ATTACHMENT 5

CENTERPOINT ENERGY FREEPORT AREA

MASTER PLAN PROJECT STUDY -

NON-CONFIDENTIAL VERSION

(Confidential Version will be provided upon the adoption of the Protective Order)

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Freeport Area Master Plan Project

March 30, 2017

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Transmission Planning

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1 Executive Summary

The Freeport Area is located in the southernmost part of the service territory of CenterPoint Energy Houston Electric, LLC (CenterPoint Energy) adjacent to the Gulf of Mexico. It has a major seaport and is a highly industrialized area with several large chemical facilities served by the CenterPoint Energy transmission system.

Beginning in 2012, CenterPoint Energy identified several transmission projects to accommodate a new trend of large load additions in the Freeport Area. CenterPoint Energy completed projects in 2016 and early 2017 (the "Freeport Area Upgrades" and the "Dow-Velasco 345/138 kV Autotransformer Addition"), and is completing a project in 2017 (the "Jones Creek Project") to increase the load-carrying capacity of the transmission system in the Freeport Area. However, as the load continues to grow in the Freeport Area and the potential for additional transmission system capacity upgrades becomes limited, the need for long-term transmission line capacity alternatives increases.

ERCOT has shown voltage and loading concerns in the Freeport Area as early as 2018/2019 through 2022 in both the 2016 Regional Transmission Plan and the 2016 Long Term System Assessment. The results from these ERCOT studies illustrate a growing need for upgrades in the Freeport Area.

CenterPoint Energy has completed a reliability evaluation of the need for additional transmission line capacity alternatives in the Freeport Area. This study identified potential reliability concerns beginning in 2019 with respect to North American Electric Reliability Corporation (NERC) Reliability Standard TPL-001-4, ERCOT Transmission Planning Criteria, and CenterPoint Energy Transmission System Design Criteria.

The sum of the non-coincident peak loads in the Freeport Area in 2016 was 1028 MW. CenterPoint Energy has signed letter agreements with customers in the Freeport Area totaling approximately 1340 MW of new load expected to be connected to the system between 2017 and 2019. In addition to this new committed load, CenterPoint Energy has received additional inquiries for another proposed 550 MW of load additions in the Freeport Area by 2021. CenterPoint Energy is already making improvements to the transmission system to serve a portion of the new committed load, including constructing the new 345/138 kV Jones Creek Substation to be completed in 2017. However, with the 1340 MW of new committed load by 2019, power flow studies show overloading of the existing 345 kV circuits as well as severe low voltages in the area.

Being that virtually the entire load in the Freeport Area is industrial load, the load level is generally unaffected by weather or time of year. This situation will make it difficult to schedule maintenance outages on any of the 345 kV lines serving the Freeport Area as the load grows. As a result, CenterPoint Energy has included maintenance outage scenarios in its evaluation of potential solutions.

CenterPoint Energy studied eight options in all, selecting Option 5 and rejecting the other seven. The eight options included one option to upgrade the existing 345 kV circuits (Option 1) and seven options to build a new 345 kV double-circuit line to serve the Freeport Area (Options 2 through 8).

System upgrades (common to Options 2 through 8) necessary to "bridge the gap" until a new 345 kV line can be placed in service were identified and are recommended to be complete before peak 2019 at an estimated cost of $32.34 million. These upgrades are included in Option 5 and are able to serve the committed load and meet ERCOT and CenterPoint Energy reliability criteria for 2019 and 2020. However, the "bridge the gap" upgrades provide little margin for additional load growth for the long-term and do not address the maintenance outage concerns that are discussed in the study report; therefore, additional system improvements are needed long-term, beyond 2020. Option 5 also includes new 345 kV transmission line improvements that meet these long-term system requirements. The construction of a new double-circuit 345 kV Bailey to Jones Creek line is proposed to be completed before peak of 2021 at an estimated cost of $214.4 million.

To serve the new committed loads in the Freeport Area, maintain transmission grid reliability, provide for future load growth, increase transfer capability to the Freeport Area, and improve the ability to take 345 kV scheduled maintenance outages in the Freeport Area, CenterPoint Energy submits the Freeport Area Master Plan Project (identified as Option 5 in this study) for the Electric Reliability Council of Texas (ERCOT) Regional Planning Group (RPG) review. The proposed Freeport Area Master Plan Project consists of the following:

To be completed before peak 2019 – (Bridge the Gap Upgrades)

- Loop 345 kV South Texas Project (STP) – Dow-Velasco circuit 27 into the Jones Creek Substation (approximately 0.9 mile)
- Install 7-ohm in-line reactors at the Jones Creek Substation on 345 kV STP – Jones Creek circuits 18 and 27
- Install 3rd 345/138 kV 800/1000 MVA Autotransformer at the Jones Creek Substation
- Install 4th 138 kV Capacitor Bank (120 MVAr) at Jones Creek Substation
- Install 1st 138 kV Automatically Switchable Capacitor Bank (140 MVAr) at Jones Creek Substation
- Install 2nd 138 kV Automatically Switchable Capacitor Bank (140 MVAr) at Jones Creek Substation

To be completed before peak 2021 – (New 345 kV Transmission Line)

- Build a new 345 kV double-circuit line from Bailey Substation to Jones Creek Substation (approximately 48 miles)
- Upgrade 345 kV Dow-Velasco – Jones Creek circuits 18 and 27 to at least a 1700 MVA emergency rating

The total cost of the Freeport Area Master Plan Project is $246.74 million. The timeline takes into consideration the typical lead times necessary to implement the proposed upgrades, including review by ERCOT and the Public Utility Commission of Texas (PUCT), and materials and construction lead times. CenterPoint Energy requests ERCOT consider designating the new transmission line project as 'critical to reliability' per PUCT Substantive Rule 25.101(b)(3)(D) due to the severity of the reliability concerns, the magnitude of new load being added to a small area, and the harm any delay in this project could have on the Texas economy.

2 Background

The Freeport Area is a highly industrialized area with several large chemical facilities as well as a major seaport on the Gulf of Mexico that is served by the CenterPoint Energy transmission system. The Freeport Area is a load pocket located approximately 50 miles south of the Houston metropolitan area. Customer activity in this area has been high in recent years and CenterPoint Energy has made the following improvements in the area to respond to the growing load.

Transmission projects sponsored by CenterPoint Energy in the Freeport Area since 2012

In June 2012, CenterPoint Energy submitted the Tier 3 Freeport Area Upgrades project to ERCOT RPG recommending conversion of the transmission system in the Freeport Area from 69 kV to 138 kV. The Freeport Area Upgrades project was needed for storm hardening, replacing aged infrastructure in the area, and positioning the system in the Freeport Area to accommodate large load additions. The Freeport Area Upgrades project was approved by ERCOT RPG and construction completed before peak 2016.

Industrial customer Freeport LNG submitted a Generation Interconnection request in 2013 which CenterPoint Energy subsequently studied and recommended connecting the new generator to the new Oyster Creek 138 kV substation connected on the 138 kV Velasco – BIPORT circuit 82. The connection required line certification approval by the PUCT which was granted in January 2014. This substation is expected to be energized by May 2017 with the generator reaching commercial operation in 2018.

In March 2014, CenterPoint Energy submitted the Tier 3 Dow-Velasco 345/138 kV Autotransformer Addition Project to ERCOT RPG recommending addition of a 2^{nd} 345/138 kV 800/1000 MVA Autotransformer at the CenterPoint Energy Dow-Velasco substation. The Dow-Velasco 345/138 kV Autotransformer Addition Project was needed for local reliability performance concerns in the Freeport Area due to ERCOT autotransformer unavailability criteria and to provide capacity for future area load growth. The Dow-Velasco 345/138 kV Autotransformer Project was reviewed by ERCOT RPG and was completed in early 2017.

In July 2014, CenterPoint Energy submitted the Tier 1 Jones Creek Project to ERCOT RPG. The Jones Creek Project is needed to serve a 700 MVA load associated with the proposed natural gas liquefaction and export facility being developed by Freeport LNG. The Jones Creek Project consists of a new 345/138 kV CenterPoint Energy substation in the Freeport Area with two 345/138 kV 800/1000 MVA autotransformers and reconfiguration of circuits such that two 345 kV and four 138 kV lines terminate into Jones Creek. The Jones Creek Project was approved by the ERCOT Board and is expected to be complete before peak 2017.

ERCOT 2016 Regional Transmission Plan and 2016 Long Term System Assessment Results

The ERCOT 2016 Regional Transmission Plan (RTP) [1] identified several reliability projects in the Freeport Area, including four capacitor banks at either Jones Creek or Velasco, to resolve voltage concerns seen in the studies beginning in 2018. The ERCOT 2016 RTP analysis also identified congestion in 2019 and 2022 on 345 kV STP – Jones Creek circuit 18. This congestion was reported as one of the highest congested elements in the ERCOT 2016 Report on Existing and Potential Electric System Constraints and Needs [2]. The ERCOT 2016 Long Term System Assessment (LTSA) [3] notes that under the Environmental Mandate scenario, under G-1 + N-1 conditions, reliability projects are needed and includes the STP to Dow/Jones Creek 345 kV double-circuit line upgrade at the top of the list. The 345 kV STP – Jones Creek circuit 18 is listed as a top congested element in the Current Trends and High Energy/Efficiency/Distribution Generation scenarios. The results from the various ERCOT studies illustrate that for the Freeport Area loads in the RTP base cases, ERCOT has identified a growing need for upgrades in the Freeport Area.

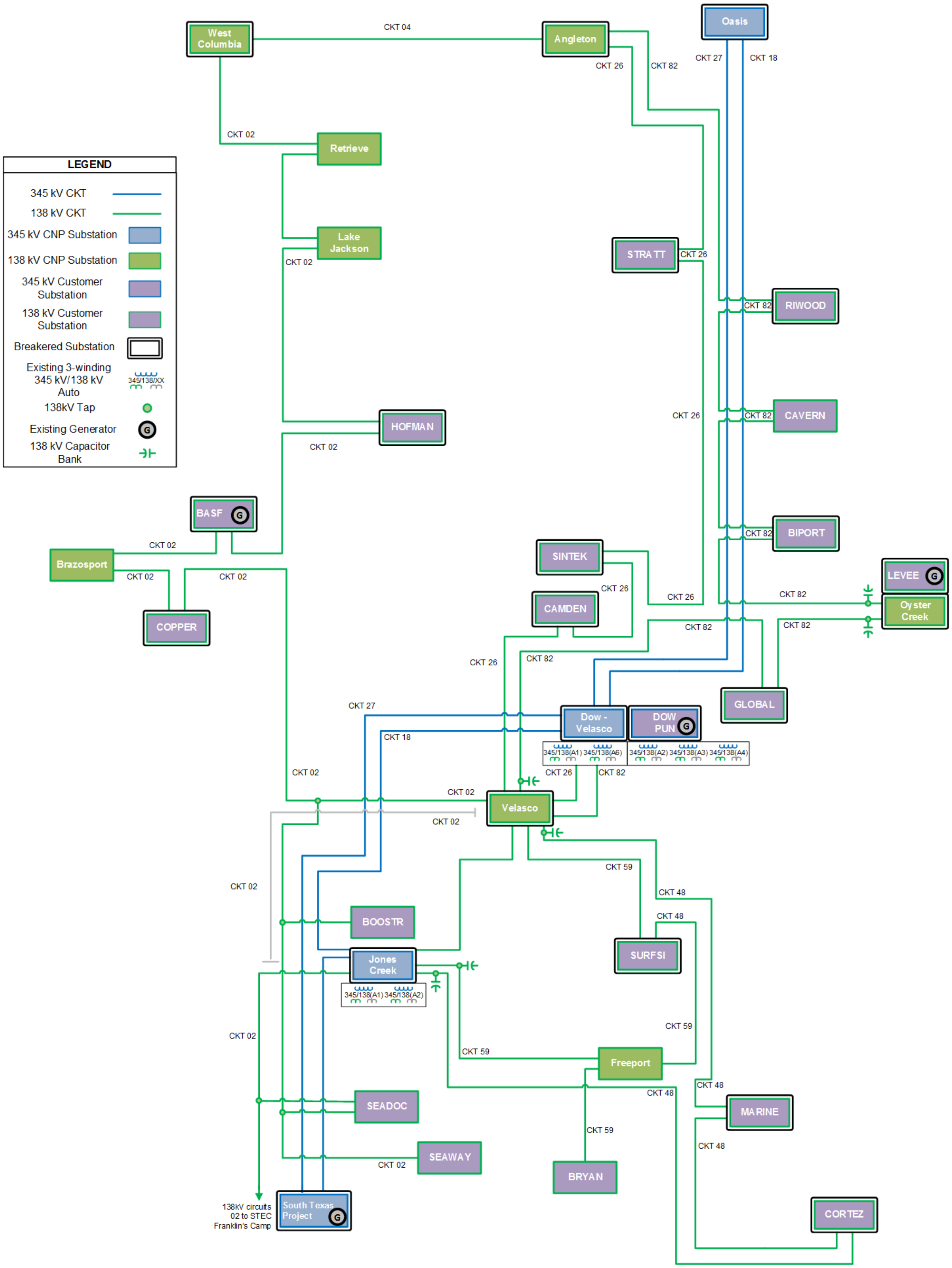
2018 Freeport Area expected configuration

After completion of the Jones Creek Project, the Freeport Area load pocket will be served primarily by four 345 kV lines (double-circuit lines from STP and Oasis) through four 345/138 kV 800/1000 MVA Autotransformers (two at Jones Creek and two at Dow-Velasco), and three approximately 20 mile long 138 kV transmission lines as shown in Figure 2-1.

The Dow Private Use Network (PUN) is served via 345/138 kV autotransformers at the Dow-Velasco 345 kV substation. Another 138 kV line in the area connects to the STEC 69 kV system at Franklin's Camp; however, this line is only for voltage support purposes for the STEC system and cannot be included as a source for serving the 138 kV load. All the generators in the Freeport Area are associated with self-serve facilities such as Dow, BASF, and the future Freeport LNG unit connected to Oyster Creek.

Voltage support for the area is primarily provided by the 345 kV lines and 345/138 kV autotransformers; however, small distribution capacitor banks are located at Freeport and Brazosport and two 40 MVAr capacitor banks are being added to the future Oyster Creek substation. One 138 kV capacitor bank (1st at Velasco) was approved in 2015 based on modeled load growth and is planned to be energized before peak 2017. A second 138 kV capacitor bank (1st at Jones Creek) was approved in 2016 based on the ERCOT 2016 RTP results and is planned to be energized by December 2017. Both capacitor banks were already modeled in the base cases used for this study. In addition, two 138 kV capacitor banks (2nd at Jones Creek and 2nd at Velasco) were approved in February 2017 based on the ERCOT 2016 RTP results, are planned to be energized before peak 2018, but were not yet modeled in the base cases used for this study.

Figure 2-1: Freeport Area Expected Configuration 2018



2.1 Load Growth and Load Additions

Since 2012, CenterPoint Energy has received numerous requests for potential industrial customer load increases in the Freeport ranging from 30 MW – 650 MW. In each case, CenterPoint Energy studies these load requests individually given expected system conditions and identifies those system upgrades that are required for serving the new load from the transmission system. In the Freeport Area, CenterPoint Energy began to notice that each load addition affected the other or shared similar system upgrades, especially since several of these load additions were larger than 100 MW. This analysis endeavors to study bulk system needs should all potential load increases occur in the area. Each individual load addition has its unique 138 kV concerns that would need to be addressed and in the case of the customer load additions with signed letter agreements are already being addressed; however, this study does not attempt to resolve all of the unique 138 kV concerns that may be seen in 2021 or 2022. ERCOT and other market participants should note that power flow analysis will show these additional 138 kV loading and voltage concerns, but they have been filtered out from the results throughout this study report. The results will show some 138 kV concerns for 345 kV contingencies. Below is a list of potential industrial customer load additions and their status:

Industrial customer load projects with signed letter agreements

In 1Q2014, industrial customer Freeport LNG entered into a Standard Generation Interconnection Agreement (SGIA) with CenterPoint Energy for a new 138 kV substation (LEVEE) in the Freeport Area consisting of 82 MW of generation and 146 MVA of load. LEVEE will connect to the CenterPoint Energy Transmission system through CenterPoint Energy 138 kV Oyster Creek substation. A 40 MVAr capacitor bank (1^{st} at Oyster Creek) will also be installed at Oyster Creek to provide voltage support in the area due to the addition of LEVEE. Oyster Creek is expected to be complete before peak 2017 while the LEVEE generator and load have an expected energization date of 3Q2018. This load addition was included in the 2016 ALDR.

In 2Q2014, an industrial customer signed a letter agreement with CenterPoint Energy for a new 138 kV substation in the Freeport Area (MARINE) consisting of 60 MVA of load and expected in-service date of 2Q2016. MARINE substation has been energized with load expected to be in service in the coming months. This load addition was included in the 2016 ALDR.

In 4Q2014, an industrial customer signed a letter agreement with CenterPoint Energy for a new 138 kV substation in the Freeport Area (CAMDEN) consisting of 75 MVA of load and expected in-service date of 2Q2016. CAMDEN substation has been energized with load expected to be in service in the coming months. This load addition was included in the 2016 ALDR.

In 1Q2015, industrial customer Freeport LNG signed a letter agreement with CenterPoint Energy for a new 138 kV substation in the Freeport Area (CORTEZ) consisting of 700 MVA of load and expected in-service date of 3Q2018. This load addition was included in the 2016 ALDR. Based on the data provided by the customer, load at CORTEZ will be energized as shown in Table 2-1 below.

Table 2-1: CORTEZ Load Schedule

CORTEZ	Total Load	In-Service
Liquefaction Train 1	217.9 MW	July 1, 2018
Liquefaction Train 2	435.8 MW	April 1, 2019
Liquefaction Train 3	653.8 MW	October 1, 2019

In 2Q2015, an industrial customer signed a letter agreement with CenterPoint Energy for a new 138 kV substation in the Freeport Area (COPPER) consisting of 62 MVA of load and expected in-service date of 4Q2016. COPPER substation has been energized with load expected to be in service in the coming months. This load addition was included in the 2016 ALDR.

In 3Q2016, an industrial customer signed a letter agreement with CenterPoint Energy for a new 138 kV substation in the Freeport Area (GLOBAL) consisting of 50 MVA of load and expected in-service date of 2Q2018. A 40 MVAr capacitor bank (2nd at Oyster Creek) was secured by the customer and will be installed at Oyster Creek to provide voltage support in the area due to the addition of GLOBAL. This load addition was included in the 2017 ALDR submission.

In 1Q2017, industrial customer Dow Chemical Company signed a letter agreement with CenterPoint Energy for a load addition of up to 850 MW in 2018 at its plant located in the Freeport Area. Dow originally requested CenterPoint Energy to support a maximum load of 950 MW by 2019. The Customer plans to install capacitor banks totaling 200 MVAr in 2017 and an additional 100 MVAr in 2018 within their private system to improve their power factor to the 0.95 level. In addition, CenterPoint Energy identified two additional capacitor banks (3rd at Jones Creek and 3rd at Velasco) on its transmission system as being necessary to serve up to the 850 MW load level and Dow has secured the cost of those capacitor bank upgrades. At the time this study began, those capacitor banks were not included in the base cases or study cases; this study has verified that those are still needed and will be shown throughout this iterative study process. However, those capacitor banks will not be included in the Freeport Master Plan Projects since they are essentially approved projects by virtue of Dow recently securing the cost. Dow and CenterPoint Energy did not sign an agreement for the full 950 MW primarily because CenterPoint Energy was uncertain as to how they would serve the full load by the need date at the time the study was completed. The Freeport Master Plan study was ultimately the avenue chosen to determine how that additional 100 MW would be served in addition to the other customers in the area. CenterPoint Energy will include the Dow load increase in Steady State Working Group (SSWG) updates in 2017 and the 2018 ALDR. CenterPoint Energy has already communicated this potential load increase to ERCOT during the course of the study.

Together all these load additions in the Freeport Area with signed letter agreements add up to 1340 MW which is approximately a 230 % increase of the load seen in 2016.

Industrial customer load inquiries under study

An industrial customer has submitted a request for a new 138 kV substation in the Freeport Area by 2021. The new substation will be located near the Oyster Creek substation and will consist of 56 MVA load.

Industrial customer owning COPPER substation has submitted a request to increase load at 138 kV COPPER substation by 2021. Based on data provided by the customer, load at COPPER will increase by 240 MW by 2021.

Industrial customer Freeport LNG has submitted a request for two new 138 kV substations in the Freeport Area by 2021. One of these new substations will be near the Freeport LNG CORTEZ substation and consist of 220 MVA load and corresponds to an addition to their LNG facility. The second substation will be near Freeport LNG LEVEE substation and consist of 50 MVA load and corresponds to an addition to their LNG facility.

Together all these proposed load additions in the Freeport Area add up to 550 MW. If all these load addition move forward, by 2021 load in the Freeport Area will add up to 2927 MW which is approximately a 280 % increase of the load seen in 2016.

Figure 2-2: Freeport Area Load Growth through 2022

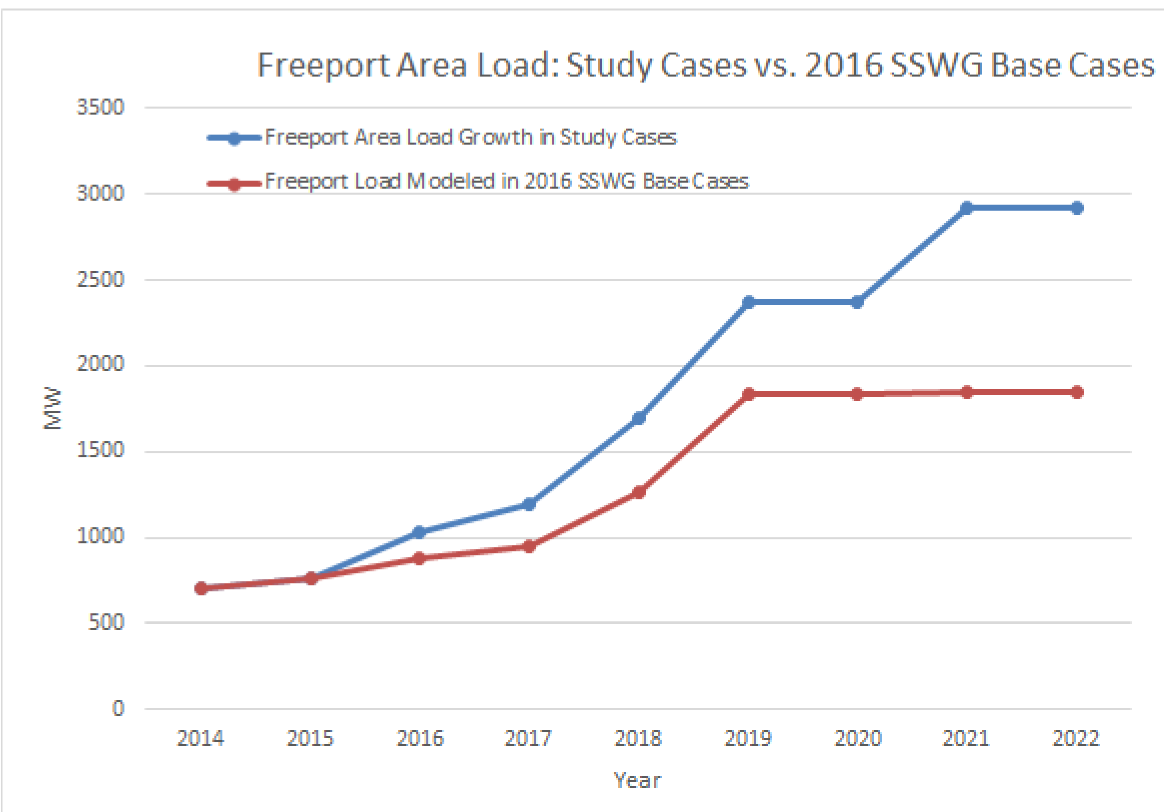


Table 2-2 shows the 11 year (2012-2016 historical, 2017-2022 projections) load data for the Freeport Area load pocket. Stated loads are the non-coincident peak loads at each individual substation during the indicated year.

Table 2-2: Non-coincident Peak Load at Individual Substations in the Freeport Area

		Historical (MW)					Projections (MW)					
	Substation	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Industrial Customer Substations	BASF	101.2	103.4	100.6	98.8	97.2	114.0	107.0	107.0	107.0	107.0	107.0
	BIPORT	69.7	63.7	64.1	62.7	64.4	53.4	53.4	53.4	53.4	53.4	53.4
	BOOSTR	3.2	3.3	3.1	3.1	3.2	2.9	2.9	2.9	2.9	2.9	2.9
	BRYAN	7.9	5.7	5.8	5.2	4.2	2.1	2.9	3.7	4.5	4.5	4.5
	CAMDEN	NA	NA	NA	NA	21.7	39.2	39.2	75.0	75.0	75.0	75.0
	COPPER	NA	NA	NA	NA	0.0	4.8	55.1	59.9	59.9	300.0*	300.0*
	CORTEZ	NA	NA	NA	NA	NA	NA	218.5	655.5	655.5	655.5	655.5
	SEADOC	NA	NA	12.8	17.1	15.6	6.8	7.7	8.6	9.5	9.5	9.5
	DOW	410.1	362.6	425.5	482.0	614.4	716.3	857.0	957.0	957.0	957.0	957.0
	GLOBAL	NA	NA	NA	NA	NA	NA	47.5	47.5	47.5	47.5	47.5
	LEVEE	NA	NA	NA	NA	NA	NA	46.2	138.7	138.7	138.7	138.7
	MARINE	NA	NA	NA	NA	24.0	54.0	54.0	54.0	54.0	54.0	54.0
	NEWSUB 1	NA	NA	NA	NA	NA	NA	NA	NA	NA	53.2*	53.2*
	NEWSUB 2	NA	NA	NA	NA	NA	NA	NA	NA	NA	209.0*	209.0*
	NEWSUB 3	NA	NA	NA	NA	NA	NA	NA	NA	NA	47.5*	47.5*
	QNTANA	5.1	5.4	8.3	8.6	5.1	2.4	2.4	2.4	2.4	2.4	2.4
	SEAWAY	5.2	6.1	7.5	60.3	7.0	5.8	5.8	5.8	5.8	5.8	5.8
	SINTEK	48.0	44.0	42.4	41.2	43.3	44.5	44.5	44.5	44.5	44.5	44.5
	SURFSI	11.4	11.6	12.0	11.3	5.6	9.5	10.2	11.0	11.7	11.7	11.7
	TOTAL	661.8	605.7	682.2	790.3	905.7	1055.7	1554.3	2226.9	2229.3	2779.1	2779.1
CenterPoint Energy Distribution Substations	Brazosport	54.2	50.6	50.0	53.9	61.4	70.7	71.9	73.1	74.4	75.6	76.9
	Freeport	29.3	26.6	26.4	28.2	27.8	31.4	31.5	31.5	31.6	31.7	31.8
	Velasco	31.2	35.1	31.9	31.5	33.2	36.2	36.9	37.5	38.1	38.8	39.5
	TOTAL	114.8	112.4	108.3	113.6	122.4	138.3	140.3	142.1	144.1	146.1	148.2
Industrial + Distribution	TOTAL	776.6	718.1	790.5	903.9	1028.1	1194.0	1694.6	2369.0	2373.4	2925.2	2927.3
* denotes projected industrial customer load inquiries under study												

2.2 Maintenance Outage Considerations

Being a highly industrial area, load in the Freeport Area does not conform to the CenterPoint Energy system load profile. Figure 2-3 below shows the historical coincident peak loading on the CenterPoint Energy system during each month for 2015 and 2016. Figure 2-4 below shows coincident peak load in the Freeport Area during each month for 2015 and 2016.

Figure 2-3: CenterPoint Energy Historical Summer Peak Loading by Month during 2014 and 2015

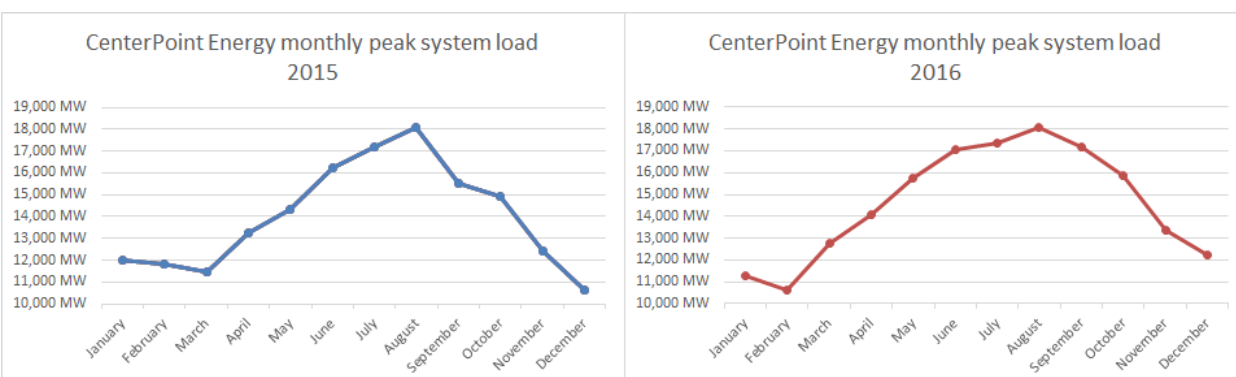
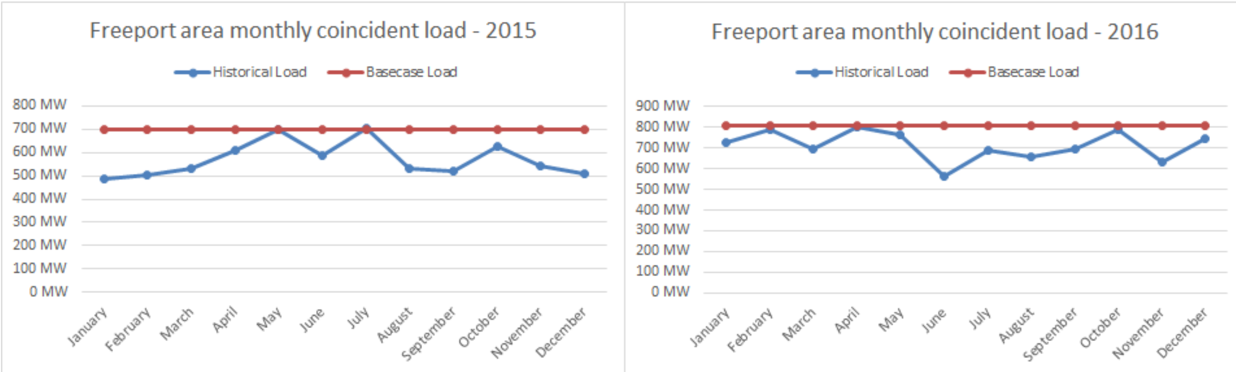


Figure 2-4: Freeport Area Monthly Coincident Peak Load for 2014 and 2015



As indicated in the plots above, the highest loading within the CenterPoint Energy system occurs during the summer months of June, July, August and September. Load in the Freeport Area however, consistently remained between 650-800 MW throughout 2016 except for a dip in June and November to approximately 600 MW. This load data demonstrates that there is no obvious time of the year to schedule an outage in the Freeport Area.

The ERCOT Nodal Operating Guides contain the rules for system monitoring and control as well as operational duties such as operational planning. Per Operating Guide Section 2.1, ERCOT operational duties include:

(2) Perform operational planning:

(a) Perform the Reliability Unit Commitment (RUC) processes in order to commit additional resources as needed to maintain reliability;

(b) Perform operational ERCOT Transmission Grid reliability studies, including those related to generation and load interconnection responsibilities;

(c) Review all Outages of Generation Resources and major transmission lines or components to identify and correct possible failure to meet credible N-1 criteria. This shall include possible failure to meet N-1 criteria not resolved through the Day-Ahead process;

(d) Perform load flows and security analyses of Outages submitted by Qualified Scheduling Entities (QSEs) or Transmission Service Providers (TSPs) as a basis for approval or rejection as described in Protocol Section 3.1, Outage Coordination;

(e) Withdraw approval of a scheduled Outage if unable to meet credible N-1 criteria after all other reasonable options are exercised as described in Protocol Section 3.1;

From the ERCOT Nodal Protocols Section 2: Definitions and Acronyms:

Credible Single Contingency

(1) The Forced Outage of any single Transmission Facility or, during a single fault, the Forced Outage of multiple Transmission Facilities (single fault multiple element);

(2) The Forced Outage of a double-circuit transmission line in excess of 0.5 miles in length;

While the items in Section 2.1(2) do not use the defined term Credible Single Contingency, use of the phrase ‘meet credible N-1 criteria’ essentially means that ERCOT Operations will use Credible Single Contingencies as the basis for operational planning. In addition, Nodal Operating Guide Section 2.2.2 gives further direction to ERCOT regarding operation of the system:

2.2.2 Security Criteria

(1) Technical limits established for the operation of transmission equipment shall be applied consistently in planning and engineering studies, Congestion Revenue Rights (CRRs), Day-Ahead studies, Real-Time security analyses, and operator actions.

(2) ERCOT shall operate the system such that pre-contingency flows are within applicable Transmission Facility Ratings.

(3) ERCOT shall operate the system such that, unless an Emergency Condition has been declared by ERCOT, the occurrence of a Credible Single Contingency will not cause any of the following conditions:

(a) Uncontrolled breakup of the ERCOT Transmission Grid;

(b) Loading of Transmission Facilities above defined Emergency Ratings that cannot be eliminated in time to prevent damage or failure following the loss through execution of a Constraint Management Plan (CMP);

(c) Transmission voltage levels outside system design limits that cannot be corrected through execution of a CMP before voltage instability or collapse occurs;

As stated earlier, the Freeport Area is served by two 345 kV double-circuit lines and three 138 kV circuits and generation is limited to Private Use Network generators. If one of the four 345 kV circuits into the Freeport Area is out of service, a Credible Single Contingency (double-circuit outage longer than 0.5 miles) of the remaining 345 kV double-circuit line will result in all Freeport load being served by a single 345 kV circuit and three 138 kV lines with virtually no generation re-dispatch possibilities. As shown in Figure 2-4 above, this situation would exist throughout the year. The overwhelming majority of proposed load growth in the area is industrial load, so the difficulty in scheduling maintenance outages will not improve but rather grow worse over time. As demonstrate in Section 5.2, the results of this situation are very severe when modeling the 2370 MW load level expected in 2019. ERCOT Operations will be forced to implement Constraint Management Plans (CMP) anytime a system element related to any of the four 345 kV lines is scheduled for an outage. The CMP will have to include shedding load in the area, including some amount of industrial load. For these reasons, CenterPoint Energy has taken maintenance outage scenarios into consideration in evaluating potential long-term solutions for the Freeport Area.

For the purposes of this study, a maintenance outage scenario is defined as an (N-1) planned maintenance outage of a single 345 kV circuit, followed by an (N-1) outage of another single 345 kV circuit or 345 kV double-circuit tower line in excess of 0.5 miles in length. Contingency analysis relating to the maintenance outage scenario has been performed for all options to analyze long-term performance under each option. CenterPoint Energy assumed that overloads between 100 to 114 % during the maintenance outages under study would be allowed; however, an overload at 115 % of emergency rating would need to be resolve with a project. The 115 % value is used as the threshold value based on ERCOT's cascade analysis methodology from the 2016 RTP Multiple Element Contingency Study Report. Any element above 115 % would be in potential danger of tripping before any mitigation steps could be enacted.

3 Study Assumptions

The study is based on the load forecast, generation pattern, and network topology for 2018 to 2022 summer peak conditions and 2019 minimum conditions contained in the ERCOT SSWG base cases posted on February 23, 2016. The base cases used for this study were built from the ERCOT SSWG cases and contain the changes listed in Appendix A. The base cases used for this study are collectively referred to as the Internal CNP Base Cases and were completed on March 18, 2016. The Freeport load level was considered to be the most important factor in this analysis; therefore, to maintain the swing bus within limits and to isolate the Freeport Area, load scaling was applied to all of ERCOT, including the CenterPoint Energy system outside of the Freeport Area.

4 Study Case Creation

A "Study Case" was created for each year with all proposed load additions mentioned in the "Background" section above.

2018 Study Case

- DOW Load Addition:
  - 2016 load addition: 160.0 MW and 37.2 MVAr
  - 2017 proposed load addition: 81.3 MW and 50.4 MVAr
  - 2017 proposed 4 - 138 kV 50 MVAr capacitor banks totaling 200 MVAr
  - 2018 proposed load addition: 140.8 MW and 87.2 MVAr
  - 2018 proposed 2 - 138 kV 50 MVAr capacitor banks totaling 100 MVAr
- GLOBAL load addition - 47.5 MW and 15.6 MVAr
- 2nd Capacitor Bank (120 MVAr) at Velasco tapped off 138kV Velasco to Dow-Velasco circuit 82
- 2nd Capacitor Bank (160 MVAr) at Jones Creek tapped off 138 kV Jones Creek to CORTEZ circuit 48
- Scaled down all ERCOT load as needed to maintain swing bus within limits

2019 – 2020 Study Cases

- All changes included in 2018 Study Case
- DOW Load Addition:
  - 2019 proposed load addition: 100.0 MW and 61.9 MVAr
- Scaled down all ERCOT load as needed to maintain swing bus within limits

2021 – 2022 Study Cases

- All changes included in 2018 and 2019-2020 Study Case
- Oyster Creek load addition of 47.5 MW and 15.6 MVAr (50 MVA)
- Freeport LNG load addition 209.0 MW and 68.7 MVAr (220 MVA)
- COPPER load addition – 240MW and 78.9 MVAr
- Customer load addition – 53.2 MW and 17.5 MVAr (56 MVA)
- Scaled down all ERCOT load as needed to maintain swing bus within limits

5 Study Case - Steady-State Power Flow Analysis

CenterPoint Energy performed steady-state power flow analysis using the base and study cases described above. Designs were tested against the applicable NERC Reliability Standard TPL-001-4, ERCOT Planning Guide Section 4 (ERCOT Transmission Planning Criteria), and CenterPoint Energy Transmission System Design Criteria. CenterPoint Energy has developed planning events based on these reliability standards and performance criteria. The CenterPoint Energy Planning Events are defined as follows:

- CNP Planning Event P0 (no contingency) which is equivalent to NERC Category P0.
- CNP Planning Event P1 (consists of normal initial conditions followed by loss of one transmission element (generator, transmission circuit, transformer, or shunt device)) which is equivalent to NERC Category P1.
- CNP Planning Event P2 (consists of normal initial conditions followed by outage of two or more circuits due to failure of a breaker to operate under fault conditions or due to a bus section fault) which is equivalent to NERC Category P2.
- CNP Planning Event P3 (consists of normal initial conditions followed by loss of a generator and an additional outage of any of the following: (single circuit, single (A-1) autotransformer outage, or a single (G-1) generator outage)) which is equivalent to NERC Category P3, but also includes ERCOT- specific Reliability Performance Criteria (RPC) Event 2 (consists of any single generating unit unavailable, followed by manual system adjustment, followed by a common tower outage, which includes outage of two circuits sharing a common tower for more than half a mile).
- NERC Category P4 Events are equivalent to NERC Category P2 Events for CenterPoint Energy's system; therefore, no specific P4 events are included in CenterPoint Energy's analysis.
- CNP Planning Event P5 (consists of normal initial conditions followed by delayed fault clearing due to the failure of a non-redundant relay protecting the faulted element to operate as designed, for one of the following: (generator, transmission circuit, transformer, shunt device, or bus section))
- CNP Planning Event P6 (consists of the outage of a 345/138 kV autotransformer (A-1) followed by an outage of any of the following: single circuit, single (A-1) autotransformer, or a single (G-1) generator) which is equivalent to NERC Category P6-2, but also includes ERCOT- specific Reliability Performance Criteria Event 3 (consist of unavailability of a 345/138 kV transformer, followed by manual system adjustments, followed by the common tower outage for circuits sharing a common tower for more than half a mile).
- CNP Planning Event P7 (consists of normal initial conditions followed by the outage of circuits sharing a common tower for more than a mile) which is equivalent to NERC Category P7, but also includes ERCOT – specific Reliability Performance Criteria Event 1 (consist of the outage of circuits sharing a common tower for more than half a mile).

- Maintenance Outage Scenario (consists of planned outage of a 345 kV circuit followed by the outage of a 345 kV circuit or 345 kV circuits sharing a common tower) as described in Section 2.2.

Studies were conducted in accordance with CenterPoint Energy Transmission System Design Criteria which includes monitoring Rate A (normal rating) for CNP Planning Events P0 and P1 and Rate B (emergency rating) for CNP Planning Events P2 through P7. Bus voltages should remain within the 0.95 p.u. to 1.05 p.u. range for CNP Planning Events P0 and P1 and the 0.92 p.u. to 1.05 p.u. range for CNP Planning Events P2 through P7. The Maintenance Outage Scenario studies monitored Rate B (emergency rating) and a voltage range of 0.92 p.u. to 1.05 p.u. For all thermal loading and voltage tables, the value in parenthesis indicates the additional number of contingencies that cause similar thermal loading and voltage concerns for that element.

5.1 CNP Planning Event P0

Under normal operating conditions, no base case thermal concerns were identified. Base case voltage results under CNP Planning Event P0 are shown below in Table 5-1.

Table 5-1: Study Case Voltage Results (in p.u.) under CNP Planning Event P0

BUSES	Nominal Voltage	2018 Summer Peak		2019 Minimum		2019 Summer Peak		2020 Summer Peak		2021 Summer Peak		2022 Summer Peak	
		Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case
42530 JONCRK__345A	345KV	> .950	> .950	> .950	> .950	> .950	> .950	> .950	> .950	> .950	0.94565	> .950	0.93992
42500 DOW_____345A	345KV	> .950	> .950	> .950	> .950	> .950	> .950	> .950	> .950	> .950	0.94303	> .950	0.93831

5.2 CNP Planning Event P1

Thermal loading and voltage results under CNP Planning Event P1 are shown below in Table 5-2 and Table 5-3.

Table 5-2: Study Case Thermal Loading Results (percent loading) under CNP Planning Event P1

Branch Loading	Rating (MVA)	Contingency	2018 Summer Peak		2019 Minimum		2019 Summer Peak		2020 Summer Peak		2021 Summer Peak		2022 Summer Peak	
	Rate A		Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1450	SINGLE 5915-42500(27): 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	70.3 % (0x)	78.3 % (0x)	76.7 % (0x)	88.4 % (0x)	87.6 % (0x)	99.5 % (0x)	88.9 % (0x)	100.8 % (1x)	90.0 % (0x)	118.4 % (1x)	91.8 % (0x)	121.2 % (1x)
5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	1450	SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	69.4 % (0x)	77.3 % (0x)	75.4 % (0x)	87.1 % (0x)	86.0 % (0x)	98.0 % (0x)	87.2 % (0x)	99.4 % (0x)	88.5 % (0x)	116.7 % (1x)	90.2 % (0x)	119.6 % (1x)

Table 5-3: Study Case Voltage Results (in p.u.) under CNP Planning Event P1

BUSES	Nominal Voltage	Contingency	2018 Summer Peak		2019 Minimum		2019 Summer Peak		2020 Summer Peak		2021 Summer Peak		2022 Summer Peak	
			Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case
42500 DOW____345A	345KV	SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	0.98367 (0x)	1.00737 (0x)	0.96722 (0x)	0.97280 (0x)	0.94697 (2x)	0.94820 (2x)	0.94602 (2x)	0.94648 (2x)	0.94289 (2x)	0.87084 (836x)	0.93901 (2x)	0.85571 (837x)
42530 JONCRK__345A	345KV		0.98457 (0x)	1.00946 (0x)	0.96597 (0x)	0.97437 (0x)	0.94485 (1x)	0.94900 (1x)	0.94389 (2x)	0.94772 (1x)	0.94167 (2x)	0.86852 (833x)	0.93669 (2x)	0.85330 (836x)

5.3 CNP Planning Event P2

Thermal loading and voltage results under CNP Planning Event P2 are shown below in Table 5-4 and Table 5-5

Table 5-4: Study Case Thermal Loading Results (percent loading) under CNP Planning Event P2

Branch Loading	Rating (MVA)	Contingency	2018 Summer Peak		2019 Minimum		2019 Summer Peak		2020 Summer Peak		2021 Summer Peak		2022 Summer Peak	
	Rate B		Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1450	P2-3_DOW-D060: 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A & 42500 - 43035 <CKT 18> DOW____345A TO OASIS___345A	72.3 % (0x)	82.1 % (0x)	82.3 % (0x)	97.2 % (0x)	94.2 % (0x)	110.1 % (1x)	95.4 % (0x)	111.2 % (4x)	96.6 % (0x)	154.5 % (4x)	98.4 % (0x)	Did Not Converge (3x)
42500 - 43035 <CKT 27> DOW____345A TO OASIS___345A	1195		17.0 % (0x)	25.8 % (0x)	36.9 % (0x)	53.6 % (0x)	42.3 % (0x)	61.3 % (0x)	42.0 % (0x)	60.8 % (0x)	42.6 % (0x)	130.7 % (1x)	42.7 % (0x)	
5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	1450	P2-3_STP-Y500X_LINE&SHUNT-R1: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	69.4 % (0x)	77.3 % (0x)	75.4 % (0x)	87.1 % (0x)	86.0 % (0x)	98.0 % (0x)	87.2 % (0x)	99.4 % (0x)	88.5 % (0x)	116.7 % (5x)	90.2 % (0x)	119.6 % (4x)

Table 5-5: Study Case Voltage Results (in p.u.) under CNP Planning Event P2

BUSES	Nominal Voltage	Contingency	2018 Summer Peak		2019 Minimum		2019 Summer Peak		2020 Summer Peak		2021 Summer Peak		2022 Summer Peak	
			Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case
42500 DOW____345A	345KV	P2-3_DOW-D060: 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A & 42500 - 43035 <CKT 18> DOW____345A TO OASIS___345A	0.97564 (0x)	1.00363 (0x)	0.94574 (0x)	0.94457 (0x)	0.92254 (0x)	0.91003 (2x)	0.92092 (0x)	0.90921 (2x)	0.91545 (1x)	0.61540 (34x)	0.91020 (1x)	Did Not Converge (3x)
42530 JONCRK__345A	345KV		0.97930 (0x)	1.00611 (0x)	0.94821 (0x)	0.94937 (0x)	0.92532 (0x)	0.91493 (1x)	0.92366 (0x)	0.91353 (2x)	0.91920 (2x)	0.62129 (25x)	0.91291 (0x)	

5.4 CNP Planning Event P3

Thermal loading and voltage results under CNP Planning Event P3 are shown below in Table 5-6 and Table 5-7.

Table 5-6: Study Case Thermal Loading Results (percent loading) under CNP Planning Event P3

Branch Loading	Rating (MVA)	Contingency	2018 Summer Peak		2019 Minimum		2019 Summer Peak		2020 Summer Peak		2021 Summer Peak		2022 Summer Peak	
	Rate B		Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case
42500 - 43035 <CKT 27> DOW_____345A TO OASIS___345A	1195	P1-1_GEN_WAP_L5_110015: 110015 WAP_WAP_G5 AND P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	< 70.0 %	58.4 %	< 70.0 %	90.9 % (0x)	74.2 % (0x)	Did Not Converge (18x)	74.7 % (0x)	Did Not Converge (22x)	75.7 % (0x)	Did Not Converge (436x)	78.6 % (0x)	Did Not Converge (758x)
42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	1195		< 70.0 %	58.4 %	< 70.0 %	90.9 % (0x)	74.2 % (0x)		74.7 % (0x)		75.7 % (0x)		78.6 % (0x)	
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173		< 70.0 %	74.1 % (0x)	91.5 % (0x)	112.9 % (98x)	85.7 % (0x)		86.8 % (0x)		88.3 % (0x)		90.4 % (0x)	
5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	1450	P1-1_GEN_CBY_N2_110072: 110072 CBY_CBY_G2 AND SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	73.4 % (0x)	81.5 % (0x)	75.7 % (0x)	87.4 % (0x)	90.7 % (0x)	102.7 % (22x)	91.9 % (0x)	104.1 % (96x)	93.1 % (0x)	Did Not Converge (436x)	95.2 % (0x)	Did Not Converge (758x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1450	P1-1_GEN_CBY_N2_110072: 110072 CBY_CBY_G2 AND SINGLE 5915-42500(27): 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	74.4 % (0x)	82.4 % (0x)	77.0 % (0x)	88.7 % (0x)	92.0 % (0x)	104.3 % (110x)	93.5 % (0x)	105.7 % (175x)	94.9 % (0x)	Did Not Converge (436x)	96.7 % (0x)	Did Not Converge (758x)
44645 - 44900 <CKT 98> SNGLTN_345 TO ZENITH__345A	1450	P1-1_GEN_STP_U2_110352: 110352 STP_STP_G2 AND P7-1_E1>>T9899C: 967 - 44900 <CKT 98> GIBN_CREK_5 TO ZENITH__345A & 967 - 44900 <CKT 99> GIBN_CREK_5 TO ZENITH__345A	82.4 % (0x)	86.8 % (0x)	52.3 %	56.9 %	89.1 % (0x)	94.4 % (0x)	87.9 % (0x)	93.1 % (0x)	90.5 % (0x)	104.7 % (2x)	93.6 % (0x)	Did Not Converge (758x)
44645 - 44900 <CKT 99> SNGLTN_345 TO ZENITH__345A	1450		82.5 % (0x)	86.8 % (0x)	52.3 %	56.9 %	89.2 % (0x)	94.4 % (0x)	87.9 % (0x)	93.1 % (0x)	90.5 % (0x)	104.7 % (2x)	93.6 % (0x)	

Table 5-7: Study Case Voltage Results (in p.u.) under CNP Planning Event P3

BUSES	Nominal Voltage	Contingency	2018 Summer Peak		2019 Minimum		2019 Summer Peak		2020 Summer Peak		2021 Summer Peak		2022 Summer Peak	
			Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case
42530 JONCRK__345A	345KV	P1-1_GEN_CBY_N2_110072: 110072 CBY_CBY_G2 AND P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	0.93446 (0x)	0.96930 (0x)	0.89104 (98x)	0.83862 (98x)	0.82930 (183x)	Did Not Converge (18x)	0.82269 (186x)	Did Not Converge (22x)	0.77008 (193x)	Did Not Converge (436x)	Did Not Converge (2x)	Did Not Converge (436x)
42500 DOW_____345A	345KV		0.93349 (0x)	0.96713 (0x)	0.89292 (98x)	0.83840 (98x)	0.83138 (185x)		0.82479 (186x)		0.77221 (197x)			

5.5 CNP Planning Event P5

No thermal loading or voltage concerns were identified under CNP Planning Event P5.

5.6 CNP Planning Event P6

Thermal loading and voltage results under CNP Planning Event P6 are shown below in Table 5-8 and Table 5-9.

Table 5-8: Study Case Thermal Loading Results (percent loading) under CNP Planning Event P6

Branch Loading	Rating (MVA)	Contingency	2018 Summer Peak		2019 Minimum		2019 Summer Peak		2020 Summer Peak		2021 Summer Peak		2022 Summer Peak	
	Rate B		Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case
42530 - 3WNDTR <A1> JONCRK__345A TO DOWA6TESTDAT	1000	JONCRK AUTOTRANSFORMER A2 AND P7-1_E1>>T1827B1: 42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	72.3 % (0x)	80.4 % (0x)	83.2 % (0x)	93.5 % (0x)	94.1 % (0x)	105.0 % (1x)	95.9 % (0x)	106.3 % (1x)	96.3 % (0x)	121.5 % (1x)	98.3 % (0x)	119.2 % (1x)
42530 - 3WNDTR <A2> JONCRK__345A TO DOWA6TESTDAT	1000	JONCRK AUTOTRANSFORMER A1 AND P7-1_E1>>T1827B1: 42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	72.3 % (0x)	80.4 % (0x)	83.2 % (0x)	93.5 % (0x)	94.1 % (0x)	105.0 % (1x)	95.9 % (0x)	106.3 % (1x)	96.3 % (0x)	121.5 % (1x)	98.3 % (0x)	119.2 % (1x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1450	BELAIR AUTOTRANSFORMER A5 AND SINGLE 5915-42500(27): 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	71.0 % (0x)	78.9 % (0x)	77.1 % (0x)	88.8 % (0x)	88.3 % (0x)	100.3 % (3x)	89.6 % (0x)	101.4 % (41x)	90.7 % (0x)	119.3 % (165x)	92.5 % (0x)	122.4 % (172x)
5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	1450	BELAIR AUTOTRANSFORMER A5 AND SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	70.0 % (0x)	77.9 % (0x)	75.7 % (0x)	87.4 % (0x)	86.6 % (0x)	98.7 % (0x)	88.0 % (0x)	100.1 % (1x)	89.1 % (0x)	117.5 % (84x)	91.0 % (0x)	120.7 % (123x)
42500 - 43035 <CKT 27> DOW____345A TO OASIS___345A	1195	PHR AUTOTRANSFORMER A4 AND P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	45.2 %	56.6 %	62.4 %	82.6 % (0x)	71.7 % (0x)	108.9 % (42x)	72.1 % (0x)	110.5 % (42x)	72.7 % (0x)	Did Not Converge (84x)	73.7 % (0x)	Did Not Converge (90x)
42500 - 43035 <CKT 18> DOW____345A TO OASIS___345A	1195		45.2 %	56.6 %	62.4 %	82.6 % (0x)	71.7 % (0x)	108.9 % (42x)	72.1 % (0x)	110.5 % (42x)	72.7 % (0x)		73.7 % (0x)	
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173	BELAIR AUTOTRANSFORMER A5 AND P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	63.3 %	72.5 % (0x)	91.1 % (0x)	107.5 % (42x)	83.7 % (0x)	108.1 % (41x)	84.5 % (0x)	108.4 % (41x)	86.1 % (0x)	Did Not Converge (84x)	87.6 % (0x)	Did Not Converge (90x)

Table 5-9: Study Case Voltage Results (in p.u.) under CNP Planning Event P6

BUSES	Nominal Voltage	Contingency	2018 Summer Peak		2019 Minimum		2019 Summer Peak		2020 Summer Peak		2021 Summer Peak		2022 Summer Peak	
			Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case
42500 DOW____345A	345KV	DOW AUTOTRANSFORMER A1 AND P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	0.94510 (0x)	0.97603 (0x)	0.89381 (42x)	0.86221 (42x)	0.85376 (42x)	0.71691 (84x)	0.84941 (42x)	0.69851 (96x)	0.84171 (42x)	Did Not Converge (84x)	0.82926 (46x)	Did Not Converge (90x)
42530 JONCRK__345A	345KV		0.94582 (0x)	0.97985 (0x)	0.89194 (42x)	0.86291 (42x)	0.85160 (42x)	0.71653 (44x)	0.84723 (42x)	0.69794 (83x)	0.83951 (42x)		0.82707 (44x)	

5.7 CNP Planning Event P7

Thermal loading and voltage results under CNP Planning Event P7 are shown below in Table 5-10 and Table 5-11.

Table 5-10: Study Case Thermal Loading Results (percent loading) under CNP Planning Event P7

Branch Loading	Rating (MVA)	Contingency	2018 Summer Peak		2019 Minimum		2019 Summer Peak		2020 Summer Peak		2021 Summer Peak		2022 Summer Peak	
	Rate B		Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1450	P7-1_E1>>T6472D: 44000 - 44200 <CKT 64> W_A_P___345A TO HILLJE__345A & 44005 - 44040 <CKT 72> W_A_P___345B TO BAILEY_POI_5	69.5 % (0x)	74.7 % (0x)	63.4 % (0x)	70.9 % (0x)	83.0 % (0x)	90.9 % (0x)	84.7 % (0x)	92.5 % (0x)	85.8 % (0x)	105.6 % (3x)	87.9 % (0x)	110.0 % (3x)
5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	1450		67.7 % (0x)	73.0 % (0x)	60.9 % (0x)	68.5 % (0x)	80.0 % (0x)	87.9 % (0x)	81.6 % (0x)	89.5 % (0x)	82.7 % (0x)	101.4 % (1x)	84.7 % (0x)	105.7 % (2x)
42500 - 43035 <CKT 27> DOW_____345A TO OASIS___345A	1195	P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	44.0 % (0x)	55.4 % (0x)	61.8 % (0x)	83.0 % (0x)	70.7 % (0x)	107.4 % (1x)	71.0 % (0x)	108.8 % (1x)	71.7 % (0x)	Did Not Converge (2x)	72.7 % (0x)	Did Not Converge (2x)
42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	1195		44.0 % (0x)	55.4 % (0x)	61.8 % (0x)	83.0 % (0x)	70.7 % (0x)	107.4 % (1x)	71.0 % (0x)	108.8 % (1x)	71.7 % (0x)		72.7 % (0x)	
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173		61.8 % (0x)	70.9 % (0x)	90.1 % (0x)	106.5 % (1x)	81.9 % (0x)	106.6 % (1x)	82.8 % (0x)	107.1 % (1x)	84.3 % (0x)		85.9 % (0x)	

Table 5-11: Study Case Voltage Results (in p.u.) under CNP Planning Event P7

BUSES	Nominal Voltage	Contingency	2018 Summer Peak		2019 Minimum		2019 Summer Peak		2020 Summer Peak		2021 Summer Peak		2022 Summer Peak	
			Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case
42500 DOW_____345A	345KV	P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	0.94416 (0x)	0.97769 (0x)	0.89510 (1x)	0.86498 (1x)	0.85615 (1x)	0.72013 (2x)	0.85205 (1x)	0.70266 (2x)	0.84424 (1x)	Did Not Converge (2x)	0.83194 (1x)	Did Not Converge (2x)
42530 JONCRK__345A	345KV		0.94519 (0x)	0.97987 (0x)	0.89321 (1x)	0.86517 (1x)	0.85404 (1x)	0.71949 (1x)	0.84994 (1x)	0.70189 (2x)	0.84212 (1x)		0.82981 (1x)	
42500 DOW_____345A	345KV	P7-1_E1>>T1899_27RADIAL: 43035 - 44000 <CKT 18> OASIS___345A TO W_A_P___345A & 43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A & 42500 - 43035 <CKT 27> DOW_____345A TO OASIS___345A	0.98743 (0x)	1.00672 (0x)	0.95637 (0x)	0.96249 (0x)	0.94692 (0x)	0.94648 (0x)	0.94487 (0x)	0.94258 (0x)	0.94187 (0x)	0.85092 (8x)	0.93691 (0x)	0.83786 (10x)
42530 JONCRK__345A	345KV		0.99107 (0x)	1.00983 (0x)	0.95884 (0x)	0.96717 (0x)	0.94907 (0x)	0.95158 (0x)	0.94704 (0x)	0.94727 (0x)	0.94448 (0x)	0.85433 (8x)	0.93900 (0x)	0.84141 (10x)

5.8 Maintenance Outage Scenario

CenterPoint Energy wanted to review the existing situation; therefore, the most recent 2017 summer peak base case was used to determine if any maintenance outage contingencies are currently a potential concern. Thermal loading and voltage results under the Maintenance Outage Scenario are shown below in Table 5-12 and Table 5-13.

Table 5-12: Study Case Thermal Loading Results (percent loading) under Maintenance Outage Scenario

Branch Loading	Rating (MVA)	Contingency	2017 Summer Peak	2019 Minimum		2020 Summer Peak		2022 Summer Peak	
	Rate B		Base Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case
5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	1450	SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T6472D: W_A_P___345A TO HILLJE__345A <CKT 64> W_A_P___345B TO BAILEY_POI_5 <CKT 72>	98.1 % (0x)	95.3 % (0x)	107.7 % (3x)	129.3 % (5x)	144.7 % (9x)	136.9 % (6x)	Did Not Converge (37x)
		SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T1827_18RADIAL: DOW_____345A TO OASIS___345A <CKT 18> DOW_____345A TO OASIS___345A <CKT 27> OASIS___345A TO W_A_P___345A <CKT 18>	73.7 % (0x)	111.6 % (2x)	Did Not Converge (4x)	140.2 % (5x)	Did Not Converge (8x)	143.4 % (6x)	Did Not Converge (37x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1450	SO_TEX__345A TO DOW_____345A <CKT 27> AND P7-1_E1>>T6472D: W_A_P___345A TO HILLJE__345A <CKT 64> W_A_P___345B TO BAILEY_POI_5 <CKT 72>	98.9 % (0x)	96.6 % (0x)	108.9 % (3x)	131.0 % (6x)	145.8 % (11x)	138.3 % (6x)	Did Not Converge (37x)
		SO_TEX__345A TO DOW_____345A <CKT 27> AND P7-1_E1>>T1827_18RADIAL: DOW_____345A TO OASIS___345A <CKT 18> DOW_____345A TO OASIS___345A <CKT 27> OASIS___345A TO W_A_P___345A <CKT 18>	73.6 % (0x)	111.8 % (2x)	Did Not Converge (4x)	139.0 % (6x)	Did Not Converge (8x)	142.2 % (6x)	Did Not Converge (37x)
42500 - 43035 <CKT 27> DOW_____345A TO OASIS___345A	1195	DOW_____345A TO OASIS___345A <CKT 18> AND P7-1_E1>>T1827B2: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO DOW_____345A <CKT 27>	69.6 %	124.1 % (1x)	Did Not Converge (4x)	155.4 % (1x)	Did Not Converge (8x)	158.4 % (1x)	Did Not Converge (37x)
42150 - 42810 <CKT 02> BASF____138A TO HOFMAN__138X	280		48.9 %	104.5 % (2x)		126.2 % (2x)		133.1 % (2x)	
42810 - 42880 <CKT 02> HOFMAN__138X TO LKJACK__138A	280		50.3 %	106.0 % (2x)		127.9 % (2x)		134.9 % (2x)	
42110 - 43300 <CKT 26> ANGLTN__138A TO STRATT__138A	220		46.2%	75.8 % (0x)		101.5 % (2x)		108.9 % (2x)	
42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	1195	DOW_____345A TO OASIS___345A <CKT 27> AND P7-1_E1>>T1827B2: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO DOW_____345A <CKT 27>	69.6 %	124.1 % (1x)	Did Not Converge (4x)	155.4 % (1x)	Did Not Converge (8x)	158.4 % (1x)	Did Not Converge (37x)
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173	OASIS___345A TO W_A_P___345A <CKT 18> AND P7-1_E1>>T1827B2: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO DOW_____345A <CKT 27>	87.1 % (0x)	154.8 % (2x)	194.3 % (9x)	143.5 % (1x)	Did Not Converge (8x)	147.3 % (1x)	Did Not Converge (37x)
43035 - 44000 <CKT 18> OASIS___345A TO W_A_P___345A	1450	OASIS___345A TO W_A_P___345A <CKT 99> AND P7-1_E1>>T1827B2: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO DOW_____345A <CKT 27>	70.5 % (0x)	125.4 % (1x)	157.4 % (1x)	116.3 % (1x)	Did Not Converge (8x)	119.3 % (1x)	Did Not Converge (37x)
5915 - 44200 <CKT 44> SO_TEX__345A TO HILLJE__345A	1200	SO_TEX__345A TO HILLJE__345A <CKT 64> AND P7-1_E1>>T1827B2: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO DOW_____345A <CKT 27>	101.8 % (1x)	91.0 % (0x)	95.2 % (0x)	73.6 % (0x)	81.2 % (0x)	78.3 % (0x)	Did Not Converge (37x)

Table 5-13: Study Case Voltage Results (in p.u.) under Maintenance Outage Scenario

BUSES	Nominal Voltage	Contingency	2017 Summer Peak	2019 Minimum		2020 Summer Peak		2022 Summer Peak	
			Base Case	Base Case	Study Case	Base Case	Study Case	Base Case	Study Case
42500 DOW_____345A	345KV	DOW_____345A TO OASIS___345A <CKT 18> AND P7-1_E1>>T1827B2: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO DOW_____345A <CKT 27>	0.88907 (2x)	0.78203 (17x)	Did Not Converge (4x)	0.65770 (22x)	Did Not Converge (8x)	0.62265 (31x)	Did Not Converge (37x)
42530 JONCRK__345A	345KV		0.88895 (2x)	0.78044 (15x)		0.65520 (19x)		0.61989 (24x)	

5.9 Summary of Study Case Results

Power flow analysis of the study case shows concerns for each planning event studied except P5, specifically voltage concerns for the 345 kV buses at Jones Creek and Dow. Also, thermal loading concerns occur on the following circuits for the study case:

- 345 kV STP – Jones Creek circuit 18 (104 % – 110%) beginning in 2019
- 345 kV STP – Dow-Velasco circuit 27 (103%) beginning in 2019
- 345 kV Oasis – Dow-Velasco circuit 18 and 27 (107% – 109%) beginning in 2019
- 345 kV Oasis – WAP circuit 99 (107% – 113%) beginning in 2019
- 345 kV Singleton – Zenith circuit 98 and 99 (105%) beginning in 2021
- 345/138 kV Jones Creek Auto A1 and A2 (105%) beginning in 2019

Maintenance outage scenarios have not been performed for the Freeport Area in previous studies, so it is not surprising to see some potential concerns, even in the base case. Results of the maintenance outage scenario indicate a minor 101.8 % overload on AEN's STP – Hillje circuit and low voltage at the 345 kV Dow-Velasco substation for the 2017 summer peak case. In the 2019 minimum load case, several fairly significant 345 kV loading concerns are seen in both the base case and study case. This indicates that by the time the expected base case loads are modeled, maintenance outages will be very difficult to schedule, even at the lightest of ERCOT load conditions. For the study cases, beginning with the 2019 minimum case several maintenance outage contingencies do not converge, which indicates insufficient reactive support in the area. Of the maintenance contingencies that do converge, thermal loading concerns are seen on the following circuits:

- 345 kV Oasis – WAP circuit 18 (157%)
- 345 kV Oasis – WAP circuit 99 (194%)

The severity of some of these overloads in future years is unknown due to the case unable to find a solution, likely due to insufficient reactive support in the area. Many of these overloads are primarily driven by depressed voltage levels in the Freeport Area under contingency. Some of these overloads may be solved if sufficient reactive support is installed in the Freeport Area to maintain adequate voltage levels under contingency.

To summarize, voltage support appears to be the biggest concern for the load increases in the Freeport Area, beginning in 2019 when the Freeport load grows from 1700 MW to 2370 MW. The depressed voltages are so severe that it is difficult to get a firm handle on the level of potential thermal concerns on the system. However, it does appear that multiple 345 kV circuits would have to be upgraded to meet required ratings, especially when considering upgrades necessary to allow maintenance outages to occur. Maintenance outages will be an enormous challenge with the expected load growth in the Freeport Area.

6 Option 1: Upgrade of Existing System

CenterPoint Energy initially decided to determine if the Freeport Area loads could be served by means of upgrading existing circuits and installing additional reactive support. Results of the Study Case analysis (Section 5) indicate at a minimum the following projects would be needed to solve thermal loading and voltage concerns in the Study Case:

- Upgrade 345 kV STP – Jones Creek – Dow-Velasco circuit 18 to 2390/2390 MVA normal/emergency ratings
- Upgrade 345 kV STP – Dow-Velasco circuit 27 2390/2390 MVA normal/emergency ratings
- Reactive support (dynamic/static)

6.1 Option 1 – Initial Analysis

As stated in Section 5, due to non-convergence seen in the Study Case, potential thermal loading and voltage concerns remain unknown. To determine the approximate amount of reactive support needed as well as to better identify upgrades that may be needed, steady-state power flow analysis was performed modeling a synchronous condenser with infinite reactive capability on the Jones Creek 138 kV bus to resolve all potential voltage concerns. The voltage set-point issued to the synchronous condenser was to maintain at least 1.0202 p.u. voltage at the Jones Creek 138 kV bus which would result in at least 0.93 p.u. being maintained at each 345 kV bus. In addition, the 345 kV STP – Jones Creek – Dow-Velasco circuit 18 and STP – Dow-Velasco circuit 27 were reconductored with 3-959 ACSS conductor. Analysis was performed for CNP Planning Events P0-P3 and P6-P7 on the 2019 case and beyond. In addition, analysis was also performed for the Maintenance Outage Scenario described in Section 5.

6.1.1 Option 1 – Initial Analysis – CNP Planning Event P0

Under normal operating conditions, no base case thermal or voltage concerns were observed.

6.1.2 Option 1 – Initial Analysis – CNP Planning Event P1

Thermal loading and voltage results under CNP Planning Event P1 are shown below in Table 6-1 and Table 6-2.

Table 6-1: Option 1 – Initial Analysis: Thermal Loading Results (percent loading) under CNP Planning Event P1

Branch Loading	Rating (MVA)	Contingency	Option 1 - Initial Analysis				
	Rate A		2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	2390	SINGLE 5915-42500(27): 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	57.1 % (0x)	63.3 % (0x)	64.1 % (0x)	71.7 % (0x)	72.7 % (0x)
42500 - 42530 <CKT 18> DOW_____345A TO JONCRK__345A	2390		34.1 % (0x)	36.9 % (0x)	37.6 % (0x)	37.3 % (0x)	38.1 % (0x)
5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	2390	SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	56.2 % (0x)	62.3 % (0x)	63.2 % (0x)	70.5 % (0x)	71.5 % (0x)

Table 6-2: Option 1 – Initial Analysis: Voltage Results (in p.u.) under CNP Planning Event P1

BUSES	Nominal Voltage	Contingency	Option 1 - Initial Analysis				
			2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
42500 DOW_____345A	345KV	SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	0.98838 (0x)	0.98293 (0x)	0.98251 (0x)	0.97501 (0x)	0.97389 (0x)
42530 JONCRK__345A	345KV		0.98931 (0x)	0.98461 (0x)	0.98425 (0x)	0.97768 (0x)	0.97673 (0x)

6.1.3 Option 1 – Initial Analysis – CNP Planning Event P2

Thermal loading and voltage results under CNP Planning Event P2 are shown below in Table 6-3 and Table 6-4.

Table 6-3: Option 1 – Initial Analysis: Thermal Loading Results (percent loading) under CNP Planning Event P2

Branch Loading	Rating (MVA)	Contingency	Option 1 - Initial Analysis				
	Rate B		2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	2390	P2-3_DOW-D060: 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A & 42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	61.0 % (0x)	67.4 % (0x)	68.1 % (0x)	77.3 % (0x)	78.2 % (0x)
42500 - 42530 <CKT 18> DOW_____345A TO JONCRK__345A	2390		38.7 % (0x)	41.6 % (0x)	42.2 % (0x)	43.4 % (0x)	44.1 % (0x)
5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	2390	P2-3_STP-Y500X_LINE&SHUNT-R1: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	56.2 % (0x)	62.3 % (0x)	63.2 % (0x)	70.5 % (0x)	71.5 % (0x)

Table 6-4: Option 1 – Initial Analysis: Voltage Results (in p.u.) under CNP Planning Event P2

BUSES	Nominal Voltage	Contingency	Option 1 - Initial Analysis				
			2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
42500 DOW_____345A	345KV	P2-3_DOW-D060: 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A & 42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	0.98296 (0x)	0.97839 (0x)	0.97806 (0x)	0.96966 (0x)	0.96866 (0x)
42530 JONCRK__345A	345KV		0.98589 (0x)	0.98167 (0x)	0.98134 (0x)	0.97352 (0x)	0.97252 (0x)

6.1.4 Option 1 – Initial Analysis – CNP Planning Event P3

Thermal loading and voltage results under CNP Planning Event P3 are shown below in Table 6-5 and Table 6-6.

Table 6-5: Option 1 – Initial Analysis: Thermal Loading Results (percent loading) under CNP Planning Event P3

Branch Loading	Rating (MVA) Rate B	Contingency	Option 1 - Initial Analysis 2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	2390	P1-1_GEN_CBY_N2_110072: 110072 CBY_CBY_G2 AND SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	< 70.0 %	65.1 %	65.9 %	73.5 % (0x)	74.6 % (0x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	2390	P1-1_GEN_CBY_N2_110072: 110072 CBY_CBY_G2 AND SINGLE 5915-42500(27): 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	< 70.0 %	66.0 %	66.9 %	74.6 % (0x)	75.8 % (0x)
42500 - 43035 <CKT 27> DOW____345A TO OASIS___345A	1195	P1-1_GEN_WAP_L5_110015: 110015 WAP_WAP_G5 AND P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	73.9 % (0x)	82.7 % (0x)	82.9 % (0x)	101.1 % (3x)	102.8 % (8x)
42500 - 43035 <CKT 18> DOW____345A TO OASIS___345A	1195		73.9 % (0x)	82.7 % (0x)	82.9 % (0x)	101.1 % (3x)	102.8 % (8x)
44645 - 44900 <CKT 98> SNGLTN_345 TO ZENITH__345A	1450	P1-1_GEN_STP_U2_110352: 110352 STP_STP_G2 AND P7-1_E1>>T9899C: 967 - 44900 <CKT 98> GIBN_CREK_5 TO ZENITH__345A & 967 - 44900 <CKT 99> GIBN_CREK_5 TO ZENITH__345A	56.5 %	93.7 % (0x)	92.4 % (0x)	99.7 % (0x)	102.8 % (4x)
44645 - 44900 <CKT 99> SNGLTN_345 TO ZENITH__345A	1450		56.6 %	93.7 % (0x)	92.4 % (0x)	99.7 % (0x)	102.8 % (4x)
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173	P1-1_GEN_CBY_N2_110072: 110072 CBY_CBY_G2 AND P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	99.8 % (0x)	96.7 % (0x)	97.4 % (0x)	112.7 % (182x)	118.2 % (182x)

Table 6-6: Option 1 – Initial Analysis: Voltage Results (in p.u.) under CNP Planning Event P3

BUSES	Nominal Voltage	Contingency	Option 1 - Initial Analysis 2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
42530 JONCRK__345A	345KV	P1-1_GEN_WAP_L6_110016: 110016 WAP_WAP_G6 AND P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	0.97336 (0x)	0.96438 (0x)	0.96392 (0x)	0.94808 (0x)	0.93987 (0x)
42500 DOW____345A	345KV		0.96943 (0x)	0.95891 (0x)	0.95837 (0x)	0.93991 (0x)	0.93023 (0x)

6.1.5 Option 1 – Initial Analysis – CNP Planning Event P6

Thermal loading and voltage results under CNP Planning Event P6 are shown below in Table 6-7 and Table 6-8.

Table 6-7: Option 1 – Initial Analysis: Thermal Loading Results (percent loading) under CNP Planning Event P6

Branch Loading	Rating (MVA) Rate B	Contingency	Option 1 - Initial Analysis				
			2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
42530 - 3WNDTR <A2> JONCRK__345A TO DOWA6TESTDAT	1000	JONCRK AUTOTRANSFORMER A1 AND P7-1_E1>>T1827B1: 42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	96.9 % (0x)	108.2 % (1x)	109.4 % (1x)	125.5 % (1x)	127.0 % (1x)
42530 - 3WNDTR <A1> JONCRK__345A TO DOWA6TESTDAT	1000	JONCRK AUTOTRANSFORMER A2 AND P7-1_E1>>T1827B1: 42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	96.9 % (0x)	108.2 % (1x)	109.4 % (1x)	125.5 % (1x)	127.0 % (1x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	2390	BELAIR AUTOTRANSFORMER A5 AND SINGLE 5915-42500(27): 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	57.3 %	63.7 %	64.5 %	72.1 % (0x)	73.1 % (0x)
5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	2390	BELAIR AUTOTRANSFORMER A5 AND SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	56.5 %	62.7 %	63.6 %	70.9 % (0x)	71.9 % (0x)
42500 - 43035 <CKT 27> DOW____345A TO OASIS___345A	1195	PHR AUTOTRANSFORMER A4 AND P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	73.1 % (0x)	80.9 % (0x)	81.1 % (0x)	98.4 % (0x)	99.0 % (0x)
42500 - 43035 <CKT 18> DOW____345A TO OASIS___345A	1195		73.1 % (0x)	80.9 % (0x)	81.1 % (0x)	98.4 % (0x)	99.0 % (0x)
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173	BELAIR AUTOTRANSFORMER A5 AND P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	100.3 % (2x)	92.1 % (0x)	92.9 % (0x)	106.6 % (41x)	108.2 % (41x)

Table 6-8: Option 1 – Initial Analysis: Voltage Results (in p.u.) under CNP Planning Event P6

BUSES	Nominal Voltage	Contingency	Option 1 - Initial Analysis				
			2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
42500 DOW____345A	345KV	THW AUTOTRANSFORMER A3 AND P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	0.97332 (0x)	0.96364 (0x)	0.96269 (0x)	0.94785 (0x)	0.94515 (0x)
42530 JONCRK__345A	345KV		0.97664 (0x)	0.96838 (0x)	0.96757 (0x)	0.95480 (0x)	0.95251 (0x)

6.1.6 Option 1 – Initial Analysis – CNP Planning Event P7

Thermal loading and voltage results under CNP Planning Event P7 are shown below in Table 6-9 and Table 6-10.

Table 6-9: Option 1 – Initial Analysis: Thermal Loading Results (percent loading) under CNP Planning Event P7

Branch Loading	Rating (MVA) Rate B	Contingency	Option 1 - Initial Analysis 2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	2390	P7-1_E1>>T6472D: 44000 - 44200 <CKT 64> W_A_P___345A TO HILLJE__345A & 44005 - 44040 <CKT 72> W_A_P___345B TO BAILEY_POI_5	44.5 % (0x)	56.2 % (0x)	57.1 % (0x)	62.5 % (0x)	63.6 % (0x)
5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	2390		43.0 % (0x)	54.4 % (0x)	55.3 % (0x)	60.1 % (0x)	61.1 % (0x)
42500 - 43035 <CKT 27> DOW_____345A TO OASIS___345A	1195	P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	72.5 % (0x)	79.7 % (0x)	79.9 % (0x)	97.3 % (0x)	98.0 % (0x)
42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	1195		72.5 % (0x)	79.7 % (0x)	79.9 % (0x)	97.3 % (0x)	98.0 % (0x)
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173		99.3 % (0x)	90.4 % (0x)	91.0 % (0x)	104.8 % (1x)	106.4 % (1x)

Table 6-10: Option 1 – Initial Analysis: Voltage Results (in p.u.) under CNP Planning Event P7

BUSES	Nominal Voltage	Contingency	Option 1 - Initial Analysis 2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
42500 DOW_____345A	345KV	P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	0.97335 (0x)	0.96436 (0x)	0.96389 (0x)	0.94975 (0x)	0.94711 (0x)
42530 JONCRK__345A	345KV		0.97667 (0x)	0.96899 (0x)	0.96859 (0x)	0.95641 (0x)	0.95417 (0x)

6.1.7 Option 1 – Initial Analysis – Maintenance Outage Scenario

Thermal loading and voltage results under the Maintenance Outage Scenario are shown below in Table 6-11 and Table 6-12.

Table 6-11: Option 1 – Initial Analysis: Thermal Loading Results (percent loading) under Maintenance Outage Scenario

Branch Loading	Rating (MVA) Rate B	Contingency	Option 1 - Initial Analysis 2019 Minimum Case	 2019 Summer Peak Case	 2020 Summer Peak Case	 2021 Summer Peak Case	 2022 Summer Peak Case
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	2390	SO_TEX__345A TO DOW____345A <CKT 27> AND P7-1_E1>>T6472D: W_A_P___345A TO HILLJE__345A <CKT 64> & W_A_P___345B TO BAILEY_POI_5 <CKT 72>	69.3 % (0x)	88.0 % (0x)	89.5 % (0x)	98.2 % (0x)	100.4 % (1x)
5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	2390	SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T6472D: W_A_P___345A TO HILLJE__345A <CKT 64> & W_A_P___345B TO BAILEY_POI_5 <CKT 72>	68.6 % (0x)	87.2 % (0x)	88.7 % (0x)	97.2 % (0x)	99.6 % (0x)
42150 - 42810 <CKT 02> BASF____138A TO HOFMAN__138X	280	DOW____345A TO OASIS___345A <CKT 18> AND P7-1_E1>>T1827B2: SO_TEX__345A TO JONCRK__345A <CKT 18> & SO_TEX__345A TO DOW____345A <CKT 27>	116.3 % (4x)	115.8 % (2x)	116.5 % (2x)	157.0 % (13x)	158.0 % (12x)
42810 - 42880 <CKT 02> HOFMAN__138X TO LKJACK__138A	280		117.7 % (4x)	117.2 % (2x)	118.0 % (2x)	158.5 % (13x)	159.5 % (13x)
42110 - 43300 <CKT 26> ANGLTN__138A TO STRATT__138A	220		82.0 % (0x)	81.9 % (0x)	82.3 % (0x)	109.4 % (2x)	110.0 % (2x)
42500 - 43035 <CKT 27> DOW____345A TO OASIS___345A	1195		131.2 % (1x)	144.8 % (1x)	145.1 % (1x)	179.4 % (1x)	180.6 % (1x)
42500 - 43035 <CKT 18> DOW____345A TO OASIS___345A	1195	DOW____345A TO OASIS___345A <CKT 27> AND P7-1_E1>>T1827B2: SO_TEX__345A TO JONCRK__345A <CKT 18> & SO_TEX__345A TO DOW____345A <CKT 27>	131.2 % (1x)	144.8 % (1x)	145.1 % (1x)	179.4 % (1x)	180.6 % (1x)
43035 - 44000 <CKT 18> OASIS___345A TO W_A_P___345A	1450	OASIS___345A TO W_A_P___345A <CKT 99> AND P7-1_E1>>T1827B2: SO_TEX__345A TO JONCRK__345A <CKT 18> & SO_TEX__345A TO DOW____345A <CKT 27>	136.4 % (1x)	124.2 % (1x)	125.0 % (1x)	144.4 % (1x)	146.6 % (1x)
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173	OASIS___345A TO W_A_P___345A <CKT 18> AND P7-1_E1>>T1827B2: SO_TEX__345A TO JONCRK__345A <CKT 18> & SO_TEX__345A TO DOW____345A <CKT 27>	168.4 % (3x)	153.3 % (1x)	154.3 % (1x)	178.2 % (11x)	181.0 % (11x)
5915 - 44000 <CKT 39> SO_TEX__345A TO W_A_P___345A	1432	W_A_P___345A TO HILLJE__345A <CKT 64> AND P7-1_E1>>T1827B2: SO_TEX__345A TO JONCRK__345A <CKT 18> & SO_TEX__345A TO DOW____345A <CKT 27>	71.5 % (0x)	89.2 % (0x)	91.4 % (0x)	99.7 % (0x)	103.4 % (1x)
5915 - 44200 <CKT 44> SO_TEX__345A TO HILLJE__345A	1200	SO_TEX__345A TO HILLJE__345A <64> AND P7-1_E1>>T6472D: W_A_P___345A TO HILLJE__345A <CKT 64> & W_A_P___345B TO BAILEY_POI_5 <CKT 72>	14.3 % (0x)	93.2 % (0x)	96.3 % (0x)	100.5 % (1x)	101.5 % (1x)

Table 6-12: Option 1 – Initial Analysis: Voltage Results (in p.u.) under Maintenance Outage Scenario

BUSES	Nominal Voltage	Contingency	Option 1 - Initial Analysis 2019 Minimum Case	 2019 Summer Peak Case	 2020 Summer Peak Case	 2021 Summer Peak Case	 2022 Summer Peak Case
42500 DOW____345A	345KV	DOW____345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T1827B2: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO DOW____345A <CKT 27>	> 0.950	0.93109 (0x)	0.92977 (0x)	0.89321 (2x)	0.88596 (2x)

6.1.8 Option 1 – Summary of Initial Analysis Results

Based on the results of the Initial Analysis, to maintain adequate voltage levels at nearby 345 kV and 138 kV buses, 850MVAr of reactive support will be needed in the area by 2019. By 2021 this reactive need is increased to 1500 MVAr.

Results of the power flow analysis show that if all potential voltage concerns are solved, overloads will exist on the following transmission elements:

- 345 kV Oasis – Dow-Velasco circuit 18 and 27 (101 % – 103 %) beginning in 2021
- 345 kV Oasis – WAP circuit. (105 % – 119 %) beginning in 2021
- 345 kV Singleton – Zenith circuit 98 and 99 (103 %) beginning in 2022
- Jones Creek Autotransformer A1 and A2 (109 % – 127.0 %) beginning in 2019

Maintenance outage scenarios show overloading above 115% for both 2019 minimum and summer conditions on the following circuits:

- 345 kV Oasis – Dow-Velasco circuit 18 and 27 (132 % – 181 %)
- 345 kV Oasis – WAP circuit 18 and 99 (137 % – 181 %)
- 138 kV BASF – HOFMAN – Lake Jackson circuit 02 (115 % – 160 %)

Maintenance outage scenarios show overloading below 115% on the following circuits:

- 138 kV Angleton – STRATT (110 %) beginning in 2021
- 345 kV STP – Jones Creek circuit 18 (101 %) beginning in 2022
- 345 kV STP – WAP circuit 39 (104 %) beginning in 2022
- 345 kV STP – Hillje circuit 44 (101 %) beginning in 2021

It is important to note that many of the overloads under the maintenance outage scenario are present in the minimum case as well as the summer case. As discussed previously, this indicates that if the expected loads in the area do not fluctuate, there would not be a time in the year where a planned maintenance outage could be taken that would not result in a severe thermal loading concern under the next contingency.

The maintenance outage scenario also shows low voltage at the 345 kV Dow-Velasco substation. This low voltage will be monitored to determine if it can be solved by projects that will be proposed in the subsequent sections.

6.2 Option 1 – Final Solution

Based on the results of the initial analysis, the following upgrades will be needed in addition to the upgrades identified prior to the initial analysis:

- Upgrade of both 345 kV Oasis – Dow-Velasco circuits to at least a 2390 MVA emergency rating
- Addition of a 3rd 345/138 kV 800/1000 MVA autotransformer at Jones Creek

A screening study was performed to determine the impact these upgrades would have on the reactive support needed in the area identified in the initial analysis. Results of the screening study indicate that after the inclusion of these upgrades the reactive support needed in the area is lowered to approximately 760 MVAr by 2019 and an additional 600 MVAr (1360 MVAr total) by 2021.

Some portion of the needed reactive support (760 MVAr by 2019 and 600 MVAr by 2021) can be installed as static capacitor banks. The only CenterPoint Energy owned substations in this area are Jones Creek, Velasco, and Freeport. Due to space limitations two additional 138 kV capacitor banks can be installed at Jones Creek while one additional 138 kV capacitor bank can be installed at Velasco. Installation of these three 138kV capacitor banks would account for approximately 360 MVAr of the needed reactive support.

The remaining 400 MVAr needed by 2019 and additional 600 MVAr needed by 2021 must be dynamic/switchable in nature due to the large amount of reactive support required and since all reactive cannot be on-line pre-contingency due to high voltage concerns. Due to reliability and unavailability concerns, CenterPoint Energy believes that the dynamic/switchable portion should be separated and installed at multiple locations. As stated above, the only CenterPoint Energy owned substations in this area are Jones Creek, Velasco, and Freeport. Real-estate at the Velasco substation is limited and not large enough to install a reactive device; therefore, the only two practical locations are Jones Creek and Freeport.

Based on results of the screening study, two sets of cases 2019-2020 and 2021-2022 were created with the following changes:

2019-2020

- Upgrade 345 kV Dow-Velasco – Oasis circuit 18 and circuit 27 to at least a 2390 MVA emergency rating
- 3rd 345/138 kV 800/1000 MVA autotransformer at Jones Creek Substation
- 3rd 138 kV Capacitor Bank (120 MVAr) at Velasco Substation (secured by DOW)
- 3rd 138 kV Capacitor Bank (120 MVAr) at Jones Creek Substation (secured by DOW)
- 4th 138 kV Capacitor Bank (120 MVAr) at Jones Creek Substation
- 1st 138kV 400 MVAr SVC at Jones Creek Substation

2021-2022

- All changes included in the 2019-2020 final solution case
- 2nd 138 kV 400 MVAr SVC at Jones Creek Substation
- 138 kV 200 MVAr SVC at Freeport Substation

Analysis was performed for all CNP Planning Events listed in Section 5 on the 2019 case and beyond. Analysis was also performed for the Maintenance Outage Scenario described in Section 5. In addition, analysis was also performed for an SVC Unavailability Scenario which consists of an initial condition outage of an SVC (SVC-1) followed by an (N-1) outage of any of the following: CNP Planning Event P1 or CNP Planning Event P7.

6.2.1 Option 1 – Final Solution – CNP Planning Event P0

Under normal operating conditions, no base case thermal or voltage concerns were observed.

6.2.2 Option 1 – Final Solution – CNP Planning Event P1

Thermal loading and voltage results under CNP Planning Event P1 are shown below in Table 6-13 and Table 6-14.

Table 6-13: Option 1 – Final Solution: Thermal Loading Results (percent loading) under CNP Planning Event P1

Branch Loading	Rating (MVA)	Contingency	Option 1 - Final Solution				
	Rate A		2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	2390	SINGLE 5915-42500(27): 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	56.1 % (0x)	62.5 % (0x)	63.3 % (0x)	70.7 % (0x)	72.1 % (0x)
5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	2390	SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	55.2 % (0x)	61.4 % (0x)	62.3 % (0x)	69.7 % (0x)	70.3 % (0x)
42500 - 43035 <CKT 27> DOW_____345A TO OASIS___345A	2390		13.3 % (0x)	14.5 % (0x)	14.2 % (0x)	19.6 % (0x)	18.9 % (0x)
42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	2390		13.3 % (0x)	14.5 % (0x)	14.2 % (0x)	19.6 % (0x)	18.9 % (0x)

Table 6-14: Option 1 – Final Solution: Voltage Results (in p.u.) under CNP Planning Event P1

BUSES	Nominal Voltage	Contingency	Option 1 - Final Solution				
			2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
42530 JONCRK__345A	345KV	SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1.01027 (0x)	0.99510 (0x)	0.99384 (0x)	0.97826 (0x)	0.98972 (0x)
42500 DOW_____345A	345KV		1.00791 (0x)	0.99298 (0x)	0.99173 (0x)	0.97617 (0x)	0.98636 (0x)

6.2.3 Option 1 – Final Solution – CNP Planning Event P2

Thermal loading and voltage results under CNP Planning Event P2 are shown below in Table 6-15 and Table 6-16.

Table 6-15: Option 1 – Final Solution: Thermal Loading Results (percent loading) under CNP Planning Event P2

Branch Loading	Rating (MVA) Rate B	Contingency	Option 1 - Final Solution 2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	2390	P2-3_STP-Y500X_LINE&SHUNT-R1: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	55.2 % (0x)	61.4 % (0x)	62.3 % (0x)	69.7 % (0x)	70.3 % (0x)
42500 - 43035 <CKT 27> DOW_____345A TO OASIS___345A	2390	P2-3_DOW-D060: 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A & 42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	21.3 % (0x)	23.2 % (0x)	22.7 % (0x)	30.2 % (0x)	29.7 % (0x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	2390	P2-3_DOW-D060: 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A & 42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	59.9 % (0x)	66.6 % (0x)	67.4 % (0x)	75.8 % (0x)	76.7 % (0x)
42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	2390	P2-3_STP_Y510X_U1_110351: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 110351 STP_STP_G1	16.9 % (0x)	17.9 % (0x)	17.6 % (0x)	22.6 % (0x)	22.3 % (0x)

Table 6-16: Option 1 – Final Solution: Voltage Results (in p.u.) under CNP Planning Event P2

BUSES	Nominal Voltage	Contingency	Option 1 - Final Solution 2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
42530 JONCRK__345A	345KV	P2-3_DOW-D060: 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A & 42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	1.00236 (0x)	0.98627 (0x)	0.98497 (0x)	0.99020 (0x)	0.99107 (0x)
42500 DOW_____345A	345KV	P2-3_DOW-D060: 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A & 42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	0.99971 (0x)	0.98336 (0x)	0.98206 (0x)	0.98663 (0x)	0.98748 (0x)

6.2.4 Option 1 – Final Solution – CNP Planning Event P3

Thermal loading and voltage results under CNP Planning Event P3 are shown below in Table 6-17 and Table 6-18.

Table 6-17: Option 1 – Final Solution: Thermal Loading Results (percent loading) under CNP Planning Event P3

Branch Loading	Rating (MVA)	Contingency	Option 1 - Final Solution				
	Rate B		2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	2390	P1-1_GEN_CBY_N2_110072: 110072 CBY_CBY_G2 AND SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	< 70.0 %	64.3 %	65.2 %	72.7 % (0x)	73.3 % (0x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	2390	P1-1_GEN_CBY_N2_110072: 110072 CBY_CBY_G2 AND SINGLE 5915-42500(27): 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	< 70.0 %	65.4 %	66.2 %	74.4 % (0x)	74.6 % (0x)
42500 - 43035 <CKT 27> DOW____345A TO OASIS__345A	2390	P1-1_GEN_WAP_L5_110015: 110015 WAP_WAP_G5 AND P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	< 70.0 %	41.9 %	42.1%	50.8%	51.4%
42500 - 43035 <CKT 18> DOW____345A TO OASIS__345A	2390		< 70.0 %	41.9 %	42.1%	50.8%	51.4%
44645 - 44900 <CKT 98> SNGLTN_345 TO ZENITH__345A	1450	P1-1_GEN_STP_U2_110352: 110352 STP_STP_G2 AND P7-1_E1>>T9899C: 967 - 44900 <CKT 98> GIBN_CREK_5 TO ZENITH__345A & 967 - 44900 <CKT 99> GIBN_CREK_5 TO ZENITH__345A	56.5 %	93.5 % (0x)	92.2 % (0x)	99.6 % (0x)	103.2 % (4x)
44645 - 44900 <CKT 99> SNGLTN_345 TO ZENITH__345A	1450		56.6 %	93.6 % (0x)	92.2 % (0x)	99.7 % (0x)	103.2 % (4x)
43035 - 44000 <CKT 99> OASIS__345A TO W_A_P__345A	1173	P1-1_CBY_1_COMBINED-CYCLE: 110075 CBY4_ST04 & 110073 CBY4_CT41 AND P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	102.2 % (55x)	93.7 % (0x)	94.0 % (0x)	108.9 % (0x)	110.0 % (0x)

Table 6-18: Option 1 – Final Solution: Voltage Results (in p.u.) under CNP Planning Event P3

BUSES	Nominal Voltage	Contingency	Option 1 - Final Solution				
			2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
42500 DOW____345A	345KV	P1-1_GEN_WAP_L6_110016: 110016 WAP_WAP_G6 AND P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	0.96899 (0x)	0.96804 (0x)	0.96844 (0x)	0.97781 (0x)	0.97175 (0x)
42530 JONCRK__345A	345KV		0.97229 (0x)	0.97354 (0x)	0.97409 (0x)	0.98708 (0x)	0.98193 (0x)

6.2.5 Option 1 – Final Solution – CNP Planning Event P5

No thermal loading or voltage concerns were identified under CNP Planning Event P5.

6.2.6 Option 1 – Final Solution – CNP Planning Event P6

Thermal loading and voltage results under CNP Planning Event P6 are shown below in Table 6-19 and Table 6-20.

Table 6-19: Option 1 – Final Solution: Thermal Loading Results (percent loading) under CNP Planning Event P6

Branch Loading	Rating (MVA) Rate B	Contingency	Option 1 - Final Solution 2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
42530 - 3WNDTR <A3> JONCRK__345A TO DOWA6TESTDAT	1000	JONCRK AUTOTRANSFORMER A1 AND P7-1_E1>>T1827B1: 42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	54.6 %	60.4 %	61.0 %	69.5 %	70.3 % (0x)
42530 - 3WNDTR <A2> JONCRK__345A TO DOWA6TESTDAT	1000		54.6 %	60.4 %	61.0 %	69.5 %	70.3 % (0x)
5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	2390	BELAIR AUTOTRANSFORMER A5 AND SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	55.4 %	61.8 %	62.7 %	70.2 % (0x)	70.8 % (0x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	2390	BELAIR AUTOTRANSFORMER A5 AND SINGLE 5915-42500(27): 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	56.3 %	62.9 %	63.8 %	71.2 % (0x)	73.0 % (0x)
42500 - 43035 <CKT 27> DOW____345A TO OASIS___345A	2390	PHR AUTOTRANSFORMER A4 AND P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	36.6 %	41.1 %	41.2 %	51.4 %	49.5%
42500 - 43035 <CKT 18> DOW____345A TO OASIS___345A	2390		36.6 %	41.1 %	41.2 %	51.4 %	49.5%
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173	BELAIR AUTOTRANSFORMER A5 AND P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	100.6 % (6x)	93.3 % (0x)	93.4 % (0x)	106.4 % (26x)	108.2 % (39x)

Table 6-20: Option 1 – Final Solution: Voltage Results (in p.u.) under CNP Planning Event P6

BUSES	Nominal Voltage	Contingency	Option 1 - Final Solution 2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
42530 JONCRK__345A	345KV	THW AUTOTRANSFORMER A3 AND P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A	0.99098 (0x)	0.97731 (0x)	0.97644 (0x)	0.97409 (0x)	0.96855 (0x)
42500 DOW____345A	345KV		0.98763 (0x)	0.97268 (0x)	0.97164 (0x)	0.96684 (0x)	0.96118 (0x)

6.2.7 Option 1 – Final Solution – CNP Planning Event P7

Thermal loading and voltage results under CNP Planning Event P7 are shown below in Table 6-21 and Table 6-22.

Table 6-21: Option 1 – Final Solution: Thermal Loading Results (percent loading) under CNP Planning Event P7

Branch Loading	Rating (MVA)	Contingency	Option 1 - Final Solution				
	Rate B		2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	2390	P7-1_E1>>T6472D: 44000 - 44200 <CKT 64> W_A_P___345A TO HILLJE__345A & 44005 - 44040 <CKT 72> W_A_P___345B TO BAILEY_POI_5	42.6 % (0x)	54.1 % (0x)	55.1 % (0x)	60.1 % (0x)	61.6 % (0x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	2390		44.3 % (0x)	56.1 % (0x)	57.1 % (0x)	62.8 % (0x)	64.4 % (0x)
42500 - 43035 <CKT 27> DOW_____345A TO OASIS___345A	2390	P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	36.4 % (0x)	40.3 % (0x)	40.8 % (0x)	48.7 % (0x)	49.1 % (0x)
42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	2390		36.4 % (0x)	40.3 % (0x)	40.8 % (0x)	48.7 % (0x)	49.1 % (0x)
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173		99.4 % (0x)	90.8 % (0x)	92.2 % (0x)	104.6 % (1x)	106.3 % (1x)

Table 6-22: Option 1 – Final Solution: Voltage Results (in p.u.) under CNP Planning Event P7

BUSES	Nominal Voltage	Contingency	Option 1 - Final Solution				
			2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
42530 JONCRK__345A	345KV	P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	0.99267 (0x)	0.98092 (0x)	0.95858 (0x)	0.99006 (0x)	0.98291 (0x)
42500 DOW_____345A	345KV		0.98932 (0x)	0.97627 (0x)	0.95476 (0x)	0.98260 (0x)	0.97537 (0x)

6.2.8 Option 1 – Final Solution – SVC Unavailability Scenario

Thermal loading results under SVC Unavailability Scenario are shown below in Table 6-23. No voltage concerns were identified.

Table 6-23: Option 1 – Final Solution: Thermal Loading Results (percent loading) under SVC Unavailability Scenario

Branch Loading	Rating (MVA)	Contingency	Option 1 - Final Solution				
	Rate B		2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	2390	JC_SVC-1: 42540 - 42545 <CKT 1> JONCRK__138A TO JONCRK_SVC1 AND SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	55.2 %	61.4 %	62.3 %	69.4 %	70.3 % (0x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	2390	JC_SVC-1: 42540 - 42545 <CKT 1> JONCRK__138A TO JONCRK_SVC1 AND SINGLE 5915-42500(27): 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	56.1 %	62.5 %	63.3 %	71.1 % (0x)	72.1 % (0x)
42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	2390	JC_SVC-1: 42540 - 42545 <CKT 1> JONCRK__138A TO JONCRK_SVC1 AND P7-1_E1>>T1827B2: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	36.5 % (0x)	41.5 % (0x)	41.7 % (0x)	49.3 % (0x)	50.3 % (0x)
42500 - 43035 <CKT 27> DOW_____345A TO OASIS___345A	2390		36.5 % (0x)	41.5 % (0x)	41.7 % (0x)	49.3 % (0x)	50.3 % (0x)
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173		99.4 % (0x)	92.7 % (0x)	93.4 % (0x)	105.6 % (2x)	108.4 % (2x)

6.2.9 Option 1 – Final Solution – Maintenance Outage Scenario

Thermal loading and voltage results under the Maintenance Outage Scenario are shown below in Table 6-24 and Table 6-25.

Table 6-24: Option 1 – Final Solution: Thermal Loading Results (percent loading) under Maintenance Outage Scenario

Branch Loading	Rating (MVA)	Contingency	Option 1 - Final Solution				
	Rate B		2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A	2390	SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T6472D: W_A_P___345A TO HILLJE__345A <CKT 64> & W_A_P___345B TO BAILEY_POI_5 <CKT 72>	< 70.0 %	87.1 % (0x)	88.7 % (0x)	97.0 % (0x)	99.3 % (0x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	2390	SO_TEX__345A TO DOW_____345A <CKT 27> AND P7-1_E1>>T6472D: W_A_P___345A TO HILLJE__345A <CKT 64> & W_A_P___345B TO BAILEY_POI_5 <CKT 72>	< 70.0 %	88.1 % (0x)	89.6 % (0x)	98.1 % (0x)	100.2 % (1x)
42500 - 43035 <CKT 27> DOW_____345A TO OASIS___345A	2390	DOW_____345A TO OASIS___345A <CKT 18> AND P7-1_E1>>T1827B2: SO_TEX__345A TO JONCRK__345A <CKT 18> & SO_TEX__345A TO DOW_____345A <CKT 27>	67.2 %	74.0 % (0x)	74.1 % (0x)	91.0 % (0x)	91.6 % (0x)
42150 - 42810 <CKT 02> BASF____138A TO HOFMAN__138X	280		108.7 % (2x)	106.9 % (2x)	107.6 % (2x)	144.2 % (14x)	145.4 % (14x)
42810 - 42880 <CKT 02> HOFMAN__138X TO LKJACK__138A	280		110.1 % (2x)	108.4 % (2x)	109.0 % (2x)	145.7 % (15x)	146.9 % (14x)
42110 - 43300 <CKT 26> ANGLTN__138A TO STRATT__138A	220		75.0 % (0x)	73.8 % (0x)	74.0 % (0x)	97.3 % (0x)	98.2 % (0x)
42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	2390	DOW_____345A TO OASIS___345A <CKT 27> AND P7-1_E1>>T1827B2: SO_TEX__345A TO JONCRK__345A <CKT 18> & SO_TEX__345A TO DOW_____345A <CKT 27>	67.2 %	74.0 % (0x)	74.1 % (0x)	91.0 % (0x)	91.6 % (0x)
43035 - 44000 <CKT 18> OASIS___345A TO W_A_P___345A	1450	OASIS___345A TO W_A_P___345A <CKT 99> AND P7-1_E1>>T1827B2: SO_TEX__345A TO JONCRK__345A <CKT 18> & SO_TEX__345A TO DOW_____345A <CKT 27>	137.4 % (1x)	125.1 % (1x)	125.8 % (1x)	145.1 % (1x)	147.4 % (1x)
5915 - 44000 <CKT 39> SO_TEX__345A TO W_A_P___345A	1432	W_A_P___345A TO HILLJE__345A <CKT 64> AND P7-1_E1>>T1827B2: SO_TEX__345A TO JONCRK__345A <CKT 18> & SO_TEX__345A TO DOW_____345A <CKT 27>	71.6 % (0x)	89.3 % (0x)	91.4 % (0x)	99.5 % (0x)	103.2 % (1x)
5915 - 44200 <CKT 44> SO_TEX__345A TO HILLJE__345A	1200	SO_TEX__345A TO HILLJE__345A <CKT64> AND P7-1_E1>>T6472D: W_A_P___345A TO HILLJE__345A <CKT 64> & W_A_P___345B TO BAILEY_POI_5 <CKT 72>	< 70.0 %	93.5 % (0x)	96.5 % (0x)	100.7 % (1x)	101.6 % (1x)
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173	OASIS___345A TO W_A_P___345A <CKT 18> AND P7-1_E1>>T1827B2: SO_TEX__345A TO JONCRK__345A <CKT 18> & SO_TEX__345A TO DOW_____345A <CKT 27>	169.6 % (7x)	154.3 % (1x)	155.3 % (1x)	179.1 % (13x)	181.9 % (13x)

Table 6-25: Option 1 – Final Solution: Voltage Results (in p.u.) under Maintenance Outage Scenario

BUSES	Nominal Voltage	Contingency	Option 1 - Final Solution				
			2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case	2022 Summer Peak Case
42530 JONCRK__345A	345KV	DOW_____345A TO OASIS___345A <CKT 27> AND P7-1_E1>>T1827B2: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO DOW_____345A <CKT 27>	> 0.950	> 0.950	> 0.950	> 0.950	> 0.950
42500 DOW_____345A	345KV		> 0.950	> 0.950	> 0.950	0.94616 (0x)	0.94289 (0x)

6.2.10 Option 1 – Summary of Final Solution Results

CNP Planning Events P1, P2, P3, P6, P7, and SVC Unavailability Scenario

Based on results of the Final Solution analysis 345 kV Oasis – WAP circuit 99 will need to be upgraded to solve overloading concerns identified under CNP Planning Events P3, P6, P7, and SVC Unavailability Scenario.

Maintenance Outage Scenario

Based on the results of the Maintenance Outage Scenario, the following circuits will need to be upgraded:

- 345 kV Oasis – WAP circuit 18
- 138 kV BASF – HOFMAN – Lake Jackson circuit 02

6.3 Option 1 – Cost Estimates and Discussion

CenterPoint Energy based the SVC estimates on rough cost estimates provided by several SVC vendors during the study process. As can be seen, three double-circuit corridors have to be reconductored/rebuilt to reach sufficient thermal ratings. The STP – Dow and STP – Jones Creek double-circuit upgrade assumed additional costs to build temporary construction to minimize outages. The Dow – Oasis double-circuit line does not have the necessary right-of-way to build temporary construction; therefore, that was not an option and the outages would be expected to be lengthy and create significant congestion. The WAP – Oasis double-circuit line upgrade assumed additional costs to build temporary construction to minimize outages. Another major concern with this option is that the three corridors would likely have to be done serially since outages allowing work on two corridors at once would not be possible. Timing then becomes an issue as a rough estimate for completion is about 2-3 years to complete all three corridors. Table 6-26 shows the estimated cost of all Option 1 upgrades. The cost of Option 1 at $453.17 million makes it much less attractive than the other options yet to be discussed. As will be seen when reviewing new line options, Option 1 is estimated to cost nearly twice than the leading new line options cost. Given all of these constraints involved with Option 1, CenterPoint Energy determined that Option 1 was not a cost-effective solution to serve the Freeport Area load growth and will not be considered further.

Table 6-26: Cost Estimate: Option 1 (Upgrade of Existing System)

Work Description	Transmission Cost	Substation Cost
Upgrade (46 miles) 345kV STP - Dow-Velasco circuit 18 Upgrade (46 miles) 345kV STP - Jones Creek -Dow-Velasco 27 Reconductor with 3-959 ACSS (Includes temporary construction)	$100,000,000	$2,560,000
Upgrade (36 miles) 345kV Dow-Velasco - Oasis circuit 18 Upgrade (36 miles) 345kV Dow-Velasco - Oasis circuit 27 Reconductor with 3-959 ACSS (No temporary construction)	$140,000,000	$1,200,000
Upgrade 138kV BASF - HOFMAN - Lake Jackson circuit 02 (minimum 500 MVA emergency rating)	$3,750,000	$930,000
Upgrade (19.6 miles) 345kV Oasis - WAP circuit 18 Upgrade (19.6 miles) 345kV Oasis - WAP circuit 99 (minimum 2200 MVA emergency rating)	$93,000,000	$125,000
Install 3rd 345/138kV 800/1000 MVA Autotransformer at Jones Creek substation	-	$11,200,000
Install 4th 138 kV Capacitor Bank (120 MVAr) at Jones Creek substation	-	$1,600,000
Install 2 - 138 kV positions at Jones Creek for two SVC's	-	$3,800,000
Convert Freeport to breakered station and install 1 - 138 kV positions at Freeport for one SVC	-	$5,000,000
Install 1st 138 kV (400 MVAr) SVC at Jones Creek Substation	-	$90,000,000
Install 2nd 138 kV (400 MVAr) SVC at Jones Creek Substation	-	
Install 1st 138 kV (200 MVAr) SVC at Freeport Substation	-	
SUB-TOTAL	$336,750,000	$116,415,000
TOTAL	$453,165,000	

7 Options 2 – 8: New Transmission Line Options

CenterPoint Energy proposes multiple long-term solutions; all of which involve building a new 345 kV double-circuit transmission line discussed in Section 7.2. Taking into consideration the time needed for ERCOT and PUCT filings, the earliest a new 345 kV line can be completed is expected to be summer 2021. Therefore, a short-term solution called Bridge the Gap Upgrades is being proposed until new lines can be constructed to the area.

7.1 Short-term Solution – Bridge the Gap Upgrades

Analysis was performed to determine what upgrades can be completed on the system to "bridge the gap" until a new double-circuit 345 kV line can be constructed to the area.

7.1.1 Bridge the Gap Upgrades – Initial Analysis

Analysis from Section 5 was reviewed to see the earliest thermal and voltage concerns. Initially, P1 overloads of STP – Dow-Velasco and numerous low 345 kV voltages are of the most concern. To solve the overload of STP – Dow-Velasco circuit 27 and STP – Jones Creek – Dow-Velasco circuit 18 an in-line reactor must be installed on the circuits to limit flow. Due to space limitations at the Dow-Velasco and STP substations, the in-line reactors will have to be installed at the Jones Creek substation; therefore, requiring looping STP – Dow-Velasco circuit 27 into Jones Creek. After reviewing Sections 5 and 6, an iterative process of modeling and simulating some known worst case contingencies was used to identify the following upgrades as a solution to "bridge the gap" until new lines can be constructed to the area.

- Loop 345 kV STP – Dow-Velasco circuit 27 into Jones Creek Substation (approximately 0.9 mile)
- 7-ohm in-line reactors at Jones Creek on 345 kV STP – Jones Creek circuits 18 and 27
- 3rd 138 kV Capacitor Bank (120 MVAr) at Velasco Substation (secured by DOW)
- 3rd 138 kV Capacitor Bank (120 MVAr) at Jones Creek Substation (secured by DOW)
- 4th 138 kV Capacitor Bank (120 MVAr) at Jones Creek Substation
- 3rd 345/138 kV 800/1000 MVA autotransformer at Jones Creek Substation
- 1st 138 kV reactive device (100 MVAr) at Jones Creek Substation
- 2nd 138 kV reactive device (100 MVAr) at Jones Creek Substation

One 7-ohm reactor was placed on each 345 kV STP – Jones Creek circuit to reduce the P1 loading seen on either circuit. The 7-ohm reactor was determined to be a reasonable size to limit the highest contingency flows while building in sufficient margin for operational flexibility. As seen in Section 5 P6 analysis, a third 345/138 kV autotransformer is needed at Jones Creek. During the iterative process, it was also determined that not all reactive support needed to maintain adequate voltage during contingency could be placed in-service pre-contingency, as would normally be the case for CenterPoint Energy capacitor banks. In fact 200 MVAr were still needed, but had to be off-line pre-contingency. Therefore, the need for fast switched reactive devices was clear, at this point in the steady-state analysis it was assumed to be an SVC.

Analysis was performed for all CNP Planning Events listed in Section 5 as well as the SVC Unavailability Scenario to determine if the projects described above would solve all thermal loading and voltage concerns in the area. In addition, analysis was also performed for the Maintenance Outage Scenario described in Section 5 to determine if the Bridge the Gap Upgrades are adequate as a permanent solution.

7.1.2 Bridge the Gap Upgrades – CNP Planning Event P0

Under normal operating conditions, no base case thermal or voltage concerns were observed.

7.1.3 Bridge the Gap Upgrades – CNP Planning Event P1

Thermal loading and voltage results under CNP Planning Event P1 are shown below in Table 7-1 and Table 7-2.

Table 7-1: Bridge the Gap – Thermal Loading Results (percent loading) under CNP Planning Event P1

Branch Loading	Rating (MVA)	Contingency	Bridge the Gap			
	Rate A		2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case
42500 - 43035 <CKT 27> DOW____345A TO OASIS___345A	1137	SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	33.8 % (0x)	36.8 % (0x)	36.4 % (0x)	50.2 % (0x)
42500 - 43035 <CKT 18> DOW____345A TO OASIS___345A	1137		33.8 % (0x)	36.8 % (0x)	36.4 % (0x)	50.2 % (0x)
5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	1450		76.4 % (0x)	85.0 % (0x)	86.1 % (0x)	98.3 % (0x)
42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	1450	SINGLE 42500-42530(18): 42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	62.4 % (0x)	67.2 % (0x)	68.4 % (0x)	68.2 % (0x)
42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	1450	SINGLE 42500-42530(27): 42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	62.4 % (0x)	67.2 % (0x)	68.4 % (0x)	68.2 % (0x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1450	SINGLE 5915-42530(27): 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	76.4 % (0x)	85.0 % (0x)	86.1 % (0x)	98.3 % (0x)

Table 7-2: Bridge the Gap – Voltage Results (in p.u.) under CNP Planning Event P1

BUSES	Nominal Voltage	Contingency	Bridge the Gap			
			2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case
42530 JONCRK__345A	345KV	SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1.01133 (0x)	0.99840 (0x)	0.99694 (0x)	0.96874 (0x)
42500 DOW____345A	345KV		1.00956 (0x)	0.99657 (0x)	0.99512 (0x)	0.96683 (0x)

7.1.4 Bridge the Gap Upgrades – CNP Planning Event P2

Thermal loading and voltage results under CNP Planning Event P2 are shown below in Table 7-3 and Table 7-4. Voltage results with a 120 MVAr capacitor bank turned off at Jones Creek are shown below in Table 7-5.

Table 7-3: Bridge the Gap – Thermal Loading Results (percent loading) under CNP Planning Event P2

Branch Loading	Rating (MVA)	Contingency	Bridge the Gap			
	Rate B		2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case
42500 - 43035 <CKT 27> DOW_____345A TO OASIS___345A	1195	P2-3_STP_Y510X_U1_110351: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 110351 STP_STP_G1	38.0 % (0x)	40.5 % (0x)	40.1 % (0x)	53.8 % (0x)
42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	1195		38.0 % (0x)	40.5 % (0x)	40.1 % (0x)	53.8 % (0x)
42500 - 42530 <CKT 18> DOW_____345A TO JONCRK__345A	1450	P2-3_DOW-D060_NEW: 42500 - 42530 <CKT 27> DOW_____345A TO JONCRK__345A & 42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	67.5 % (0x)	72.6 % (0x)	73.6 % (0x)	76.5 % (0x)
42500 - 42530 <CKT 27> DOW_____345A TO JONCRK__345A	1450	P2-3_DOW-D030X: 42500 - 42530 <CKT 18> DOW_____345A TO JONCRK__345A & 42500 - 43035 <CKT 27> DOW_____345A TO OASIS___345A	67.5 % (0x)	72.6 % (0x)	73.6 % (0x)	76.5 % (0x)
5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	1450	P2-3_STP-Y500X_LINE&SHUNT-R1: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	76.4 % (0x)	85.0 % (0x)	86.1 % (0x)	98.3 % (0x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1450	P2-3_STP-Y540_NEW: 5133 - 5915 <CKT 18> ELMCREEK TO SO_TEX__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	76.4 % (0x)	85.2 % (0x)	86.1 % (0x)	98.0 % (0x)

Table 7-4: Bridge the Gap – Voltage Results (in p.u.) under CNP Planning Event P2

BUSES	Nominal Voltage	Contingency	Bridge the Gap			
			2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case
42530 JONCRK__345A	345KV	P2-3_DOW-D060: 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW_____345A & 42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	0.99804 (0x)	0.98002 (0x)	0.97831 (0x)	0.97831 (0x)
42500 DOW_____345A	345KV		0.99454 (0x)	0.97636 (0x)	0.97466 (0x)	0.97466 (0x)
42540 JONCRK__138A	138KV	P2-3_COR-V600-CB1: 42540 - 43440 <CKT &1> JONCRK__138A TO CORTEZ__138X & 43155 - 43440 <CKT 48> MARINE_138X TO CORTEZ__138X	1.05940 (11x)	1.05585 (2x)	1.05461 (1x)	1.04245 (0x)
42645 FREEPT_L138X	138KV		1.05820 (7x)	1.05436 (2x)	1.05308 (1x)	1.04011 (0x)
43220 SW_SD_TAP02	138KV		1.05941 (10x)	1.05520 (2x)	1.05396 (1x)	1.04176 (0x)
43315 SURFSI_L138X	138KV		1.05644 (3x)	1.05285 (1x)	1.05158 (1x)	1.03820 (0x)
43360 VLASCO__138A	138KV		1.05465 (2x)	1.05137 (1x)	1.05013 (1x)	1.03629 (0x)
44205 BRYAN__R59_8	138KV		1.05809 (7x)	1.05425 (1x)	1.05294 (1x)	1.04011 (0x)

Table 7-5: Bridge the Gap – Voltage Results (in p.u.) under CNP Planning Event P2 – 120 MVAr capacitor bank at Jones Creek off

BUSES	Nominal Voltage	Contingency	Switch off 120MVAr Capbank @ Jones Creek			
			2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case
42540 JONCRK__138A	138KV	P2-3_COR-V600-CB1: 42540 - 43440 <CKT &1> JONCRK__138A TO CORTEZ__138X & 43155 - 43440 <CKT 48> MARINE_138X TO CORTEZ__138X	1.04942 (0x)	1.04483 (0x)	1.04409 (0x)	1.03172 (0x)
42645 FREEPT_L138X	138KV		1.04930 (0x)	1.04457 (0x)	1.04382 (0x)	1.03076 (0x)
43220 SW_SD_TAP02	138KV		1.04951 (0x)	1.04502 (0x)	1.04428 (0x)	1.03112 (0x)
43315 SURFSI_L138X	138KV		1.04816 (0x)	1.04376 (0x)	1.04303 (0x)	1.02964 (0x)
43360 VLASCO__138A	138KV		1.04713 (0x)	1.04315 (0x)	1.04247 (0x)	1.02870 (0x)
44205 BRYAN__R59_8	138KV		1.04919 (0x)	1.04446 (0x)	1.04368 (0x)	1.03062 (0x)

7.1.5 Bridge the Gap Upgrades – CNP Planning Event P3

Thermal loading and voltage results under CNP Planning Event P3 are shown below in Table 7-6 and Table 7-7. Voltage results with a 120 MVAr capacitor bank turned off at Jones Creek are shown below in Table 7-8.

Table 7-6: Bridge the Gap – Thermal Loading Results (percent loading) under CNP Planning Event P3

Branch Loading	Rating (MVA)	Contingency	Bridge the Gap			
	Rate B		2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case
42500 - 43035 <CKT 27> DOW_____345A TO OASIS___345A	1195	P1-1_GEN_WAP_L5_110015: 110015 WAP_WAP_G5 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	72.4 % (0x)	81.5 % (0x)	81.8 % (0x)	Did Not Converge (399x)
42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	1195		72.4 % (0x)	81.5 % (0x)	81.8 % (0x)	Did Not Converge (399x)
42500 - 42530 <CKT 18> DOW_____345A TO JONCRK__345A	1450	P1-1_GEN_CBY_N2_110072: 110072 CBY_CBY_G2 AND SINGLE 42500-42530(27): 42500 - 42530 <CKT 27> DOW_____345A TO JONCRK__345A	< 70.0 %	71.6 % (0x)	72.8 % (0x)	72.6 % (0x)
42500 - 42530 <CKT 27> DOW_____345A TO JONCRK__345A	1450	P1-1_GEN_CBY_N2_110072: 110072 CBY_CBY_G2 AND SINGLE 42500-42530(18): 42500 - 42530 <CKT 18> DOW_____345A TO JONCRK__345A	< 70.0 %	71.6 % (0x)	72.8 % (0x)	72.6 % (0x)
5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	1450	P1-1_GEN_CBY_N2_110072: 110072 CBY_CBY_G2 AND SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	76.6 % (0x)	88.9 % (0x)	90.1 % (0x)	103.2 % (38x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1450	P1-1_GEN_CBY_N2_110072: 110072 CBY_CBY_G2 AND SINGLE 5915-42530(27): 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	76.6 % (0x)	88.9 % (0x)	90.1 % (0x)	103.2 % (38x)
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173	P1-1_CBY_1_COMBINED-CYCLE: 110075 CBY4_ST04 110073 CBY4_CT41 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	100.4 % (3x)	92.1 % (0x)	92.8 % (0x)	Did Not Converge (399x)

Table 7-7: Bridge the Gap – Voltage Results (in p.u.) under CNP Planning Event P3

BUSES	Nominal Voltage	Contingency	Bridge the Gap			
			2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case
42500 DOW_____345A	345KV	P1-1_GEN_WAP_L6_110016: 110016 WAP_WAP_G6 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	0.96101 (0x)	0.93924 (0x)	0.93202 (0x)	Did Not Converge (399x)
42530 JONCRK__345A	345KV		0.96290 (0x)	0.94200 (0x)	0.93474 (0x)	Did Not Converge (399x)
42540 JONCRK__138A	138KV	P1-1_GEN_STP_U2_110352: 110352 STP_STP_G2 AND P7-1_E1>>4848K-CB1: 42540 - 43440 <CKT &1> JONCRK__138A TO CORTEZ__138X & 43155 - 43440 <CKT 48> MARINE_138X TO CORTEZ__138X	1.05943 (756x)	1.05815 (183x)	1.05723 (184x)	1.04420 (0x)
42645 FREEPT_L138X	138KV		1.05818 (581x)	1.05660 (180x)	1.05564 (180x)	1.04176 (0x)
43220 SW_SD_TAP02	138KV		1.05937 (579x)	1.05742 (183x)	1.05650 (183x)	1.04345 (0x)
43315 SURFSI_L138X	138KV		1.05639 (106x)	1.05504 (179x)	1.05409 (177x)	1.03978 (0x)
43360 VLASCO__138A	138KV		1.05457 (100x)	1.05350 (169x)	1.05258 (48x)	1.03777 (0x)
44205 BRYAN__R59_8	138KV		1.05807 (100x)	1.05648 (180x)	1.05550 (180x)	1.04162 (0x)

Table 7-8: Bridge the Gap – Voltage Results (in p.u.) under CNP Planning Event P3 – 120 MVAr capacitor bank at Jones Creek off

BUSES	Nominal Voltage	Contingency	Switch off 120MVAr Capbank @ Jones Creek			
			2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case
42540 JONCRK__138A	138KV	P1-1_GEN_STP_U2_110352: 110352 STP_STP_G2 AND P7-1_E1>>4848K-CB1: 42540 - 43440 <CKT &1> JONCRK__138A TO CORTEZ__138X & 43155 - 43440 <CKT 48> MARINE_138X TO CORTEZ__138X	1.05145 (0x)	1.04653 (0x)	1.04605 (0x)	1.03358 (0x)
42645 FREEPT_L138X	138KV		1.05126 (2x)	1.04618 (0x)	1.04567 (0x)	1.03258 (0x)
43220 SW_SD_TAP02	138KV		1.05146 (2x)	1.04664 (0x)	1.04615 (0x)	1.03291 (0x)
43315 SURFSI_L138X	138KV		1.05007 (2x)	1.04531 (0x)	1.04482 (0x)	1.03142 (0x)
43360 VLASCO__138A	138KV		1.04898 (0x)	1.04462 (0x)	1.04417 (0x)	1.0304 (0x)
44205 BRYAN__R59_8	138KV		1.05115 (2x)	1.04606 (0x)	1.04553 (0x)	1.03244 (0x)

7.1.6 Bridge the Gap Upgrades – CNP Planning Event P5

No thermal loading or voltage concerns were identified under CNP Planning Event P5.

7.1.7 Bridge the Gap Upgrades – CNP Planning Event P6

Thermal loading and voltage results under CNP Planning Event P6 are shown below in Table 7-9 and Table 7-10. Voltage results with a 120 MVAr capacitor bank turned off at Jones Creek are shown below in Table 7-11.

Table 7-9: Bridge the Gap – Thermal Loading Results (percent loading) under CNP Planning Event P6

Branch Loading	Rating (MVA)	Contingency	Bridge the Gap			
	Rate B		2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case
42500 - 43035 <CKT 27> DOW_____345A TO OASIS___345A	1195	PHR AUTOTRANSFORMER A4 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	71.0 % (0x)	81.2 % (0x)	81.7 % (0x)	Did Not Converge (86x)
42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	1195		71.0 % (0x)	81.2 % (0x)	81.7 % (0x)	Did Not Converge (86x)
42500 - 42530 <CKT 18> DOW_____345A TO JONCRK__345A	1450	JONCRK AUTOTRANSFORMER A1 AND SINGLE 42500-42530(27): 42500 - 42530 <CKT 27> DOW_____345A TO JONCRK__345A	66.7 %	72.1 % (0x)	73.4 % (0x)	74.8 % (0x)
42500 - 42530 <CKT 27> DOW_____345A TO JONCRK__345A	1450	JONCRK AUTOTRANSFORMER A1 AND SINGLE 42500-42530(18): 42500 - 42530 <CKT 18> DOW_____345A TO JONCRK__345A	66.7 %	72.1 % (0x)	73.4 % (0x)	74.8 % (0x)
5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	1450	BELAIR AUTOTRANSFORMER A5 AND SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	76.7 % (0x)	85.5 % (0x)	86.7 % (0x)	98.9 % (0x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1450	BELAIR AUTOTRANSFORMER A5 AND SINGLE 5915-42530(27): 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	76.7 % (0x)	85.5 % (0x)	86.7 % (0x)	98.9 % (0x)

Table 7-10: Bridge the Gap – Voltage Results (in p.u.) under CNP Planning Event P6

BUSES	Nominal Voltage	Contingency	Bridge the Gap			
			2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case
42500 DOW_____345A	345KV	GRNBYU AUTOTRANSFORMER A2 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	0.98074 (0x)	0.97134 (0x)	0.96782 (0x)	Did Not Converge (86x)
42530 JONCRK__345A	345KV		0.98266 (0x)	0.97420 (0x)	0.97067 (0x)	Did Not Converge (86x)
42540 JONCRK__138A	138KV	BUS 49062: 42500 - 42510 <A1> DOW AUTOTRANSFORMER A1 AND P7-1_E1>>4848K-CB1: 42540 - 43440 <CKT &1> JONCRK__138A TO CORTEZ__138X & 43155 - 43440 <CKT 48> MARINE_138X TO CORTEZ__138X	1.06448 (427x)	1.06060 (81x)	1.05935 (60x)	1.04467 (0x)
42645 FREEPT_L138X	138KV		1.06541 (309x)	1.05997 (48x)	1.05870 (47x)	1.04409 (0x)
43155 MARINE_138X	138KV		1.06136 (43x)	1.05649 (7x)	1.05526 (2x)	1.03930 (0x)
43220 SW_SD_TAP02	138KV		1.06443 (362x)	1.05990 (68x)	1.05865 (56x)	1.04395 (0x)
43315 SURFSI_L138X	138KV		1.06484 (98x)	1.05966 (47x)	1.05839 (47x)	1.04319 (0x)
43360 VLASCO__138A	138KV		1.06452 (65x)	1.05966 (47x)	1.05843 (34x)	1.04253 (0x)
44205 BRYAN__R59_8	138KV		1.06530 (309x)	1.05986 (48x)	1.05856 (47x)	1.04395 (0x)

Table 7-11: Bridge the Gap – Voltage Results (in p.u.) under CNP Planning Event P6 – 120 MVAr capacitor bank at Jones Creek off

BUSES	Nominal Voltage	Contingency	Switch off 120MVAr Capbank @ Jones Creek			
			2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case
42540 JONCRK__138A	138KV	BUS 49062: 42500 - 42510 <A1> DOW AUTOTRANSFORMER A1 AND P7-1_E1>>4848K-CB1: 42540 - 43440 <CKT &1> JONCRK__138A TO CORTEZ__138X & 43155 - 43440 <CKT 48> MARINE_138X TO CORTEZ__138X	1.05292 (7x)	1.04802 (0x)	1.04728 (0x)	1.03301 (0x)
42645 FREEPT_L138X	138KV		1.05459 (7x)	1.04808 (0x)	1.04733 (0x)	1.03365 (0x)
43155 MARINE_138X	138KV		1.05170 (1x)	1.04576 (0x)	1.04508 (0x)	1.03039 (0x)
43220 SW_SD_TAP02	138KV		1.05296 (7x)	1.04816 (0x)	1.04742 (0x)	1.03239 (0x)
43315 SURFSI_L138X	138KV		1.05455 (6x)	1.04830 (0x)	1.04757 (0x)	1.03344 (0x)
43360 VLASCO__138A	138KV		1.05489 (2x)	1.04896 (0x)	1.04829 (0x)	1.03364 (0x)
44205 BRYAN__R59_8	138KV		1.05447 (7x)	1.04797 (0x)	1.04719 (0x)	1.03350 (0x)

7.1.8 Bridge the Gap Upgrades – CNP Planning Event P7

Thermal loading and voltage results under CNP Planning Event P7 are shown below in Table 7-12 and Table 7-13. Voltage results with a 120 MVAr capacitor bank turned off at Jones Creek are shown below in Table 7-14.

Table 7-12: Bridge the Gap – Thermal Loading Results (percent loading) under CNP Planning Event P7

Branch Loading	Rating (MVA) Rate B	Contingency	Bridge the Gap 2019 Minimum Case	Bridge the Gap 2019 Summer Peak Case	Bridge the Gap 2020 Summer Peak Case	Bridge the Gap 2021 Summer Peak Case
42500 - 43035 <CKT 27> DOW____345A TO OASIS___345A	1195	P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	70.8 % (0x)	80.5 % (0x)	81.0 % (0x)	Did Not Converge (2x)
42500 - 43035 <CKT 18> DOW____345A TO OASIS___345A	1195		70.8 % (0x)	80.5 % (0x)	81.0 % (0x)	Did Not Converge (2x)
42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	1450	P7-1_E1>>T6472D: 44000 - 44200 <CKT 64> W_A_P___345A TO HILLJE__345A & 44005 - 44040 <CKT 72> W_A_P___345B TO BAILEY_POI_5	41.6 % (0x)	53.6 % (0x)	54.8 % (0x)	55.1 % (0x)
42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	1450		41.6 % (0x)	53.6 % (0x)	54.8 % (0x)	55.1 % (0x)
5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	1450		63.5 % (0x)	80.6 % (0x)	82.0 % (0x)	91.4 % (0x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1450		63.5 % (0x)	80.6 % (0x)	82.0 % (0x)	91.4 % (0x)

Table 7-13: Bridge the Gap – Voltage Results (in p.u.) under CNP Planning Event P7

BUSES	Nominal Voltage	Contingency	Bridge the Gap 2019 Minimum Case	Bridge the Gap 2019 Summer Peak Case	Bridge the Gap 2020 Summer Peak Case	Bridge the Gap 2021 Summer Peak Case
42530 JONCRK__345A	345KV	P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	0.98406 (0x)	0.97889 (0x)	0.97752 (0x)	Did Not Converge (2x)
42500 DOW____345A	345KV		0.98214 (0x)	0.97601 (0x)	0.97465 (0x)	Did Not Converge (2x)
42540 JONCRK__138A	138KV	P7-1_E1>>4848K-CB1: 42540 - 43440 <CKT &1> JONCRK__138A TO CORTEZ__138X & 43155 - 43440 <CKT 48> MARINE_138X TO CORTEZ__138X	1.05940 (5x)	1.05585 (1x)	1.05461 (1x)	1.04245 (0x)
42645 FREEPT_L138X	138KV		1.05820 (4x)	1.05436 (1x)	1.05308 (1x)	1.04011 (0x)
43220 SW_SD_TAP02	138KV		1.05941 (4x)	1.05520 (1x)	1.05396 (1x)	1.04176 (0x)
43315 SURFSI_L138X	138KV		1.05644 (1x)	1.05285 (1x)	1.05158 (1x)	1.03820 (0x)
43360 VLASCO__138A	138KV		1.05465 (1x)	1.05137 (1x)	1.05013 (1x)	1.03629 (0x)
44205 BRYAN__R59_8	138KV		1.05809 (4x)	1.05425 (1x)	1.05294 (1x)	1.04011 (0x)

Table 7-14: Bridge the Gap – Voltage Results (in p.u.) under CNP Planning Event P7 – 120 MVAr Capacitor Bank at Jones Creek off

BUSES	Nominal Voltage	Contingency	Switch off 120MVAr Capbank @ Jones Creek			
			2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case
42540 JONCRK__138A	138KV	P7-1_E1>>4848K-CB1: 42540 - 43440 <CKT &1> JONCRK__138A TO CORTEZ__138X & 43155 - 43440 <CKT 48> MARINE_138X TO CORTEZ__138X	1.04942 (0x)	1.04483 (0x)	1.04409 (0x)	1.03172 (0x)
42645 FREEPT_L138X	138KV		1.04930 (0x)	1.04457 (0x)	1.04382 (0x)	1.03076 (0x)
43220 SW_SD_TAP02	138KV		1.04951 (0x)	1.04502 (0x)	1.04428 (0x)	1.03112 (0x)
43315 SURFSI_L138X	138KV		1.04816 (0x)	1.04376 (0x)	1.04303 (0x)	1.02964 (0x)
43360 VLASCO__138A	138KV		1.04713 (0x)	1.04315 (0x)	1.04247 (0x)	1.02870 (0x)
44205 BRYAN__R59_8	138KV		1.04919 (0x)	1.04446 (0x)	1.04368 (0x)	1.03062 (0x)

7.1.9 Bridge the Gap Upgrades – SVC Unavailability Scenario

Thermal loading and voltage results under SVC Unavailability Scenario are shown below in Table 7-15 and Table 7-16. Voltage results with a 120 MVAr capacitor bank turned off at Jones Creek are shown below in Table 7-17.

Table 7-15: Bridge the Gap – Thermal Loading Results (percent loading) under SVC Unavailability Scenario

Branch Loading	Rating (MVA)	Contingency	Bridge the Gap			
	Rate B		2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case
42500 - 43035 <CKT 27> DOW_____345A TO OASIS___345A	1195	JONCRK__138A TO JONCRK_SVC1 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	70.8 % (0x)	80.5 % (0x)	81.0 % (0x)	Did Not Converge (2x)
42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	1195		70.8 % (0x)	80.5 % (0x)	81.0 % (0x)	Did Not Converge (2x)
42500 - 42530 <CKT 27> DOW_____345A TO JONCRK__345A	1450	JONCRK__138A TO JONCRK_SVC1 AND SINGLE 42500-42530(18): 42500 - 42530 <CKT 18> DOW_____345A TO JONCRK__345A	62.4 % (0x)	67.2 % (0x)	68.4 % (0x)	68.3 % (0x)
42500 - 42530 <CKT 18> DOW_____345A TO JONCRK__345A	1450	JONCRK__138A TO JONCRK_SVC1 AND SINGLE 42500-42530(27): 42500 - 42530 <CKT 27> DOW_____345A TO JONCRK__345A	62.4 % (0x)	67.2 % (0x)	68.4 % (0x)	68.3 % (0x)
5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	1450	JONCRK__138A TO JONCRK_SVC1 AND SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	76.4 % (0x)	85.0 % (0x)	86.1 % (0x)	99.0 % (0x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1450	JONCRK__138A TO JONCRK_SVC1 AND SINGLE 5915-42530(27): 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	76.4 % (0x)	85.0 % (0x)	86.1 % (0x)	99.0 % (0x)

Table 7-16: Bridge the Gap – Voltage Results (in p.u.) under SVC Unavailability Scenario

BUSES	Nominal Voltage	Contingency	Bridge the Gap 2019 Minimum Case	 2019 Summer Peak Case	 2020 Summer Peak Case	 2021 Summer Peak Case
42500 DOW_____345A	345KV	JONCRK__138A TO JONCRK_SVC1 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18>	0.98214 (0x)	0.95409 (0x)	0.95212 (0x)	Did Not Converge (2x)
42530 JONCRK__345A	345KV	SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	0.98406 (0x)	0.95639 (0x)	0.95441 (0x)	Did Not Converge (2x)
42540 JONCRK__138A	138KV	JONCRK__138A TO JONCRK_SVC1 AND P7-1_E1>>4848K-CB1: 42540 - 43440 <CKT &1> JONCRK__138A TO CORTEZ__138X & 43155 - 43440 <CKT 48> MARINE_138X TO CORTEZ__138X	1.05940 (8x)	1.05585 (1x)	1.05461 (1x)	1.04240 (0x)
42645 FREEPT_L138X	138KV		1.05820 (6x)	1.05436 (1x)	1.05308 (1x)	1.04007 (0x)
43220 SW_SD_TAP02	138KV		1.05941 (7x)	1.05520 (1x)	1.05396 (1x)	1.04166 (0x)
43315 SURFSI_L138X	138KV		1.05644 (1x)	1.05285 (1x)	1.05158 (1x)	1.03817 (0x)
43360 VLASCO__138A	138KV		1.05465 (1x)	1.05137 (1x)	1.05013 (1x)	1.03626 (0x)
44205 BRYAN__R59_8	138KV		1.05809 (6x)	1.05425 (1x)	1.05294 (1x)	1.03993 (0x)

Table 7-17: Bridge the Gap – Voltage Results (in p.u.) under SVC Unavailability Scenario – 120 MVAr Capacitor Bank at Jones Creek off

BUSES	Nominal Voltage	Contingency	Switch off 120MVAr Capbank @ Jones Creek 2019 Minimum Case	 2019 Summer Peak Case	 2020 Summer Peak Case	 2021 Summer Peak Case
42540 JONCRK__138A	138KV	JONCRK__138A TO JONCRK_SVC1 AND P7-1_E1>>4848K-CB1: 42540 - 43440 <CKT &1> JONCRK__138A TO CORTEZ__138X & 43155 - 43440 <CKT 48> MARINE_138X TO CORTEZ__138X	1.04942 (0x)	1.04483 (0x)	1.04409 (0x)	1.03165 (0x)
42645 FREEPT_L138X	138KV		1.04930 (0x)	1.04457 (0x)	1.04382 (0x)	1.03070 (0x)
43220 SW_SD_TAP02	138KV		1.04951 (0x)	1.04502 (0x)	1.04428 (0x)	1.03099 (0x)
43315 SURFSI_L138X	138KV		1.04816 (0x)	1.04376 (0x)	1.04303 (0x)	1.02959 (0x)
43360 VLASCO__138A	138KV		1.04713 (0x)	1.04315 (0x)	1.04247 (0x)	1.02865 (0x)
44205 BRYAN__R59_8	138KV		1.04919 (0x)	1.04446 (0x)	1.04368 (0x)	1.03056 (0x)

7.1.10 Bridge the Gap Upgrades – Maintenance Outage Scenario

Thermal loading and voltage results under the Maintenance Outage Scenario are shown below in Table 7-18, Table 7-19 and Table 7-20.

Table 7-18: Bridge the Gap – Non Converging Contingencies under Maintenance Outage Scenario

Contingency	Bridge the Gap			
	2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case
SO_TEX__345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>T1827_18RADIAL: DOW_____345A TO OASIS___345A <CKT18> DOW_____345A TO OASIS___345A <CKT 27> OASIS___345A TO W_A_P___345A <CKT 18>	Did Not Converge (2x)	Did Not Converge (4x)	Did Not Converge (4x)	Did Not Converge (31x)
SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T1827_18RADIAL: DOW_____345A TO OASIS___345A <CKT18> DOW_____345A TO OASIS___345A <CKT 27> OASIS___345A TO W_A_P___345A <CKT 18>	Did Not Converge (2x)	Did Not Converge (4x)	Did Not Converge (4x)	Did Not Converge (31x)

Table 7-19: Bridge the Gap – Thermal Loading Results (percent loading) under Maintenance Outage Scenario

Branch Loading	Rating (MVA)	Contingency	Bridge the Gap			
			2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case
42500 - 43035 <CKT 27> DOW_____345A TO OASIS___345A	1195	DOW_____345A TO OASIS___345A <CKT 18> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	173.1 % (1x)	Did Not Converge (4x)	Did Not Converge (4x)	Did Not Converge (31x)
42500 - 43035 <CKT 18> DOW_____345A TO OASIS___345A	1195		173.1 % (1x)	Did Not Converge (4x)	Did Not Converge (4x)	Did Not Converge (31x)
42150 - 42810 <CKT 02> BASF____138A TO HOFMAN__138X	280		159.5 % (4x)	Did Not Converge (4x)	Did Not Converge (4x)	Did Not Converge (31x)
42810 - 42880 <CKT 02> HOFMAN__138X TO LKJACK__138A	280		161.3 % (4x)	Did Not Converge (4x)	Did Not Converge (4x)	Did Not Converge (31x)
42110 - 43300 <CKT 26> ANGLTN__138A TO STRATT__138A	220		129.0 % (2x)	Did Not Converge (4x)	Did Not Converge (4x)	Did Not Converge (31x)
5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	1450	SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T6472D: W_A_P___345A TO HILLJE__345A <CKT 64> W_A_P___345B TO BAILEY_POI_5 <CKT 72>	95.9 % (0x)	123.5 % (3x)	125.8 % (4x)	Did Not Converge (31x)
		SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T1899_27RADIAL: OASIS___345A TO W_A_P___345A <CKT 18> OASIS___345A TO W_A_P___345A <CKT 99> DOW_____345A TO OASIS___345A <CKT 27>	113.1 % (1x)	116.3 % (3x)	115.2 % (4x)	Did Not Converge (31x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1450	SO_TEX__345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>T6472D: W_A_P___345A TO HILLJE__345A <CKT 64> W_A_P___345B TO BAILEY_POI_5 <CKT 72>	95.9 % (0x)	123.5 % (3x)	125.8 % (4x)	Did Not Converge (31x)
		SO_TEX__345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>T1899_27RADIAL: OASIS___345A TO W_A_P___345A <CKT 18> OASIS___345A TO W_A_P___345A <CKT +K69+K67	113.1 % (1x)	116.3 % (3x)	115.2 % (4x)	Did Not Converge (31x)
43035 - 44000 <CKT 18> OASIS___345A TO W_A_P___345A	1450	OASIS___345A TO W_A_P___345A <CKT 99> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	136.3 % (1x)	123.2 % (1x)	125.0 % (1x)	Did Not Converge (31x)
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173	OASIS___345A TO W_A_P___345A <CKT 18> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	168.2 % (9x)	152.1 % (1x)	154.3 % (1x)	Did Not Converge (31x)

Table 7-20: Bridge the Gap – Voltage Results (in p.u.) under Maintenance Outage Scenario

BUSES	Nominal Voltage	Contingency	Bridge the Gap			
			2019 Minimum Case	2019 Summer Peak Case	2020 Summer Peak Case	2021 Summer Peak Case
42530 JONCRK__345A	345KV	DOW_____345A TO OASIS___345A <CKT 18> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	0.65581 (2x)	Did Not Converge (4x)	Did Not Converge (4x)	Did Not Converge (31x)
42500 DOW_____345A	345KV	DOW_____345A TO OASIS___345A <CKT 27> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	0.65442 (2x)	Did Not Converge (4x)	Did Not Converge (4x)	Did Not Converge (31x)

7.1.11 Bridge the Gap Upgrades – Summary of Initial Analysis Results

Results under CNP Planning Events P1, P2, P3, P6, P7, and SVC Unavailability Scenario

For the 2019 and 2020 case, except for a slight loading concern on 345 kV Oasis – WAP circuit 99 in the 2019 Minimum case, all thermal loading and low voltage concerns under CNP Planning Event P1, P2, P3, P6, P7, and SVC Unavailability Scenario are solved by the Bridge the Gap upgrades proposed in Section 7 above. For the 2021 case, the case failed to find a solution under any contingency that resulted in the loss of both 345 kV STP – Jones Creek circuits.

High voltage concerns under contingency can be mitigated by switching off a capacitor bank at Jones Creek. This process can be automated by modifying one of the original static capacitor banks into an automatically switched capacitor bank capable of coming off-line without operator interaction.

Results under Maintenance Outage Scenario

Under maintenance outage conditions, the case fails to find a solution under planned outage of one of the four 345 kV circuits serving the Freeport Area, followed by a P7 common tower loss of two of the remaining three 345 kV circuits in the area. This situation leaves all load in the Freeport Area being served from a single 345 kV circuits resulting in a potential voltage collapse, even with the 560 MVAr of capacitive reactive additions to support voltage.

Results of the maintenance outage condition reiterate that the Bridge the Gap solution is an interim solution until a new double-circuit 345 kV line can be built. Even if no additional load growth beyond that already committed to be in-service in 2019 occurs in the Freeport Area, performing maintenance on any of the four 345 kV circuits in the area could potentially result in a voltage collapse condition under the next P7 common tower contingency outage. In summary, the Bridge the Gap set of projects are just that, projects that can be implemented in a short time frame to solve P1-P7 Planning Events with the loads expected by 2019, but does not allow additional Freeport Area load growth and provides no ability to ease concerns around taking 345 kV maintenance outages in this highly industrialized area.

7.1.12 Bridge the Gap Upgrades – Stability Analysis

The steady-state analysis for the 2019-2020 Bridge the Gap transition period (Section 7), determined that under certain contingencies an additional 200 MVAr in capacitive support is needed at Jones Creek 138 kV to alleviate low voltages conditions, while slight overvoltage could be expected for the loss of the two circuits connected to CORTEZ substation, a fault that would disconnect the supply to the 650 MW Freeport LNG load.

Several technical solutions are feasible to solve these voltages concerns, among them:

- Automatic switch shunts at Jones Creek 138 kV: This option would consist of two additional 100 MVAr or higher fast mechanical switchable capacitor banks.
- Two dynamic devices such as SVC's or STATCOM's with leading and lagging reactive power capability. Dynamic devices are of particular interest if there is slow voltage recovery in the area, but are not commonly used as steady-state alternatives unless there are other potential concerns, such as the protection coordination and control of the three switchable capacitors.
- Two synchronous condensers at Jones Creek 138 kV Substation
- Two 2 x 100 MVAr Thyristor-switched capacitors (TSC) and a controlled mechanical switchable capacitor in lieu of one of the proposed fixed 120 MVAr capacitor banks at Jones Creek 138 kV.

After discussions with several equipment vendors, CenterPoint Energy decided not to move forward with the synchronous condenser alternative due to cost and required installation footprint.

7.1.12.1 Methodology and Study Assumptions

CenterPoint Energy performed this study using Siemens PTI's PSS®E and Powertech TSAT transient stability software. The procedure is discussed in the following sections.

7.1.12.2 Contingencies Description

Contingencies from the steady-state analysis were selected for further dynamic simulations. Specifically, CNP Planning Events P1-P3 and P5-P7 were reviewed to identify those contingencies within each category that may cause the lowest/highest voltage conditions.

The selected contingencies are described in Table 7-21.

Table 7-21: Transient Stability Contingencies

Fault No.	Fault id	Event Description	Open Circuits
1	FLT-P1-Dow_JCREEK	3-Phase Fault at Dow 345 kV	Dow to Jones Creek 345 kV
2	FLT-P2-DOW A6- DOW - JCREEK	3-Phase Fault at Dow 345 kV	DOW Autotransformer A6 and Dow to Jones Creek 345 kV
3	FLT-LOSS_LNG	3-Phase Fault at Cortez 138 kV	Jones Creek to Cortez 138 kV and Marine to Cortez 138 kV, loss of inline 160 MVAr
4	FLT-WAP_P7-STP_JC	3-Phase Fault at STP 345 kV Previous outage WAP_G6	STP-Jones Creek 345 kV ckt 18 and ckt 27
5	FLT-WAP_P7-STP_JC_FJC	3-Phase Fault at Jones Creek 345 kV Previous outage WAP_G6	STP -Jones Creek 345 kV ckt 18 and ckt 27
6	FLT-WAP_P7-STP_DOW_JC_DOW	3-Phase Fault at DOW 345 kV Previous outage WAP_G6	DOW-Jones Creek 345 kV ckt 18 and ckt 27
7	FLT-P6_THW_A3_STP_JCREEK	3-Phase Fault at Jones Creek 345 kV	STP-Jones Creek 345 kV ckt 18 and ckt 27 and THW Autotransformer A3
8	FLT-CHEST_P7-STP_JC_FJC	3-Phase Fault at Jones Creek 345 kV Previous outage CHEST1	STP-Jones Creek 345 kV ckt 18 and ckt 27
9	FLT-WAP_P7-JC_DOW_FJC	3-Phase Fault at Jones Creek 345 kV Previous outage WAP_G6	DOW-Jones Creek 345 kV ckt 18 and ckt 27
10	FLT-DOW_2_units_P7-STP_JC_FJC	3-Phase Fault at STP 345 kV Previous outage Dow ST84 And GT83	STP-Jones Creek 345 kV ckt 18 and ckt 27
11	FLT-DOW_1_units_P7-STP_JC_FJC	3-Phase Fault at STP 345 kV Previous outage Dow ST84	STP-Jones Creek 345 kV ckt 18 and ckt 27
12	FLT-OASIS_P7-STP_JC	3-Phase Fault at STP 345 kV Previous outage WAP_G6	STP-Jones Creek 345 kV ckt 18 and ckt 27 and OASIS-DOW ckt 18
13	FLT-P6x-DOW A1- FLT-LOSS_LNG	3-phase fault at Cortez previous outage DOW Auto A1	Jones Creek to Cortez 138 kV and Marine to Cortez 138 kV

Three phase faults with clearing times consistent with Table 7-22 below, were applied. This conservative approach for CNP Planning Event P2 was deemed reasonable to allow an extra security margin in the proposed solution.

The existing UVLS program settings in Table 7-23, were used and modeled in the simulation to verify if the low voltages activate any UVLS relays causing load shed and to ensure that system performance is consistent with TPL-001-4 performance requirements and meet ERCOT voltage response criteria and voltage ride-through requirements.

For each simulation, the total load shed due to the existent UVLS relay operation as described in Table 7-23 was recorded.

Table 7-22: Fault Clearing Times

Voltage Level (kV)	Clearing Time (cycles)	
	Normal	Delayed (Due to Breaker Failure)
345	5	10
138	6	12
69	8	18

Table 7-23: Existing UVLS Voltage Set Points and timing

	Undervoltage Threshold (p.u.)	Time Delay (s)
Block 1	0.91	3
Block 2	0.91	5
Block 3	0.91	8

7.1.12.3 TPL-001-4 Transient Voltage Criteria

Transient voltage response in accordance with ERCOT Planning Guide Section 4.1.1.5 was followed in the analysis:

- For P1 contingencies, system voltage should recover to 90% within 5 seconds
- For P2-P7 contingencies, system voltage should recover to 90% within 10 seconds

7.1.12.4 Topology Modification

CenterPoint Energy performed all transient stability analysis using the ERCOT 2020 Summer Peak flat start case created by the ERCOT Dynamics Working Group (DWG). The load flow case was modified by disconnecting the mothballed units at Capitol Cogen and by applying System Study 2018 and 2019-2020 topology changes as described in Section 4.

CenterPoint Energy's UVLS dynamic file (CNP_UVLS_relay_PTI_2015_FINAL.DYR) corresponding with the 2020 Summer Peak flat start case was used in the simulation. The over-excitation limiter (OEL) model MAXEX2 was applied for all generators. This model corresponds to an OEL that acts at the voltage reference of the excitation system with an inverse time characteristic. Special consideration is given to the load model as described below as it can have a significant effect on the voltage recovery in the area.

7.1.12.5 Dynamic Load Modeling Development Process

CenterPoint Energy load was modeled using a composite load model where load characteristics described by percentage of Motor A, B, C, D, Electronic, and Static for each type of load component are assigned using EPRI's Load Component Export Tool and CenterPoint Energy load composition data.

For purposes of this study, the most significant three-phase induction machine parameters are the mechanical load torque characteristic exponent and the under voltage tripping thresholds, fractions of load to be tripped, and time delays. Motor A represents three-phase induction motors with low inertia (H = 0.1 sec) driving constant torque loads. This represents motors commonly found in commercial/industrial air conditioning compressors and refrigeration systems. Motor B represents three-phase induction motors with high inertia (H = 0.25-1.0 sec) driving loads whose torque is proportional to speed squared. This represents motors commonly found in commercial ventilation fans and air-handling systems. Motor C represents three-phase induction motors with low inertia (H = 0.1-0.2 sec) driving loads whose torque is proportional to speed squared. This represents motors commonly found in commercial water circulation pumps in central cooling systems. Motor D is a single phase air conditioner model, these motors stall when voltage drops below a set value and a portion of these motors restart when voltage recovers.

The composite load model allows for modeling of embedded under voltage tripping relays for Motors A, B and C. Since CenterPoint Energy does not possess information about its customer's under voltage settings, and modeling of this internal protection affects the amount of load shed by the existing UVLS scheme, all the transient stability studies were performed with and without modeling motor under voltage relays. When modeling with embedded under voltage motor protection, typical voltage and time setting parameters were utilized. These voltage and time setting parameters, as well as additional information of the composite load model are given in Appendix B.

Freeport LNG load was modeled as constant PQ load which is a conservative approach for voltage recovery studies. In general, the VFD will block for voltage sags below 0.7 p.u. and drive de-blocking upon grid fault clearing when voltage recovers to 0.92 p.u. After voltage recovery, according to their documentation, the drive should synchronize in less than 100 msec. Another option to model the Freeport VFD load is as a 100% electronic load inside the composite load model. This approach was verified by CenterPoint Energy as being less conservative than the constant PQ approach because it provided faster voltage recovery.

7.1.12.6 Selection of Reactive Compensation Device

The contingency analysis results in Section 6 show that under P3 contingencies or loss of a generator and a common tower outage, in particular the tower outage of the 345 kV STP – Jones Creek circuits 18 and 27, the voltage at some 345 kV buses in the Freeport Area are below 0.92 p.u. As additional capacitive compensation in the order of 200 MVAr was identified to eliminate post-contingency steady-state voltage concerns, the question arises about the type of capacitive compensation to be chosen. Either a dynamic device in the form of a TSC, SVC, or STATCOM, or static devices such as fast switchable capacitor banks is needed to resolve the expected post-contingency slow voltage recovery in this mostly industrial area.

For the first generator outage of the P3 contingency, two reasonable and realistic load flow scenarios based on the 2020 Summer Peak Case from the Bridge the Gap Analysis without the additional compensation in the area were identified. Both scenarios were evaluated using PSS®E Transient Stability Program:

- Year 2020 Bridge the Gap Base case with Dow steam unit ST84 out-of-service (227.5 MVA, Pmax = 80 MW, Qmax = 100 MVAr) after being dispatched at full output in the Base Case. This steam unit is part of a combined cycle, with three more combustion turbines.
- Year 2020 Bridge the Gap Base case with Dow Steam unit ST84 and gas unit GT83 (116.8 MVA, Pmax = 70 MW Qmax= 43.3 MVAr) out-of-service. With both units having been dispatched at full output in the Base Case.

The outage of two DOW units goes beyond P3 criteria, but it represents a reasonable mode of operation of the Dow units. Post-contingency voltages are similar to the results reported for the loss of the W.A Parish unit; however, DOW unit outages were considered more critical for transient voltage recovery due to proximity to the Jones Creek 345 kV bus, approximately three miles away. These units can provide significant voltage support during transient conditions.

Transient Stability analysis was performed on both unit outage scenarios and for the Base Case with all the units online, followed by a 5 cycle three-phase fault at Jones Creek 345 kV and the loss of the circuits 18 and 27 from STP to Jones Creek 345 kV. Two different load models were used for each case, one load model has all the under-voltage protection of Motor A, B, and C disabled, only allowing for Motor D tripping due to overcurrent/temperature and another load model has them enabled according to typical settings as described in Appendix B. Figure 7-1 shows the behavior of the Jones Creek 345 kV bus in the absences of any additional compensation with the embedded protection disabled and Figure 7-2 when it is enabled.

Figure 7-1: Jones Creek 345 kV Voltage Comparison – No Protection model

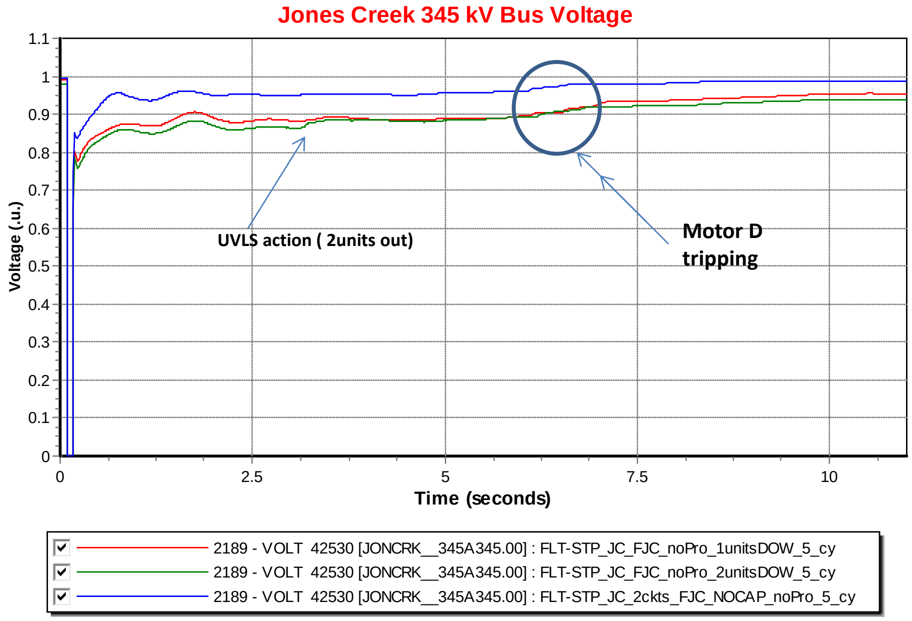


Figure 7-2: Jones Creek 345 kV Voltage Comparison – with Protection models

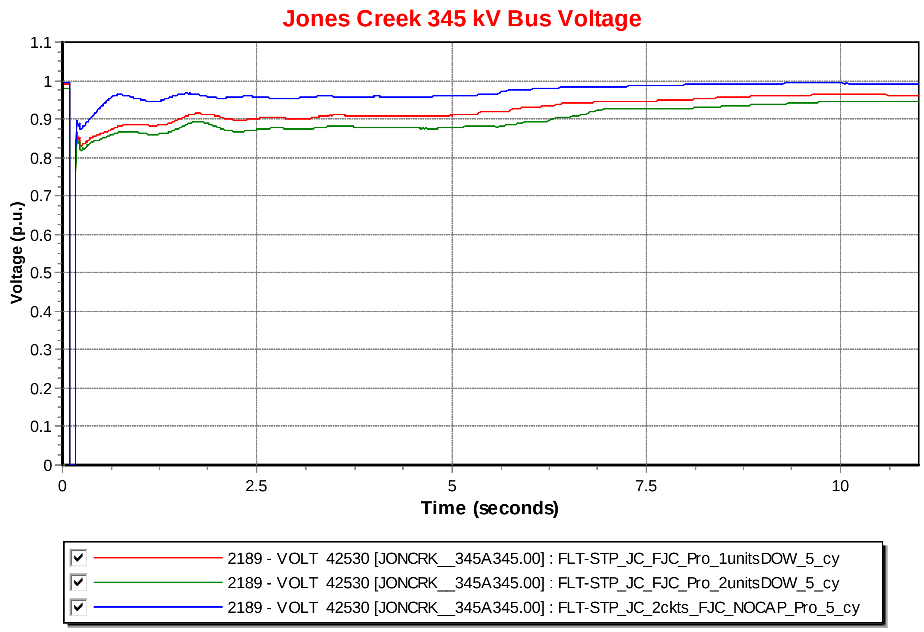


Figure 7-1 results shows for the No-protection case, a slow voltage recovery but within criteria for the Base Case with all the units on and with only one unit out. For these two cases voltage recovers above 0.9 p.u. mainly due to the tripping of some Motor D load. In the case with both DOW units out of service, it also recovers thanks to UVLS load tripping action at Brazosport and Motor D tripping due to overcurrent.

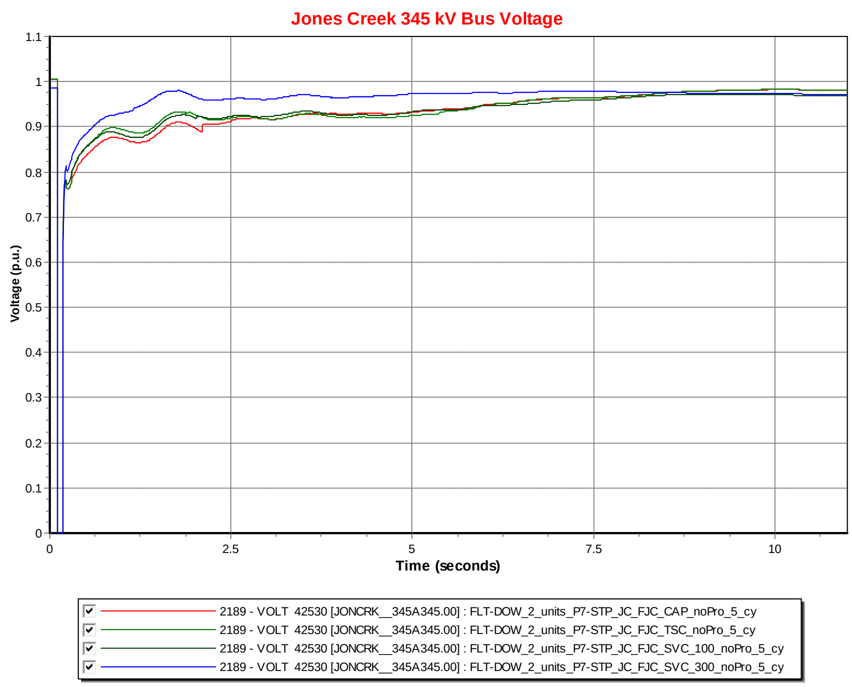
To avoid the action of UVLS and speed the voltage recovery, the following additional capacitive compensation options were connected to Jones Creek 345 kV bus and tested individually:

- 2 x 100 MVAr fast switched capacitor banks, which are modeled using PSS®E SWSHNT, switch-in 2 seconds
- 2 x 100 MVAr TSC, which are modeled using PSS®E SWSHNT, switch-in 0.2 seconds
- 2 x (+100/-100) MVAr SVC, modeled with standard PSS®E dynamic model SVSMO1U1
- 2 x (+300/-100) MVAr SVC, modeled with standard PSS®E dynamic model SVSMO1U1

It should be noted that a dynamic reactive device will not minimize the amount of load loss due to motor tripping during a three phase fault condition. The dynamic reactive device is effective in resolving post contingency voltage violations as shown in the plots for the different scenarios.

Figure 7-3 shows the Jones Creek 345 kV bus voltage for the different devices. The bus voltage recovers above 0.9 p.u. faster in the presence of additional compensation, no UVLS is activated in any case. For all the cases Motor D tripping is similar and is not as noticeable in the case with the larger SVC due to the additional reactive support. System performance using either the TSC's, fast switchable mechanical capacitor banks or 100 MVAr SVC is similar, proving that the capacitor size is more vital than instantaneous response of the device.

Figure 7-3: Jones Creek 345 kV – Bus voltage with 2x (100 MVAr) Capacitive Compensation Comparison



After considering the results, CenterPoint Energy selected the fast mechanical switch shunt option, based on system performance meeting ERCOT and CenterPoint Energy Transient Voltage Recovery criteria, cost and the fact that this is considered a "Bridge the Gap" solution that will be further enhanced when the new 345 kV line to the Freeport Area is energized.

As the load model is an important consideration in system performance, CenterPoint Energy proceeded to disable any motor tripping, including Motor D overload protection, and repeated the analysis for the same fault.

Figure 7-4 compares the Jones Creek bus voltage response with and without motor tripping. When the tripping is disabled, the final voltage for the Jones Creek 345 kV bus settles at 0.93 p.u., slightly above CenterPoint Energy voltage criteria of 0.92 p.u. Therefore, CenterPoint Energy decided to increase the capacitor size to 140 MVAr as the cost increase is not significant and as shown on Figure 7-5 provides better performance and builds margin for different operating conditions. Figure 7-6 shows final system performance comparison for the 140 MVAr capacitor bank with and without embedded protection.

Figure 7-4: Jones Creek 345 kV – Bus voltage with 2x (100 MVAr) Capacitive compensation Motor D model

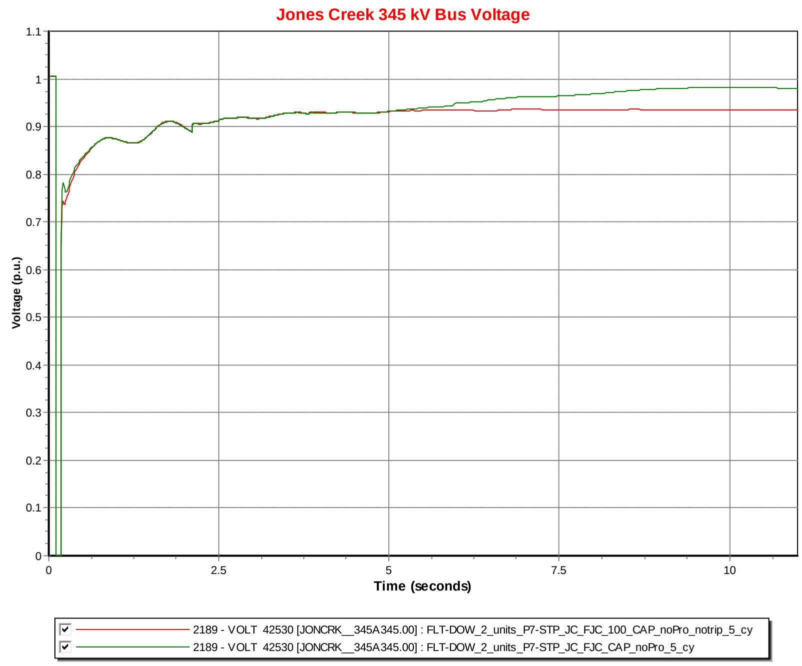


Figure 7-5: Jones Creek 345 kV – Bus voltage with different Fast Switch Capacitor sizes, 100 vs 140 MVAr.

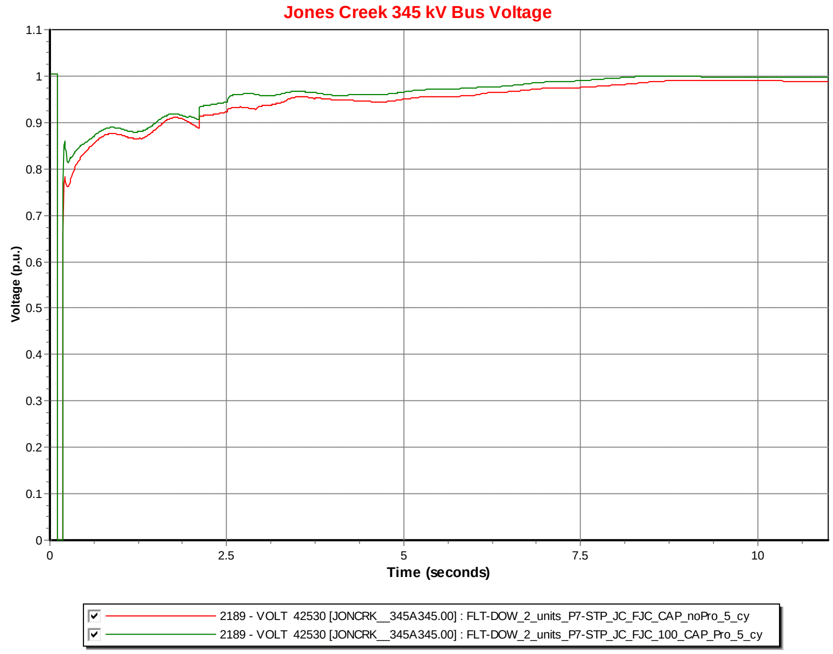
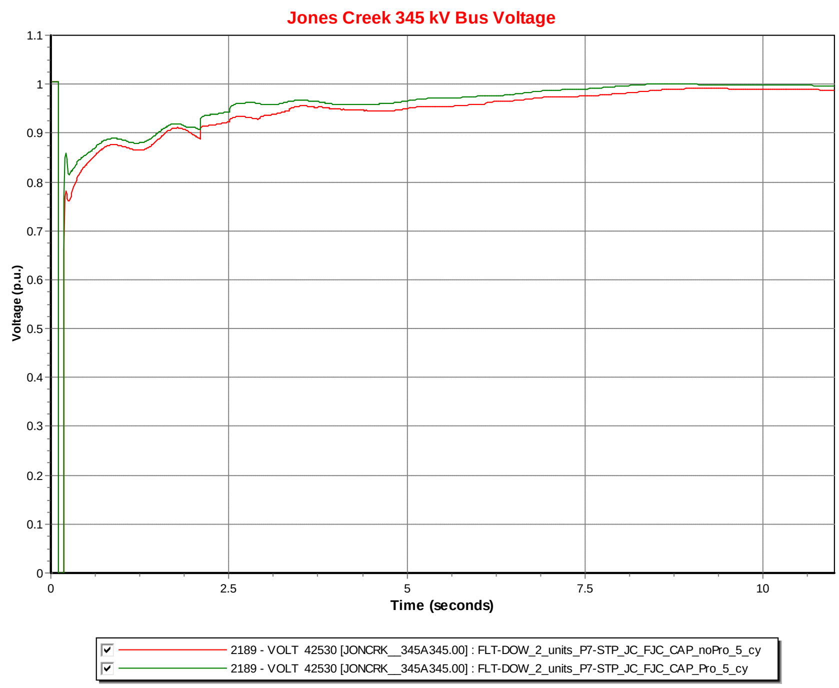


Figure 7-6: Jones Creek 345 kV – Voltage Bus, with and without Embedded Protection



7.1.12.7 Contingency Results

CenterPoint Energy performed transient stability analysis on all the contingencies listed in Table 7-18 and plots are shown in Appendix C. Table 7-24 presents the amount of load tripping with embedded protection, for all the faults described in Table 7-18. For all the faults under evaluation, no action of the existing UVLS in the area occurred.

Table 7-24: Motor Load Tripping all Faults

			WITH PROTECTION	
Fault id	**Event Description**	**Open Circuits**	**MW**	**MVAr**
FLT-P1-Dow_JCREEK	3-Phase Fault at Dow 345 kV	Dow to Jones Creek 345 kV	93	50
FLT-P2-DOW A6- DOW - JCREEK	3-Phase Fault at Dow 345 kV	DOW Autotransformer A6 and Dow to Jones Creek 345 kV	181	95
FLT-LOSS_LNG	3-Phase Fault at Cortez 138 kV	Jones Creek to Cortez 138 kV and Marine to Cortez 138 kV, loss of inline 160 MVAr	81	43
FLT-WAP_P7-STP_JC	3-Phase Fault at STP 345 kV Previous outage WAP_G6	STP-Jones Creek 345 kV ckt 18 and ckt 27	75	39
FLT-WAP_P7-STP_JC_FJC	3-Phase Fault at Jones Creek 345 kV Previous outage WAP_G6	STP -Jones Creek 345 kV ckt 18 and ckt 27	93	50
FLT-WAP_P7-STP_DOW_JC_DOW	3-Phase Fault at DOW 345 kV Previous outage WAP_G6	DOW-Jones Creek 345 kV ckt 18 and ckt 27	93	50
FLT-P6_THW_A3_STP_JCREEK	3-Phase Fault at Jones Creek 345 kV	STP-Jones Creek 345 kV ckt 18 and ckt 27 and THW Autotransformer A3	93	50
FLT-CHEST_P7-STP_JC_FJC	3-Phase Fault at Jones Creek 345 kV Previous outage CHEST1	STP-Jones Creek 345 kV ckt 18 and ckt 27	93	50
FLT-WAP_P7-JC_DOW_FJC	3-Phase Fault at Jones Creek 345 kV Previous outage WAP_G6	DOW-Jones Creek 345 kV ckt 18 and ckt 27	93	50
FLT-DOW_2_units_P7-STP_JC_FJC	3-Phase Fault at STP 345 kV Previous outage Dow ST84 And GT83	STP-Jones Creek 345 kV ckt 18 and ckt 27	93	50
FLT-DOW_1_units_P7-STP_JC_FJC	3-Phase Fault at STP 345 kV Previous outage Dow ST84	STP-Jones Creek 345 kV ckt 18 and ckt 27	93	50
FLT-OASIS_P7-STP_JC	3-Phase Fault at STP 345 kV Previous outage WAP_G6	STP-Jones Creek 345 kV ckt 18 and ckt 27 and OASIS-DOW ckt 18	75	39
FLT-P6x-DOW A1- FLT-LOSS_LNG	3-phase fault at Cortez previous outage DOW Auto A1	Jones Creek to Cortez 138 kV and Marine to Cortez 138 kV	132	74

7.1.12.8 Summary of Bridge the Gap Stability Analysis

Transient stability analysis indicated that rather than a dynamic reactive device, such as an SVC, fast automatically switched capacitor banks are sufficient to achieve desired voltage recovery.

7.1.13 Bridge the Gap Upgrades – Capacitor Bank Switching Study

Based on the results of the Stability Analysis, fast automatically switched capacitor banks are sufficient to achieve desired voltage recovery. A switching study was performed to determine the voltage rise when switching various size capacitor banks at the Jones Creek 138 kV bus. In accordance with CenterPoint Energy design criteria:

> "CenterPoint Energy designs its transmission system such that switching of its transmission capacitor banks or inductive reactors (static reactive devices) limits the momentary voltage change at a transmission bus to less than 2 % with the strongest source out of service for major buses (with three or more network transmission elements)."

The strongest sources at the Jones Creek 138 kV bus were determined to be:

- 138 kV Jones Creek – Velasco circuit 02, or
- Jones Creek 345/138 kV Autotransformer – only one of the Jones Creek Autotransformers was switched to perform the study

Results of the capacitor bank switching study are shown in Table 7-25

Table 7-25: Capacitor Bank Switching Study

Out of Service	Cap Bank (MVAr)	Initial Voltage	New Voltage	Voltage Rise
138 kV Jones Creek - Velasco circuit 02	100	1.0156	1.0266	1.09%
	120	1.0156	1.0289	1.31%
	140	1.0156	1.0311	1.53%
	160	1.0156	1.0334	1.75%
	180	1.0156	1.0356	1.97%
	200	1.0156	1.0379	2.20%
Jones Creek Autotransformer	100	1.0311	1.0425	1.11%
	120	1.0311	1.0448	1.33%
	140	1.0311	1.0471	1.56%
	160	1.0311	1.0495	1.79%
	180	1.0311	1.0518	2.01%
	200	1.0311	1.0542	2.24%

Based on the results of the switching study, a capacitor bank size of 160 MVAr results in a voltage rise of 1.75%-1.79% while providing a reasonable margin below 2%.

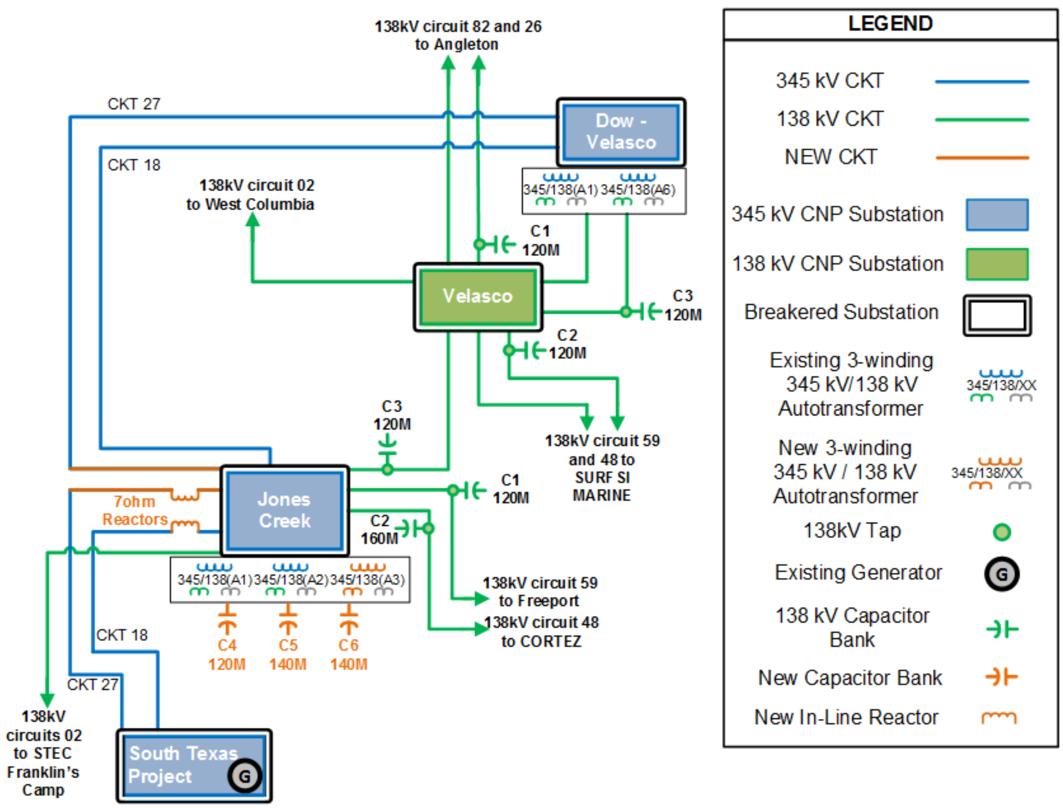
7.1.14 Bridge the Gap Upgrades – Final Solution

The results from the steady-state analysis indicated a change in at least one of the capacitor banks at Jones creek was needed from a fixed typed to switched type. The results from the Stability Analysis indicated that rather than a dynamic reactive device, such as an SVC, fast automatically switched capacitor banks are sufficient to achieve desired voltage recovery. Therefore, CenterPoint Energy selected the fast mechanical switch shunt option at Jones Creek and also decided to increase the capacitor size to 140 MVAr. Note: The 3rd 138 kV capacitor banks (secured by Dow) at Velasco and Jones Creek are shown as installed in Figure 7-7.

The Bridge the Gap Upgrades (Figure 7-7) include:

- Loop 345 kV South Texas Project (STP) – Dow-Velasco circuit 27 into the Jones Creek Substation (approximately 0.9 mile)
- Install 7-ohm in-line reactors at the Jones Creek Substation on 345 kV STP – Jones Creek circuits 18 and 27
- Install 3rd 345/138 kV 800/1000 MVA Autotransformer at the Jones Creek Substation
- Install 4th 138 kV Capacitor Bank (120 MVAr) at Jones Creek Substation
- Install 1st 138 kV Automatically Switchable Capacitor Bank (140 MVAr) at Jones Creek Substation
- Install 2nd 138 kV Automatically Switchable Capacitor Bank (140 MVAr) at Jones Creek Substation

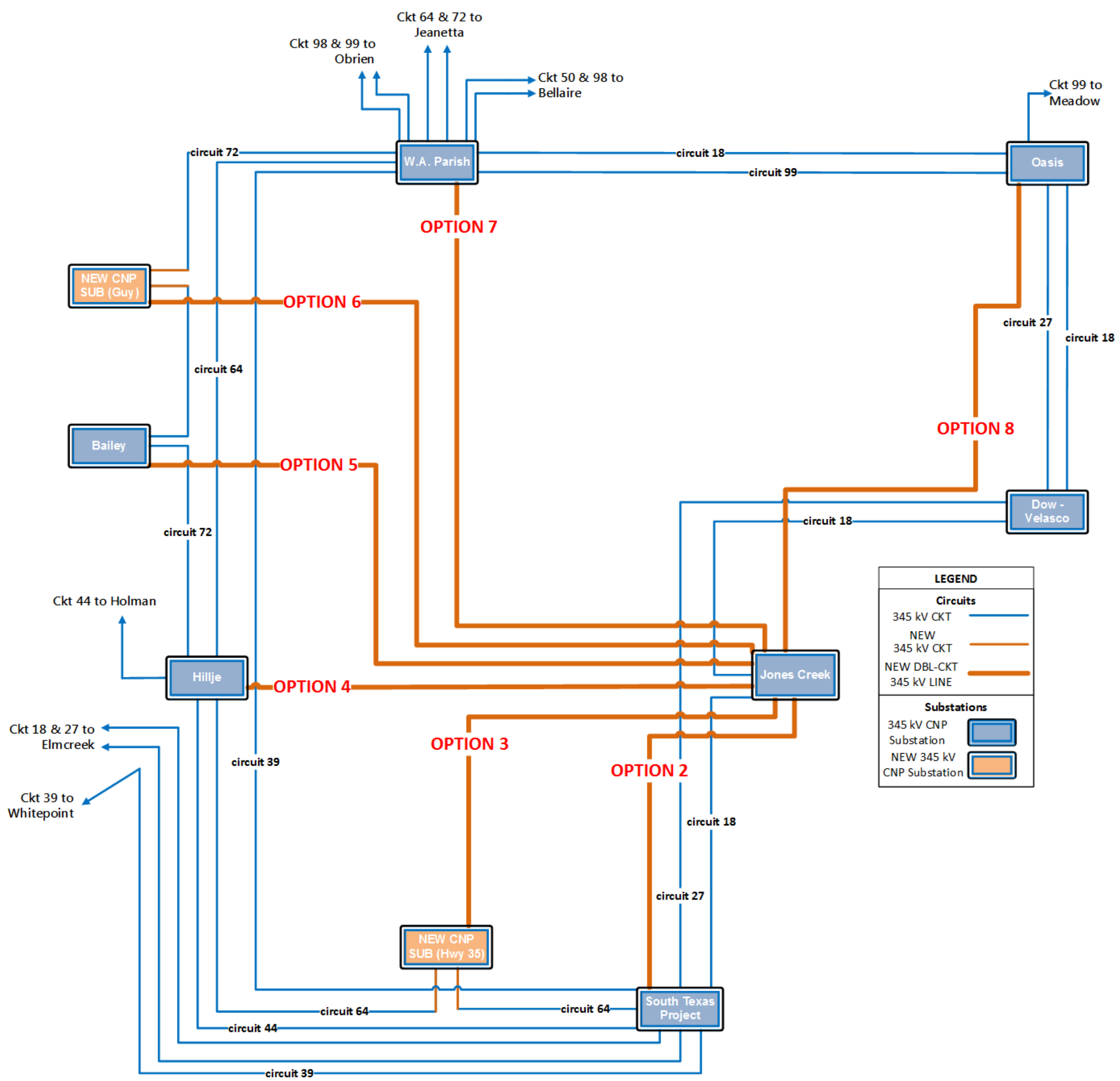
Figure 7-7: Bridge the Gap Upgrades – Final Solution



7.2 Long-Term Solution – New Transmission Line Options

Since the Bridge the Gap Upgrades alone, as detailed in Section 7.1, provide little margin for additional load growth and do not address the maintenance outage concerns, additional long-term improvements are needed including building a new 345 kV double-circuit line into the Freeport Area. This long-term solution will provide the ability to take 345 kV maintenance outages on circuits in the area and serve load additions in 2021 and beyond. Seven new 345 kV double-circuit line options (Figure 7-8) were identified to solve potential thermal loading and voltage concerns seen in the Freeport Area. All seven options terminate at the Jones Creek 345 kV Substation because the only other 345 kV substation in the Freeport Area (Dow-Velasco 345 kV Substation) has no room for further expansion.

Figure 7-8: New Line Options (Options 2 - 8)



For Options 2 through 8 the straight-line distance to Jones Creek Substation plus a 20 % adder was used to perform the study. The straight-line and total line distances to Jones Creek Substation including the 20 % adder are shown below in Table 7-26.

Table 7-26: Distance of New Line Options (Options 2 - 8)

Option	Description	Straight-Line Distance (miles)	20% adder (miles)	Total Line Distance (structure miles)
2	South Texas Project to Jones Creek	42	8.4	50.4
3	Hwy 35 area to Jones Creek	46	9.2	55.2
4	Hillje to Jones Creek	52	10.4	62.4
5	Bailey to Jones Creek	40	8	48
6	Guy/West Columbia area to Jones Creek	37	7.4	44.4
7	W.A. Parish to Jones Creek	39	7.8	46.8
8	Oasis to Jones Creek	35	7	42

The starting point for each New Line Option included the following:

- The Bridge the Gap final upgrades outlined in Section 7.1.14 were included.
- All autotransformers at Jones Creek and Dow-Velasco Substations allowed to tap (Vmin for autotransformers set to 1.0 p.u.)

Analysis was performed for all CNP Planning Events listed in Section 5. In addition, analysis was also performed for the following:

- Switched Capacitor Bank (SWCB) Unavailability Scenario which consists of an initial condition outage of one of the two Switchable Capacitor Banks (SWCB-1) followed by an (N-1) outage of any of the following: CNP Planning Event P1 or CNP Planning Event P7
- Maintenance Outage Scenario (consists of planned outage of a 345 kV line followed by the outage of a 345 kV circuit or 345 kV circuits sharing a common tower)
- Extreme Event Scenario

For the SWCB Unavailability Scenario, Maintenance Outage Scenario, and the Extreme Event Scenario, studies monitored Rate B (emergency rating) and a voltage range between 0.92 p.u. and 1.05 p.u.

7.2.1 New Line Options – CNP Planning Event P0

Under normal operating conditions, no base case thermal or voltage concerns were observed.

7.2.2 New Line Options – CNP Planning Event P1

Thermal loading and voltage results under CNP Planning Event P1 are shown below in Table 7-27 and Table 7-28.

Table 7-27: New Line Options – Thermal Loading Results (percent loading) under CNP Planning Event P1

Branch Loading	Rating (MVA) Rate A	Contingency	2021 Summer Peak Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	1450	SINGLE 42500-42530(27): 42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	99.1 % (0x)	96.4 % (0x)	97.3 % (0x)	100.5 % (1x)	93.5 % (0x)	87.5 % (0x)	79.6 % (0x)
42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	1450	SINGLE 42500-42530(18): 42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	99.1 % (0x)	96.4 % (0x)	97.3 % (0x)	100.5 % (1x)	93.6 % (0x)	87.5 % (0x)	79.6 % (0x)
Branch Loading	Rating (MVA) Rate A	Contingency	2022 Summer Peak Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	1450	SINGLE 42500-42530(27): 42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	101.1 % (1x)	98.3 % (0x)	99.1 % (0x)	102.1 % (1x)	95.0 % (0x)	88.9 % (0x)	80.6 % (0x)
42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	1450	SINGLE 42500-42530(18): 42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	101.1 % (1x)	98.3 % (0x)	99.1 % (0x)	102.1 % (1x)	95.0 % (0x)	88.9 % (0x)	80.6 % (0x)

Table 7-28: New Line Options – Voltage Results (in p.u.) under CNP Planning Event P1

BUSES	Nominal Voltage	Contingency	2021 Summer Peak Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42530 JONCRK__345A	345KV	SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1.00863 (0x)	0.99991 (0x)	0.99606 (0x)	1.00209 (0x)	0.99535 (0x)	0.99347 (0x)	0.99646 (0x)
42500 DOW____345A	345KV		1.00563 (0x)	0.99720 (0x)	0.99344 (0x)	0.99921 (0x)	0.99262 (0x)	0.99066 (0x)	0.99401 (0x)
BUSES	Nominal Voltage	Contingency	2022 Summer Peak Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42530 JONCRK__345A	345KV	SINGLE 5915-42530(18): 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1.00720 (0x)	0.99789 (0x)	0.99378 (0x)	1.00048 (0x)	0.99261 (0x)	1.01011 (0x)	0.99267 (0x)
42500 DOW____345A	345KV		1.00411 (0x)	0.99512 (0x)	0.99113 (0x)	0.99753 (0x)	0.98984 (0x)	1.00705 (0x)	0.99020 (0x)

7.2.3 New Line Options – CNP Planning Event P2

Thermal loading and voltage results under CNP Planning Event P2 are shown below in Table 7-29 and Table 7-30.

Table 7-29: New Line Options – Thermal Loading Results (percent loading) under CNP Planning Event P2

Branch Loading	Rating (MVA)	Contingency	2021 Summer Peak Case						
	Rate B		OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	1450	P2-3_DOW-D060_NEW: 42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A & 42500 - 43035 <CKT 18> DOW____345A TO OASIS___345A	102.3 % (2x)	100.3 % (2x)	101.1 % (2x)	103.7 % (2x)	98.5 % (0x)	94.0 % (0x)	89.5 % (0x)
42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	1450	P2-3_DOW-D030X: 42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A & 42500 - 43035 <CKT 27> DOW____345A TO OASIS___345A	102.3 % (2x)	100.3 % (2x)	101.1 % (2x)	103.7 % (2x)	98.5 % (0x)	94.0 % (0x)	89.5 % (0x)

Branch Loading	Rating (MVA)	Contingency	2022 Summer Peak Case						
	Rate B		OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	1450	P2-3_DOW-D060_NEW: 42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A & 42500 - 43035 <CKT 18> DOW____345A TO OASIS___345A	103.8 % (2x)	101.8 % (2x)	102.6 % (2x)	105.0 % (2x)	99.7 % (0x)	95.2 % (0x)	90.4 % (0x)
42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	1450	P2-3_DOW-D030X: 42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A & 42500 - 43035 <CKT 27> DOW____345A TO OASIS___345A	103.8 % (2x)	101.8 % (2x)	102.6 % (2x)	105.0 % (2x)	99.7 % (0x)	95.2 % (0x)	90.4 % (0x)

Table 7-30: New Line Options – Voltage Results (in p.u.) under CNP Planning Event P2

BUSES	Nominal Voltage	Contingency	2021 Summer Peak Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42530 JONCRK__345A	345KV	P2-3_DOW-D060: 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A & 42500 - 43035 <CKT 18> DOW____345A TO OASIS___345A	> 0.980	> 0.980	> 0.980	> 0.980	> 0.980	> 0.980	> 0.980
42500 DOW____345A	345KV		> 0.980	> 0.980	> 0.980	> 0.980	> 0.980	> 0.980	> 0.980

BUSES	Nominal Voltage	Contingency	2022 Summer Peak Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42530 JONCRK__345A	345KV	P2-3_DOW-D060: 5915 - 42500 <CKT 27> SO_TEX__345A TO DOW____345A & 42500 - 43035 <CKT 18> DOW____345A TO OASIS___345A	> 0.980	> 0.980	> 0.980	> 0.980	> 0.980	> 0.980	> 0.980
42500 DOW____345A	345KV		> 0.980	> 0.980	> 0.980	> 0.980	> 0.980	> 0.980	> 0.980

7.2.4 New Line Options – CNP Planning Event P3

Thermal loading and voltage results under CNP Planning Event P3 are shown below in Table 7-31, Table 7-32, and Table 7-33 .

Table 7-31: New Line Options – Thermal Loading Results (percent loading) under CNP Planning Event P3 – 2021

Branch Loading	Rating (MVA) Rate B	Contingency	2021 Summer Peak Case OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	1450	110146 DOW_DOW_GT96 AND SINGLE 42500-42530(27): 42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	105.5 % (94x)	102.8 % (15x)	103.7 % (24x)	107.0 % (186x)	100.2 % (1x)	94.5 % (0x)	86.7 % (0x)
42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	1450	110146 DOW_DOW_GT96 AND SINGLE 42500-42530(18): 42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	105.5 % (94x)	102.8 % (15x)	103.7 % (24x)	107.0 % (186x)	100.2 % (1x)	94.5 % (0x)	86.7 % (0x)
5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	1450	110018 WAP_WAP_G8 AND P7-1_E1>>T6472D: 44000 - 44200 <CKT 64> W_A_P___345A TO HILLJE__345A & 44005 - 44040 <CKT 72> W_A_P___345B TO BAILEY_POI_5	< 70.0 %	< 70.0 %	< 70.0 %	< 70.0 %	Contingency Not Valid	99.2 % (0x)	97.1 % (0x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1450		< 70.0 %	< 70.0 %	< 70.0 %	< 70.0 %	Contingency Not Valid	99.2 % (0x)	97.1 % (0x)
5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	1450	110018 WAP_WAP_G8 AND P7-1_E1>>FPASS_OPT6-3: 44000 - 44200 <CKT 64> W_A_P___345A TO HILLJE__345A & 44040 - 44045 <CKT 72> BAILEY_POI_5 TO GUY_CNP	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	98.8 % (0x)	Contingency Not Valid	Contingency Not Valid
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1450		Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	98.8 % (0x)	Contingency Not Valid	Contingency Not Valid
975 - 3400 <CKT 1> JKCREEK1 TO TWIN_OAK_N5	1376	110352 STP_STP_G2 AND P7-1_E1>>T7498C_INT: 3390 - 44645 <CKT 98> JEWETT_S5 TO SNGLTN_345 & 3391 - 44645 <CKT 74> JEWETT_N5 TO SNGLTN_345	94.6 % (0x)	95.0 % (0x)	95.2 % (0x)	96.0 % (0x)	97.0 % (0x)	97.6 % (0x)	97.2 % (0x)
44005 - 47300 <CKT 64> W_A_P___345B TO JENETA__345B	1971	110072 CBY_CBY_G2 AND P7-1_E1>>T5098: 44005 - 47000 <CKT 50> W_A_P___345B TO BELAIR__345A & 44650 - 47000 <CKT 98> SMTHRS__345A TO BELAIR__345A	93.6 % (0x)	93.1 % (0x)	91.7 % (0x)	78.1 % (0x)	73.7 % (0x)	71.9 % (0x)	100.5 % (4x)
5915 - 44050 <CKT 64> SO_TEX__345A TO HWY 35_CNP	1450	111143 CBECII_STG9 111141 CBECII_CT7 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	Branch Not Valid	107.3 % (191x)	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid
44900 - 45500 <CKT 71> ZENITH__345A TO T_H_W___345B	1314	110352 STP_STP_G2 AND P7-1_E1>>T7475E: 44645 - 46500 <CKT 74> SNGLTN_345 TO TOMBAL__345B & 40600 - 46290 <CKT &1> ROANS___345C TO RTHWOD__345A	92.2 % (0x)	92.8 % (0x)	92.9 % (0x)	94.7 % (0x)	95.7 % (0x)	96.6 % (0x)	95.9 % (0x)
44645 - 44900 <CKT 98> SNGLTN_345 TO ZENITH__345A	1450		94.7 % (0x)	95.2 % (0x)	95.4 % (0x)	96.5 % (0x)	97.5 % (0x)	98.2 % (0x)	98.5 % (0x)
44645 - 44900 <CKT 99> SNGLTN_345 TO ZENITH__345A	1450		94.8 % (0x)	95.3 % (0x)	95.4 % (0x)	96.6 % (0x)	97.5 % (0x)	98.3 % (0x)	98.5 % (0x)
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173	110146 DOW_DOW_GT96 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	< 70.0 %	< 70.0 %	< 70.0 %	< 70.0 %	< 70.0 %	< 70.0 %	117.5 % (190x)

Table 7-32: New Line Options – Thermal Loading Results (percent loading) under CNP Planning Event P3 – 2022

Branch Loading	Rating (MVA)	Contingency	2022 Summer Peak Case						
	Rate B		OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42500 - 42530 <CKT 18> DOW_____345A TO JONCRK__345A	1450	110146 DOW_DOW_GT96 AND SINGLE 42500-42530(27): 42500 - 42530 <CKT 27> DOW_____345A TO JONCRK__345A	107.4 % (188x)	104.6 % (45x)	105.5 % (93x)	108.6 % (186x)	101.7 % (2x)	95.9 % (0x)	87.8 % (0x)
42500 - 42530 <CKT 27> DOW_____345A TO JONCRK__345A	1450	110146 DOW_DOW_GT96 AND SINGLE 42500-42530(18): 42500 - 42530 <CKT 18> DOW_____345A TO JONCRK__345A	107.4 % (188x)	104.6 % (45x)	105.5 % (93x)	108.6 % (186x)	101.7 % (2x)	96.0 % (0x)	87.8 % (0x)
5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	1450	110018 WAP_WAP_G8 AND P7-1_E1>>T6472D: 44000 - 44200 <CKT 64> W_A_P___345A TO HILLJE__345A & 44005 - 44040 <CKT 72> W_A_P___345B TO BAILEY_POI_5	< 70.0 %	< 70.0 %	< 70.0 %	< 70.0 %	Contingency Not Valid	104.8 % (2x)	102.9 % (6x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1450		< 70.0 %	< 70.0 %	< 70.0 %	< 70.0 %	Contingency Not Valid	104.8 % (2x)	102.9 % (6x)
5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	1450	110018 WAP_WAP_G8 AND P7-1_E1>>FPASS_OPT6-3: 44000 - 44200 <CKT 64> W_A_P___345A TO HILLJE__345A & 44040 - 44045 <CKT 72> BAILEY_POI_5 TO GUY_CNP	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	104.3 % (2x)	Contingency Not Valid	Contingency Not Valid
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1450		Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	104.3 % (2x)	Contingency Not Valid	Contingency Not Valid
975 - 3400 <CKT 1> JKCREEK1 TO TWIN_OAK_N5	1376	110352 STP_STP_G2 AND P7-1_E1>>T7498C_INT: 3390 - 44645 <CKT 98> JEWETT_S5 TO SNGLTN_345 & 3391 - 44645 <CKT 74> JEWETT_N5 TO SNGLTN_345	97.7 % (0x)	98.2 % (0x)	98.3 % (0x)	99.2 % (0x)	100.4 % (2x)	100.6 % (2x)	100.5 % (2x)
44005 - 47300 <CKT 64> W_A_P___345B TO JENETA__345B	1971	110072 CBY_CBY_G2 AND P7-1_E1>>T5098: 44005 - 47000 <CKT 50> W_A_P___345B TO BELAIR__345A & 44650 - 47000 <CKT 98> SMTHRS__345A TO BELAIR__345A	95.0 % (0x)	94.7 % (0x)	93.2 % (0x)	79.3 % (0x)	75.2 % (0x)	73.7 % (0x)	102.0 % (18x)
5915 - 44050 <CKT 64> SO_TEX__345A TO HWY 35_CNP	1450	111143 CBECII_STG9 111141 CBECII_CT7 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	Branch Not Valid	109.4 % (191x)	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid
44900 - 45500 <CKT 71> ZENITH__345A TO T_H_W___345B	1314	110352 STP_STP_G2 AND P7-1_E1>>T7475E: 44645 - 46500 <CKT 74> SNGLTN_345 TO TOMBAL__345B & 40600 - 46290 <CKT &1> ROANS___345C TO RTHWOD__345A	95.7 % (0x)	96.2 % (0x)	96.4 % (0x)	97.6 % (0x)	99.4 % (0x)	101.1 % (2x)	102.8 % (2x)
44645 - 44900 <CKT 98> SNGLTN_345 TO ZENITH__345A	1450		98.0 % (0x)	98.6 % (0x)	98.8 % (0x)	99.5 % (0x)	101.0 % (2x)	102.7 % (2x)	105.5 % (2x)
44645 - 44900 <CKT 99> SNGLTN_345 TO ZENITH__345A	1450		98.0 % (0x)	98.7 % (0x)	98.8 % (0x)	99.5 % (0x)	101.1 % (2x)	102.8 % (2x)	105.6 % (2x)
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173	110146 DOW_DOW_GT96 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	< 70.0 %	< 70.0 %	< 70.0 %	< 70.0 %	< 70.0 %	70.5 % (0x)	118.6 % (172x)

Table 7-33: New Line Options – Voltage Results (in p.u.) under CNP Planning Event P3

BUSES	Nominal Voltage	Contingency	2021 Summer Peak Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42530 JONCRK__345A	345KV	110018 WAP_WAP_G8 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	> 0.980	> 0.980	> 0.980	> 0.980	> 0.980	0.95437 (0x)	0.86731 (19x)
42500 DOW_____345A	345KV		> 0.980	> 0.980	> 0.980	> 0.980	0.97719 (0x)	0.95073 (0x)	0.86318 (28x)
42530 JONCRK__345A	345KV	110018 WAP_WAP_G8 AND P7-1_E1>>FPASS_OPT6-3: 44000 - 44200 <CKT 64> W_A_P___345A TO HILLJE__345A & 44040 - 44045 <CKT 72> BAILEY_POI_5 TO GUY_CNP	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	0.95040 (0x)	Contingency Not Valid	Contingency Not Valid
42500 DOW_____345A	345KV		Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	0.94734 (0x)	Contingency Not Valid	Contingency Not Valid

BUSES	Nominal Voltage	Contingency	2022 Summer Peak Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42530 JONCRK__345A	345KV	110018 WAP_WAP_G8 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	> 0.980	> 0.980	> 0.980	> 0.980	0.96385 (0x)	0.89844 (3x)	Did Not Converge (27x)
42500 DOW_____345A	345KV		> 0.980	> 0.980	> 0.980	> 0.980	0.95980 (0x)	0.89350 (3x)	Did Not Converge (27x)
42530 JONCRK__345A	345KV	110018 WAP_WAP_G8 AND P7-1_E1>>FPASS_OPT6-3: 44000 - 44200 <CKT 64> W_A_P___345A TO HILLJE__345A & 44040 - 44045 <CKT 72> BAILEY_POI_5 TO GUY_CNP	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	0.90721 (2x)	Contingency Not Valid	Contingency Not Valid
42500 DOW_____345A	345KV		Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	0.90274 (2x)	Contingency Not Valid	Contingency Not Valid

7.2.5 New Line Options – CNP Planning Event P5

No thermal loading or voltage concerns were identified under CNP Planning Event P5.

7.2.6 New Line Options – CNP Planning Event P6

Thermal loading and voltage results under CNP Planning Event P6 are shown below in Table 7-34 and Table 7-35.

Table 7-34: New Line Options – Thermal Loading Results (percent loading) under CNP Planning Event P6

Branch Loading	Rating (MVA) Rate B	Contingency	2021 Summer Peak Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	1450	JONCRK AUTOTRANSFORMER A1 AND SINGLE 42500-42530(27): 42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	106.5 % (3x)	103.8 % (3x)	104.7 % (3x)	108.0 % (39x)	100.8 % (3x)	94.5 % (0x)	85.9 % (0x)
42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	1450	JONCRK AUTOTRANSFORMER A1 AND SINGLE 42500-42530(18): 42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	106.5 % (3x)	103.8 % (3x)	104.7 % (3x)	108.0 % (39x)	100.8 % (3x)	94.5 % (0x)	85.9 % (0x)
42530 - 3WNDTR <A3> JONCRK__345A TO DOWA6TESTDAT	1000	JONCRK AUTOTRANSFORMER A1 AND P7-1_E1>>T1827B1_NEW: 42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A & 42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	92.6 % (0x)	90.8 % (0x)	90.5 % (0x)	91.4 % (0x)	86.3 % (0x)	81.7 % (0x)	71.8 % (0x)
5915 - 44050 <CKT 64> SO_TEX__345A TO HWY 35_CNP	1450	GRNBYU AUTOTRANSFORMER A1 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	Branch Not Valid	101.5 % (43x)	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173	GRNBYU AUTOTRANSFORMER A2 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	< 80.0 %	< 80.0 %	< 80.0 %	< 80.0 %	< 80.0 %	< 80.0 %	110.9 % (43x)

Branch Loading	Rating (MVA) Rate B	Contingency	2022 Summer Peak Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	1450	JONCRK AUTOTRANSFORMER A1 AND SINGLE 42500-42530(27): 42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	108.5 % (40x)	105.7 % (3x)	106.5 % (3x)	109.6 % (40x)	102.3 % (3x)	95.9 % (0x)	87.0 % (0x)
42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	1450	JONCRK AUTOTRANSFORMER A1 AND SINGLE 42500-42530(18): 42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	108.5 % (40x)	105.7 % (3x)	106.6 % (3x)	109.6 % (40x)	102.3 % (3x)	95.9 % (0x)	87.0 % (0x)
42530 - 3WNDTR <A3> JONCRK__345A TO DOWA6TESTDAT	1000	JONCRK AUTOTRANSFORMER A1 AND P7-1_E1>>T1827B1_NEW: 42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A & 42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	93.7 % (0x)	92.0 % (0x)	91.6 % (0x)	92.3 % (0x)	87.8 % (0x)	83.0 % (0x)	72.2 % (0x)
5915 - 44050 <CKT 64> SO_TEX__345A TO HWY 35_CNP	1450	GRNBYU AUTOTRANSFORMER A1 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	Branch Not Valid	103.5 % (43x)	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173	BELAIR AUTOTRANSFORMER A5 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	< 80.0 %	< 80.0 %	< 80.0 %	< 80.0 %	< 80.0 %	< 80.0 %	113.5 % (43x)

Table 7-35: New Line Options – Voltage Results (in p.u.) under CNP Planning Event P6

BUSES	Nominal Voltage	Contingency	2021 Summer Peak Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42530 JONCRK__345A	345KV	OBRIENB AUTOTRANSFORMER A1 & 44510 OBRIEN_B138A CB1 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	> 0.980	> 0.980	> 0.980	> 0.980	> 0.980	> 0.980	0.93500 (0x)
42500 DOW_____345A	345KV		> 0.980	> 0.980	> 0.980	> 0.980	> 0.980	> 0.980	0.93048 (0x)

BUSES	Nominal Voltage	Contingency	2022 Summer Peak Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42530 JONCRK__345A	345KV	OBRIENB AUTOTRANSFORMER A1 & 44510 OBRIEN_B138A CB1 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	> 0.980	> 0.980	> 0.980	> 0.980	> 0.980	> 0.980	0.91657 (3x)
42500 DOW_____345A	345KV		> 0.980	> 0.980	> 0.980	> 0.980	> 0.980	0.97846 (0x)	0.91191 (13x)

7.2.7 New Line Options – CNP Planning Event P7

Thermal loading and voltage results under CNP Planning Event P7 are shown below in Table 7-36 and Table 7-37.

Table 7-36: New Line Options – Thermal Loading Results (percent loading) under CNP Planning Event P7

Branch Loading	Rating (MVA) Rate B	Contingency	2021 Summer Peak Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
5915 - 44050 <CKT 64> SO_TEX__345A TO HWY 35_CNP	1450	P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	Branch Not Valid	101.0 % (1x)	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173		42.7 % (0x)	48.1 % (0x)	50.1 % (0x)	51.9 % (0x)	60.1 % (0x)	66.0 % (0x)	108.9 % (1x)
Branch Loading	Rating (MVA) Rate B	Contingency	2022 Summer Peak Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
5915 - 44050 <CKT 64> SO_TEX__345A TO HWY 35_CNP	1450	P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	Branch Not Valid	103.0 % (1x)	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173		42.9 % (0x)	48.4 % (0x)	50.5 % (0x)	52.5 % (0x)	60.9 % (0x)	67.2 % (0x)	111.0 % (1x)

Table 7-37: New Line Options – Voltage Results (in p.u.) under CNP Planning Event P7

BUSES	Nominal Voltage	Contingency	2021 Summer Peak Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42530 JONCRK__345A	345KV	P7-1_E1>>T9797B: 40000 - 40240 <CKT 97> CEDARP_B345A TO CENTER__345A & 40240 - 42000 <CKT 97> CENTER__345A TO P_H_R___345E	1.00755 (0x)	1.00214 (0x)	0.99948 (0x)	1.00363 (0x)	0.99675 (0x)	0.99067 (0x)	0.99689 (0x)
42500 DOW_____345A	345KV		1.00387 (0x)	0.99861 (0x)	0.99603 (0x)	0.99990 (0x)	0.99320 (0x)	0.98709 (0x)	0.99409 (0x)
BUSES	Nominal Voltage	Contingency	2022 Summer Peak Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42530 JONCRK__345A	345KV	P7-1_E1>>T9797B: 40000 - 40240 <CKT 97> CEDARP_B345A TO CENTER__345A & 40240 - 42000 <CKT 97> CENTER__345A TO P_H_R___345E	1.00269 (0x)	0.99575 (0x)	0.99449 (0x)	1.00170 (0x)	1.00767 (0x)	1.00467 (0x)	0.98498 (0x)
42500 DOW_____345A	345KV		0.99895 (0x)	0.99217 (0x)	0.99094 (0x)	0.99791 (0x)	1.00391 (0x)	1.00071 (0x)	0.98208 (0x)

7.2.8 New Line Options – SWCB Unavailability Scenario

Thermal loading and voltage results under SWCB Unavailability Scenario are shown below in Table 7-38 and Table 7-39.

Table 7-38: New Line Options – Thermal Loading Results (percent loading) under SWCB Unavailability Scenario

Branch Loading	Rating (MVA)	Contingency	2021 Summer Peak Case						
	Rate B		OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	1450	JONCRK__138A TO JONCRK_SWCB1 AND SINGLE 42500-42530(27): 42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	99.1 % (0x)	96.4 % (0x)	97.3 % (0x)	100.5 % (1x)	93.5 % (0x)	87.5 % (0x)	80.2 % (0x)
42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	1450	JONCRK__138A TO JONCRK_SWCB1 AND SINGLE 42500-42530(18): 42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	99.1 % (0x)	96.4 % (0x)	97.3 % (0x)	100.5 % (1x)	93.6 % (0x)	87.5 % (0x)	80.2 % (0x)
5915 - 44050 <CKT 64> SO_TEX__345A TO HWY 35_CNP	1450	JONCRK__138A TO JONCRK_SWCB1 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	Branch Not Valid	101.6 % (1x)	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173		< 70.0 %	< 70.0 %	< 70.0 %	< 70.0 %	< 70.0 %	< 70.0 %	110.9 % (1x)
Branch Loading	Rating (MVA)	Contingency	2022 Summer Peak Case						
	Rate B		OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	1450	JONCRK__138A TO JONCRK_SWCB1 AND SINGLE 42500-42530(27): 42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	101.1 % (1x)	98.3 % (0x)	99.1 % (0x)	102.1 % (1x)	95.0 % (0x)	88.9 % (0x)	81.3 % (0x)
42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	1450	JONCRK__138A TO JONCRK_SWCB1 AND SINGLE 42500-42530(18): 42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	101.1 % (1x)	98.3 % (0x)	99.1 % (0x)	102.1 % (1x)	95.0 % (0x)	88.9 % (0x)	81.3 % (0x)
5915 - 44050 <CKT 64> SO_TEX__345A TO HWY 35_CNP	1450	JONCRK__138A TO JONCRK_SWCB1 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	Branch Not Valid	103.6 % (1x)	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173		< 70.0 %	< 70.0 %	< 70.0 %	< 70.0 %	< 70.0 %	< 70.0 %	113.8 % (1x)

Table 7-39: New Line Options – Voltage Results (in p.u.) under SWCB Unavailability Scenario

BUSES	Nominal Voltage	Contingency	2021 Summer Peak Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42530 JONCRK__345A	345KV	JONCRK__138A TO JONCRK_SWCB1 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	> 0.980	> 0.980	> 0.980	> 0.980	> 0.980	0.97778 (0x)	0.91420 (1x)
42500 DOW_____345A	345KV		> 0.980	> 0.980	> 0.980	> 0.980	> 0.980	0.97476 (0x)	0.91024 (1x)

BUSES	Nominal Voltage	Contingency	2022 Summer Peak Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42530 JONCRK__345A	345KV	JONCRK__138A TO JONCRK_SWCB1 AND P7-1_E1>>T1827B2_NEW: 5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A & 5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	> 0.980	> 0.980	> 0.980	> 0.980	> 0.980	0.96877 (0x)	0.89352 (1x)
42500 DOW_____345A	345KV		> 0.980	> 0.980	> 0.980	> 0.980	0.97907 (0x)	0.96526 (0x)	0.88964 (1x)

7.2.9 New Line Options – Maintenance Outage Scenario

A 2022 Minimum Case was created using the 2019 Minimum Case and modeling the load additions and changes listed in Section 4 under the 2021-2022 Study Case section. Contingencies related to the Maintenance Outage Scenario were run only on the 2022 Summer Case and 2022 Minimum Case. Thermal loading and voltage results under the Maintenance Outage Scenario are shown below in Table 7-40, Table 7-41, and Table 7-42.

Table 7-40: New Line Options – Thermal Loading Results (percent loading) under Maintenance Outage Scenario – Summer Peak

Branch Loading	Rating (MVA)	Contingency	2022 Summer Peak Case						
	Rate B		OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
43035 - 44000 <CKT 18> OASIS___345A TO W_A_P___345A	1450	OASIS___345A TO W_A_P___345A <CKT 99> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	< 70.0 %	< 70.0 %	< 70.0 %	< 70.0 %	79.4 % (0x)	87.3 % (0x)	Did Not Converge
5915 - 44000 <CKT 39> SO_TEX__345A TO W_A_P___345A	1432	W_A_P___345A TO HILLJE__345A <CKT 64> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	< 70.0 %	< 70.0 %	< 70.0 %	< 70.0 %	82.3 % (0x)	92.9 % (0x)	Did Not Converge
		SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T6472D: W_A_P___345A TO HILLJE__345A <CKT 64> W_A_P___345B TO BAILEY_POI_5 <CKT 72>	< 70.0 %	57.7 %	59.7 %	< 70.0 %	SCNV	99.6 % (0x)	102.7 % (2x)
5915 - 44200 <CKT 44> SO_TEX__345A TO HILLJE__345A	1200	SO_TEX__345A TO HWY 35_CNP <CKT 64> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	Contingency Not Valid	121.7 % (2x)	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid
		SO_TEX__345A TO HILLJE__345A <CKT 64> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	< 70.0 %	Contingency Not Valid	126.0 % (1x)	112.3 % (1x)	99.6 % (0x)	91.6 % (0x)	85.6 % (0x)
		SO_TEX__345A TO HILLJE__345A <CKT 64> AND P7-1_E1>>T6472D: W_A_P___345A TO HILLJE__345A <CKT 64> W_A_P___345B TO BAILEY_POI_5 <CKT 72>	105.3 % (1x)	Contingency Not Valid	< 70.0 %	< 70.0 %	SCNV	98.6 % (0x)	98.1 % (0x)
5915 - 44200 <CKT 64> SO_TEX__345A TO HILLJE__345A	1450	SO_TEX__345A TO HILLJE__345A <CKT 44> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	< 70.0 %	Branch Not Valid	102.4 % (1x)	91.4 % (0x)	81.1 % (0x)	74.6 % (0x)	< 70.0 %
44050 - 44200 <CKT 64> HWY 35_CNP TO HILLJE__345A	1450	SO_TEX__345A TO HWY 35_CNP <CKT 64> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	Branch Not Valid	112.0 % (1x)	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid
5915 - 44050 <CKT 64> SO_TEX__345A TO HWY 35_CNP	1450	HWY 35_CNP TO HILLJE__345A <CKT 64> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	Branch Not Valid	126.5 % (15x)	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid	Branch Not Valid
40240 - 42000 <CKT 97> CENTER__345A TO P_H_R___345E	1450	SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T1899_27RADIAL: OASIS___345A TO W_A_P___345A <CKT 18> OASIS___345A TO W_A_P___345A <CKT 99> DOW_____345A TO OASIS___345A <CKT 27>	75.5 % (0x)	77.1 % (0x)	77.2 % (0x)	76.6 % (0x)	78.6 % (0x)	79.8 % (0x)	103.6 % (2x)
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173	OASIS___345A TO W_A_P___345A <CKT 18> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	< 70.0 %	77.8 % (0x)	81.3 % (0x)	84.3 % (0x)	98.0 % (0x)	107.7 % (1x)	Did Not Converge
		BAILEY_POI_5 TO HILLJE__345A <CKT 72> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	< 70.0 %	< 70.0 %	< 70.0 %	73.3 % (0x)	72.7 % (0x)	73.1 % (0x)	113.1 % (17x)

Branch Loading	Rating (MVA)	Contingency	2022 Summer Peak Case						
	Rate B		OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42500 - 42530 <CKT 18> DOW____345A TO JONCRK__345A	1450	DOW____345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>T6472D: W_A_P___345A TO HILLJE__345A <CKT 64> W_A_P___345B TO BAILEY_POI_5 <CKT 72>	139.6 % (24x)	136.8 % (18x)	137.3 % (18x)	137.8 % (27x)	Contingency Not Valid	101.8 % (3x)	103.7 % (3x)
		DOW____345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>T6472D_GUY: W_A_P___345A TO HILLJE__345A <CKT 64> W_A_P___345B TO GUY_CNP <CKT 72>	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	132.5 % (14x)	Contingency Not Valid	Contingency Not Valid
		DOW____345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>T1899_27RADIAL: OASIS___345A TO W_A_P___345A <CKT 18> OASIS___345A TO W_A_P___345A <CKT 99> DOW____345A TO OASIS___345A <CKT 27>	123.2 % (24x)	122.0 % (18x)	123.0 % (18x)	125.2 % (27x)	122.3 % (14x)	119.7 % (3x)	101.5 % (3x)
42500 - 42530 <CKT 27> DOW____345A TO JONCRK__345A	1450	DOW____345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T6472D: W_A_P___345A TO HILLJE__345A <CKT 64> W_A_P___345B TO BAILEY_POI_5 <CKT 72>	139.6 % (24x)	136.8 % (18x)	137.3 % (18x)	137.8 % (27x)	Contingency Not Valid	101.8 % (3x)	103.7 % (3x)
		DOW____345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T6472D_GUY: W_A_P___345A TO HILLJE__345A <CKT 64> W_A_P___345B TO GUY_CNP <CKT 72>	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	132.5 % (14x)	Contingency Not Valid	Contingency Not Valid
		DOW____345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T1899_27RADIAL: OASIS___345A TO W_A_P___345A <CKT 18> OASIS___345A TO W_A_P___345A <CKT 99> DOW____345A TO OASIS___345A <CKT 27>	123.2 % (24x)	122.0 % (18x)	123.0 % (18x)	125.2 % (27x)	122.3 % (14x)	119.7 % (3x)	101.5 % (3x)
5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	1450	SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>FPASS_OPT2-1: SO_TEX__345A TO JONCRK__345A <CKT 95> SO_TEX__345A TO JONCRK__345A <CKT 96>	99.6 % (0x)	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid
		SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>FPASS_OPT3-1: JONCRK__345A TO HWY 35_CNP <CKT 95> JONCRK__345A TO HWY 35_CNP <CKT 96>	Contingency Not Valid	99.6 % (0x)	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid
		SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>FPASS_OPT4-1: JONCRK__345A TO HILLJE__345A <CKT 95> JONCRK__345A TO HILLJE__345A <CKT 96>	Contingency Not Valid	Contingency Not Valid	99.6 % (0x)	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid
		SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T6472CX_64RADIAL: W_A_P___345A TO HILLJE__345A <CKT 64> BAILEY_POI_5 TO HILLJE__345A <CKT 72> SO_TEX__345A TO HILLJE__345A <CKT 64>	< 70.0 %	Contingency Not Valid	< 70.0 %	103.2 % (1x)	104.2 % (6x)	105.8 % (3x)	111.3 % (11x)
		SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>FPASS_OPT6-3: W_A_P___345A TO HILLJE__345A <CKT 64> BAILEY_POI_5 TO GUY_CNP <CKT 72>	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	148.5% (6x)	Contingency Not Valid	Contingency Not Valid
		SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T6472D: W_A_P___345A TO HILLJE__345A <CKT 64> W_A_P___345B TO BAILEY_POI_5 <CKT 72>	< 70.0 %	< 70.0 %	72.5 % (0x)	73.8 % (0x)	Contingency Not Valid	146.9 % (3x)	151.0 % (11x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1450	SO_TEX__345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>FPASS_OPT2-1: SO_TEX__345A TO JONCRK__345A <CKT 95> SO_TEX__345A TO JONCRK__345A <CKT 96>	99.6 % (0x)	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid
		SO_TEX__345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>FPASS_OPT3-1: JONCRK__345A TO HWY 35_CNP <CKT 95> JONCRK__345A TO HWY 35_CNP <CKT 96>	Contingency Not Valid	99.6 % (0x)	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid
		SO_TEX__345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>FPASS_OPT4-1: JONCRK__345A TO HILLJE__345A <CKT 95> JONCRK__345A TO HILLJE__345A <CKT 96>	Contingency Not Valid	Contingency Not Valid	99.6 % (0x)	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid
		SO_TEX__345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>T6472CX_64RADIAL: W_A_P___345A TO HILLJE__345A <CKT 64> BAILEY_POI_5 TO HILLJE__345A <CKT 72> SO_TEX__345A TO HILLJE__345A <CKT 64>	< 70.0 %	Contingency Not Valid	< 70.0 %	103.2 % (1x)	104.2 % (6x)	105.8 % (3x)	111.3 % (11x)
		SO_TEX__345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>FPASS_OPT6-3: W_A_P___345A TO HILLJE__345A <CKT 64> BAILEY_POI_5 TO GUY_CNP <CKT 72>	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	148.5% (6x)	Contingency Not Valid	Contingency Not Valid
		SO_TEX__345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>T6472D: W_A_P___345A TO HILLJE__345A <CKT 64> W_A_P___345B TO BAILEY_POI_5 <CKT 72>	< 70.0 %	< 70.0 %	72.5 % (0x)	73.8 % (0x)	Contingency Not Valid	146.9 % (3x)	151.0 % (11x)

Table 7-41: New Line Options – Thermal Loading Results (percent loading) under Maintenance Outage Scenario – Minimum

Branch Loading	Rating (MVA) Rate B	Contingency	2022 Minimum Case OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
42500 - 42530 <CKT 18> DOW_____345A TO JONCRK__345A	1450	DOW_____345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>T1827_18RADIAL: DOW_____345A TO OASIS___345A <CKT 18> DOW_____345A TO OASIS___345A <CKT 27> OASIS___345A TO W_A_P___345A <CKT 18>	103.4 % (4x)	103.3 % (2x)	103.5 % (2x)	103.4 % (2x)	103.3 % (2x)	103.1 % (2x)	103.1 % (1x)
		DOW_____345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>T1899_27RADIAL: OASIS___345A TO W_A_P___345A <CKT 18> OASIS___345A TO W_A_P___345A <CKT 99> DOW_____345A TO OASIS___345A <CKT 27>	120.7 % (4x)	119.2 % (2x)	119.7 % (2x)	118.9 % (2x)	119.0 % (2x)	119.4 % (2x)	95.1 % (0x)
42500 - 42530 <CKT 27> DOW_____345A TO JONCRK__345A	1450	DOW_____345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T1827_18RADIAL: DOW_____345A TO OASIS___345A <CKT 18> DOW_____345A TO OASIS___345A <CKT 27> OASIS___345A TO W_A_P___345A <CKT 18>	103.4 % (4x)	103.3 % (2x)	103.5 % (2x)	103.4 % (2x)	103.3 % (2x)	103.1 % (2x)	103.1 % (1x)
		DOW_____345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T1899_27RADIAL: OASIS___345A TO W_A_P___345A <CKT 18> OASIS___345A TO W_A_P___345A <CKT 99> DOW_____345A TO OASIS___345A <CKT 27>	120.7 % (4x)	119.2 % (2x)	119.7 % (2x)	118.9 % (2x)	119.0 % (2x)	119.4 % (2x)	95.1 % (0x)
5915 - 42530 <CKT 27> SO_TEX__345A TO JONCRK__345A	1450	SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>FPASS_OPT2-1: SO_TEX__345A TO JONCRK__345A <CKT 95> SO_TEX__345A TO JONCRK__345A <CKT 96>	86.5 % (0x)	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid
		SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>FPASS_OPT3-1: JONCRK__345A TO HWY 35_CNP <CKT 95> JONCRK__345A TO HWY 35_CNP <CKT 96>	Contingency Not Valid	86.5 % (0x)	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid
		SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>FPASS_OPT4-1: JONCRK__345A TO HILLJE__345A <CKT 95> JONCRK__345A TO HILLJE__345A <CKT 96>	Contingency Not Valid	Contingency Not Valid	86.5 % (0x)	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid
		SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T1899_27RADIAL: OASIS___345A TO W_A_P___345A <CKT 18> OASIS___345A TO W_A_P___345A <CKT 99> DOW_____345A TO OASIS___345A <CKT 27>	< 70.0 %	< 70.0 %	< 70.0 %	79.4 % (0x)	84.7 % (0x)	87.4 % (0x)	126.4 % (3x)
		SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T6472CX_64RADIAL: W_A_P___345A TO HILLJE__345A <CKT 64> BAILEY_POI_5 TO HILLJE__345A <CKT 72> SO_TEX__345A TO HILLJE__345A <CKT 64>	< 70.0 %	Contingency Not Valid	< 70.0 %	102.3 % (1x)	101.1 % (2x)	99.8 % (0x)	102.4 % (3x)
5915 - 42530 <CKT 18> SO_TEX__345A TO JONCRK__345A	1450	SO_TEX__345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>FPASS_OPT2-1: SO_TEX__345A TO JONCRK__345A <CKT 95> SO_TEX__345A TO JONCRK__345A <CKT 96>	86.5 % (0x)	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid
		SO_TEX__345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>FPASS_OPT3-1: JONCRK__345A TO HWY 35_CNP <CKT 95> JONCRK__345A TO HWY 35_CNP <CKT 96>	Contingency Not Valid	86.5 % (0x)	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid
		SO_TEX__345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>FPASS_OPT4-1: JONCRK__345A TO HILLJE__345A <CKT 95> JONCRK__345A TO HILLJE__345A <CKT 96>	Contingency Not Valid	Contingency Not Valid	86.5 % (0x)	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid
		SO_TEX__345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>T1899_27RADIAL: OASIS___345A TO W_A_P___345A <CKT 18> OASIS___345A TO W_A_P___345A <CKT 99> DOW_____345A TO OASIS___345A <CKT 27>	< 70.0 %	< 70.0 %	< 70.0 %	79.4 % (0x)	84.7 % (0x)	87.4 % (0x)	126.4 % (3x)
		SO_TEX__345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>T6472CX_64RADIAL: W_A_P___345A TO HILLJE__345A <CKT 64> BAILEY_POI_5 TO HILLJE__345A <CKT 72> SO_TEX__345A TO HILLJE__345A <CKT 64>	< 70.0 %	Contingency Not Valid	< 70.0 %	102.3 % (1x)	101.1 % (2x)	99.8 % (0x)	102.4 % (3x)

Branch Loading	Rating (MVA) Rate B	Contingency	2022 Minimum Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
43035 - 44000 <CKT 18> OASIS___345A TO W_A_P___345A	1450	OASIS___345A TO W_A_P___345A <CKT 99> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	72.3 % (0x)	81.2 % (0x)	83.2 % (0x)	92.0 % (0x)	96.3 % (0x)	99.2 % (0x)	157.6 % (5x)
5915 - 44200 <CKT 44> SO_TEX__345A TO HILLJE__345A	1200	SO_TEX__345A TO HWY 35_CNP <CKT 64> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	CNV	129.6 % (1x)	CNV	CNV	CNV	CNV	CNV
		SO_TEX__345A TO HILLJE__345A <CKT 64> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	< 70.0 %	CNV	133.5 % (1x)	119.9 % (1x)	111.0 % (1x)	104.8 % (1x)	98.2 % (0x)
5915 - 44050 <CKT 64> SO_TEX__345A TO HWY 35_CNP	1450	SO_TEX__345A TO HILLJE__345A <CKT 44> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	BNV	130.1 % (11x)	BNV	BNV	BNV	BNV	BNV
5915 - 44200 <CKT 64> SO_TEX__345A TO HILLJE__345A	1450		< 70.0 %	BNV	108.5 % (1x)	97.6 % (0x)	90.4 % (0x)	85.3 % (0x)	79.9 % (0x)
43035 - 44000 <CKT 99> OASIS___345A TO W_A_P___345A	1173	OASIS___345A TO W_A_P___345A <CKT 18> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	89.2 % (0x)	100.1 % (2x)	102.6 % (2x)	113.5 % (2x)	118.8 % (2x)	122.3 % (2x)	194.6 % (24x)
		OASIS___345A TO W_A_P___345A <CKT 18> AND P7-1_E1>>T1827B1_NEW: DOW____345A TO JONCRK__345A <CKT 18> DOW____345A TO JONCRK__345A <CKT 27>	104.4 % (1x)	106.1 % (2x)	106.7 % (2x)	109.4 % (2x)	111.0 % (2x)	112.2 % (2x)	109.5 % (24x)

Table 7-42: New Line Options – Voltage Results (in p.u.) under Maintenance Outage Scenario

BUSES	Nominal Voltage	Contingency	2022 Summer Peak Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
	-	BAILEY_POI_5 TO GUY_CNP <CKT 72> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Contingency Not Valid	Did Not Converge	Contingency Not Valid	Contingency Not Valid
42530 JONCRK__345A	345KV	W_A_P___345A TO HILLJE__345A <CKT 64> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	> 0.950	> 0.950	> 0.950	> 0.950	> 0.950	0.94791 (0x)	Did Not Converge
42500 DOW____345A	345KV		> 0.950	> 0.950	> 0.950	> 0.950	> 0.950	0.94481 (0x)	Did Not Converge
42530 JONCRK__345A	345KV	SO_TEX__345A TO JONCRK__345A <CKT 27> AND P7-1_E1>>T6472D: W_A_P___345A TO HILLJE__345A <CKT 64> W_A_P___345B TO BAILEY_POI_5 <CKT 72>	> 0.950	> 0.950	> 0.950	> 0.950	Contingency Not Valid	0.88275 (2x)	0.83501 (9x)
42500 DOW____345A	345KV		> 0.950	> 0.950	> 0.950	> 0.950	Contingency Not Valid	0.87852 (2x)	0.83208 (11x)

BUSES	Nominal Voltage	Contingency	2022 Minimum Case						
			OPT 2	OPT 3	OPT 4	OPT 5	OPT 6	OPT 7	OPT 8
	-	SO_TEX__345A TO JONCRK__345A <CKT 18> AND P7-1_E1>>T1899_27RADIAL: OASIS___345A TO W_A_P___345A <CKT 18> OASIS___345A TO W_A_P___345A <CKT 99> DOW____345A TO OASIS___345A <CKT 27>	> 0.950	> 0.950	> 0.950	> 0.950	> 0.950	> 0.950	Did Not Converge
42500 DOW____345A	345KV	OASIS___345A TO W_A_P___345A <CKT 99> AND P7-1_E1>>T1827B2_NEW: SO_TEX__345A TO JONCRK__345A <CKT 18> SO_TEX__345A TO JONCRK__345A <CKT 27>	> 0.950	> 0.950	> 0.950	> 0.950	> 0.950	> 0.950	0.82435 (11x)
42530 JONCRK__345A	345KV		> 0.950	> 0.950	> 0.950	> 0.950	> 0.950	> 0.950	0.82747 (9x)

7.2.10 New Line Options – Extreme Event Scenario

THE FOLLOWING IS PROTECTED INFORMATION / CEII

7.2.11 New Line Options – Transfer Capability Analysis

A transfer capability analysis was performed on the 2021 case for Option 2 through 8 using linear transfer capability evaluation (Siemens MUST). Table 7-45 shows the potential maximum total transfer capability into the Freeport Area after increasing transfer to the thermally constrained contingency limit.

The transfers were modelled by increasing load in the Freeport Area (defined as the substations listed in Table 2-2), and reducing load by the same amount across the rest of ERCOT. All the 345 kV transmission lines within CenterPoint Energy service territory as well as lines connecting CenterPoint Energy System with the rest of ERCOT were monitored using Rate B, and the contingencies were evaluated utilizing CNP Planning Events P1 and P7 contingency files.

Table 7-43: Transfer Capability Analysis

Study Option	Total Transfer		Limiting Element
	AC	DC	
Option 2	785.7	2378.4	STP - Jones Creek circuit 18 & 27
Option 3	785.3	2383.9	STP - Jones Creek circuit 18 & 27
Option 4	785.3	2386.2	STP - Jones Creek circuit 18 & 27
Option 5	785.3	2382.5	STP - Jones Creek circuit 18 & 27
Option 6	476.3	759.5	STP - Jones Creek circuit 18 & 27
Option 7	493	771.6	STP - Jones Creek circuit 18 & 27
Option 8	438.8	514.7	STP - Jones Creek circuit 18 & 27

Results of the transfer capability analysis show that Options 2, 3, 4, and 5 perform similarly with a total transfer capability 785 MW AC and 2380 MW DC. Option 6, 7 and 8 do not perform well with a total transfer capability range of 438-493 MW AC and 514-771 MW DC. Detailed transfer capability analysis results are provided in Appendix E.

7.2.12 New Line Options – Stability Analysis

Transient stability performance for all the options was repeated for the Year 2022 system configuration and for the faults in Table 7-21, additionally for each option the loss of the new double-circuit transmission lines to Jones Creek 345 kV as described in Table 7-46 was studied.

Plots for system performance under all the contingencies are shown in Appendix D. All the contingencies are stable and well damped, with no UVLS shedding with the exception of Option 7 and Option 8 where some contingencies triggered the UVLS at Brazosport 138 kV substation, tripping around 80 MW of load.

The total amount of motor load tripped for each of the contingencies is shown in Table 7-47 and Table 7-48.

Table 7-44: Transient stability contingency list - new Line options

Fault id	Event Description	Open Circuits
OPTION 2	3-Phase Fault at STP 345 kV	DOW-Jones Creek 345 kV ckt 1 and ckt 2
OPTION 3	3-Phase Fault at STP 345 kV	HWY 35 Sub-Jones Creek 345 kV ckt 1 and ckt 2
OPTION 4	3-Phase Fault at STP 345 kV	Hillje-Jones Creek 345 kV ckt 1 and ckt 2
OPTION 5	3-Phase Fault at STP 345 kV	Bailey-Jones Creek 345 kV ckt 1 and ckt 2
OPTION 6	3-Phase Fault at STP 345 kV	Guy CNP-Jones Creek 345 kV ckt 1 and ckt 2
OPTION 7	3-Phase Fault at STP 345 kV	W.A.P_B-Jones Creek 345 kV ckt 1 and ckt 2
OPTION 8	3-Phase Fault at STP 345 kV	Oasis-Jones Creek 345 kV ckt 1 and ckt 2

Table 7-45: Loss of motor load (non-UVLS)

			OPTION 2		OPTION 3		OPTION 4		OPTION 5		OPTION 6		OPTION 7		OPTION 8	
Fault id	**Event Description**	**Open Circuits**	**MW**	**MVAr**	**MW**	**MVAr**	**MW**	**MVAr**	**MW**	**MVAr**	**MW**	**MVAr**	**MW**	**MVAr**	**MW**	**MVAr**
FLT-P1-Dow_JCREEK	3-Phase Fault at Dow 345 kV	Dow to Jones Creek 345 kV	153	68	103	55	106	55	107	56	107	56	158	73	106	55
FLT-P2-DOW A6- DOW - JCREEK	3-Phase Fault at Dow 345 kV	DOW Autotransformer A6 and Dow to Jones Creek 345 kV														
FLT-LOSS_LNG	3-Phase Fault at Cortez 138 kV	Jones Creek to Cortez 138 kV and Marine to Cortez 138 kV, loss of inline 160 MVAr	125	55	89	46	89	46	90	47	90	46	87	44	93	48
FLT-WAP_P7-STP_JC	3-Phase Fault at STP 345 kV Previous outage WAP_G6	STP-Jones Creek 345 kV ckt 18 and ckt 27	127	57	89	46	85	44	85	44	83	43	87	44	83	43
FLT-WAP_P7-STP_JC_FJC	3-Phase Fault at Jones Creek 345 kV Previous outage WAP_G6	STP -Jones Creek 345 kV ckt 18 and ckt 27	151	67	103	55	103	55	107	56	107	56	165	76	106	55
FLT-WAP_P7-STP_DOW_JC_DOW	3-Phase Fault at DOW 345 kV Previous outage WAP_G6	DOW-Jones Creek 345 kV ckt 18 and ckt 27	153	68	103	55	106	55	107	56	107	56	158	73	106	55
FLT-P6_THW_A3_STP_JCREEK	3-Phase Fault at Jones Creek 345 kV	STP-Jones Creek 345 kV ckt 18 and ckt 27 and THW Autotransformer A3	151	68	103	55	103	55	107	56	107	56	165	76	106	55
FLT-CHEST_P7-STP_JC_FJC	3-Phase Fault at Jones Creek 345 kV Previous outage CHEST1	STP-Jones Creek 345 kV ckt 18 and ckt 27	151	67	103	55	103	55	107	56	107	56	165	76	106	55
FLT-WAP_P7-JC_DOW_FJC	3-Phase Fault at Jones Creek 345 kV Previous outage WAP_G6	DOW-Jones Creek 345 kV ckt 18 and ckt 27	151	67	103	55	103	55	107	56	107	56	165	76	106	55
FLT-DOW_2_units_P7-STP_JC_FJC	3-Phase Fault at STP 345 kV Previous outage Dow ST84 And GT83	STP-Jones Creek 345 kV ckt 18 and ckt 27	151	67	103	55	103	55	107	56	107	56	165	76	106	55
FLT-DOW_1_units_P7-STP_JC_FJC	3-Phase Fault at STP 345 kV Previous outage Dow ST84	STP-Jones Creek 345 kV ckt 18 and ckt 27	151	67	103	55	103	55	107	56	107	56	165	76	106	55
FLT-OASIS_P7-STP_JC	3-Phase Fault at STP 345 kV Previous outage WAP_G6	STP-Jones Creek 345 kV ckt 18 and ckt 27 and OASIS-DOW ckt 18	127	57	89	46	85	44	85	44	83	43	83	43	83	43
FLT-P6x-DOW A1- FLT-LOSS_LNG	3-phase fault at Cortez previous outage DOW Auto A1	Jones Creek to Cortez 138 kV and Marine to Cortez 138 kV	178	88	143	79	144	80	148	81	148	81	206	100	147	79

Table 7-46 Loss of load (non-UVLS) for the loss of new Line Options

			With Protection	
Fault id	Event Description	Open Circuits	MW	MVAr
OPTION 2	3-Phase Fault at STP 345 kV	DOW-Jones Creek 345 kV ckt 1 and ckt 2	151	67
OPTION 3	3-Phase Fault at STP 345 kV	HWY 35 Sub-Jones Creek 345 kV ckt 1 and ckt 2	103	55
OPTION 4	3-Phase Fault at STP 345 kV	Hillje-Jones Creek 345 kV ckt 1 and ckt 2	103	55
OPTION 5	3-Phase Fault at STP 345 kV	Bailey-Jones Creek 345 kV ckt 1 and ckt 2	107	56
OPTION 6	3-Phase Fault at STP 345 kV	Guy CNP-Jones Creek 345 kV ckt 1 and ckt 2	107	56
OPTION 7	3-Phase Fault at STP 345 kV	W.A.P_B-Jones Creek 345 kV ckt 1 and ckt 2	165	76
OPTION 8	3-Phase Fault at STP 345 kV	Oasis-Jones Creek 345 kV ckt 1 and ckt 2	106	55

Reviewing the results, and based on the amount of load shed there is a clear advantage on Options 3 through 6. For most of the Year 2022 options, the fast switching capacitor banks discussed in the Bridge the Gap section do not switch-in indicating that the new line options provide sufficient support for the Freeport Area.

7.2.13 New Line Options – Results Summary

For Option 8, the case fails to find a solution under several P3 contingencies and fails to mitigate all low voltage concerns under P6 and SWCB Unavailability contingencies. It is clear that Option 8 does not provide sufficient reactive support compared to the other options. As a result, Option 8 was removed from further consideration.

Results under CNP Planning Events P1, P2, P3, P6, P7, and SWCB Unavailability Scenario

Based on the results of the New Line Options analysis, 345 kV Dow-Velasco – Jones Creek circuit 18 and 27 will need to be upgraded by 2021 to solve overloading concerns identified under CNP Planning Events P1, P2, P3, P6, P7, and SWCB Unavailability Scenario for Options 2 – 7

For Option 3, upgrade of 345 kV STP – HWY 35 circuit 64 will also be needed to solve overloading concerns under CNP Planning Event P3, P6, P7, and SWCB Unavailability Scenario.

For Options 6 and 7, under CNP Planning Event P3, 345 kV STP – Jones Creek circuits 18 and 27 are overloaded between 102.0 %-105 % for the 2022 summer peak case while loading on those two circuits for Options 2-5 are below 70 %. Transfer capability analysis from Section 8.11 showed that Options 2-5 have approximately the same transfer capability which was much higher than Options 6-7. For these reasons, Options 6 and 7 were removed from further consideration.

Results under Maintenance Outage Scenario

Under maintenance outage conditions, overloads greater than 115% of the emergency rating (Rate B) were used to identify circuits that needed to be upgraded.

For Options 3 and 4, 345 kV STP – Hillje circuit 44 overloads higher than 115 % under both summer peak and minimum conditions. For all other options loading on 345 kV STP – Hillje circuit 44 is below 115 % under summer peak or minimum conditions. 345 kV STP – Hillje circuit 44 is owned and operated by Austin Energy. Although the line uses the same conductor on similar towers to CenterPoint Energy 345 kV STP – Hillje circuit 64, due to a difference in rating methodology, Austin Energy rates their line at a lower rating. Should Options 3 and 4 be viewed as leading options, then further discussion between ERCOT, Austin Energy, and CenterPoint Energy needs to occur to resolve the need for upgrading.

Option 2 considerations

THE FOLLOWING IS PROTECTED INFORMATION / CEII

8 Short Circuit Analysis

Short circuit analysis was performed to identify any fault duty upgrades that may be needed as a result of the projects proposed in Bridge the Gap and Options 2 - 5. The base cases outlined in Section 3, Study Assumptions, were used to perform the analysis and include applicable zero sequence and mutual coupling data. Fault currents were calculated for three-phase and single-line-to-ground faults at nearby substations. In accordance with CenterPoint Energy Design Criteria, available three-phase and single-phase fault current should not exceed 97 % of any facility's short circuit rating. Fault currents at nearby substations did not exceed 97 % for any of the options. Fault duty results are shown in Table 8-1 below. All new substations were assumed to have a minimum KAIC rating of 63kA.

Table 8-1: Fault Duty

Bus	Bus Name	kV	KAIC	2019 Base Case				Bridge the Gap			
				3PH	SLG	HIGHEST	% of KAIC	3PH	SLG	HIGHEST	% of KAIC
5915	SO_TEX__345A	345	63	43	48.02	48.02	76.22%	41.87	47.03	47.03	74.65%
42500	DOW_____345A	345	50	28.69	24.55	28.69	57.38%	27.04	24.24	27.04	54.08%
42530	JONCRK__345A	345	63	25.6	21.41	25.6	40.63%	26.31	23.55	26.31	41.76%
42540	JONCRK__138A	138	63	42.24	39.53	42.24	67.05%	45.98	45.8	45.98	72.98%
43360	VLASCO__138A	138	63	46.21	38.55	46.21	73.35%	46.72	39.93	46.72	74.16%
44000	W_A_P___345A	345	63	49.15	46.46	49.15	78.02%	49.1	46.49	49.1	77.94%
44005	W_A_P___345B	345	63	30.44	30.25	30.44	48.32%	30.41	30.24	30.41	48.27%
44040	BAILEY_POI_5	345	63	18.76	18.4	18.76	29.78%	18.71	18.37	18.71	29.70%
44200	HILLJE__345A	345	63	30.87	24.98	30.87	49.00%	30.59	24.85	30.59	48.56%

Bus	Bus Name	kV	KAIC	OPTION 2				OPTION 3			
				3PH	SLG	HIGHEST	% of KAIC	3PH	SLG	HIGHEST	% of KAIC
5915	SO_TEX__345A	345	63	44.98	50.07	50.07	79.48%	43.41	48.53	48.53	77.03%
42500	DOW_____345A	345	50	32.36	28.44	32.36	64.72%	31.57	27.7	31.57	63.14%
42530	JONCRK__345A	345	63	32.33	28.56	32.33	51.32%	31.44	27.67	31.44	49.90%
42540	JONCRK__138A	138	63	52.07	51.43	52.07	82.65%	51.18	50.43	51.18	81.24%
43360	VLASCO__138A	138	63	52.09	43.34	52.09	82.68%	51.31	42.7	51.31	81.44%
44000	W_A_P___345A	345	63	49.35	46.64	49.35	78.33%	49.23	46.54	49.23	78.14%
44005	W_A_P___345B	345	63	30.49	30.29	30.49	48.40%	30.53	30.32	30.53	48.46%
44040	BAILEY_POI_5	345	63	18.82	18.44	18.82	29.87%	19	18.58	19	30.16%
44050	HWY 35_CNP	345	63	N/A	N/A	N/A	N/A	31.81	26.99	31.81	50.49%
44200	HILLJE__345A	345	50	31.29	25.19	31.29	62.58%	32.37	26.08	32.37	64.74%

Bus	Bus Name	kV	KAIC	OPTION 4				OPTION 5			
				3PH	SLG	HIGHEST	% of KAIC	3PH	SLG	HIGHEST	% of KAIC
5915	SO_TEX__345A	345	63	42.51	47.65	47.65	75.63%	42	47.15	47.15	74.84%
42500	DOW_____345A	345	50	31.63	27.63	31.63	63.26%	32.22	28.32	32.22	64.44%
42530	JONCRK__345A	345	63	31.53	27.59	31.53	50.05%	32.22	28.45	32.22	51.14%
42540	JONCRK__138A	138	63	51.21	50.32	51.21	81.29%	51.86	51.21	51.86	82.32%
43360	VLASCO__138A	138	63	51.32	42.61	51.32	81.46%	51.88	43.15	51.88	82.35%
44000	W_A_P___345A	345	63	49.16	46.49	49.16	78.03%	49.18	46.49	49.18	78.06%
44005	W_A_P___345B	345	63	30.61	30.38	30.61	48.59%	31.67	31.11	31.67	50.27%
44040	BAILEY_POI_5	345	63	19.37	18.87	19.37	30.75%	26.42	24.56	26.42	41.94%
44200	HILLJE__345A	345	50	34.94	28.48	34.94	69.88%	31.83	25.49	31.83	63.66%

Results of the short circuit analysis show that fault duty remains below 80% for all 345 kV substations and below 85% for all 138 kV substations.

9 Cost Estimates

As part of their letter agreement, DOW has provided financial security for the third capacitor bank (120 MVAr) at Jones Creek substation and third capacitor bank (120 MVAr) at Velasco substation to accommodate their planned load addition. The capacitor banks are already planned to be installed BP2019 by CenterPoint Energy; therefore, the costs are not included in the Freeport Area Master Plan estimates.

9.1 Cost estimate – Bridge the Gap Upgrades

Cost estimate for the Bridge the Gap solution are shown in Table 9-1.

Table 9-1: Cost Estimate - Bridge the Gap Upgrades

Work Description	Transmission Cost	Substation Cost
Loop 345 kV STP - Dow-Velasco circuit 27 into Jones Creek	$1,700,000	$5,400,000
Install 345kV 7 ohm in-line reactor at Jones Creek on 345 kV STP - Jones Creek circuit 18 Install 345kV 7 ohm in-line reactor at Jones Creek on 345 kV STP - Jones Creek circuit 27 (reactor rated for 5000A continuous and 5500A emergency)	-	$4,000,000
Install 3rd 345/138kV 800/1000 MVA Autotransformer at Jones Creek substation	-	$11,200,000
Install 4th 138kV (120 MVAr) capacitor bank at Jones Creek	-	$1,600,000
Install 2 - 138 kV positions at Jones Creek for two automatic switched capacitor banks	-	$3,800,000
Install 1st 138 kV (140 MVAr) automatic switched capactior bank at Jones Creek Substation	-	$2,320,000
Install 2nd 138 kV (140 MVAr) automatic switched capactior bank at Jones Creek Substation	-	$2,320,000
TOTAL	$32,340,000	

9.2 Cost estimates – New Line Options

For Options 2 through 5 the straight-line distance to Jones Creek plus a 20% adder was used to calculate cost. The straight-line distances and total line distances to Jones Creek including the 20% adder are shown below in Table 9-2.

Table 9-2: Straight-line distance to Jones Creek including 20 % adder

Option	Description	Straight-Line Distance (miles)	20% adder (miles)	Total Line Distance (structure miles)
2	South Texas Project to Jones Creek	42	8.4	50.4
3	Hwy 35 area to Jones Creek	46	9.2	55.2
4	Hillje to Jones Creek	52	10.4	62.4
5	Bailey to Jones Creek	40	8	48

CenterPoint Energy estimated a $4 million cost per mile for 345 kV double-circuit line construction including right-of-way. Cost estimates for the new line options are provided in Table 9-3 and also include any cost associated with purchasing property for a new substation.

Table 9-3: Cost Estimates: New Line Options

OPTION	Work Description	Transmission Cost	Substation Cost
2	Build a new approximately 50.4 mile 345 kV double circuit transmission line from STP to Jones Creek (does not include cost for STP for providing property and relocating one plant standby transformer circuit)	$201,600,000	$9,630,000
	Upgrade 345kV Dow-Velasco - Jones Creek circuits 18 and 27 (minimum 1700 MVA emergency rating)	$12,000,000	-
	TOTAL	$223,230,000	
3	Build New Switching Station near intersection of STP - Hillje circuit 64 and Highway 35 (referred to as HWY 35 substation in following estimates)	-	$11,710,000
	Loop in STP - Hillje circuit 64 into HWY 35 and upgrade 345 kV STP - Hwy35 substation circuit 64 (minimum 2000 MVA emergency rating)	$36,000,000	$120,000
	Build a new approximately 55.2 mile 345 kV double circuit transmission line from Hwy35 substation to Jones Creek	$220,800,000	$5,400,000
	Upgrade 345kV Dow-Velasco - Jones Creek circuits 18 and 27 (minimum 1700 MVA emergency rating)	$12,000,000	-
	TOTAL	$286,030,000	
4	Build a new approximately 62.4 mile 345 kV double circuit transmission line from Hillje to Jones Creek	$249,600,000	$10,900,000
	Upgrade 345kV Dow-Velasco - Jones Creek circuits 18 and 27 (minimum 1700 MVA emergency rating)	$12,000,000	-
	TOTAL	$272,500,000	
5	Build a new approximately 48 mile 345 kV double circuit transmission line from Bailey to Jones Creek (includes converting Bailey to breaker-and-half configuration)	$192,000,000	$10,400,000
	Upgrade 345kV Dow-Velasco - Jones Creek circuits 18 and 27 (minimum 1700 MVA emergency rating)	$12,000,000	-
	TOTAL	$214,400,000	

The total cost for each option including the short-term Bridge the Gap Upgrades and long-term new transmission line options are shown below in Table 9-4.

Table 9-4: Summary of Cost for Options 2 - 5

Option	Description	Bridge the Gap	New Line Option	Total Cost
2	South Texas Project to Jones Creek	$32,340,000	$223,230,000	$255,570,000
3	Hwy 35 area to Jones Creek	$32,340,000	$286,030,000	$318,370,000
4	Hillje to Jones Creek	$32,340,000	$272,500,000	$304,840,000
5	Bailey to Jones Creek	$32,340,000	$214,400,000	$246,740,000

10 Conclusion

The primary objective of the study was to determine a solution for serving the short term and long term load requirements of the Freeport Area while maintaining transmission grid reliability under the current projected demand and generation scenarios for years 2018 to 2022.

CenterPoint Energy created Study Cases for years 2018 to 2022 from ERCOT's SSWG base cases and analyzed them according to the applicable NERC Reliability Standard TPL-001-4, ERCOT Planning Guide Section 4 (ERCOT Transmission Planning Criteria), and CenterPoint Energy Transmission System Design Criteria. Consistent with other previous ERCOT assessments, the results shown in this report for the different planning events studied indicate that the voltage and thermal loading criteria are not satisfied in the Study Case for anticipated system conditions beginning in 2019 unless new reliability projects are constructed.

CenterPoint Energy evaluated eight options to serve the new committed loads in the Freeport Area, maintain transmission grid reliability, provide for future load growth, increase transfer capability to the Freeport Area, and improve the ability to take 345 kV scheduled maintenance outages in the Freeport Area. These included one option (Option 1) to upgrade the existing 345 kV and 138 kV transmission system and seven options (Options 2-8) that include short term system upgrades (i.e., "bridge the gap" upgrades) coupled with long term system upgrades (i.e., building a new 345 kV double-circuit transmission line into the Freeport Area).

CenterPoint Energy evaluated the eight options for steady-state, short circuit, transient stability, and transfer capability performance. Option 1 upgrades the existing system in the Freeport Area, including upgrading of three 345 kV double-circuit lines and adding significant reactive support with new capacitor banks and SVCs at a total estimated cost of $453.17 million. Option 1 was rejected since its cost is almost double the cost of the other options and is, therefore, not a cost effective solution. Options 6 and 7 were rejected because they did not resolve all of the 345 kV circuit overloads, and Option 8 was rejected because it did not provide sufficient reactive support to the Freeport Area compared to the other options. It is also notable that Options 6, 7 and 8 had almost half the AC transfer capacity of the remaining Options 2 through 5.

CenterPoint Energy identified additional upgrades associated with the remaining options. Options 2-5 show similar steady-state, short circuit, and transient stability performance; however, Option 2 has additional risk considerations when compared to Options 3-5. The upgrades were included in the cost estimates. The total costs of Options 2-5 are shown in Table 10-1.

Table 10-1: Summary of Costs for Options 2 - 5

Option	Description	Total Cost
2	South Texas Project to Jones Creek	$255,570,000
3	Hwy 35 area to Jones Creek	$318,370,000
4	Hillje to Jones Creek	$304,840,000
5	Bailey to Jones Creek	$246,740,000

Based on all of the analyses performed and cost estimates, CenterPoint Energy recommends pursuing Option 5 for the Freeport Area Master Plan Project, which includes the following improvements:

To be completed before peak 2019 – (Bridge the Gap Upgrades)

- Loop 345 kV South Texas Project (STP) – Dow-Velasco circuit 27 into the Jones Creek Substation (approximately 0.9 mile)
- Install 7-ohm in-line reactors at the Jones Creek Substation on 345 kV STP – Jones Creek circuits 18 and 27
- Install 3rd 345/138 kV 800/1000 MVA Autotransformer at the Jones Creek Substation
- Install 4th 138 kV Capacitor Bank (120 MVAr) at Jones Creek Substation
- Install 1st 138 kV Automatically Switchable Capacitor Bank (140 MVAr) at Jones Creek Substation
- Install 2nd 138 kV Automatically Switchable Capacitor Bank (140 MVAr) at Jones Creek Substation

To be completed before peak 2021 – (New 345 kV Transmission Line)

- Build a new 345 kV double-circuit line from Bailey Substation to Jones Creek Substation (approximately 48 miles)
- Upgrade 345 kV Dow-Velasco – Jones Creek circuits 18 and 27 to at least a 1700 MVA emergency rating

The Freeport Area Master Plan successfully meets the design criteria requirements for steady-state, short circuit, and transient stability analysis with an estimated cost of $246.74 million. The project is recommended to be completed in two stages. The Bridge the Gap Upgrades are recommended to be complete before peak 2019 to serve the new committed loads. The new 345 kV line upgrades are to be completed before peak 2021 to serve long term load growth as well as provide for the ability to take maintenance outages in the Freeport Area. This timeline takes into consideration the typical lead times necessary to implement the proposed projects, including ERCOT review and approval, and materials and construction lead times. CenterPoint Energy requests ERCOT consider designating the project as ‘critical to reliability’ per PUCT Substantive Rule 25.101(b)(3)(D) due to the severity of the reliability concerns, the magnitude of new load being added to a small area, and the harm any delay in this project could have on the Texas economy.

11 References

[1] "2016 Regional Transmission Plan", ERCOT December 2016

[2] "2016 ERCOT Report on Existing and Potential Electric System Constraints and Needs", ERCOT December 2016

[3] "2016 Long Term System Assessment for the ERCOT Region", ERCOT December 2016

12 Appendix A: Changes Made to Base Case to Create Study Case

These cases are based on the ERCOT 15SSWG U2 cases posted on 02/23/2016.
The following are the complete changes that have been made to the ERCOT cases to create Internal Cases:

- SEQ DATA UPDATED USING LATEST SPWG FY CASES 06262015
- MISSING CNP AREA SEQUENCE DATA UPDATED USING PREVIOUS INTERNAL CASES
- ADDED PHILLIPS 3WINDING TRANSFORMERS, UPDATED RATEA FOR HE-WO-CKT34
- ADDED OYSTER CREEK GENERATION (16INR0003) FOR 2017-2022 CASES
- ADDED FRIENDSWOOD GENERATION (13INR0049) FOR 2017-2022 CASES
- UPDATED PGEN WITH BAYTOWN CHILLER (14INR0031) FOR 2016-2022 CASES
- UPDATED PHR A1 & OB A3 SERIAL NUMBER TO MATCH TEST REPORT
- UPDATED PHR A2 IMPEDANCES BASED UPON TEST REPORT
- UPDATED GSU TRANSFORMER CONTROL MODE TO NONE WITHIN CNP AREA
- UPDATED CNP AREA ZERO SEQUENCE DATA WITH CAPE REPORT
- SWITCHED OFF PETRONOVA UNIT (WAPGT2)IN 2016 SUMMER CASE
- UPDATE COLORADO BEND II (17INR0007) VSCHED & REMOTE BUS
- ZENITH A2 TERT ZONE FIX, CBY G1 & CBY G2 PGEN DECRESED BY 100 MW EACH
- SWITCHED OFF LAREDOVFT TO ADJUST SWING BUS IN 2017-2021 CASES
- UPDATED HOC-INTERMEDIATE CKT05 RATEB IN 2016-2022 CASES
- UPDATED HOC-INTERMEDIATE CKT05 RATEA & RATEC IN 2019-2022 CASES
- UPDATED COTTON VSCHED IN 2018 CASE & AMOCO & CCEC VSCHED in 2019 MIN CASE
- UPDATED PAP1, COTTON_PAP2 VSCHED & REMOTE BUS IN 2017& 2022 CASE
- UPDATED PYR, INDN, INDNENR, SENATE WIND, GRSES2 VSCHED IN 2016-2022 CASES
- ADJUSTED CBY AT2A, AT2B, & AT1 TAP RANGE TO FULL IN 2016-2022 CASES
- UPDATED HEIGHTS-WHITEOAK CKT34 RATEA IN 2016-2022 CASES
- UPDATED LIMESTONE AT1, AT2 AND NORTH BELT A2 RMAX AND RMIN IN 2016-2022 CASES
- UPDATED OBRIEN 2A AND 2B RMAX IN 2016-2022 CASES
- UPDATED WAP-BAILEY CKT72 & BAILEY-HILLJE CKT72 RATEA IN 2016-2022 CASES
- UPDATED NUMEROUS BRANCH RATINGS TO MATCH WITH MLSE
- UPDATED BELLAIRE A4 SERIAL NUMBER AND WNDV2 VOLTAGE IN 2016-2022 CASES
- UPDATED DOW NET LOAD MW AND MVAr VALUES IN 2016-2022 CASES
- UPDATED BVE VSCHED TO 1.0285 IN 2017 CASE
- UPDATED WEST COLUMBIA - VELASCO CKT02 RATINGS IN 2016-2022 CASES
- UPDATED DOWST65 PGEN TO MATCH THH SELF-SERVE LOAD IN 2019 MIN CASE
- 2016 – SWITCHED OFF ALL CTL UNITS IN 2016 AND BEYOND, AND SCALE DOWN ALL ERCOT LOAD (INCLUDING CNP)
- 2016 – SWITCHED OFF GBY UNIT 5 IN 2016 AND BEYOND, AND SCALE DOWN ALL ERCOT LOAD (INCLUDING CNP)

- 2017 - REMOVED QNTANA 138 kV BEGINNING IN 2017
- 2017 - UPDATED JONES CREEK TO FRANKLINS CAMP TOPOLOGY (MOVE SEADOC, SEAWAY, AND BOOSTR TAPS TO VELASCO CKT 02) IN 2017 AND BEYOND
- 2017 – SWITCHED OFF LOAD AT CORTEZ AND LEVEE DUE TO FLNG DELAY
- 2017 – SWITCHED OFF GENERATION AT OYSTER CREEK (LEVEE) DUE TO FLNG DELAY
- 2018 – UPDATED LOAD AT CORTEZ AND OYSTER CREEK DUE TO FLNG DELAY
- 2018 - ADDED 1ST JONES CREEK 120 MVAr CAPBANK TAPPED OFF JONES CREEK TO FREEPORT CIRCUIT IN 2018 AND BEYOND
- 2020 - SWITCH OFF ALL SRB UNITS BEGINNING IN 2020 AND BEYOND (WERE ALREADY OFF IN EARLIER YEARS) AND SCALE DOWN ALL ERCOT LOAD (INCLUDING CNP)
- 2017 – JONES CREEK TO VELASCO CIRCUIT 02 UPGRADED TO 1000 MVA EMERGENCY RATING

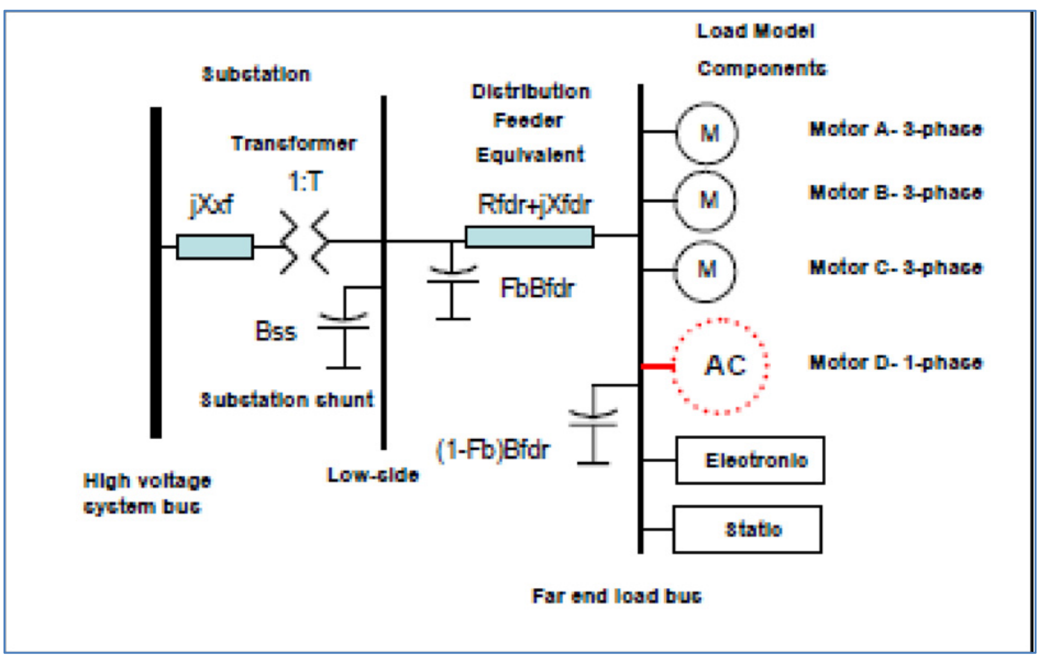
13 Appendix B: Composite Load Model

Load models and their parameters are probably the most difficult and important representation data to obtain. Loads are sensitive to voltage, frequency, and time. Therefore, having a representative load model is imperative in order to obtain reasonable results.

In late 2014, CenterPoint Energy contracted to EPRI their Load Component Export Tool. In this particular study, the load model was based on various factors. The load at each bus is modeled as a combination of voltage dependent components as shown in Figure A-1. For this representation, each load is split into Resistive, Small Motor, Large Motor, Single Phase motors and Discharge Lighting components based on load classification (percentage of Residential, Commercial and Industrial) and load composition data for Hot and Humid weather as indicated in Table A-1 for distribution feeders and Table A-2 for industrial customers served at the transmission level. Typical parameters provided by EPRI with some CenterPoint Energy adjustments were used in the dynamic simulation. Motor D stalling parameters used for this assessment are shown in Table A-3 below.

CenterPoint Energy is continuously investigating the development of improved load models and increased insight to the actual and evolving representation of system load compositions.

Figure A-1: Composite Load Model Representation



From MMWG report to TSS, August 2009

Table B-1 - Load Composition – Distribution Feeders

Load Composition								
Load Class/ Season	Motor A %	Motor B %	Motor C %	Motor D %	PE %	Z %	I %	P %
Residential / summer	0	5.55	24	48.66	7.62	13.54	0.62	0
Commercial / summer	46.27	8.78	5.37	0	15.26	5.09	19.21	0
Industrial / summer	15	20	20	0	20	10	15	0
Other / summer	10	0	0	0	10	13.33	53.33	13.34

Table B-2 - Load Composition – Industrial Feeders

Load Composition								
Load Class/ Season	Motor A %	Motor B %	Motor C %	Motor D %	PE %	Z%	I%	P%
Industrial / summer	15	20	20	0	20	10	15	0

Table B-3 – Motor D Stalling Parameters

Motor D Stalling Parameters				
Vstall	Rstall	Xstall	Frst	Vrst
0.45	0.124	0.114	0.5	0.8

Table B-4: Motor Protection Voltage Set Points and Timing

	Vtr1 (pu)	Ttr1 (s)	Ftr1	Vrc1 (pu)	Trc1 (s)	Vtr2 (pu)	Ttr2 (s)	Ftr2	Vrc2 (pu)	Trc2 (s)
Motor A	0.6	0.1	0.2	1	99999	0.5	0.02	0.7	0.6	0.05
Motor B	0.6	0.02	0.2	0.75	0.05	0.5	0.02	0.3	0.65	0.05
Motor C	0.65	0.02	0.2	1	99999	0.5	0.02	0.3	0.65	0.1

14 Appendix C: Transient Stability Reports – Bridge the Gap Year 2020

2020 Year – Bridge the Gap – No Motor Protection	2020_BaseCase_NO Prot.pdf
2020 Year – Bridge the Gap –With Motor Protection	2020_BaseCase_Pro t.pdf

15 Appendix D: Transient Stability Reports – New Line Options

Option 2	2020 Year – Option 2 Motor Protection	Option 2 NoPro.pdf
Option 2	2020 Year – Option 2 With Motor Protection	Option 2 Pro.pdf
Option 3	2020 Year – Option 3 No Motor Protection	Option 3 NoPro.pdf
Option 3	2020 Year – Option 3 With Motor Protection	Option 3 Pro.pdf
Option 4	2020 Year – Option 4 No Motor Protection	Option 4 NoPro.pdf
Option 4	2020 Year – Option 4 With Motor Protection	Option 4 Pro.pdf
Option 5	2020 Year – Option 5 No Motor Protection	Option 5 NoPro.pdf
Option 5	2020 Year – Option 5 With Motor Protection	Option 5 Pro.pdf
Option 6	2020 Year – Option 6 No Motor Protection	Option 6 NoPro.pdf
Option 6	2020 Year – Option 6 With Motor Protection	Option 6 Pro.pdf
Option 7	2020 Year – Option 7 No Motor Protection	Option 7 NoPro.pdf
Option 7	2020 Year – Option 7 With Motor Protection	Option 7 Pro.pdf
Option 8	2020 Year – Option 8 No Motor Protection	Option 8 NoPro.pdf
Option 8	2020 Year – Option 8 With Motor Protection	Option 8 Pro.pdf

16 Appendix E: Detailed Transfer Capability Analysis – New Line Options

From	To	Transfer Level	AC FCITC	DC FCITC	Delta FCITC	Limiting Constraint	Contingency	Ncon	PreShift	PostShift	Rating	AC TDF	DC TDF	LODF	PTDF
ERCOT_LOAD	FPAREA	5000.0													
OPTION 2 STP			785.7	2378.4	-1592.7	L: 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 27			981.7	1276.9	1450.0	0.37567	0.18959	-	0.10956
			NotConv				C:P7-1_E1>>FPASS_OPT2-1	3							
							Open 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 95								
							Open 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 96								
			785.7	2378.4	-1592.7	L: 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 18			981.7	1276.9	1450.0	0.37567	0.18959	-	0.10956
			NotConv				C:P7-1_E1>>FPASS_OPT2-1	3							
							Open 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 95								
							Open 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 96								
OPTION 3 HWY 35			785.3	2383.9	-1598.6	L: 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 18			982.0	1279.6	1450.0	0.37893	0.18959	-	0.12291
			NotConv				C:P7-1_E1>>FPASS_OPT3-1	3							
							Open 42530 JONCRK__345A 345 44050 HWY 35_CNP 345 95								
							Open 42530 JONCRK__345A 345 44050 HWY 35_CNP 345 96								
			785.3	2384.0	-1598.6	L: 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 27			982.0	1279.6	1450.0	0.37893	0.18959	-	0.12291
			NotConv				C:P7-1_E1>>FPASS_OPT3-1	3							
							Open 42530 JONCRK__345A 345 44050 HWY 35_CNP 345 95								
							Open 42530 JONCRK__345A 345 44050 HWY 35_CNP 345 96								
OPTION 4 Hillje			785.3	2386.2	-1600.9	L: 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 18			982.0	1279.6	1450.0	0.37893	0.18959	-	0.12779
			NotConv				C:P7-1_E1>>FPASS_OPT4-1	6							
							Open 42530 JONCRK__345A 345 44200 HILLJE__345A 345 95								
							Open 42530 JONCRK__345A 345 44200 HILLJE__345A 345 96								
			785.3	2386.2	-1600.9	L: 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 27			982.0	1279.6	1450.0	0.37893	0.18959	-	0.12779
			NotConv				C:P7-1_E1>>FPASS_OPT4-1	6							
							Open 42530 JONCRK__345A 345 44200 HILLJE__345A 345 95								
							Open 42530 JONCRK__345A 345 44200 HILLJE__345A 345 96								
OPTION 5 BAILEY			785.3	2382.5	-1597.1	L: 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 18			982.0	1279.5	1450.0	0.37892	0.18959	-	0.13835
			NotConv				C:P7-1_E1>>FPASS_OPT5-1	6							
							Open 42530 JONCRK__345A 345 44040 BAILEY_POI_5 345 95								
							Open 42530 JONCRK__345A 345 44040 BAILEY_POI_5 345 96								
			785.3	2382.5	-1597.2	L: 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 27			982.0	1279.5	1450.0	0.37892	0.18959	-	0.13835
			NotConv				C:P7-1_E1>>FPASS_OPT5-1	6							
							Open 42530 JONCRK__345A 345 44040 BAILEY_POI_5 345 95								
							Open 42530 JONCRK__345A 345 44040 BAILEY_POI_5 345 96								
OPTION 6 GUY			476.3	759.5	-283.2	L: 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 18			1311.4	1450.2	1450.0	0.29139	0.17097	-	0.14297
							C:P7-1_E1>>FPASS_OPT6-3	8							
							Open 44000 W_A_P___345A 345 44200 HILLJE__345A 345 64								
							Open 44040 BAILEY_POI_5 345 44045 GUY_CNP 345 72								
			476.3	759.5	-283.2	L: 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 27			1311.4	1450.2	1450.0	0.29139	0.17097	-	0.14297
							C:P7-1_E1>>FPASS_OPT6-3	8							
							Open 44000 W_A_P___345A 345 44200 HILLJE__345A 345 64								
							Open 44040 BAILEY_POI_5 345 44045 GUY_CNP 345 72								
OPTION 7 WAP			493.0	771.6	-278.6	L: 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 18			1312.3	1449.4	1450.0	0.27820	0.16557	-	0.14457
							C:P7-1_E1>>T6472D	288							
							Open 44000 W_A_P___345A 345 44200 HILLJE__345A 345 64								
							Open 44005 W_A_P___345B 345 44040 BAILEY_POI_5 345 72								
			493.0	771.6	-278.6	L: 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 27			1312.3	1449.4	1450.0	0.27820	0.16557	-	0.14457
							C:P7-1_E1>>T6472D	288							
							Open 44000 W_A_P___345A 345 44200 HILLJE__345A 345 64								
							Open 44005 W_A_P___345B 345 44040 BAILEY_POI_5 345 72								
OPTION 8 OASIS			438.8	514.7	-75.9	L: 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 18			1316.9	1450.1	1450.0	0.30370	0.22453	0.37900	0.16282
							C: 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 27	581							
							Open 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 27								
			438.8	514.7	-75.9	L: 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 27			1316.9	1450.1	1450.0	0.30370	0.22453	0.37900	0.16282
							C: 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 18	582							
							Open 5915 SO_TEX__345A 345 42530 JONCRK__345A 345 18								

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