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OGRR Number	208	OGRR Title	Voltage Ride-Through (VRT) Requirement
Timeline	Normal	**Action**	Approved
Date of Decision		October 2, 2008	

Operating Guide Sections Requiring Revision	3.1.4.1, PGC Data Reporting 3.1.4.6, Protective Relaying Requirement
Effective Date	November 1, 2008
Priority and Rank Assigned	Not applicable.
Revision Description	This Operating Guide Revision Request (OGRR) proposes a requirement for VRT capability for all new generating units.
Overall Market Benefit	The intent of this OGRR is to maintain system reliability as new generators are added to the ERCOT System.
Overall Market Impact	Power Generation Companies will have to design their generation plants to meet the new standard which will result in some added capital cost but the transmission system reliability will be greater resulting in additional revenue for the generators since Outages should be reduced.
Consumer Impact	Consumers will see reduced costs due to increased reliability of new generators with some potential that increased capital cost of complying with the standard will be passed on to Consumers.
Procedural History	➢ On 4/15/08, OGRR208 was posted. ➢ On 4/21/08, the Operations Working Group (OWG) comments were posted. ➢ On 5/02/08, ERCOT Staff comments were posted. ➢ On 5/12/08, CenterPoint Energy comments were posted. ➢ On 5/15/08, Luminant comments were posted. ➢ On 5/16/08, the Wind Coalition comments were posted. ➢ On 5/20/08, the Operating Guides Revision Task Force (OGRTF) comments were posted. ➢ On 5/21/08, the OWG considered OGRR208. ➢ On 6/17/08, a second set of OGRTF comments were posted. ➢ On 6/18/08, the OWG again considered OGRR208. ➢ On 7/9/08, a Preliminary Impact Analysis was posted. ➢ On 7/16/08, the OWG considered the OWG Recommendation Report and the Preliminary Impact Analysis. ➢ On 8/14/08, ROS considered OGRR208. ➢ On 8/19/08, a third set of OGRTF comments were posted. ➢ On 8/20/08, OWG again considered OGRR208. ➢ On 9/11/08, ROS again considered OGRR208. ➢ On 9/19/08, a second set of Wind Coalition comments were

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	posted. ➢ On 9/23/08, an Impact Analysis was posted. ➢ On 9/25/08, a revised Impact Analysis was posted. ➢ On 9/25/08, Invenergy comments were posted. ➢ On 9/30/08, Oncor comments were posted. ➢ On 9/30/08, Horizon Wind Energy comments were posted. ➢ On 9/30/08, E. ON comments were posted. ➢ On 10/1/08, AES Wind Generation comments were posted. ➢ On 10/2/08, TAC considered OGRR208.
OWG Decision	On 5/21/08, the OWG was in consensus to defer action on OGRR208 as recommended by the OGRTF comments. On 6/18/08, the OWG was in consensus to recommend approval of OGRR208 as amended by the 061708 OGRTF comments and contingent upon resolution of the issues identified in the 061708 OGRTF comments by ROS. On 7/16/08, the OWG was in consensus to forward the OWG Recommendation Report and the Preliminary Impact Analysis to the ROS for consideration. On 8/20/08, the OWG was in consensus to forward OGRR208 to ROS as amended by the 081908 OGRTF comments and as revised by OWG.
Summary of OWG Discussion	On 05/21/08, the OGRTF chair explained that at its 5/20/08 meeting, OGRTF considered the comments that had been submitted on OGRR208. OGRTF consolidated the comments and made suggested revisions. OGRTF recommended that this draft document be reviewed at its June 17th meeting to address issues surrounding site specificity and low VRT timing requirements. OGRTF requested that representatives from AEP, Oncor, ERCOT Staff, the System Protection Working Group (SPWG), and the Wind Coalition be present at the June 17th OGRTF meeting. On 6/18/08, the OGRTF chair reviewed the 061708 OGRTF comments and identified the issues that OGRTF could not come to consensus on. The OGRTF chair recommended that these issues be taken to ROS for resolution. On 7/16/08, ERCOT Staff stated that the Preliminary Impact Analysis did not take into consideration the unresolved issues surrounding OGRR208 and that depending on ROS resolution, the Preliminary Impact Analysis might have to be updated prior to TAC consideration. On 8/20/08, the OWG reviewed the 081908 OGRTF comments. Concerns were raised regarding compliance of Wind-powered

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	Generation Resources (WGRs). It was suggested that WGRs provide a status and implementation plan of compliance to ERCOT.
ROS Decision	On 8/14/08, ROS unanimously voted to remand OGRR208 to OWG as revised by ROS with the directive that "grandfathering" and compliance issues be addressed. All Market Segments were present for the vote. On 9/11/08, ROS unanimously voted to recommend approval of OGRR208 as recommended by OWG and as revised by ROS. The Consumer Market Segment was not present for the vote.
Summary of ROS Discussion	On 8/14/08, ROS addressed issues identified in the 061708 OGRTF comments. ROS came to consensus on all issues with the exception of grandfathering and compliance of WGRs. ROS asked that this issue be resolved and language be developed by OGRTF and ERCOT Staff and brought to the September 11th ROS meeting. On 9/11/08, concerns were raised regarding the retrofit and retro-application of the VRT standard. It was suggested that a dynamic study be performed to justify the standard and to determine specifics of the problem. ERCOT stated that the proposal is to complete site-specific studies which would be extremely challenging and time consuming for ERCOT. ERCOT did not believe this was a practical proposal. A Market Participant pointed out that the Operating Guides could be modified in the future if the requirements did not meet the actual need of the market. Language revisions were proposed to update the compliance dates.
TAC Decision	On 10/2/08, TAC voted to approve OGRR208 as recommended by ROS with three opposing votes from the Independent Power Marketer (IPM) (2) and Independent Generator Market Segments and three abstentions from the Independent Retail Electric Provider (IREP) (2) and IPM Market Segments. All Market Segments were present for the vote.
Summary of TAC Discussion	On 10/2/08, concerns were expressed by the Wind Coalition regarding the retroactive application of the low VRT requirement proposed by OGRR208. It was stated that studies have not been completed to justify the retroactive application of low VRT and that it would essentially require WGRs to retrofit some of their equipment which could incur significant costs. A participant stated that the reliability of the ERCOT grid had to be taken into consideration. It was stated that the low VRT requirement was a large part of successful system planning and would in turn support the reliability of the ERCOT grid. It was emphasized that compliance for WGRs that signed Generation Interconnection Agreements between January 1, 2003 and November 1, 2008 was not required until 2015 and that if issues did come up, the Operating Guide standards could be changed.

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ERCOT/Market Segment Impacts and Benefits

Assumptions	1		
	2		
	3		
	4		
Market Cost		**Impact Area**	**Monetary Impact**
	1	*Power Generation Companies will have to design their generation plants to meet the new standard which will result in some added capital cost but the transmission system reliability will be greater resulting in additional revenue for the generators since Outages should be reduced*	
	2		
	3		
	4		
Market Benefit		**Impact Area**	**Monetary Impact**
	1	*Maintain system reliability as new generators are added to the ERCOT System.*	
	2		
	3		
	4		
Additional Qualitative Information	1		
	2		
	3		
	4		
Other Comments	1		
	2		
	3		
	4		

Original Sponsor	
Name	Walter J. Reid on behalf of the Wind Coalition
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Company	Wind Coalition

Comments Received	
Comment Author	**Comment Description**
OWG 042108	Recommended that the focus/scope of OGRR208 be narrowed to the consideration of wind generation only.
ERCOT Staff 050208	Proposed minor changes to reflect ERCOT and transmission owner concerns; Stated that VRT capability is needed across the ERCOT Transmission Grid.
CenterPoint Energy 051208	Supported ERCOT's comments with minor changes and proposed clarifying language.

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Luminant 051508	Proposed language to narrow scope of OGRR208 to wind generation only.
Wind Coalition 051608	Proposed language to convert to a relay standard and not a performance standard; to clarify that this is applicable to voltages at the point of interconnection; and to allow for additional equipment protection for generators experiencing significant low voltages.
OGRTF 052008	Recommended that OWG defer action until issues surrounding OGRR208 can be resolved.
OGRTF 061708	Recommended approval of OGRR208 as amended by CenterPoint Energy, ERCOT, and Wind Coalition comments and as revised by the OGRTF contingent upon resolution of issues by ROS.
OGRTF 081908	Proposed dates for WGR compliance with requirements in Section 3.1.4.6.1.
Wind Coalition 091908	Proposed language regarding evaluation and study of low VRT compliance requirement.
Invenergy 092508	Requested that retroactive requirements be struck.
Oncor 093008	Supported requirement for low VRT and presented brief studies.
Horizon Wind Energy 093008	Opposed retroactive application of low VRT requirements.
E.ON 093008	Supported new VRT requirements going forward; Opposed retroactive application of low VRT requirements.
AES Wind Generation 100108	Supported new VRT requirements going forward; Opposed retroactive application of low VRT requirements.

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Proposed Guide Language Revision

3.1.4.1 PGC Data Reporting

The PGC's reporting QSE shall provide the following information to ERCOT Control Area Authority at the times specified:

TIME	INFORMATION
Every 10 seconds	➢ Generation net MW output ➢ Generation net MVAR ➢ Status of switching devices in switchyard ➢ Generating unit breaker status ➢ Generating unit High Operating Limit ➢ Generating unit Low Operating Limit
Daily	➢ Planned unit status, ➢ Planned unit capability (both hourly and daily), ➢ Fuel limitations. The reporting Entity will promptly report this condition to ERCOT Control Area Authority
Annually	➢ Seasonal capability where applicable, ➢ Planned maintenance schedules. This information shall be updated when it changes.
Upon request	➢ Fuel capability as described in Section 6.2.7, Unit Alternative Fuel Capability Operating Guide Form, in conjunction with an Operating Condition Notice, Alert, Advisory, or Emergency Notice,

Each generator at a generation facility shall have its turbine's automatic speed governor in service when the generator is in normal operation. Testing and regulation performance of the speed governor shall be in accordance with Section 2.2.5, Turbine Speed Governors, of these Operating Guides. The generator operator is required to notify the ERCOT Control Area Authority, through its QSE, if the operation of speed governors is impaired.

Each generation facility providing an Ancillary Service shall provide output consistent with the requirements of that Ancillary Service and ERCOT instructions.

In the event of an ERCOT declared Emergency, ERCOT may require the QSE to notify the generation facility through the reporting Entity and require it to increase or decrease generation or change voltage and reactive requirements in accordance with the Protocols. The generation facility shall use its best efforts in meeting these required output levels in order that the ERCOT System can maintain safe and reliable operation.

It is the responsibility of all generators to carry an operational share of reactive support to insure adequate and safe Voltage Profiles are maintained in all areas of ERCOT. To accomplish this, the following requirements shall apply to each generation facility.

- Each generation facility shall have Automatic Voltage Regulators and power system stabilizers in service as defined in Section 3.1.4.5, Automatic Voltage Regulators and Power System Stabilizers, below.
- The generation facility shall be designed and operated consistent with its obligations to supply Voltage Support Service as required in the ERCOT Protocols and ERCOT Control Area Authority Procedures.
- ERCOT has the right and obligation to Dispatch the reactive output (Vars) of each generation facility within its design capability to maintain adequate transmission voltage in ERCOT.
- ERCOT and the TSP shall be notified of any equipment changes that affect the reactive capability of an operating generating unit no less than 60 days prior to implementation. ~~of the C~~changes~~, and any such changes~~ that decrease the reactive capability of the generating unit below the required level and changes that decrease the Voltage Ride-Through (VRT) capability of the plant must be approved by ERCOT prior to implementation. "Voltage Ride-Through" is defined as the ability of a generation plant to remain connected to the transmission system for specified high voltage and low voltage conditions.
- High reactive loading or reactive oscillations on generation units should be communicated to the QSE, the transmission operator, and ERCOT as soon as practicable.
- The tripping off line of a generating unit due to voltage or reactive problems should be reported to ERCOT, the transmission operator, and the QSE as soon as practicable.

REFERENCE: PROTOCOL SECTION 6.10.2, GENERAL CAPACITY TESTING REQUIREMENTS (IN PART)

QSEs shall provide ERCOT a list identifying each Generation Resource unit that is expected to operate more than one hundred sixty eight (168) hours in a Season as a provider of energy and/or Ancillary Services. ERCOT shall evaluate, during each Season of expected operation, the Net Dependable Capability of each unit expected to operate more than one hundred sixty eight (168) hours during that Season, except for any Generation Resources used solely for energy services and whose capacity is less than ten (10) MW. Prior to the beginning of each Season, QSEs shall identify the Generation Resources to be tested during the Season and the specific week of the test if known. This schedule may be modified by the QSE (including retests) during the Season. QSEs not identifying a specific week for a Generation Resource unit test must test the unit within the first one hundred sixty eight (168) hours of run time during the Season or operate with a Net Dependable Capability equal to the highest integrated hourly MWh output demonstrated during the first one hundred sixty eight (168) hours of run time. QSEs do not have to bring units On-line or shut down solely for the purpose of the seasonal verification. Any unit for which the QSE desires qualification to provide Ancillary Services shall have its Net Dependable Capability verified prior to providing services using the Generation Resource unit even if it fits the less than one hundred sixty eight (168) hour or small capacity exception. The capability of hydro units operating in the synchronous condenser fast response mode to provide hydro Responsive Reserve shall be evaluated by Season.
Load acting as a Resource to provide Ancillary Services shall have its telemetry attributes verified by ERCOT annually. In addition, once every two (2) years, any LaaR providing Responsive Reserve Service shall test the under frequency relay or the output from the solid-state switch, whichever

applies, for correct operation. However, if the Load's performance has been verified through response to an actual event, the data from the event can be used to meet the annual telemetry verification requirement for that year and/or the biennial relay testing requirement…

3.1.4.6 Protective Relaying and Voltage Ride-Through (VRT) Requirement

The Facility's generation machine characteristics and plant design shall incorporate the under-frequency firm Load shedding philosophy and criteria defined in Operating Guide 2.9.~~.~~ Requirements for Under-Frequency Relaying. Inherent in this philosophy is the idea that all generators remain on line until all three steps of firm Load shedding have been executed. In addition, Generation Resources must set generator voltage relays to remain connected to the transmission system during the following operating conditions:

- Generator terminal ~~terminal~~ voltages are within five percent (5%) of the rated design voltage and volts per hertz are less than one hundred five percent (105%) of generator rated design voltage and frequency;
- Generator terminal ~~terminal~~ voltage deviations exceed five percent (5%) but are within ten percent (10%) of the rated design voltage and persist for less than 10.0 seconds;
- Generator volts per hertz conditions are less than one hundred sixteen percent (116%) of generator rated design voltage and frequency and last for less than 1.5 seconds;
- A transmission system fault (three-phase, single-phase or phase-to-phase), but not a generator bus fault, is cleared by the protection scheme coordinated between the Generation Entity and the TDSP on any line connected to the generator's transmission interconnect bus, provided such lines are not connected to induction generators described in Protocol subsection 6.5.7.1, Generation Resources Required to Provide Voltage Support Service Installed Reactive Capability, paragraph (7). However, in the case of a generator bus fault or a primary transmission system relay failure, the generator protective relaying may clear the generator independent of the operation of any transmission protective relaying.

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The generation Facility shall have protective relaying necessary to protect its equipment from abnormal conditions as well as to be consistent with protective relaying criteria as described in ~~Operating Guide~~ Section ~~5: Planning~~7.2, System Protective Relaying.

Within thirty (30) days of ERCOT's request, Generation Resources shall provide ERCOT with the operating characteristics of any generating unit's equipment protective relay system or controls that may respond to temporary excursions in voltage with actions that could lead to tripping of the generating unit.

Generating Resources required to provide VSS shall have and maintain the following capability:

(1) Over-excitation limiters shall be provided and coordinated with the thermal capability of the generator field winding and protective relays in order to permit short-term reactive capability that allows at least eighty percent (80%) of the unit design standard (ANSI C50.13-1989), as follows:

Time (seconds)	10	30	60	120
Field Voltage %	208	146	125	112

After allowing temporary field current overload, the limiter shall operate through the automatic AC voltage regulator to reduce field current to the continuous rating. Return to normal AC voltage regulation after current reduction shall be automatic. The over-excitation limiter shall be coordinated with the over-excitation protection so that over-excitation protection only operates for failure of the voltage regulator/limiter.

(2) Under-excitation limiters shall be provided and coordinated with loss-of-field protection to eliminate unnecessary generating unit disconnection as a result of operator error or equipment misoperation.

3.1.4.6.1 Protective Relaying Requirement and Voltage Ride-Through Requirement for Wind-p-~~P~~owered Generation Resources

- Wind-p-~~P~~owered Generation Resources (W~~P~~GRs) ~~are required to remain in-service during all transmission faults with normal clearing (no more than nine (9) cycles) in accordance with~~ are required to set generator voltage relays to remain in-service during all transmission faults ~~with normal clearing~~ (no more than nine (9) cycles) in accordance with ~~shall remain interconnected during faults on the transmission system for a voltage as low as zero volts with a duration as long as nine (9) cycles, as measured at the transmission side of the generator step-up transformer, as shown in~~ Figure 1, Voltage Ride-Through Boundaries For Generating Units, below. Faults on individual phases with delayed clearing (zone 2) may result in phase voltages outside this boundary but if the phase voltages remain inside this boundary then ~~plant~~ generator voltage relays are ~~is~~ required to be set to remain connected and recover within the voltage recovery boundary of Figure 1. ~~Normal relay communication status will be assumed to exist in meeting the 9 cycle requirement.~~

~~Generation Resources shall remain interconnected during three-phase faults on the transmission system for a voltage level as low as zero volts with a duration no more than nine (9) cycles for 69 kV faults, seven (7) cycles for 138 kV faults, and four (4) cycles for 345 kV faults, as measured at the transmission voltage side of the generator step-up transformer as shown in Figure 1. The clearing time requirement for a three-phase fault will be specific to the generating plant substation location, as~~

determined by and documented by the transmission provider. WPGR voltage relays shall be set to remain interconnected during three-phase faults on the transmission system for a voltage level as low as zero volts with a duration no more than nine (9) cycles as measured at the transmission voltage side of the generator step-up transformer point of interconnection as shown in Figure 1. The clearing time requirement for a three-phase fault will be specific to the generating plant substation location point of interconnection, as determined by and documented by the transmission provider in conjunction with the interconnection agreement.

- This requirement does not apply to faults that would occur between the generator terminals and the transmission voltage side of the generation step-up transformer or when clearing the fault effectively disconnects the generator from the system.
- WPGRsGeneration Resources may be tripped after the fault period if this action is intended as part of a special protection system.
- WPGRs Generation Resources may meet the VRT requirements of Figure 1 by the performance of the generators or by installing additional equipment (e.g., Static VAr Compensator) within the generating plant or by a combination of generator performance and additional equipment.
- Generation ResourcesWPGRs that have had over 50 seconds cumulative operation over the life of the WPGR at below 10% of nominal voltage at the point of interconnection shall be allowed, with ERCOT's approval, to set generator voltage relays to provide sufficient protection to the Generation ResourceWPGR to comply with warranty requirements and to retain the expected life of the resource.Existing individual generator unitsWPGRs that are, or have been, interconnected to the network at the same location on SeptemberOctober 1, 2008 are exempt from meeting this VRT requirement for the remaining life of the existing generation equipment. will have to meet this requirement no later than January 1, 2
- are exempt from meeting this VRT requirement for the remaining life of the existing generation equipment. Existing individual generator unitsWPGRs that are replaced are required to meet the requirements of Figure 1.
- Existing individual WGRs that have signedare part of an Generation Iinterconnect Aagreement signed prior to January 1, 2003 are exempt from the requirements of Section 3.1.4.6.1, Protective Relaying Requirement and Voltage Ride-Through Requirement for Wind-powered Generation Resources.
- WGRs that are part of a Generation Interconnect Agreement signed after January 1, 2003 and before August November 1, 2008 shall meet the requirements of Section 3.1.4.6.1 by January 1, 2015.
- WGRs that are part of a Generation Interconnect Agreement signed after AugustNovember 1, 2008 shall meet the requirements of Section 3.1.4.6.1.
- All WGRs shall provide a status of compliance with the requirements of Section 3.1.4.6.1 to ERCOT System Planning by July 1, 2009.
- All non-exempt WGRs shall provide an implementation plan for compliance with the requirements of Section 3.1.4.6.1 to ERCOT System Planning by July 1, 2009.
- Notwithstanding any allowed exemptions, existing individual WGRs that meet the requirements of Figure 1 on AugustNovember 1, 2008 shall continue to meet the requirements of Figure 1.

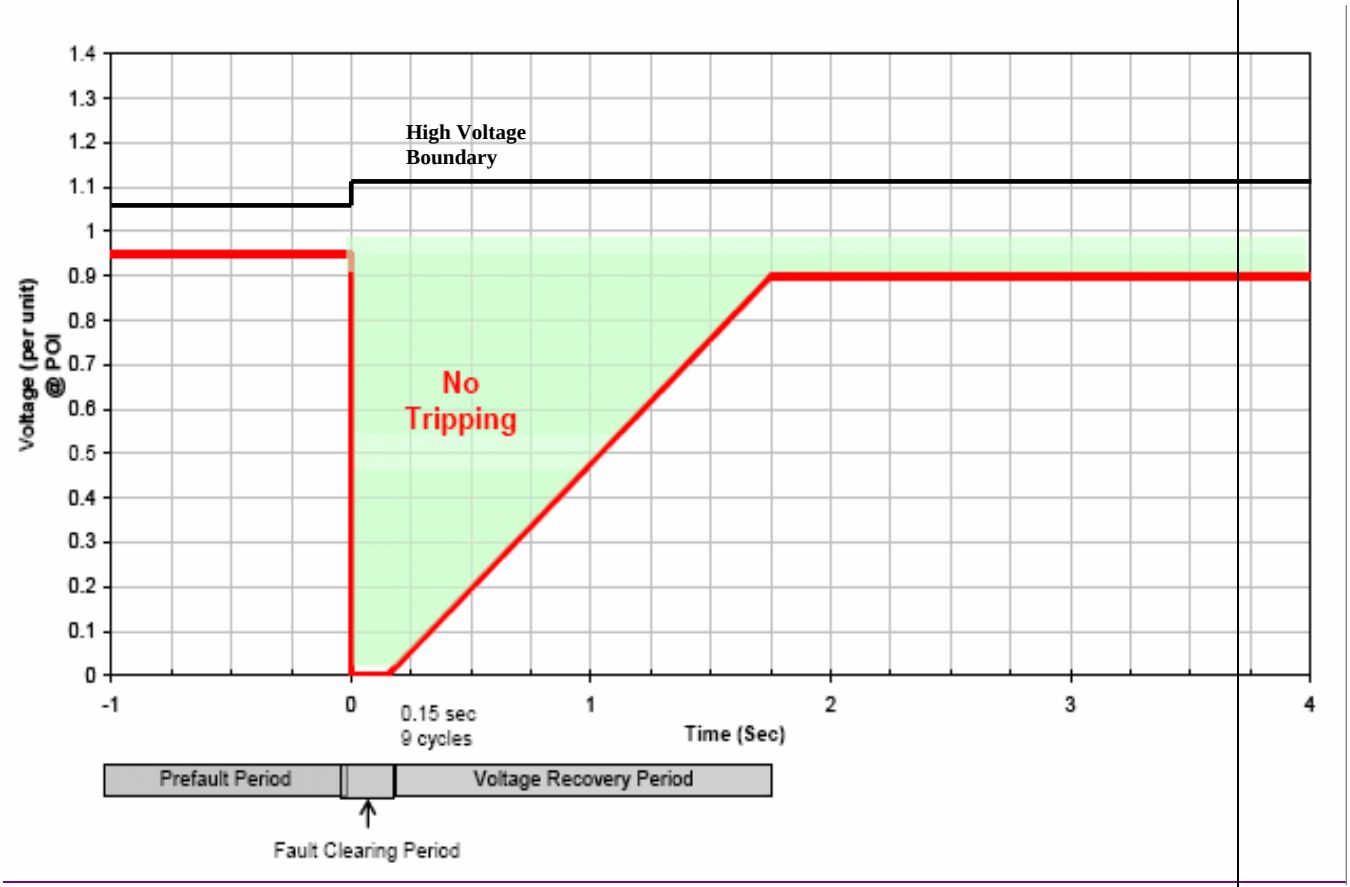
~~Units that are part of a Generation Interconnect Agreement signed before September 1, 2008 are exempt from meeting this VRT requirement for the remaining life of the generation equipment.~~

~~WPGRs that are part of a Generation Interconnect Agreement signed before October 1, 2008 are exempt from meeting this VRT requirement for the remaining life of the generation equipment.~~

~~WPGRs that come into commercial operation less than twelve (12) months after October 1, 2008 are exempt from meeting this VRT requirement for the remaining life of the existing equipment.~~

- If, due to a system disturbance, a W~~P~~GR come off-line within the boundaries of the VRT requirement of Figure 1, then the W~~P~~GR owner and the TSP shall be required to investigate and report to ERCOT on the cause of the W~~P~~GR trip identifying a reasonable mitigation plan and timeline.

ERCOT and the TSP shall be notified of any equipment changes that affect the reactive capability of an operating W~~P~~GR no less than sixty (60) days prior to implementation. of the changes, and any such changes that decrease the reactive capability of the W~~P~~GR below the required level and changes that decrease the Voltage Ride-Through (VRT) capability of the plant must be approved by ERCOT prior to implementation.



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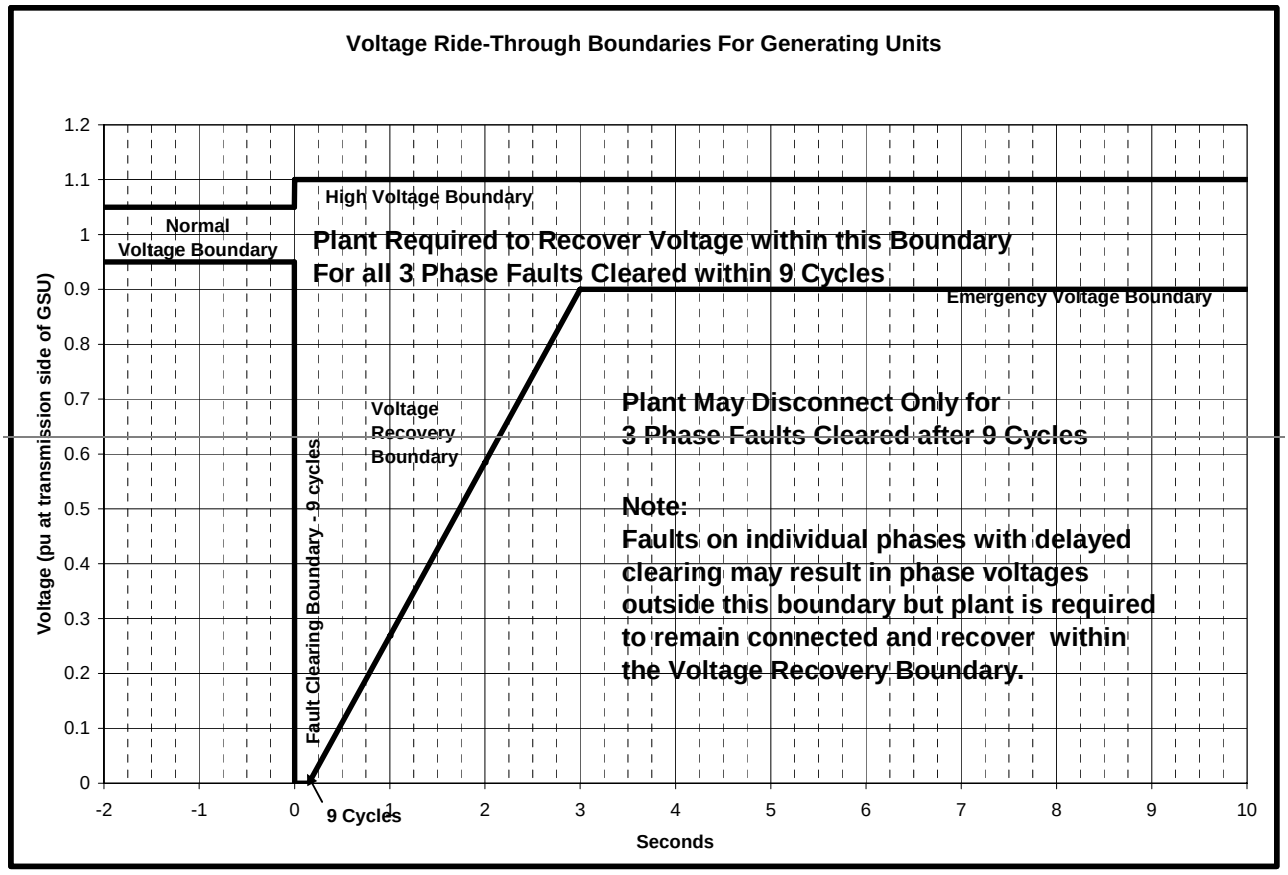

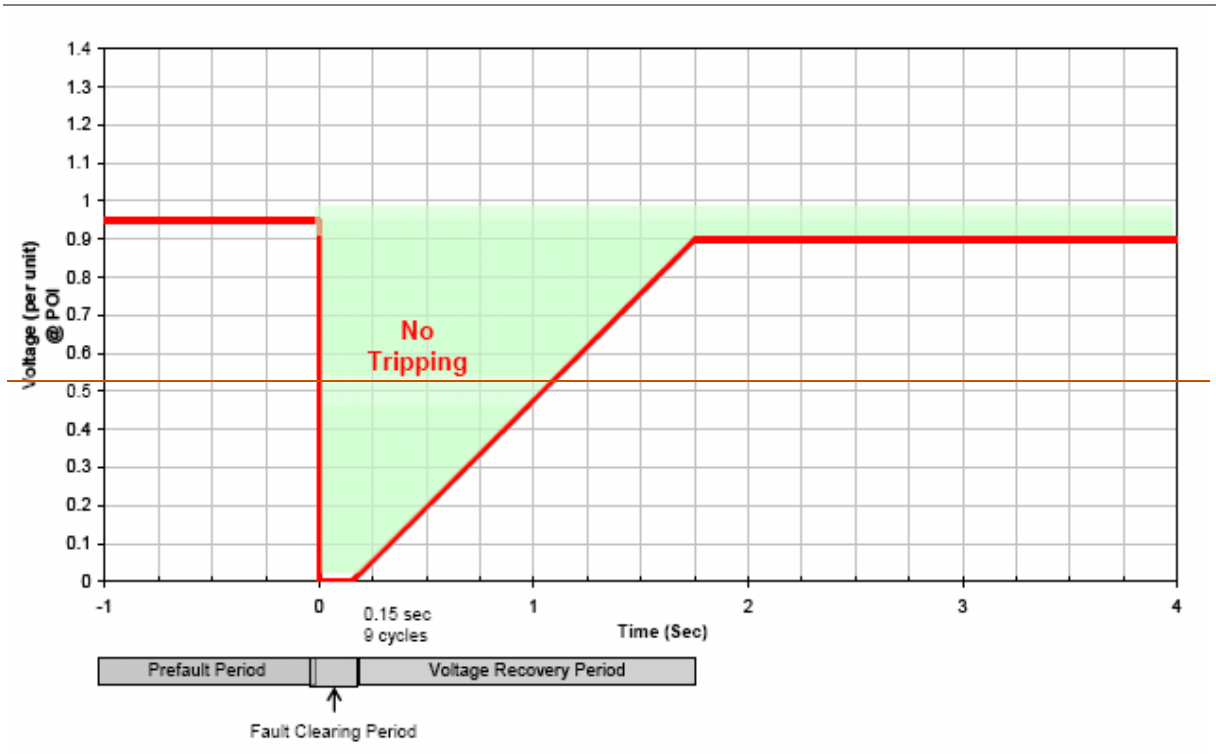

Figure 1: Voltage Ride-Through Boundaries For ~~Generating Units~~Wind-p~~-P~~owered Generation Resources