TRANSMISSION SERVICE REQUEST
565 MW CLUSTER RESTUDY

PREPARED ON BEHALF OF THE COMMON USE SYSTEM
BY
BLACK HILLS POWER
TRANSMISSION PLANNING

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1.0 Executive Summary

Black Hills Power, as the Tariff Administrator of the Joint Tariff, performed a clustered system impact restudy evaluating four queued Point-to-Point and Network Transmission Service Requests totaling 565 MW. The requests were studied under both heavy summer and light winter conditions to determine if the combined TSRs would cause violations, if any, on the power system. TOT 4A/4B studies were not performed as the previous System Impact Study for 765 MW of transfers showed now impact to the published TOT 4A/4B nomogram. The base case was modified to remove the projects identified in the Wyoming Joint Queue Study as these are no longer considered viable.

The clustered requests 565 MW caused a thermal overload on the Wyodak-Osage 230 kV line for a loss of the Hughes-Lookout 230 kV line. This overload is mitigated by constructing a new transmission line connecting the Osage and Teckla 230 kV substations.

Network Integration Transmission Service (NITS) requests which serve load not physically connected to the Common Use System must have capacity allocated to specific scheduling paths to facilitate calculation of Available Transfer Capability. The only NITS request analyzed in this study was request #6 for 205 MW with a POR of Wyodak and a POD of Dave Johnston or Stegall. The 205 MW Network request was allocated between the Wyodak to Stegall and Wyodak to Dave Johnston paths. Specifically, 100 MW was allocated on the Wyodak to Stegall path and 105 MW was allocated on the Wyodak to Dave Johnston path.

2.0 Introduction

Black Hills Power ("Black Hills"), Basin Electric Power Cooperative ("Basin") and Powder River Energy Corporation ("PRECorp") own and operate 230 kV transmission facilities in Wyoming and South Dakota which are governed by a FERC approved Joint Open Access Transmission Tariff ("Joint Tariff") and commonly referred to as the Common Use System ("CUS"). Black Hills Power has been designated as the Tariff Administrator of the Joint Tariff and, as such, is responsible for evaluating and studying all transmission service requests made on the Joint Tariff.

A number of point-to-point and network Transmission Service Requests have been submitted to the CUS with similar Point of Receipt ("POR") and Point of Delivery ("POD") pairs, along with similar requested start dates. These requests were clustered together in a single Transmission Service Request ("TSR") study. The requests represented in this study are shown below:

Request #	Capacity	Request Type	Point of Receipt	Point of Delivery
70108465	130 MW	Point-to-Point	Wyodak	RC West
70422032	25 MW	Point-to-Point	Wyodak	Dave Johnston
71264294	100 MW	Point-to-Point	Wyodak	Dave Johnston
71264295	100 MW	Point-to-Point	Wyodak	Dave Johnston
71365725	205 MW	Network	N/A	Dave Johnston/Stegall
71374841	5 MW	Point-to-Point	Wyodak	Dave Johnston

These requests were studied together to determine the cumulative effect the TSRs would have on the CUS facilities and if they cause any violations.

3.0 Base Case Development

Base cases were prepared for the 2011 timeframe, both heavy summer and light winter. The heavy summer base case was utilized to ensure that the requested transfers could be accommodated under maximum load serving requirements. The light winter scenario was utilized to evaluate the system under maximum transfers and was also used to analyze impacts on the TOT 4A/4B path.

The 2011 heavy summer base case was created by modifying the 2010 base case developed by WAPA for use in the Miracle Mile TOT3 Rated Path studies. The 2010 Western Area Power Administration ("WAPA") case was then updated with forecasted 2011 peak loads requested from WAPA, Black Hills, Basin and PacifiCorp.

The 2011 light winter base case was created from the 2010 Wyoming Joint Queue Study light winter base case. This case was updated with forecasted 2011 light winter loads requested from WAPA, Black Hills, Basin and PacifiCorp.

Both 2011 base cases were updated to include expected transmission system upgrades and generation additions. These included:

- 100 MVAR Lange Voltage Support
- Teckla Dynamic Voltage Support (+/- 32 MVAR)
- Miracle Mile Project
- DJ-Casper-Spence 230 kV loop-in

Present day system operating restrictions require a runback of the Rapid City DC Tie under the studied load and generation levels for a loss of the Wyodak generating unit. Additionally, there are additional operating restrictions at load and generation levels below those modeled in this study for single contingencies. The planned Rapid City voltage support is expected to reduce or remove many of these single contingency restrictions.

Currently, the CUS network load and firm transfers are greater than the local generating resources. Therefore, power is currently imported into the CUS footprint. To eliminate any net positive system effects caused by combining these imports with the TSRs, additional unplanned local generating resources were added to the base case. This allowed the TSRs to be analyzed under a worst-case scenario of no imports into the CUS.

It is important to understand that should the additional modeled resources not materialize, the impacts on the overall system of the TSRs will be reduced due to the netting effect any imports into the CUS would have on exports out of the CUS.

4.0 Study Approach

2011 Heavy Summer/Light Winter

To establish any pre-existing criteria violations, the base case was simulated with all forced outages. Once a base solution had been determined the TSRs were simulated simultaneously to determine the cumulative impact of the requests.

The TSRs were simulated with PORs in the Wyodak area and PODs south of TOT3. The TSR PORs were chosen based upon expected resource locations. The study PODs were determined based upon the TSR PODs along with matching TSRs in neighboring Transmission Provider queues.

Two sensitivity scenarios were simulated in the restudy:

- Replacement the DJ-Casper-Spence 230 kV loop-in with the current system configuration
- Pumpkin Buttes-DJ Double Circiut

TOT 4A/4B

TOT 4A/4B analysis was not conducted in the restudy as the original study with higher transfers showed no impacts on the current nomogram.

5.0 Steady State Evaluation Criteria

System Intact and Prior Outage (N-0 and N-1) Criteria

All bus voltages are within 0.95 and 1.05 p.u. and all transformer and transmission lines are below 100% of their continuous rating. Transformer taps and switched shunts were allowed to operate.

Forced Outages (N-1-1 and N-2) Criteria

All bus voltages are within 0.90 and 1.1 p.u. and all transformer and transmission lines are below 100% of their continuous or emergency rating. Most of PacifiCorp transmission lines in Eastern Wyoming have an emergency rating equal to 123% of their continuous rating. Other lines were allowed to load to their emergency ratings. All regulating devices with the exception of DC taps were locked.

6.0 Powerflow Results

2011 Heavy Summer

BASE CASE

Pre-transfers:
A two percent post-contingent overload occurred on the Stegall 100 MVA 230/115 kV transformer for loss of the Stegall 167 MVA 230/115 kV transformer. The pre-contingent loading on the 100 MVA transformer was less than 70 percent, therefore a 120% short-time rating is allowed on the transformer per the WAPA facility rating methodology. Should the post-contingent loading on the Stegall 100 MVA 230/115 kV transformer exceed 100 percent, communication with WAPA will be required to coordinate procedures to relieve loading on the transformer.

Post-transfers:
There are no system intact criteria violations. Post-contingent criteria violations are shown below:

Contingency	Overloaded Facility	Facility Loading
Wyodak-Osage 230 kV	Lookout-Hughes 230 kV	102.9%
Lookout-Hughes 230 kV	Wyodak-Osage 230 kV	108.5%

The Lookout-Hughes 230 kV line contingency causes a thermal overload on the Wyodak-Osage 230 kV line. This violation can be mitigated through additional transmission facilities which would electrically parallel the Wyodak-Osage 230 kV line. A new 60 mile 230 kV line was modeled between the Teckla and Osage 230 kV substations. This added facility effectively mitigated the overload.

CURRENT DAVE JOHNSTON-SPENCE 230 KV LINE CONFIGURATION
The current Dave Johnston-Spence 230 kV line configuration sensitivity resulted in system performance equal to that of the base case scenario for both pre- and post-transfer conditions.

PUMPKIN BUTTES-DAVE JOHNSTON DOUBLE CIRCUIT
The Pumpkin Buttes-Dave Johnston 230 kV double circuit sensitivity resulted in system performance slightly better than that of the base case scenario described above for both pre-transfer and post-transfer conditions. However, the post-contingent criteria violations with the full transfers remained. Therefore, the mitigation options outlined in the base case scenario are required for this scenario.

2011 Light Winter

BASE CASE
The 2011 light winter pre-transfer case did not show any system intact or prior outage criteria violations. There were no criteria violations with the full 565 MWs of requests simulated.

CURRENT DAVE JOHNSTON-SPENCE 230 KV LINE CONFIGURATION
The current Dave Johnston-Spence 230 kV line configuration sensitivity did not result in any criteria violations for all transfer levels.

PUMPKIN BUTTES-DAVE JOHNSTON DOUBLE CIRCUIT

The Pumpkin Buttes-Dave Johnston 230 kV double circuit sensitivity did not result in any criteria violations for all transfer levels.

7.0 Transmission Addition Costs

A new 60-mile transmission line between the Teckla and Osage 230 kV substations has been identified as a solution to mitigate thermal overloads. It is estimated that the 230 kV transmission line project cost will be approximately $19 million. The actual transmission line cost will be approximately $18 million with an additional $1 million for substation equipment at Teckla and expansion at the Osage substation. A Facilities Study will provide a more detailed cost estimate and will outline substation equipment and expansion needs.

8.0 NITS Capacity Allocation

The Network Integration Transmission Service requests which serve load not physically connected to the Common Use System must have capacity allocated to specific scheduling paths to facilitate calculation of Available Transfer Capability. The only NITS request analyzed in this study was the 205 MW request which was allocated between the Wyodak to Stegall and Wyodak to Dave Johnston paths. Specifically, 100 MW was allocated on the Wyodak to Stegall path and 105 MW was allocated on the Wyodak to Dave Johnston path.

9.0 Conclusion

Based on the above study analysis, the full 565 MWs of Transmission Service Requests can be accommodated by the Common Use System with the addition of a transmission line between the Teckla and Osage 230 kV substations.

APPENDIX A
POWER FLOW RESULTS

HEAVY SUMMER
BASE CONFIGURATION

NC;DJ-CSP UPGRADE;NC;

STATUS	VIOLATED ELEMENT	PU
OUTAGES:		
22_1A1 OUTAGE: STEGALL 115 -STEGALL 230	STEGALL 115-STEGALL 230	102.1 % OF 100.0 MVA RATING

565 MW;DJ-CSP UPGRADE;NC;

STATUS	VIOLATED ELEMENT	PU
OUTAGES:		
78_5A1 OUTAGE: WYODAK 230 -OSAGE 230	LOOKOUT1 230-HUGHES 230	102.9 % OF 421.0 MVA RATING
101_5A1 OUTAGE: LOOKOUT1 230 -HUGHES 230	WYODAK 230-OSAGE 230	108.5 % OF 421.0 MVA RATING

BASE CONFIGURATION WITH TECKLA-OSAGE 230 KV LINE

565 MW;DJ-CSP UPGRADE;TEK-OSG;

STATUS	VIOLATED ELEMENT	PU
OUTAGES:		

NO DAVE JOHNSTON-CASPER UPGRADES

NC;DJ-CSP CURRENT;NC;

STATUS	VIOLATED ELEMENT	PU
OUTAGES:		
22_1B1 OUTAGE: STEGALL 115 -STEGALL 230	STEGALL 115-STEGALL 230	102.0 % OF 100.0 MVA RATING

565 MW;DJ-CSP CURRENT;NC;

STATUS	VIOLATED ELEMENT	PU
OUTAGES:		
78_5B1 OUTAGE: WYODAK 230 -OSAGE 230	LOOKOUT1 230-HUGHES 230	103.0 % OF 421.0 MVA RATING
101_5B1 OUTAGE: LOOKOUT1 230 -HUGHES 230	WYODAK 230-OSAGE 230	108.5 % OF 421.0 MVA RATING

565 MW;DJ-CSP CURRENT;TEK-OSG;

STATUS	VIOLATED ELEMENT	PU
OUTAGES:		

PUMPKIN BUTTES-DAVE JOHNSTON DOUBLE CIRCUIT

NC;DJ-CSP UPGRADE;PB-DJ DOUBLE;

STATUS	VIOLATED ELEMENT	PU

OUTAGES:

22_1A2 OUTAGE: STEGALL 115 -STEGALL 230 | STEGALL 115-STEGALL 230 | 101.8 % OF 100.0 MVA RATING

565 MW;DJ-CSP UPGRADE;PB-DJ DOUBLE;

STATUS	VIOLATED ELEMENT	PU

OUTAGES:

78_5A2 OUTAGE: WYODAK 230 -OSAGE 230 | LOOKOUT1 230-HUGHES 230 | 100.5 % OF 421.0 MVA RATING

101_5A2 OUTAGE: LOOKOUT1 230 -HUGHES 230 | WYODAK 230-OSAGE 230 | 106.0 % OF 421.0 MVA RATING

PUMPKIN BUTTES-DAVE JOHNSTON DOUBLE CIRCUIT WITH TECKLA-OSAGE 230 KV LINE

565 MW;DJ-CSP UPGRADE;PB-DJ DOUBLE;TEK-OSG;

STATUS	VIOLATED ELEMENT	PU

OUTAGES:

LIGHT WINTER
BASE CONFIGURATION

NC;DJ-CSP UPGRADE;NC;

STATUS	VIOLATED ELEMENT	PU

OUTAGES:

565 MW;DJ-CSP UPGRADE;NC;

STATUS	VIOLATED ELEMENT	PU

OUTAGES:

NO DAVE JOHNSTON-CASPER UPGRADES

NC;DJ-CSP CURRENT;NC;

STATUS	VIOLATED ELEMENT	PU

OUTAGES:

565 MW;DJ-CSP CURRENT;NC;

STATUS	VIOLATED ELEMENT	PU

OUTAGES:

PUMPKIN BUTTES-DAVE JOHNSTON DOUBLE CIRCUIT

NC;DJ-CSP UPGRADE;PB-DJ DOUBLE;

STATUS	VIOLATED ELEMENT	PU

OUTAGES:

565 MW;DJ-CSP UPGRADE;PB-DJ DOUBLE;

STATUS	VIOLATED ELEMENT	PU

OUTAGES: