Southwest Minnesota-->Twin Cities EHV Development
Analysis of off-Ridge Generation Additions

Background

The Southwest Minnesota-->Twin Cities EHV Development's "Base Plan" consists primarily of a 345 kV line from Brookings Co (White) eastward to Lyon Co, to Franklin, and ultimately to the southern Twin Cities (Helena/Lk Marion/Hampton Corner). Steady-state performance of this Base Plan and the "System Alternative" have been previously tabulated with regard to the amount of capital investment required to achieve given levels of Buffalo Ridge area generation outlet capacity.

This present analysis examines the effect of adding some "off-Ridge" generation capacity to the Southwest Minnesota transmission system. A revised "cost vs. MWs" graph has been developed summarizing results of the corresponding PSS/E "TLTG" simulations for this sensitivity study.

Analysis

To test the effect of the addition of some off-Ridge generation, TLTG simulations were run on the "Base Plan" configuration, with 50 MW of generation added at both Lyon Co and Franklin 115 kV buses, representing a total of 100 MW of off-Ridge generation additions.

The natural "stopping point", for Buffalo Ridge generation outlet, based on previous analysis, is likely to be within the range 1800 - 2000 MW, as this is where the needs for several 345 and 230 kV reconductors are encountered in quick succession, and satisfactory performance with respect to incremental losses, voltage stability, and dynamic stability appears to become progressively more difficult and expensive to attain.

The attached Excel file provides TLTG summary sheets for

- Base (all incremental generation on Ridge)
- Base + 100 MW off-ridge generation additions (Lyon Co & Franklin 50 MW each)
- Comparison ("diff") listing of limiting facilities
- Graph of cost vs. MW for both scenarios

From these tables and the graph, the following observations are made:

- Within the 1800 - 2000 MW range, it is noted that for any given level of on-Ridge generation, the additional transmission investment caused by adding the 100 MW of off-Ridge generation is generally 0 - $3 million. This equates to at most $30/kW. There are short MW intervals over which the difference is as high as $8 -13 million, but these are not representative of typical values encountered. Even so, $13 million for 100 MW of outlet would be $130/kW; a not unreasonable figure considering that the Base Plan facilities are achieving approximately 600 - 800 MW of incremental outlet at a cost of approximately $300 million; this equates to roughly $375 - $500/kW. It should be noted, however, that the Base Plan facilities provide important regional transmission benefits

beyond the Buffalo Ridge outlet capability monitored in this analysis, and therefore the cost should not be gauged solely against Buffalo Ridge generation outlet benefit attained.

- An alternative perspective is to examine the amount of on-Ridge generation outlet which would need to be sacrificed to provide outlet for each MW of off-Ridge generation. From the TLTG tables, it is noted that if the selected "stopping point" (with no off-Ridge generation) had been 1892 MW (the point just before the Wilmarth-Lakefield Gen 345 kV reconductor would be needed), the corresponding limit with the off-Ridge generation would be 1880 MW. Therefore, in this scenario a "sacrifice" of 12 MW of on-Ridge generation is required to accommodate 100 MW of off-Ridge generation.

- If the "stopping point" had instead been chosen at 1954 MW (just before the Eden Prairie 345/115 kV transformer limit) the corresponding "sacrifice" for the 100 MW off-Ridge generation increment would be 88 MW (1954 - 1866 MW). This is still less than 1 MW of on-ridge sacrifice for each off-Ridge generation MW. Examination of the TLTG "diff" table reveals that the conditions which indicate a "sacrifice" of over 100 MW occur only at Base Scenario Buffalo Ridge generation levels under 1600 MW, or over 2300 MW. Consequently, if it is presumed the "stopping point" will actually be within the 1800 - 1900 MW range, there appears to be no risk of off-Ridge generation additions at Lyon Co and Franklin causing excess sacrifice of on-Ridge generation outlet capability.

- It is only beyond 2000 MW of Buffalo Ridge generation outlet that the presence of the off-Ridge generation studied causes significant increases in outlet cost for the on-Ridge generation. This is due to three limiters previously encountered between 2329 MW and 2433 MW now being encountered at 2014 – 2182 MW, as shown in the following table

On-Ridge Gen outlet, MW				
Base	Add LYC & FRA 50 MW gens	Diff	Limiting facility	Outage
2329	2077	- 252	Granite Falls-Minn Valley 230	Hazel-Minn Valley 230
2349	2182	- 167	Granite Falls-Willmar 230	Minn Valley-Panther 230
2433	2014	- 419	Franklin-Ft Ridgely 115 kV	Franklin-Helena 345

At the "over 2000 MW" levels, the incremental cost caused by the 100 MW of off-ridge generation addition is in the range of $3 – $14 million; this represents an incremental outlet cost of $30 – 140/kW.

Conclusions

For the particular off-Ridge sites studied (Lyon Co and Franklin) addition of up to 50 MW at each site is not likely to cause significant incremental cost or alternatively, significant sacrifice of on-Ridge generation outlet capability. This is true within the 1800 – 2000 MW range of total SW Minnesota Buffalo Ridge area generation outlet expected to be achieved with the EHV development under study. At higher Buffalo Ridge generation levels (over 2000 MW), a larger incremental cost is incurred, although it does not appear to be unreasonable ($30 – 140/kW).

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