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UNITED STATES OF AMERICA  
BEFORE THE  
FEDERAL ENERGY REGULATORY COMMISSION

2004 MAY 20 A 10:30  
REGULATORY COMMISSION

Standardizing Generator Interconnection  
Agreements And Procedures

Docket No. RM02-1-001-005

PETITION FOR RULEMAKING OR, IN THE ALTERNATIVE, REQUEST FOR  
CLARIFICATION OF ORDER 2003-A,  
AND REQUEST FOR TECHNICAL CONFERENCE OF THE  
AMERICAN WIND ENERGY ASSOCIATION

I. INTRODUCTION

Pursuant to Rules 207 and 212 of the Commission's Rules of Practice<sup>1</sup> and Commission Order 2003-A ("Order")<sup>2</sup>, the American Wind Energy Association ("AWEA")<sup>3</sup> hereby petitions the Commission to adopt certain requirements for the interconnection of large wind generators described in Footnote 85 at page 86 of that Order. That footnote states the following:

We recognize that the LGIA and LGIP are designed around the needs of large synchronous generators and that many generators relying on newer technologies may find that either a specific requirement is inapplicable or that it calls for a slightly different approach. We are granting clarifications regarding wind generators in our LGIA Article 5.4 (Power System Stabilizers), LGIA Article 5.10.3 (ICIF Construction), and LGIA Article 9.6.1 (Power Factor Design Criteria). We realize that there may be other areas of the LGIP and LGIA that may call for a slightly different approach for a generator relying on newer technology because it may have unique electrical characteristics. Accordingly, we are adding a new Appendix G (Requirements of Generators Relying on Newer Technologies) to the LGIA as a placeholder for inclusion of requirements specific to newer technologies.

AWEA appreciates the Commission's recognition that modern wind generation technologies typically differ in certain respects from the technologies assumed in determining the

<sup>1</sup> 18 C.F.R. §§ 385.207 and 385.212

<sup>2</sup> Order dated March 5, 2004 in Docket No. RM02-1-001; 106 FERC 61,220

<sup>3</sup> AWEA is a national trade association representing a broad range of entities with a common interest in encouraging the expansion and facilitation of wind energy resources in the United States. AWEA members include wind turbine

interconnection requirements set forth in the Order. Typical wind plants use comparatively small, non-synchronous generator technologies that respond differently to grid disturbances and have different effects on the grid than large, synchronous generators. In light of these differences, it is entirely appropriate that there be different requirements for some parameters applicable to the interconnection of these technologies.

At the same time, AWEA members recognize that the wind industry's rapidly growing market share (wind is the fastest growing generation technology in the world) carries with it a responsibility to assist system planners and operators in maintaining reliable operation of the grid. Given the declining cost, planning flexibility, fuel diversity and environmental benefits of wind facilities, all credible forecasts predict growing reliance on wind facilities across the United States and North America. To ensure successful integration of wind energy into utility electric systems in the future, the wind industry intends to work closely with this Commission, the North American Electric Reliability Council ("NERC"), our Transmission Providers and our utility customers to address key issues such as low voltage ride-through during transmission system disturbances, provision of reactive power, and remote utility supervisory control and data acquisition ("SCADA") capability.

It is critical to the wind industry that such issues be addressed in a technically valid, non-discriminatory and consistent manner that enables rational business planning for this rapidly growing industry. Wind turbine manufacturers cannot meet the projected demand for their product if they are required to meet a patchwork quilt of inconsistent standards imposed by each grid operator. To that end, AWEA herein voluntarily asks the Commission to adopt in Appendix

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manufacturers, component suppliers, project developers, project owners and operators, financiers, researchers, renewable energy supporters, utilities, marketers, customers and their advocates.

G certain national standards for the interconnection of wind facilities that will address the concerns of both grid operators and the wind industry.

These standards are ones that wind turbine manufacturers and industry participants believe are now technologically and economically feasible while being responsive to legitimate concerns of Transmission Providers for interconnection of new wind plants. The standards are, however, not intended to be retroactively applied to existing wind plants, as the cost of doing so could not only be prohibitive, but may be inconsistent with existing contractual terms. In addition, any final rule should direct Transmission Providers to allow exceptions to the low voltage ride-through provisions for wind turbines that are in suppliers' existing inventory as of the date of acceptance of this filing, but were not designed to meet the proposed standards.

Accordingly, this filing sets forth the specific aspects of the Order that the Commission has stated should be different for wind generators and makes specific proposals for alternative requirements to be included in Appendix G. Recognizing that power system stabilizers, excitation systems, and automatic voltage regulators are not applicable to technologies using non-synchronous generators such as wind turbines, AWEA proposes instead a meaningful standard for low-voltage ride-through capability as well as proposals for installing SCADA capability for wind facilities. Low voltage ride-through capability will ensure that new wind turbines and large wind arrays will remain on line through most common power system disturbances and do their part in supporting the integrity and stability of the electric power grid.

With regard to power factor design criteria, AWEA members have concluded that their facilities (if not specifically the wind generators themselves) can provide up to the 0.95 leading/lagging capability set forth in Section 9.6.1 of Order 2003-A, subject to a demonstrated need for this capability and certain other clarifications we propose for inclusion in Appendix G.

However, flexibility in the application of this standard to reflect the unique circumstances of modern wind plant design should be recognized as discussed in detail below.

In addition to these standards, this petition also seeks certain "process standards" relevant to the on-going implementation of the Order. These include ensuring the accuracy of modeling and enabling interconnecting generators to self-study at the feasibility stage to recognize the unique engineering challenges in electrical design of modern wind plants.

In presenting these proposals in the context of Order 2003-A, AWEA understands that these proposals (if adopted by the Commission) and the other aspects of Order 2003-A applicable to wind facilities comprise standards that if met presumptively entitle a facility to be interconnected. Stated differently, AWEA urges the Commission to reemphasize that Transmission Providers may not impose additional or more stringent standards as a precondition to interconnection unless the Commission determines that such additional standards not only are just and reasonable for the specific application in question, but are comparable with or superior to the standards set forth in the final rule applicable to wind facilities. Such a restriction on all Transmission Providers is appropriate due to the need for the standardization of wind technologies to meet these new standards.

Finally, the Commission should find that Transmission Providers, on a case by case basis, should retain an obligation to waive or defer requirements that are not presently needed to meet applicable reliability standards, provided that they do not discriminate in doing so among intermittent resources. This latter point is important to AWEA because there are many circumstances, particularly for relatively small wind plants, where some of these requirements are not needed to meet any applicable reliability standard.

While there potentially will be differences in the interconnection standards for small and large wind facilities, just as the Commission has proposed for thermal generating facilities, AWEA has consciously proposed standards intended to address generic concerns arising from the growing penetration of typical wind facilities in regional markets. This approach avoids proposing only “lowest common denominator” standards that would be justified in every circumstance. In so doing, we rely on the good faith of Transmission Providers (and ultimately this Commission if the Transmission Providers refuse to consider alternative standards) when reliability standards can be met with less stringent and costly requirements. Just as the Commission has allowed variation where reliability standards demand additional requirements, it should emphasize that it expects Transmission Providers to waive or defer requirements in specific applications where such requirements are not needed to meet applicable reliability standards.

**II. PROPOSED STANDARDS**

In this section, AWEA discusses in detail its proposed standards. These discussions are organized by topic. Each topic discussion begins by quoting the relevant requirement from the Order as well as relevant Commission’s comments thereon. Thereafter, AWEA sets forth its proposed wind-specific standard together with an explanation for it. As an appendix to this petition, AWEA also sets forth its exact proposed language for Appendix G to the Commission’s Order.

**A. Proposed Appendix G Interconnection Requirements.**

**a. Power System Stabilizers and ICIF Construction**

**Order 2003-A Requirement:**

**5.4 Power System Stabilizers.** The Interconnection Customer shall procure, install, maintain and operate Power System Stabilizers in accordance with the guidelines and procedures established by the Applicable Reliability Council. Transmission Provider reserves the right to reasonably establish minimum acceptable settings for any installed Power System Stabilizers, subject to the design and operating limitations of the Large Generating Facility. If the Large Generating Facility's Power System Stabilizers are removed from service or not capable of automatic operation, Interconnection Customer shall immediately notify Transmission Provider's system operator, or its designated representative. The requirements of this paragraph shall not apply to wind generators.

**5.10.3 ICIF Construction.** The ICIF shall be designed and constructed in accordance with Good Utility Practice. Within one hundred twenty (120) Calendar Days after the Commercial Operation Date, unless the Parties agree on another mutually acceptable deadline, Interconnection Customer shall deliver to Transmission Provider "as-built" drawings, information and documents for the ICIF, such as: a one-line diagram, a site plan showing the Large Generating Facility and the ICIF, plan and elevation drawings showing the layout of the ICIF, a relay functional diagram, relaying AC and DC schematic wiring diagrams and relay settings for all facilities associated with Interconnection Customer's step-up transformers, the facilities connecting the Large Generating Facility to the step-up transformers and the ICIF, and the impedances (determined by factory tests) for the associated step-up transformers and the Large Generating Facility. The Interconnection Customer shall provide Transmission Provider specifications for the excitation system, automatic voltage regulator, Large Generating Facility control and protection settings, transformer tap settings, and communications, if applicable.

**Order 2003-A Comment:**

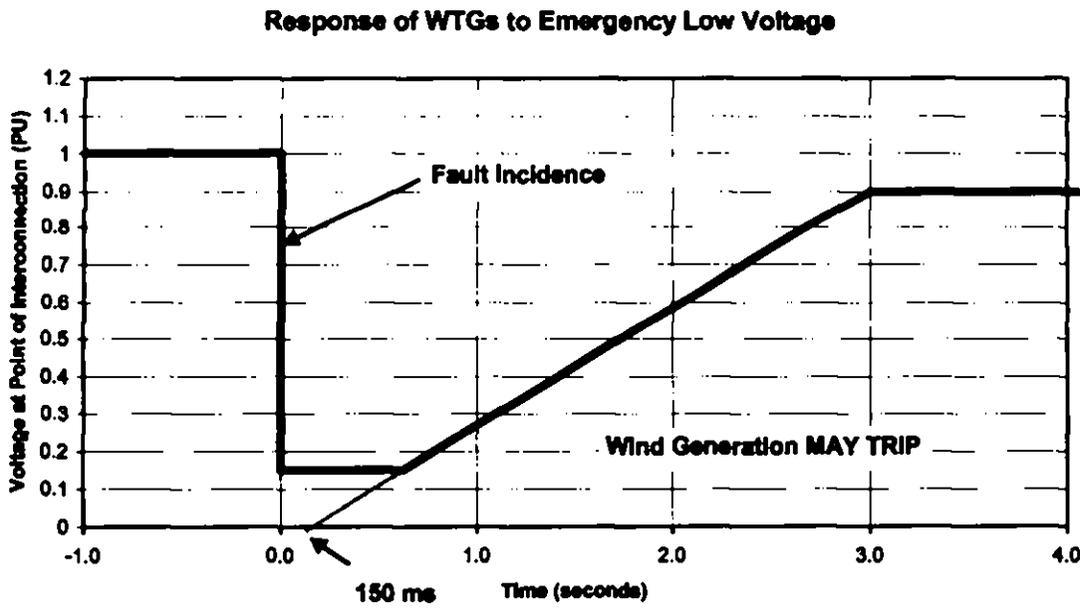
We agree with FPL Energy that power system stabilizers, excitation systems, and automatic voltage regulators may not be appropriate for non-synchronous technologies such as wind generators, and are amending Articles 5.4 and 5.10.3 to state that the requirements of these provisions do not apply to wind generators.

(AWEA notes that Section 5.10.3 does not, in fact, contain an explicit exemption for wind facilities and suggests that the Commission include such language as part of this rulemaking.)

**AWEA Proposed Appendix G Requirement:**

In lieu of these requirements applicable to synchronous generators<sup>4</sup>, AWEA proposes that the Commission adopt: 1) a low voltage ride-through standard applicable to the interconnection of non-synchronous wind facilities; and 2) a standard for the installation of SCADA equipment allowing the remote command and control of certain operating parameters of non-synchronous wind facilities, subject to appropriate tariffs for the use of this capability.

Specifically, AWEA proposes that utilities be authorized to require for interconnection of non-synchronous wind generators the ability to ride-through low voltage events caused by power system disturbances outside of the wind plant. The proposed voltage requirements are described by Figure 1, below. The requirements apply to voltage measured at the point of interconnection. The point of interconnection is understood to be at the transmission voltage (i.e. on the high voltage side of the wind plant substation transformer(s)).



**Figure 1 Proposed low-voltage ride through requirement**

<sup>4</sup> AWEA recognizes that some wind facilities may, in the future, employ synchronous generation technologies without power conversion interfaces where power system stabilizers and similar equipment may be appropriate.

This provision is clearly necessary to allow “high penetration” of wind energy taking into account (1) strength of the transmission grid; and (2) the ability of the system to balance wind resources with other resources and loads. Only recently have Transmission Providers begun asking turbine manufacturers/project developers to include this capability when interconnecting new plants. In fact, early on, some Transmission Providers actually discouraged low voltage ride-through capability, believing wind's contribution to system supply would be too small to be of meaningful assistance in responding to disturbances. It is a clear sign of the growing acceptance of wind energy that Transmission Providers world-wide value wind energy production in real time and are beginning to ask for fault tolerance broadly consistent with other forms of generation. The wind industry is rapidly responding to this challenge.

AWEA members have spent considerable time and effort debating the specifics of Figure 1 and believe it is emerging as an “international standard” for wind turbines. It is especially critical at this stage of maturity of wind turbine technology and the development of Good Utility Practice that turbine manufacturers have a stable, realistic design target and that wind plant developers have a reasonable expectation of the criteria by which their specific proposals will be evaluated. AWEA emphasizes that this proposed requirement is a nominal, national interconnection standard whose costs will be borne by the wind developer/turbine manufacturer.

As discussed in the introduction, the Commission should also make clear that Transmission Providers shall permit the interconnection of wind plants with lesser or no such capability where circumstances warrant (e.g. where, based on interconnection studies or the requirements of a particular provider's system, this capability is not necessary to meet reliability standards). The important caveat is that this discretion must be exercised in a non-discriminatory manner consistent with the Commission's comparability principle.

As to SCADA capability, AWEA proposes an interconnection standard requiring the installation of equipment enabling remote command and control of the following: 1) limitation of maximum plant output during system emergency and system contingency events; and 2) telemetry communication for "automatic" forecasting/scheduling.<sup>5</sup> Again, the Transmission Provider should be free to interconnect without such equipment or to defer its use where it is not beneficial to a particular system. AWEA emphasizes that this proposed standard requires only the installation of the physical equipment as an interconnection standard. It is crucial to this standard that the Commission clearly state that the terms and conditions for use of this capability is a separate transmission service issue, not an interconnection issue. Accordingly, such terms and conditions must be resolved by contract or Commission approved transmission tariff and not as an interconnection standard. AWEA therefore does not address such terms and conditions in this petition and emphasizes that nothing in this proposal should be read as an implied or explicit agreement regarding the terms and conditions for use of this equipment.

b. Reactive Power

Order 2003-A Requirement:

**9.6 Reactive Power.**

**9.6.1 Power Factor Design Criteria.** Interconnection Customer shall design the Large Generating Facility to maintain a composite power delivery at continuous rated power output at the Point of Interconnection at a power factor within the range of 0.95 leading to 0.95 lagging, unless Transmission Provider has established different requirements that apply to all generators in the Control Area on a comparable basis. The requirements of this paragraph shall not apply to wind generators.

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<sup>5</sup> By this AWEA means bi-directional electronic communication between the system operator and the wind facility of sufficient capability to accommodate reliable scheduling and forecasting information exchange.

**AWEA Proposed Appendix G Requirement:**

AWEA proposes that a power factor design criteria standard of up to 0.95 leading/lagging be applied to wind plants (but not necessarily each individual wind generator). As noted in the introduction, however, in accepting this standard AWEA is relying upon the flexibility inherent in the Order 2003-A language. Thus, in lieu of a different substantive requirement in Appendix G, AWEA proposes to delete the final sentence above exempting wind generators from this requirement and to insert the following in Appendix G:

Although the power factor design criteria is expressed at the point of interconnection, for wind generators, Good Utility Practice shall be used to locate the required reactive support either at the wind turbine(s) or throughout the wind plant medium voltage collection system. This flexibility in optimizing the placement of required reactive support shall consider potential limitations to wind plants' reactive output capability based on parameters such as system voltage and frequency, and shall not be used to shift cost responsibility for pre-existing deficiency in grid voltage control onto the Interconnection Customer. If System Impact Studies demonstrate that reliability criteria are met at less than (closer to unity) 0.95 lagging (capacitive), then that resulting figure becomes the power factor range requirement. The power factor range requirement shall be met via the design-based reactive capability of the wind turbines used for each project (taking into account any limitations due to voltage level, real power output, etc.) plus switched and/or fixed capacitors.

The objective of this standard is to ensure good voltage control on the grid. Wind technology is different from conventional technology in this regard in two ways:

1. Wind plants generally have large medium voltage collection grids whose design can significantly affect grid and turbine voltage control in and of itself; and
2. Voltage control/reactive support for wind plants consists of multiple voltage control devices at the turbines (as for conventional technology) and, in addition, discrete voltage control devices whether static or dynamic or both distributed throughout the wind plant.

These inherent differences mean that, many times, expressing a required power factor range at the single point of interconnection does not optimize voltage control of the wind plant

and/or the transmission grid. While wind generation should be held to a performance standard roughly equivalent to conventional generation in this regard, engineers should be given the freedom to optimize grid voltage control. It may be that adherence to the nominal 0.95 leading/lagging standard is totally unnecessary at that point on the grid. If so, the addition of costly external voltage control devices necessary to meet the nominal standard may not be "used and useful" and should not be required.

Lastly, AWEA suggests that the Commission make explicit three additional points. First, the Commission should make clear that the Interconnection Customer is prohibited from disabling low-voltage ride through or power factor equipment after the wind plant is in operation.<sup>6</sup> Second, generators providing voltage regulated reactive power control to an agreed voltage schedule should not be charged for reactive power consumption and should be paid for the provision of reactive power capability on a non-discriminatory basis to the extent others are paid. Third, that these standards shall be accepted by both Interconnection Customers and Transmission Providers as the standards that apply to wind generators; and Transmission Providers shall not adopt and apply more onerous standards. On this latter point, AWEA proposes that the Order 2003-A language that would allow a more stringent requirement where the "Transmission Provider has established different requirements that apply to all generators in the Control Area on a comparable basis" would not apply to wind generators.

**B. Proposed "Process" Standards.**

In addition to the Appendix G performance standard issues discussed above, the Commission should address two important process issues affecting interconnection of wind facilities. These relate to: 1) ensuring that engineering models used to determine interconnection

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<sup>6</sup> Note: the Commission has adopted equivalent language with regard to power system stabilizers in Order 2003-A.

requirements are reasonable and current; and 2) allowing generators the option to enter the interconnection queue, then to “self-study” the feasibility of interconnection.

a. Modeling Issues

Order 2003-A Statement:

Note: A completed General Electric Company Power Systems Load Flow (PSLF) data sheet or other compatible formats, such as IEEE and PTI power flow models, must be supplied with the Interconnection Request. If other data sheets are more appropriate to the proposed device, then they shall be provided and discussed at Scoping Meeting.<sup>7</sup>

AWEA Proposed Appendix G Requirement:

AWEA urges the Commission to require that Transmission Providers and wind generator manufacturers participate in a formal process for developing, updating and improving the engineering models and turbine specifications used for modeling the wind plant interconnection. The Utility Wind Interest Group (“UWIG”)<sup>8</sup> is an example of one organization working on such a process. UWIG and AWEA have made preliminary contacts with the newly formed IEEE Power Engineering Society Emerging Technology Coordinating Committee to begin the process of transferring this effort over the next few years to the more traditional engineering community protocols for model and standards development and validation. AWEA members have also had some preliminary discussions within the Western Electric Coordinating Council—Modeling and Validation Work Group regarding these issues. This process will assure that consistent wind plant/turbine models are available within the industry standard power system modeling software (PTI-PSS/E and General Electric – PSLF) for electric system planners to evaluate the wind plant

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<sup>7</sup> Order 2003-A, Attachment A to Appendix 1 at p. 4. AWEA notes that there is no “PSLF data sheet” per se, and that many of the more recent wind generator PSLF models do not appear in the standard PSLF library. AWEA interprets this requirement, in the case of wind generators, to mean submission of generator and collection system design data sufficient to allow use of the PSLF model to accurately study the impacts of the proposed interconnection on the surrounding grid. AWEA uses the phrase “PSLF data (or equivalent)” to convey this meaning in this petition.

<sup>8</sup> UWIG is a voluntary organization of 55 utilities that are self-selected for an interest in application of wind technology on their grid.

interconnection. Given the rapid pace of wind turbine product development and the key role these models play in determining interconnection costs and requirements, it is imperative that these models reflect current generator technologies accurately and are updated and validated in a timely manner as new turbine product development occurs. AWEA believes it should be a requirement of the interconnection tariffs that Transmission Providers participate along with wind turbine manufacturers in a reasonable, formal process for achieving this result.

b. Self-study of Feasibility

AWEA's final proposal is that interconnecting generators should be permitted to self-study feasibility in a manner analogous to the NY-ISO practice in the State of New York. Under this proposal, the generator should be able to enter the interconnection queue and conduct its own Feasibility Study, having obtained the information necessary to do so upon paying the initial deposit and submitting its interconnection application. Interconnecting wind generators, like other generators, should also be permitted to proceed directly to the System Impact Study where, due to their own feasibility work or otherwise, they conclude that the provider's Feasibility Study would not be useful or necessary.

This proposal is needed because the Order 2003-A requirement that completed PSLF data (or equivalent) for the generator be submitted with the interconnection request is impractical for wind generators. For wind plants, the turbine selection and the electrical design of the wind plant is an output of, not an input to, the Feasibility Study. Due to the very fast project development cycle for wind generation, the particular make and model of wind turbine has not normally been selected at the time an interconnection request is submitted. More importantly, the turbine selection decision is significantly influenced by the grid conditions at the point of interconnection.

Thus, the requirement that the PSLF data (or equivalent) be submitted before the Feasibility Study can leave the wind developer with a Catch-22. The wind plant developer must enter the interconnection queue in order to complete his electrical design, but must have a completed electrical design in order to enter the queue. Either the developer must submit several interconnection requests hoping that at least one possible turbine selection/electrical design will fit, or the developer must prevail on the good graces of the Transmission Provider to “go the extra mile” and work interactively to achieve a mutually acceptable result without sticking to the letter of the LGIP.

AWEA therefore proposes that the LGIP be modified to enable wind facilities to pay the \$10K deposit, enter the interconnection queue, have the scoping meeting and receive from the Transmission Provider the grid Base Case data, including Load Flow, Stability and Short Circuit Base Case data. The developer, having entered the queue, can then study feasibility itself and present the Transmission Provider with an electrical design sufficiently detailed to allow the Transmission Provider to conduct the subsequent System Impact Study.

### **III. PROPOSED TRANSITION RULES**

The equipment standards proposed above (i.e. low voltage ride-through, SCADA capability and reactive power) will require some lead time for the industry to implement given the time required for wind turbine design and manufacture as well as wind project planning. By the time the Commission finalizes these standards, most projects that will seek interconnection in the months immediately following the order will have already made commitments for their turbines and will have planned their projects without reference to these new standards. Accordingly, in order for the industry to implement these standards without substantial project disruption or “stranded” equipment, AWEA proposes that the physical standards proposed herein take effect

for interconnection requests submitted to a Transmission Provider on the later of: 1) final approval of the Transmission Provider's interconnection tariff incorporating these standards; or 2) six (6) months following the Commission's final rule. This short lag in the implementation of the final rule is necessary due to the ongoing efforts of wind turbine manufacturers to develop and demonstrate these capabilities. AWEA proposes that the process standards take effect immediately for interconnection requests filed after adoption of the final order.

#### **IV. REQUEST FOR TECHNICAL CONFERENCE**

As part of the rulemaking or clarification sought by this petition, AWEA recommends that the Commission hold a technical conference as soon as possible. In addition to discussing the specific proposals of this petition, the purpose of the technical conference is to allow a full discussion of the interaction of non-synchronous wind facilities with the grid in the context of interconnection requirements. AWEA understands fully that these issues are important to grid operators, reliability councils and many other stakeholders and looks forward to their input into these rules. To that end, AWEA recommends that NERC, the regional reliability councils, IEEE, and perhaps others be involved in the planning of the technical conference.

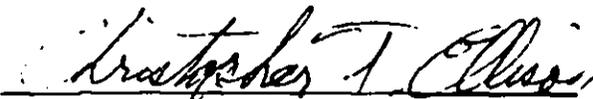
#### **V. CONCLUSION**

AWEA again wishes to express its appreciation to the Commission for the provisions in Order 2003-A recognizing that some interconnection requirements must be specifically tailored for new technologies such as wind. By this petition, AWEA urges the Commission to take the next step in implementing these provisions. The specific proposed rules set forth above seek to balance the needs of Transmission Providers and system operators while also providing the wind industry with uniform, technically-achievable standards that enable rational development,

manufacture and deployment of wind turbines. AWEA looks forward to working with the Commission, NERC, UWIG, IEEE, and all parties as this rulemaking moves forward.

Dated: May 20, 2004

Respectfully submitted,

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**PROPOSED LANGUAGE FOR APPENDIX G OF ORDER 2003-A**

**APPENDIX G**

**REQUIREMENTS OF GENERATORS  
RELYING ON NEWER TECHNOLOGIES**

Pursuant to the discussion at Footnote 85 at page 86 of this Order, this Appendix G sets forth requirements specific to newer technologies that differ from the typical large synchronous generators assumed in the Order. The application of each standard set forth below is premised on the Transmission Provider making a determination of need based on Good Utility Practice and applicable reliability standards during the Generator Interconnection Study. If such a determination is made, the Transmission Provider would require as a condition of interconnection that such technologies meet the requirements of this Appendix.

**A. Standards Applicable to Wind Generators.**

**i. Low Voltage Ride-Through Capability**

Non-synchronous wind generators shall demonstrate the ability to remain on-line during *nominal voltage disturbances up to the time periods and associated voltage levels set forth in Figure 1, below.* The requirements apply to voltage measured at the point of interconnection. The point of interconnection is understood to be at transmission voltage (i.e. on the high voltage side of the wind plant substation transformer(s)). Nothing in this standard shall authorize a Transmission Provider to refuse to interconnect facilities with lesser or no such capability where the Transmission Provider determines, based on interconnection studies or the requirements of a particular Transmission Provider's system, that this capability is not necessary to meet applicable reliability requirements. The Interconnection Customer may not disable low voltage ride-through equipment after the wind plant is in operation. Transmission Providers shall allow exceptions to

the low voltage ride-through provisions for wind turbines that are in suppliers' existing inventory as of the adoption of this rule, but were not designed to meet the proposed standards.

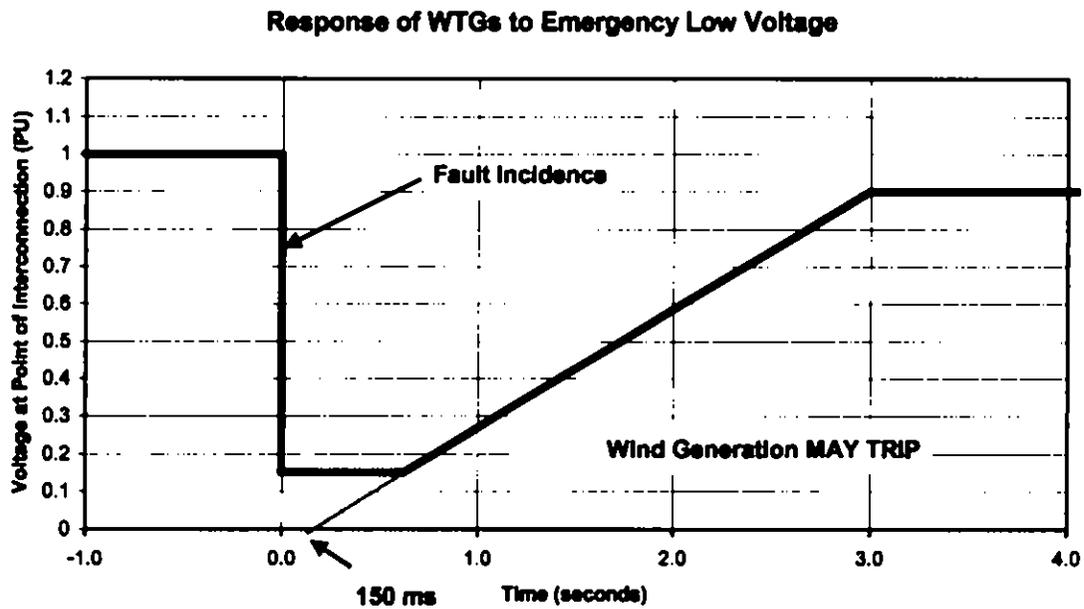


Figure 1 Proposed low-voltage ride through requirement

This standard shall become effective for interconnection requests submitted to a Transmission Provider on the later of: 1) final approval of a Transmission Provider's interconnection tariff incorporating these standards; or 2) six (6) months following the Commission's final order.

**ii. Telecommunication Equipment**

As a condition of interconnection, non-synchronous wind generators shall install equipment enabling remote supervisory control and data acquisition ("SCADA") of the following: 1) limitation of maximum plant output during system emergency and system contingency events; and 2) bi-directional electronic communication between the system operator and the wind facility of sufficient capability to accommodate reliable scheduling and forecasting

information exchange. A Transmission Provider shall interconnect facilities with lesser or no such capability where this capability is not necessary to meet applicable reliability standards on a particular Transmission Provider's system. Nothing in this standard shall authorize a Transmission Provider as a condition of interconnection to require any terms or conditions for the use of this capability. Such terms and conditions shall be addressed as a matter of transmission service pursuant to the appropriate transmission service contract or tariff and such capability shall only be employed on a non-discriminatory basis when necessary to maintain system reliability.

This standard shall become effective for interconnection requests submitted to a Transmission Provider on the later of: 1) final approval of a Transmission Provider's interconnection tariff incorporating these standards; or 2) six (6) months following the Commission's final order.

### **iii. Reactive Power**

As a condition of interconnection as determined by the Generator Interconnection Study, non-synchronous wind generators shall be required to maintain a composite power delivery at full rated power output at the Point of Interconnection at a power factor within the range of up to 0.95 leading and up to 0.95 lagging. Although the power factor design criteria is expressed at the Point of Interconnection, for non-synchronous wind generators Good Utility Practice shall be used to locate the required reactive support either at the wind turbine(s) or throughout the wind plant medium voltage collection system. This flexibility in optimizing the placement of required reactive support shall consider potential limitations to the wind plant's reactive output capability based on parameters such as system voltage and frequency, and shall not be used to shift cost responsibility for pre-existing deficiency in grid voltage control onto the Interconnection

Customer. This distribution of reactive support may result in actual power factor ranges different from the up to 0.95 leading/lagging criteria at the Point of Interconnection.

If System Impact Studies demonstrate that reliability requirements are met at less than (closer to unity) 0.95 lagging (capacitive), then that resulting figure becomes the power factor range requirement. The power factor range requirement shall be met via the design-based reactive capability of the wind turbines used for that project (taking into account any limitations due to voltage level, real power output, etc.) plus fixed and/switched capacitors. Transmission Providers shall interconnect facilities with lesser or no such capability where circumstances warrant (e.g. where, based on interconnection studies or the requirements of a particular Transmission Provider's system, this capability is not necessary to meet applicable reliability requirements). Nothing in this standard shall prevent a Transmission Provider from deferring to a future time compliance with this standard, provided that the terms of such deferral are non-discriminatory and are set forth clearly in the Interconnection Agreement. The Interconnection Customer shall not disable power factor equipment after the wind plant is in operation. The Transmission Provider shall not charge wind generators providing voltage regulated reactive power control to an agreed voltage schedule for reactive power consumption and shall compensate wind generators for the provision of reactive power capability on a non-discriminatory basis to the extent others are compensated.

This standard shall become effective for interconnection requests submitted to a Transmission Provider on the later of: 1) final approval of a Transmission Provider's interconnection tariff incorporating these standards; or 2) six (6) months following the Commission's final order.

#### **iv. Models and Self-Study of Feasibility**

As set forth in this Order, Large Generator Interconnection Customers must submit an Interconnection Request that includes, among other things, General Electric Company Power Systems Load Flow (PSLF) data or other compatible formats, such as IEEE and PTI. In applying this requirement to wind generators, however, the Transmission Provider shall: 1) participate in a formal process for updating, improving, and validating the engineering models used for modeling the interconnection impacts of wind turbines; and 2) permit self-study of feasibility as described below. Self-study of feasibility means that the wind generator shall be permitted to submit the Interconnection Application without the provision of the PSLF (or equivalent) data, pay the \$10K deposit, enter the interconnection queue, have the scoping meeting and receive from the Transmission Provider the grid Base Case data (including Load Flow, Stability and Short Circuit Base Case data). The wind generator shall then be permitted to self-study the feasibility of interconnection and present the Transmission Provider with an electrical design and wind turbine/plant models sufficiently detailed to allow the Transmission Provider to conduct the subsequent System Impact Study as if the PSLF data had been submitted with the Interconnection Application.

## CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document upon each party designated on the official service list in this proceeding.

Dated at Sacramento, California, this 20<sup>th</sup> day of May, 2004.

  
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Ron O'Connor