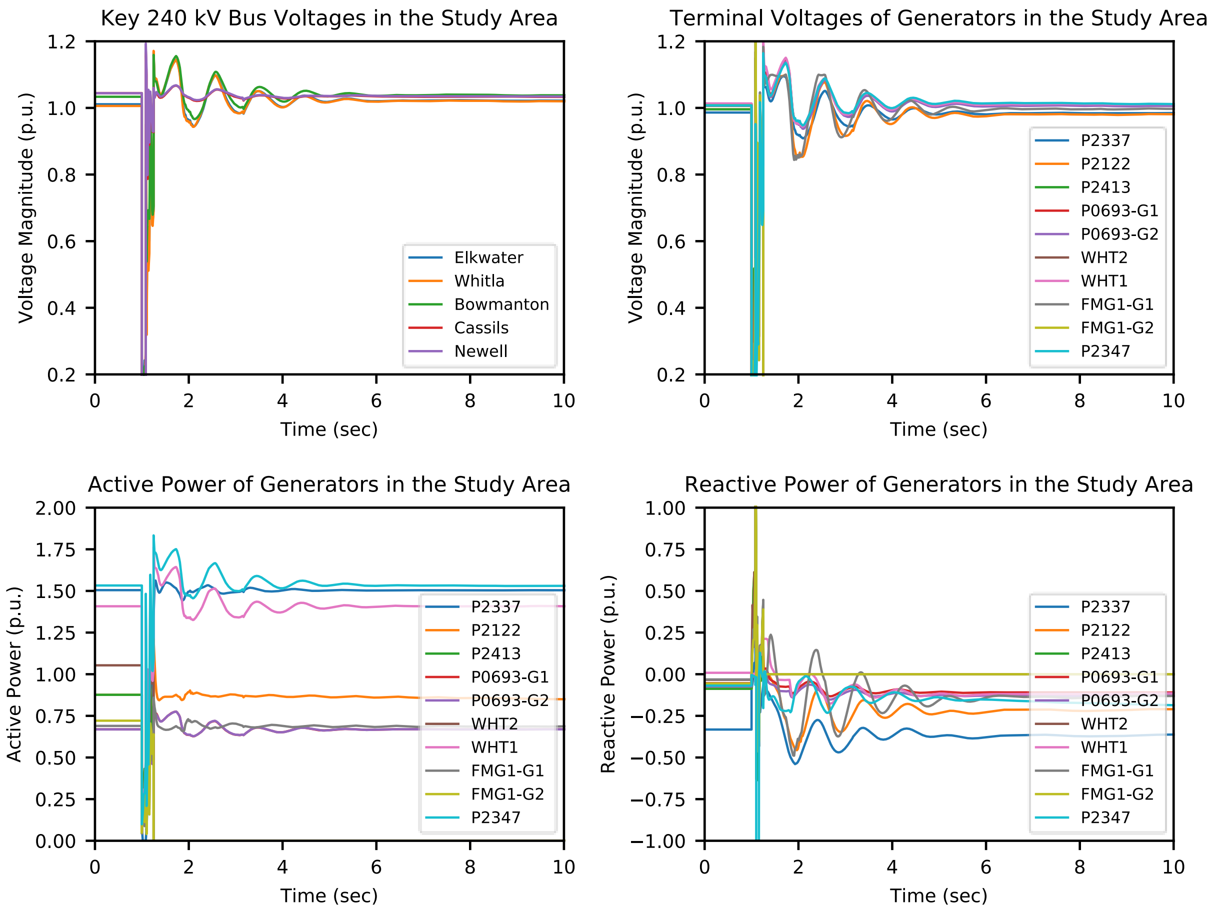
Case Description:

- Post-development 2023 summer light case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 50



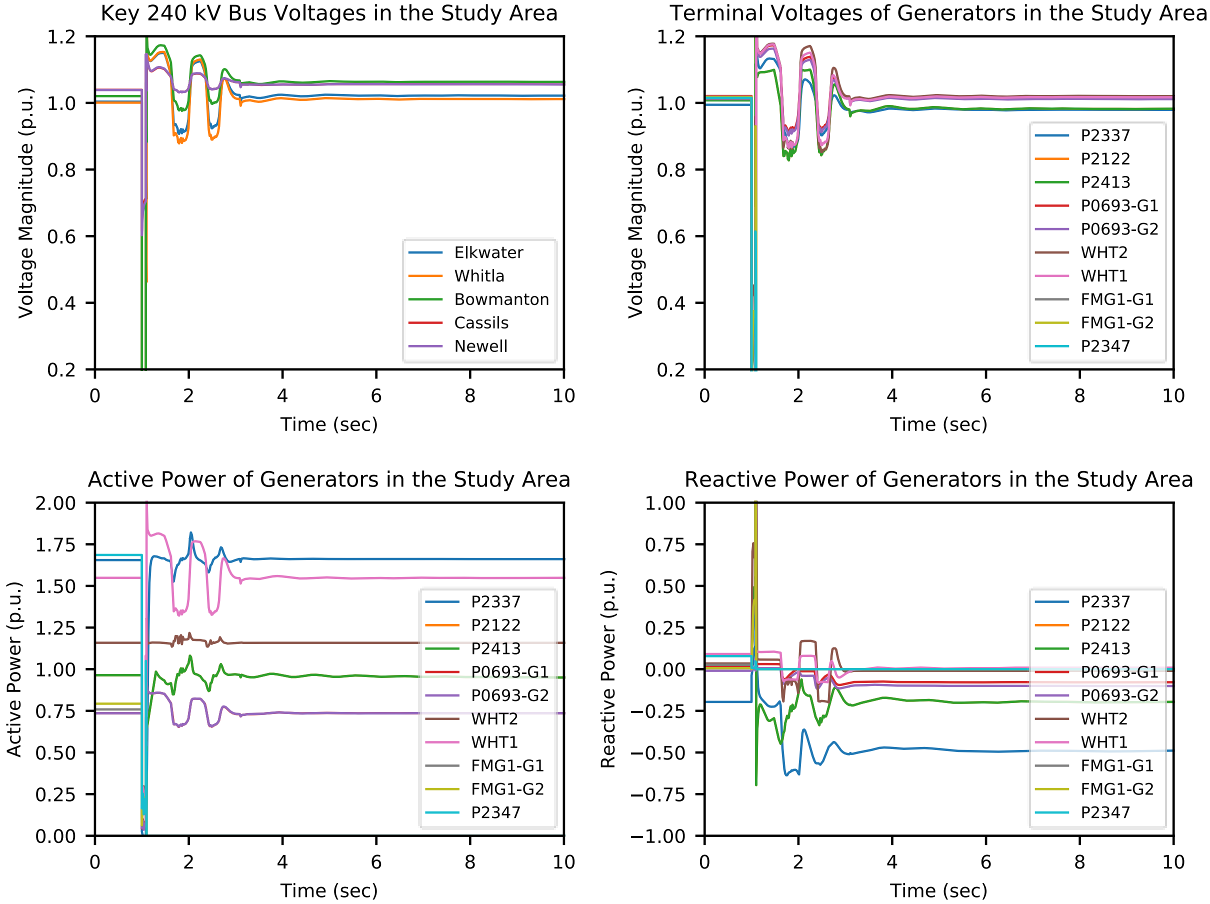
Case Description:

- Post-development 2023 summer light case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Newell 2075S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 51



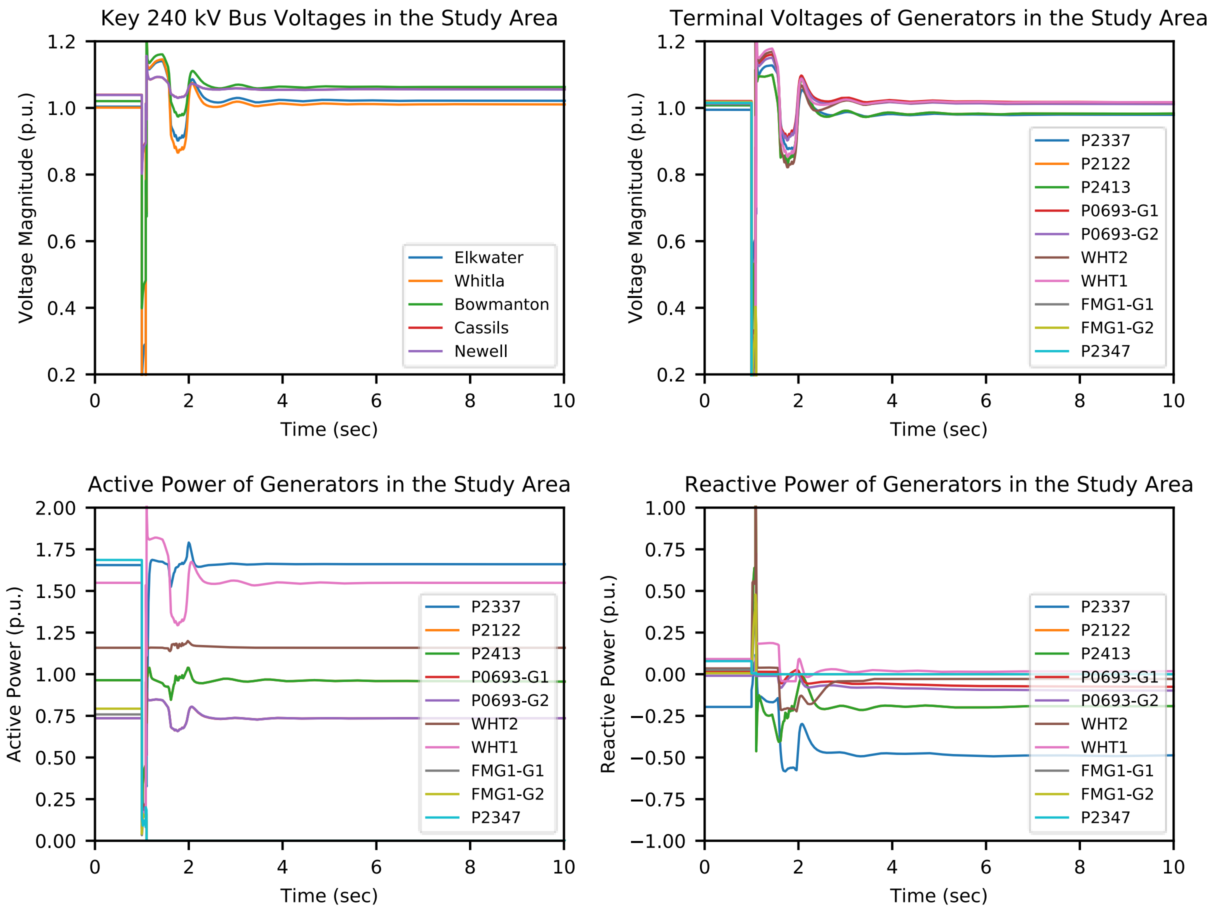
Case Description:

- Post-development 2023 summer light case
- 1100 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 52



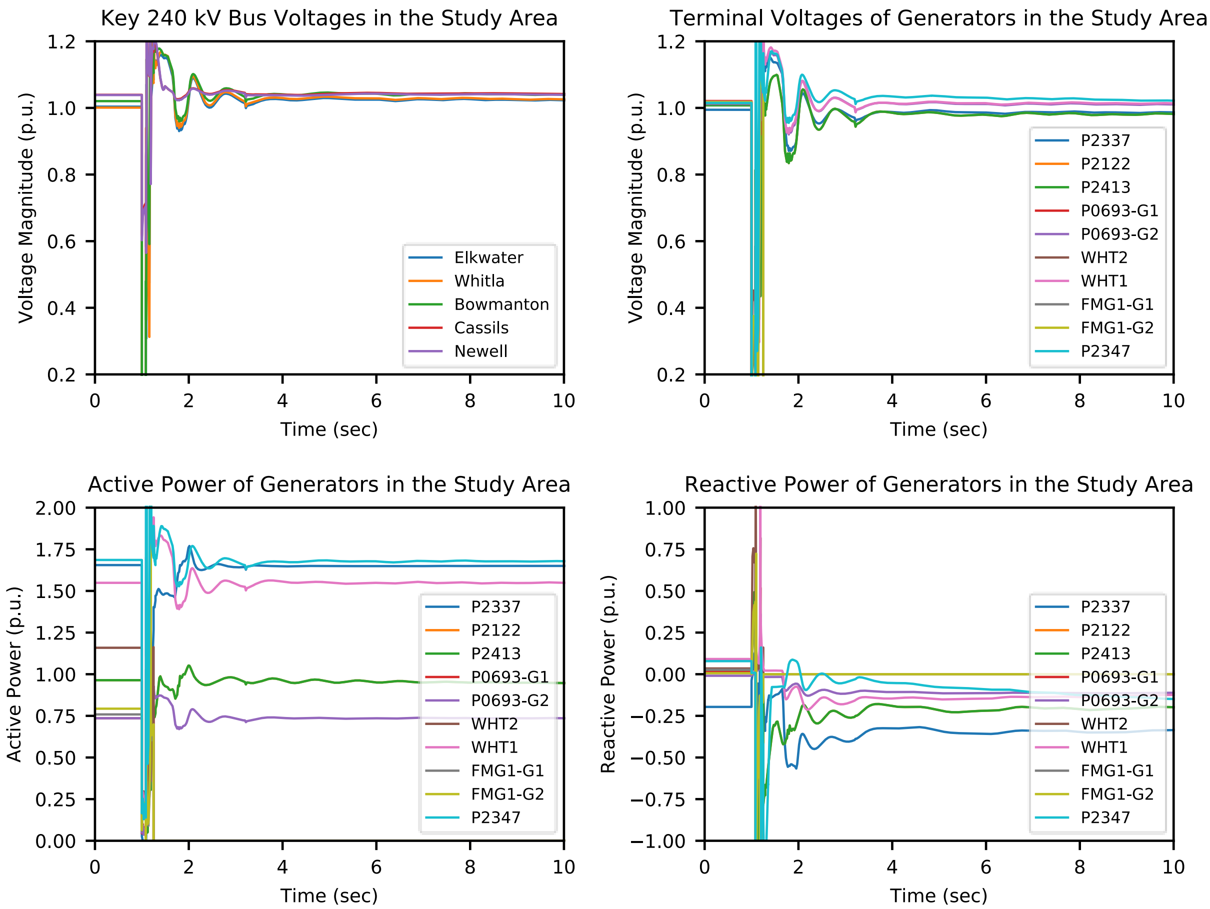
Case Description:

- Post-development 2023 summer light case
- 1100 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 53



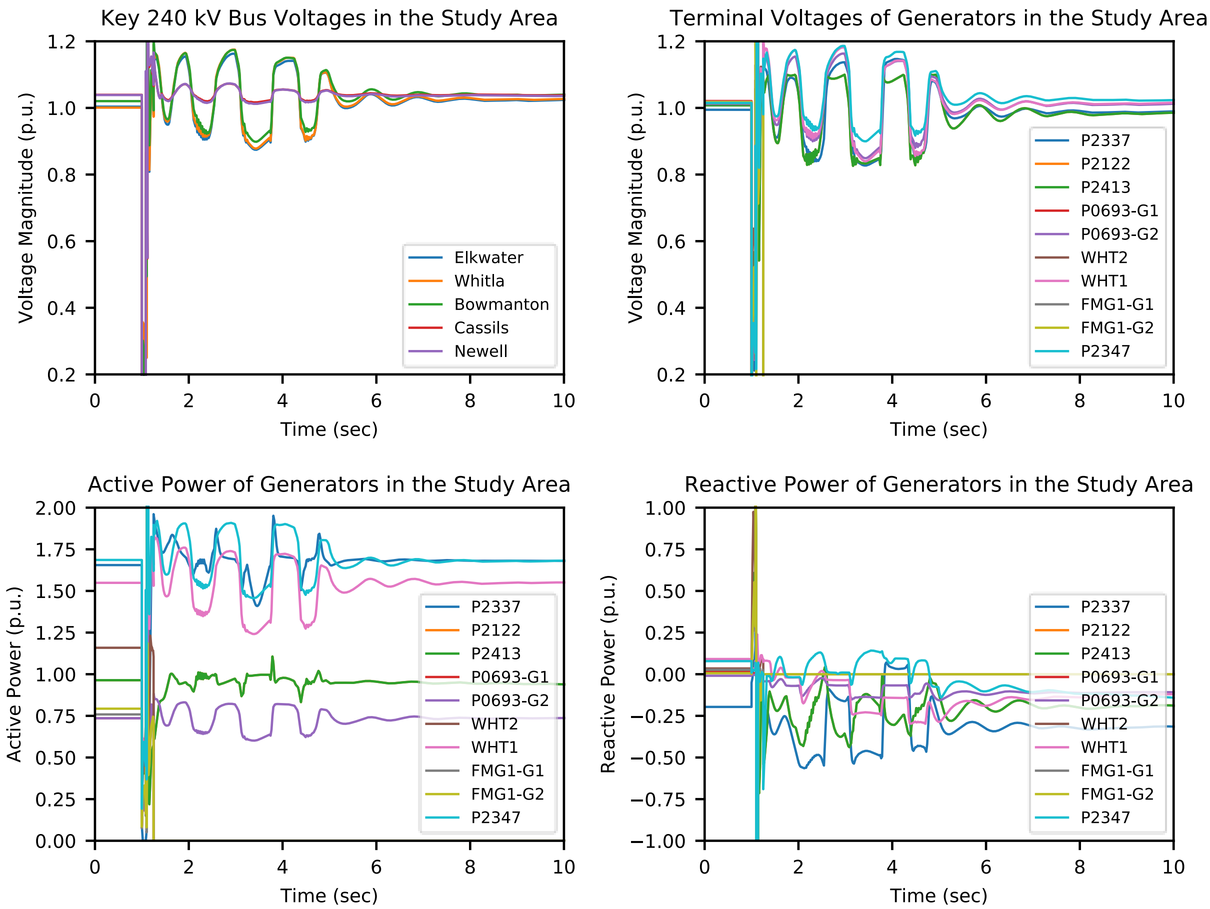
Case Description:

- Post-development 2023 summer light case
- 1100 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 54



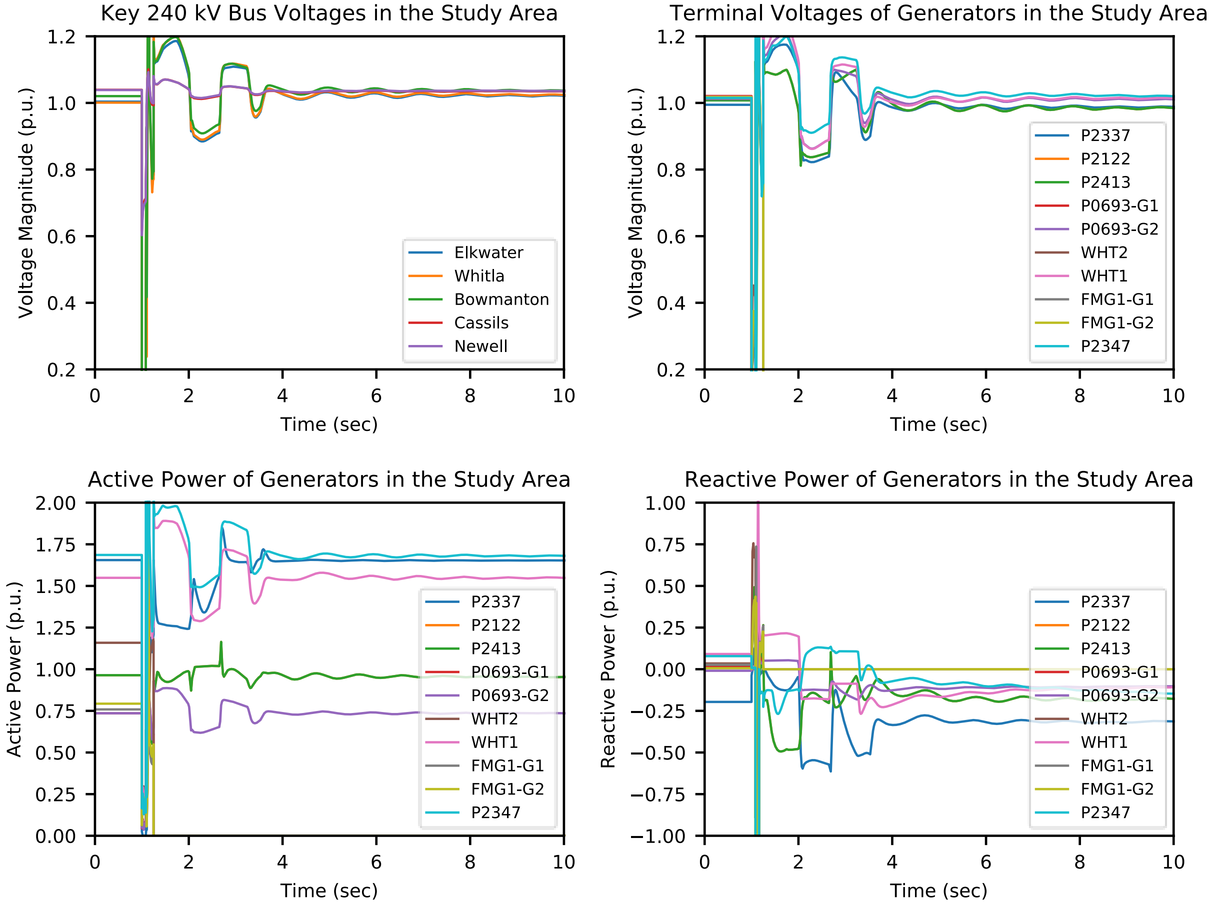
Case Description:

- Post-development 2023 summer light case
- 1100 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Cassils 324S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 55



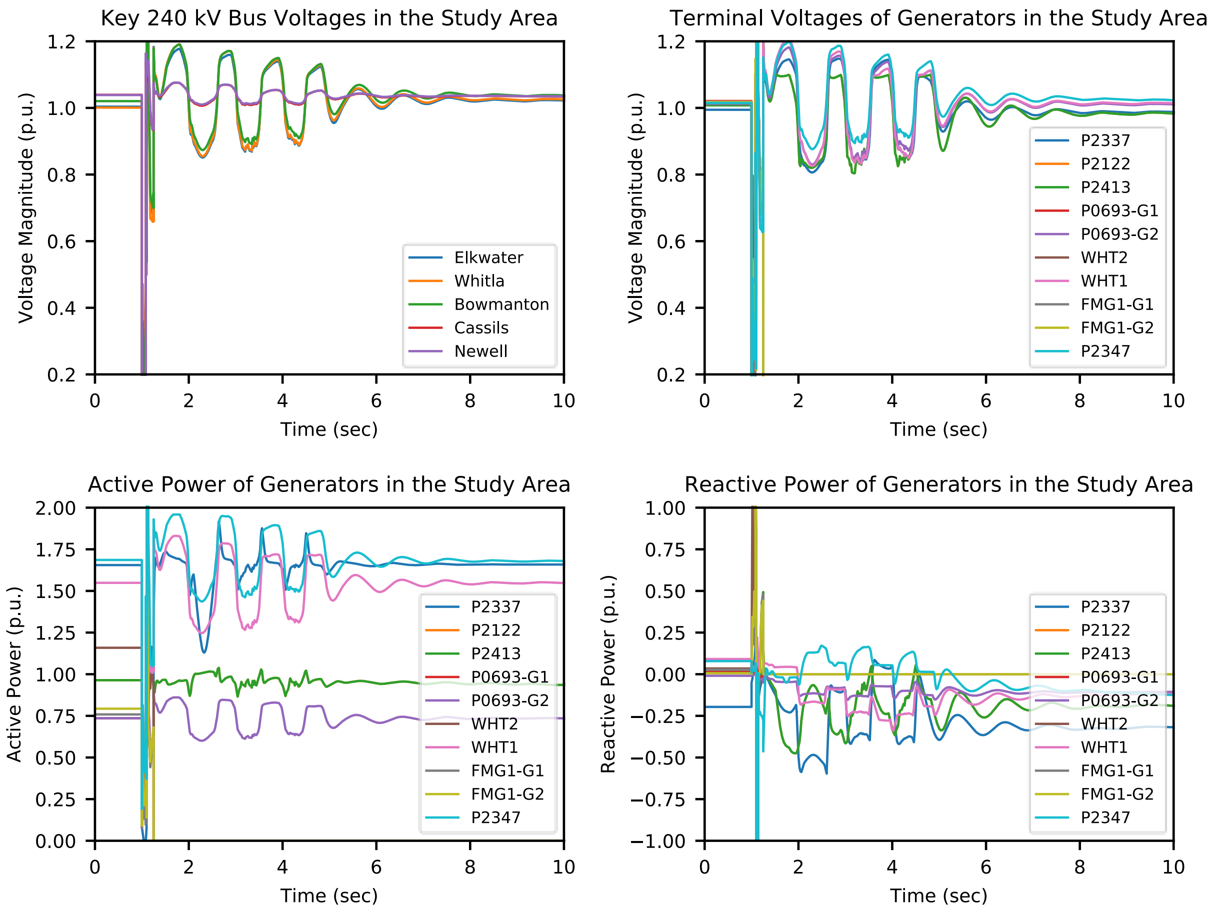
Case Description:

- Post-development 2023 summer light case
- 1100 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 56



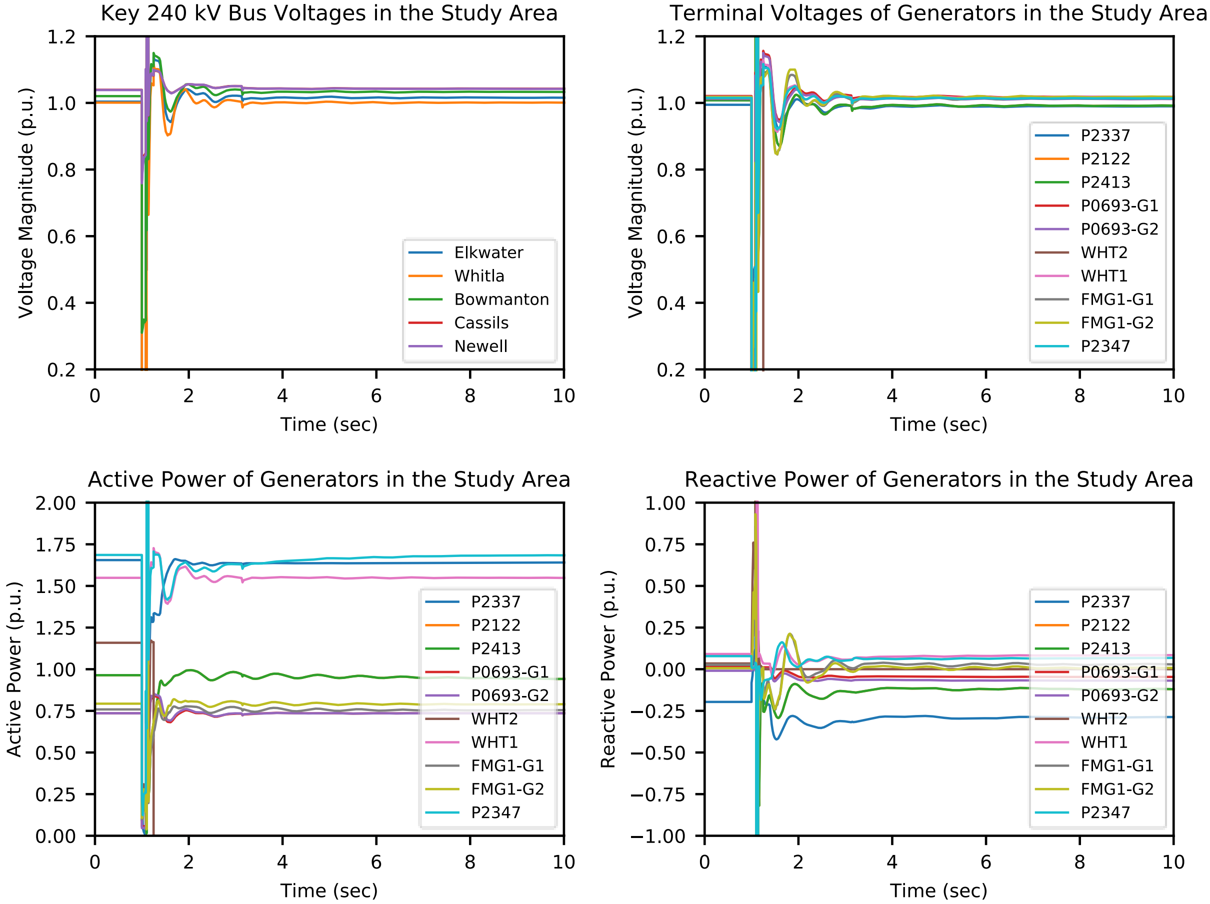
Case Description:

- Post-development 2023 summer light case
- 1100 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Newell 2075S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 57



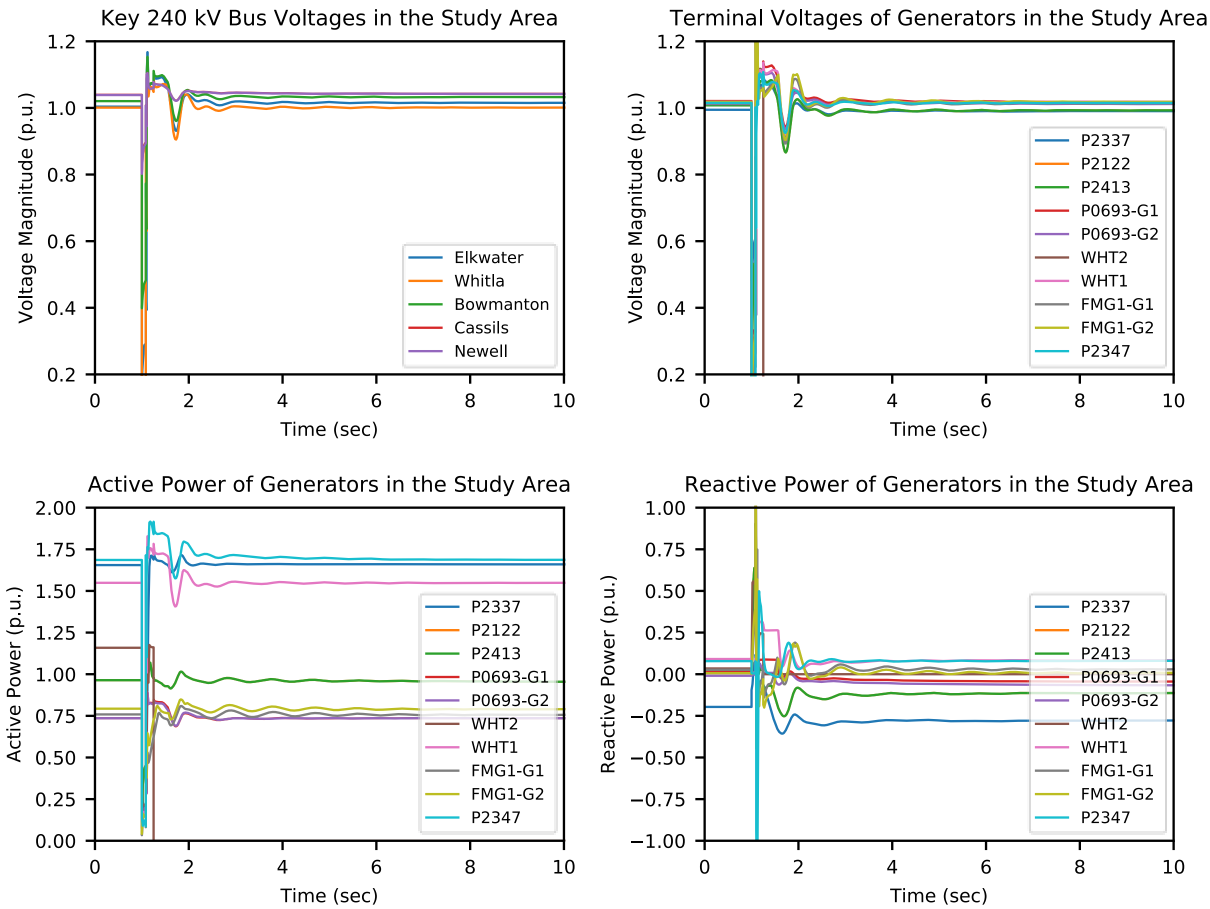
Case Description:

- Post-development 2023 summer light case
- 1100 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 58



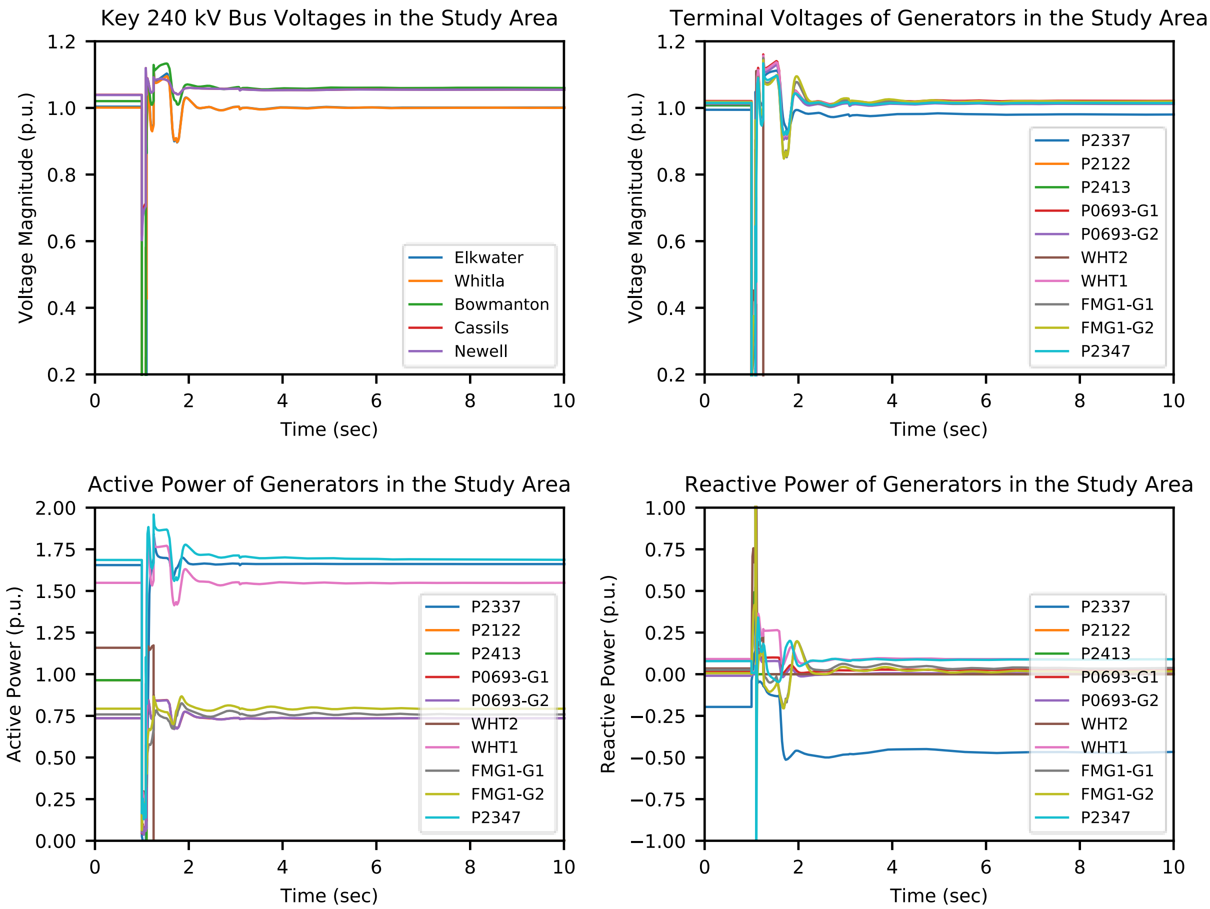
Case Description:

- Post-development 2023 summer light case
- 1100 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 59



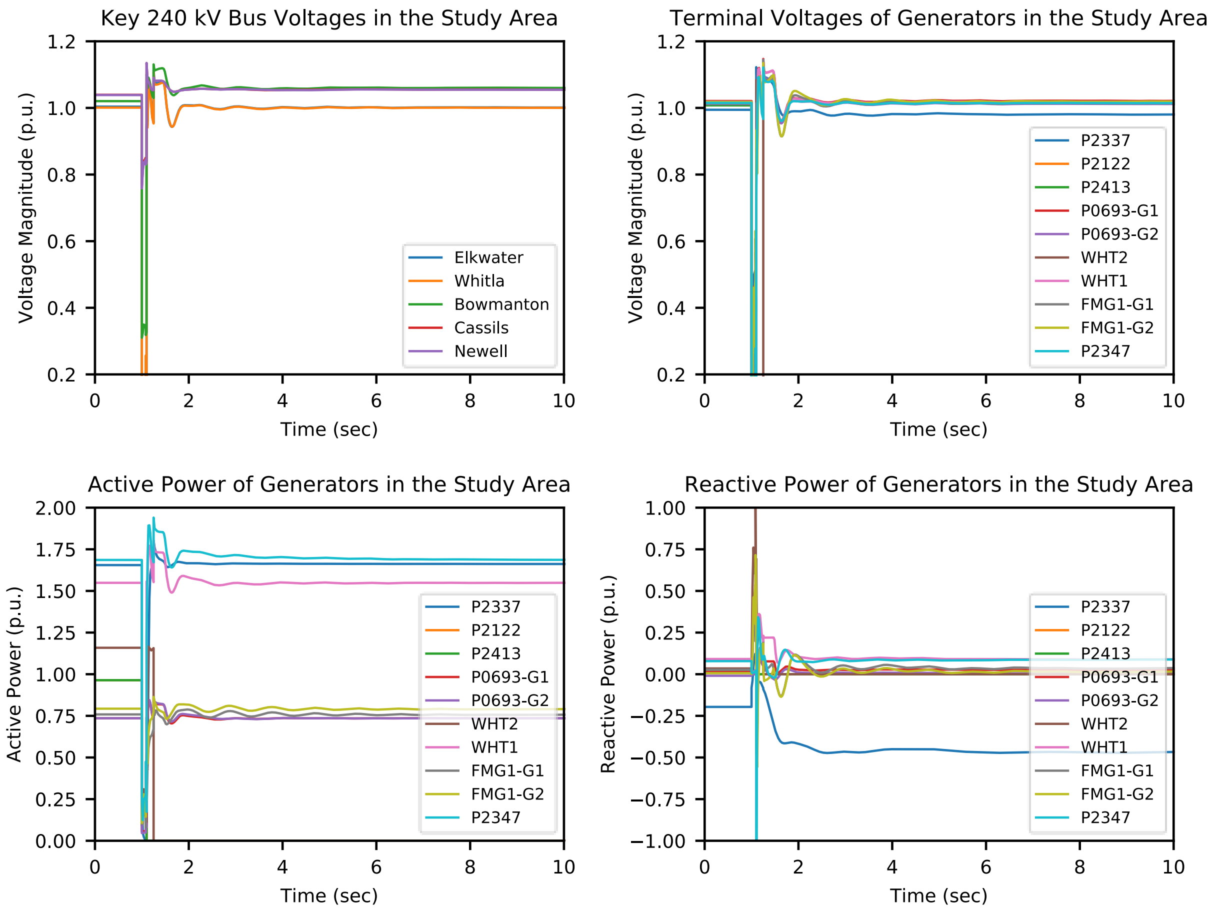
Case Description:

- Post-development 2023 summer light case
- 1100 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 60



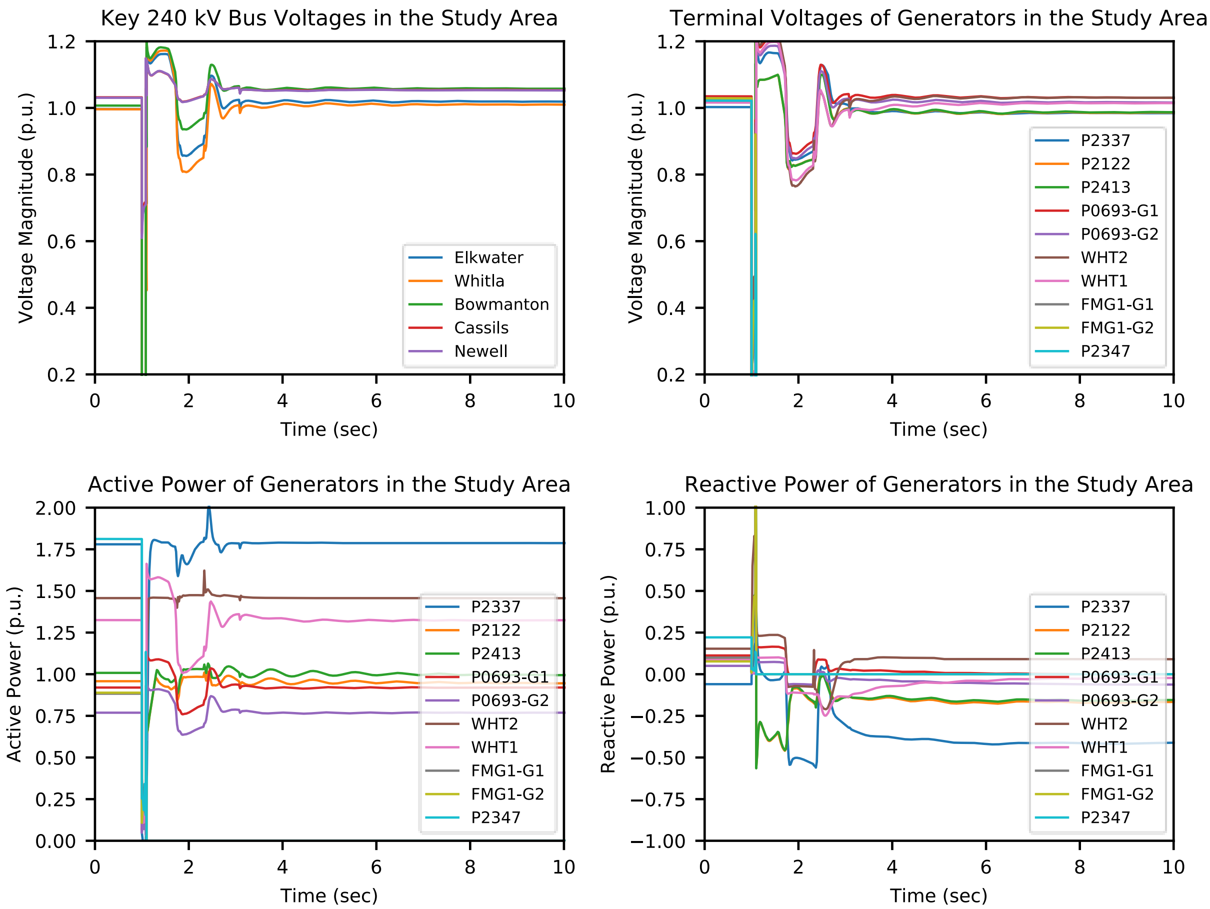
Case Description:

- Post-development 2023 summer light case
- 1100 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 61



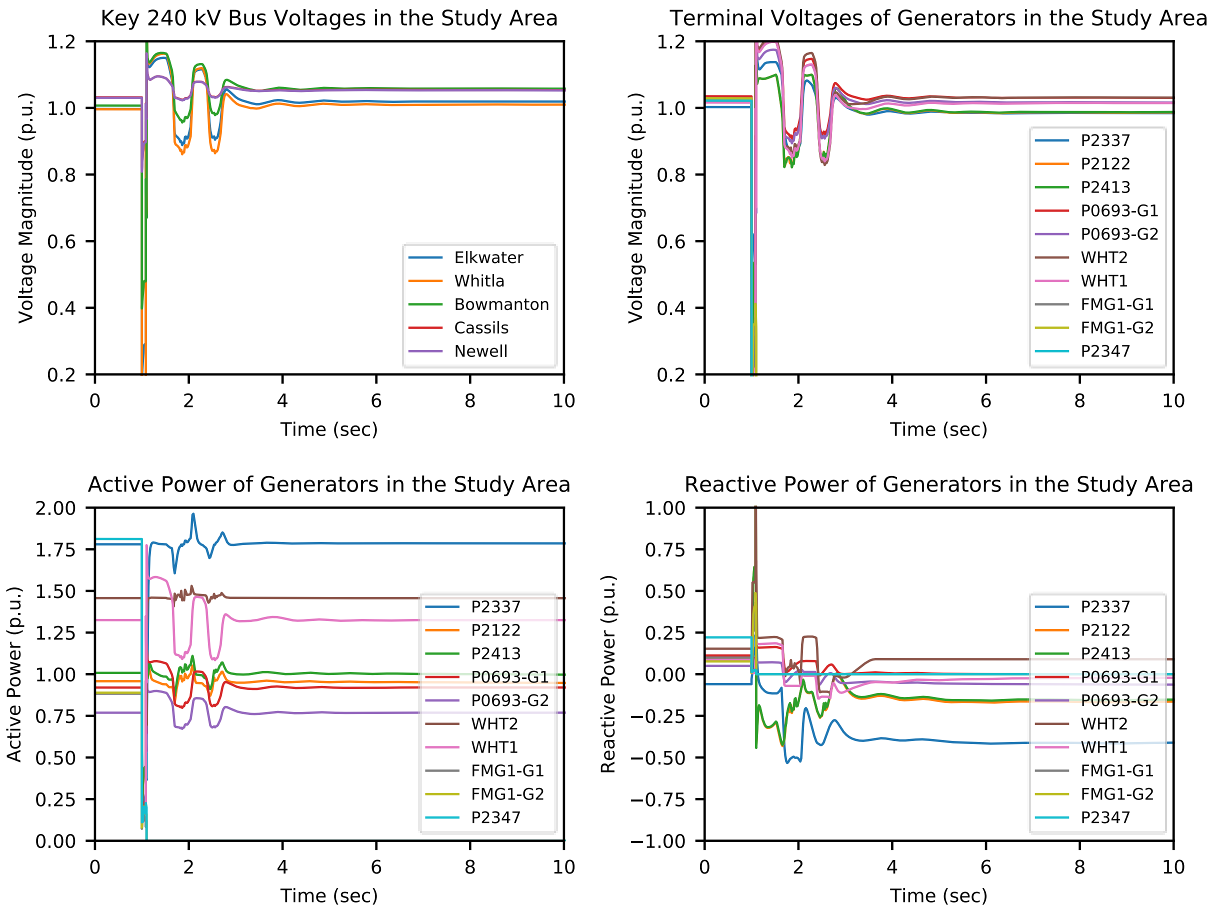
Case Description:

- Post-development 2023 summer light case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 62



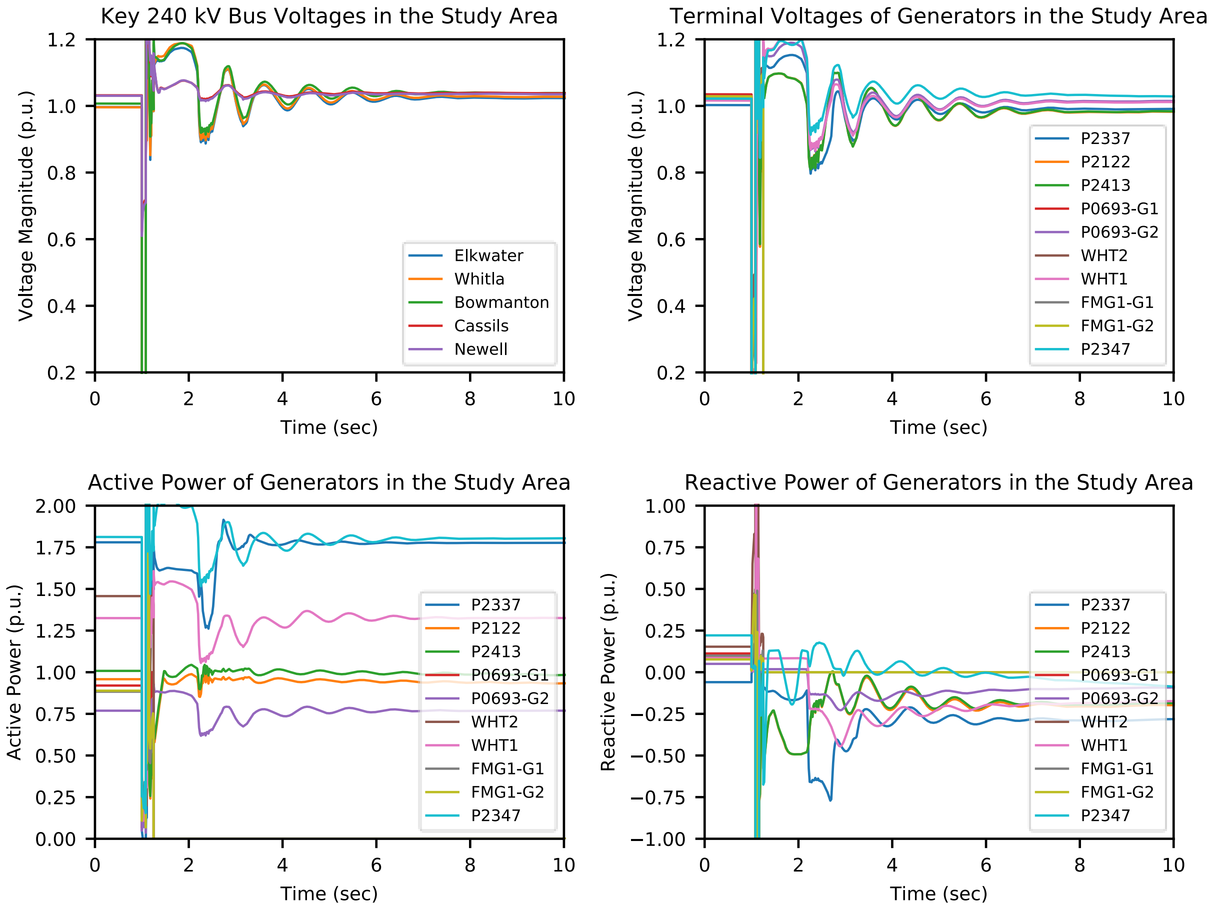
Case Description:

- Post-development 2023 summer light case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 63



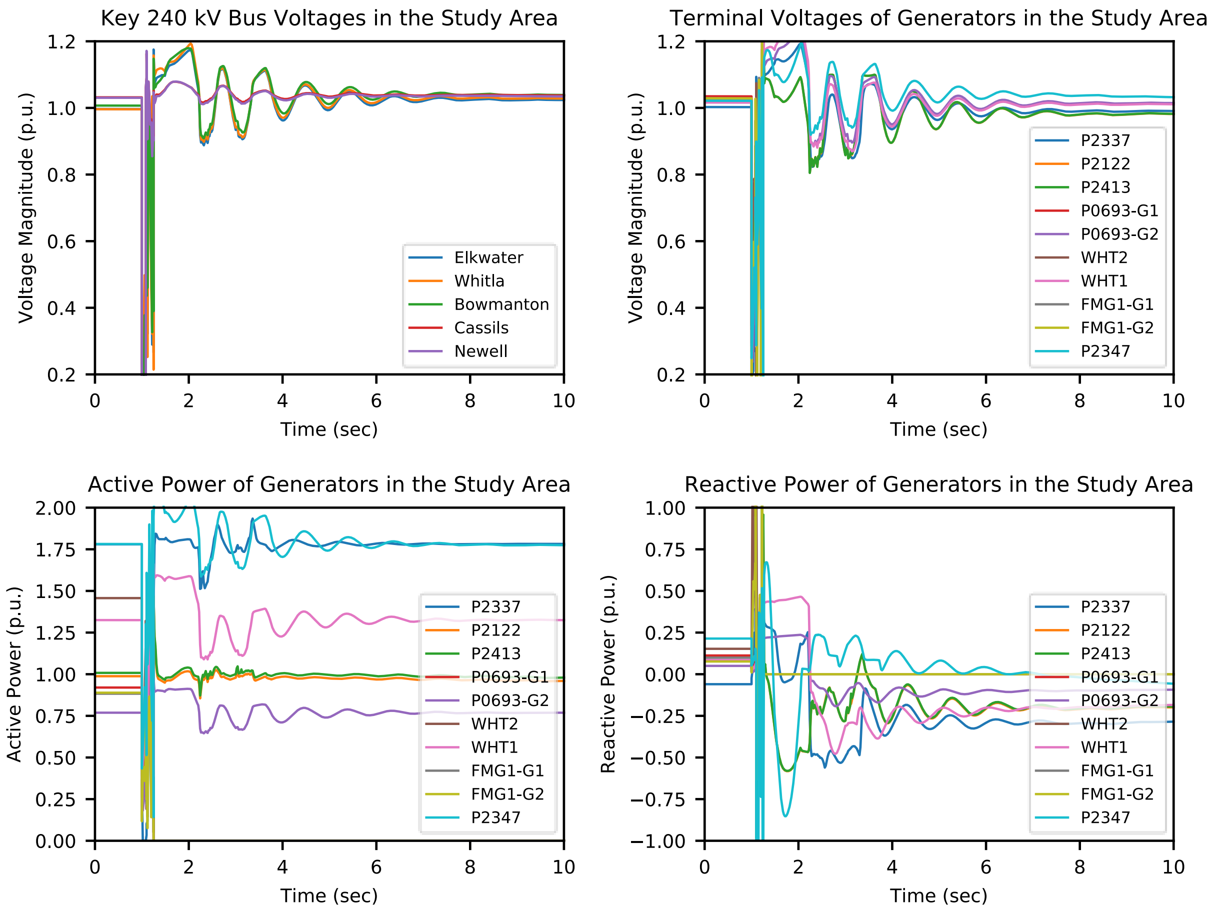
Case Description:

- Post-development 2023 summer light case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 64



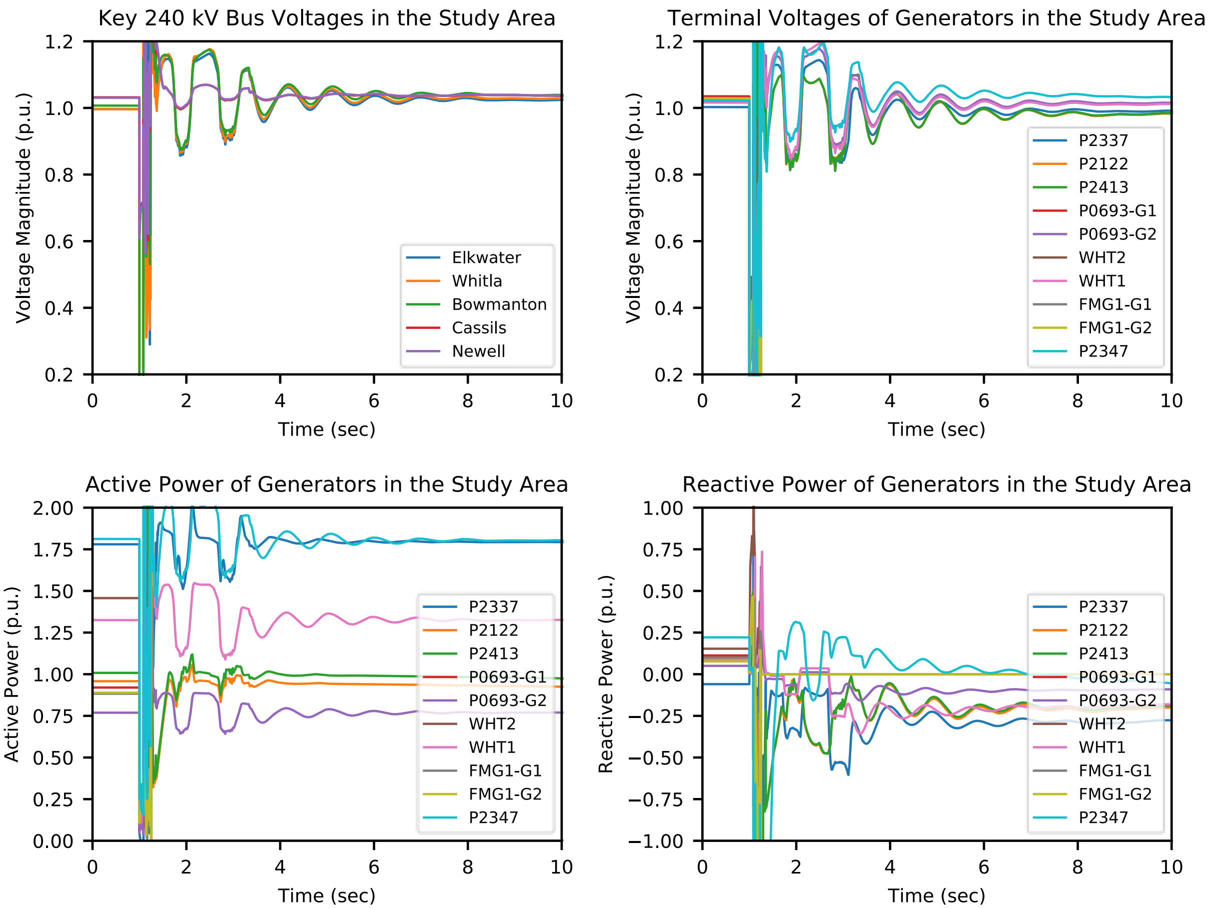
Case Description:

- Post-development 2023 summer light case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Cassils 324S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 65



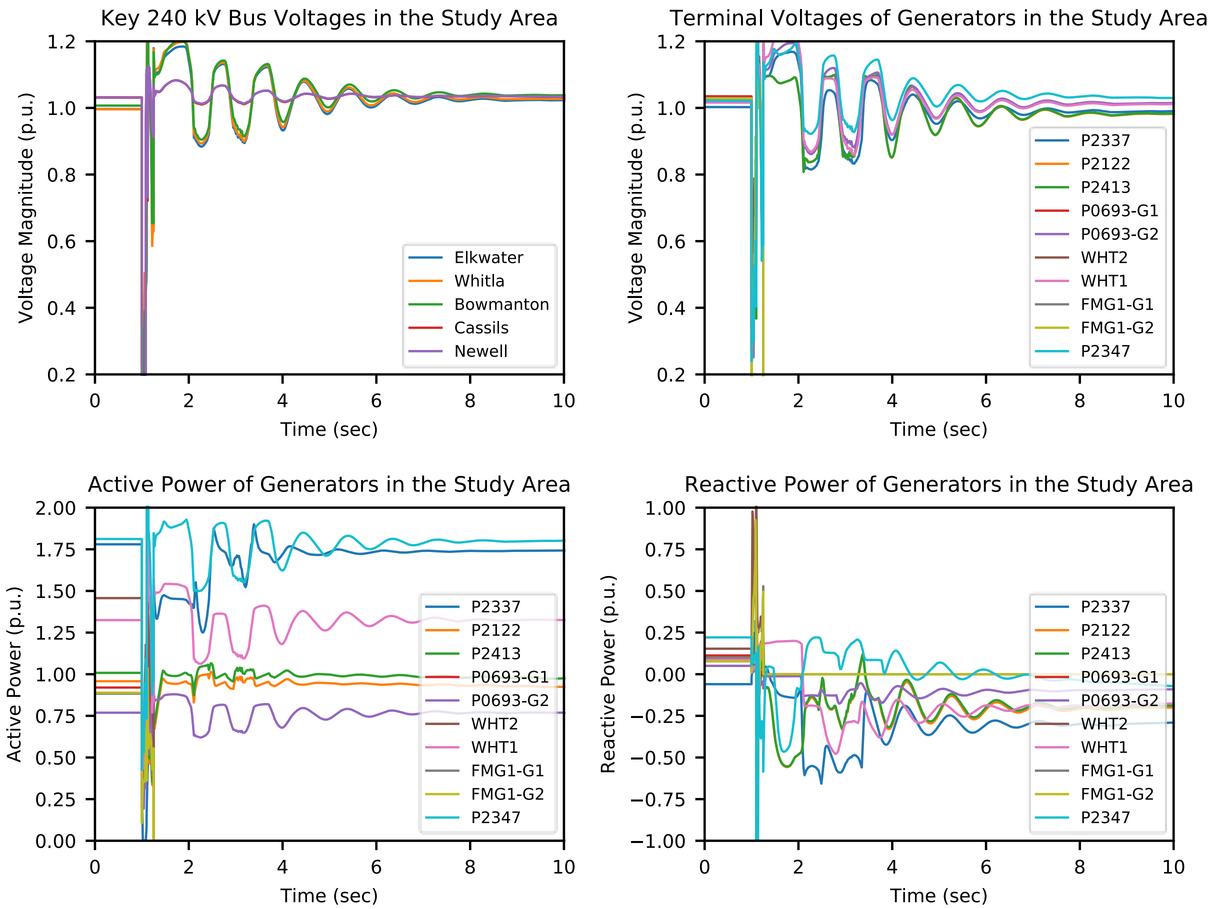
Case Description:

- Post-development 2023 summer light case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 66



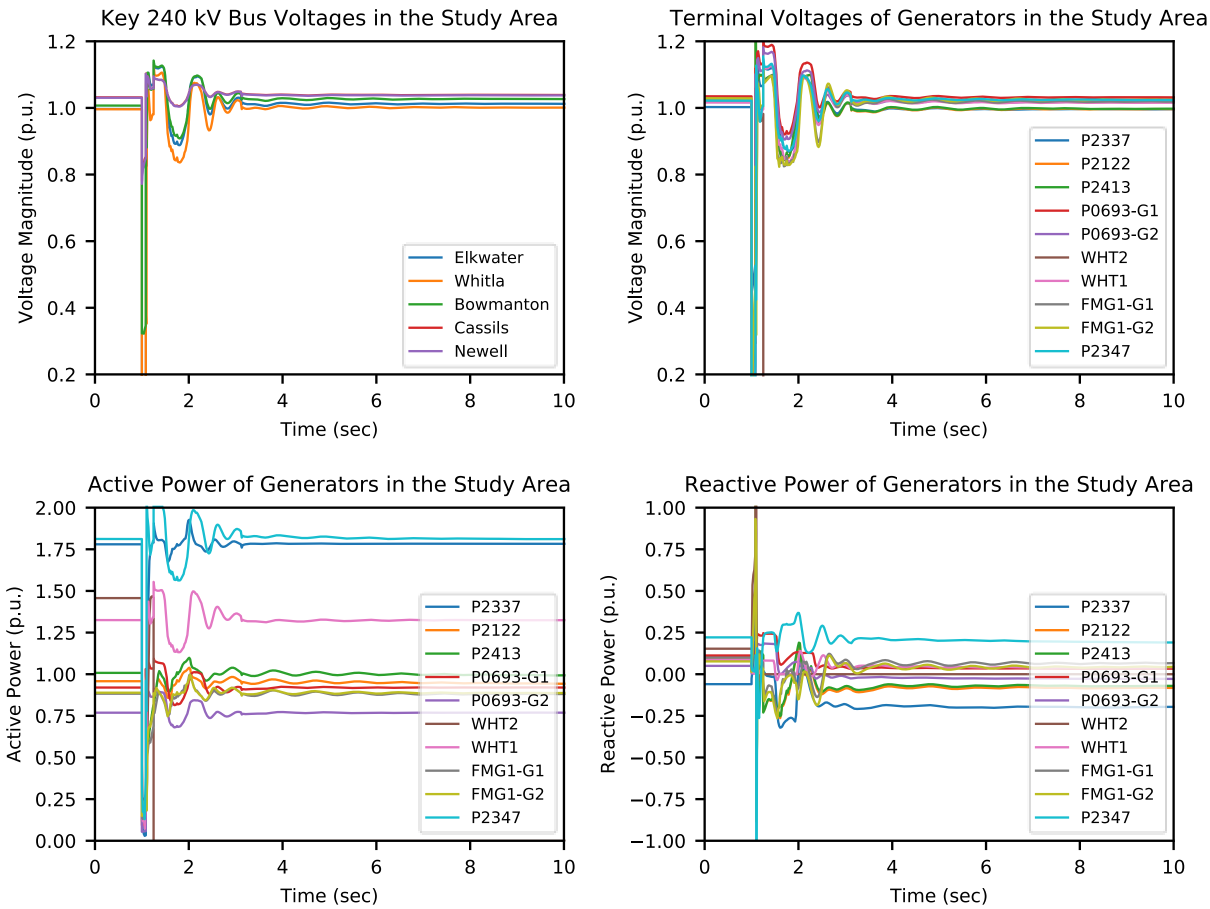
Case Description:

- Post-development 2023 summer light case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Newell 2075S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 67



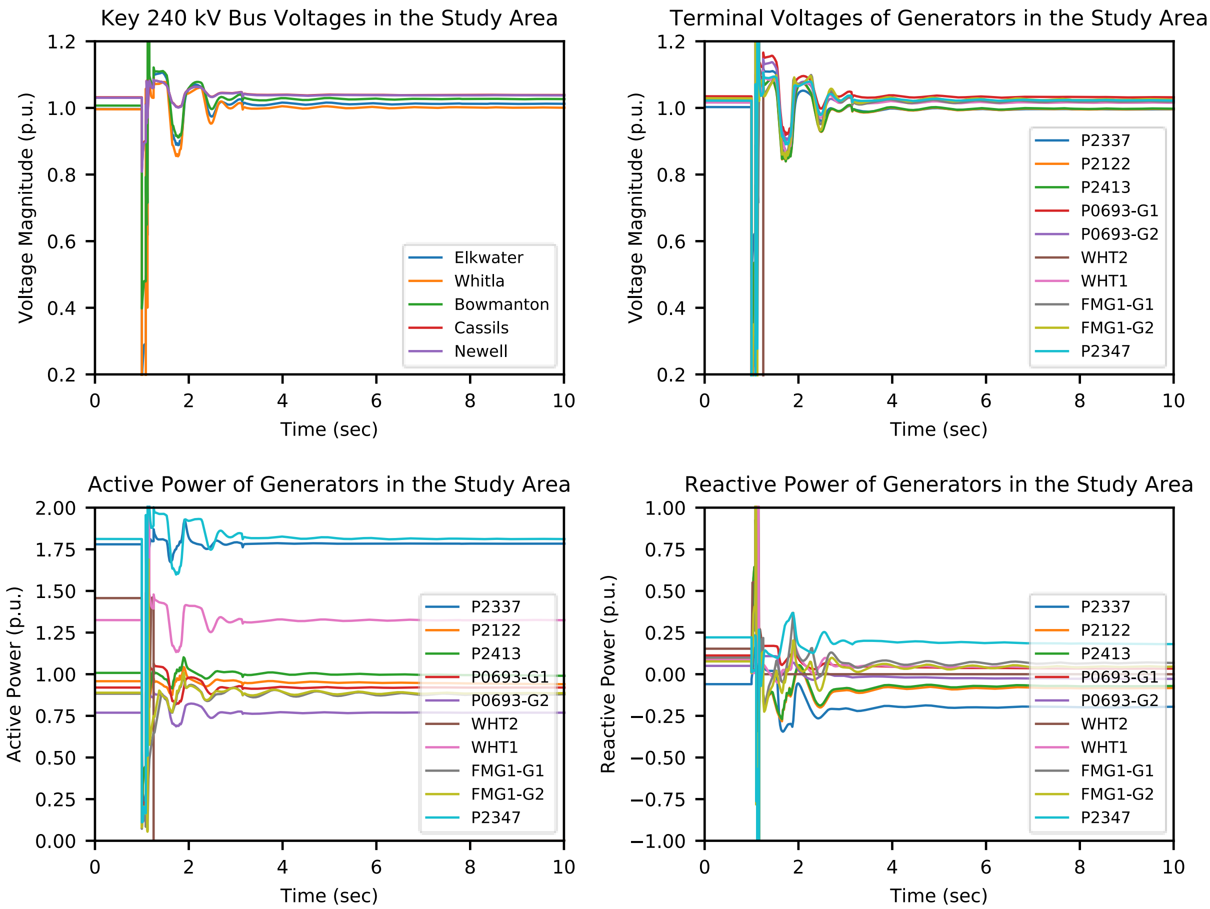
Case Description:

- Post-development 2023 summer light case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 68



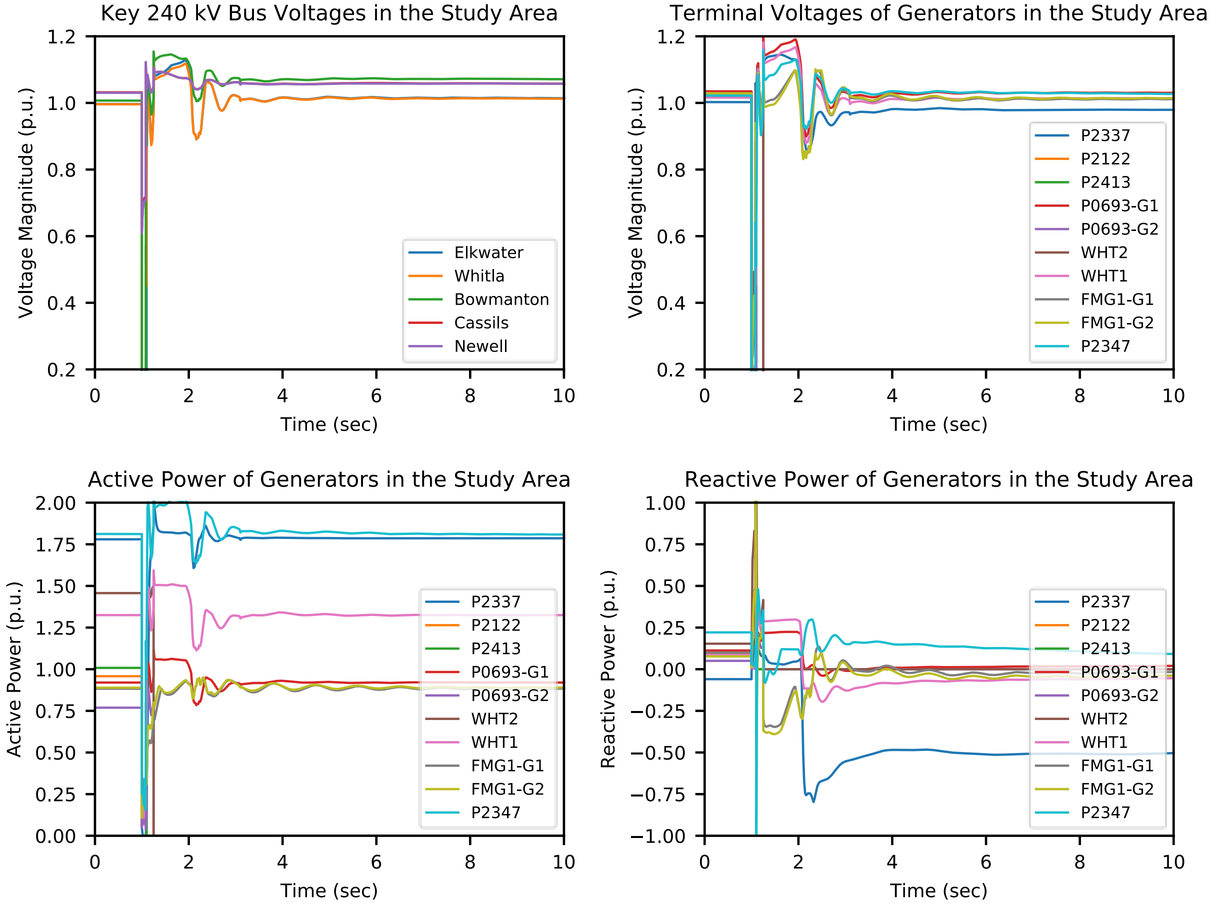
Case Description:

- Post-development 2023 summer light case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 69



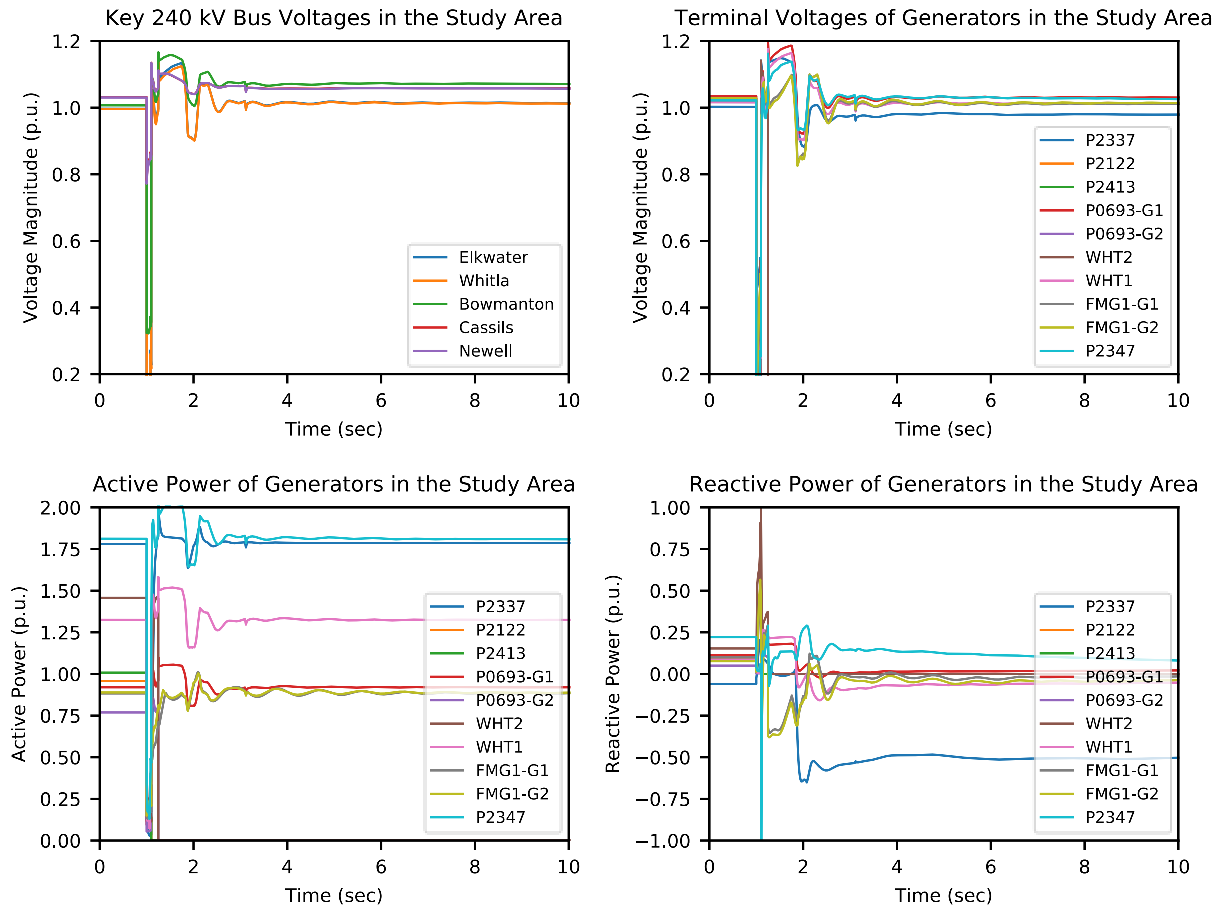
Case Description:

- Post-development 2023 summer light case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 70



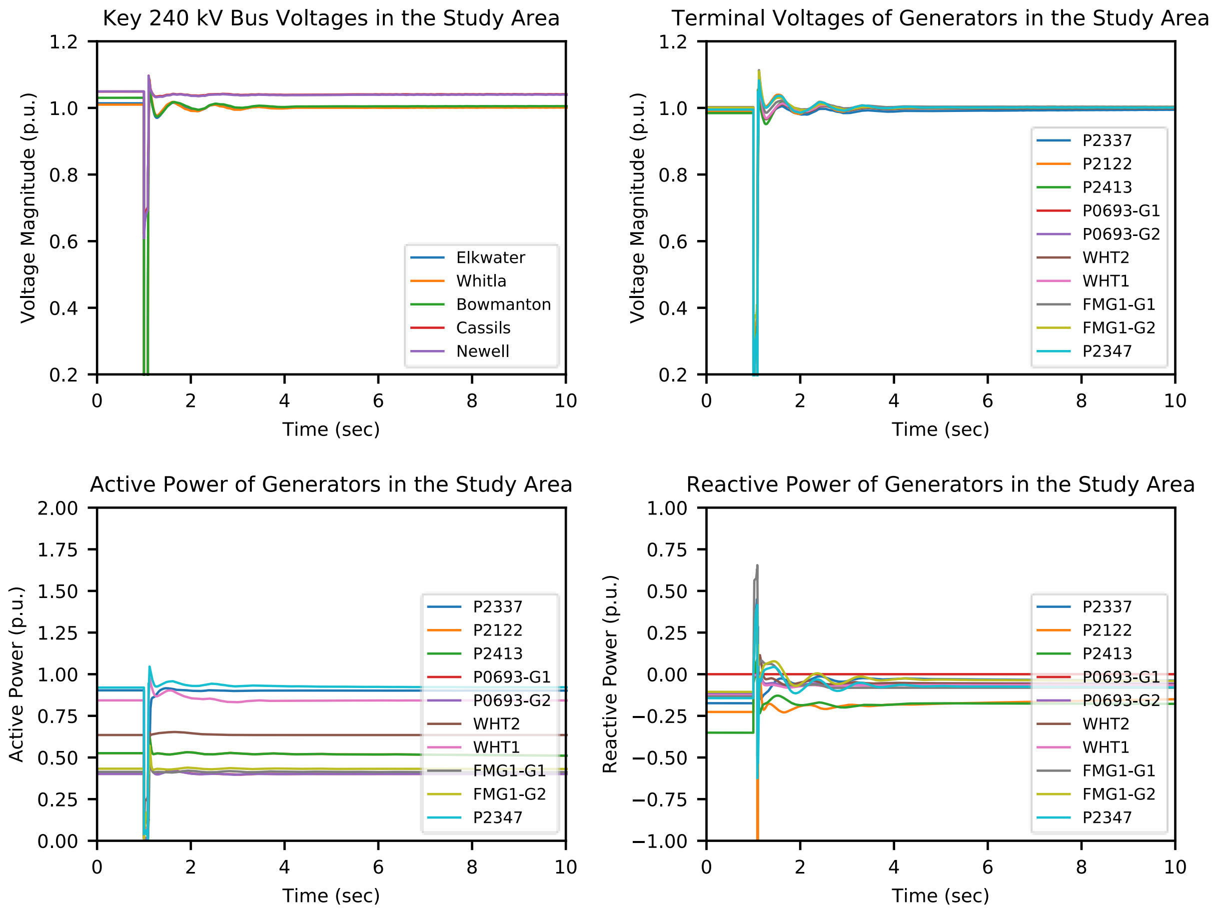
Case Description:

- Post-development 2023 summer light case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 71



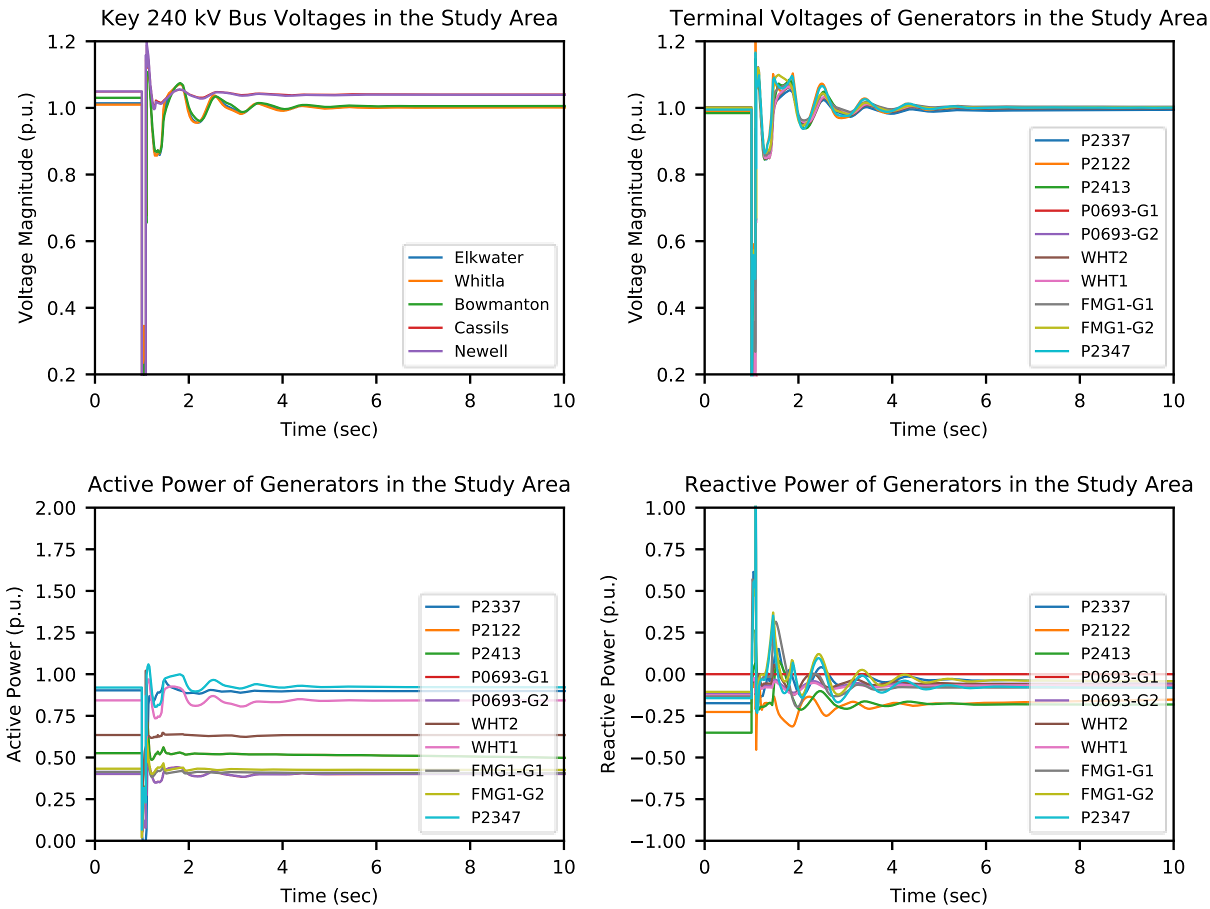
Case Description:

- Post-development 2023 summer peak case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 72



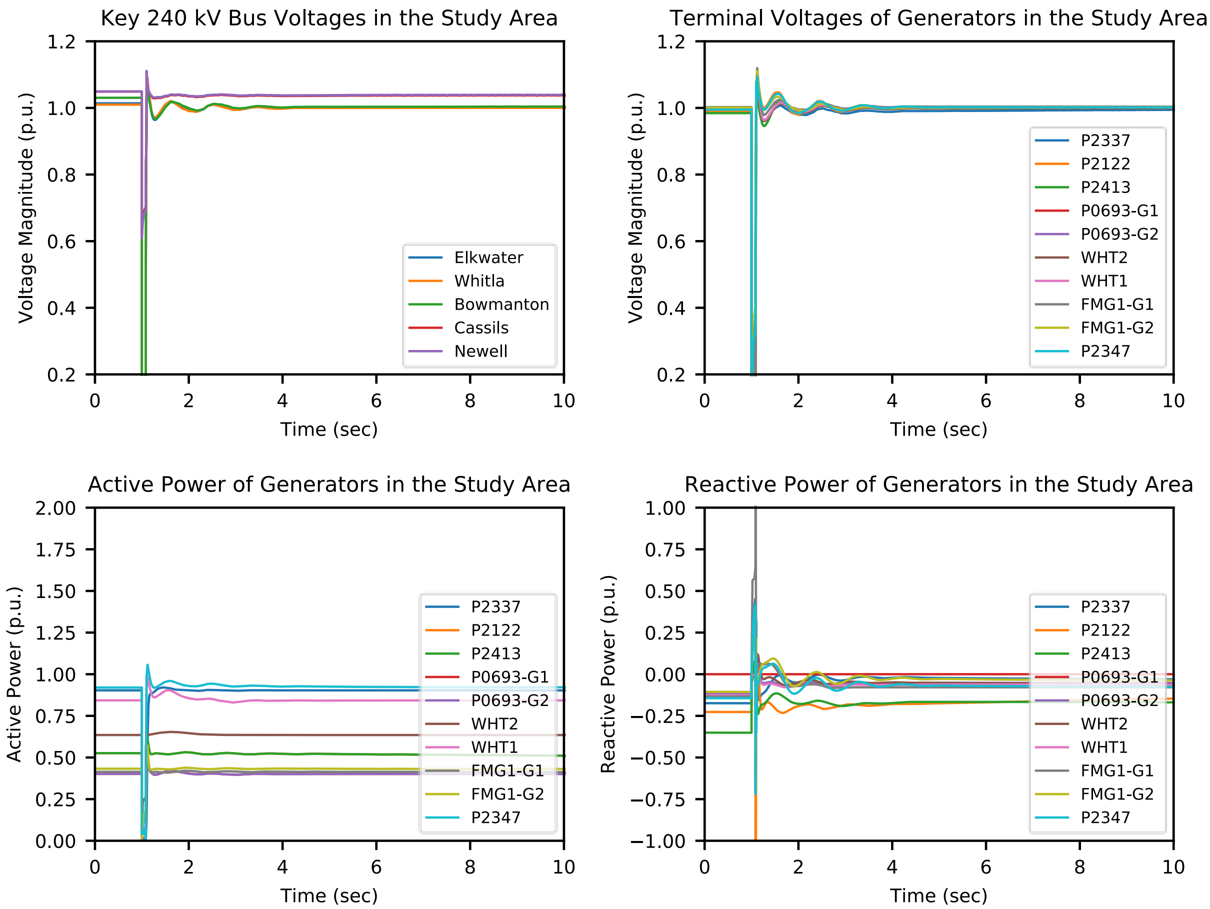
Case Description:

- Post-development 2023 summer peak case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Cassils 324S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 73



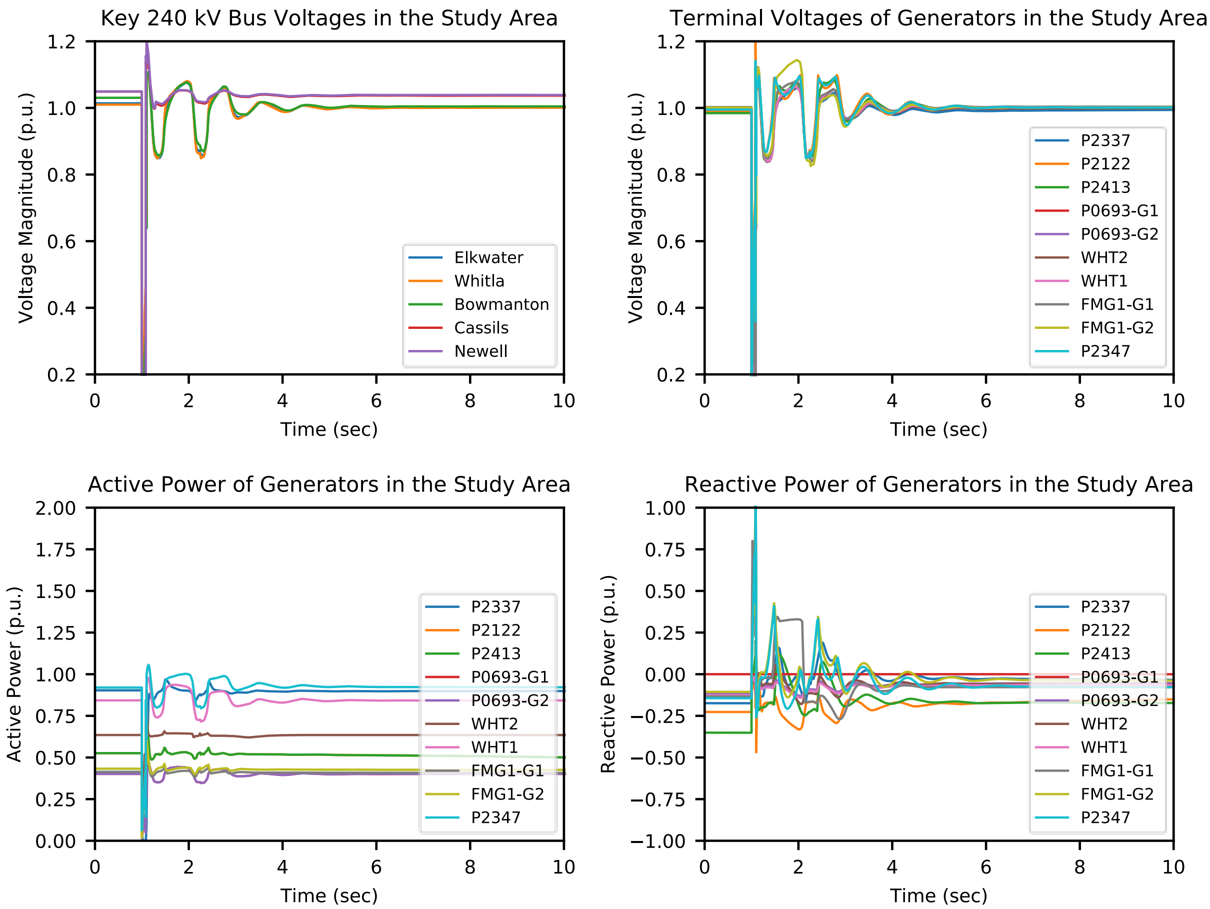
Case Description:

- Post-development 2023 summer peak case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 74



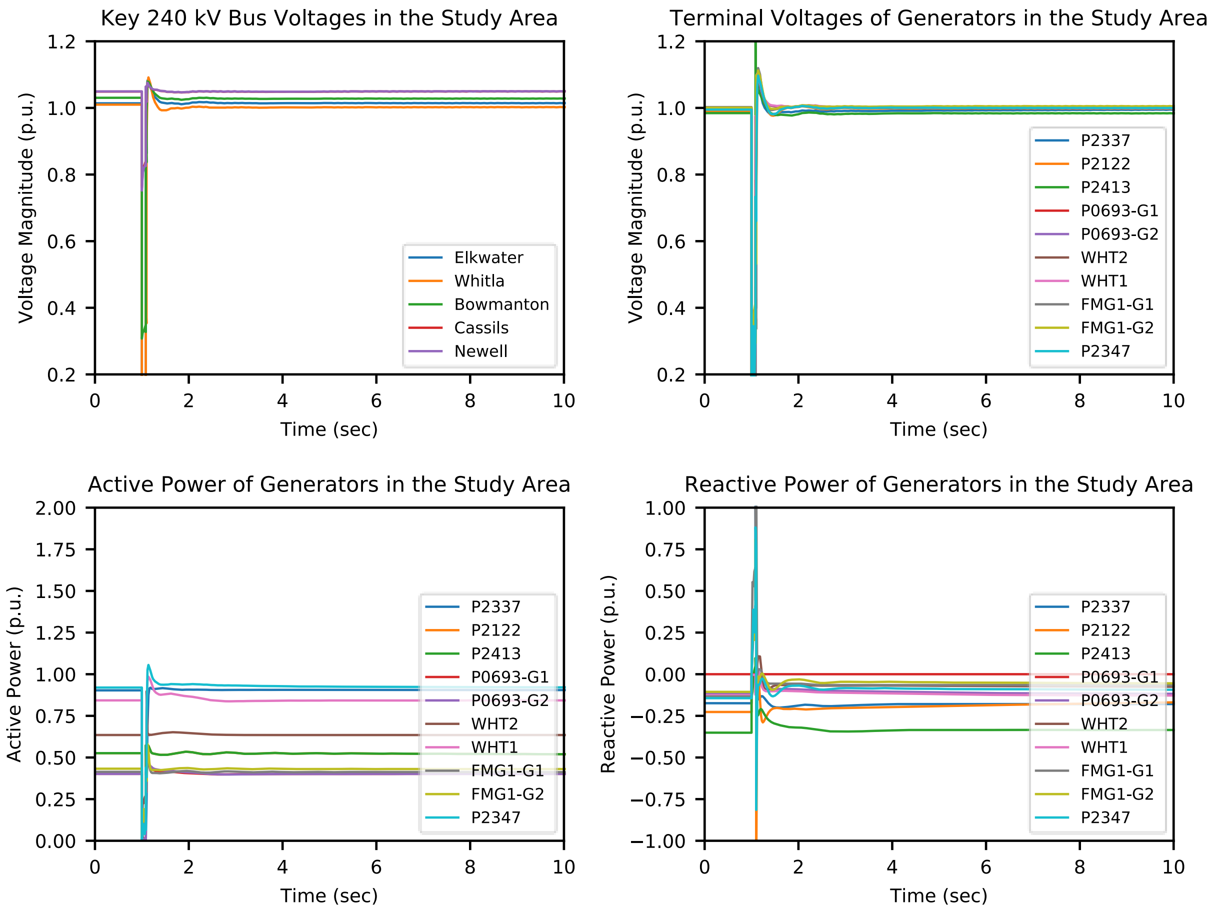
Case Description:

- Post-development 2023 summer peak case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Newell 2075S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 75



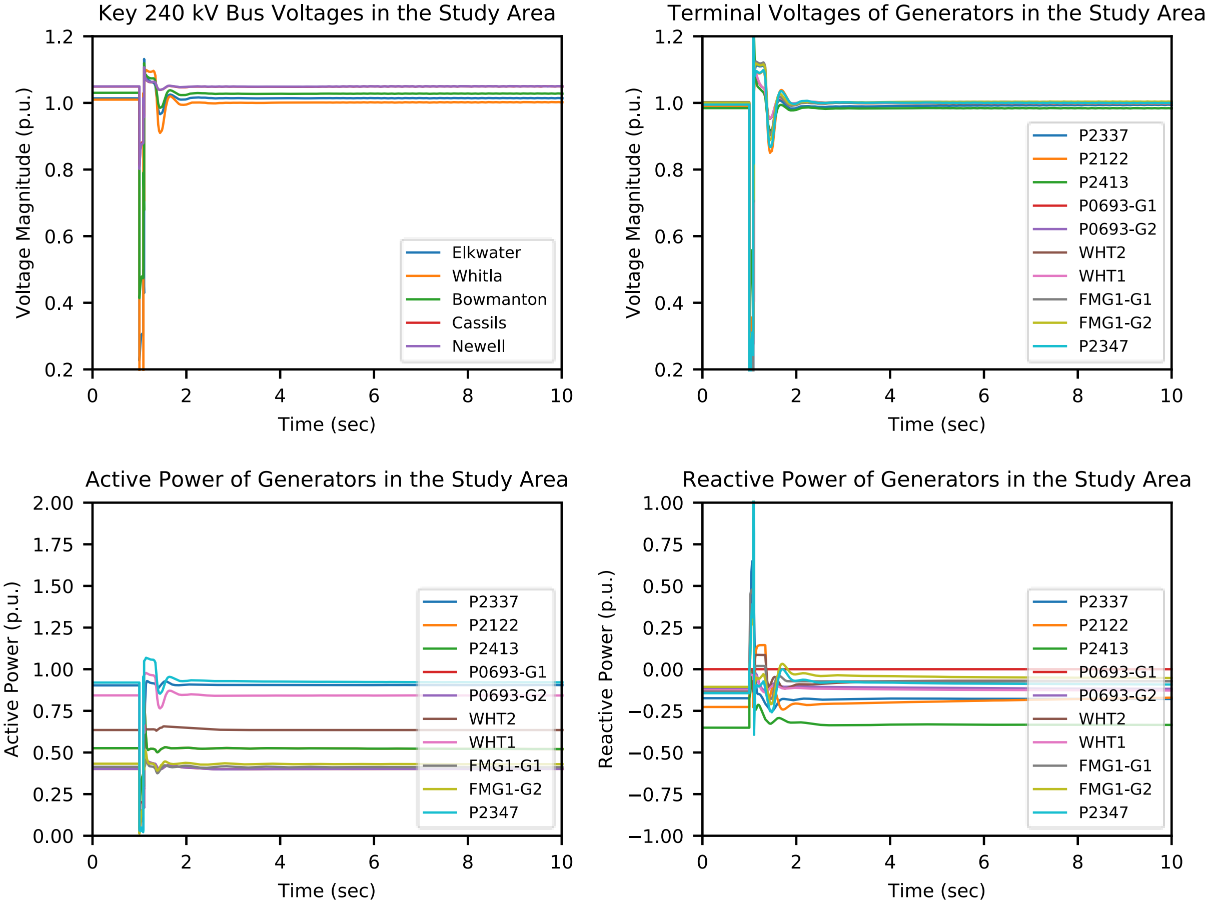
Case Description:

- Post-development 2023 summer peak case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 76



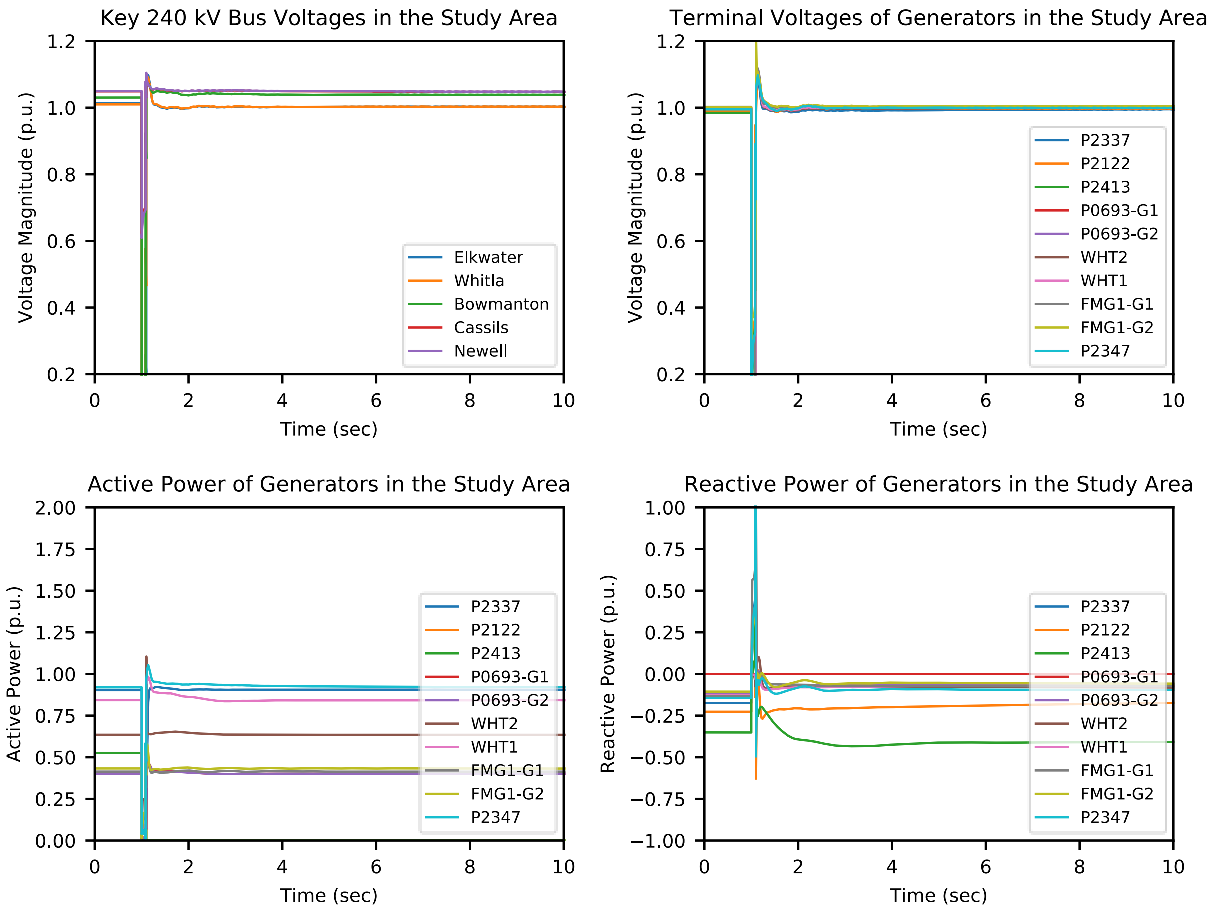
Case Description:

- Post-development 2023 summer peak case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 77



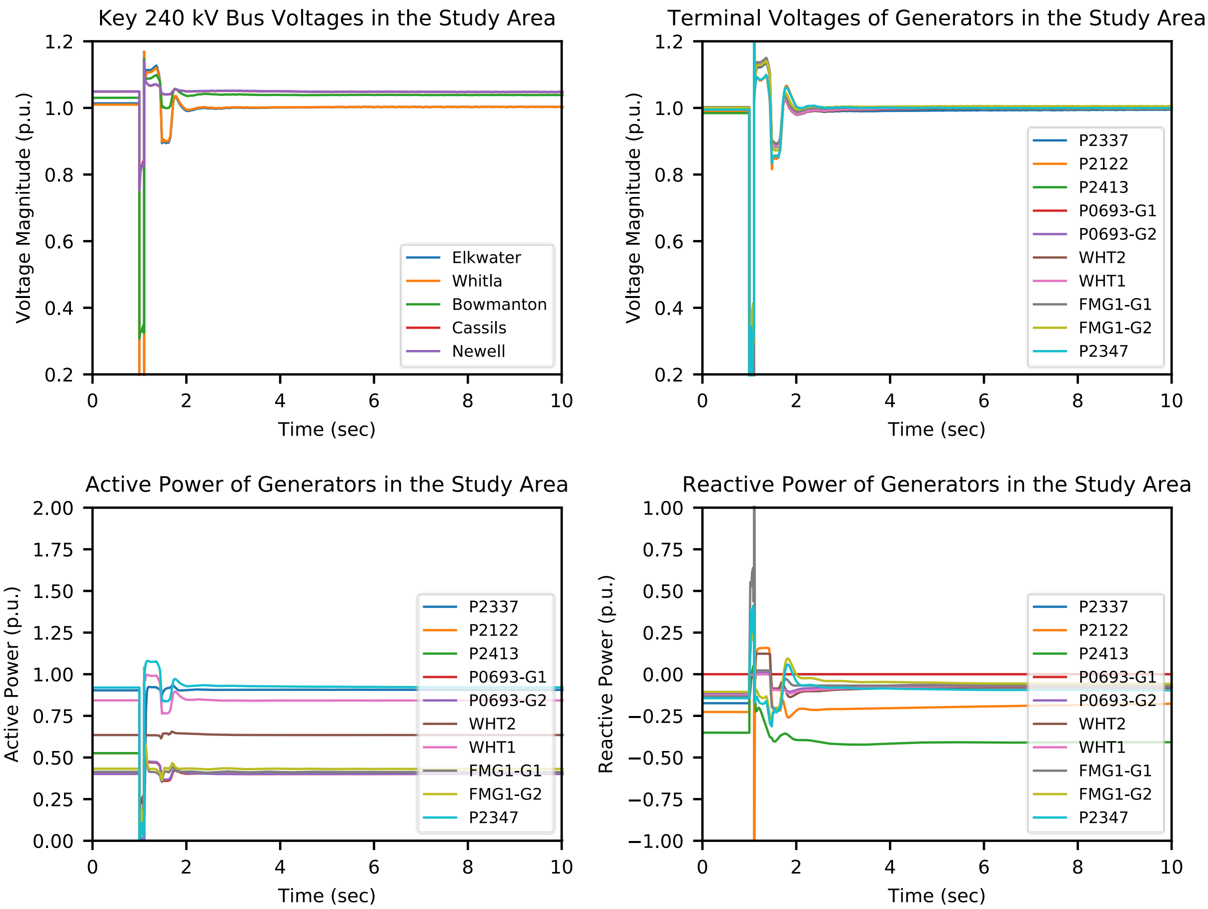
Case Description:

- Post-development 2023 summer peak case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 78



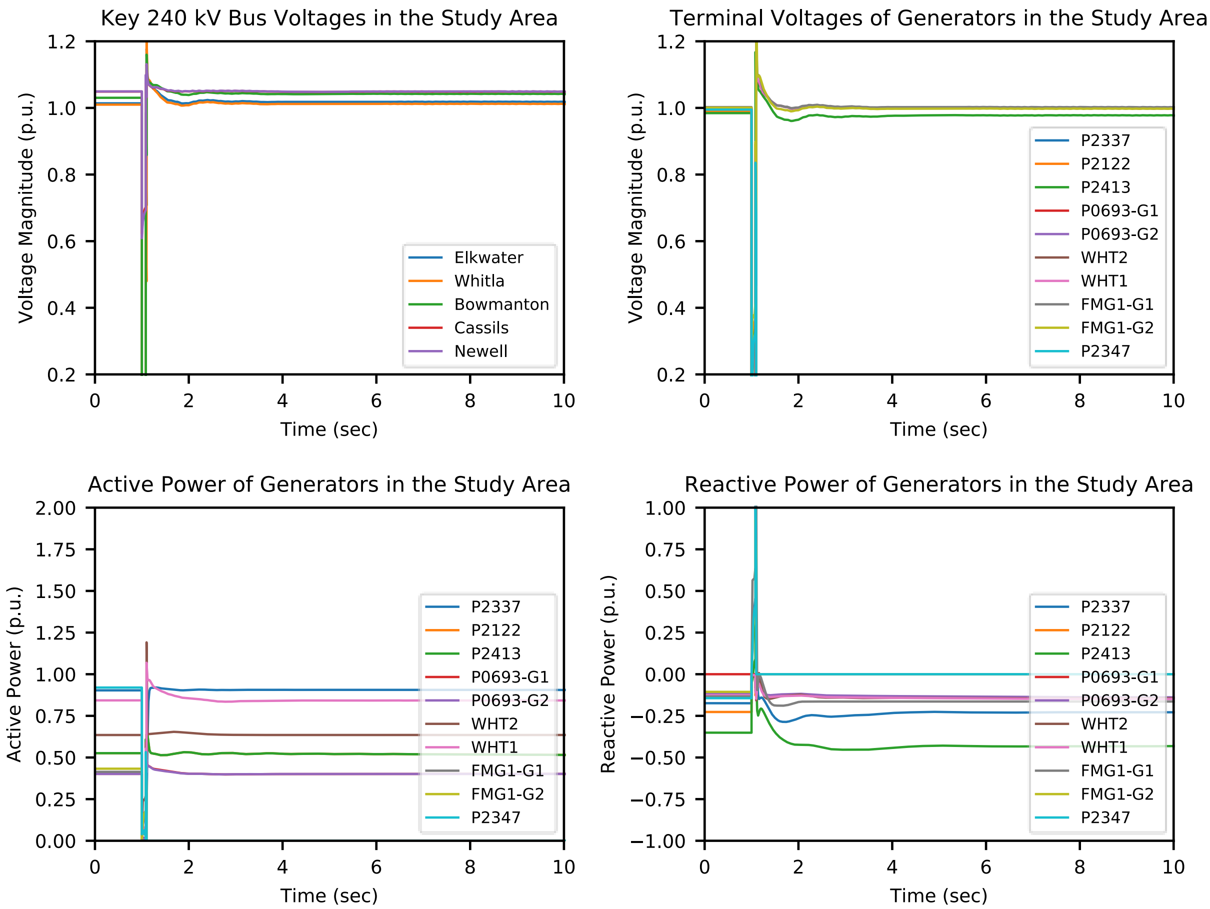
Case Description:

- Post-development 2023 summer peak case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 79



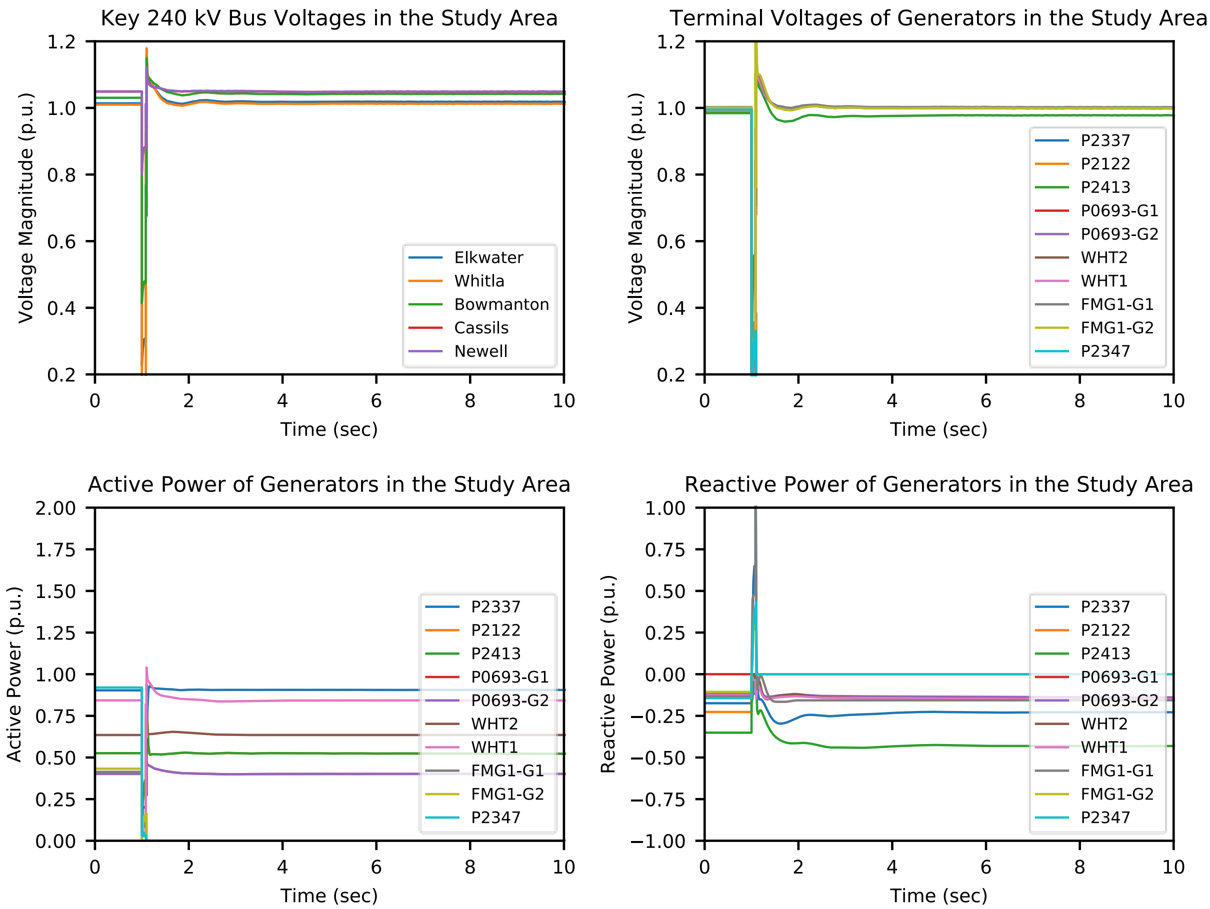
Case Description:

- Post-development 2023 summer peak case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 80



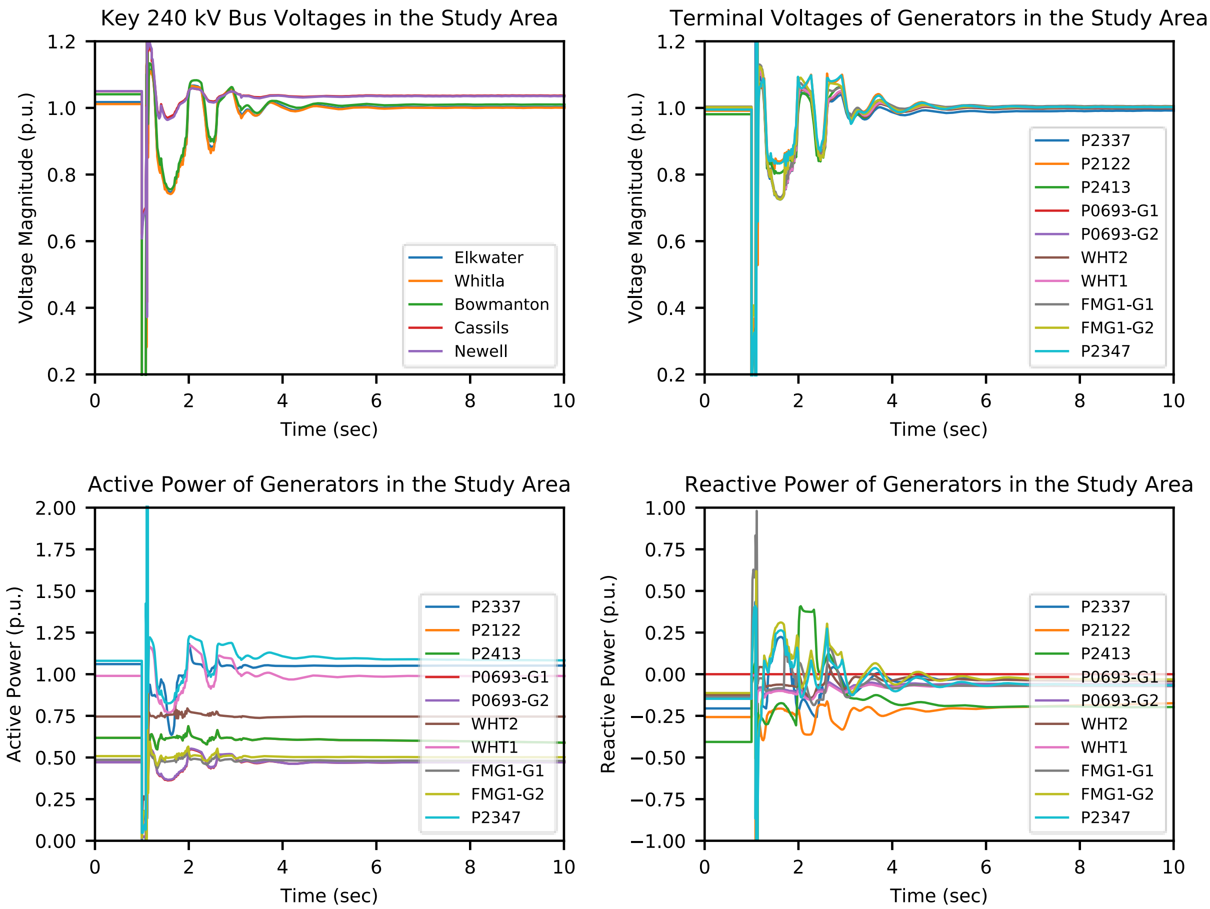
Case Description:

- Post-development 2023 summer peak case
- 600 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 81



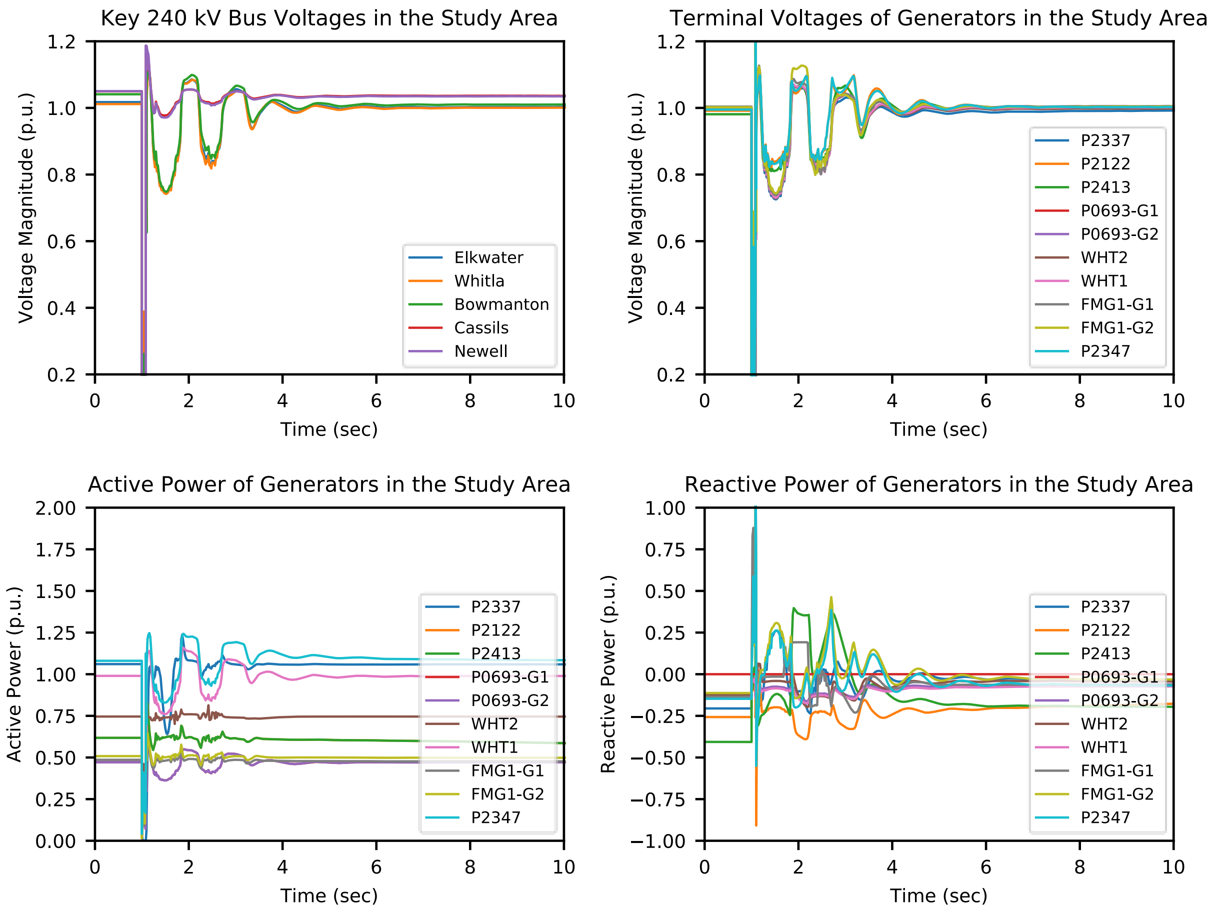
Case Description:

- Post-development 2023 summer peak case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 82



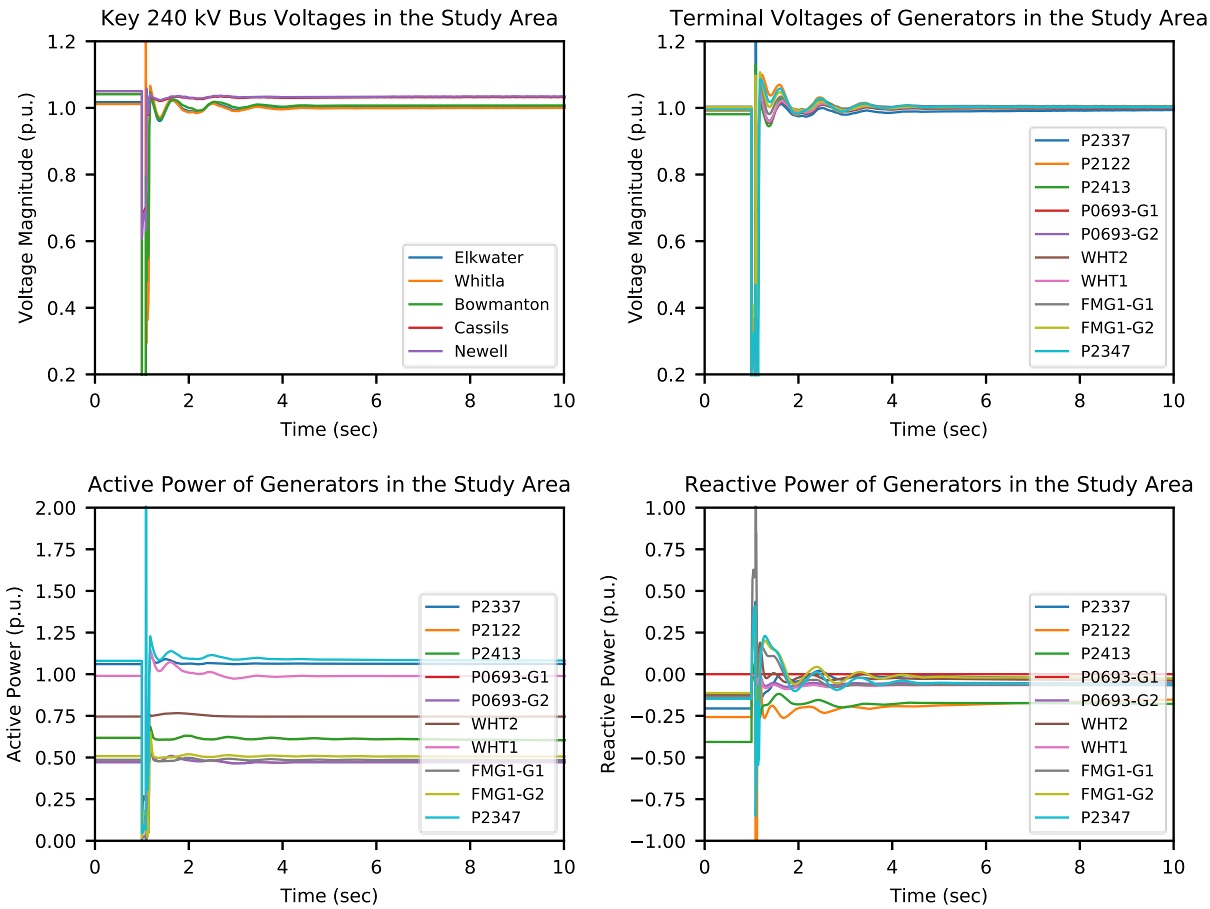
Case Description:

- Post-development 2023 summer peak case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Cassils 324S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 83



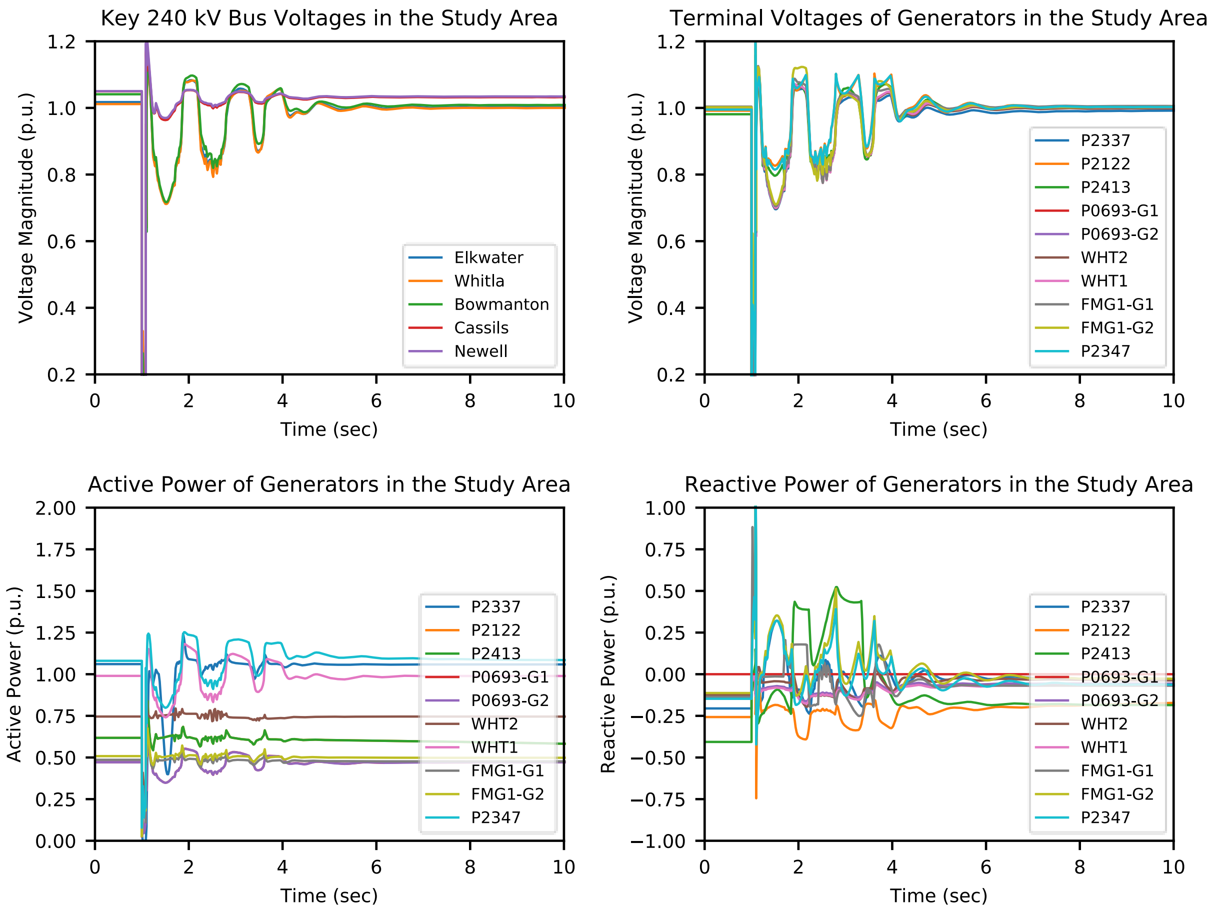
Case Description:

- Post-development 2023 summer peak case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 84



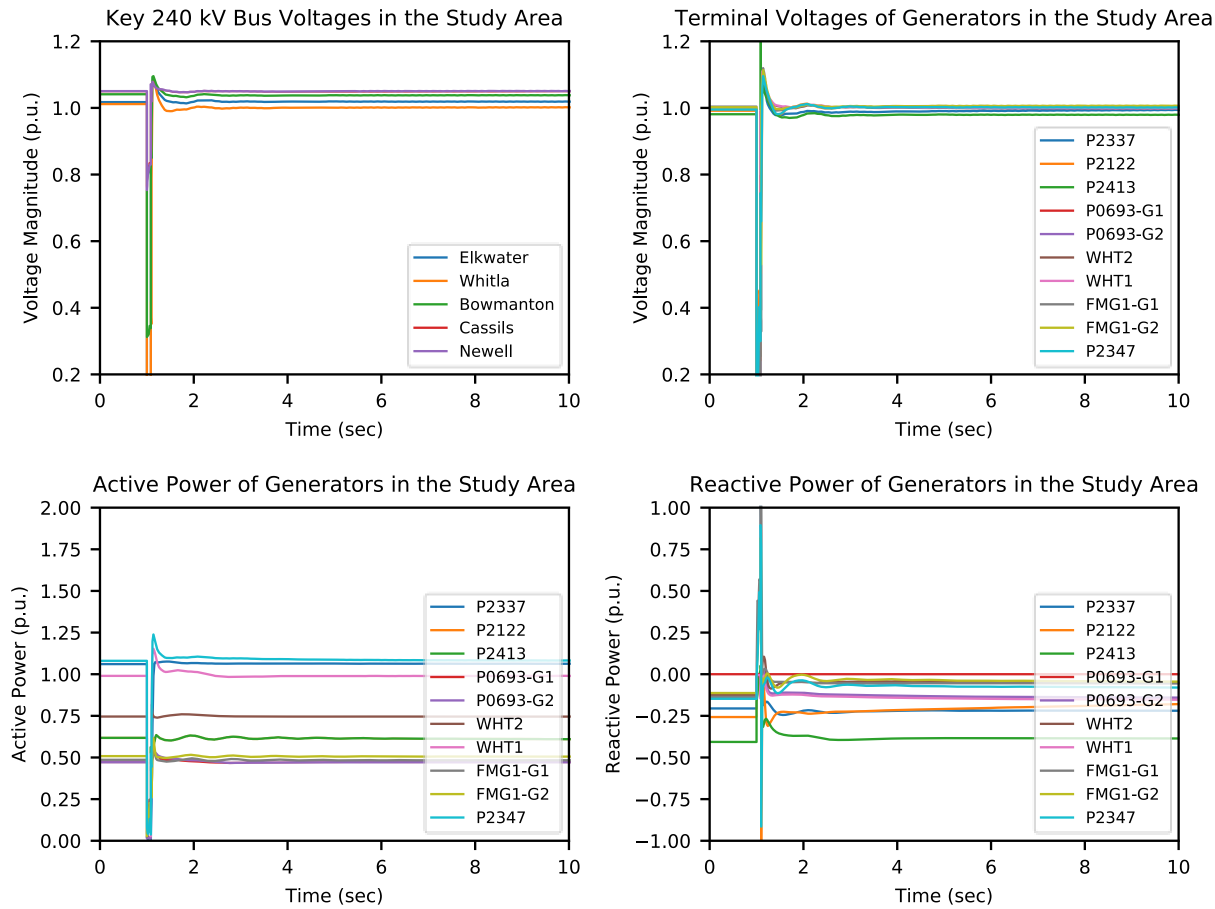
Case Description:

- Post-development 2023 summer peak case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Newell 2075S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 85



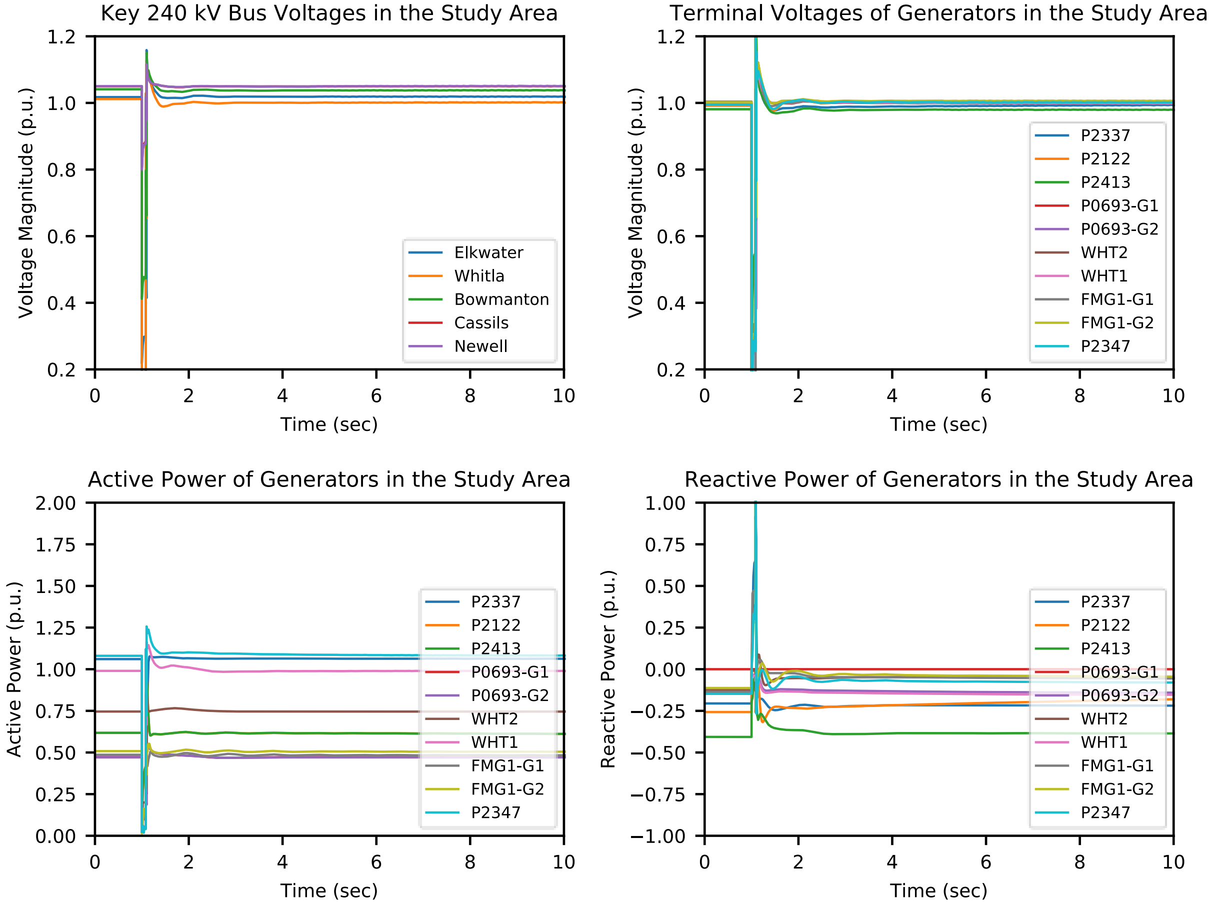
Case Description:

- Post-development 2023 summer peak case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 86



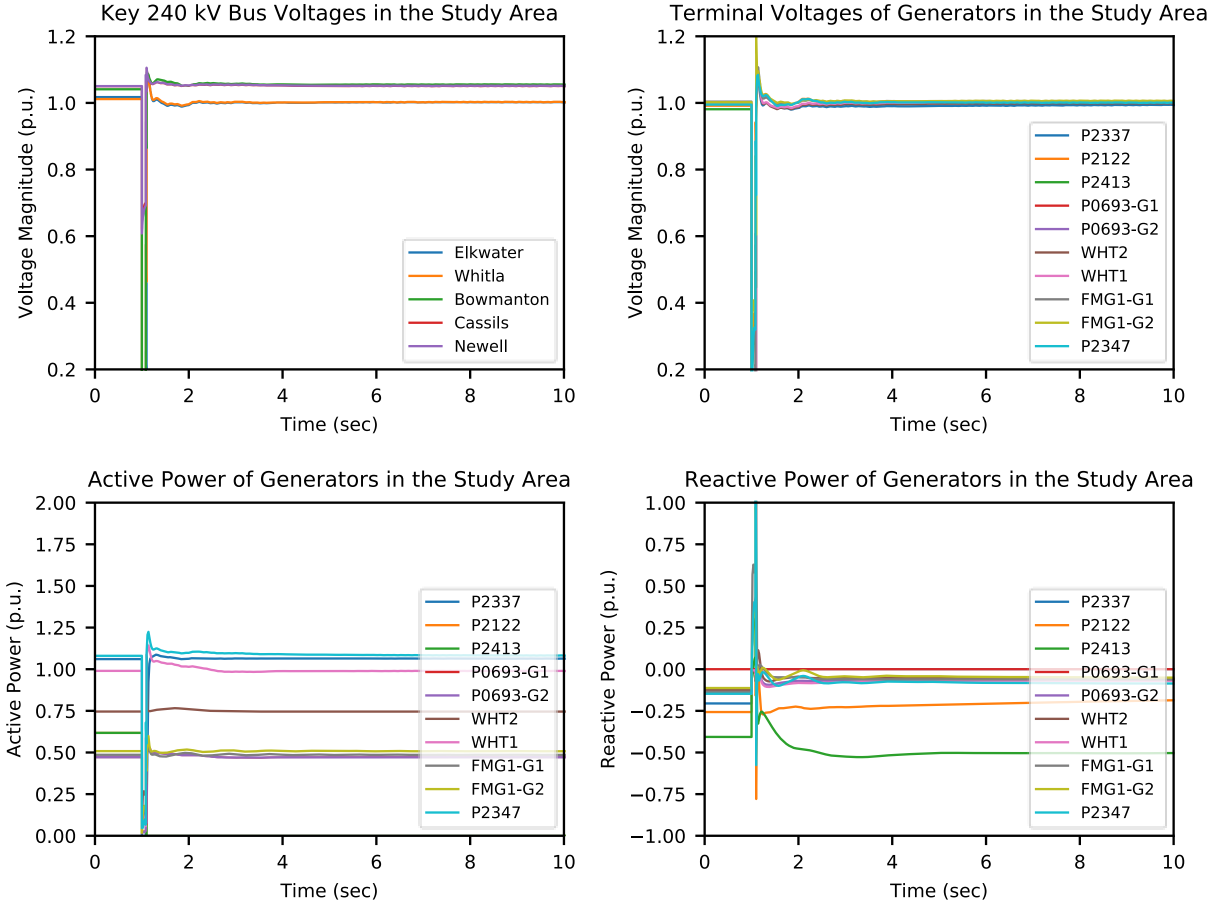
Case Description:

- Post-development 2023 summer peak case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 87



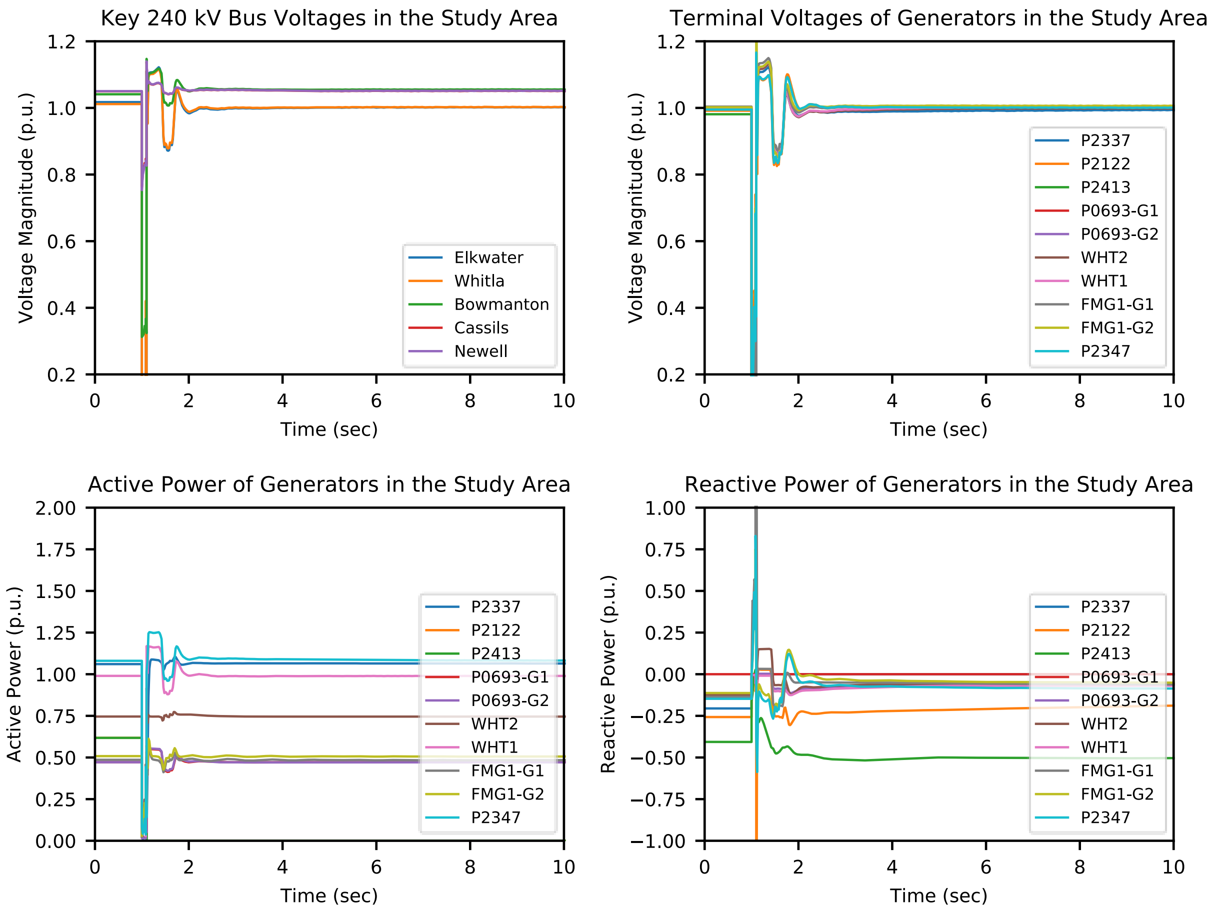
Case Description:

- Post-development 2023 summer peak case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 88



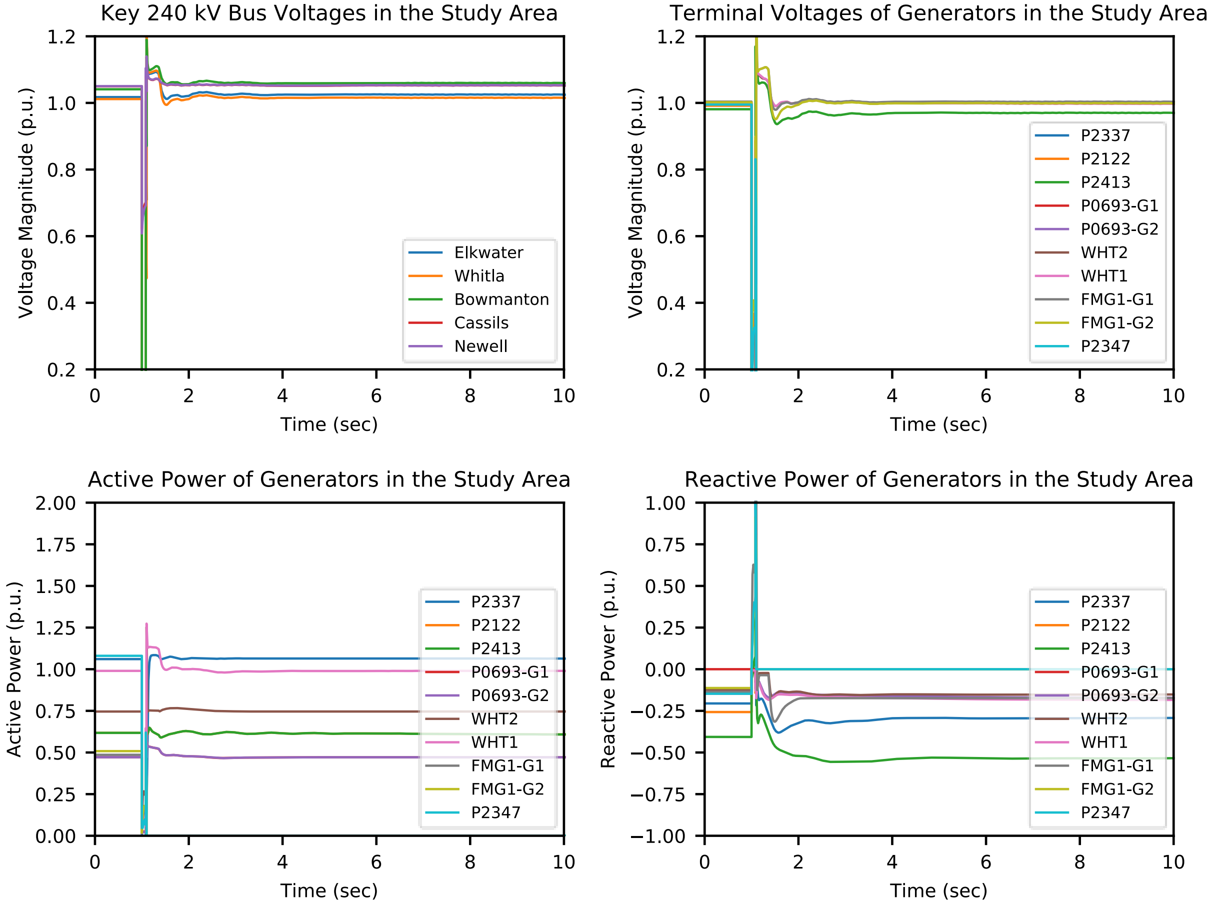
Case Description:

- Post-development 2023 summer peak case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 89



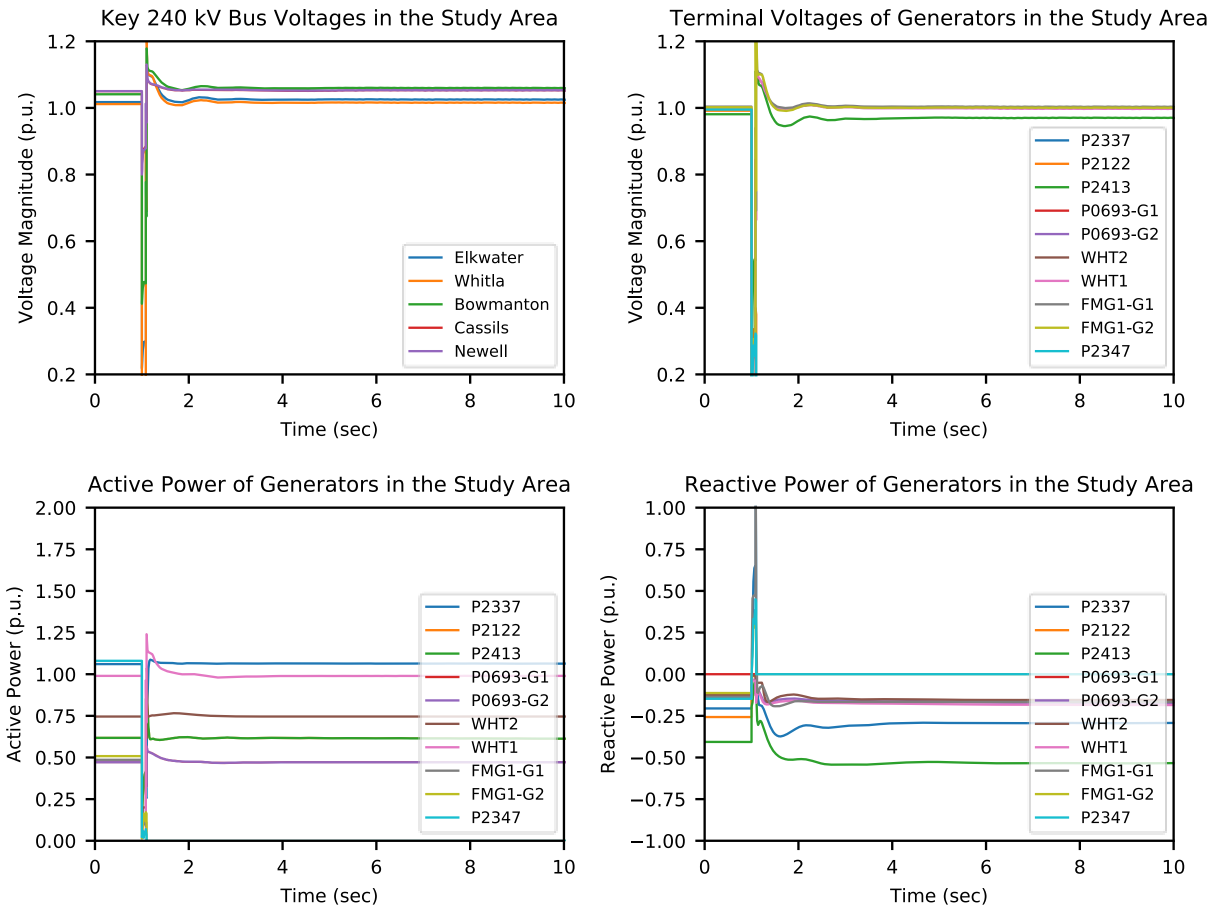
Case Description:

- Post-development 2023 summer peak case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 90



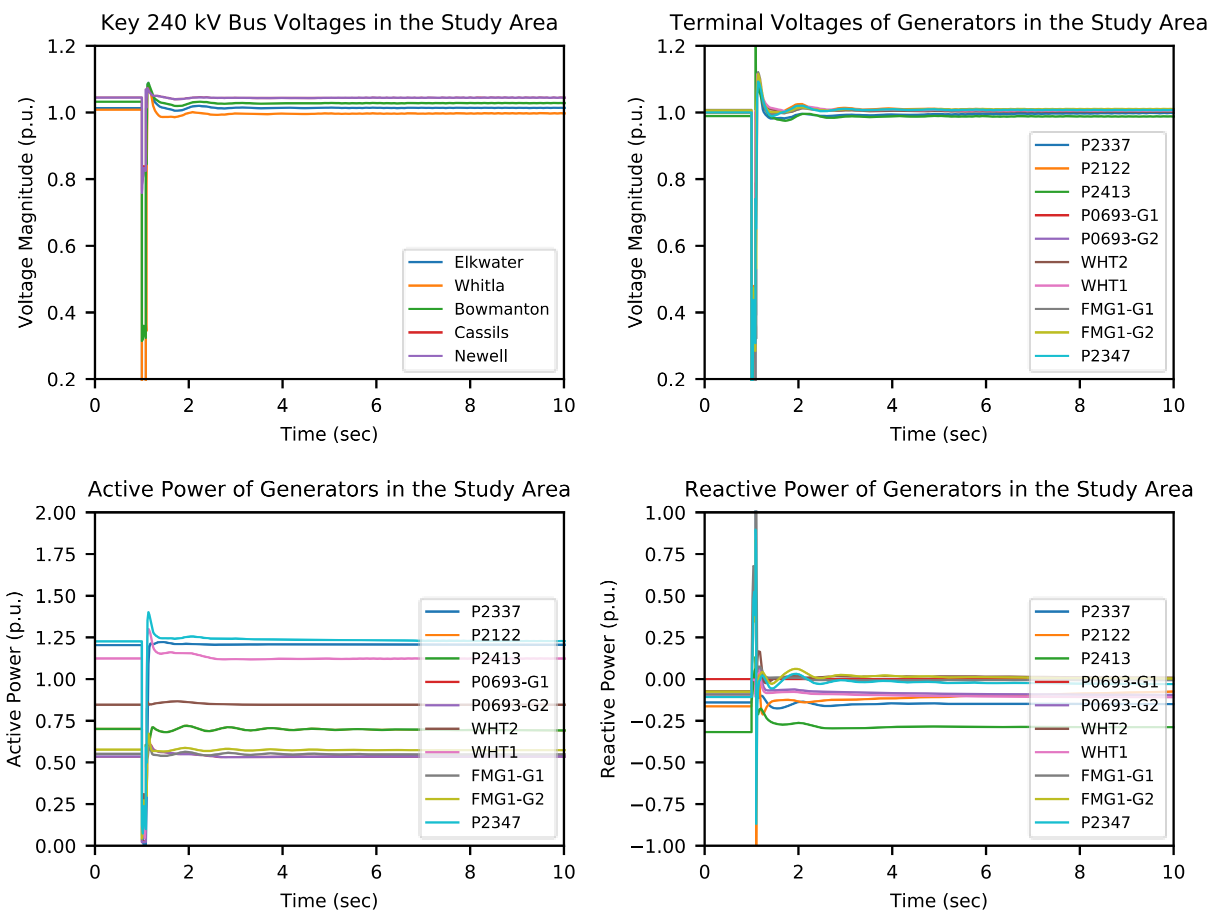
Case Description:

- Post-development 2023 summer peak case
- 700 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 91



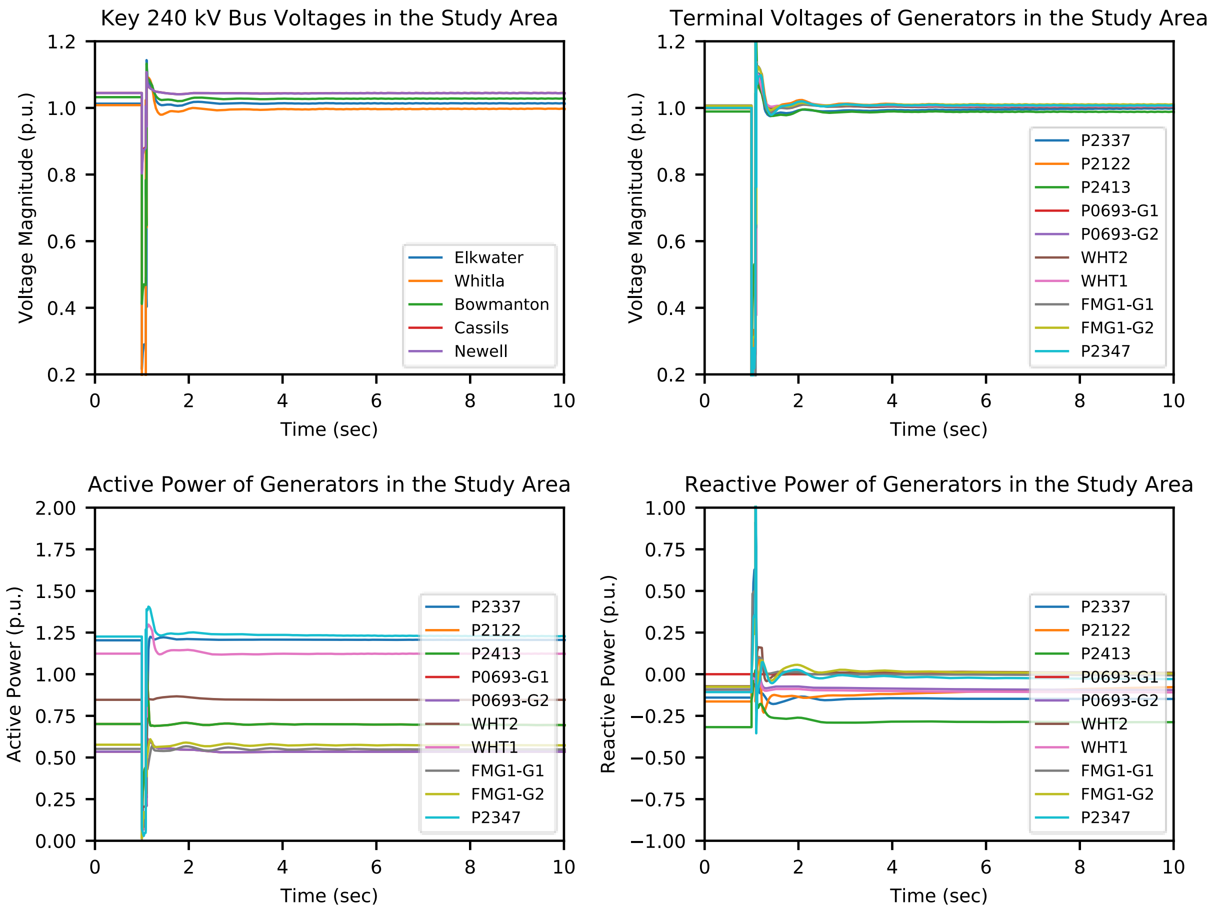
Case Description:

- Post-development 2023 summer peak case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 92



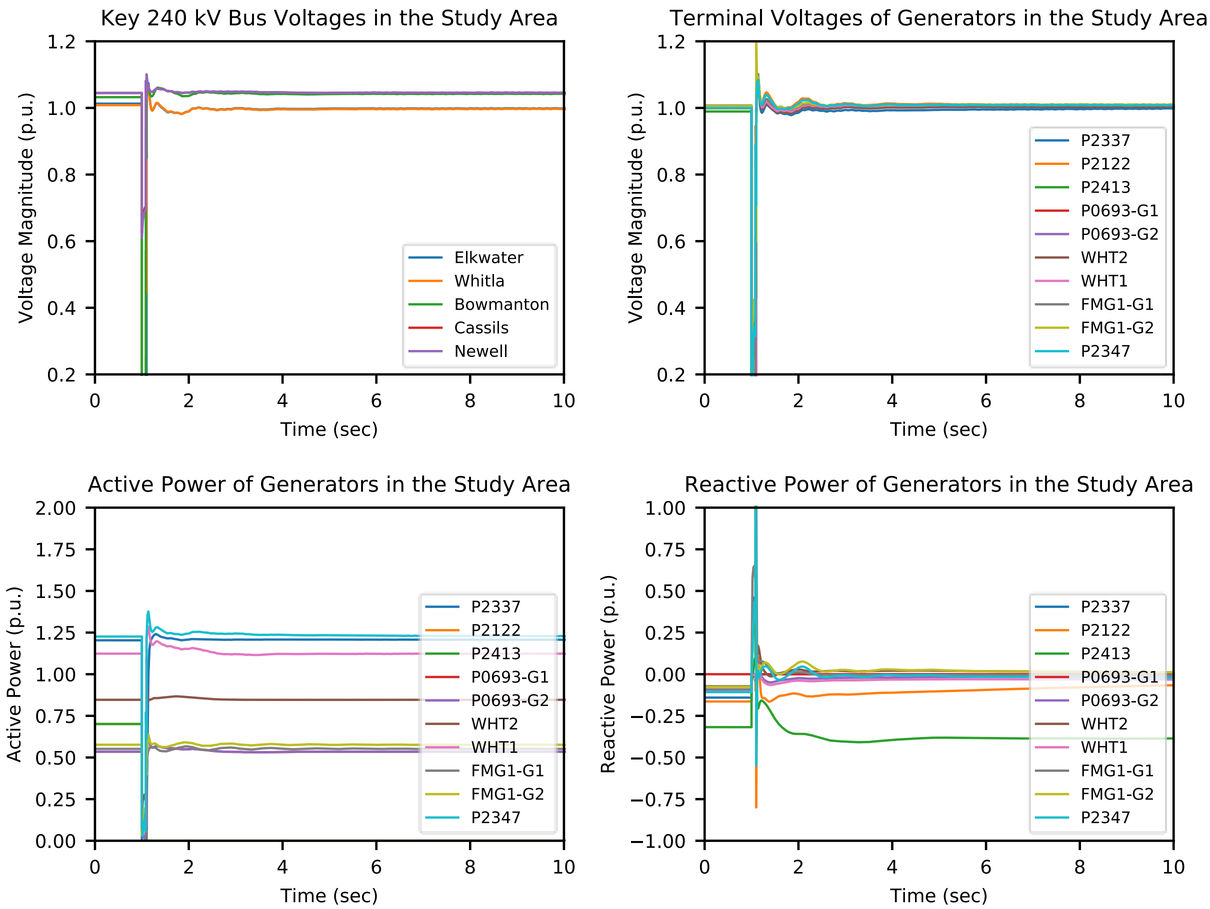
Case Description:

- Post-development 2023 summer peak case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 93



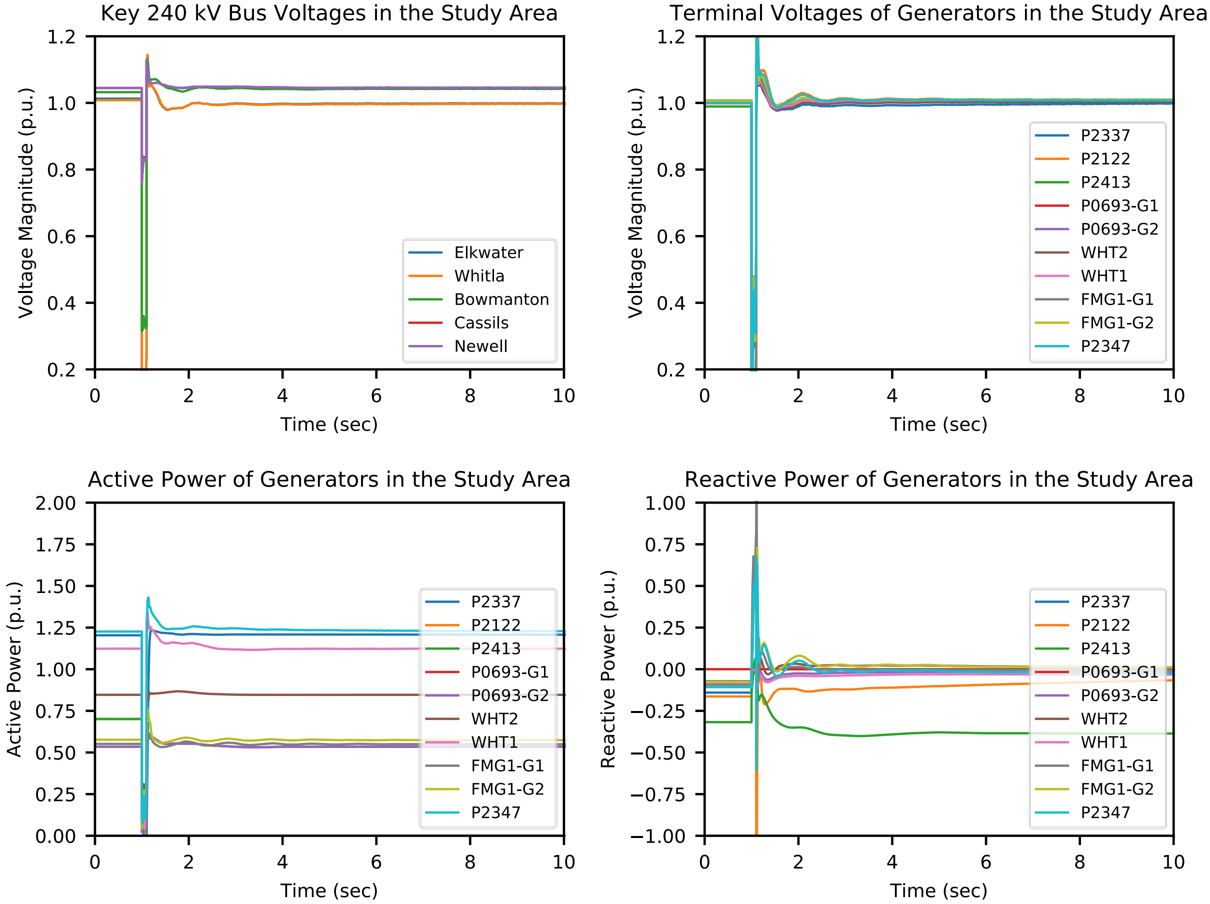
Case Description:

- Post-development 2023 summer peak case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 94



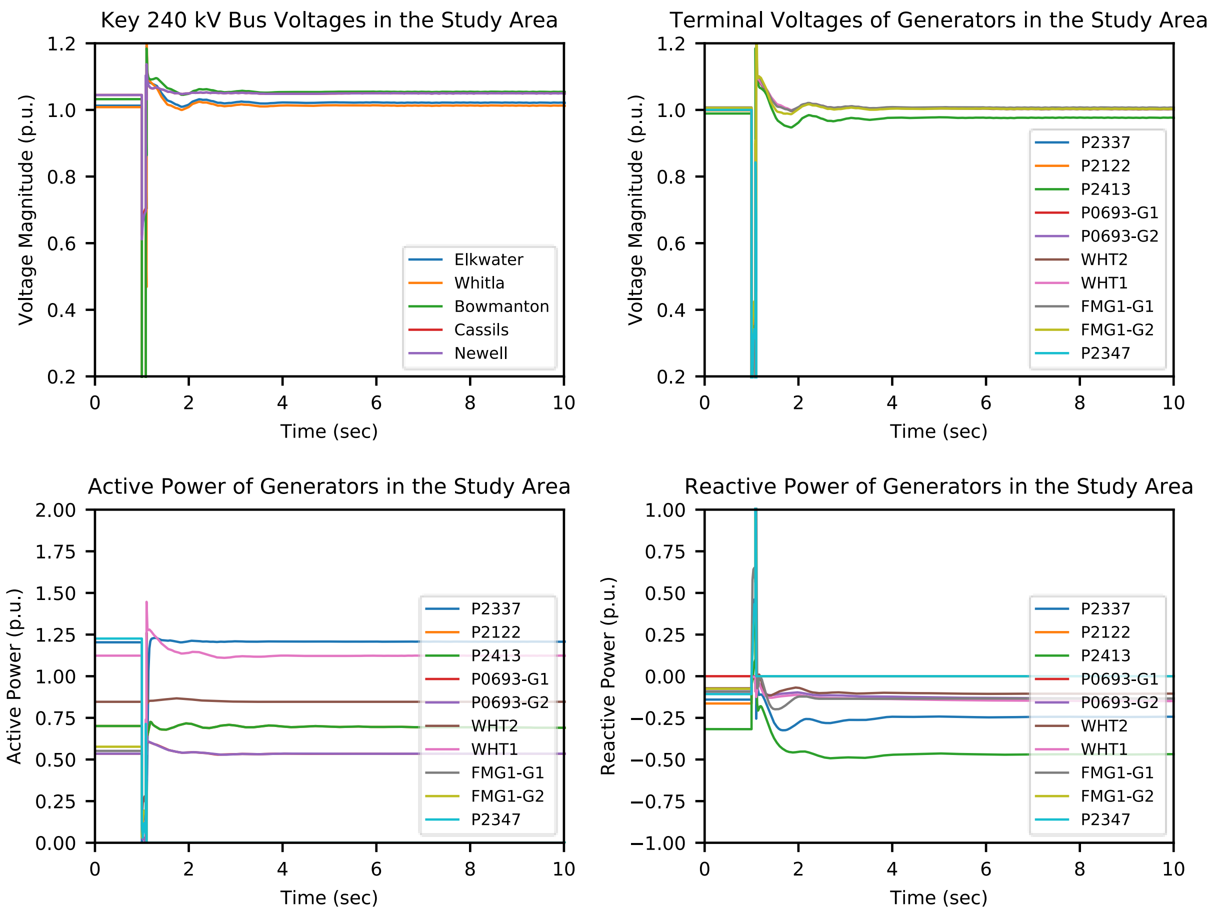
Case Description:

- Post-development 2023 summer peak case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 95



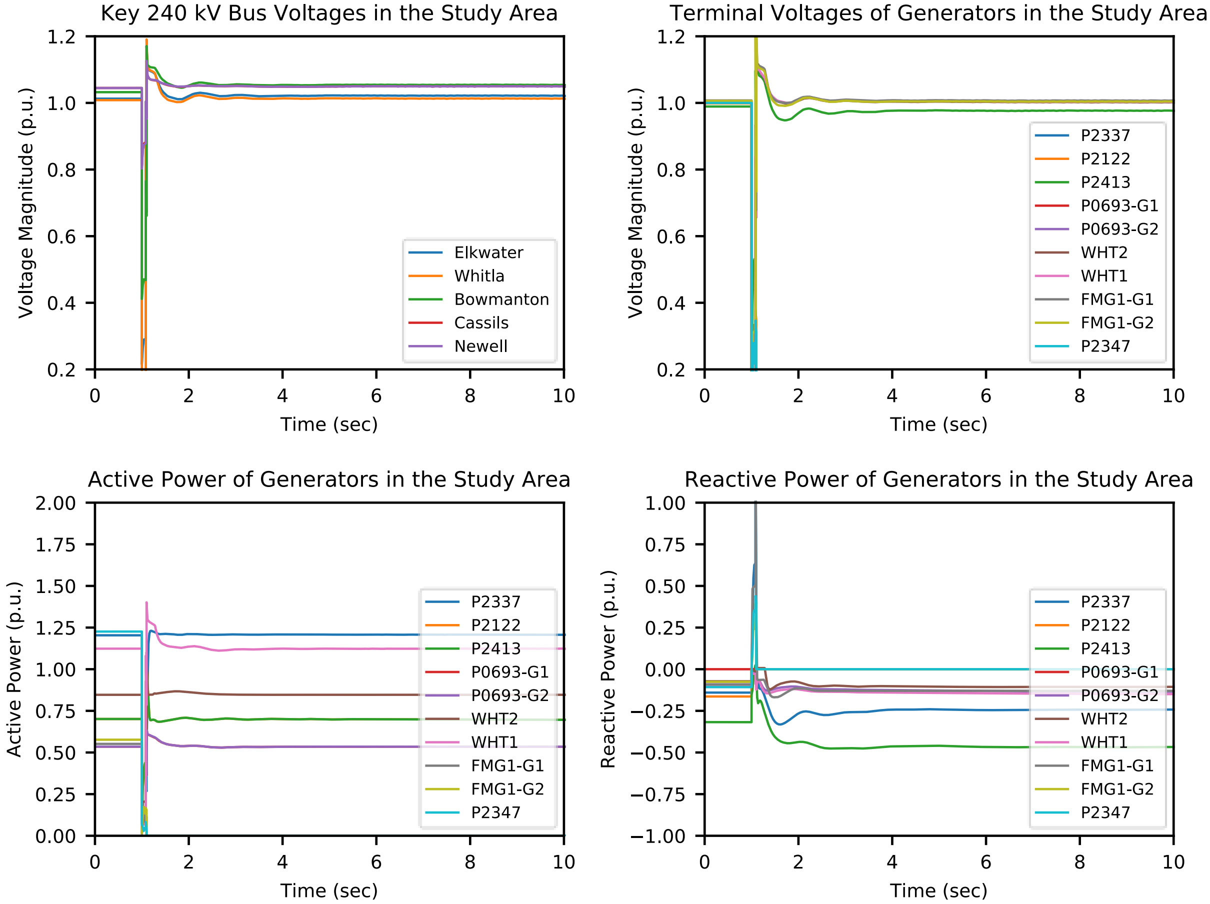
Case Description:

- Post-development 2023 summer peak case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 96



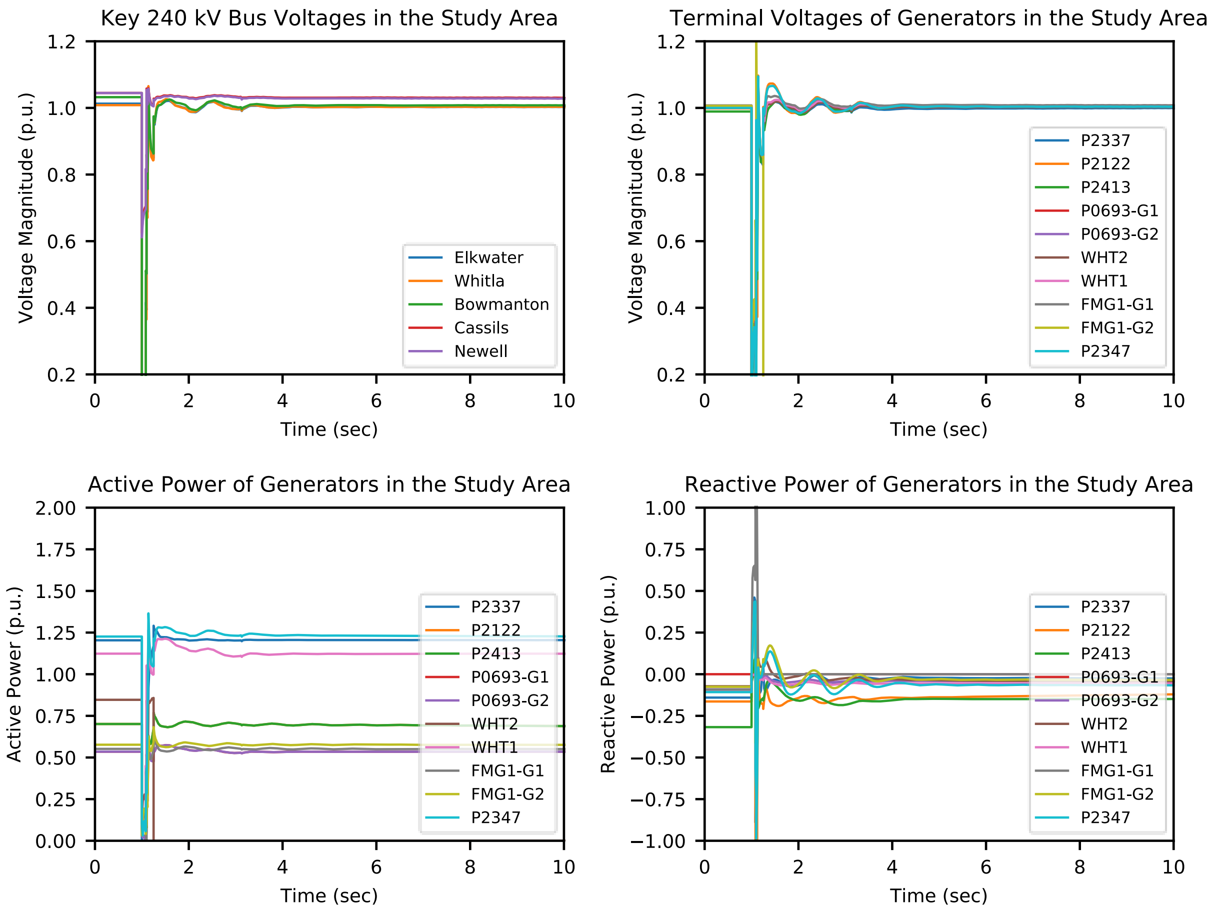
Case Description:

- Post-development 2023 summer peak case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 97



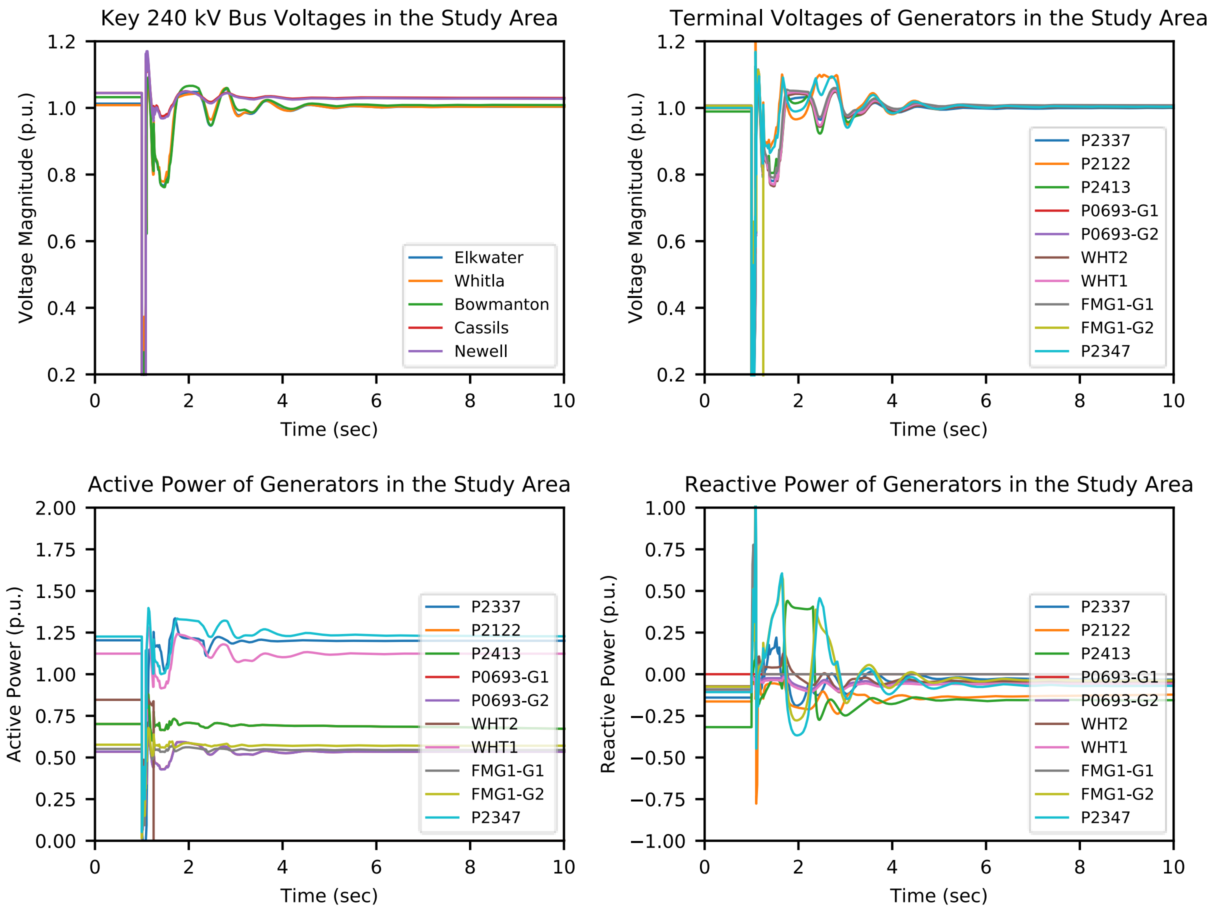
Case Description:

- Post-development 2023 summer peak case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 98



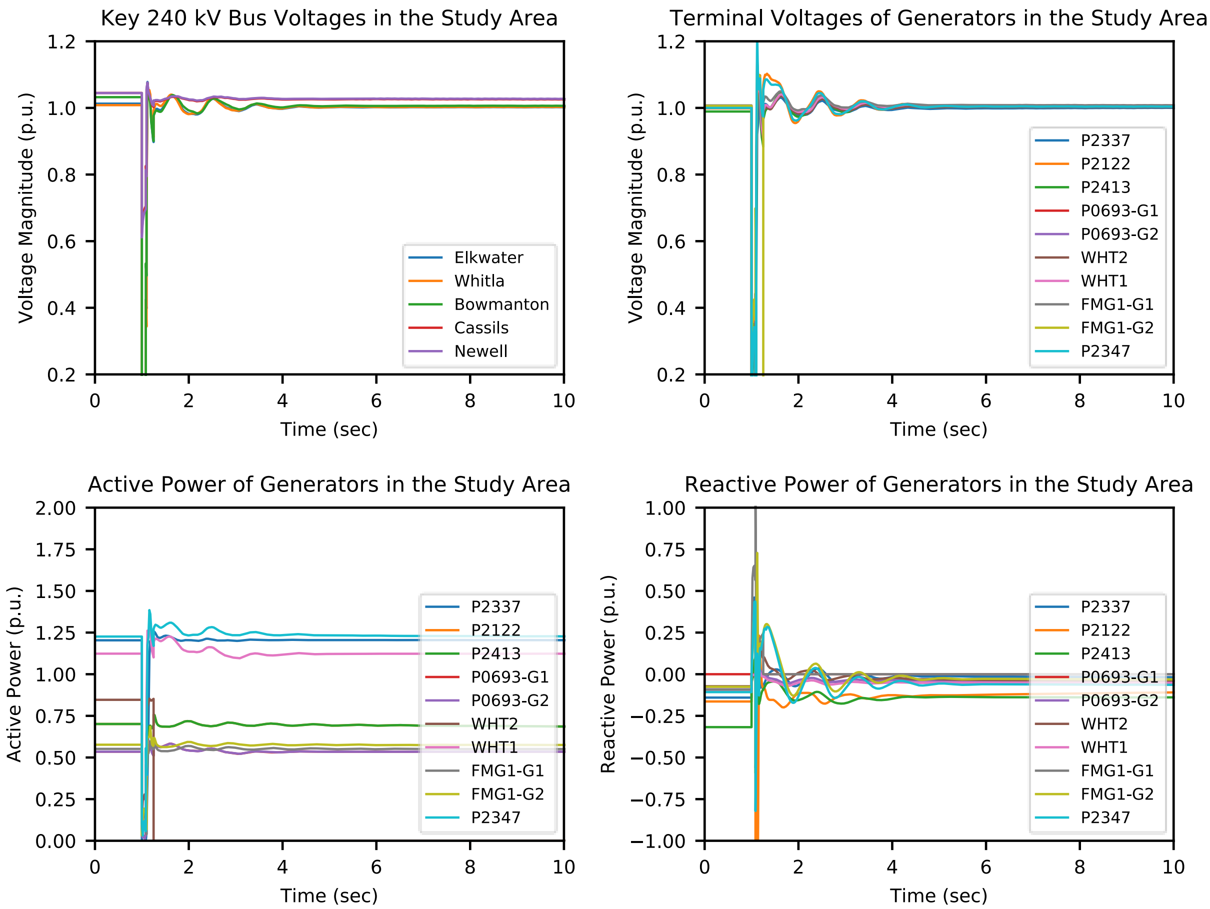
Case Description:

- Post-development 2023 summer peak case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Cassils 324S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 99



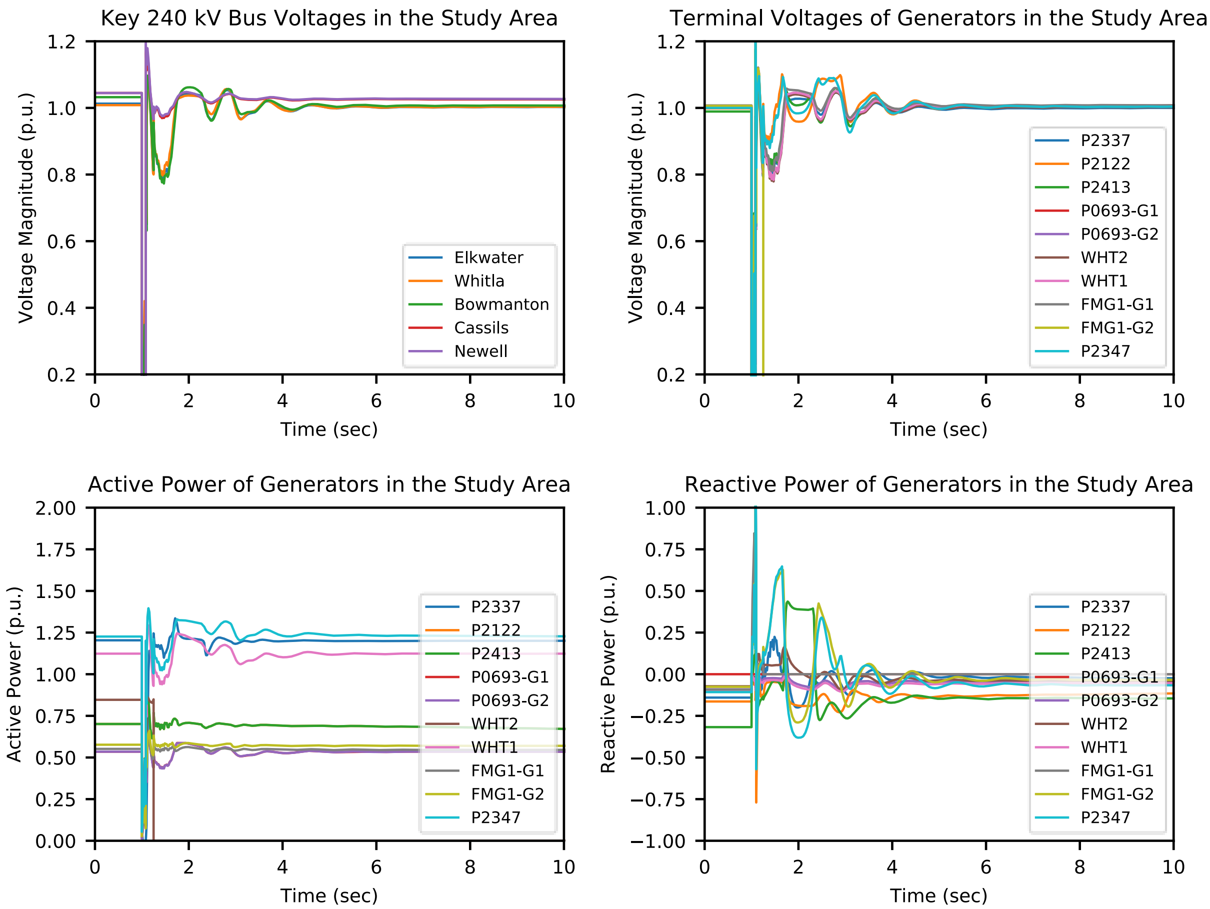
Case Description:

- Post-development 2023 summer peak case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 100



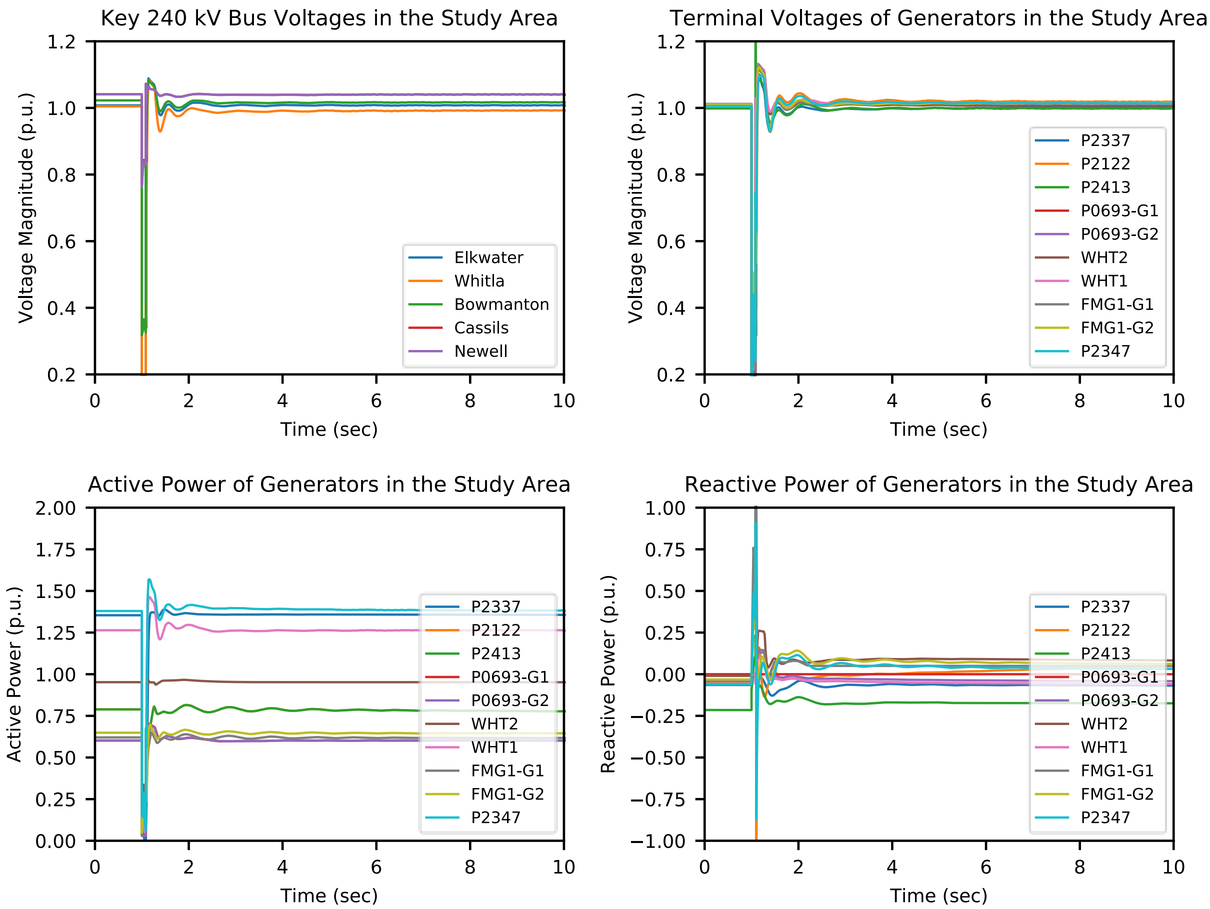
Case Description:

- Post-development 2023 summer peak case
- 800 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Newell 2075S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 101



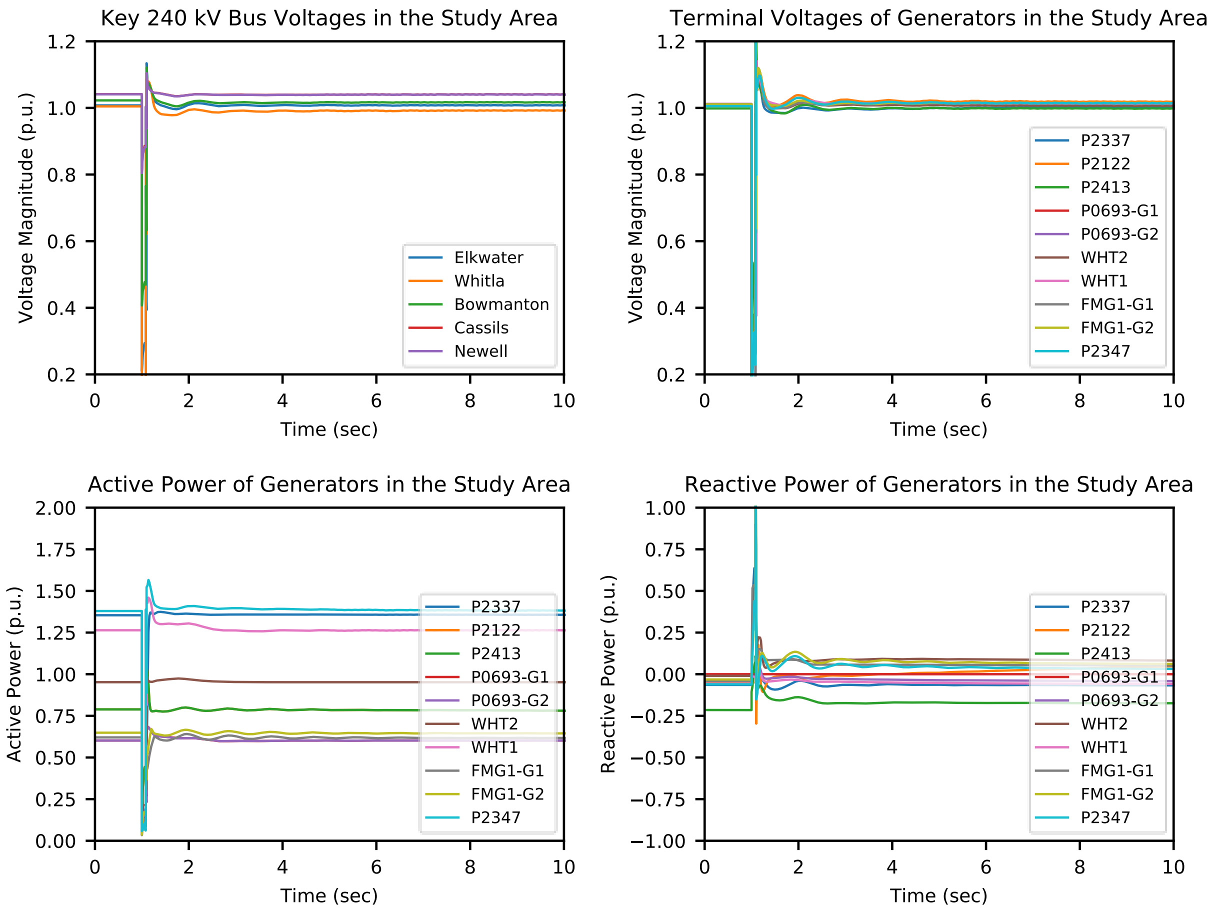
Case Description:

- Post-development 2023 summer peak case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 102



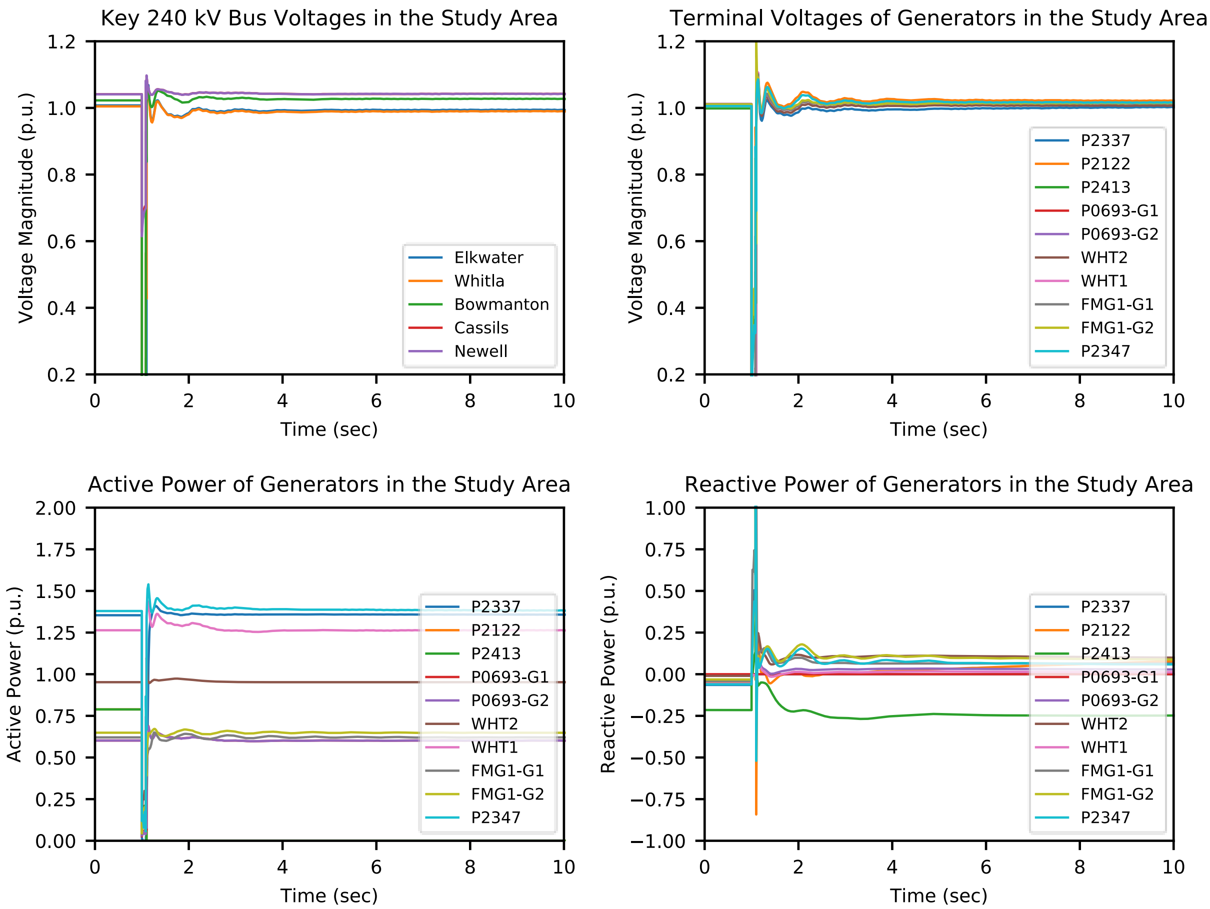
Case Description:

- Post-development 2023 summer peak case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 103



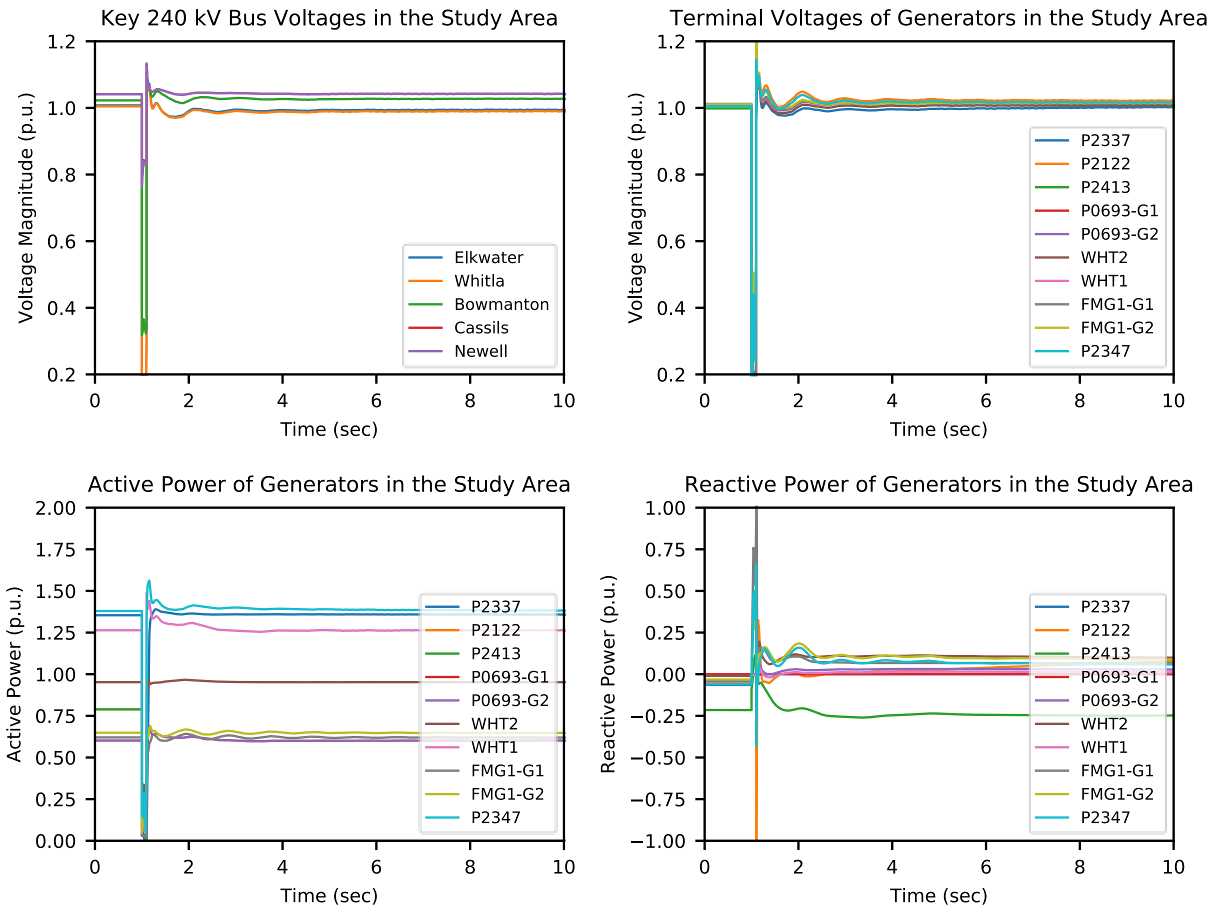
Case Description:

- Post-development 2023 summer peak case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 104



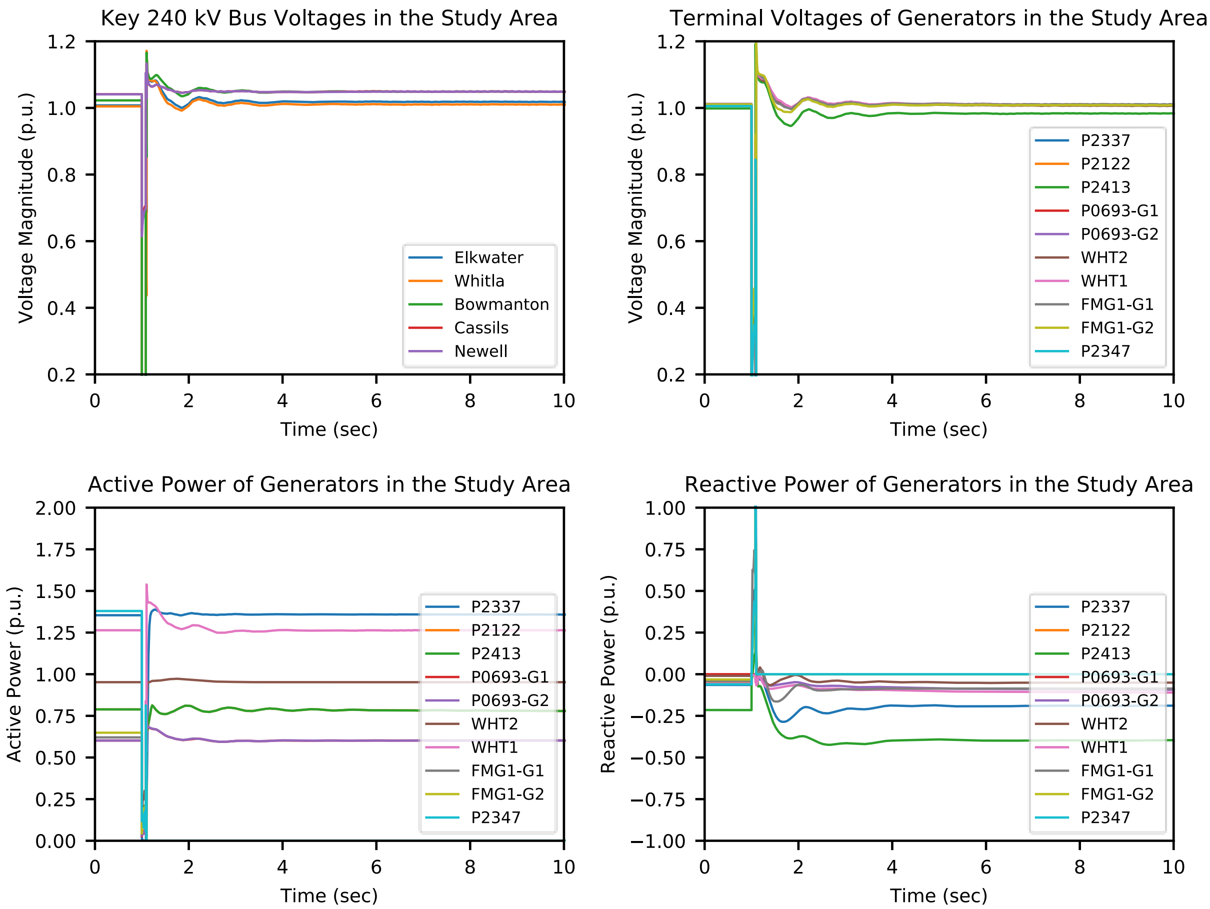
Case Description:

- Post-development 2023 summer peak case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 105



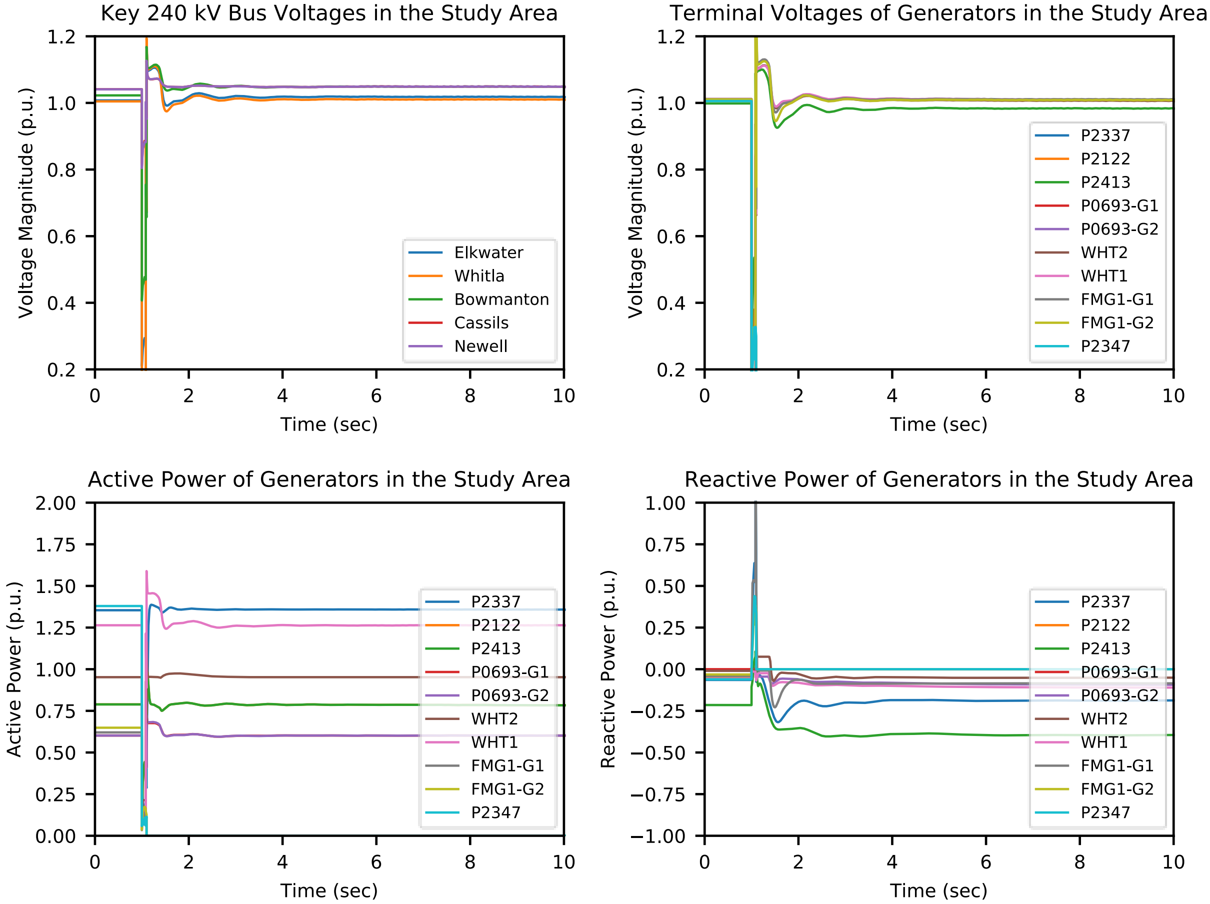
Case Description:

- Post-development 2023 summer peak case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 106



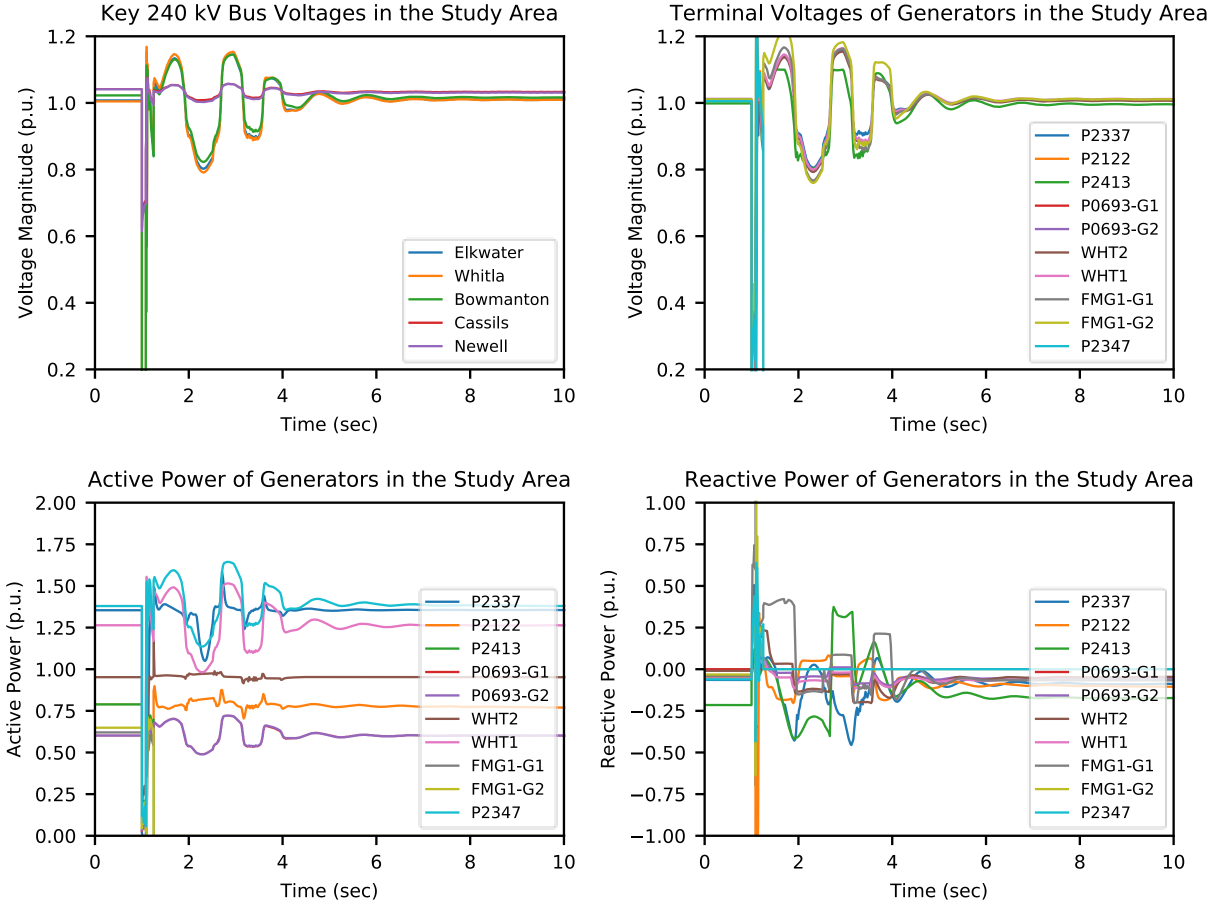
Case Description:

- Post-development 2023 summer peak case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 107



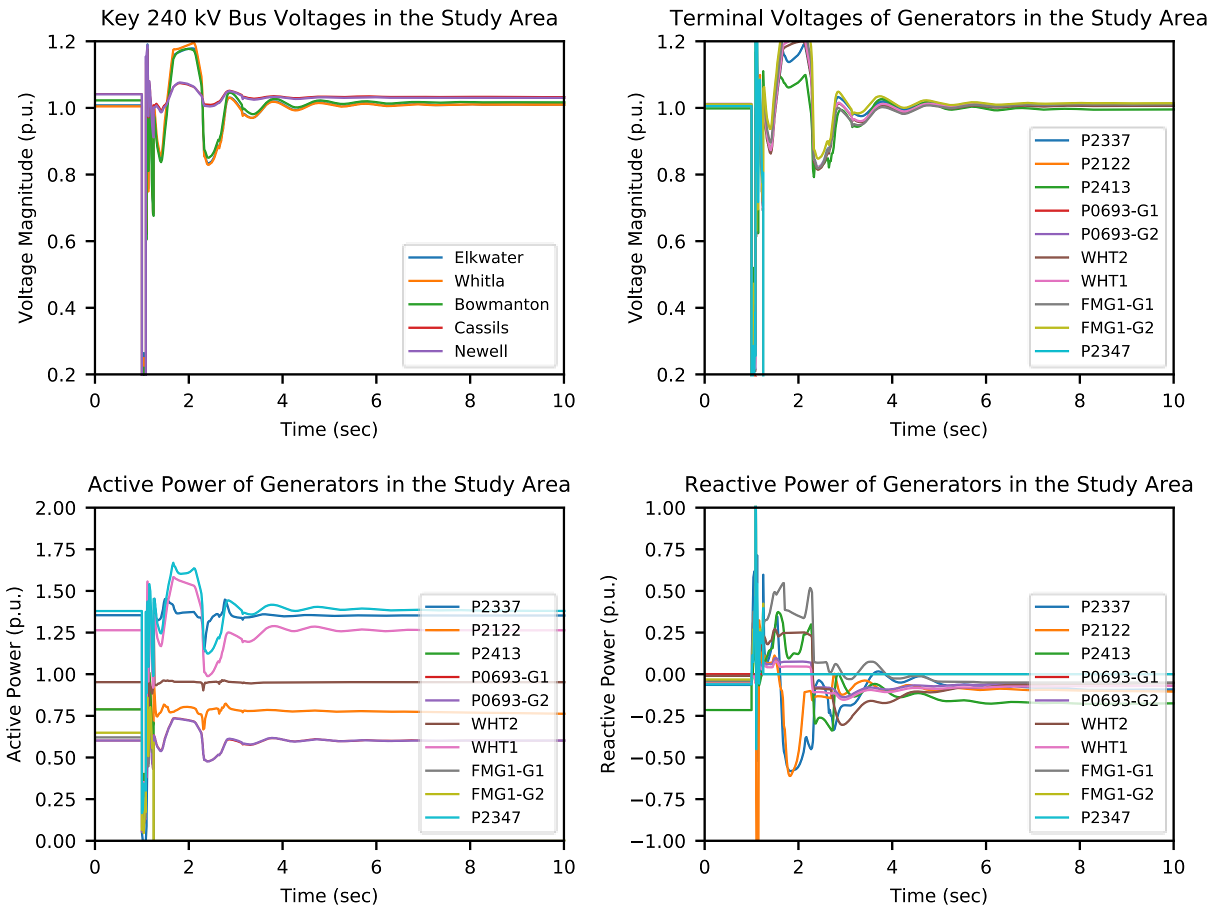
Case Description:

- Post-development 2023 summer peak case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 108



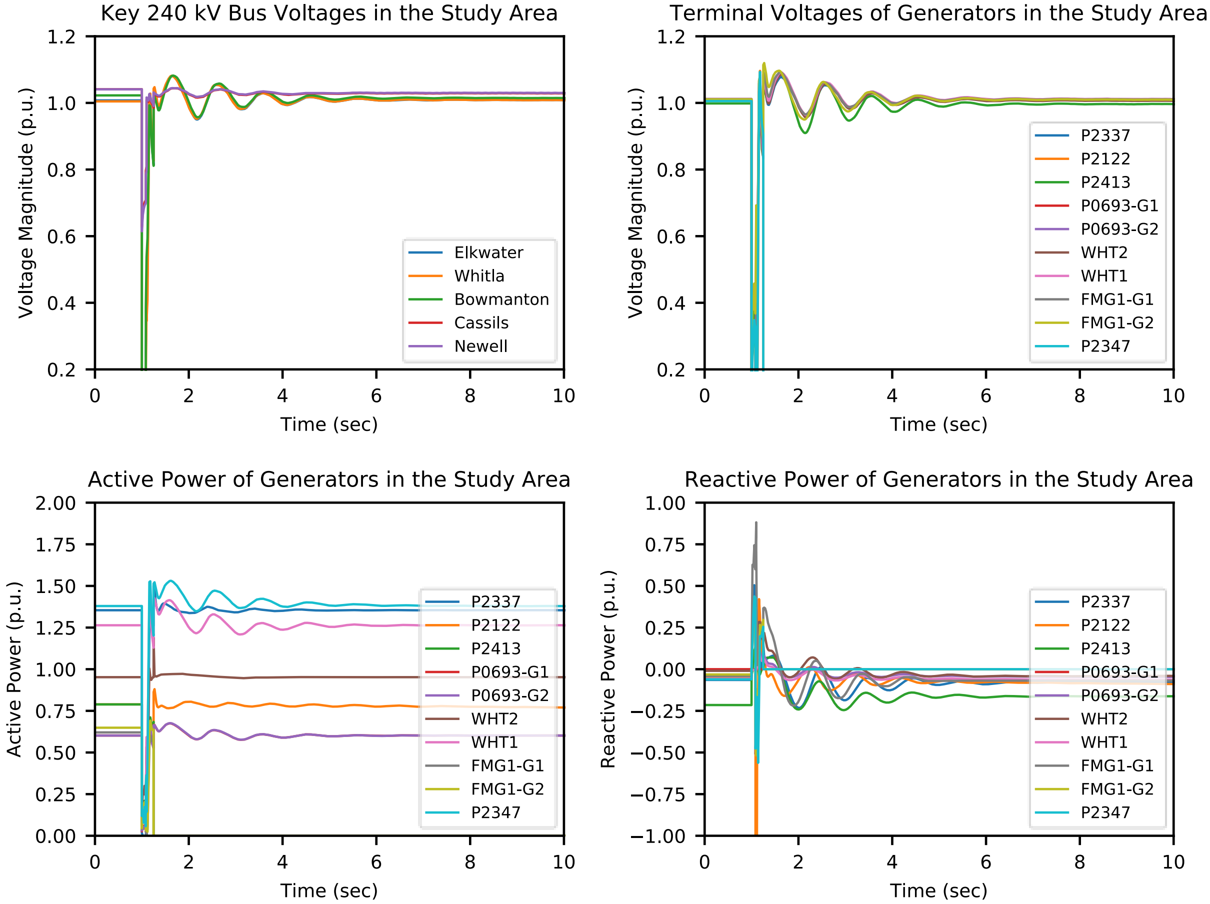
Case Description:

- Post-development 2023 summer peak case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Cassils 324S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 109



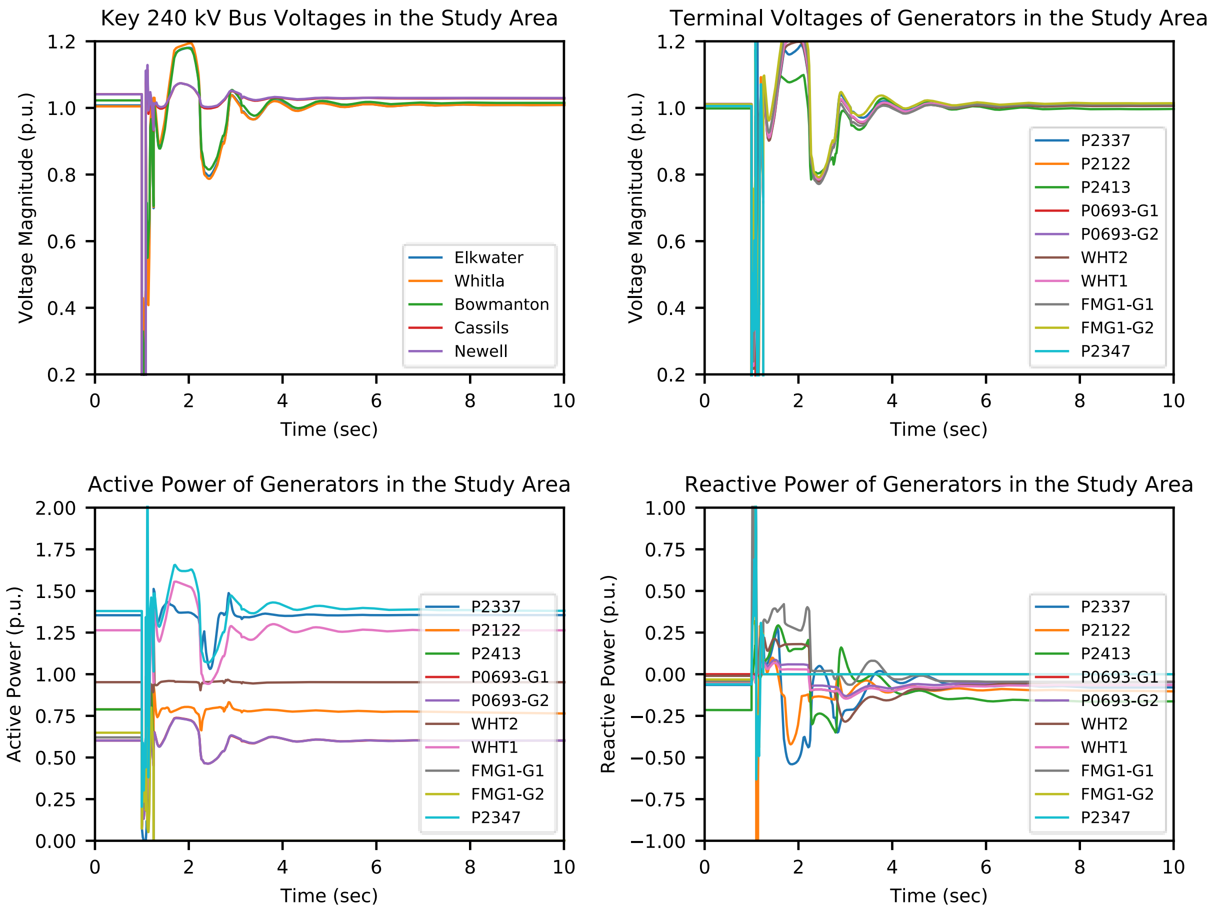
Case Description:

- Post-development 2023 summer peak case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 110



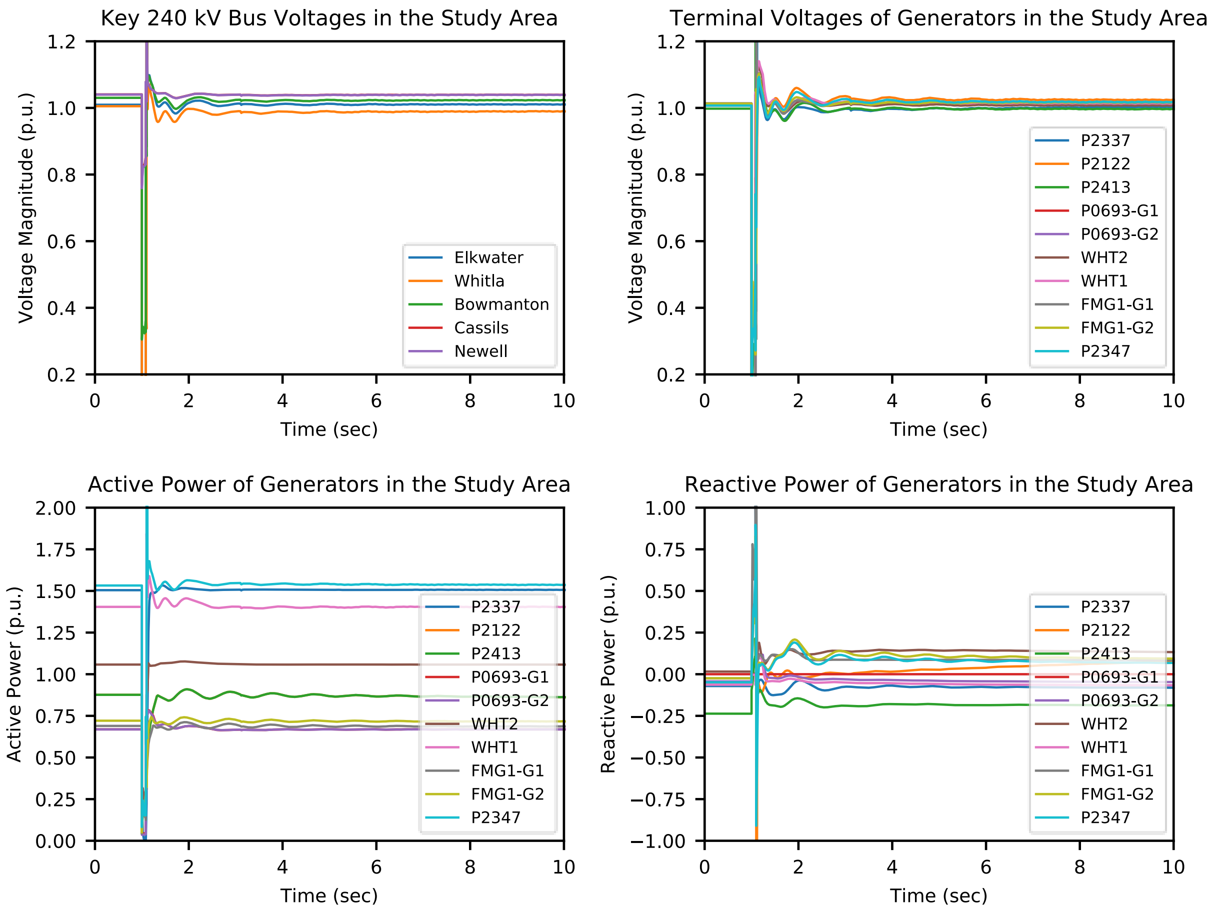
Case Description:

- Post-development 2023 summer peak case
- 900 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Newell 2075S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 111



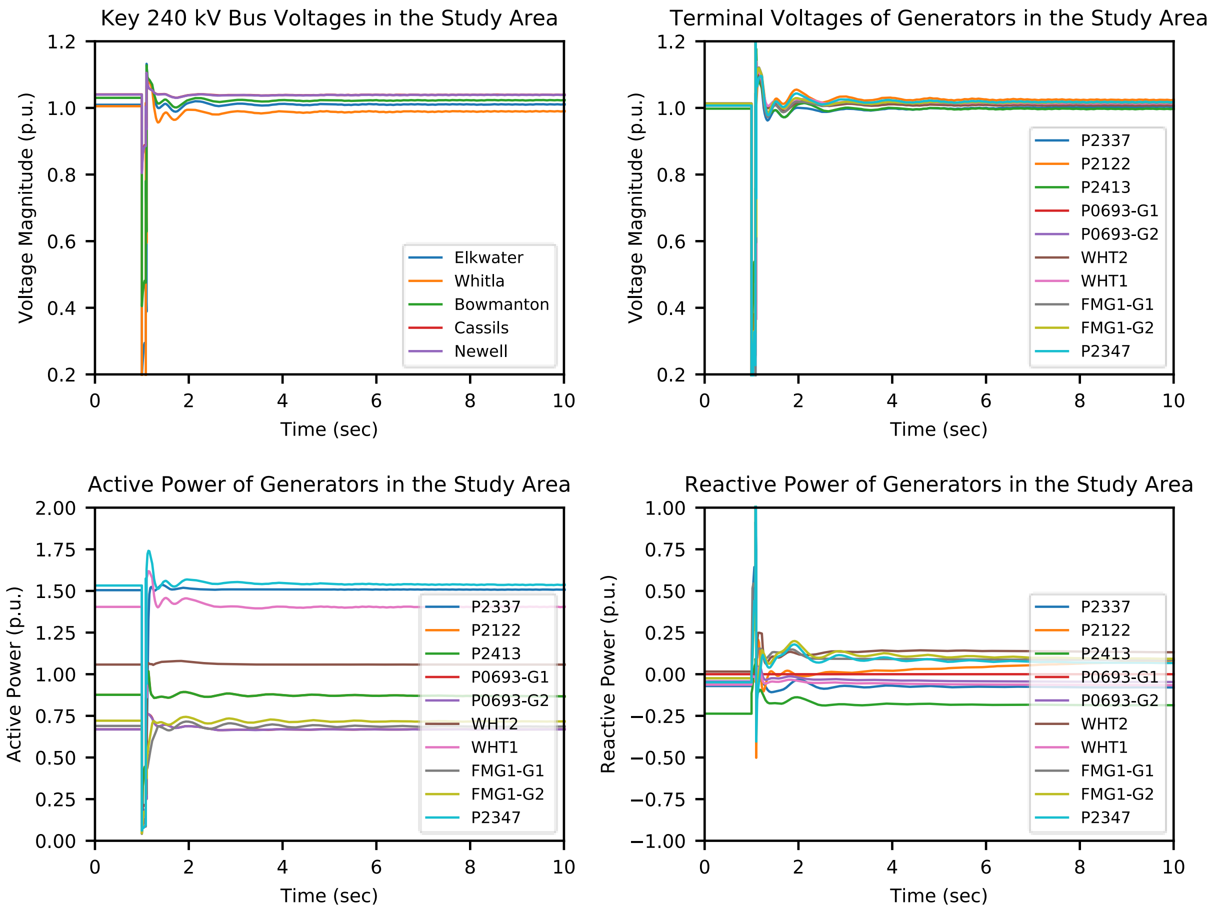
Case Description:

- Post-development 2023 summer peak case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 112



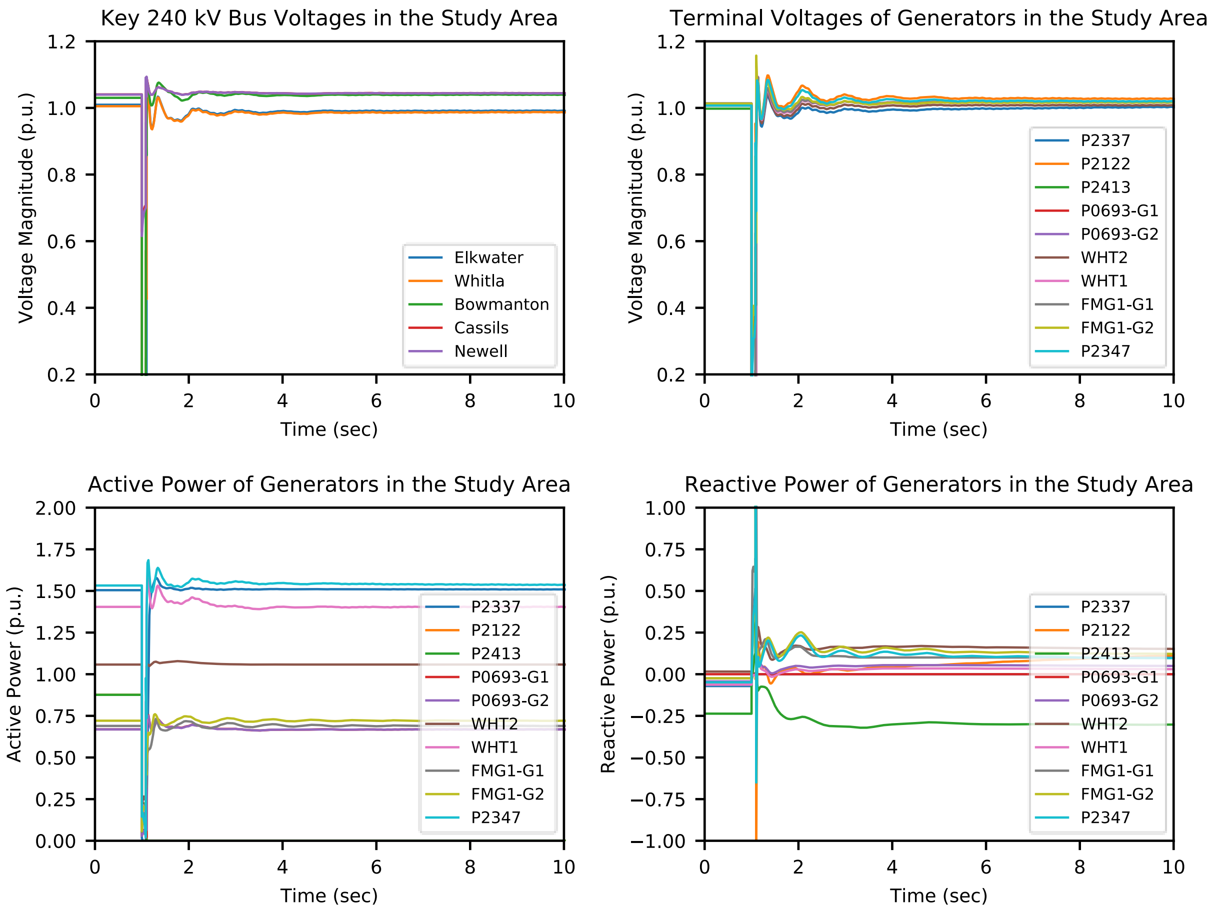
Case Description:

- Post-development 2023 summer peak case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 113



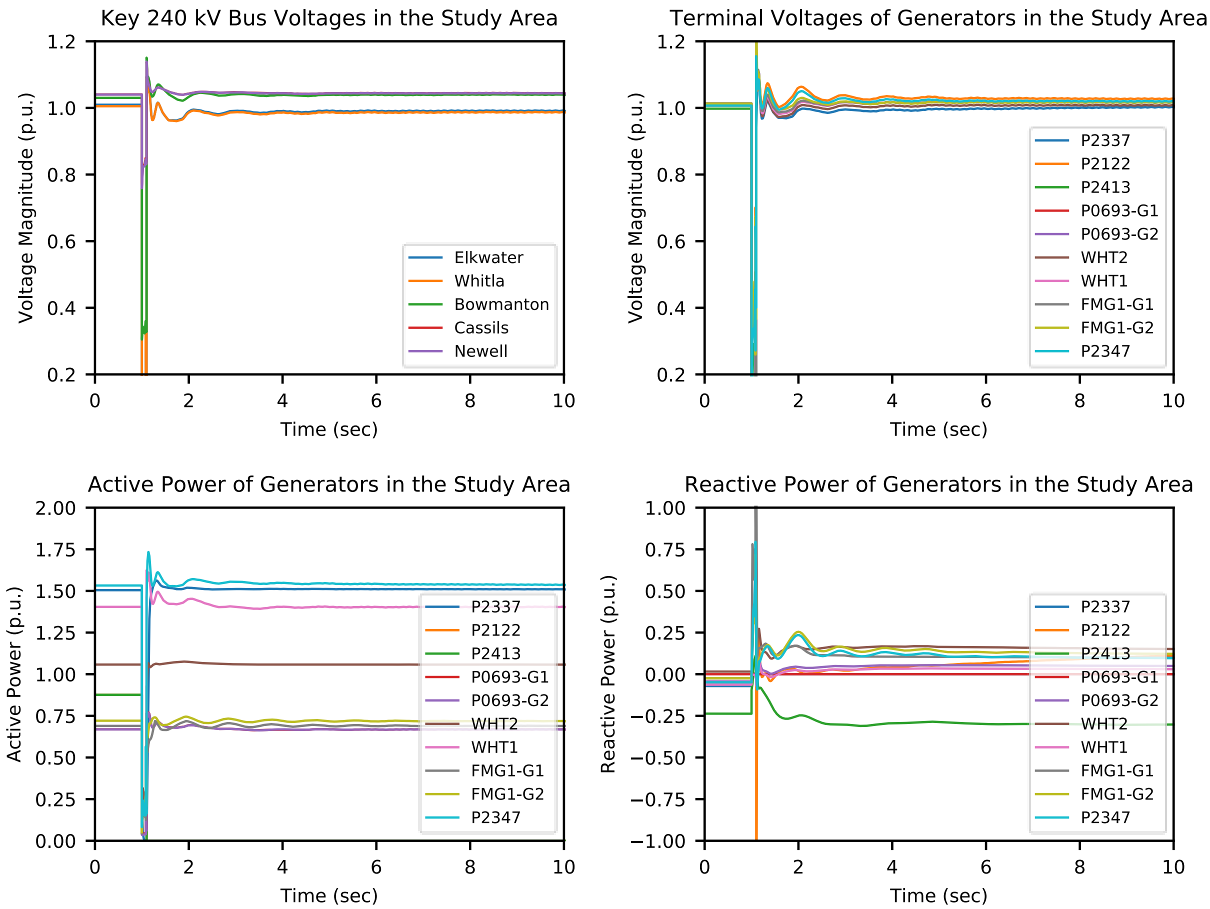
Case Description:

- Post-development 2023 summer peak case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 114



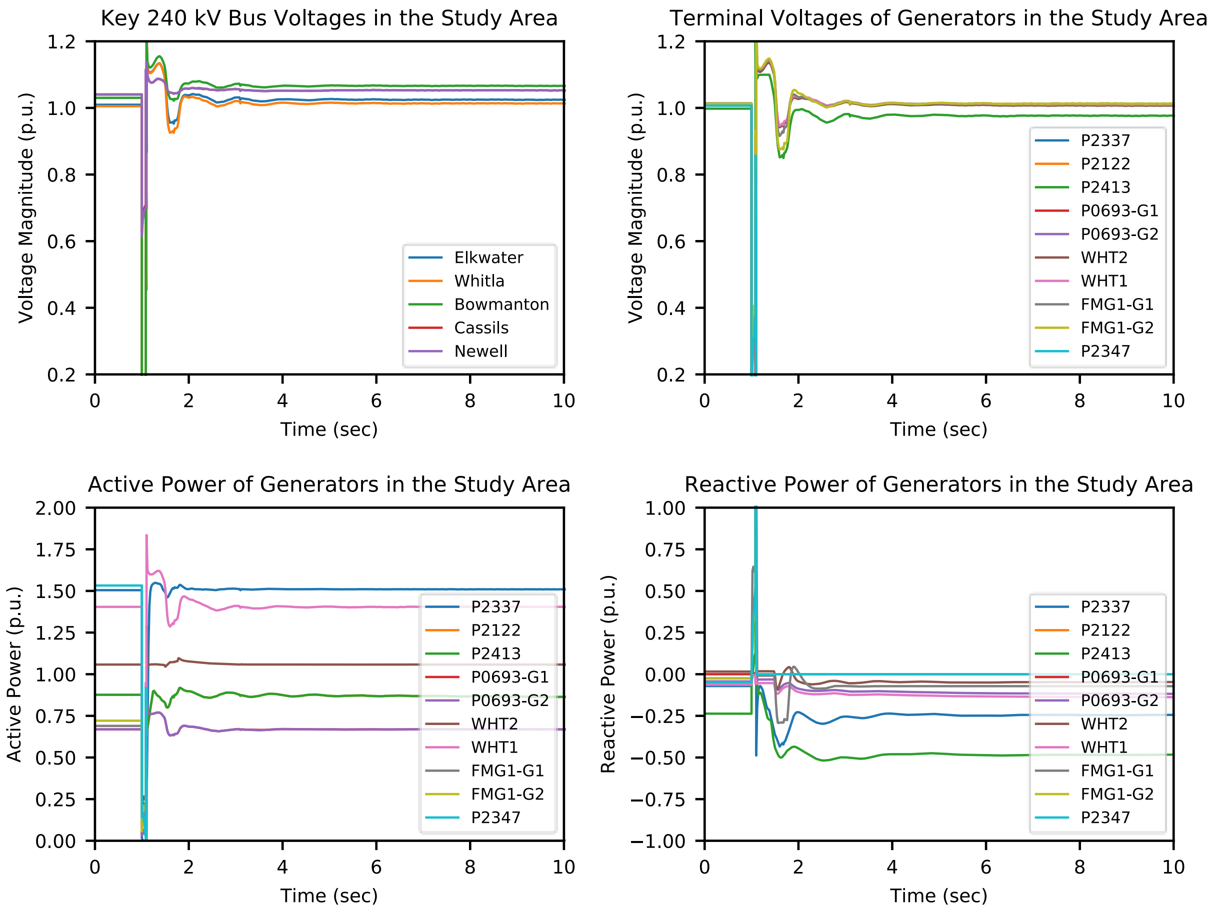
Case Description:

- Post-development 2023 summer peak case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 115



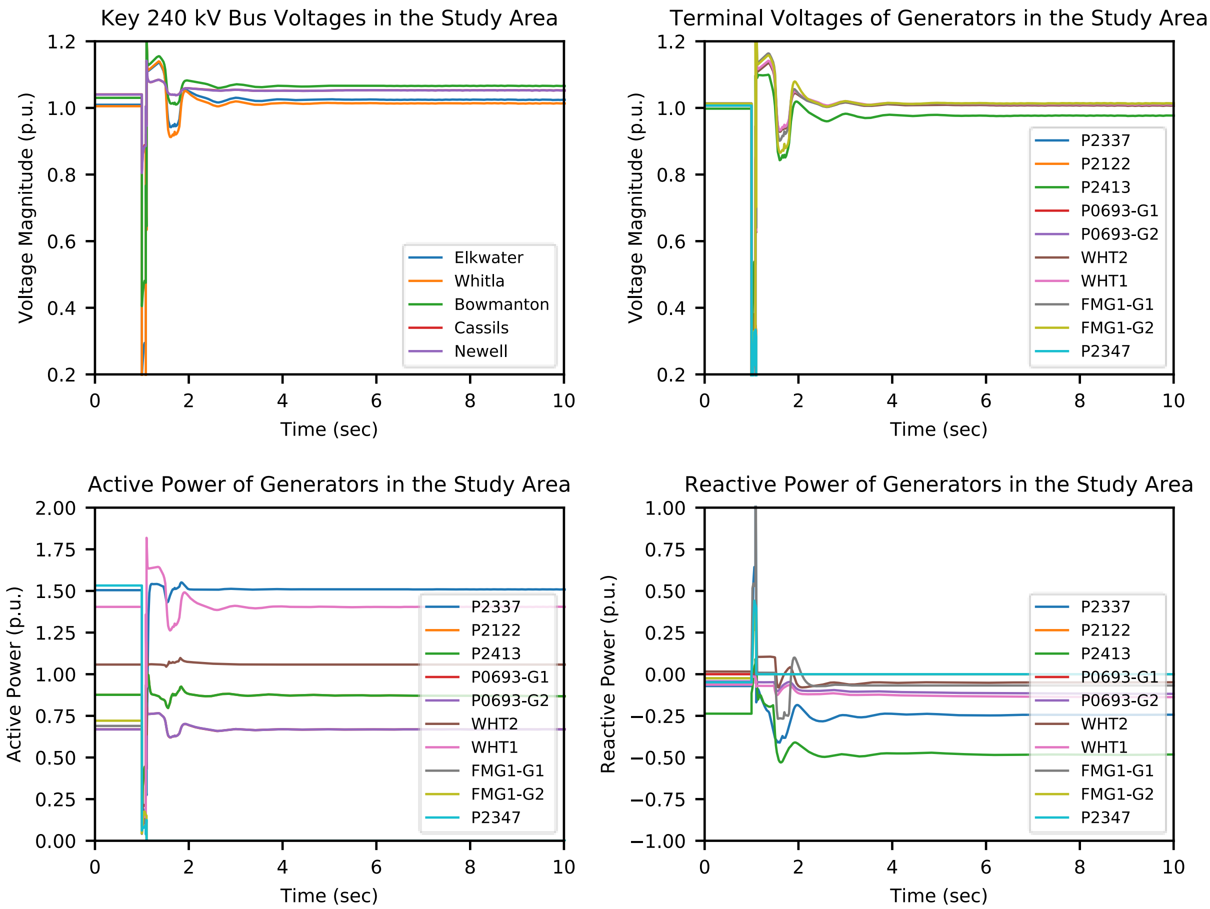
Case Description:

- Post-development 2023 summer peak case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 116



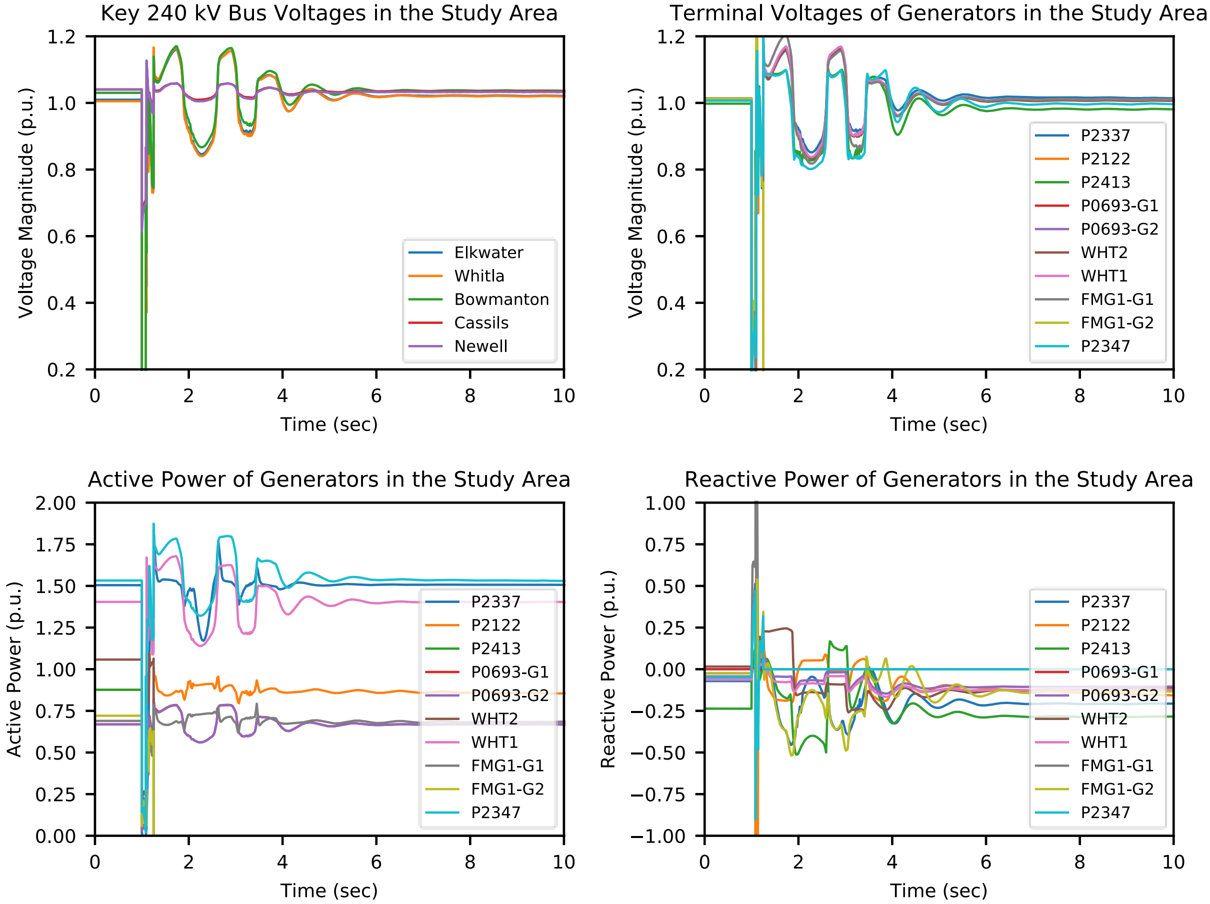
Case Description:

- Post-development 2023 summer peak case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 117



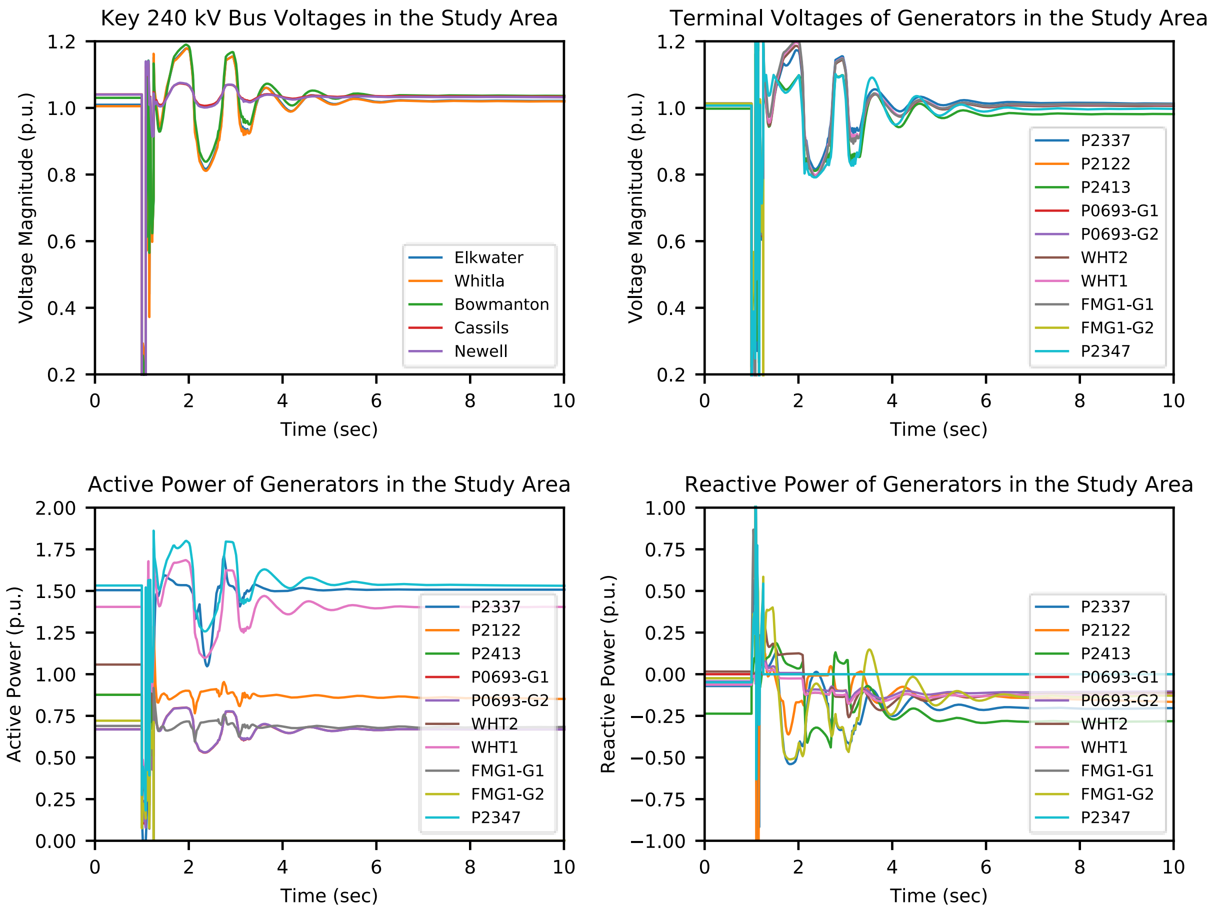
Case Description:

- Post-development 2023 summer peak case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 118



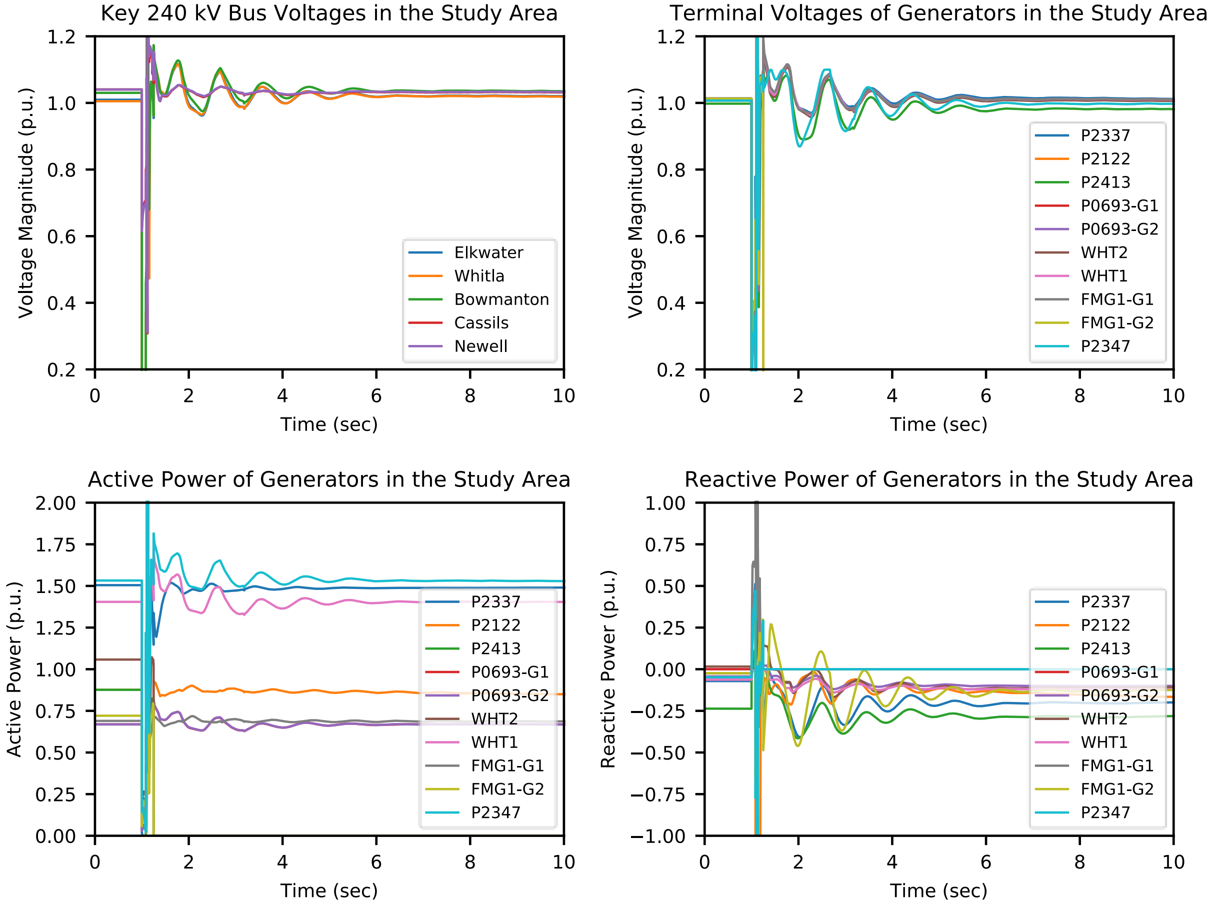
Case Description:

- Post-development 2023 summer peak case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Cassils 324S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 119



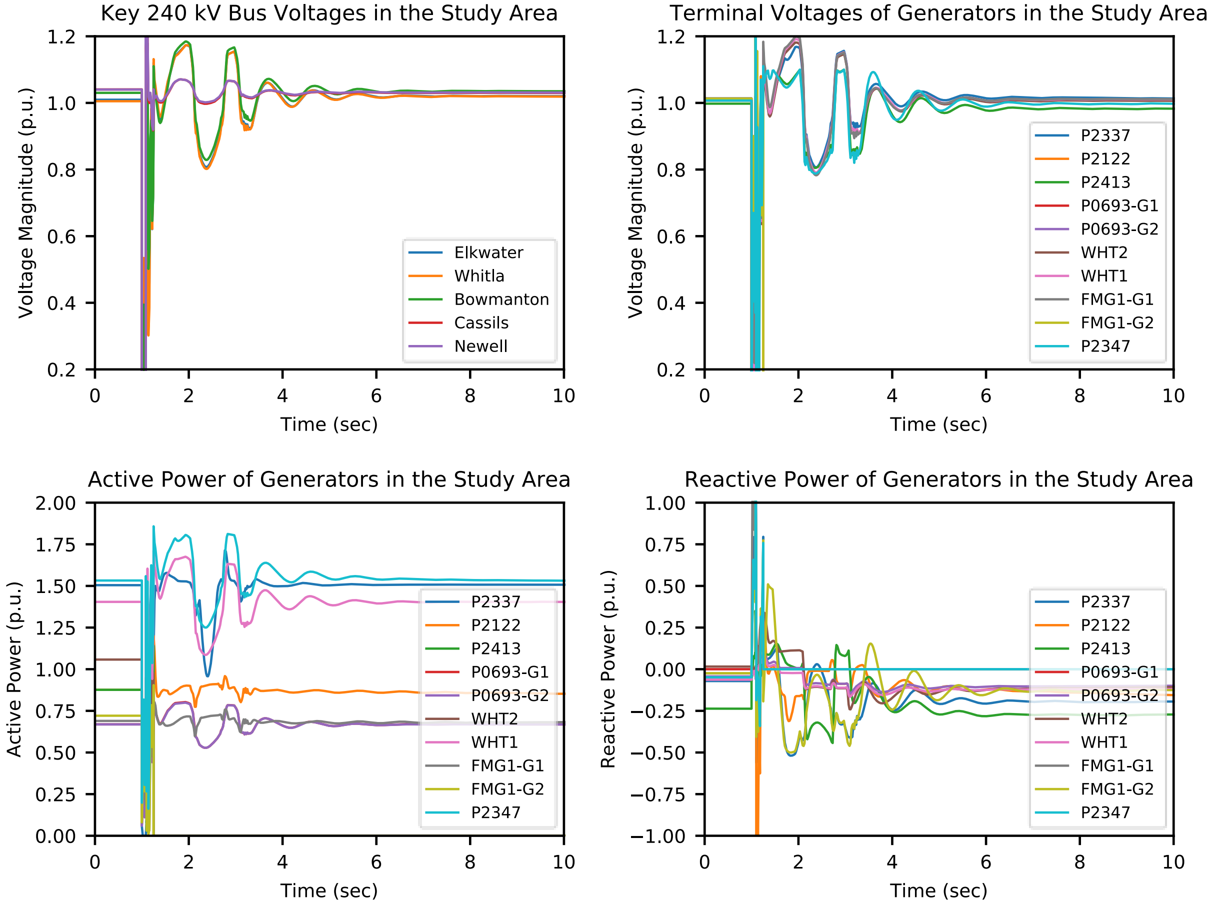
Case Description:

- Post-development 2023 summer peak case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 120



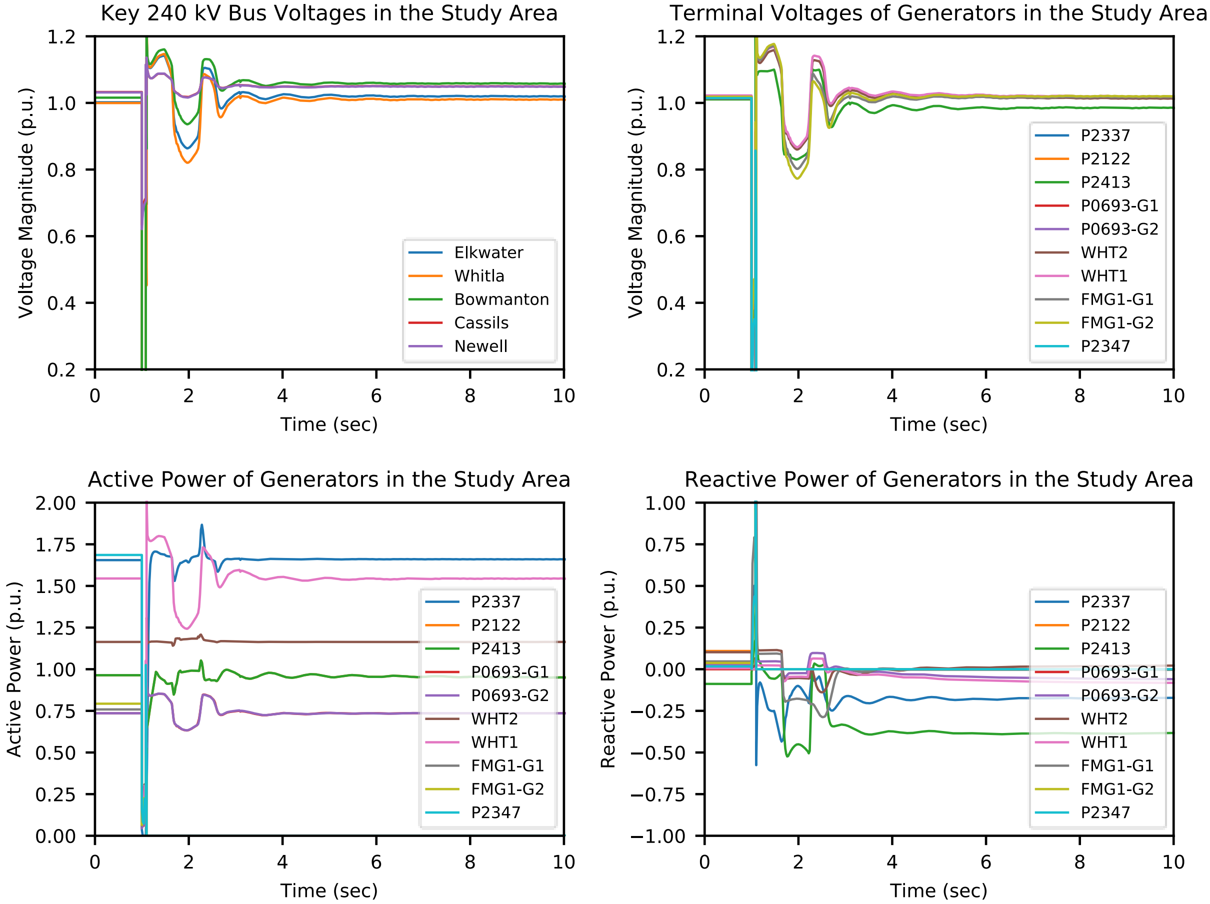
Case Description:

- Post-development 2023 summer peak case
- 1000 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Newell 2075S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 121



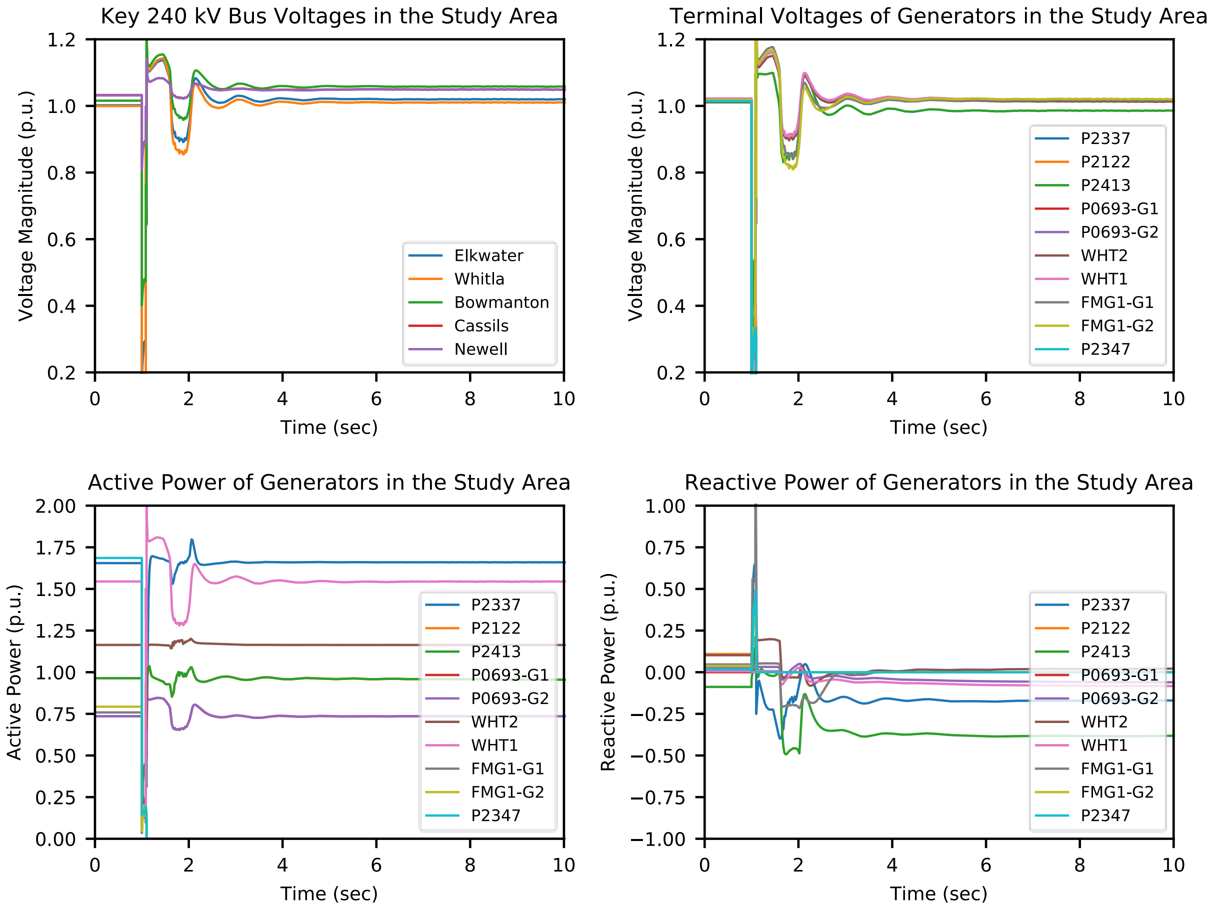
Case Description:

- Post-development 2023 summer peak case
- 1100 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 122



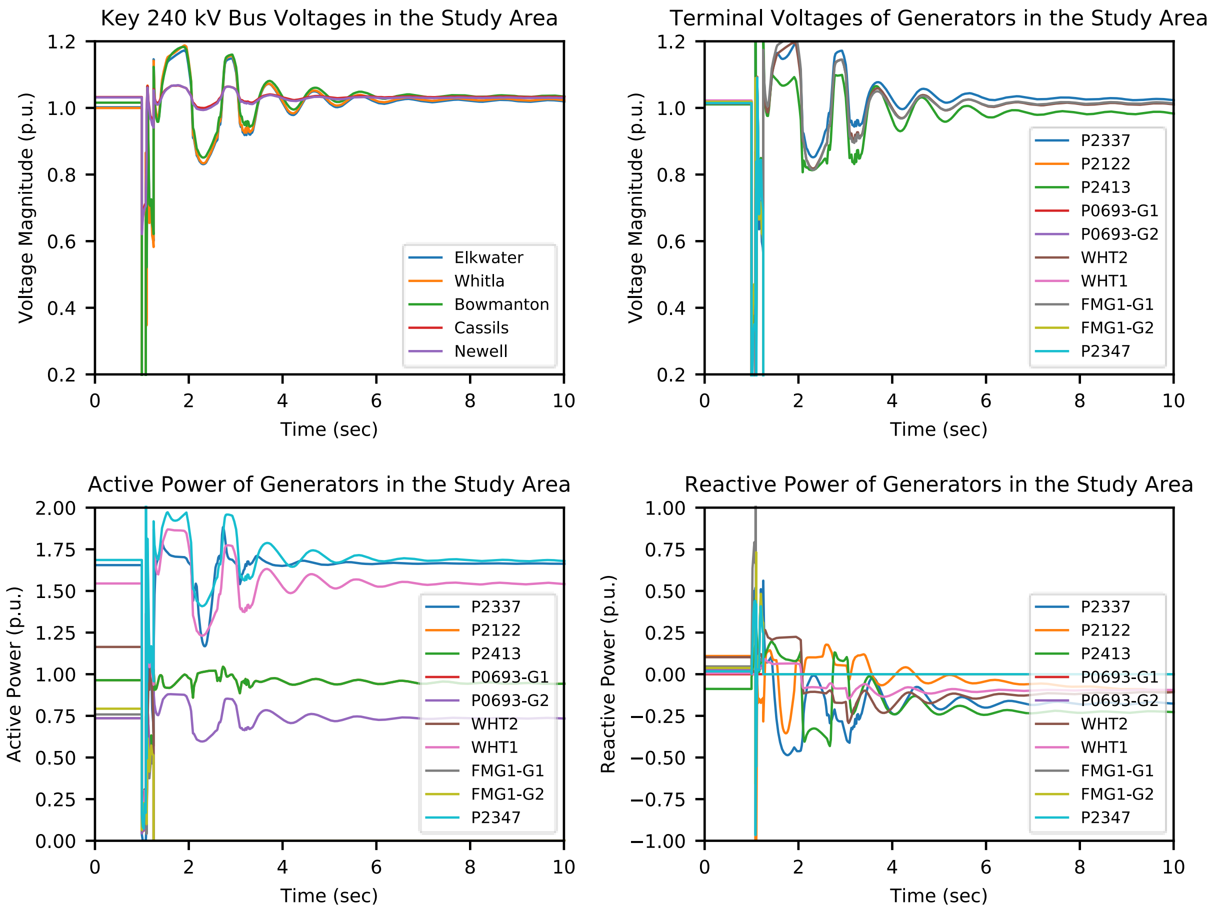
Case Description:

- Post-development 2023 summer peak case
- 1100 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 123



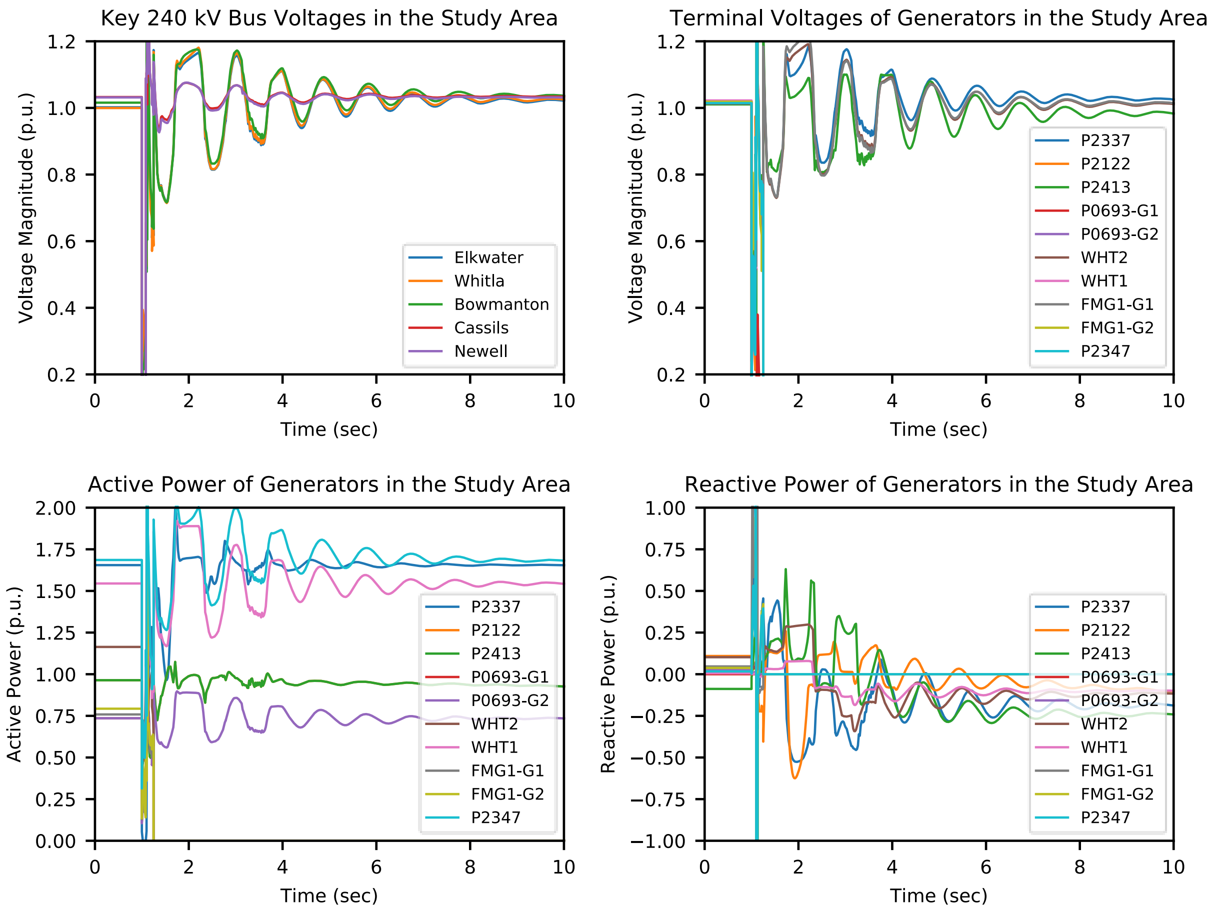
Case Description:

- Post-development 2023 summer peak case
- 1100 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 124



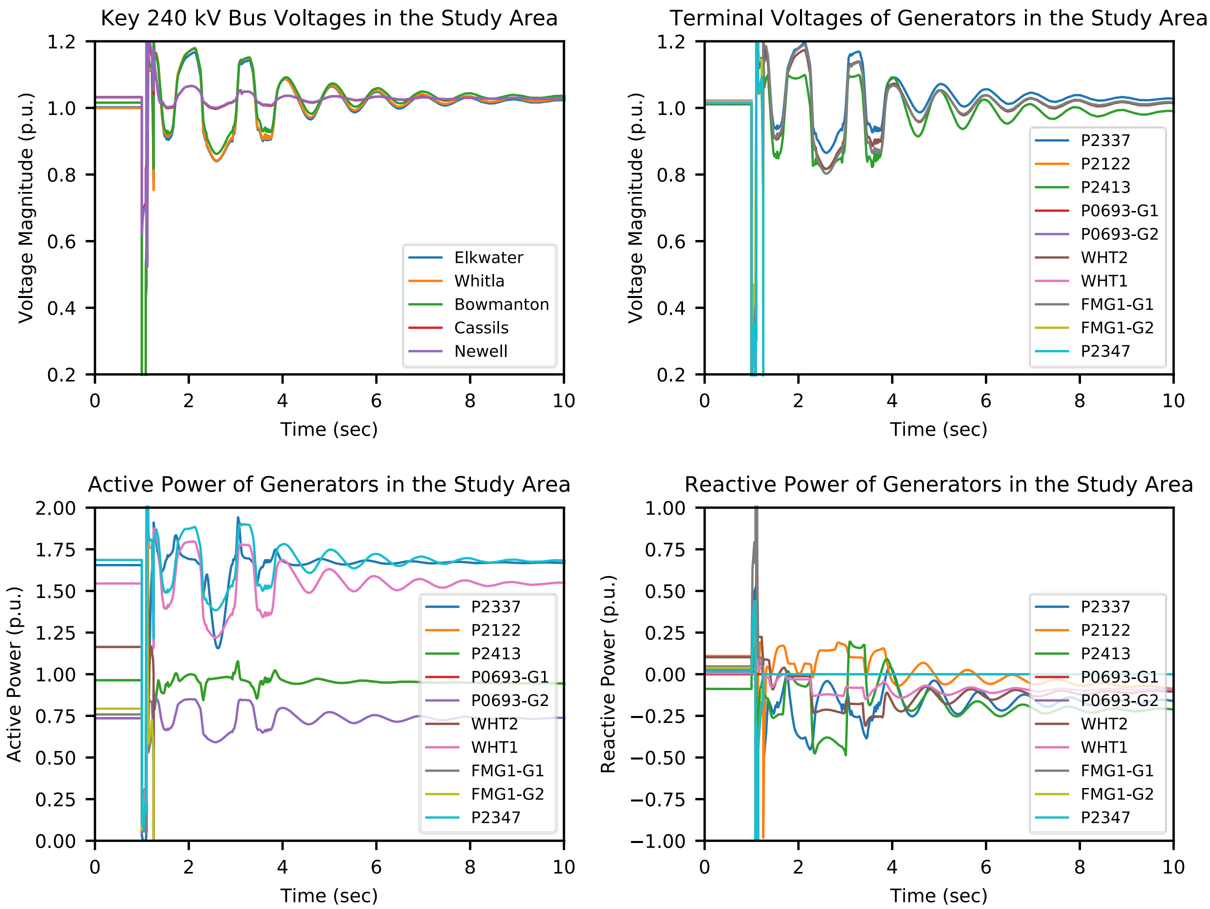
Case Description:

- Post-development 2023 summer peak case
- 1100 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Cassils 324S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 125



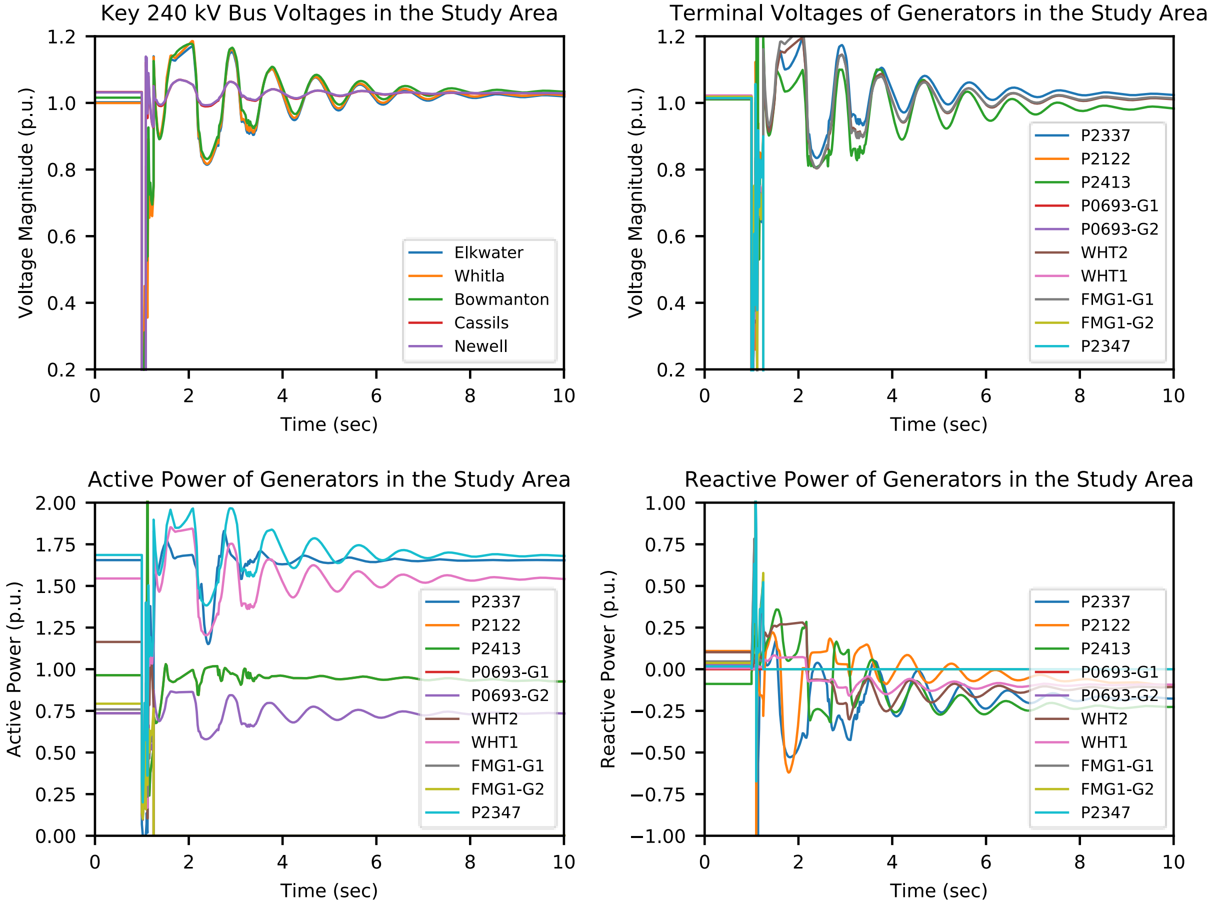
Case Description:

- Post-development 2023 summer peak case
- 1100 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 126



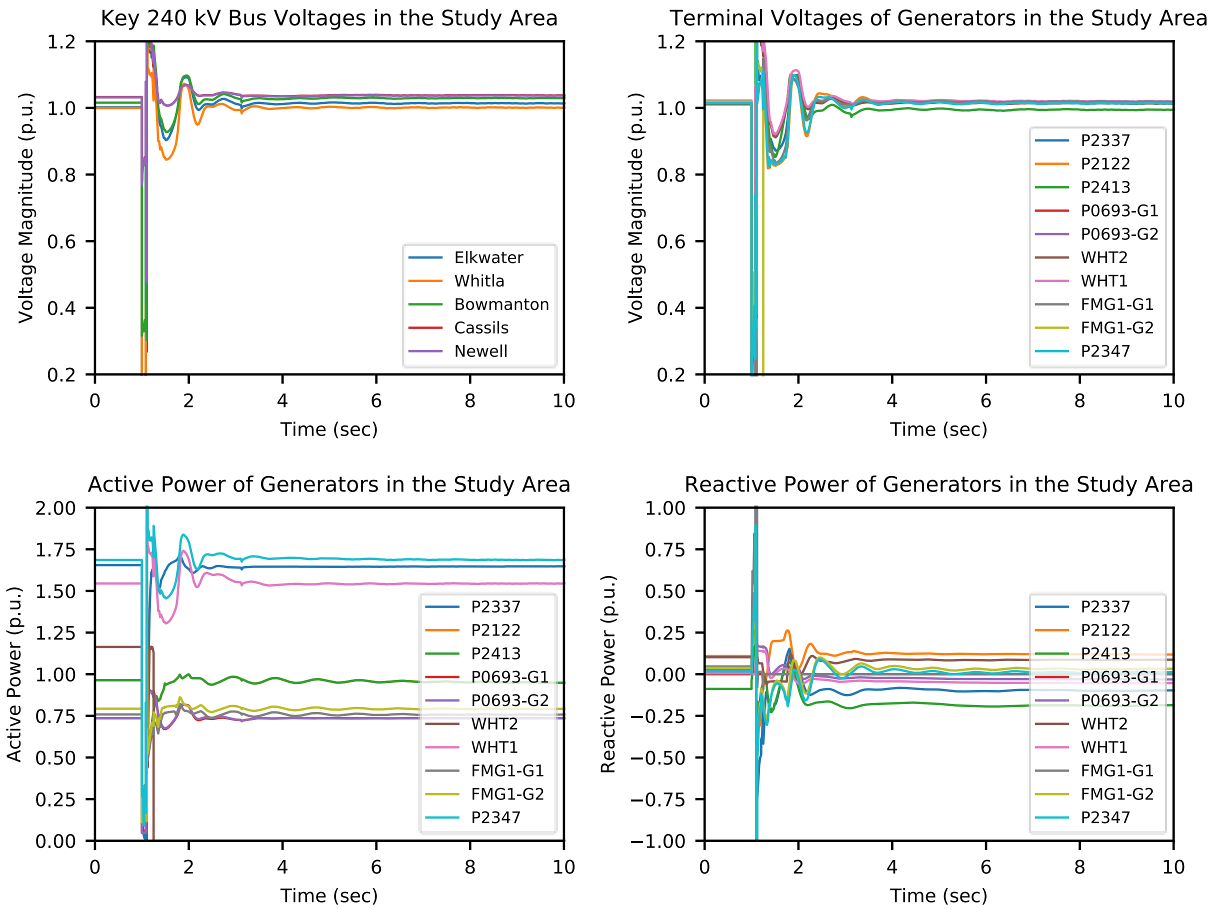
Case Description:

- Post-development 2023 summer peak case
- 1100 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Newell 2075S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 127



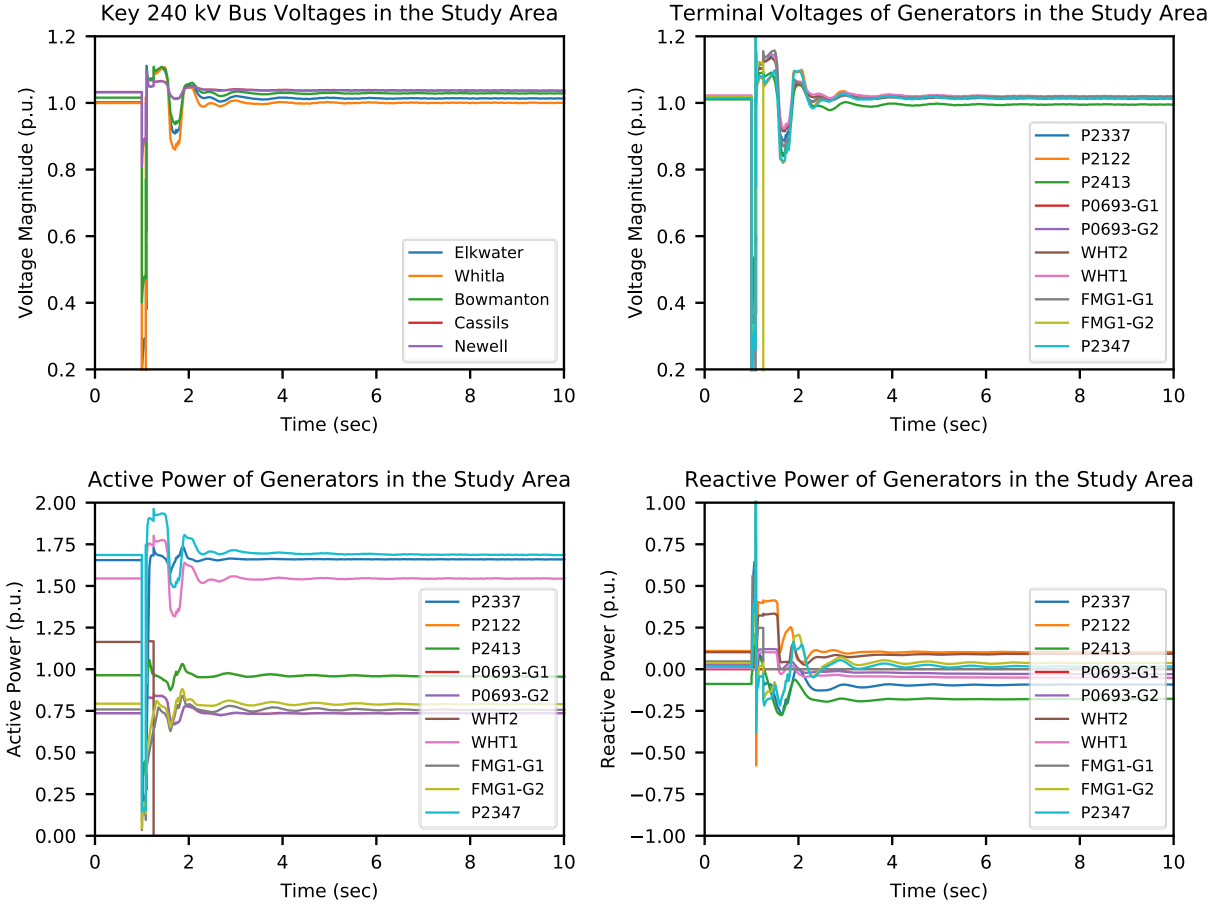
Case Description:

- Post-development 2023 summer peak case
- 1100 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 128



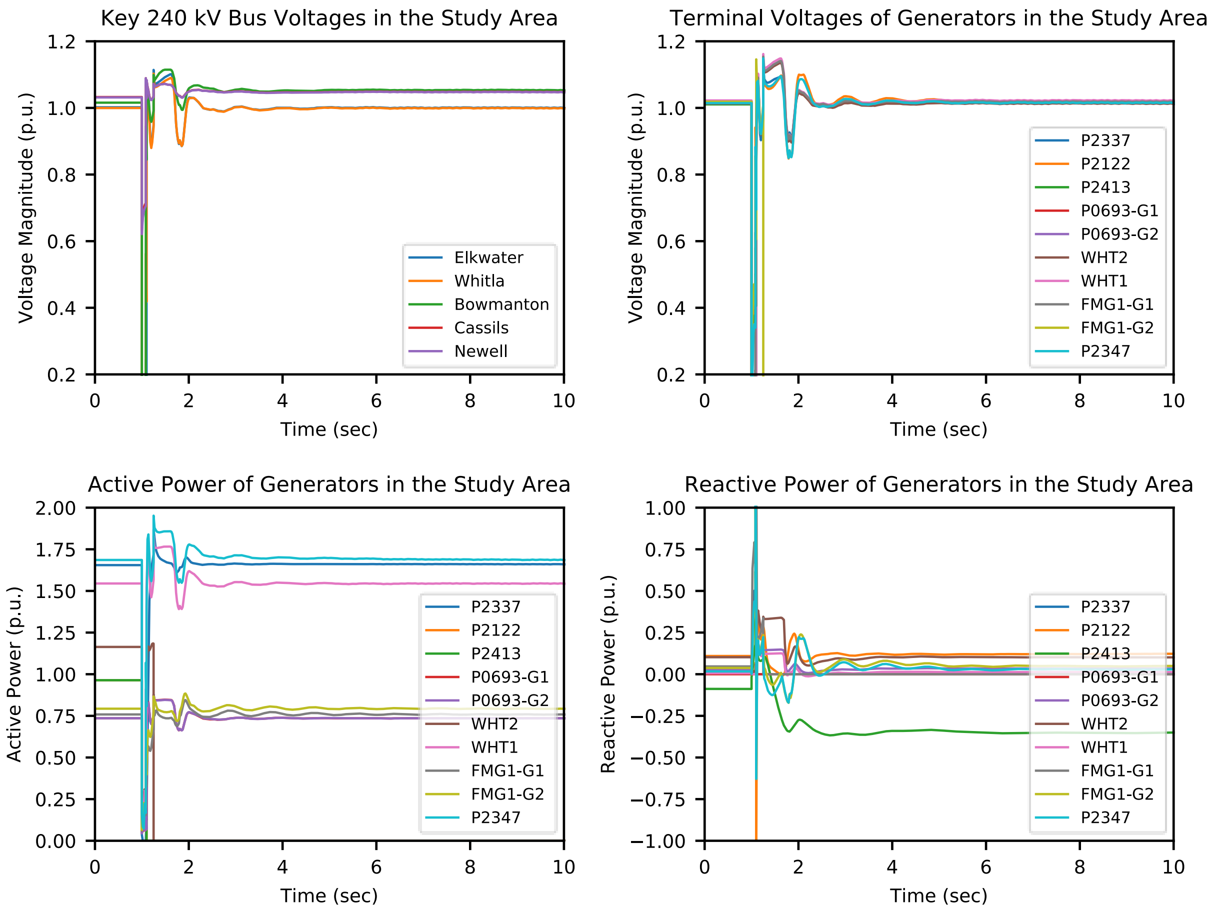
Case Description:

- Post-development 2023 summer peak case
- 1100MW MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 129



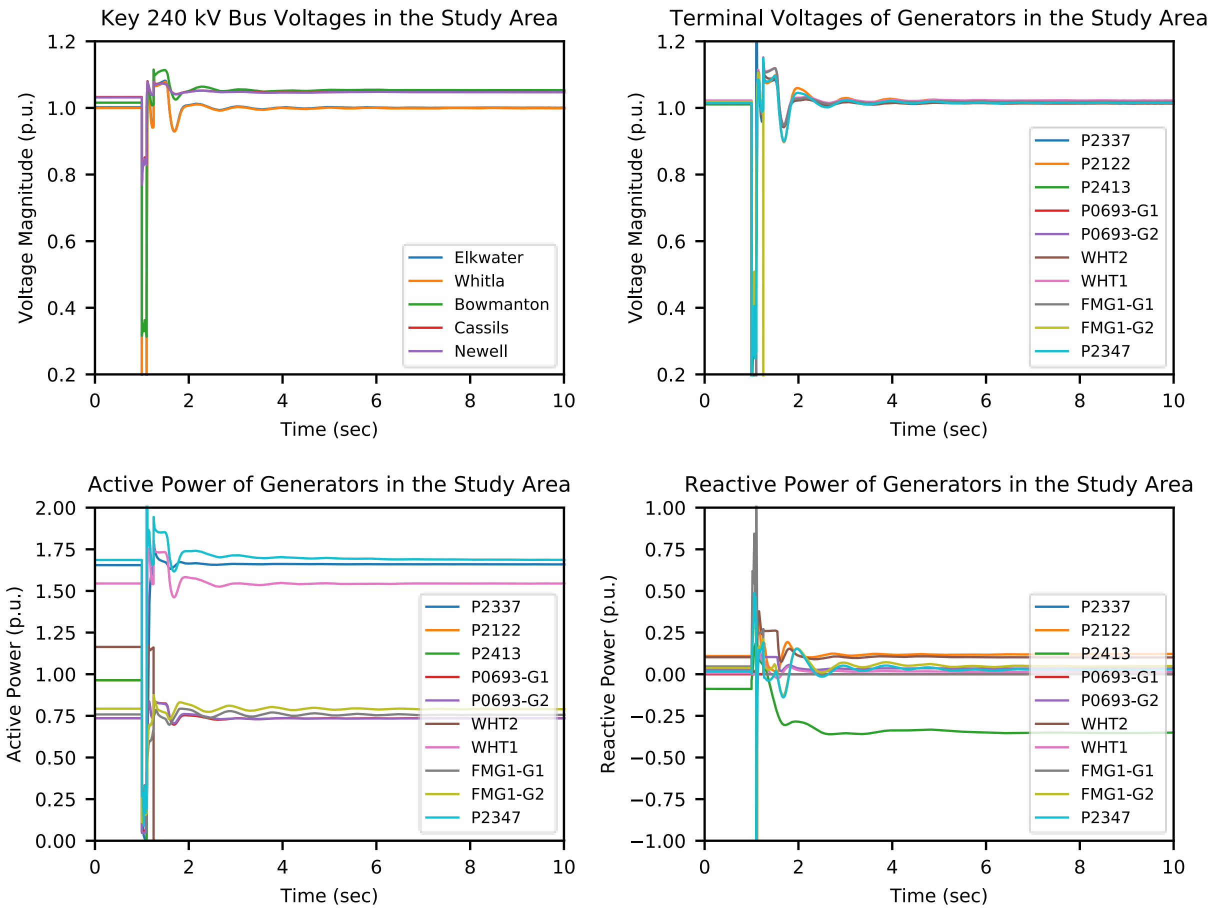
Case Description:

- Post-development 2023 summer peak case
- 1100 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 130



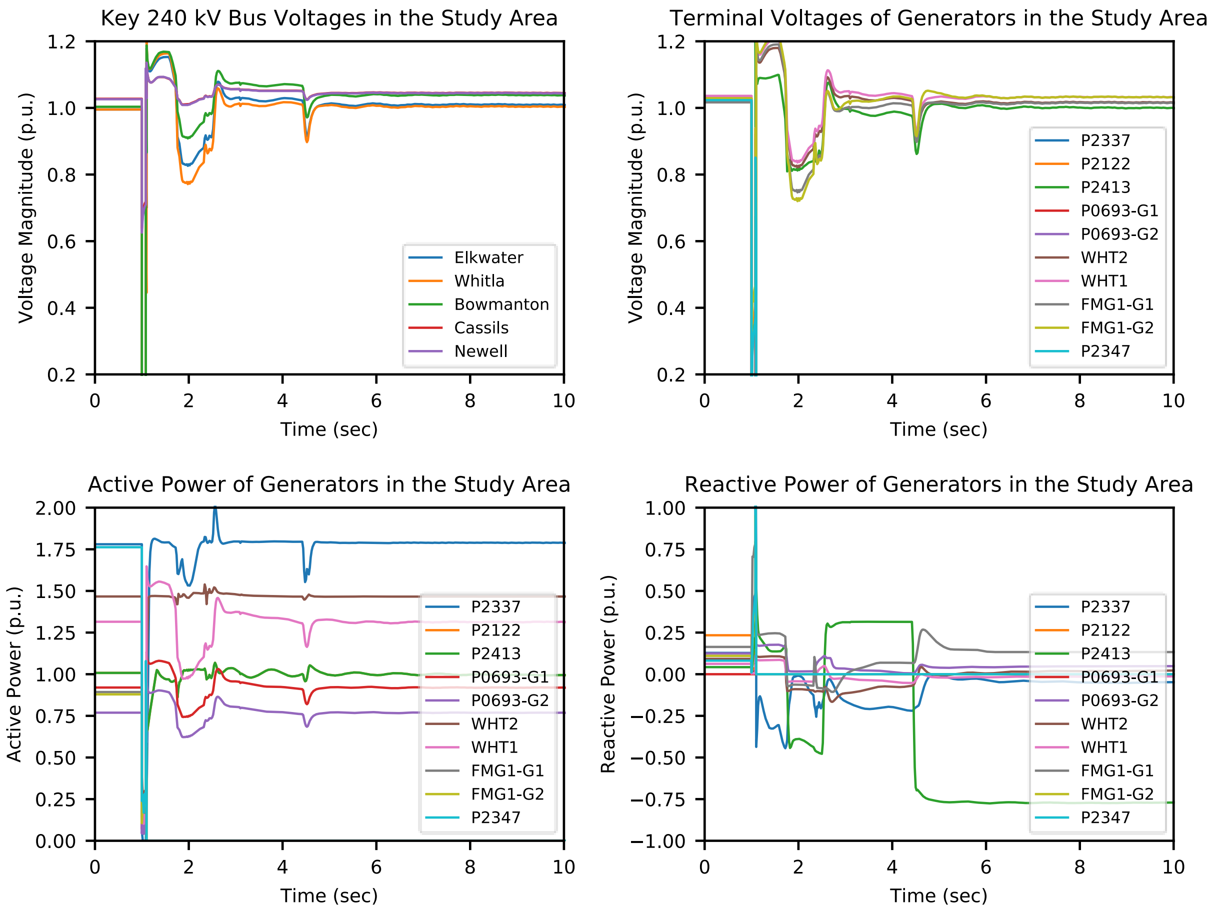
Case Description:

- Post-development 2023 summer peak case
- 1100 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 131



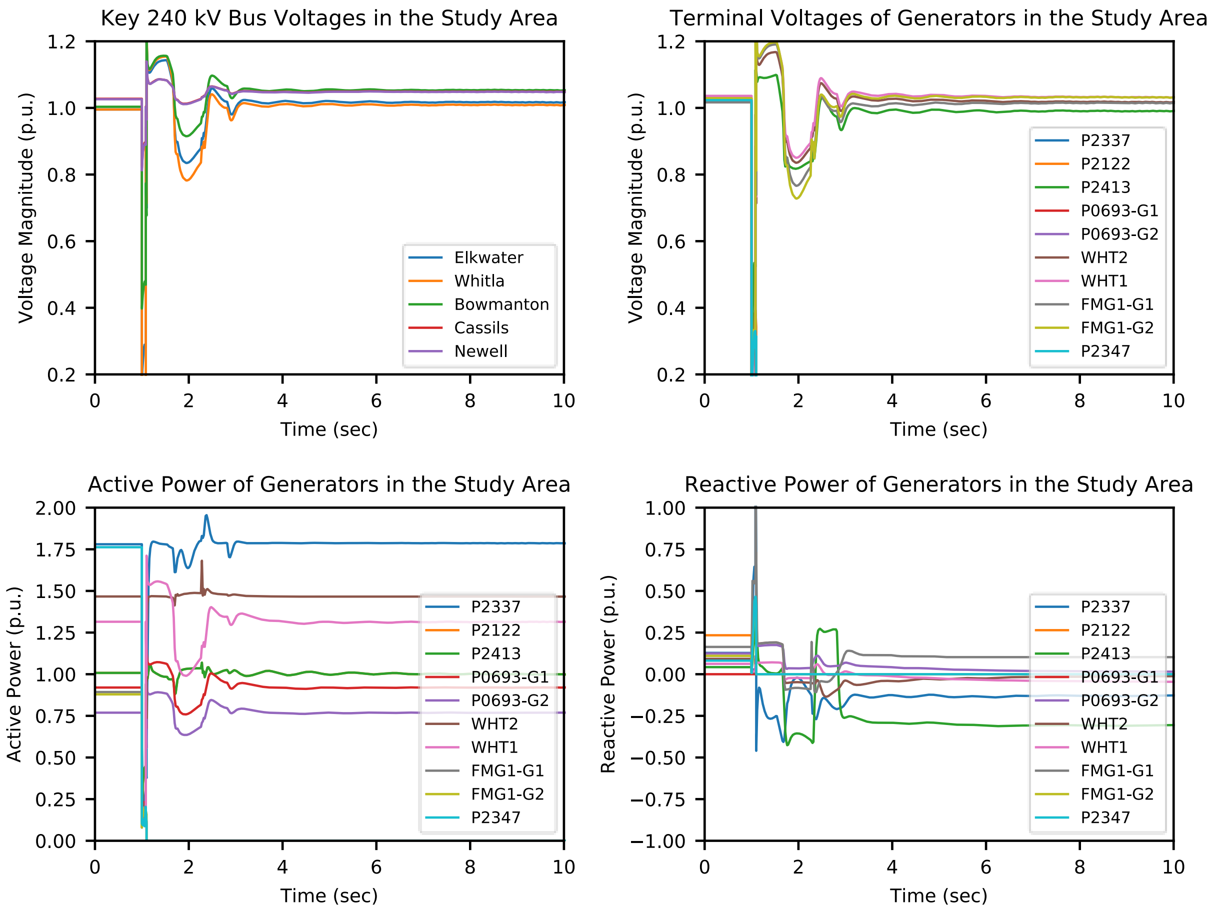
Case Description:

- Post-development 2023 summer peak case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 132



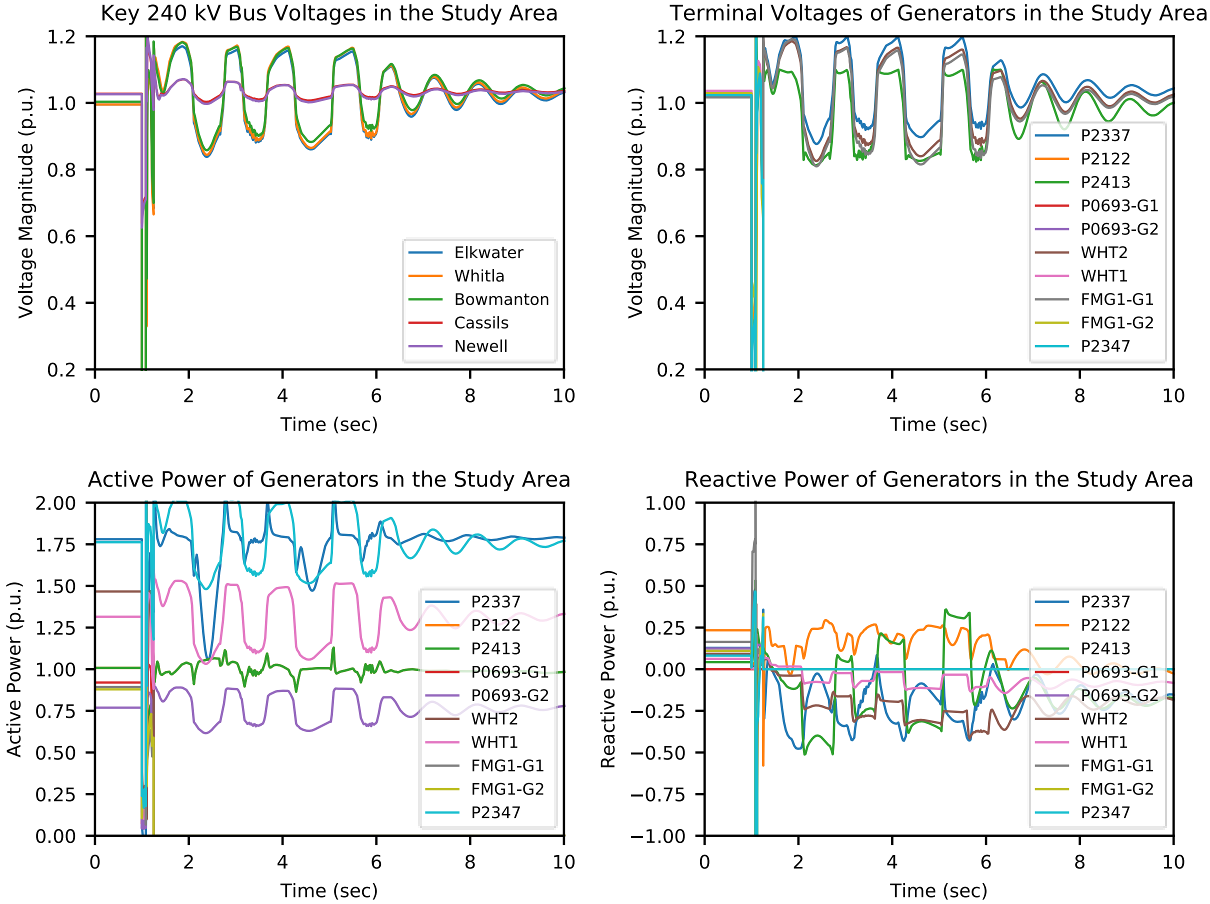
Case Description:

- Post-development 2023 summer peak case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 964L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared

Figure 133



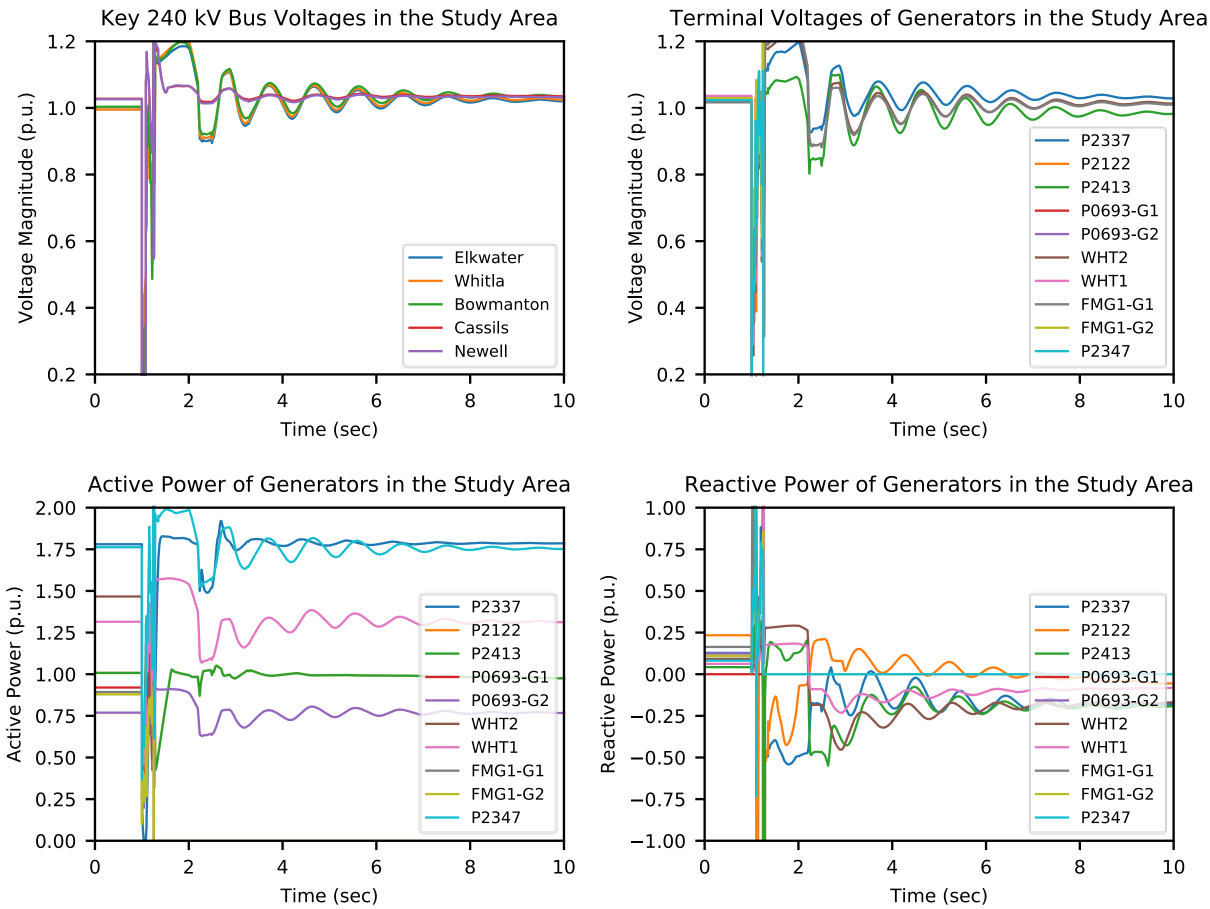
Case Description:

- Post-development 2023 summer peak case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 134



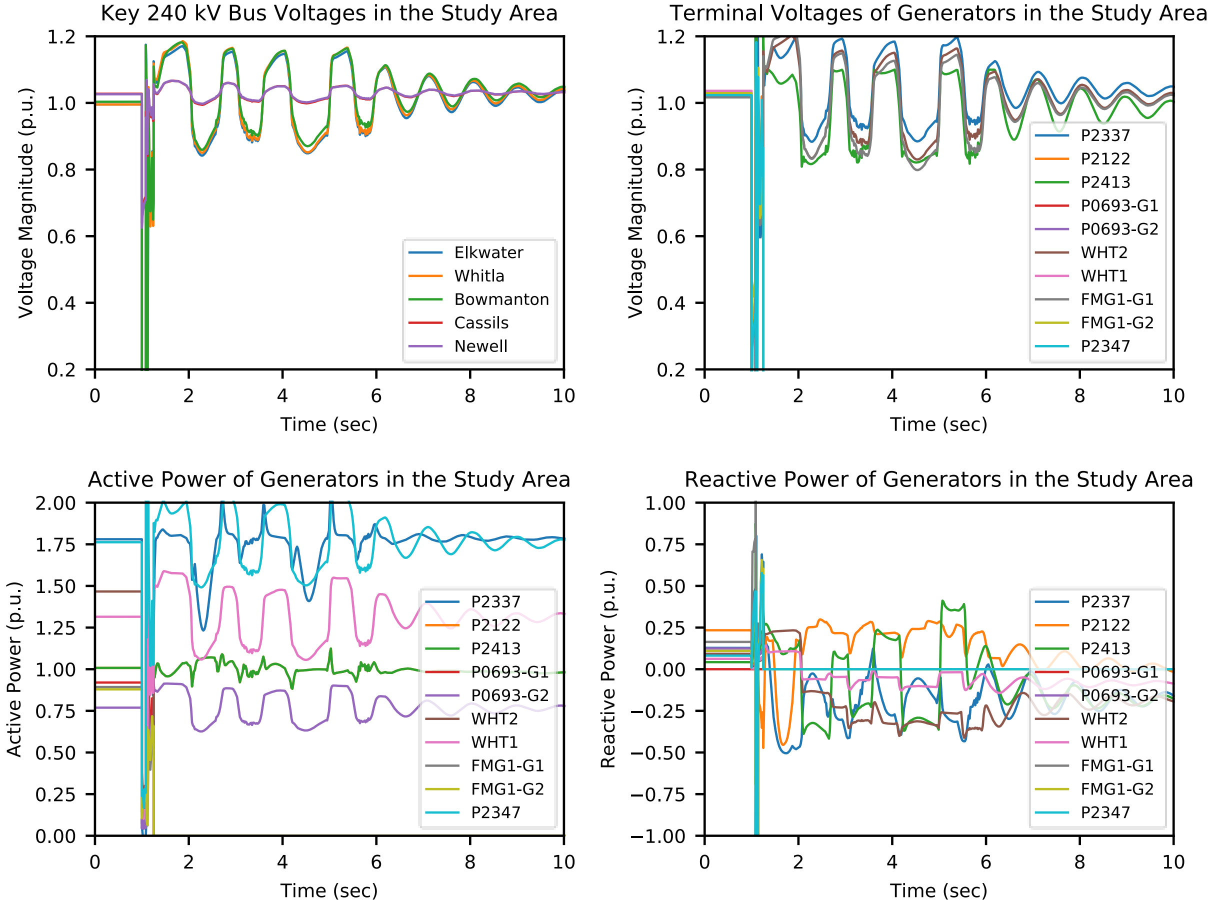
Case Description:

- Post-development 2023 summer peak case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1034L line near Cassils 324S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 135



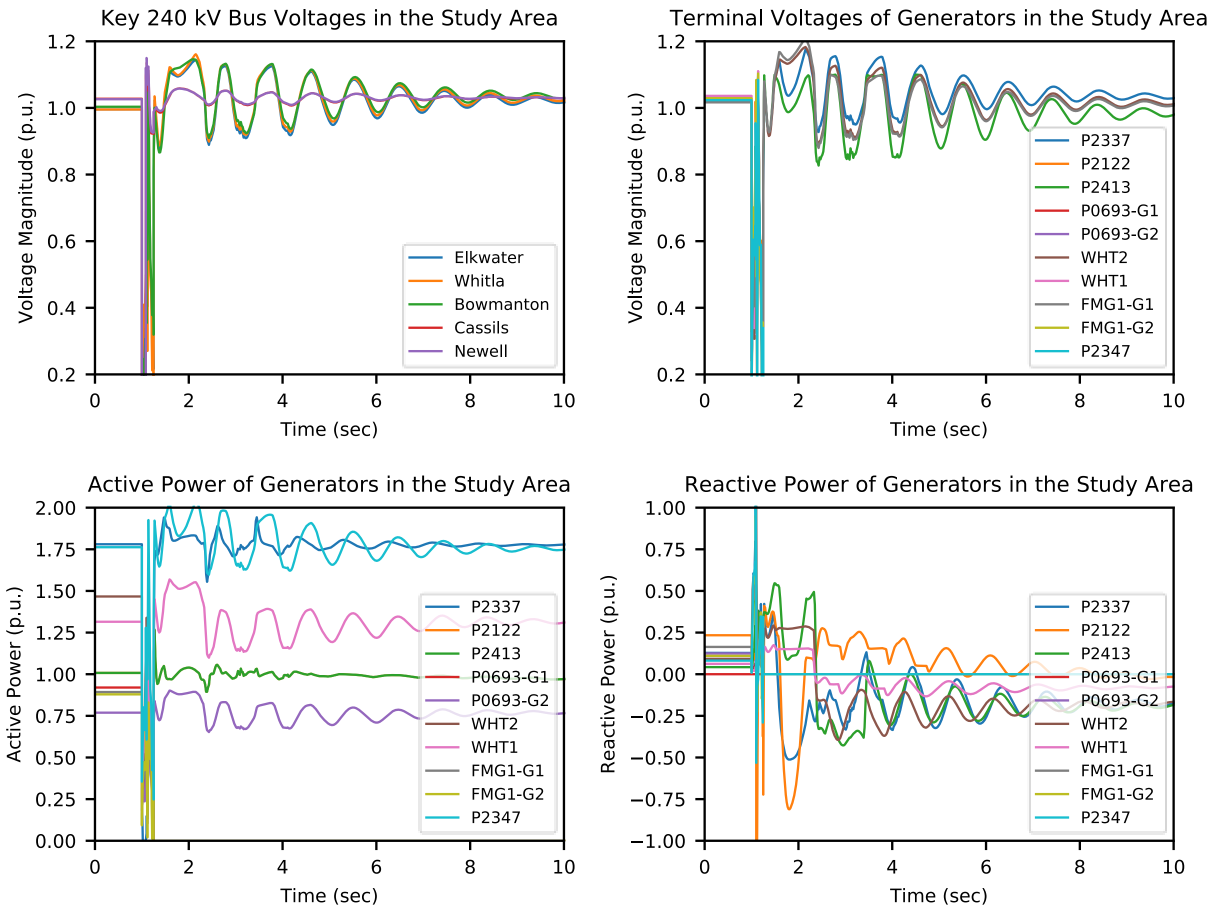
Case Description:

- Post-development 2023 summer peak case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 136



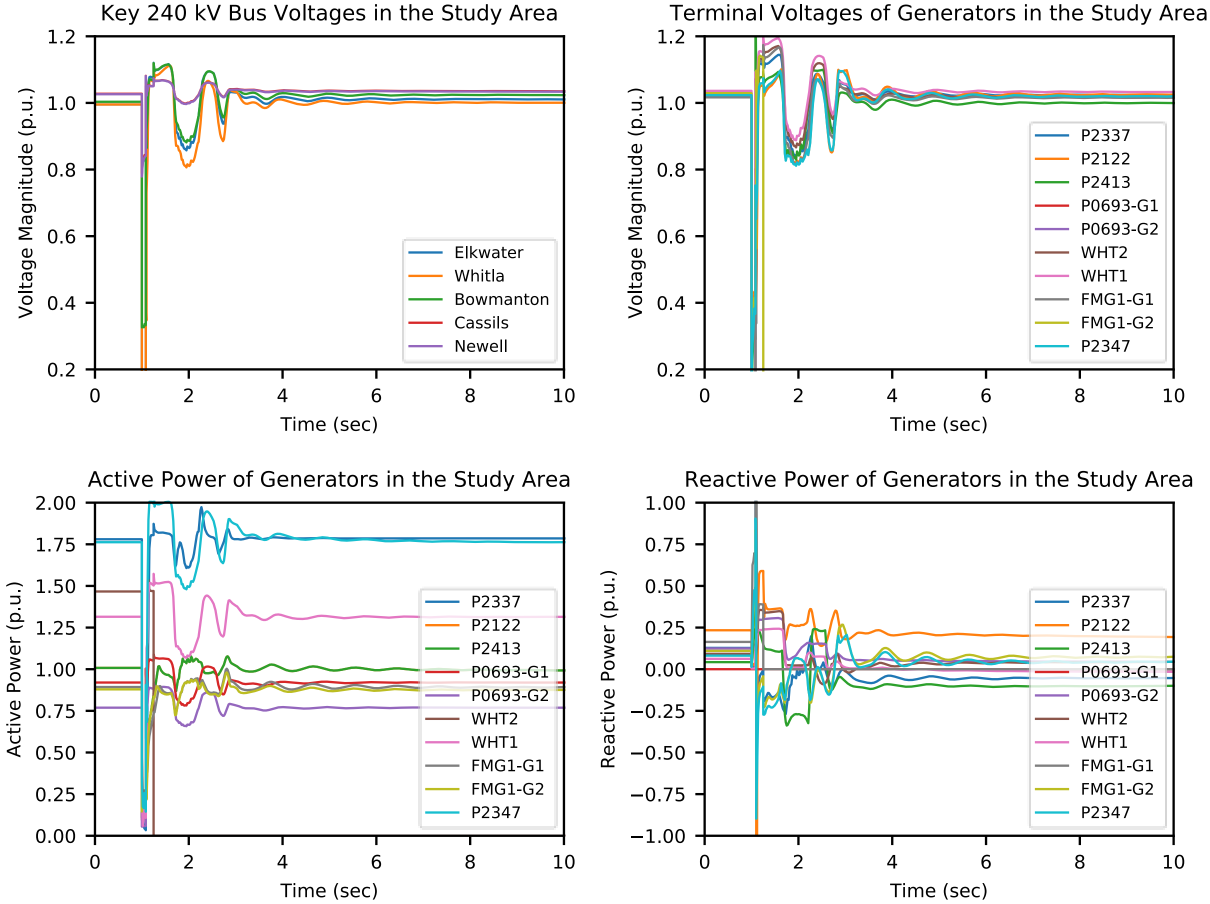
Case Description:

- Post-development 2023 summer peak case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1035L line near Newell 2075S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 137



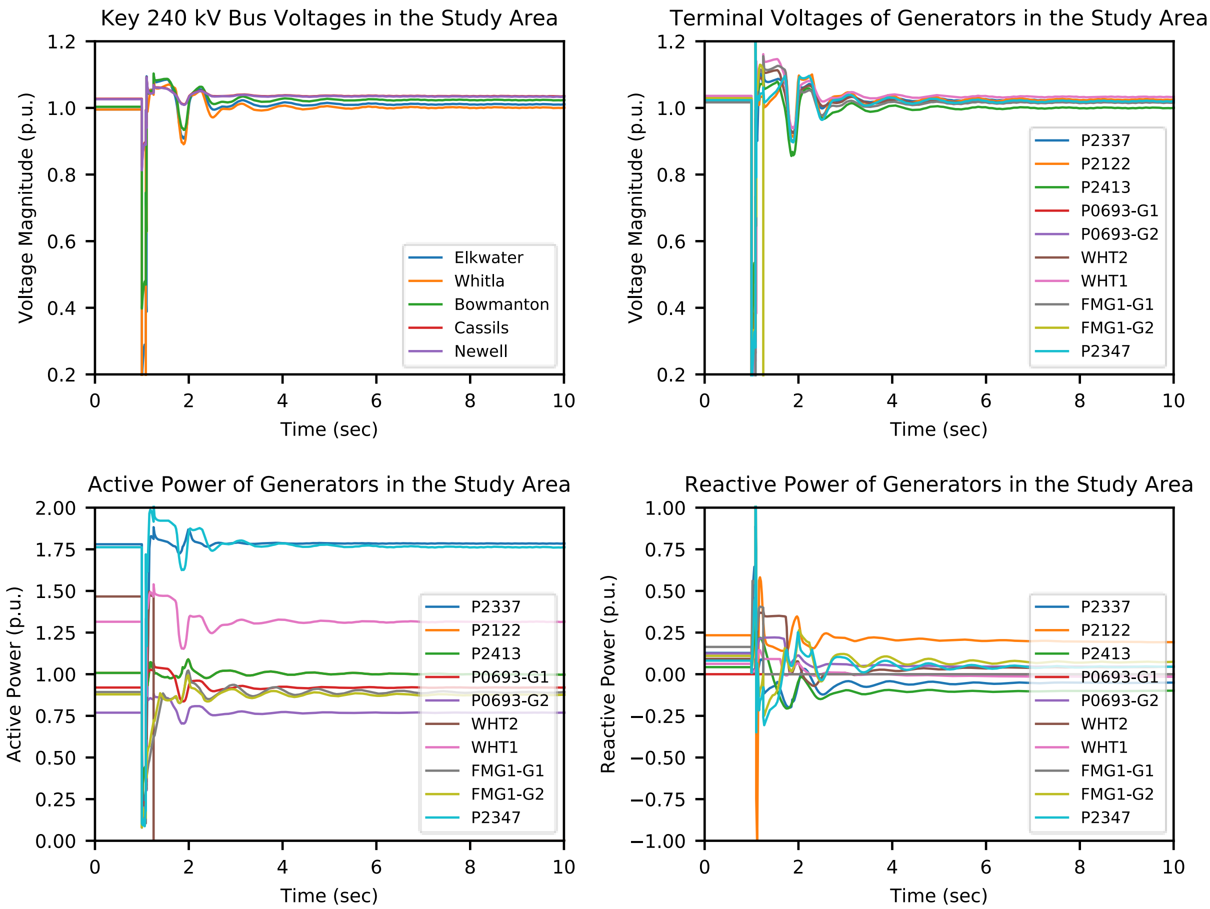
Case Description:

- Post-development 2023 summer peak case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 138



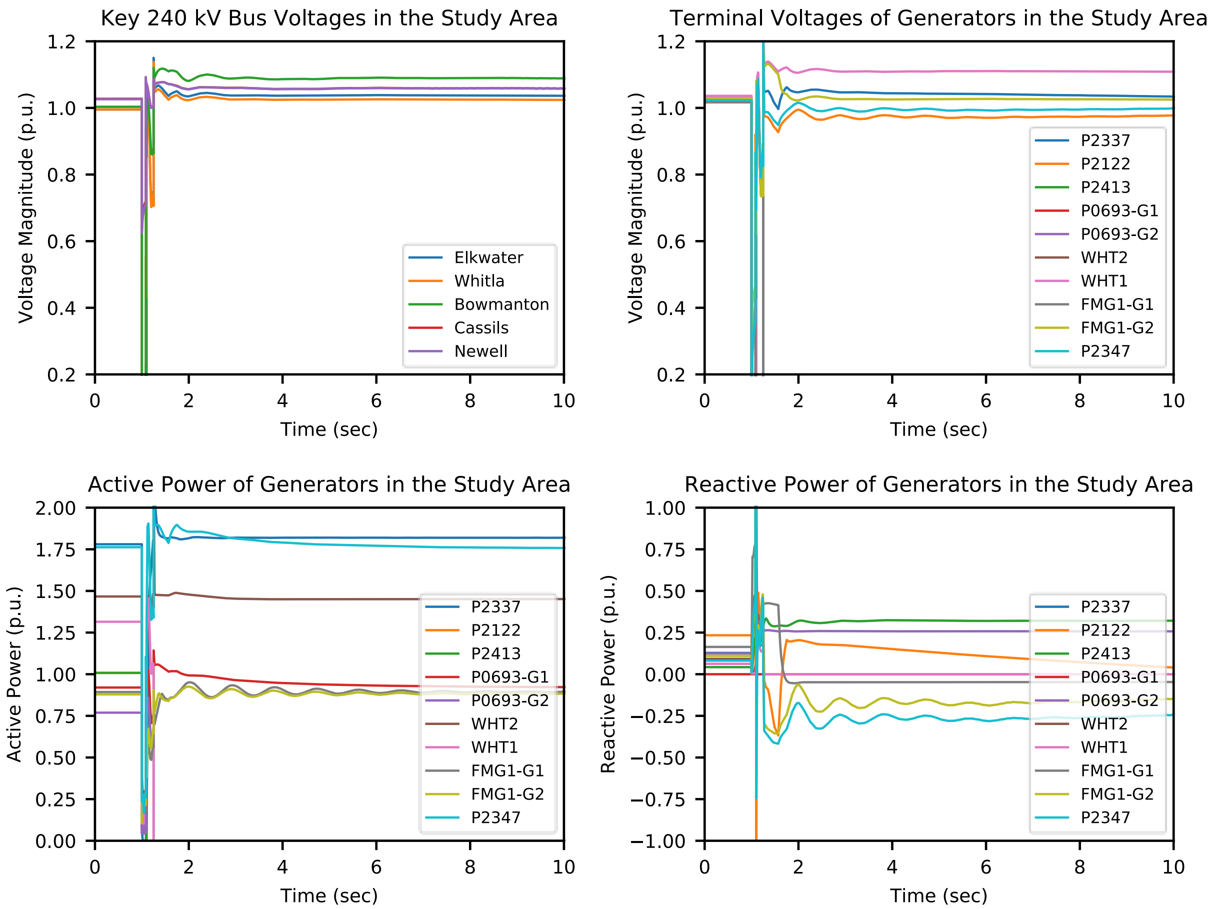
Case Description:

- Post-development 2023 summer peak case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 983L line near Whitla 251S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 139



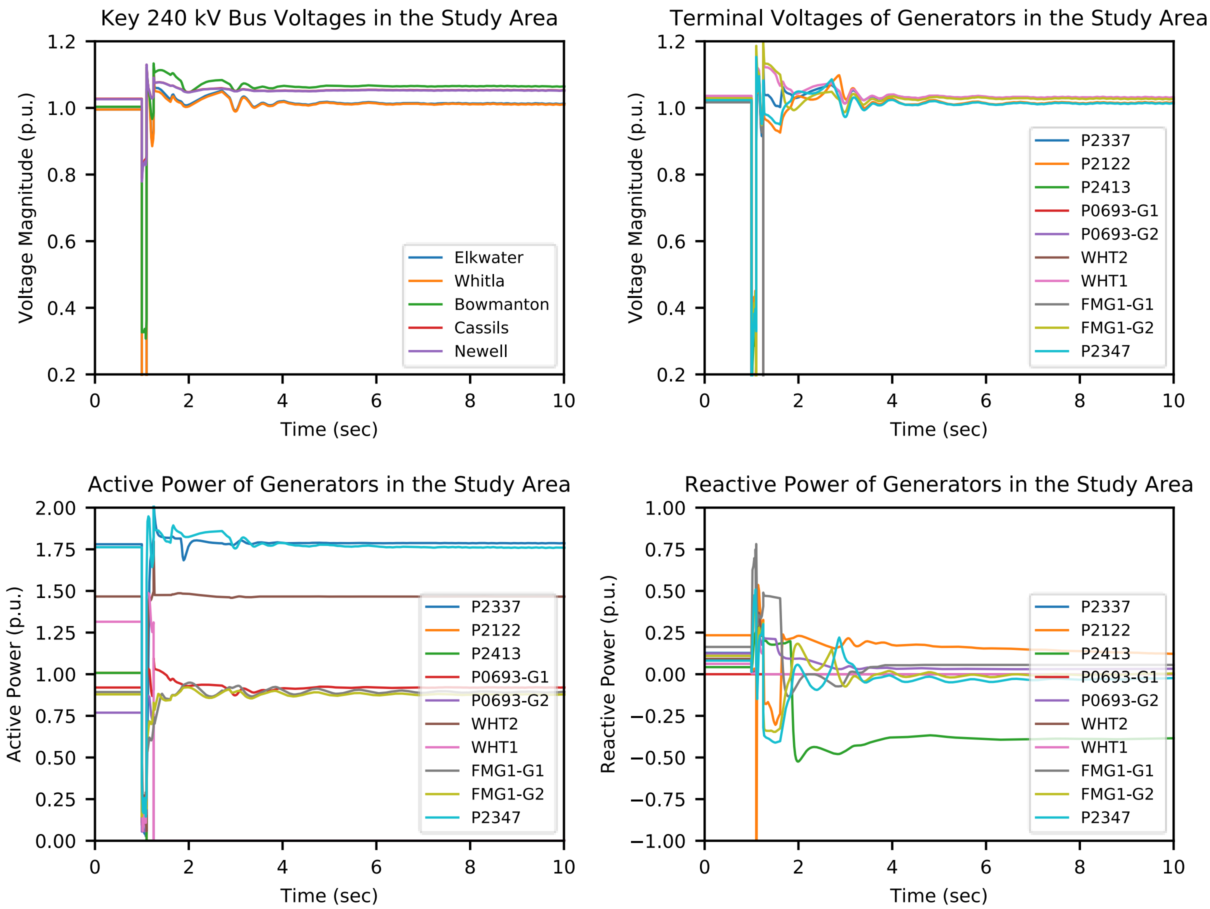
Case Description:

- Post-development 2023 summer peak case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Bowmanton 244S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation

Figure 140



Case Description:

- Post-development 2023 summer peak case
- 1180 MW of dispatched generation in the Study Area

Event Description:

- T = 1.0000 sec → Applied 3-phase fault on 1074L line near Elkwater 264S substation
- T = 1.0833 sec → Opened near-end breaker
- T = 1.1000 sec → Opened far-end breaker
- T = 1.1000 sec → Fault was cleared
- T = 1.2500 sec → RAS was used to disconnect generation