

Preliminary System Impact Study Results
GI-2006-1; Portfolios A - J
March 7, 2006

I. Summary

This report summarizes the preliminary powerflow analyses to accommodate Portfolios A through J for the GI-2006-1 Cluster studies. These preliminary results are provided for information only.

A. Delivery Upgrades

Table 1 shows the estimated costs for Interconnection and Delivery as indicated by the preliminary powerflow analysis. Transient stability and fault analyses must also be performed and can potentially result in additional recommendations for network upgrades.

The following Network Upgrades are required for Delivery by June 1, 2007:

1. Upgrade the Spruce to Smoky Hill 230 kV transmission and associated substation equipment to 800 MVA.
2. Modify 230 kV transmission lines between Smoky Hill and Jordan to achieve 558 MVA continuous rating.
3. Modify the double-circuit 230 kV transmission between Ft.St.Vrain and Valmont to achieve a 525 MVA continuous rating.
4. Modify the 230 kV transmission line between Cherokee and Silver Saddle to achieve a continuous rating of at least 495 MVA.
5. Add a second 280 MVA 230/115 kV autotransformer to the existing Valmont substation.

The following Network Upgrades are required for Delivery by June 1, 2010:

6. Create a 345 kV transmission circuit between Midway and Waterton:
 - a) Add single 345/230 kV 560 MVA autotransformers at Midway and Waterton substations.
 - b) Rebuild the 230 kV line between Daniels Park and Waterton to double-circuit 345 kV standards.
 - c) Tie the new circuit created by the double-circuit transmission to the existing Midway-Daniels Park 230 kV line, but don't tie into the Daniels Park substation. The created Midway – Waterton circuit can then be operated at 345 kV.
 - d) Operate the other circuit of the double-circuit between Daniels and Waterton at 230 kV. Tie the line into Daniels Park and Waterton.
 - e) Tie the existing Daniels Park-Tarryall 230-kV line into the Waterton Substation.
7. Replace the two 100 MVA 230/115 kV transformers at Waterton with 280 MVA units.
8. Upgrade the Waterton – Littleton 115 kV line from 135 MVA to 217 MVA.

| Table 1 | | | | | | | | | | | | |
|--|---|--------------------|--|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| GI-2006-1 Cluster Portfolio Studies | | | Portfolio Cost Estimates (millions) | | | | | | | | | |
| | | Date Needed | A | B | C | D | E | F | G | H | I | J |
| Interconnection Costs | | Various | \$18.93 | \$19.04 | \$18.82 | \$17.16 | \$16.94 | \$11.60 | \$10.91 | \$11.49 | \$10.80 | \$15.74 |
| Delivery Component | | | | | | | | | | | | |
| 1 | Spruce - Smoky 230kV Uprate | 6/1/07 | \$2.19 | \$2.19 | \$2.19 | \$2.19 | \$2.19 | \$2.19 | \$2.19 | \$2.19 | \$2.19 | \$2.19 |
| 2 | Smoky Hill - Jordan 230kV Uprate | 6/1/07 | \$0.92 | | | \$0.92 | \$0.92 | \$0.92 | \$0.92 | | | \$0.92 |
| 3 | St. Vrain - Niwot/Valmont 230kV Uprate | 6/1/07 | \$2.78 | \$2.78 | \$2.78 | | | \$2.78 | \$2.78 | \$2.78 | \$2.78 | \$2.78 |
| 4 | Cherokee - Silver Saddle 230kV Uprate | 6/1/07 | | \$0.98 | \$0.98 | \$0.98 | \$0.98 | | | \$0.98 | \$0.98 | \$0.98 |
| 5 | Valmont 230/115 Transformer Addition | 6/1/07 | | | | | | \$3.82 | | \$3.82 | | |
| 6 | Midway - Waterton 345kV Transmission Addition | 6/1/10 | \$23.56 | \$23.56 | \$23.56 | \$23.56 | \$23.56 | | | | | |
| 7 | Waterton Autotransformer Replacement | 6/1/10 | \$7.24 | \$7.24 | \$7.24 | \$7.24 | \$7.24 | | | | | |
| 8 | Waterton - Littleton 115kV Uprate | 6/1/10 | \$0.10 | \$0.10 | \$0.10 | \$0.10 | \$0.10 | | | | | |
| Total Delivery Costs | | | \$36.78 | \$36.85 | \$36.85 | \$34.99 | \$34.99 | \$9.70 | \$5.88 | \$9.77 | \$5.95 | \$6.87 |
| Total Portfolio Costs | | | \$55.71 | \$55.89 | \$55.67 | \$52.15 | \$51.92 | \$21.31 | \$16.80 | \$21.26 | \$16.75 | \$22.61 |

Dollars include applicable overheads; AFUDC removed; escalated to anticipated in service dates.

II. Cost Estimates and Assumptions

Assumptions

1. The estimates above are for reference only and are subject to change with a more detailed system study.
2. The estimated costs provided are “Scoping Estimates” with an accuracy of $\pm 30\%$.
3. Estimates are escalated to account for planned in-service dates. Estimates are fully loaded with appropriate overheads, but do not include AFUDC.
4. Estimates include the time and cost to permit, acquire land and right-of-way, engineer, permit, procure materials, construct, and commission the facilities.
5. PSCo (or its contractor) crews will perform all construction and wiring associated with PSCo-owned and maintained equipment.
6. Customer Interconnection estimates are according to PSCo design with PSCo construction costs.
7. Timeline and cost estimates assume permits, substation land, and right-of-way, as needed, will be available within typical costs and time frames.
8. The delivery infrastructure cost reflects the assumption that gas generation in PSCo’s system was reduced to accommodate the wind generation projects in this portfolio. The delivery infrastructure cost would increase significantly if wind and gas generation were both accommodated.
9. Estimates assume all generation projects can be constructed simultaneously.

III. Transmission Issues

1. Wind Considerations: In order to accommodate the wind generation, gas generation at the following locations may have to be reduced under system normal and/or contingency conditions:
 - a) RMEC by up to 300 MW
 - b) Manchief by up to 280 MW
 - c) Brush NUGS by up to 120 MW
2. According to estimates, the infrastructure recommended to interconnect some or all of the portfolio generation might not be implemented by the proposed in service date.
3. Certain operating conditions will require that some of the proposed gas-fired generation be reduced to bring the system to a reliable operating state.
4. Some portfolios could potentially impact the limit of the South-of-St. Vrain (SOSV) transmission path. That path facilitates the flow of power from the Tot 7 transfer path and generation from Ft. St. Vrain into the Denver-metro area. These impacts were not fully evaluated in this study.

5. Studies were performed using power flow analysis. Transient stability and fault analyses must also be performed and can potentially result in additional recommendations for network upgrades.
6. Studies focused on contingency element loading. Preliminary analysis did not reveal any voltage issues, but some additional evaluation may be required to verify acceptable performance.
7. Implementation of the recommended infrastructure for delivery will require that existing facilities be taken out of service for sustained periods. In most cases, these outages cannot be taken during peak load periods due to operational constraints. As a result, the estimated time frame for implementation could be increased by 3-6 months.
8. Firm delivery for these portfolios may require multiple transmission projects for which existing facilities must be taken out of service. System constraints may require that some delivery projects be implemented in a sequential manner. This requirement could increase the estimated time frames for full implementation of all delivery by 3-12 months.
9. If the Chambers 230/115 kV Interconnection Project is not implemented as planned, reduced regional generation levels may be required to mitigate potential contingency overloads. Certain operating conditions will require that the generation output of generation located in the region (including proposed projects) be reduced up to the full amount.
10. Certain portfolios may have some impacts to the Colorado Springs Utilities transmission system. Additional joint studies may be required to determine if any upgrades to that system would be required.
11. For some portfolios, coordination will be required with the Comanche – Daniels Park 345 kV Transmission Project, in order to achieve assumed back-feed dates. The Comanche Project has a scheduled in-service date of May 2009.
12. It is assumed that The Midway – Waterton 345 Transmission addition will require the granting of a Certificate of Public Necessity and Convenience by the Colorado Public Utility Commission. Scheduled in-service dates could be impacted by any delays in that process.
13. The recommendations for the transmission infrastructure for delivery reflect the assumption that gas generation in the PSCo system would be adjusted to accommodate the wind generation projects in the portfolio. In order to accommodate full wind and gas generation simultaneously, the delivery infrastructure recommendations and costs would increase significantly.