RESPONSES TO
ROS REQUEST FOR COMMENTS

on

“LOW VOLTAGE RIDE THROUGH”
WORDING PROPOSAL

February 29, 2008

This report contains the original text of all responses sent to the ROS mail exploder. Comments have been pulled from multiple document formats and converted to a consistent font style.

E.ON Climate and Renewables (Airtricity North America)
Commentor: Conrad Davis

1. As owners and operators of exclusively wind farms we appreciate the effort and energy expended in compiling a voltage ride through standard within ERCOT.
2. We concur with all bulleted statements listed in the draft OGRR, but would add language to address key concerns for Airtricity:
    a. Airtricity would like to request the inclusion to the OGRR of a transition period for projects presently in the pipeline and without signed interconnection agreements, but that have Commercial Operation Dates no later than 1 August 2010. This transitional period is in recognition of the very large lead times associated with wind turbine acquisition and project development and the large capital expenditures that have already been committed by development companies.
    b. The transitional period would enforce a low voltage standard identical to the "low voltage" standard prescribed in FERC Order 661A in which wind plants subject to the FERC recognized transitional period are required to ride through low voltage events down to 0.15 per unit for normal clearing times up to a maximum of nine cycles. The point of measurement is understood as the high side of the step up transformation. Additionally, wind plants may meet this transitional period with the performance of the turbines alone or with additional power electronic equipment.
    c. Moreover, all projects with signed Interconnection Agreements as of the effective date of the revision to the Operating Guides should be grandfathered and required only to meet the fault ride through standards applicable to wind generation in effect at the time of execution of the Interconnection Agreement. This is in recognition of the difficulty and expense of retrofitting equipment. We recognize the language of the draft OGRR addresses this issue for existing plants, but we have several wind plants under construction that may not be declared commercial before the OGRR is finalized. Again, this is in recognition of the great difficulty and expense to retrofit, if even possible, plants that were designed under current grid code standards.
    d. However, to recognize the importance of this new standard, we would accept language within the Guide such that should any project covered by the transitional phase be shown to cause an unacceptable loss of generation due to its lack of zero voltage fault ride through capability, the post transitional fault ride through requirements shall apply to that plant.

FPL Energy
Commentor: Mark Bruce

FPL Energy believes it may be appropriate to adopt VRT standards for generation units in ERCOT and does not necessarily oppose doing so through a revision to the Operating Guide. We note, however, some concerns with the language proposed by SPWG.

It is essential the OGRR maintain its prospective nature and the VRT requirements not be imposed upon existing units. One clarification needed in the draft language is a statement that, at a minimum, any unit with a signed IA by the OGRR effective date should be exempt from such a requirement.

The High VRT requirement may pose challenges for wind turbines and should be more closely examined. FPLE believes the proposed Low VRT standard can be met by current technology but cannot be retrofitted to many types of older units, which reinforces the need for the OGRR to apply only prospectively.

Luminant raises useful considerations regarding development of a NERC VRT standard and FPLE notes the ability to implement a region-appropriate variation in ERCOT. Therefore we do not oppose waiting for NERC standard development. This would allow time for furthher consideration of issues identified by stakeholders in the comments on this draft OGRR.

LCRA

Commentor: Jack Thormahlen,

After reading both FERC Order 661 and 661-A, I can find no reference to LVRT requirements for any other type of generation except wind generation. This was obviously written to address a concern that wind was tripping off line when the voltage went below the 85% levels. As you can see by the comments below, there is concern that there are possible aspects of fossil fuel generation and hydro generation that may cause unintended consequences or damage should this proposal be implemented.

There is also the issue of what is really meant by "Existing individual units that are replaced are required to meet the requirement of figure 1." Does this mean the generator as a whole or some element or combination of elements?

Therefore, this proposed OGRR is very premature. This proposed OGRR has the same aspects of forceful requirements as OGRR188 had. That OGRR is still on hold for the rewrite of the associated MODs. This proposed OGRR needs to wait for NERC to get a standard written that addresses the FERC Order 661A, which is for wind.

Commentor: Bracy Nesbit, P.E.,

I am concerned about the outside the plant boundary 9-cycle fault. I think we will have to re-look at our fault studies to further investigate the impacts on equipment and relay settings. This will take some time to accomplish.

Hydroelectric units are designed, built, and rewound to standard ANSI C50.12. Round rotor machines (steam units) are typically designed, built, and rewound to standard is ANSI C50.13. These standards have different excitation requirements. For example, the 208% field voltage for 10 second ERCOT requirement may not be possible on a indirectly cooled hydro generator unit; we would have to get information from the OEM on the actual capability.

The document references ANSI C50.13-1989. The latest version of standard is: ANSI C50.13-2005. The ANSI C50.13-2005 version is a combination of the ANSI C50.10, ANSI C50.14, and ANSI C50.15. The ANSI C50.13-2005 version also compliments the IEC standards. OEM's typically are asked to meet one or the other standard. ERCOT should not be asking us to meet old standards on new or repaired equipment.

I interpret the statement about existing individual units that have been interconnected in the past to mean that all existing Hydro units do not have to comply with these requirements, even if they are rewound. Perhaps the key word is replaced versus repaired/rewound.

LCRA (continued)
Commentor: Tony Marsh

I do not think we need this VRT requirement for the following reasons:

1) Transmission faults that do cause a large voltage excursion typically are isolated within 3 to 5 cycles.
2) Transmission faults that are exposed longer are typically high impedance faults and should not affect voltage adversely enough to cause damage to the generating units.
3) Transmission faults that are "close in" faults to our generating facilities are isolated 3 to 5 cycles with no reclose or the remote end must reclose successfully before reclose of generating plant end of a TSC line.
4) Our generating units have back up protection from TSC faults in event TSC relays fail to isolate the fault and protect WPS assets such as the GSU and Generator: 46, 21P, 51V, 51N (GSU), 87T. The relays mentioned with the exception of the 87T relay for the GSU all have time delay functions that are set based on the thermal curves of the generator and GSU, not a definite timer such as 9 cycles.
5) Breaker Failure relays are already or should be set to maintain stability of the generating units especially steam driven units.

Commentor: Mike Davis, P.E.,

1. Have these requirements been thoroughly vetted out with generation owners and manufacturers concerning the possibility of long term life expectancy issues of the new units?
2. Has anyone in the meetings you have attended brought up the ancillary issue of coordinating the undervoltage ride through with the under frequency ride through requirement? It may not be an issue, but it was a thought that I had.
3. The language suggested by ERCOT may be interpreted as requiring the generator protection to wait until 9 cycles have passed before being allowed to trip. With the additional timing required to allow the relay and breaker to operate the actual time would be closer to 15 cycles. As I stated in #1 this should be vetted out with the manufacturers to see if additional costs would be incurred to build a generator that could withstand this much of a disturbance, for this duration and not sustain life expectancy shortfalls. The industry has been moving away from large overdesigned generators as compensation for unexplained/unexpected system conditions to more efficient designs that may not have as much "beef" inherit in the design. Also I would suggest a clarification of the language as follows:

Generation Resources shall remain interconnected during three-phase faults on the transmission system for the voltage levels illustrated in Figure 1 Voltage Ride-Through Boundaries For Generating Units, as measured at the transmission voltage side of the GSU as shown in Figure 1. Generation

LCRA (continued)

Resources shall be allowed to separate from the grid according to the recovery boundaries illustrated in Figure 1 Voltage Ride-Through Boundaries For Generating Units.

If we do not clarify this then we may be subjected to penalties for relays that clear to fast

4. Finally, the following language deems further discussion prior to approval of this OGRR: (Bullet Point No. 4) Faults on individual phases with delayed clearing may result in phase voltages outside this boundary but plant is required to remain connected and recover within the Voltage Recovery Boundary of Figure 1. A single phase fault would seem to be more reason for concern on our machines than a three phase fault. This language seems to imply that we cannot separate from the grid for a single phase fault of any duration, while the three phase fault has a definitive time limit prior to separation. If we utilize voltage imbalance is this implying that we only alarm for the condition? I believe that since this appears to be suggested new language from ERCOT that we should include language as follows:

Faults on individual phases with delayed clearing may result in phase voltages outside this boundary, but the individual generation owner shall protect their equipment, as instructed by the manufacturer, with voltage imbalance relaying or equivalent protection. This protection scheme shall be submitted to ERCOT along with the manufacturers recommended voltage imbalance ride through capabilities of each machine.

Luminant Generation Company LLC
Commentor: Henry Durrwachter

Luminant Generation Company LLC (Luminant) appreciates the work done by the SPWG to develop proposed changes to the ERCOT Operating Guides to reflect changes in Voltage Ride-Through (VRT) requirements consistent with recent changes required by the Federal Energy Regulatory Commission (FERC) pertaining to VRT.

However, Luminant is concerned that this process is attempting to get out ahead of the work on this issue currently being done by the NERC Generation Verification Drafting Team on the NERC PRS-024 standard, which is focused on VRT issues. Luminant would note that the NERC standards revision process usually requires 12 to 18 months to complete development, review, comments and approval of changes in standards. It seems logical and prudent for the SPWG, the OGRRTF and ROS to wait until the NERC standards revision process is complete before completing work on this topic. In addition, rather than addressing this issue through an OGRR, Luminant suggests that the issue be addressed through a Standards Authorization Request (SAR) submitted for review and approval by the Texas Regional Entity (Texas RE).

The notion that passing this OGRR before NERC would somehow prevent "dumping" of wind turbines that do not have adequate VRT capability fails to recognize that the wind turbines for projects planned for completion during 2008 have already been procured. Such turbines cannot easily be retro-fitted to be compliant with VRT capability in a timely manner and it would extremely expensive to require such units to meet a more stringent VRT requirement that is implemented after they had been procured.

Also, it appears to be the intent of this OGRR to require VRT capability on new generation construction. If so, and if ROS decides to consider this OGRR, Luminant recommends that it be revised to apply to only those projects that have NOT signed generation interconnect agreements or received air permits (if applicable) as of the date of implementation of this proposed OGRR. Luminant believes that it would be inappropriately expensive to require changes in standards for any generation project (wind or conventional) that could significantly impact equipment procurement for projects that are close to commercial operation. Such projects will have already acquired their major equipment (e.g., wind turbines or turbine-generators) and would incur significant cost increases and associated delays in reaching commercial operation if this proposed OGRR were made applicable to them.

Luminant is also concerned that there may be unintended consequences of this proposed OGRR on conventional generating units. While it may be possible to adjust relay settings on prime movers (i.e., generators and turbines) to meet more stringent VRT requirements, there is concern that a VRT requirement

Luminant Generation Company LLC (continued)

applicable to the entire plant (as contemplated by the proposed OGRR) could be very difficult (if not impossible) and very expensive to comply with. Auxiliary equipment at conventional power plants is typically comprised of induction motors, pumps, fans, etc. that are protected by over-current protective devices. Clearly, during a low-voltage event, a voltage decrease increases motor current, causing the possibility that existing over-current protective devices will disconnect auxiliary equipment and shut down the generating unit. Adjusting the over-current protective devices to allow greater VRT capability could diminish protection from actual fault conditions and permanently damage equipment. Luminant believes that ROS needs to consider the implications of this proposed OGRR on conventional generation before approving any OGRR or SAR related to VRT.

Luminant appreciates the opportunity to provide comments and looks forward to working with ROS and other market participants to develop appropriate standards to address this issue.

NRG Energy
Commentors: Dom Liu, Sydney L. Niemeyer

Based on market condition, a significant lead time is required for orderly design, procure, construct and commission a generating facility, any change to comply with LVRT would be unduly difficult and costly. It is recommended that this LVRT requirement be exempted for generating units already under construction.

The fault clearing duration is system specific, it could be in the 3~4 cycle range for a 500kV or 345kV system while up to 6~8 cycles on a 230kV or 138kV system; the plant design for a generating unit interconnected to 345kV system may be unnecessarily over designed to comply with the 9 cycle requirement.

Listed below are recommended changes to the proposed LVRT OGRR:

Under Article 3.1.4.6, add:

- *Individual generator units that are under construction and have an executed Interconnect Agreement to interconnect to the network at the same location at the effective date of this revision are exempt from meeting the requirements of Figure 1 for the remaining life of the generation equipment. Individual generator units that are replaced are required to meet the requirements of Figure 1.*

Under Article 3.4.1.6, make the following revision:

- Generation Resources are required to remain in-service during all transmission faults with normal clearing (no more than 9 cycles) in accordance with Figure 1*, site specific clearing time shall be determined by the interconnecting* transmission provider. Faults on individual phases with delayed clearing may result in phase voltages outside this boundary but plant is required to remain connected and recover within the Voltage Recovery Boundary of Figure 1.

Figure 1, Voltage Ride-Through Boundaries For Generating Units

- For a power station utilizing synchronous generators, the specific characteristics of the generating units and the grid to which they are connected affect the voltage recovery following a fault. Thus, defining a specific post-fault voltage recovery period of up to 3 seconds may be overly conservative and does not take into account the plant and system characteristics which in reality could be beneficial to voltage recovery following a system fault. It is also assumed that the voltage recovery profile are different on a 345kV system than that of 138kV system, the Voltage Recovery Boundary of Figure 1 could adversely impact the design of a generating unit interconnected to a stronger system unnecessarily. Recommend the 3-second duration be reduced to 1.75 seconds or make it site specific to be provided by the transmission provider.

Topaz Power Group
Commentor: Dale Lebsack

Topaz Power Group ("Topaz") appreciates this opportunity to provide comment to SPWG and ROS on the draft OGRR concerning implementation of Low Voltage Ride Through ("LVRT") requirements for generators.

While Topaz appreciates the aim of the draft OGRR, we believe that implementation of a LVRT requirement for non-wind generation is, at this time, premature for several reasons.

First, Topaz believes that concerns of this nature are best handled at the national level by NERC. From a practicality perspective, Topaz believes that, unless specific interconnection conditions dictate, individual reliability councils should not adopt different LVRT requirements as it will negatively impact turbine-generator manufacturers' and power plant designers' efforts to employ common design standards for power generating plants. For instance, Topaz understands that WECC is currently considering an LVRT requirement that is somewhat different from that currently before ROS. Topaz believes that there should be coordination between reliability councils and with organizations such as IEEE at the national level to ensure that standards are uniform.

Second, Topaz believes that further consideration should be given to the effect that the proposed requirement will have on current design standards for power plants, particularly steam power plants and combined cycle power plants. In discussing the proposed requirement with a turbine-generator OEM and with power plant design engineers, Topaz has found that the ability to stay on-line for at least 9 cycles when system voltage drops to 0 pu is not typically considered in the design of gas turbinegenerators and steam turbine-generators, nor is it considered in the design of power plants as a whole. The OEM indicated that a quite extensive, site-specific study and detailed analysis would need to be performed to determine the effect that a transient such as that contemplated in the OGRR would have on an individual generating unit. Consideration would need to be given not only to excitation systems and generator protection schemes but also to breaker and protection schemes for auxiliary equipment as, during transients such as is contemplated by the OGRR, generator terminal voltage could drop to as much as 40% of rated voltage. As most power generating units use a feed from the generator terminal to power their auxiliary equipment, a large drop in generator terminal voltage equates to a large drop in auxiliary bus voltage, which in turn will cause large induction motors that drive things like boiler feed pumps, circulating water pumps, lube oil pumps, etc. to stop for reasons including starter dropout and overcurrent relay activation. Topaz suggests that, in further considering an LVRT requirement, ROS and SPWG specifically solicit input and feedback from turbinegenerator OEMs and power plant design engineers.

Topaz Power Group (continued)

Third, Topaz believes that this requirement, if implemented, should not apply to new generating units that are currently under construction. Plants under construction have already purchased major equipment based on electrical system designs that do not incorporate the LVRT requirement. For the reasons stated in the preceding paragraph, retrofitting a power plant already under construction to meet the LVRT requirement as proposed would be quite costly and potentially delay construction of the unit. Therefore, if an LVRT requirement is to be implemented, it should be implemented in a way as to allow a generating unit already under construction to meet the LVRT requirements that are in effect at the time that the unit is designed.

Fourth, Topaz believes that the language that is meant to exempt existing generator units from the proposed LVRT requirement needs to be clarified and amplified with regards to loss of the exemption upon generator unit replacement. Specifically, what will constitute generator unit replacement needs to be better defined. For instance, will the entire generating unit including prime mover, steam source, etc. have to be replaced? Or, will just the generator itself have to be replaced? Will replacement of generator sub-components such as the exciter or the generator protection trigger the requirements?

Topaz looks forward to working with SPWG, ROS, and other market participants to appropriately address this issue.

Walter J. Reid:
Commentor: Walter J. Reid

The ERCOT proposed standard seems to be dramatically more stringent then any currently adopted standard and more stringent then standards currently under consideration. WECC has an adopted standard and FERC has an adopted standard. The ERCOT standard has two very difficult requirements; one is the high voltage requirement and the second is the long time a generator is required to stay on line for low voltages. There seems to be no basis for adopting a standard that is so much beyond current standards in the industry. If we wish to rectify the total lack of a VRT standard for wind-power in ERCOT then we should adopt the FERC standard embodied in order 661A (this is more stringent than the current WECC standard). The work currently being done by NERC on this issue should be the focus for any more stringent standard; not a regional effort by ERCOT.

In addition, the grandfathering requirement for existing generators needs to be extended to include new projects where it can be demonstrated that the engineering and procurement of hardware have proceeded to the point that it is impractically expensive to meet the new standard. In no case shall the new standard apply to any project that is scheduled to become commercial in less than 12 months after the adoption of the standard nor shall the new standard apply to any project that has signed its interconnect agreement before the standard has been adopted.