DPNS-2023-APRIL-1762

Delivery Point Network Study

Published on 8/8/2023

By SPP Engineering, Transmission Services

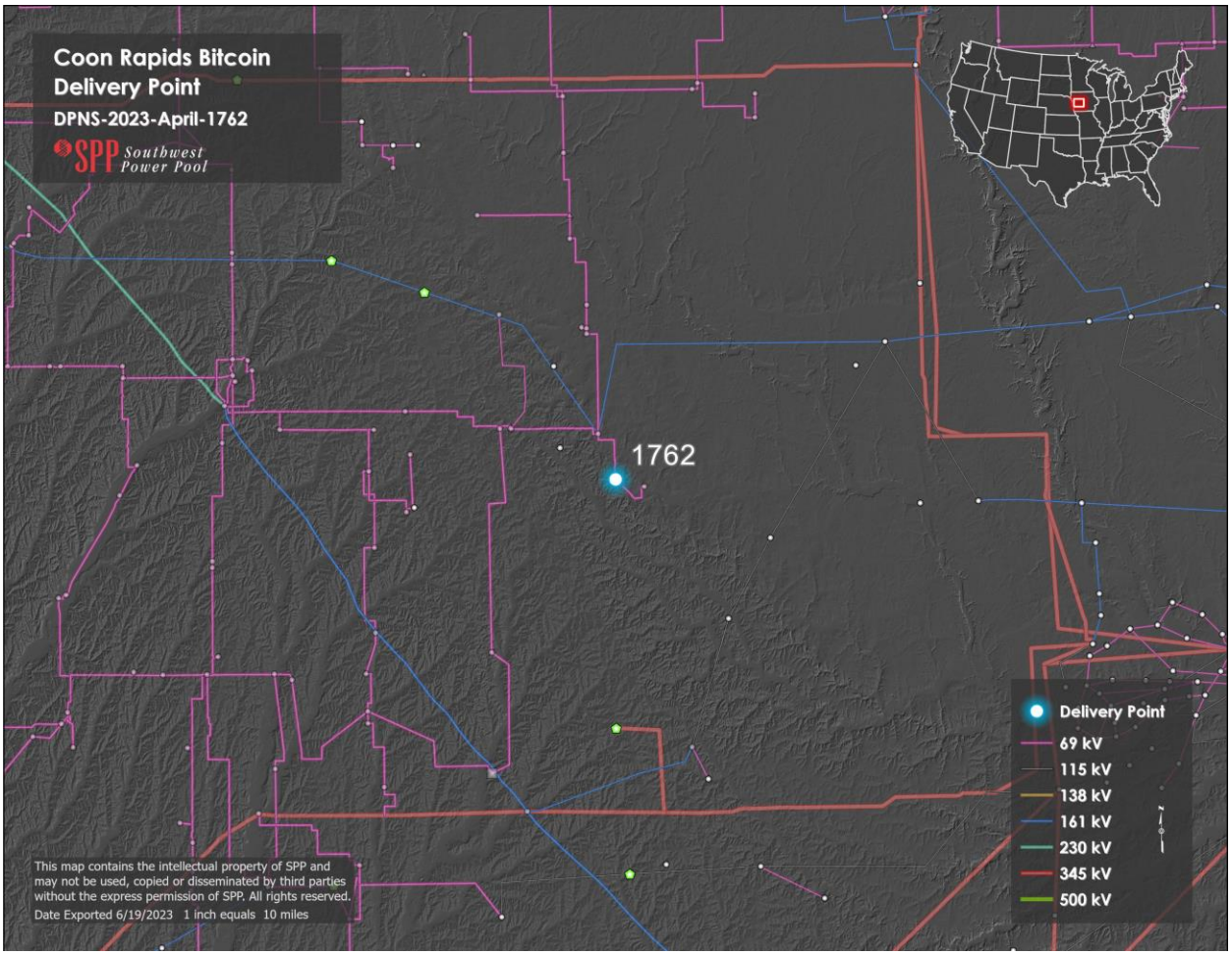
REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION	COMMENTS
7/12/2023	SPP	Original	
8/8/2023	SPP	Modified the total amount of load being studied	

CONTENTS

SECTION 1: INTRODUCTION

This report outlines the results of an evaluation of regional transmission impacts from delivery point request DPNS-2023-April-1762. The requesting entity plans to add additional load to an existing delivery point called Coon Rapids. The Coon Rapids delivery point is in the Corn Belt Power Cooperative (CBPC) transmission system.



The load flow models used for the evaluation were 2023 ITP models. SPP performed an AC contingency analysis on these models using PSS®E.

SECTION 2: STUDY METHODOLOGY

OBJECTIVE

The purpose of this study was to determine the regional transmission system impacts within the SPP footprint due to the change in load served by CBPC. SPP performed a Delivery Point Network Study ("DPNS") with the configurations shown in Table 2-1 below.

STUDY PROCESS

- Model Assumptions
  - 2023 ITP models
    - Model years 2023, 2024, 2027, and 2032
    - Summer Peak (2024S, 2027S, and 2032S), Winter Peak (2023W, 2024W, 2027W, and 2032W), and Light Load (2024L, 2027L, and 2032L)
  - 2023 ITP Short Circuit model set
    - 2027 Summer Max Fault
  - MDWG Dynamic model set
    - 2031 MDWG Summer Peak Base and Change Case

Case Name	Study Year	Season	Scenario	Load (MW/MVAR)
2023ITPPF-23W.sav	2023	Winter Peak	Base Reliability	Base Case
2023ITPPF-24L.sav	2024	Light Load	Base Reliability	Base Case
2023ITPPF-24S.sav	2024	Summer Peak	Base Reliability	Base Case
2023ITPPF-24W.sav	2024	Winter Peak	Base Reliability	Base Case
2023ITPPF-27L.sav	2027	Light Load	Base Reliability	Base Case
2023ITPPF-27S.sav	2027	Summer Peak	Base Reliability	Base Case
2023ITPPF-27W.sav	2027	Winter Peak	Base Reliability	Base Case
2023ITPPF-32L.sav	2032	Light Load	Base Reliability	Base Case
2023ITPPF-32S.sav	2032	Summer Peak	Base Reliability	Base Case
2023ITPPF-32W.sav	2032	Winter Peak	Base Reliability	Base Case
2023ITPPF-23W_1762.sav	2023	Winter Peak	Base Reliability	Coon Rapids = 59.0/8.4075
2023ITPPF-24L_1762.sav	2024	Light Load	Base Reliability	Coon Rapids = 59.0/8.4075
2023ITPPF-24S_1762.sav	2024	Summer Peak	Base Reliability	Coon Rapids = 59.0/8.4075
2023ITPPF-24W_1762.sav	2024	Winter Peak	Base Reliability	Coon Rapids = 59.0/8.4075
2023ITPPF-27L_1762.sav	2027	Light Load	Base Reliability	Coon Rapids = 59.0/8.4075
2023ITPPF-27S_1762.sav	2027	Summer Peak	Base Reliability	Coon Rapids = 59.0/8.4075
2023ITPPF-27W_1762.sav	2027	Winter Peak	Base Reliability	Coon Rapids = 59.0/8.4075
2023ITPPF-32L_1762.sav	2032	Light Load	Base Reliability	Coon Rapids = 59.0/8.4075
2023ITPPF-32S_1762.sav	2032	Summer Peak	Base Reliability	Coon Rapids = 59.0/8.4075

Case Name	Study Year	Season	Scenario	Load (MW/MVAR)
2023ITPPF-32W_1762.sav	2032	Winter Peak	Base Reliability	Coon Rapids = 59.0/8.4075

Table 2-1: Study Cases

- Steady State Analysis
  - Assumptions (consistent with the ITP analysis)
    - AC contingency analysis on all load flow models using PSS®E
    - Monitored Elements
      - SPP facilities 69 kV and above
      - First-tier companies 100 kV and above
    - Contingencies (consistent with the ITP analysis)
      - Provided for the ITP by SPP members and first-tier companies
    - Apply SPP Criteria and NERC reliability standards
  - Compare thermal overloads and voltage violations that occur with and without the Coon Rapids delivery point changes to determine thermal overloads and voltage violations resulting from the load addition to the transmission system.
- Dynamics Analysis
  - Assumptions
    - MDWG Dynamics Model Set
      - 2023 and 2031 MDWG Summer Peak Base and Change Case
  - Analyses
    - Fast Fault Screening using POM Studio
- Short Circuit Analysis
  - Assumptions
    - Used 2023 Final ITP Short Circuit models (Max Fault)
      - Placed all available facilities in service
        - Generation
        - Transmission lines
        - Transformers
        - Buses
      - Short Circuit Output
        - Physical
      - Short Circuit Coordinates
        - Polar
      - Short Circuit Parameters
        - 3 Phase
      - FLAT – classical fault analysis conditions
  - Analyses
    - Three-phase fault

SECTION 3: RESULTS OF ANALYSIS

POTENTIAL THERMAL OVERLOADS AND VOLTAGE VIOLATIONS

The analysis identified potential thermal and voltage violations resulting from the load being added to the Coon Rapids delivery point. Table 3-1 details the potential thermal overloads resulting from the load addition.

Year	Season	Facility Name	Contingencies	RATE A, RATE B (MVA)	Max Flow (MVA)	Change Case Max Loading (%)
2023	Winter	TCE8 - TCE TAP8 - 1	CAROLTON8 - COONRPDS G - 1	59.6/65.6	65.9936	100.6
2024	Winter	TCE8 - TCE TAP8 - 2	CAROLTON8 - COONRPDS G - 1	59.6/65.6	65.8624	100.4
2027	Summer	TCE8 - TCE TAP8 - 3	CAROLTON8 - COONRPDS G - 1	59.6/65.6	65.9936	100.6

Table 3-2 details the potential voltage violations resulting from the load addition.

Year	Season	Facility Name	Facility Voltage (kV)	Contingency Name	Voltage Maximum (pu)	Voltage Minimum (pu)	Bus Voltage (pu)
2023	Winter	COONRPDS G	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.65467
2023	Winter	TCE TAP8	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.66342
2023	Winter	TCE8	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.69919
2023	Winter	TCE8	69	TCE8 - RAILWAY 8 - 1	1.05	0.9	0.87469
2023	Winter	TCE TAP8	69	TCE8 - RAILWAY 8 - 1	1.05	0.9	0.87829
2023	Winter	COONRPDS G	69	TCE8 - RAILWAY 8 - 1	1.05	0.9	0.87913
2023	Winter	COONRPDS G	69	TCE TAP8 - COONRPDS G - 1	1.05	0.9	0.89922
2023	Winter	TCE TAP8	69	TCE8 - TCE TAP8 - 1	1.05	0.9	0.89926
2023	Winter	COONRPDS G	69	TCE8 - TCE TAP8 - 1	1.05	0.9	0.89926
2023	Winter	TCE TAP8	69	BASE CASE	1.05	0.95	0.94663
2024	Summer	COONRPDS G	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.63185
2024	Summer	TCE TAP8	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.64082
2024	Summer	TCE8	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.67761
2024	Summer	TCE8	69	TCE8 - RAILWAY 8 - 1	1.05	0.9	0.86379
2024	Summer	TCE TAP8	69	TCE8 - RAILWAY 8 - 1	1.05	0.9	0.86744
2024	Summer	COONRPDS G	69	TCE8 - RAILWAY 8 - 1	1.05	0.9	0.86829
2024	Summer	COONRPDS G	69	TCE TAP8 - COONRPDS G - 1	1.05	0.9	0.89054
2024	Summer	COONRPDS G	69	TCE8 - TCE TAP8 - 1	1.05	0.9	0.89059
2024	Summer	TCE TAP8	69	TCE8 - TCE TAP8 - 1	1.05	0.9	0.89059
2024	Summer	TCE TAP8	69	BASE CASE	1.05	0.95	0.93897
2024	Summer	TCE8	69	BASE CASE	1.05	0.95	0.94795
2024	Winter	COONRPDS G	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.66514
2024	Winter	TCE TAP8	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.66943
2024	Winter	TCE8	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.70504
2027	Light Load	COONRPDS G	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.67292
2027	Light Load	TCE TAP8	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.67716
2027	Light Load	TCE8	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.71222

Year	Season	Facility Name	Facility Voltage (kV)	Contingency Name	Voltage Maximum (pu)	Voltage Minimum (pu)	Bus Voltage (pu)
2027	Summer	COONRPDS G	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.64649
2027	Summer	TCE TAP8	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.65089
2027	Summer	TCE8	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.68752
2027	Winter	COONRPDS G	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.63374
2027	Winter	TCE TAP8	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.63818
2027	Winter	TCE8	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.67514
2032	Light Load	COONRPDS G	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.67617
2032	Light Load	TCE TAP8	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.68039
2032	Light Load	TCE8	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.7153
2032	Summer	COONRPDS G	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.83866
2032	Summer	TCE TAP8	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.84209
2032	Summer	TCE8	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.86997
2032	Winter	COONRPDS G	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.84271
2032	Winter	TCE TAP8	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.84611
2032	Winter	TCE8	69	CAROLTON8 - COONRPDS G - 1	1.05	0.9	0.87378

Table 3-2: Potential Voltage Violations

SHORT CIRCUIT

SPP performed short circuit analysis for the 2027 Summer Peak with the load changes at Coon Rapids. The analysis identified the currents as listed in Table 3-3.

Season	Model	Fault	Bus	Current(Amps)
27S	Max Fault	Three Phase	CLC-69-B2 69	12,180
27S	Max Fault	Three Phase	AUD-69 69	3,896
27S	Max Fault	Three Phase	CAW-69 69	7,581
27S	Max Fault	Three Phase	CLN-69 69	9,444
27S	Max Fault	Three Phase	CLC-13.8-8T113	16,735
27S	Max Fault	Three Phase	CLS-6T1-12.412	7,812
27S	Max Fault	Three Phase	TEM-6T1-12.412	2,902
27S	Max Fault	Three Phase	CAW-34.5 34	3,429
27S	Max Fault	Three Phase	AUD SW 7211 69	3,896
27S	Max Fault	Three Phase	AUD SW 7212 69	3,896
27S	Max Fault	Three Phase	CLS-13-LINEZ12	4,214
27S	Max Fault	Three Phase	RAILWAY 8 69	3,975
27S	Max Fault	Three Phase	SCRANTN RC8 69	2,038
27S	Max Fault	Three Phase	SEELYREC TP869	4,551
27S	Max Fault	Three Phase	BGLYRECTP 8 69	3,319
27S	Max Fault	Three Phase	BAGLEYREC 8 69	2,695
27S	Max Fault	Three Phase	SEELY REC 8 69	3,404
27S	Max Fault	Three Phase	INDUSTRLREC869	5,599
27S	Max Fault	Three Phase	CAROL S8 69	9,272
27S	Max Fault	Three Phase	TEMPLTN8 69	7,581
27S	Max Fault	Three Phase	WSIDETP8 69	9,330
27S	Max Fault	Three Phase	DENISON8 69	11,865

Season	Model	Fault	Bus	Current(Amps)
27S	Max Fault	Three Phase	CAROLTON8 69	6,482
27S	Max Fault	Three Phase	CONNER8 69	5,503
27S	Max Fault	Three Phase	COONRPDS G 69	4,874
27S	Max Fault	Three Phase	GLIDDEN8 69	6,777
27S	Max Fault	Three Phase	WEAKLEND8 69	8,573
27S	Max Fault	Three Phase	TCE8 69	4,215
27S	Max Fault	Three Phase	TCE TAP8 69	4,748
27S	Max Fault	Three Phase	TEMPLTON8 69	7,577
27S	Max Fault	Three Phase	TOYNE8 69	8,373
27S	Max Fault	Three Phase	SCHUMACHERT869	6,929
27S	Max Fault	Three Phase	SCHUMACHER8 69	6,418
27S	Max Fault	Three Phase	RALSTONT8 69	3,811
27S	Max Fault	Three Phase	MANNINGTAP 869	6,415
27S	Max Fault	Three Phase	DRAGER5 16	9,200
27S	Max Fault	Three Phase	DRAGER TERT 12	12,151
27S	Max Fault	Three Phase	DRAGER8 69	7,823
27S	Max Fault	Three Phase	L9 MANNI-NI869	5,752

Table 3-3: Short Circuit Results

STABILITY

SPP performed a Fast Fault Screening (FFS) for the base case and change case models. The change case models include the Coon Rapids delivery point changes. The FFS was performed for the 2031 Summer Peak model. There were no significant differences in the critical clearing times between the base and change cases. Therefore, a transient stability analysis is not required.

TRANSMISSION SOLUTIONS

The load caused potential voltage violations on the 69kV line from Carrollton to Coon Rapids to Tall Corn Ethanol as well as a potential thermal overload on the TCE – TCE Tap 69kV line. The project listed in Table 3-4 is recommended to mitigate these violations.

New Upgrade Description*	Mileage	MVAR	Date Needed**	Estimated Cost***
Coon Rapids 69kV Capacitor Bank (32 MVAR)	-	32	1/1/2024	$1,143,416
Rebuild TCE – TCE Tap 69kV line	3.7	-	1/1/2024	$1,487,500
TOTAL NEW UPGRADE COST				**$2,630,916**

Table 3-4: Recommended Upgrade

*All requests with a Network Upgrade(s) identified in the DPNS will be subject to further evaluation in the soonest available Integrated Transmission Planning Assessment that is able to include the load changes, if it is determined that the Network Upgrade(s) will be able to meet the study timeframe requirements pursuant to the standardized project timelines in SPP Business Practices, based on the SPP determined Network Upgrade(s) need date. If it is determined that a Network Upgrade(s) identified from a DPNS is unable to be further evaluated pursuant to the Integrated Transmission Planning Assessment, the DPNS report will be posted on the SPP website once SPP is notified by the Transmission Customer to update the applicable Network Integration Transmission Service Agreement to reflect the changes in delivery points and the Network Upgrade(s).

**If the project need date specified in this study cannot be met, the Transmission Owner will be required to submit mitigations pursuant to the SPP Project Tracking process. All upgrades or mitigations must be in place prior to the dates shown in Table 3-3.

***Note that the estimated new upgrade cost provided in this report is an SPP Conceptual Cost Estimate only; this is preliminary, and a more refined Study Cost Estimate will be developed after issuance of this report through a Standardized Cost Estimate Reporting Template (SCERT).

SECTION 4: CONCLUSION

The AC analysis revealed potential voltage violations associated with the Coon Rapids delivery point load changes. The study shows that the following upgrades are required to reliably serve the load change:

Coon Rapids 69kV Capacitor Bank (32 MVAR)
Rebuild TCE – TCE Tap 69kV line

The transmission upgrades in Table 3-4 are recommended to mitigate the potential thermal and voltage violations in the most cost-effective manner.