27 December 2011

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Subject: Impact of locating an SVC at or near Mt Storm

Dear Ronnie:

You asked KEMA to consider the advantages and disadvantages of locating a static var compensator (SVC) at the Mt. Storm power plant site as compared to a new 500 kV substation located about 20 miles away in the Mt. Storm–Valley 500 kV line. While no technical analyses were made, we identified several important reasons to prefer the Mt. Storm location based on common knowledge and our past experience.

At its 15 December 2011 TEAC meeting, PJM recommended several "n-1-1 reactive upgrades." Among these recommendations was a 250 MVar SVC to be located at the Mt. Storm 500 kV substation or at a new 500 kV substation in the Mt. Storm–Valley line. Specifically:

- The Mt. Storm–Valley proposal would locate the SVC at a new station about 20 miles from the Mt. Storm station, requiring a new tap position east of Mt. Storm, on the Mt. Storm–Valley 500 kV line and developing a new station to accommodate the SVC.
- The Mt. Storm proposal would locate the SVC directly at the existing Mt. Storm station, connected directly to the 500 kV bus.

At either location, the SVC will provide very rapid reactive support to maintain proper voltages in the PJM 500 kV system and meet PJM, RFC and NERC reliability standards.

The PJM studies showed that a 250 MVar SVC would perform acceptably at either location. The SVC performance was very similar at both locations. The Mt. Storm location would use more of the SVC capability in 5 of 8 critical contingencies, but would use less in the other 3.

In terms of overall performance, the SVC operational requirements can be classified into three areas i) steady-state, ii) dynamic stability; and iii) transients:

i. Steady-state—in this specific case, the impact on steady-state operation of the SVC should be nearly identical between the two locations.

ii. Dynamic stability—the impact on dynamic stability is more significant. By locating the SVC directly at Mt. Storm, the dynamic response capability of the SVC controls to react to voltage conditions can be optimized with the controls at the Mt. Storm plant. Coordinating the dynamic control response, including slope and gain settings of the SVC control, as well as implementing the maximum overshoot and settling time requirements can also be optimized. This will not only enhance operation, but also simplify the design of the SVC.

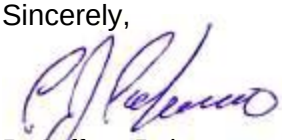
iii. Transient—as with the dynamic stability considerations, there are advantages to the SVC being located at the Mt. Storm 500 kV bus. The response capabilities for transient events will be less complex, including protection coordination of the SVC equipment itself under such conditions. Also, if the SVC were not located at the Mt. Storm 500 kV bus, transmission line operation transients caused by switching and other events, would require increased relay coordination and could potentially result in reduced reliability and availability of the SVC. Reducing the complexity of the SVC protection scheme, by locating the SVC at Mt. Storm will also increase the overall reliability and availability of the system.

In comparing the two, there are a number of other advantages for the Mt. Storm 500 kV location, as compared to a location a short distance away including:

- Coordinating control of the SVC and the existing 600 Mvar capacitor bank at Mt. Storm could be extended to include the generation control. Locating the SVC at the Mt. Storm station would simplify the implementation and reduce costs. Including the generator controls as part of the overall SVC coordinated control scheme would also greatly enhance to overall voltage profile in the region—both for steady-state and dynamic conditions—and provide a means for optimizing overall volt/var management.
- Locating the SVC at Mt. Storm simplifies the overall protection scheme and operational coordination.
- Installing the SVC directly at the Mt, Storm 500 kV bus increases overall reliability because the existing bus provides a simple and minimal interconnection scenario. Tapping a line and creating a new interconnection adds more infrastructure and increases possible failure modes of the overall interconnection, thus reducing reliability and increasing potential unavailability scenarios.
- The additional connection infrastructure required to connect into the Mt. Storm–Valley 500 kV line will increase the footprint of the overall SVC installation.
- Finally, by locating the SVC at Mt. Storm, any 500 kV line outages do not impact the operational capability of the SVC.

Based on the operating characteristics, design parameters, installation/construction considerations, and associated system and control interactions, locating an SVC directly at the Mt. Storm 500 kV bus should have important significant advantages in terms of complexity, reliability, and cost as compared to a location about 20 miles away.

Sincerely,



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