4/28/2005

PJM Small Generation Interconnection Working Group meeting of 4/28/2005

PJM is pushing hard to have the revised Attachment H applied to voltage levels above what is typically considered distribution. In this case, it would be the PPL EU 69 kV system. There was much discussion on this during the meeting. Below is a DRAFT response to PJM.

General Comments:

1. The PPL EU 12 kV distribution system can handle a maximum of 10 to 12 MVA on a dedicated line, and much lower values, typically 2.5 MVA or less, on lines that have PPL EU customers. [technical requirement: PPL EU plans our system upgrades with a 2.5 MW, the connection of greater then 2.5 Mw negatively impacts on the planning window.]

   In all cases the PJM Tariff interconnection procedure will be followed. System impacts, such as the above, are outside the scope of IEEE Std. 1547.

2. Installations with generation in excess of the above 5 Mw are typically connected to our 69 kV system. [Technical requirement: units above 2.5 Mw will have a significant impact on the local voltage control and line profile. Units between 2.5 and 5.0 Mw are on a case by case basis, and above 5 Mw on a dedicated line or 69 kV connection.]

   Response is the same as that for General Comment number 1 above.

3. The PPL EU 12 kV system is radial, the PPL EU 69 kV system has both radial and networked facilities.

4. The protection requirements for the 12 kV and 69 kV systems are functionally different with 69kV reviews requiring more detail to ensure adequate protection to the IPP and other PPL EU customers. Because 69kV connected IPPs can impact more PPL EU customers, additional reviews are justified. (Recognize here that PJM will not get the customer complaints and damage claims - PPL EU will. We should have the right to dictate what goes on here, not PJM).

   IEEE Standard 1547 Section 4.2.1 (Area EPS Faults) requires that “The DR unit shall cease to energize the Area EPS for faults on the Area EPS circuit to which it is connected” This requires that the protection be compatible with TO protection used for the line or substation to which it is interconnected.

5. The larger facilities will require stability studies and review of the Northeast PA Transfer Limits. This stability limit is aggravated as more generation is added to the distribution system. [Technical requirement: the system impedance for the 12 kV and 69 kv systems are significantly different.] Stability analysis generally not required for generation less than 25 MW.

   Northeast PA is a special case where it is a peninsula with too much generation hanging on limited transmission outlets. The issue is independent of the voltage and more to do with MWs.

6. In general, LINE connected facilities will be required to ABSORB VARS to compensate for the voltage rise due to the generation. However, the IPP should be capable of operating in either the leading or lagging mode. System studies will be needed to determine the appropriate mode. This is a system dynamic requiring detailed review. The "one size fits all" approach will not work in all situations. (Again, the IPP response directly affects PPL EU customers - PJM should not dictate this). [Technical requirement: The IEEE 1547 document covers the voltage at the POC, it does not address the effect of the voltage rise due to the generation at other locations on the system.]

   IEEE Std 1547 only addresses the requirements at the POI (or PCC). System requirements such as described above come out of the complete evaluation done as part of the study procedure – This is done now for all PJM Tariff studies.

7. The existing interconnection protection requirements were intended for smaller generating units (<2.5 MVA) and do not address possible additional protection requirements for the larger units, like step distance and out of step relaying.

   IEEE Std 1547 allows for stepped distance if needed to adequately detect a fault within required time on the line the generating facility is connected to. Stability analysis and Out of Step relay requirement generally not applicable for generation <25MW. See General Comment number 5.

Specific comments:

1. ALL facilities connected to the PPL EU 69 kV system are required to have DTT (Direct transfer Trip) back to the PPL EU source substation. Those facilities connecting to network lines are required to have two (2) DTT systems, one to each of the PPL EU source substations.

   OK, this is reasonable and allowed by IEEE Std. 1547.

2. **Section 4.1.1, voltage regulation**, this MUST be applied to the Point of Contact. This will require high side (69 kV) potential monitoring, as low side monitoring may not accurately reflect high side conditions. The technical difference is that smaller units at 12 kV MAY be allowed to monitor a voltage other then at the Point of Common Coupling due to limited impact on the utility system (Area EPS). However, even in this case, studies must be done to verify PCC voltage monitoring is not required.

   OK, this is reasonable and allowed by IEEE Std. 1547.

3. **Section 4.1.2, Integration with Area EPS Grounding**, PPL EU will continue with our requirements for WYE grounded transformer connections for NEW installations at both 12 and 69 kV levels. On the 69 kV system this is more critical as there are few if any ground banks to stabilize the system upon loss of the PPL EU source. [Technical requirements: PPL EU has extensive test results showing the impact of using DELTA high side transformers on these types of systems and the resultant voltage deviations. We are not willing to subject our existing customers to these potential conditions.]

   Existing PPL exception / clarification will apply at all voltage levels.

4. **Section 4.1.3, Synchronization**, PPL EU agrees with the current requirements for both 12 kV and 69 kV.

5. **Section 4.1.4.1, distribution Secondary Grid Networks**, PPL EU agrees with the current requirements, however, there may be cases where the additional generation may impact operation of existing PPL EU facilities due to power or voltage imbalance introduced by the generation. Excess generation will cause network protectors to incorrectly respond. Low Tension Networks were never designed to accept generation. We do not have secondary grid networks supplied from the 69 kV system, so there is no impact.

6. **Section 4.1.4.2, Distribution Secondary Spot Networks**, PPL EU agrees with the current requirements, however, there may be cases where the additional generation may impact operation of existing PPL EU facilities due to power or voltage imbalance introduced by the generation. . Excess generation will cause network protectors to incorrectly respond. Low Tension Networks were never designed to accept generation. We do not have secondary spot networks supplied from the 69 kV system, so there is no impact.

7. **Section 4.1.5, inadvertent Energization of the Area EPS**, PPL EU agrees with the current requirements for both 12 kV and 69 kV.

8. **Section 4.1.6, Monitoring**, the section refers to the requirement for the DR to provide monitoring facilities. PPL EU does not object to this requirement. However, from a practical application, this does satisfy the requirement for SCADA or real time monitoring. ALL generation facilities in the PPL EU system above 2.5 Mw or on the 69 kV system are required to have a PPL EU SCADA RTU installed. There is no currently defined interface between the DR equipment and the Area EPS equipment. For this reason, PPL EU specifies our standard SCADA RTU. For these types of installations, the following with be the typical minimum requirements for this SCADA RTU:
    - Instantaneous three phase high side (69 kV) voltage, per phase
    - Instantaneous three phase high side (69 kV) current, per phase
    - High side instantaneous Mw (three phase reading)
    - High side instantaneous MVAR (three phase reading)
    - System frequency (two decimal places)
    - ALL of the above readings are to be updated every 2 seconds or better.

    - Position of all breakers (or equivalent devices) between the PPL EU line and the DR. In the case of wind farms, we only monitor the high side and low side collector system substation breakers, not each generator breaker.
    - The capability to control (trip only) of one circuit breaker for system emergency conditions.
    - PPL EU also supplies a “unit trip” signal that can be used to shut down the DR facility in a more graceful manner then opening a circuit breaker and causing a ‘loss of outlet’ condition.

    - kWh pulses for power flow into and out of the facility.
    - Other kWh pulses as required

    - Alarms as required, typically: IPR relay health, DTT health, high side circuit breaker health, and any other devices that may impact the PPL EU system.

PPL and most / all others have specific real time SCADA requirements at some threshold of MWs or Voltage. We will add this general Clarification / exception.

9. **Section 4.1.7, Isolate Device**, PPL EU requires a high side (69 kV) isolation device capable of de-energizing the substation transformation for all customer and DR facilities.

   Requirement presently allowed by standard.

10. **Section 4.1.8.1, protection from EMI**, PPL EU agrees with the current requirements, for both 12 kV and 69 kV facilities.

11. **Section 4.1.8.2, Surge Withstand Performance**, PPL EU agrees with the current requirements, however, there may be instances where the surge protection devices will need to be coordinated with the PPL EU system design.

    Requirement presently allowed by standard.

12. **Section 4.1.8.3, Paralleling Device Withstand**, PPL EU agrees with the current requirements, however, the circuit breaker must include the out of phase switching requirement for synchronizing duty.

13. **Section 4.2.1, Area EPS Faults**, PPL EU agrees with the current requirements, however, we will object to the use of low side sensing for 69 kV faults. These must be sensed at the 69 kV level. This is different from small 12 kV installations where low side sensing may be allowed in specific cases.

    Requirement presently allowed by standard. Also see typical one line for 2 – 10 MW.

14. **Section 4.2.2, Area EPS Reclosing Coordination**, PPL EU agrees with the current requirements for both 12 kV and 69 kV.

15. **Section 4.2.3, Voltage**, PPL EU does not agree with the limits or the times in 1547 or the PJM adoption of 1547. The voltage limits will typically be +/- 5% of NOMINAL SYSTEM voltage; therefore the use of the table should be clarified. Also, the operation times for the over and under voltage must be faster to coordinate with other protection and reclosing on the 69 kV system.

16. **Section 4.2.4, Frequency**, PPL EU accepts the stated limits, however we point out that the under frequency limit interferes with the PJM and PPL EU under frequency load shedding. ALL levels of load shedding should be activated BEFORE any generation is tripped on under frequency, therefore for these larger installation, the under frequency setting should be 57.5 hertz and 5.0 seconds. This is acceptable for both 12 kV and 69 kV.

MAAC Standards, therefore PPL and PJM Standards, allow for waiver for generation equal to or less than 20 MW.

17. **Section 4.2.5, Loss of Synchronism**, PPL EU accepts the current requirement for both 12 kV and 69 kV. Loss of synchronism protection will need to be applied to larger units based on stability studies.

    Stability analysis not typically required for generation < 25 MW. Generator can be impacted but will not cause movement of synchronized system.

18. **Section 4.2.6, Reconnection to Area EPS**, PPL EU disagrees with the current requirement, as we currently require verbal communication with the System Operator before paralleling generation on the 69 kV and above system. [Technical requirement: after a line fault, the system may be placed in a different configuration from the normal configuration. The IPP would not be aware of this condition, and without verbal confirmation, may incorrectly parallel to a system that is NOT configured for parallel operation of the generation.]

    Requirement for prior communication with system operator and approval to reconnect is reasonable and allowed by standard. Communication with system operator is probably required by PJM Operating Agreement as well.

19. **Section 4.3.1, DC injection**, PPL EU agrees with the current limits for both 12 kV and 69 Kv.

20. **Section 4.3.2, Limitation of flicker**, PPL EU agrees with the current limits, however, wind farms, large PV installations, and other facilities that are subject to large changes in generation maybe subject to additional voltage regulation requirements. This will be determined during the various studies for the project.

    This is being addressed by FERC in their Wind generation Final Order “Rule 661”. FERC requirements will be the standard trumping PPL or IEEE 1547.

    Section 4.3.4, Harmonics, PPL EU does not agree with the current limits. On 12kV, we limit THD to 3% with no individual harmonic greater than 1.7%. On the 69kV system, THD is limited to 1.5% with no individual harmonic greater than 1.0%. This is our current limit for all customers, and we do not intend to treat generators differently.

    Existing PPL exception will apply at all voltage levels.

21. **Section 4.4.1, Unintentional Islanding**, PPL EU does not agree with the current time limit, as this will interfere with normal PPL EU reclosing. The DR is free to island their own facility, provided sufficient controls and protection are installed for restoration once the PPL EU system is back to normal.

    What time limit does PPL require ? Is the time limit satisfied with the requirement for transfer trip in Specific Comment number 1 ?

22. **Section 4.4.2, Intentional Islanding,** PPL EU does NOT support any form of Islanding that contains any portion of the PPL EU system and customers because PPL EU has the obligation to supply customers with proper voltage and frequency. The IPP does not have that obligation.

    Not addressed in the current version of IEEE Std. 1547.

23. **Section 5.1, Design Test**, PPL EU does not see the applicability of representative sample, factory, or laboratory testing for these larger installations (69 kV). Full commissioning testing will be required.

    Section 5.1 does not preclude the need for commissioning tests.

24. **Section 5.2, Productions Tests**, PPL EU does not agree that production test will be applicable to these larger facilities and therefore full-commissioning tests will be required.

    Section 5.2 does not preclude the need for commissioning tests.

25. **Section 5.3, Interconnection Installation Evaluation**, PPL EU expects these facilities will require full commissioning tests.

    Section 5.3 does not preclude the need for commissioning tests.

26. **Section ~~5.3~~ 5.4 , Commissioning Tests**, PPL EU does not agree with the proposed test procedure as defined for installation 2 Mw and below for these larger units. The larger units will typically be made from a collection of individual components. This type of installation does not lend itself to the 'system' type of tests. Full field commissioning tests will be required for these installations.

    Section 5.4 does not preclude the need for commissioning tests.

27. **Section 5.5, Periodic tests**, PPL EU would expect that the DR facilities would be subjected to the same testing requirements as other PJM generation facilities, once every four (4) years.

    The "once every four (4) years" you refer to was a voluntary standard by MAAC TOs thru the PJM Relay Subcommittee when TOs were vertically integrated. Generators are now owned by affiliates.

Respectively submitted,

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Comments and responses in red font and highlight by Joe Burdis, PJM Interconnection Planning on June 4, 2005.

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