Operational Performance Issues on AEP 765kV Reactors

The following AEP 765kV have fixed reactors (using isolating switches with no breakers), which require the associated 765kV lines to be switched out of service to energize or de-energize their line reactors.

- 765kV reactor at Broadford on the Broadford – Jacksons Ferry 765kV line.
- 765kV reactor at Broadford on the Broadford – Baker 765kV line.
- 765kV reactor at Jefferson on the Jefferson – Greentown 765kV line.
- 765kV reactor at Baker on the Broadford – Baker 765kV line.

As system conditions change during day-to-day operations, the reactors may need to be switched Off (under higher transfers or heavy load conditions) or On (to manage potential high voltages under low transfer conditions). Currently, the four-765kV lines listed above will need to be taken out of service to allow for safe switching of their associated line reactors. These reactors need to be removed from service prior to issues developing and most of the time it is not feasible to perform such switching maneuver during real-time operations. Additionally, switching the 765kV line(s) out of service during high transfer conditions poses operational risk and add unnecessary operation cycles to the main line breakers.

The associated 765kV lines directly impact the AEP/DOM interface and are key to reliable operation under high power transfer conditions. During high load conditions as well as high transfer conditions, the line reactors may need to be switched off to manage low 765kV voltages conditions. Under high power transfer conditions, including extreme weather, switching the lines out of service in order to disconnect the line reactors poses an operational risk as breakers ~~and/~~or other equipment may fail during the maneuver preventing the switched off line from being returned to service. Under light load and low transfer conditions; the reactors are required to be switched in to manage high voltages in the area. These reactors need to be removed from service prior to issues developing and most of the time it is not feasible to perform during real-time operations. System operations face these reliability operational challenges during a large number of days annually (conditions binding several hundred hours). Normally, system operations need~~s~~ the line to be in service without the reactors for the peak(s) and needs the reactors in overnight for the valley. That's four switching operations in ~24hr period daily. Every switching operation carries some risk. Continued and repeated switching operations exponentially increases that risk.

During Winter Storm Elliot, the Broadford 765kV bus was one of the limiting facilities due to low voltage, which caused multiple IROL exceedances. The worst post contingency voltage is 0.90 p.u.. In real-time, it requires the line to come out of service to remove the reactors. During this event, the lines could not be removed from service, as it would create additional low voltage and voltage drop violations, severely reduced the transfer capability of the AEP/DOM interface, and including approaching or exceeding the IROL limit.

Most recently, in January 2024, Operations had to proactively remove the reactors from service to help with voltages in the area during heavy transfers. At the same time, all of the reactors could not be removed ahead of time as high voltages were a concern during off-peak hours. If these line reactors were switchable, the operational limitation on the AEP/DOM IROL Interface during Winter Storm Gerri would have removed the need to issue a TLR1.

The AEP-DOM interface has bound 596 times since June 1, 2022 until February 25, 2024. In January 2024, the interface was binding for 303 times, among that 201 times are limited by steady state voltage collapse even with reactors out at Broadford.

Power system studies were conducted including peak and valley studies on multiple days including extreme days such as Winter Storm Elliot, Winter Storm Gerri, and middle of the day with mild forecasts. Broadford 765kV bus typically has the lowest voltage in the area and is the limiting element for the AEP/DOM IROL Interface. The switchable reactors will allow for increasing the interface limits when most required, preventing potential voltage collapse conditions that may occur at higher transfers with the reactors connected. The switchable reactors will also enable control of higher voltages during valley/light loading periods. A Real-Time state estimator case from January 10 shows that removing the 765kV reactors at Broadford would have provided an additional 200 MVA of transfer capability on the AEP/DOM interface. During high transfers, such as during a winter storm, the reactors out of service would have provided an addition 500 MVA of transfer capability.

The issue become more prevalent and is identified as a critical operational performance issue more recently as more than 5000MW generation in the BGE/PEPCO/DOM areas retired in the past several years, which pushes the AEP/DOM interface closer to the limits. Another reason is that the recent extreme weather conditions such as winter storm events occur more frequently and make such operational need for flexibility more important.

PJM has determined that the operational performance issues described above create an immediate reliability need for which a competitive window is not feasible. The identified operational performance issues are based on a review of historical concerns associated with the operation of the system, therefore projects needed to address such issues must be initiated as soon as practically possible. PJM determined that no other transmission or non-transmission options would sufficiently address the immediate reliability need. Due to these reasons and consideration that a shortened competitive window will lead to delays of about six months, without material benefit, PJM has determined to designate AEP construction responsibility to mitigate these immediate need violations.