SPP Southwest Power Pool

System Impact Study For Transmission Service Requested By Tenaska Power Service Co.

From CSWS to ERCOTN

For a Reserved Amount Of 25 MW From 1/1/02 To 1/1/03

SPP Coordinated Planning

Table of Contents

1. Executive Summary

Tenaska Power Service Co. (TNSK) has requested a system impact study for long-term Firm Point-to-Point transmission service from CSWS to ERCOTN. The period of the transaction is from 1/1/02 to 1/1/03. The request is for OASIS reservation 242043 in the amount of 25 MW.

The principal objective of this study is to identify the system limitations and potential system modifications necessary to facilitate the additional 25 MW transfer while maintaining system reliability.

The capacity of the ERCOTN HVDC Tie at Oklaunion is limited to 185 MW in the summer months due to the converter/inverter cooling system restrictions and possible gassing of one of the DC tie transformers. Effort is currently underway by AEPW to increase the DC tie capacity to the rated capacity of 200 MW.

The 15 MW increase in capacity of the DC tie from 185 to 200 MW will allow 15 MW of the 25 MW request from CSWS to ERCOTN to be accepted without further expansion of the tie. The remaining 10 MW from CSWS to ERCOTN and any requests from ERCOTN would require additional capacity above the 200 MW. The 200 MW of capacity is already reserved from ERCOTN. One of the options for increasing the capability of the DC tie above 200 MW at Oklaunion is to install an additional HVDC tie in parallel with the existing tie. The estimated cost for 25 to 36 MW of capacity is $21,250,000.

TNSK presently has confirmed Monthly Firm Transmission Service ending 6/1/02 for 15 MW from CSWS to ERCOTN, OASIS reservation 261699. System Impact Analysis for a deferred service period from 6/1/02 to 6/1/03 for the available 15 MW is included.

The CSWS to ERCOTN 15 MW transfer impacts a facility that has been identified as a limiting constraint for previously studied transfers. Table 3 lists the previously identified facility impacted by the 15 MW transfer. The facility found in Table 3 limits the ATC to zero in the 2002 Summer (6/1/02-10/1/02).

2. Introduction

Tenaska Power Service Co. (TNSK) has requested an impact study for transmission service from CSWS to ERCOTN.

The principal objective of this study is to identify the restraints on the SPP Regional Tariff System that may limit the transfer too less than 25 MW. This study includes the AEPW assessment of the existing ERCOTN HVDC Tie, the options for expansion of the tie including the estimated costs, a summary of the higher priority requests that reserve the ERCOTN Tie Capacity, steady-state contingency analyses (PSS/E function ACCC), and Available Transfer Capability (ATC) analyses.

The steady-state analyses consider the impact of the transfer on transmission line loading and transmission bus voltages for outages of single and selected multiple transmission lines and transformers on the SPP system.

3. Existing ERCOTN HVDC Tie at Oklaunion

Currently there are about 10 GE HVDC installations in Canada (2) and the US (8). The first installation was completed in the early 1970's and the last in late 1980's. GE sold this line of business and they are currently providing minimum support to maintain the existing installations.

Currently the Oklaunion HVDC tie is de-rated to 185 MW due to the converter/inverter cooling system restrictions and possible gassing of one of the DC tie transformers. Effort is currently underway by AEPW to increase the DC tie capacity to the rated capacity of 200MW. A summary of these activities are listed below:

A. Converter/Inverter Cooling System

The existing cooling system has reduced efficiency due to corrosion of the cooling towers. Meers Consulting Firm has a contract with AEPW to specify, purchase, and install new cooling towers. The instillation of three new fluid coolers (cooling towers) and new pipes is underway. In order to minimize the DC tie outage during the cooling system modification, the towers and piping will be installed in two phases. Meers was requested to investigate the cooling system protection to make sure that the new towers can be integrated into the existing control.

B. Converter/Inverter Transformer

Currently AEPW has a spare GE three phase 345/34.5 kV, 270 MVA transformer at the site. The issue with transformer gassing should be investigated further and it may not be a real problem. This could be a result of CT lead arcing and it could possibly be repaired at the site in the future. In the past, AEPW has experienced two transformer failures due to the failure of the tap changers when the load was above 200 MW. If the tie is operated at a rating above 200 MW, there is a chance of failing transformers (harmonics, 5th, 7th, 23rd, and 2nd) and failing the SCRs due to insufficient converter/inverter cooling.

C. Thyristors

AEPW has experienced frequent failure of thyristors due to heat. 288 thyristors (6 valves of 48 thyristors) out of a total of 2,344 thyristors have been replaced ($700 per thyristor). AEPW has the intention to continue with the replacement of the thyristors in the future, possibly 150 thyristors per year. GE is not manufacturing these thyristors any more. These thyristors are available and can be purchased from SPCO or other suppliers.

D. DC Tie Controls

The DC tie controls are housed in three cabinets. Most of the controls are analog with some digital. In the past AEPW has replaced the failed control boards with the new spare boards or by replacing failed chips. AEPW has the capability of testing and repairing the control boards at the site. In addition, AEPW is currently maintaining a number of spare control boards at the site. There is no intention to replace the complete controls with the new generation of digital controls. However, ABB and possibly other manufacturers will be able to do this (ABB in the past, has supplied quotes for replacing the same generation of controls). GE is currently maintaining an inventory for some of the control boards and can repair and modify some of the failed boards.

E. Training

Training the current personnel to operate, trouble shoot, and maintain the HVDC tie seems to be one important issue that AEPW needs to address.

Considering the above effort, it is expected that the HVDC tie at Oklaunion will reach its rated capacity of 200 MW.

4. Expansion of HVDC Tie at Oklaunion

One of the options for increasing the capability of the DC tie at Oklaunion above the existing 200 MW is to install an additional HVDC tie in parallel with the existing tie. Sufficient leveled area exists at the station to accommodate the installation of the new HVDC. This option may bring up some challenges such as interaction of controls and the SSR issues. However, these issues can be addressed through studies and the proper adjustment of controls and possibly the installation of the tortional damping relays (SSR relay is installed on the existing DC).

A VSC similar to the BTBVSC at Eagle Pass (CP&L) can be installed to increase the capacity. The budgetary estimate for ABB's VSC is as follows:

- The turnkey cost for a 25MW to 36MW VSC is approximately $14 million. Additional cost for incorporating the new installation and PM is estimated to be $3 million. Total estimate unloaded cost is approximately $17 million. Add 20%-25% for overhead.

- The turnkey cost for a 50 MW VSC is approximately $15 million. Additional cost for incorporating the new installation and PM is estimated to be $3 million. Total estimate unloaded cost is approximately $18 million. Add 20%-25% for overhead.

- The turnkey cost for a 100MW VSC is approximately $23 million. Additional cost for incorporating the new installation and PM is estimated to be $3 million. Total estimate unloaded cost is approximately $ 26 million. Add 20%-25% for overhead.

- The turnkey cost for a 150MW VSC is approximately $25 million. Additional cost for incorporating the new installation and PM is estimated to be $3 million. Total estimate unloaded cost is approximately $ 28 million. Add 20%-25% for overhead.

5. Summary of Requests With a POR or POD of ERCOTN

Currently existing long-term firm point-to-point transmission requests reserve the capacity of the tie.

- For ERCOTN North to South, the tie capacity is reserved for 185 MW, which includes SWPP Oasis reservations 241294 for 172 MW (CSWS-ERCOTN, 4/1/01 to 4/1/02) and 242499 for 13 MW (CSWS-ERCOTN, 1/1/02-1/1/03).

- For ERCOTN South to North, the tie capacity is reserved for 200 MW, which includes CSWS Oasis reservations 79038 for 106 MW (ERCOTN-CSWS, 6/1/98-1/1/08), 94781 for 78 MW (ERCOTN-CSWS, 6/1/98-1/1/08), and 164601 for 16 MW (ERCOTN-CSWS, 1/1/98-1/1/08).

6. Study Methodology

A. Description

Two analyses were conducted to determine the impact of the 15 MW transfer on the system. The first analysis was conducted to identify any new overloads caused by the 15 MW transfer. The second analysis was done to ensure that available capacity exists on previously identified circuits.

The first analysis was to study the steady-state analysis impact of the 15 MW transfer on the SPP system. The second step was to study Available Transfer Capability (ATC) of the facilities identified in the steady-state analysis impact. The steady-state analysis was done to ensure current SPP Criteria and NERC Planning Standards requirements are fulfilled. The Southwest Power Pool (SPP) conforms to the NERC Planning Standards, which provide the strictest requirements, related to thermal overloads with a contingency. It requires that all facilities be within emergency ratings after a contingency.

The second analysis was done to determine the impact of the transfer on previously assigned and identified facilities.

B. Model Updates

SPP used six seasonal models to study the 15 MW request. The SPP 2001 Series Cases: 2002 Summer Peak, 2002 Fall Peak, 2002/03 Winter Peak, and 2003 Spring Peak were used to study the impact of the 15 MW transfer on the SPP system during a deferred transaction period from 6/1/02 to 6/1/03.

The chosen base case models were modified to reflect the most current modeling information. The cases were modified to reflect future firm transfers during the request period that were not already included in the January 2001 base case series models.

C. Transfer Analysis

Using the created models and the ACCC function of PSS\E, single and select double contingency outages were analyzed. Then full AC solution was used to obtain the most accurate results possible. Any facility overloaded, using MVA ratings, in the transfer case and not overloaded in the base case was flagged. The PSS/E options chosen to conduct the Impact Study analysis can be found in Appendix A.

7. Study Results

Tables 1, 2, and 3 contain the analysis results of the System Impact Study. The tables identify the seasonal case in which the event occurred; the emergency rating of the overloaded circuit (Rate B), the contingent loading percentage of circuit with and without the studied transfer, the estimated ATC value using interpolation if calculated, any SPP identification or assignment of the event, and any solutions received from the transmission owners.

Table 1 shows the new facility overloads caused by the 15 MW transfer. Upgrades associated with these new overloads can be directly assigned to the CSWS to ERCOTN 15 MW transfer. Available solutions are given in the table.

Table 2 documents overloads on Non SPP Regional Tariff participants' transmission systems caused by the 15 MW transfer.

Table 3 documents the 15 MW transfer impact on previously assigned and identified facilities. Available solutions are given in the table.

Table 1 - SPP Facility Overloads caused by the CSWS to ERCOTN 15 MW Transfer

Study Year	From Area To Area	Branch Over 100% Rate B	Rate B <MVA>	No Transfer %Loading	Transfer Case %Loading	Outaged Branch That Caused Overload	ATC	Solution
02SP		NONE					15	
02FA		NONE					15	
02WP		NONE					15	
03G		NONE					15	

Table 2 – Non-SPP Facility Overloads caused by the CSWS to ERCOTN 15 MW Transfer

Study Year	From Area To Area	Branch Over 100% Rate B	Rate B <MVA>	No Transfer %Loading	Transfer Case %Loading	Outaged Branch That Caused Overload
02SP		NONE				
02FA		NONE				
02WP		NONE				
03G		NONE				

Table 3 – Previously Assigned and Identified SPP Facilities Impacted by the CSWS to ERCOTN 15 MW Transfer

Study Year	From Area To Area	Branch Over 100% Rate B	Rate B	No Transfer %Loading	Transfer Case %Loading	Outaged Branch That Caused Overload	ATC	Assignment
02SP	OKGE-WFEC	**MIDWEST TAP TO FRANKLIN SWITCH, 138KV** 54946 MIDWEST4 138 to 55917 FRNKLNS4 138 CKT 1	215	101.6	101.8	**PHAROAH TO WETUMKA, 138KV** 56026 PHAROAH4 138 to 56084 WETUMKA4 138 CKT1	0	Replace 600A Metering CTs @ Franklin
02FA		NONE					15	
02WP		NONE					15	
03G		NONE					15	

8. Conclusion

The capacity of the existing ERCOTN HVDC Tie at Oklaunion will be increased from 185 MW to 200 MW. The existing HVDC Tie capacity cannot be increased above 200 MW. SPP and CSWS have already reserved 185 MW of capacity to ERCOTN and the full 200 MW of capacity from ERCOTN with long-term point-to-point transmission reservations.

The 15 MW increase in capacity of the DC tie from 185 to 200 MW will allow 15 MW of the 25 MW request from CSWS to ERCOTN to be accepted without further expansion of the tie. The remaining 10 MW from CSWS to ERCOTN and any requests from ERCOTN would require additional capacity above the 200 MW. One of the options for increasing the capability of the ERCOTN HVDC tie at Oklaunion above 200 MW is to install an additional HVDC tie in parallel with the existing tie. The estimated cost for 25 to 36 MW of capacity is $21,250,000.

The System Impact Analysis for a deferred service period from 6/1/02 to 6/1/03 for the available 15 MW from CSWS to ERCOTN shows that the Oklahoma Gas & Electric and Western Farmers Electric Coop Midwest Tap to Franklin Switch 138 kV line limits the ATC to zero in the 2002 Summer (6/1/02-10/1/02). A Facility Study is required to determine the details and cost of the upgrade.

Appendix A

PSS/E CHOICES IN RUNNING LOAD FLOW PROGRAM AND ACCC

BASE CASES:
Solutions - Fixed slope decoupled Newton-Raphson solution (FDNS)
1. Tap adjustment – Stepping
2. Area interchange control – Tie lines only
3. Var limits – Apply immediately
4. Solution options - X Phase shift adjustment
   _ Flat start
   _ Lock DC taps
   _ Lock switched shunts

ACCC CASES:
Solutions – AC contingency checking (ACCC)
1. MW mismatch tolerance –0.5
2. Contingency case rating – Rate B
3. Percent of rating – 100
4. Output code – Summary
5. Min flow change in overload report – 1 MW
6. Excld cases w/ no overloads form report – YES
7. Exclude interfaces from report – NO
8. Perform voltage limit check – YES
9. Elements in available capacity table – 60000
10. Cutoff threshold for available capacity table – 99999.0
11. Min. contng. case Vltg chng for report – 0.02
12. Sorted output – None

Newton Solution:
1. Tap adjustment – Stepping
2. Area interchange control – Tie lines only
3. Var limits - Apply automatically
4. Solution options - X Phase shift adjustment
   _ Flat start
   _ Lock DC taps
   _ Lock switched shunts