Exhibit A:

Emerging Technologies Integration Plan (ETIP)

Prepared by the Electric Reliability Council of Texas

Technical Advisory Committee

Renewable Technologies Working Group

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Preface

The combination of several forces has led to a rapid and significant addition of renewable energy generating capacity within the Electric Reliability Council of Texas (ERCOT) in recent years, primarily in the form of large-scale wind generation resources. While this influx of wind power has provided many benefits to Texas, it has also created numerous challenges which must be addressed to maintain bulk electric system reliability and wholesale market functionality.

Although work on this document began as a quest to develop a holistic approach to the myriad issues associated with wind generation with an eye toward other emerging renewable technologies, ERCOT stakeholders quickly realized that many emerging technologies other than renewable generation resources have characteristics similar to wind generation, such as variable energy output or limitations on dispatchability, which must be addressed. Accordingly, this document evolved from the original concept of a renewable technologies integration plan into a broader emerging technologies integration plan which more accurately captures the full array of potentially significant technical challenges likely to be presented to ERCOT system planners and operators in the coming years in a number of key areas.

The ERCOT stakeholders acknowledge the open access network paradigm adopted by the Texas Legislature[1]; strive to effectively and efficiently implement policy directives to integrate renewable energy resources into the ERCOT system[2]; and endeavor to allow market forces, to the greatest extent possible, to provide the generation resources, ancillary services, and other technical solutions necessary to ensure adequate system security[3]. However, those parties responsible for system planning and operational security also recognize that the widespread

[1] Title II, Texas Utilities Code, Public Utility Regulatory Act (PURA), §39.151(a)(1) requires an independent organization to "ensure access to the transmission and distribution systems for all buyers and sellers of electricity on nondiscriminatory terms."

[2] *e.g.*, PURA §§39.904(a) and (g), 39.905(d)(11), 39.9053, 39.911, 39.914, 39.916.

[3] PURA § 39.001(4)(d) directs regulatory authorities to "authorize or order competitive rather than regulatory methods to achieve the goals of this chapter to the greatest extent feasible," and, "adopt rules and issue orders that are both practical and limited so as to impose the least impact on competition."

introduction of variable energy resources and other emerging technologies presents significant challenges which must be addressed in order to effectively and efficiently maintain system reliability.

In particular, meeting the Texas Legislature's target for increased amounts of installed renewable energy generation capacity[4] and implementing the Public Utility Commission of Texas order designating Competitive Renewable Energy Zones[5] has required a comprehensive review of ERCOT planning models and assumptions, operational capabilities and procedures, and certain elements of the ERCOT Zonal and Nodal market designs and systems.

The Emerging Technologies Integration Plan (ETIP) documents recent ERCOT stakeholder efforts to integrate renewable and other emerging technologies; catalogues a number of recommendations and strategies to address future integration issues; and provides a holistic framework to guide and track further integration activities.

The ETIP is the work product of the ERCOT Technical Advisory Committee (TAC) by and through its Renewable Technologies Working Group (RTWG).

[4] PURA 39.904(a). The original Goal for Renewable Energy established in 1999 required 2,000 MW of new generation capacity from renewable energy technologies be installed in Texas by Jan. 1, 2009. The goal was met in early 2006. In 2005, the Legislature increased the goal to 5,000 MW of new renewable capacity by Jan. 1, 2015 and also established a target of 10,000 MW of renewable capacity, including 500 MW from non-wind resources, by Jan. 1, 2025. The 5,000 MW goal was met in 2008 and the 10,000 MW target for renewable capacity in Texas was achieved in June 2010, more than 14 years ahead of schedule. However, at this time Texas has not achieved the target to install at least 500 MW of new non-wind renewable technologies.

[5] *Staff's Petition for Designation of Competitive Renewable Energy Zones*, Public Utility Commission of Texas Docket No. 33672, Order on Rehearing, Oct. 7, 2008. The Commission selected 6 "zones" and ordered numerous major transmission system improvements to deliver renewable energy from the designated renewable energy zones to customers. The Commission estimated the ordered transmission system improvements could accommodate 18,456 MW of generation capacity.

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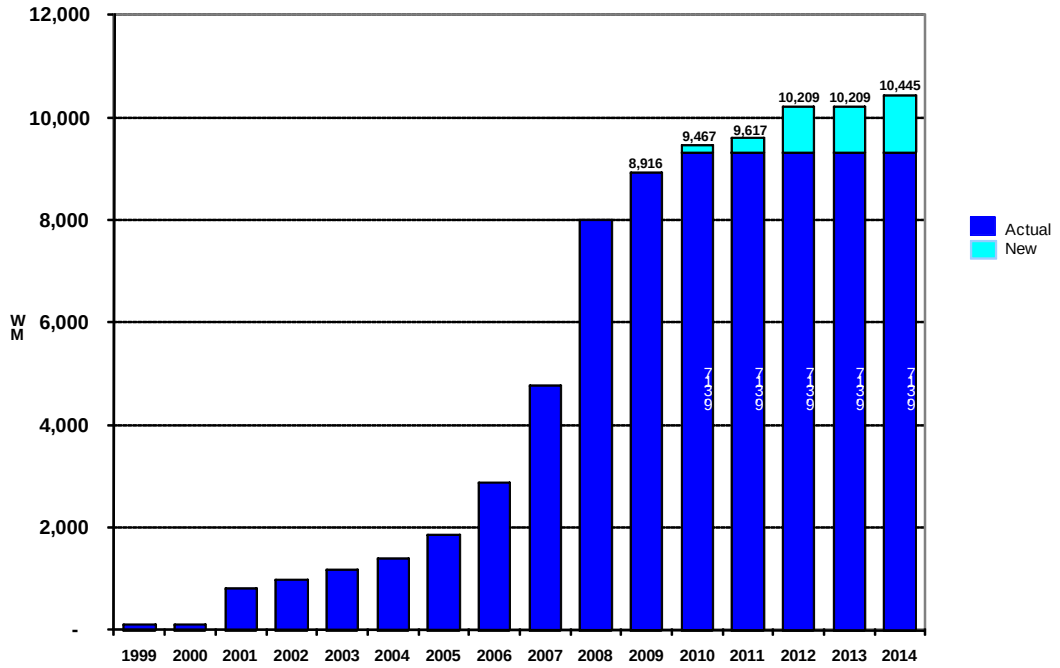
1. Introduction

The electric power industry is undergoing a period of significant change. In recent years, a number of factors including public policy directives, consumer choices, environmental concerns, the emergence of organized open access markets, and technological advances in telecommunications and information technologies combined with advances in power generation and equipment manufacturing technologies have merged to introduce a number of new products and services in the electric power sector at both the transmission and distribution system levels and on both the resource and load sides of the equation. The State of Texas, and ERCOT in particular, have been significantly impacted by many of these technological changes – notably, the rapid interconnection of large-scale wind generation units as illustrated in Figure 1. For reasons discussed in detail below, it is reasonable to assume additional impacts to ERCOT planning and operations functions will appear in the near term. To maintain bulk electric power system security, it is essential that ERCOT understand the emerging changes in generation resources and load behaviors and management capabilities.

Fig. 1 Historical and Projected Installed Wind Capacity in ERCOT



Source: ERCOT System Planning Report to ROS for July 2010, p. 7.

In early 2008, ERCOT Staff approached the ERCOT Technical Advisory Committee (TAC) leadership with a request to hold a workshop focused on operational challenges related to the increasing amount of wind energy production on the ERCOT system. The workshop, which has since become known as Wind Workshop I, was scheduled for mid-March 2008[6]. In the intervening period, ERCOT experienced a significant system disturbance on Feb. 26, 2008. During this event, which had numerous causes and complicating factors, dramatic variations in wind energy output and deviation from wind energy schedules were noteworthy contributing factors[7]. This event added urgency to the scheduled workshop and demonstrated the near-term importance of addressing several operational challenges posed by wind energy production.

Wind Workshop I kicked off a 2-year period of intense focus by ERCOT Staff and stakeholders to address wind integration challenges. The immediate task was to address the issues raised by ERCOT Staff at the workshop because they were viewed to be critical to system security. The key issues and their resolution are summarized below.

- Develop a common understanding of the impact of wind generation on operations: ERCOT provided examples of recent operational experiences with wind generation under various scenarios and noted that a lack of understanding on the part of some wind resource owners regarding the details of certain operational procedures produced inconsistent results in unit responses to instructions and introduced operational challenges. As a common understanding of wind generation impacts on ERCOT operations was developed, numerous changes to operational practices by many parties including ERCOT, Wind Generation Resource (WGR) operators, Qualified Scheduling Entities (QSEs), and Transmission Service Providers (TSPs) were implemented such as voltage control practices, the timing of QSE updates to energy schedules and Resource Plans, and changes to wind forecasting practices and uses.

- Replace WGR QSE wind schedules with ERCOT wind forecast: ERCOT observed that the accuracy of WGR Resource Plans varied widely across the market and illustrated the consequences of poor forecasting on Day Ahead and Hour Ahead capacity adequacy studies. Because ERCOT's look-ahead studies automatically use Resource Plan data from the Scheduling Pricing Dispatch (SPD) system, any modifications to the software would have significantly impacted ERCOT resources and budget. A quicker and more cost-effective solution was developed (Protocol Revision Request (PRR) 763 – Use of WGRPP as PLanned Operating Level in Day-Ahead Resource Plan for WGRs) that

[6] WInd Workshop I presentations are available at www.ercot.com/calendar/2008/03/20080317-WIND
[7] Feb. 26, 2008 EECP Step 2 Report, available at www.ercot.com/calendar/2008/03/20080318-BOD

required WGR QSEs to make the changes in their own Resource Plans using ERCOT-provided forecast data (*i.e.*, the AWS TruePower forecast). ERCOT developed a system project to provide wind operators with the forecast for use in the Resource Plans. PRR 763 became effective July 1, 2008.

- Establish ramp rate limitations for WGRs: ERCOT provided examples of wind units with high ramp rates, especially when released from down balancing instructions during windy periods. The steep ramp rates presented operational challenges to ERCOT, notably impacting system frequency control. Due to variations in wind turbine technical capabilities, stakeholders bifurcated the issue into two solutions. The first (PRR 771 – Ramp Rate Limitation of 10% per minute of On-Line Installed Capability for Wind-powered Generation Resources)), applied a ramp rate limit when responding to or being released from an ERCOT deployment instruction for WGRs with Interconnection Agreements executed on or after January 1, 2009. The second (PRR 788 – Ramp Rate Limits for Existing WGRs), applied to the same standard to most existing wind turbines in ERCOT. PRRs 771 and 788 were effective Jan. 1, 2009 and Feb. 1, 2009, respectively.

- Identify the list of current issues and potential future issues which should be addressed in the stakeholder process and identify ERCOT system changes which should be implemented in the zonal market or in the nodal market prior to the nodal market launch date: In the weeks following Wind Workshop I, ERCOT and stakeholders identified a range of issues which required Revision Requests to implement. The limited lifespan on zonal market systems and the ERCOT and stakeholder resource constraints related to the nodal market transition effort guided the parties to narrow stakeholder focus to high priority items and reach solutions that minimized systems impacts and maximized ease of implementation. The full list of approved Revision Requests stemming from this effort are described in Section 2.3.1.3. Some noteworthy examples include:

    - replacing WGR QSE wind schedules with an independent ERCOT wind forecast;
    - imposing WGR ramp rate limitations;
    - requiring WGRs to accelerate implementation of nodal telemetry standards;
    - clarifying definitions and performance measures for WGR energy schedule and Resource Plan submission and updating practices; and
    - imposing WGR voltage ride-through requirements.

- Additionally, focused collaboration between ERCOT and stakeholders led to numerous procedural changes and data collection projects which did not require Revision Requests to implement. Noteworthy examples of issues addressed identified and resolved in this manner include:

    - improved communication between WGRs and TSPs regarding operational practices;

- clarification and strengthening of voltage support requirements;
- improved quality and quantity of ERCOT data on WGR unit designs and capabilities; and
- more frequent CSC limit calculations to improve zonal transfers.

Following Wind Workshop I and the subsequent related work of resolving the identified issues of immediate concern, TAC and the ERCOT Board directed ERCOT Staff and the stakeholder process to undertake a variety of efforts to more holistically address the wide array of issues related to integration of renewable technologies with a particular focus in the near term on operational challenges associated with WGRs while also developing a long term view on an appropriate scope of renewable technologies integration activities. TAC formed the Renewable Technologies Working Group (RTWG) and charged it to identify, frame, prioritize, and track renewable technologies issues while coordinating with other stakeholder committees to develop strategies to resolve identifies issues.

This Emerging Technologies Integration Plan (ETIP) is one product of the broad stakeholder effort to address renewable technologies integration issues. It also includes detailed discussion of other, non-renewable emerging technologies which have impacts similar to those posed by certain renewable technologies. Herein, the RTWG has endeavored to provide sufficient background discussion and information to give the reader some contextual sense of the issues in relationship to each other and to other ERCOT priorities. However, this document is not intended to be a general primer on renewable and other emerging technologies integration issues. Section 6 of this document provides references to such material. Rather, this document is intended to track recent activities to address emerging technologies, identify key issues, and propose a process through which ERCOT stakeholders can further identify, track, consider, and resolve issues related to emerging technologies integration. The ETIP is intended for use by an audience already generally familiar with most of these issues and with the ERCOT stakeholder process.

2. Emerging Technologies Integration Plan Overview

The ETIP is a work product of the TAC by and through its RTWG. The ETIP describes the efforts of ERCOT and stakeholders to address the challenges posed by the integration emerging technologies into the ERCOT system.

The ETIP provides detailed documentation of integration efforts from March 2008-August 2010 and discusses a range of contemplated activities and potential issues to be addressed in the 2011-2014 timeframe.

The ETIP strives to be technology-neutral and avoid endorsing or contesting the appropriateness of introducing any particular technology into the ERCOT marketplace, applying any particular technology to provide solutions to emerging technologies integration issues, or modifying any market rules or reliability standards to accommodate emerging technologies. Furthermore, the ETIP does not recommend solutions for any specific identified issue. Such solutions are appropriately developed through normal stakeholder processes such as the Revision Request process or the Regional Planning Group process. Rather, as discussed below, the ETIP strives to document renewable and emerging technology issues addressed to date and to identify and organize pending and future key issues and considerations to enable informed, holistic decision-making regarding the challenges presented by emerging technologies.

The ETIP focuses on five broad areas:

1. Process: The ERCOT stakeholder process has been reasonably effective at resolving a number of the issues presented by significant levels of installed wind capacity. Between Wind Workshop I in March 2008 and October 2010, the ERCOT Board adopted 27 Revision Requests related to wind integration issues[8]. However, the Public Utility Commission of Texas (PUCT) and ERCOT Board have requested ERCOT and stakeholders look beyond wind-specific issues to identify opportunities and challenges presented by other renewable technologies as well non-renewable technologies such as energy storage devices. Policy makers and decision makers have requested TAC devise a

[8] See p. 137 for the complete list of approved PRRs, NPPRs, OGRRs, and NOGRRs related to wind integration issues.

means of tracking and communicating the activities associated with the integration of emerging technologies to provide a tool for more holistic decisionmaking.

2. Awareness: Although the electric power industry is undergoing a period of rapid change, many new technologies will take a significant amount of time to appear on the system at such levels of penetration as to require action by ERCOT. In several areas, the ETIP addresses the need for a general level of awareness of industry trends and in many places discusses ERCOT and stakeholder efforts to balance the desire for up-to-date knowledge with resource constraints and the recognition that not all identified or potential issues require ERCOT and/or stakeholder activity in the near term.

3. Education: The ETIP documents recent efforts by ERCOT and stakeholders to increase technical education in key areas related to renewable and emerging technologies and discusses potential areas where further education may be beneficial. The ETIP also discusses a need to balance the desire to gain technical expertise with the application of ERCOT and stakeholder resources to those select integration issues which pose near-term challenges to core ERCOT functions.

4. Preparedness: A primary concern of the efforts to address identified renewable and emerging technology issues is to ensure that ERCOT and stakeholder resources are appropriately applied to ensure ERCOT is reasonably prepared to deal with integration challenges associated with emerging technologies which pose near-term challenges to core ERCOT functions.

5. Communication: The ETIP itself is designed to communicate a wide range of identified issues for consideration by policy makers, decision makers, and stakeholders as well as to identify means of improving future effectiveness of communication on these issues and related activities.

2.1. ETIP Purpose

The ETIP serves five key purposes.

1. Identify issues related to the integration of renewable and emerging technologies which have been recently addressed by ERCOT or the ERCOT stakeholder process, issues which are currently under active consideration in ERCOT and stakeholder processes, and issues which perhaps should be considered in the future.

2. Report the status of identified renewable and emerging technologies integration issues.

3. Provide TAC, the ERCOT Board, and the PUCT with a resource document and high-level plan from which to holistically consider the appropriate policies, activities, and

allocation of resources committed to addressing renewable and emerging technologies integration efforts.

4. Suggest goals to guide the emerging technologies integration efforts of ERCOT and stakeholders.

5. Recommend organizational and procedural changes in the ERCOT stakeholder process to improve the management of renewable and emerging technologies issues and the transparency of ERCOT and stakeholder activities related to integration of renewable and emerging technologies.

2.2. ETIP Structure

The ETIP is primarily organized around specific identified issues regarding the integration of emerging technologies as related to ERCOT functions and ERCOT market functionality. The issues are divided into four broad categories – system planning, system operations, market design, and workshops and training. A consistent set of considerations are applied to each issue within a category to ensure all concerns are thoroughly addressed. As the issues are framed, most are assigned a priority, a schedule for resolution, and one or more responsible parties are identified to produce the required work product, such as a white paper or Protocol Revision Request. Each of the renewable and emerging technology issues identified between March 2008 and August 2010 are discussed in detail in Section 3. Summary tables of the issues are provided in Section 4.

The ETIP also identifies three broad phases of integration activities and suggests five goals to guide further ERCOT and stakeholder emerging technology integration efforts. Finally, the ETIP contains four specific recommendations to improve the process for addressing integration issues and discusses the many issue-specific strategies which have been pursued to date by ERCOT and stakeholders to address identified issues.

2.2.1. Phases

As discussed in greater detail below, two specific policy directives of the PUCT directly impact the scope of efforts to address emerging technologies challenges – the order for ERCOT to

implement a nodal market design and the designation of Competitive Renewable Energy Zones (CREZs). The significance and scope of the Texas Nodal Market implementation project presents a variety of challenges to any effort to revise the ERCOT market rules, systems, and procedures in both the zonal and nodal markets. Additionally, the scale of future wind generation capacity which may be installed as part of the CREZ initiative by early 2014 requires particular focus to ensure ERCOT preparedness to deal with significant levels of wind energy penetration. Accordingly, the ETIP suggests ERCOT and stakeholders consider three broad phases of integration activities which are organized around the nodal market implementation project and CREZ implementation activities.

1. Phase One: Identify high priority wind integration issues which can and should be resolved in the zonal market as well as those with ERCOT systems changes deemed necessary for the Texas Nodal Market Implementation Date (TNMID). Phase One began in March 2008 with Wind Workshop I and ended in Summer 2010 with the "pens down" date for zonal systems changes and TNMID systems changes.

2. Phase Two: Identify post-TNMID wind integration and CREZ implementation issues which require resolution, develop and implement resolution strategies, and keep policy makers and decision makers appraised of integration activities. Also, as appropriate, identify integration issues associated with other renewable and emerging technologies such as solar generation and energy storage devices which present near-term opportunities and challenges related to core ERCOT functions and ERCOT market functionality. Continue Phase One follow-up activities to evaluate effectiveness of previously implemented solutions. Phase Two activities should begin in the weeks preceding TNMID and draw to a close as the PUCT's CREZ Plan is integrated into the ERCOT system.

3. Phase Three: Contemplated Phase Three activities include tracking and communication of the implementation of Phase Two solutions and follow-up activities. The ETIP does not contemplate many ERCOT or stakeholder activities beyond early 2014. It is assumed TAC and the ERCOT Board will reassess ERCOT and stakeholder efforts relating to the integration of renewable and other emerging technologies prior to 2014 and make appropriate adjustments as necessary.

Due to the large number and urgent nature of wind integration issues which were addressed as the ETIP was developed, most Phase One activities described in this document are shown as completed issues, although some of them have ongoing follow-up activities.

2.2.2. Goals

The ERCOT Board may wish to consider the adoption of goals relating to the integration of emerging technologies in order to guide ERCOT and stakeholder efforts in this area. The ETIP suggests five goals for emerging technologies integration efforts.

1. Process: *Improve the stakeholder processes for identifying, organizing, deliberating, resolving, and tracking issues of importance regarding the integration of emerging technologies into the ERCOT system.*

   The first step to ensuring an adequate and appropriate response to the introduction and integration of new technologies on the ERCOT system is to utilize a process through which issues of importance can be identified and managed. Such processes should be efficient, transparent, and user-friendly both at a detailed technical level as well as at the strategic level.

   The process should allow for development and deliberation of issues which may not yet be ripe for resolution through the Revision Request process and should broaden current stakeholder efforts beyond strictly renewable technologies to those emerging technologies which pose or address similar issues such as forecasting uncertainty or variable energy output.

   This goal purposefully includes restrictive language ("issues of importance") to guide ERCOT and stakeholders to limit the application of time and resources to those issues which should be addressed in the stakeholder process and to exclude the application of ERCOT and stakeholder resources to issues not yet ripe for consideration or action. An important function of the revised process should be to transparently filter issues by priority to enable long-term assessment of ERCOT and stakeholder resource requirements to address emerging technologies integration issues.

2. Awareness: *Increase ERCOT and stakeholder awareness of emerging technologies which may impact ERCOT functions or ERCOT market functionality*.

   The increased pace of development and deployment of new technologies suggests ERCOT and stakeholders should proactively increase awareness of those technologies which have the potential to pose challenges to key ERCOT functions. While there is an identified need to maintain awareness of technological developments, this goal contains purposefully restrictive language ("which may impact ERCOT functions or ERCOT market functionality") to guide the application of ERCOT and stakeholder resources to focus on those emerging technologies which may raise issues requiring resolution by ERCOT. The suggested approach is to stay current without striving to be *avant garde*. A general level of awareness of industry trends should be sufficient for ERCOT and stakeholders to identify those emerging issues which require particular focus.

3. Education: *Increase ERCOT and stakeholder education on those technical issues related to emerging technologies which are anticipated to have meaningful impact on ERCOT functions or ERCOT market functionality*.

   Recent efforts to address wind integration challenges have highlighted a need to increase ERCOT and stakeholder technical understanding of wind generation technologies, WGR unit design, transmission system equipment options and functionality, and ERCOT modeling and operating capabilities and limitations. Preliminary investigation into solar generation and energy storage technologies has highlighted similar educational needs.

   This goal purposefully includes restrictive language ("anticipated to have meaningful impact on ERCOT functions or ERCOT market functionality") to guide ERCOT and stakeholders to limit the application of time and resources to those issues which should be addressed in ERCOT and/or stakeholder processes and to exclude the application of ERCOT and stakeholder resources to issues not yet ripe for the timely development of technical expertise.

4. Preparedness: *Ensure ERCOT is sufficiently prepared to resolve integration challenges associated with emerging technologies.*

   This goal is informed by the core ERCOT function of maintaining electric system reliability. The ultimate aim of increasing awareness, broadening education, developing technical expertise, and executing a holistic approach to resolving issues associated with emerging technologies is to not be surprised by the challenges they may present to ERCOT system security.

   This goal purposefully includes restrictive language ("sufficiently prepared") to guide ERCOT and stakeholders to limit the application of time and resources to those issues which should be addressed in the stakeholder process and to exclude the application of ERCOT and stakeholder resources to issues not yet requiring preparedness activities.

   The ETIP in general and this goal in particular do not attempt to define "sufficiently prepared" as such determinations will likely be informed on an issue-specific and fact-specific basis through the stakeholder deliberative process with guidance from policy makers and decision makers.

5. Communication: *Provide timely and effective communication to policy makers, decision makers, and stakeholders regarding the issues arising from the integration of emerging technologies and the progress and effectiveness of strategies to resolve such issues.*

   Many stakeholders have opined that the breadth of renewable technologies integration issues under consideration in the stakeholder process is difficult to track and difficult to consider from a high-level strategic perspective. Timely and effective communication of emerging technologies issues and activities will facilitate better planning and

management of issues and the application of ERCOT and stakeholder resources where most needed and most effective and/or efficient.

2.2.3. Recommendations and Strategies

The ETIP includes four specific recommendations related to organization of the ERCOT stakeholder process to better address emerging technologies integration issues. The recommendations are located in Section 2.3.3. below and are designed to facilitate strategic-level decision-making regarding ERCOT and stakeholder efforts to address emerging technologies issues and provide an open, transparent process by which issues can be identified, resolved, and tracked.

Section 3 of the ETIP also identifies numerous considerations and approaches to certain emerging technologies concerns and discusses many of the strategies employed by ERCOT and stakeholders to date to resolve identified integration issues. Particularly for current issues discussed in the ETIP, these various strategies should be considered informative, not dispositive. They are not intended to be prescriptive or binding and may evolve as ERCOT and stakeholders gain new information and experience and as issues are resolved through the deliberative stakeholder processes.

2.2.4. Issues Organization

The ETIP is organized around identified emerging technology integration issues. These issues are organized by general area of impact as follows:

- System Planning (SP): Issues which impact or are impacted by the system planning function or require system planning activities to achieve resolution.
- System Operations (SO): Issues which impact or are impacted by the system operations function or require system operations activities by ERCOT and/or market participants to achieve resolution.
- Market Design (MD): Issues primarily concerning market activities or market outcomes.

- Workshops and/or Training (WT): Issues which require stakeholder education and/or brainstorming. Also, the activities related to effective communication of issues resolutions to market participants and the industry for implementation and operations.

2.2.5. Issues Identification and Prioritization

Included in the ETIP is a detailed exploration of renewable and other emerging technologies issues which impact ERCOT functions and/or markets. These issues are discussed in Section 3. To facilitate issues management, identified issues are named, numbered, described, and prioritized. Issue prioritization depends upon several factors including significance of the issue to system reliability or market functionality, time required to complete associated tasks, resource availability, and any other identified dependencies. Prioritization of issues is expected to assist ERCOT and market participants with the allocation of resources to emerging technologies integration efforts in a timely, methodical, coordinated, and cost-effective manner.

2.2.6. Considerations

As emerging technologies integration issues are identified, stakeholders must address a wide array of considerations to ensure each issue is vetted from multiple perspectives, effective strategies for resolution are developed, and unintended consequences are minimized. At a minimum, stakeholders are encouraged to weigh the eight key considerations outlined below for each issue. Not all considerations will be applicable to each issue and some issues may present multiple considerations of importance.

2.2.6.1. Policy Considerations

Some issues discussed in the ETIP arise from public policy directives of jurisdictional legislative or regulatory bodies related to emerging technologies which must be followed. Where such public policy directives impact ERCOT functions and/or markets they may require activity by ERCOT or stakeholders. Some issues discussed in the ETIP present policy questions which may not be suited for resolution in the stakeholder process and should be forwarded to the appropriate body for resolution.

Federal tax policy has perhaps been the most significant single driver for the installation of renewable generation technologies in the past two decades. Since the passage of the federal Production Tax Credit (PTC) in the Energy Policy Act of 1992[9], installations of wind generation capacity have typically surged during periods of PTC availability and typically slowed during periods in which the PTC was allowed to lapse. Likewise, the availability of an Investment Tax Credit (ITC), which could also be converted to a cash grant spurred installations of large-scale and distributed-scale renewable technologies. ERCOT and stakeholders may wish to consider the availability of federal tax incentives on the likely installations of additional renewable or other emerging technologies.

Likewise, federal environmental and energy policies may also play a significant role in either encouraging the installation and use of renewable technologies through mechanisms such as a Renewable Energy Standard (RES) or limitations on certain emissions such as carbon dioxide (CO2). At the request of the PUCT, ERCOT performed an analysis of possible impacts of proposed legislation to limit CO2 emissions and found that such a policy directive could have significant market and technical impacts on the ERCOT system.[10]

State energy policy can also significantly impact the installation of renewable and other emerging technologies on the ERCOT system. The Goal for Renewable Energy adopted by the Texas Legislature and the Competitive Renewable Energy Zone plan developed by the PUCT have incentivized wind energy development in ERCOT and will likely result in significant amounts of wind generation capacity connected to ERCOT transmission system but located outside the traditional ERCOT footprint.

When considering emerging technologies issues, stakeholder should be mindful of public policy directives which may spur the introduction of certain technologies or increase the pace of

[9] Pub. L. No. 102-486, 106 Stat. 2776 (1992)

[10] Electric Reliability Council of Texas, Analysis of Potential Impacts of CO_2 Emissions Limits on Electric Power Costs in the ERCOT Region, May 8, 2009, filed in *Reports of the Electric Reliability Council of Texas*, PUCT Project No. 27706.

emerging technologies penetration on the ERCOT system. Stakeholders should also consider policies and policy directions set by the ERCOT Board of Directors where applicable.

2.2.6.2. System Reliability Considerations

A primary mission of the ERCOT Independent System Operator is to maintain the reliability of the ERCOT transmission system. Both the system planning function and the system operations function play critical roles in ensuring system reliability. Many emerging technology integration issues present challenges to one or both of these functions. Issues identified in the ETIP are explored from both the planning and operations perspectives to ensure that the integration of new technologies does not compromise system reliability.

The ERCOT system planning function entails a wide array of activities essential to system security. Key system planning issues explored in the ETIP include the improving the quality of data and models used by system planners[11], identifying and performing timely and appropriate system planning studies[12], and ensuring the appropriate application of ERCOT system planning resources to emerging technologies issues[13].

As challenging as variable generation and other emerging technologies can be for system planning, the task of effectively and efficiently integrating new technologies into Real Time system operations can be especially difficult. It is no surprise, therefore, that majority of ETIP issues identified and resolved to date have primarily addressed operational issues. In particular, the significant penetration of wind generation in the ERCOT system in recent years has revealed a need for greater system flexibility and raised concerns about ERCOT's ability to reliably perform core operational functions under ever-changing and increasingly uncertain operating conditions without additional tools or resources. Key system operations issues explored in the ETIP include improving the quality of data, models, and systems used for operational functions[14]; addressing the impacts of using generation resources with limited dispatchability[15];

[11] For examples, see issues SP-001, SP-002, SP-009, and SP-013.
[12] For examples, see issues SP-004, SP-005, SP-008, SP-010, and SP-011.
[13] For examples, see issues SO-008, SP-010, and SP-011.
[14] For examples, see issues SO-001, SO-005, SO-020, SO-026, SO-032, and SO-033.

addressing issues arising from fast generation ramping or limitations on generation ramping[16]; maintaining system frequency control[17]; ensuring the availability and effectiveness of adequate ancillary services[18]; maintaining voltage control[19]; improving renewable generation forecasting[20]; and ensuring the appropriate application of ERCOT system operations resources to emerging technologies issues.[21]

As reliability considerations are addressed in the stakeholder process, it is important to adhere to the reliability standards set by the North American Electric Reliability Corporation (NERC) and administered by the Texas Reliability Entity (TRE).

2.2.6.3. Technical Considerations

One consequence of the introduction of competitive markets and open access transmission networks in North America is the surge in research and development of grid-connected technologies across the planning and operations spectrum – demand management technologies, distribution system devices, retail products and services, transmission system equipment, and generation and storage technologies. But while many emerging technologies may provide technical or economic benefits to the electricity grid and energy consumers, they may also introduce significant technical challenge or incremental system costs. In some respects, the electric power industry is moving away from the economies of scale of the historic large-scale conventional generating technologies which provide a full range of grid functionality and toward a more complex system of numerous technologies providing more specialized functionality which, therefore, require higher degrees of coordination and integration.

[15] For examples, see issues SO-002, SO-003, SO-007, SO-008, SO-016, SO-025, SO-027, MD-003, MD-004, MD-006, MD-007, and MD-009.
[16] For examples, see issues SO-003, SO-007, SO-008, SO-016, MD-003, MD-004, and MD-007.
[17] For examples, see issues SP-005, SO-003, SO-007, SO-008, SO-016, SO-021, SO-025, SO-026, MD-004, MD-007, and WT-011
[18] For examples, see issues SP-010, SO-002, SO-025, MD-001, MD-002, MD-003, MD-004, MD-006, MD-007, MD-008, and WT-008.
[19] For examples, see issues SP-003, SP-004, SP-007, SP-008, SO-010, SO-012, SO-015, and MD-008.
[20] For examples, see issues SO-002, SO-005, SO-014, SO-018, SO-032, SO-033, and MD-013.
[21] For examples, see issues SO-002, SO-035, and WT-011.

Many of the emerging technologies discussed in the ETIP have very different operating abilities and characteristics than the conventional generation technologies familiar to system planners and operators. Technical issues explored in the ETIP include the need for more advanced technical information and education regarding specific technologies and their related system integration issues[22] and a discussion of methodological approaches to technical requirements for grid-connected equipment.[23]

2.2.6.4. Market Design Considerations

Sound market design principles can address many issues posed by new emerging technologies through alignment of technical requirements and market incentives with desired performance and behavior outcomes. As market issues, such as potential barriers to market entry by new emerging technologies are examined, care must be taken to also examine potential impacts to market efficiency and/or market functionality which may result from proposed market design changes. The interrelated nature of market constructs and system reliability requirements is also an area requiring careful consideration. Market design elements explored in the ETIP include numerous issues related to ancillary services provision and anticipated impacts of renewable technologies in the coming Texas Nodal Market design.[24]

2.2.6.5. Performance Criteria and Compliance Metrics Considerations

Some integration issues may be addressed through clarification or creation of performance criteria for new technologies or market participants. In some instances, compliance metrics may also be required to provide regular, transparent reporting on adherence to market rules or procedures, both as a dashboard gauge for policy makers and to enable follow-up measurement and analysis for ongoing integration efforts.[25]

[22] For examples, see issues SP-005, SP-010, SO-004, SO-010, SO-026, and MD-005, WT-001, WT-003, WT-005, WT-007, WT-009, and WT-010.
[23] For examples, see issues SP-006, SO-011, and SO-013.
[24] For examples, see issues SP-010, SO-002, SO-025, MD-001, MD-002, MD-003, MD-004, MD-006, MD-007, MD-008, MD-009, MD-010, MD-011, and WT-008.
[25] For example, see issue SO-013.

2.2.6.6. Cost Allocation Considerations

The ERCOT market design utilizes various cost allocation methodologies, some costs are directly assigned to one or more market participants based on direct cost causation principles while others are assigned across a number of market participants on a *pro rata* basis where direct cost assignment is not possible, cost-effective or appropriate.

At the request of the ERCOT Board, ERCOT stakeholders have twice considered whether some ancillary services costs should be allocated to wind generation resources and other renewable technologies. The first investigation of this question produced a recommendation to maintain the current allocation methodology which does not assign ancillary services costs to renewable generators. The second investigation of this question did not produce a recommendation.

2.2.6.7. Texas Nodal Market Implementation Considerations

As previously discussed, the significance and scope of the Texas Nodal Market implementation effort has been a major influence on ERCOT and stakeholder efforts to address renewable and emerging technologies issues. As wind integration issues grew in importance to ERCOT operations, the short lifespan of the zonal market limited the cost-effective options available to stakeholders where changes to ERCOT zonal systems could provide solutions. Likewise, the need to finalize the "Go-Live" version of nodal market systems for the Texas Nodal Market Implementation Date (TNMID) necessitated stakeholders work quickly to identify any ERCOT nodal system improvements which could and should be implemented prior to TNMID and develop a second set of solutions more appropriate to post-TNMID implementation.

2.2.6.8. ERCOT Resource Considerations

Although the nodal market implementation project is a dominant constraint on ERCOT and stakeholder resources to address emerging technologies issues, it is far from the only one. Like all recommendations for system changes or other allocations of ERCOT resources, the framing of emerging technologies issues must balance the need to address particular issues with the availability of ERCOT and stakeholder resources to execute necessary day to day functions while addressing other important near and long term issues. Consideration of ERCOT resource

requirements during the emerging technologies issues development and prioritization process will likely enable a clearer view of the appropriate scope and scale of ERCOT efforts related to emerging technologies issues and the appropriate level of internal and external resources required to successfully address such issues.

2.2.7. Issues Resolution and Follow-Up

The ETIP documents the various strategies adopted to address emerging technologies integration issues. Some issues still require strategies to be developed. Issues deemed unnecessary or unripe for stakeholder deliberation may not have resolution strategies – they may closed or assigned a low priority for resolution. The ETIP identifies some instances where closed issues require follow-up activities to evaluate the effectiveness of the adopted solution or to monitor whether further action is necessary.

2.2.8. Schedule

Where possible, the ETIP identifies the schedules for activities related to a number of emerging technologies issues.

2.2.9. Activities for ERCOT and Market Participants

The ETIP identifies activities undertaken by ERCOT and/or market participants.

2.2.10. Issues Tracking

Identified emerging technologies integration issues are tracked on the RTWG Issues List, which is an abbreviated spreadsheet that captures key components of Section 3 of the ETIP. The Issues List is updated at least quarterly and presented to TAC, the Board, and the PUCT. For each identified issue, the Issues List includes:

- the issue identification number;
- a brief description of the issue;
- the stakeholder or other body currently working on the issue;
- the issue priority ranking;
- the proposed mechanism for issue resolution, if known (such as PRR, OGRR, etc.); and
- the current status of the issue, including keeping track of completed issues to preserve institutional knowledge.

2.2.11. Quarterly Reports

In fulfillment of the PUCT Order requiring ERCOT to provide quarterly updates on the resolution of wind integration issues[26], the RTWG prepares quarterly reports on wind integration and other emerging technologies issues to the TAC which, in turn, reports to the ERCOT Board and PUCT[27]. Each quarterly report features:

- the amount of installed renewable generation capacity in ERCOT;
- a summary of renewable technology interconnection activities;
- a review of significant events in the previous quarter related to renewable technologies;
- an update on issues completed or new issues identified in the previous quarter;
- the most recent version of the RTWG Issues List; and
- any other relevant information.

[26] PUCT Docket No. 33672 Order on Rehearing, Oct. 7, 2008, Ordering Paragraph No. 7, p.50. "ERCOT is directed to study, in association with market participants, the system reliability and stability issues implicated by increased wind generation, particularly wind generation that is geographically concentrated, and report the status of these studies to the Commission at least quarterly through a committee or task force as designated by ERCOT."

[27] Previous quarterly reports to the PUCT can be found in Project No. 34577.

2.3. Integration of ETIP Issues into ERCOT and TAC Processes

An important step to ensuring ERCOT is sufficiently prepared to meet the challenges associated with the integration of new technologies is to effectively integrate the management of emerging technology issues into ERCOT and stakeholder processes. Recent ERCOT and stakeholder activities related to emerging technologies issues are described below and four recommendations are provided to improve the process of identifying, resolving, and tracking such issues.

2.3.1. TAC Activities Related to Emerging Technologies Integration

The TAC has spent a considerable amount of time and effort related to wind integration issues and has taken steps to more broadly address other emerging technologies issues as described below.

2.3.1.1. Renewable Technologies Working Group

The RTWG Charter was approved by the TAC on November 6, 2008.

> The ERCOT Technical Advisory Committee creates the Renewable Technologies Work Group to coordinate and track stakeholder efforts to capture the benefits and address the challenges associated with the introduction of renewable energy generating technologies interconnected to the ERCOT grid.
>
> Created as a Working Group, rather than a Subcommittee, the RTWG does not have a formal voting structure, but rather strives to achieve consensus on the issues raised during the conduct of its duties. Where applicable, the RTWG will report the consensus, majority, and / or minority views of participants on each issue.
>
> The Chair and Vice Chair of the RTWG will be appointed by the TAC Chair and confirmed by the TAC. The RTWG shall meet not less than quarterly and shall continue in the conduct of its duties until such time as TAC decides to dissolve the work group.
>
> The RTWG is charged with the following duties:
>
> - Identify issues related to renewable energy generation on the ERCOT system – either benefits not realized or challenges which need to be addressed. This activity does not preclude WMS or ROS from identifying and resolving wind integration issues within their traditional purview.

- Define, frame, and prioritize the identified issues for resolution
- Refer issues to the appropriate TAC subcommittees for further development and resolution
- Gather input as provided from TAC subcommittees and RTWG activities and develop recommendations and / or frame issues for resolution by TAC
- Provide monthly status reports to TAC
- Maintain an issues tracking system
- Organize and host technical workshops as needed to ensure ERCOT Staff and market participants stay abreast of new technologies deployed on the ERCOT system, emerging technologies offering solutions to renewable generation technology challenges, and industry best practices
- Organize training seminars as needed to ensure ERCOT Staff and affected market participants effectively coordinate practices and procedures adopted to reliably integrate renewable generation technologies into the ERCOT grid
- Draft quarterly reports to TAC to support the ERCOT process to provide quarterly reports to the PUCT regarding reliability and grid integration issues related to renewable resources

From November 2008 through August 2010, the RTWG met 24 times. All markets segments participated in RTWG activities. The RTWG worked with ERCOT to develop Wind Workshops II, III, and IV, hosted educational presentations related to solar and energy storage technologies, and produced quarterly reports to TAC as required by its charter.

Subsequent to creating the RTWG, the TAC instructed the working group to develop a renewable technologies integration plan to provide a vehicle for discussion of longer-term renewable technology integration issues and to provide a tool facilitating a holistic approach to management of renewable technology issues. The ETIP fulfills this purpose.

2.3.1.2. Development of the ETIP

The ETIP was drafted by RTWG participants between January 2009 and September 2010. Several versions were produced and distributed for comment to market participants and stakeholder groups. RTWG received written comments from Calpine, Centerpoint, Luminant, Oncor, PSEG Texas, The Solar Alliance, and South Texas Electric Cooperative. The RTWG also received written comments from the Dynamics Working Group, the Operations Working Group, the Performance Disturbance Compliance Working Group and the QSE Managers Working Group. The RTWG received oral input to the ETIP at meetings of the PUCT, ERCOT Board, TAC, ROS, and WMS.

2.3.1.3. Revision Requests Related to Emerging Technologies Issues

For reasons previously discussed, much of the early TAC activity related to renewable technologies was focused on addressing the operational challenges associated with WGRs. A high priority was placed on solving those issues which would require changes to ERCOT zonal systems while such changes were still cost effective and providing solutions required for TNMID in time for such solutions to be incorporated into the Go-Live nodal systems. Later efforts produced some solutions requiring post-TNMID implementation and broadened stakeholder focus to non-wind renewable technologies, other emerging technologies, and longer term issues not yet ripe for consideration in the Revision Request process. Figure 2 below details the wind-related Revision Requests considered by TAC between Wind Workshop I in March 2008 and August 2010 as the ETIP was finalized and the "pens down" date was reached for both zonal market and TNMID system changes. No Revision Requests particular to non-wind renewable technologies or other emerging technologies have yet been considered by TAC.

Fig. 2. Summary of Revision Requests Addressing WGR/CREZ Issues (March 2008-October 2010)

Revision Requests	Filed	Approved	Rejected	Pending
PRRs	17	15	2	0
OGRRs	6	6	0	0
NPRRs for TNMID	5*	5	0	0
NPRRs for Parking Deck	0*	-	-	-
NOGRRs	3	3	0	1
Total RRs	30	27	2	1

* A portion of NPRR 214 is gray-boxed as a Parking Deck project.

2.3.1.4. Other Noteworthy Stakeholder Activities

In addition to RTWG activities and the considerable amount of time dedicated to processing wind-related Revision Requests, market participants and stakeholders engaged in other noteworthy activities including two task forces which considered whether to allocate certain costs to wind generators or other renewable technologies, addressing emerging technology issues through the ERCOT-led Regional Planning Group and Long-Term Study Task Force, creation of a Power Storage Working Group, participation in an energy storage issues workshop, and addressing issues related to the profiling and settlement of distributed renewable generation resources.

2.3.2. ERCOT Activities Related to Emerging Technologies Integration

ERCOT has been heavily engaged in issues relating to emerging technologies, particularly large-scale wind generation issues, for the past several years. In addition to supporting and participating in stakeholder deliberations on renewable resource integration issues and serving as a resource for the PUCT and market participants on CREZ implementation issues, ERCOT has also taken on more of a leadership role in identifying and resolving wind integration issues, particularly in the area of system operations.

2.3.2.1. Workshop and Training Activities

ERCOT played a central role in organizing workshops focused on wind integration issues and energy storage device questions. ERCOT also worked with the Texas Reliability Entity to incorporate certain WGR operations issues into the annual operator training seminars.

2.3.2.2. Participation in Stakeholder Activities

Even with the resource constraints imposed by the nodal market implementation project, ERCOT has actively participated in numerous stakeholder efforts to address renewable integration issues, particularly through the Revision Request process. Additionally, ERCOT's System Planning Division has actively participated in the RTWG and development of the ETIP. ERCOT Staff also actively participates in the NERC Integration of Variable Generation Task Force (IVGTF).

2.3.2.3. System Planning Activities

In addition to numerous activities to support the PUCT's CREZ process, ERCOT has conducted a variety of system planning activities related to renewable technologies integration and other emerging technology issues. ERCOT has overseen third-party studies on WGR voltage ride-through needs, sub-synchronous resonance issues, reactive compensation needs, and a long-term study addressing possible future system needs to integrate new technologies.

2.3.2.4. System Operations Activities

In addition to actively working with stakeholders on numerous Revision Requests related to operational challenges associated with WGRs, ERCOT has developed new tools for system operators to predict and prepare for large wind ramping events, incorporated improved wind forecasting into operational activities, and coordinated solutions for WGR issues with stakeholders which could be addressed outside the Revision Request process.

2.3.3. Recommendations for TAC Organization of Emerging Technologies Issues

As discussed above, numerous challenges exist to ensuring that ERCOT is sufficiently prepared to resolve integration challenges associated with emerging technologies. The significant efforts devoted to nodal market implementation, the increased level of activity associated with CREZ development, the normal workload of a robust generation interconnection process, day to day system planning and operations functions, and support for the myriad issues resolved through the stakeholder process already challenge available ERCOT resources. Likewise, the ERCOT stakeholder process is also focused on the same set of challenging issues while market participants also must tend to their core business functions.

An additional challenge to framing and resolving emerging technologies issues in the existing ERCOT stakeholder process is that many of the issues are not yet ripe for consideration in the Revision Request process which is the primary process by which issues are addressed by stakeholders. Issues addressed by stakeholders outside the Revision Request process typically

fall to one or more of the many working groups or task forces under the TAC and there is not a robust system for tracking such issues development or resolution.

The four recommendations outlined below are designed to create a process through which stakeholders can raise emerging technologies issues to be prioritized, framed, studied, resolved, tracked, and communicated to policy makers and decision makers. Although the proposed process is modeled on the existing Revision Request process, it is not intended to be duplicative. Rather, the process is intended to be used for issues which may not yet be ripe for the Revision Request process or which may be resolved by means other than a Revision Request. For emerging technologies issues which are being resolved through the Revision Request process, the process outlined below simply provides a means of organizing, tracking, and communicating such issues as they relate to the full scope of emerging technologies integration activities for the benefit of the policy makers and decision makers who guide ERCOT's full emerging technologies integration efforts.

2.3.3.1. Recommendation 1: Revise and Expand the Scope of and Rename the RTWG

For the same reasons that the stakeholder effort to develop a renewable technologies integration plan evolved into a broader emerging technologies integration plan, the RTWG recommends that the scope of the Renewable Technologies Working Group be expanded to include all emerging technologies and that the working group should be renamed the Emerging Technologies Working Group (ETWG). Many of the core issues presented by a number of emerging technologies are similar in nature to those posed by renewable technologies: variable or limited energy output; forecasting issues; and the introduction of new uncertainties into system planning and operations functions, among others. Because so many of the issues are similar or interrelated, it makes sense to take them up together under a single umbrella and utilize the same process to address them.

2.3.3.2. Recommendation 2: Place the new ETWG under WMS

While a majority of RTWG participants favor placing the new ETWG under a standing TAC subcommittee such as the Wholesale Market Subcommittee (WMS), a minority of participants prefer to leave the repurposed working group under the TAC.

Proponents of moving the ETWG under a TAC subcommittee note that the lack of voting structure within the working group requires that certain issues be elevated to a voting body for resolution and that many such decisions may not be ripe for deliberation by the TAC. Opponents of the recommendation argue that WMS, or any other TAC subcommittee, may be too narrowly focused for all of the issues which could arise and that TAC, as a higher level body with a broader scope, is better suited to address the range of issues which may arise.

Opponents of the recommendation to move the ETWG under a TAC subcommittee also note that many of the issues explored by the ETWG will likely not be "wholesale market" issues but rather may best be addressed by any number of stakeholder groups which fall under other TAC subcommittees. Proponents of the recommendation counter that such a condition is no different than the scope of work performed by RTWG today where the bulk of work on emerging technologies issues is performed in various working groups under various subcommittees and the RTWG primarily serves to organize, track, and communicate the issues. This work can be done, proponents argue, under the guidance of any of the TAC subcommittees, although WMS or ROS are the obvious candidates.

2.3.3.3. Recommendation 3: Improve ET Issues Tracking System

Since the RTWG began identifying and tracking renewable and emerging technologies issues, 71 discrete issues have been identified and tracked on the RTWG Issues List, which has been presented quarterly to the TAC, ERCOT Board, and PUCT. For the issues which were addressed through the Revision Request process, a complete and transparent record of discussions, comments, votes, and final disposition are available on the ERCOT website. For the remaining issues, however, whether deliberated in the RTWG or other TAC subgroups, it can often be difficult to construct a complete record of deliberations as issues can be raised in multiple forums

and documents related to the discussions are posted, if at all, on scattered calendar pages of the ERCOT website.

In order to facilitate the development of a more complete and organized record of ERCOT and stakeholder activities related to emerging technologies integration efforts, the RTWG recommends that a more defined process be utilized for this purpose. A process modeled on the existing Revision Request process would have the benefits of being familiar to stakeholders, providing uniform treatment of all issues, centralized storage of documentation, and enhanced transparency of issues deliberations and accessibility of information related to the issues.

The Emerging Technologies Issues process would function similar to the Revision Request process. Draft forms to facilitate this process are included in Appendices 6.1 and 6.2. Any interested party could file an ET Issue Submission Form. Any interested party could file an ET Issue Comment Form. The ETWG could be charged with periodically updating the status of ET Issues using the ET Issue Tracking Form. This would enable a periodic compilation of the status of all issues, similar to Section 3 of this document. Additionally, the quarterly reports produced for the TAC, Board, and PUCT could easily be compiled from the tracking forms.

2.3.3.4. Recommendation 4: Provide ERCOT Staff Support for ETWG Activities

Implementation of the formalized ET Issues submission, comment, and tracking system would require resources beyond the abilities of the volunteer stakeholder process. Like the existing Revision Request process, the processing, distribution, and posting of the documents would require the allocation of some ERCOT resources, likely the Market Rules staff who currently manage the Revision Request process. Additionally, the participation of ERCOT subject matter experts may be utilized by the ETWG on as as-needed basis. This will ensure emerging technologies issues which may impact ERCOT are addressed in a coordinated, timely manner.

3. Key Issues and Strategies for Resolution

The task of documenting the full range of renewable technologies integration issues of importance to ERCOT began with the list of issues generated through the interactive discussion at Wind Workshop I in March 2008. From that initial list, other issues were identified by the RTWG and added to the list. The RTWG further noted other renewable technologies issues which had been identified elsewhere in the stakeholder process and added them to the list. As the RTWG refined the format for documenting integration issues considerations and activities over time, an attempt was made to return to earlier issues and fill in the blanks in the documentation to construct a recent historical record of ERCOT and stakeholder activity on such issues. Therefore, some of the issues in this section are discussed more thoroughly than others, reflecting the evolution of the RTWG deliberative process over the time in which the ETIP was developed.

Some issues may seem to appear more than once or may be very similar to other issues. Usually, this is because the issue may have significant implications from multiple perspectives and so may be included in multiple issues groups. For example, both the system planning and the system operations functions rely on quality data and models to perform studies and other tasks. But each process may rely on different data sets or have different specific modeling requirements. Thus there are multiple discrete issues relating to data verification and model validation on both the System Planning list and the System Operations lists to ensure each instance of identified deficiencies in data accuracy or model sufficiency is addressed as appropriate by the relevant subject matter experts.

The renewable and other emerging technologies issues identified to date are presented in this section organized by issue group. Section 4 of the ETIP includes summary tables of these issues organized by priority and status to provide high-level views of the full scope of emerging technologies issues addressed in the stakeholder process.

3.1. System Planning Issues

SP-01: Verify Wind Turbine Technical Data: Wind turbines of various vintages in the ERCOT system possess different technical capabilities. Generally speaking, newer turbine types offer more technically advanced features and control systems than older technologies. It is unclear whether technical specifications and models for wind units provided to ERCOT by wind generators are sufficiently accurate or detailed for system planning and operations purposes. ERCOT and wind generators should collaborate to ensure wind turbine technical data relied upon by ERCOT is accurate.	
Priority	High.
Considerations	Policy: No policy impacts.
	Reliability: Accurate technical data for use in system planning and operations models is critical to ensuring system reliability.
	Technical: Accurate representation of WGR design, configuration, and technical capabilities and limitations are required inputs for various planning and operation functions. The Resource Asset Registration Form (RARF) for each WGR should reflect all relevant data.
	Market: No market impacts.
	Performance/Compliance: No performance criteria are recommended. No compliance metrics are recommended. Wind generators are expected to comply with ERCOT requests to update, complete, or verify data. Failure to comply with ERCOT requests for information can lead to enforcement action by the Texas Reliability Entity.
	Cost Allocation: There are no costs to allocate. WGRs are responsible for submitting timely, accurate data to ERCOT through the RARF process.
Strategy	ERCOT and WGR owners should collaborate to ensure completeness and accuracy of relevant wind turbine technical data used by ERCOT.
Activities	ERCOT: ERCOT Operations will develop questionnaire for WGR owners to complete.
	Market Participants: WGR owners must complete the ERCOT questionnaire.
Schedule	Questionnaire developed in July 2008. All responses deemed complete by ERCOT in January 2009. Follow-Up activity to occur post-TNMID on a schedule to be determined by TAC and ERCOT Staff.
Follow-Up	Market Participants: Market Participants may wish to consider follow-up activities to this issue during deliberations on SO-35 Operational Checklist for Resource Interconnection. Establishing a process by which RARF data is verified

	during the interconnection or RARF submission process may reduce or eliminate errors in data or incomplete data submissions and remove the need for a "catch-up" exercise such as this one. Market Participants: Determine post-TNMID whether additional data fields or other modifications are required to the RARF for WGRs or other renewable Resources.
Status	This issue was closed in Jan. 2009 after ERCOT deemed the responses of all WGR Owners to be complete. Follow-Up activity rests with TAC, which has not yet assigned it to a responsible subcommittee.

SP-02 Wind Turbine Computer Models: Computer models used in operations and planning have not always been able to represent all wind-turbine technologies accurately. There are several factors affecting the accuracy of the modeling effort. The primary problem to date has been getting accurate, detailed, functional models from WGR manufacturers. Another factor is the mutual lack of familiarity and understanding between modelers and WGRs owners leading to misunderstanding of requirements. Yet another factor is the rapid growth of installed WGR capacity which makes an orderly incorporation of the new technologies' characteristics difficult. Lastly, there is the rapidly evolving nature of the WGR technology itself, which makes it difficult to keep models current.	
Priority	High
Considerations	Policy: None
	Reliability: This is a key reliability issue. Proper models are needed to accurately perform planning, design, and operational studies. While a variety of approximations are used for all technologies, the degree of approximation for WGRs has seemed excessive.
	Technical: Deficiencies in model availability and technical deficiencies in modeling software should be explored and addressed to aid key studies such as Voltage Ride Through requirements, sub-synchronous resonance issues, and other studies. In addition, those designing the software and running the studies have limited experience with WGRs and may require additional education and training. A major technical issue for the whole industry is the need to create non proprietary standard models for the many different WGR turbine types.
	Market: Indirectly, lack of confidence in the models used for studies can result in unneeded conservatism on the part of system planners which can increase the cost of facility designs and on the part of system operators which can increase the cost of market operations or lead to inefficient commitment of Resources.
	Performance/Compliance: It is incumbent upon WGRs to provide accurate technical data to TSPs and ERCOT. Existing NERC standards and ERCOT Protocols define responsibilities and time frames.
	Cost Allocation: Entire market absorbs cost of inefficiencies arising from modeling that is not as robust as it could be. WGRs operators absorb costs of providing their data to ERCOT.
Strategy	Near-term focus is to identify discrepancies between installed equipment and how that equipment is represented in studies. Two key areas should be addressed – lack of common understanding regarding technical specifications of equipment in the field and the technical capabilities and limitations of the modeling software itself. Increase ERCOT and market participant education regarding renewable generation technology and associated modeling issues.

	Encourage stakeholder participation in WGR model improvement efforts in the industry, such as the Electric Power Research Institute (EPRI) Project 17. Require WGRs to provide accurate models of their equipment.
Activities	ERCOT: Hold workshops for Market Participants and ERCOT staff to allow WGRs, equipment vendors, Transmission Service Providers, and ERCOT to present their information and issues to each other. Take advantage of study efforts to verify WGR data, to develop more appropriate models, and to initiate software changes. ERCOT and the Transmission Service Providers need to consider appropriate modeling processes for WGRs and use of a common database for all studies.
	Market Participants: WGR Owners need to work with equipment suppliers to insure that the vendors provide complete, detailed, and accurate technical data for their equipment as needed to support all required studies. WGR Owners must update ERCOT and TSPs promptly and completely as their plans and actual facilities change.
Schedule	Wind Workshop I, March 17, 2008: Model issues raised. Wind Workshop II, August 22, 2008: Model discrepancies identified. Wind Workshop III, June 26, 2009: RARF data update process identified. Wind Workshop IV, date to be determined: ERCOT requirements should be explicitly identified and vendor solutions proposed. Voltage Ride Through Study phase 2, June 2010: WGR data and model verification. Post-TNMID: Consider creation of updated data repository, modified data collection process and establishment of common data base for planning and operations studies.
Follow-Up	Ensure that the Voltage Ride Through findings relative to WGR modeling needs as well as the modeling data itself is captured and documented. Consider revisions to procedures and Protocols to establish a common data collection system and data base for all generators with appropriate modifications to ensure that ERCOT documents the actual characteristics of each facility's technology.
Status	Open. Recommended next step is to further refine and define these issues at Wind Workshop IV, which has not yet been scheduled.

SP-03 Wind Turbine Fault Tolerance: System reliability requires that during short circuit conditions (transmission system faults) that generators stay on line during the short circuit and after it clears. WGRs had been given specific exemption from fault tolerance requirements. As more WGRs were added to the ERCOT system, it became necessary to evaluate existing WGR fault tolerance capabilities as well as to establish fault tolerance standards for new WGRs. SP-03 identifies the Voltage Ride-Through (VRT) issue for WGRs. The issue was divided into two parts for follow through; SO-12 dealing with establishing new standards for new WGRs and SP-08 dealing with studies related to existing WGRs. A portion of the discussion is repeated in these three issue write-ups to allow each to be complete.	
Priority	High
Considerations	Policy: Yes. At issue is whether the application of new technical requirements to existing equipment is appropriate or, conversely, whether the establishment of higher technical standards for new market entrants than those applicable to existing market participants is equitable. The policy decision reached by the Board on this issue was to establish a VRT requirement for new WGRs and to conduct a study to determine which, if any, existing WGRs should also meet the new standard to ensure system reliability.
	Reliability: The ability of generators to have a reasonable level of fault tolerance is critical to system reliability. During system fault conditions, voltages electrically close to the fault are depressed and generators may come off line if the depressed voltages last too long. The fault tolerance requirements can be met by designing the transmission system to clear faults quickly and by designing generators to remain on line for certain low voltage situations. WGR fault tolerance must be evaluated / designed to function for typical transmission fault clearing times.
	Technical: There is no significant technical challenge to designing new WGRs to meet fault tolerance requirements. However, existing WGRs may not be easily modified to meet new fault tolerance requirements. In most cases, new WGRs can meet fault tolerance requirement by buying certain options in the wind-powered turbines. In some cases, such options cannot be retrofitted onto existing wind-powered turbines. Thus, the ability to meet new requirements may provide a significant technical challenge for older WGRs.
	Market: New requirements would cause certain wind-powered turbines to no longer be able to be supplied for WGRs in ERCOT. The provision of fault tolerance for new WGRs from other wind-power turbine suppliers will increase WGR capital costs. There will not typically be any significant change in operating costs for new WGRs. There is little expected change in the competitive landscape for new WGRs that comply with new fault tolerance standards. For existing WGRs the possible expense of retrofitting existing equipment could

	be significant. Compliance by the WGR may require the addition of very expensive dynamic reactive devices in the WGR substation. The expense could cause some WGRs to be retired rather than be upgraded. For all WGRs there is likely to be both increased capital cost and operating cost as a result of complying with new standards. There are also commercial issues with inability to control single source prices and with warranty terms and conditions as well as warranty cost. These technical, cost, and commercial issues raise compliance with new standards by existing generators to a policy level as discussed above. See SP-08 for additional details pertaining to existing WGRs.
	Performance/Compliance: The WGR VRT standards established by OGRR 208 will utilize the standard ERCOT/TRE event-driven compliance regime.
	Cost Allocation: The cost of OGRR 208 compliance associated with new WGRs will be borne by the new WGR developers. For existing WGRs see the discussion for ET-SP-08.
Strategy	Adopt an Operating Guide Revision Request establishing new standards applicable to new WGRs for Voltage Ride Through to provide fault tolerance capability. Perform detailed studies to evaluate exiting WGRs capability to ride through system faults and system fault tolerance needs from those existing facilities.
Activities	ERCOT: Participate in the process of establishing new standards. Specify scope and contract for studies to evaluate the need for system design changes related to faults affecting existing WGRs.
	Market Participants: TSPs, generators and all market participants actively participate in the development of new standards for WGRs and provide input as needed for development of VRT Study for existing WGRs.
Schedule	OGRR 208: Approved November 17, 2008. Established VRT standards for new WGRs (SO-12). VRT Study for existing WGRs completed in June 2010 (see SP-08). NOGRR synchronizing OGRR 208 to Nodal Operating Guide to be completed in late 2010.
Follow-Up	Synchronizing NOGRR required upon completion of VRT Study for existing WGRs.
Status	Open. NOGRR 043 to synchronize OGRR 208 into the Nodal Operating Guide is currently pending.

SP-04 Voltage Transient and Small Signal Stability Study: The West-to-North Transfer study is performed annually by ERCOT Operations, with input from ERCOT Planning and review by the Dynamics Working Group. The purpose is to calculate how much power can safely be transferred from West to North while maintaining a safe small signal stability margin. The DWG assembles the dynamic data set necessary for ERCOT staff to do the study.	
Priority	Medium
Considerations	Policy: None
	Reliability: Yes. The results of the study inform ERCOT Operations how much transfer they can allow reliably in the real time operation. Without this information they must operate more conservatively to maintain the system reliability.
	Technical: The technical challenge is to allow as much power transfer as possible without risking a system separation due to the undesired system oscillation. The solution is to do the study every year and limit the west to north power transfer based on small signal stability criteria.
	Market: The market consideration is to maximize the wind-to-load transfer based on security constraints. Generally, ERCOT appears to take action when loading on the stability limit reaches 85%. Encourage ERCOT and market participants to periodically review commercial implications of the management of stability limits with the ultimate goal of the stability limit elements being managed similarly to the rest of the system.
	Performance/Compliance: Each renewable generation resource owner must provide good dynamic models and each TSP must provide a good dynamic load model. 'Good' in this context means (1) compatible with the version of software being used, and (2) accurately describing the dynamic electrical characteristics of the equipment or load. Re-using old models for old facilities is not always good enough.
	Cost Allocation: None.
Strategy	No specific strategy outside of existing annual ERCOT study process.
Activities	ERCOT: Perform study annually or as needed when major system changes occur that may impact previous study results.
	Market Participants: TSPs should maintain database of dynamic models of all transmission and generation facilities and provide to DWG when requested. Resource Owners must provide complete dynamic model of generators to TSPs and ERCOT staff. The provision of accurate models is also addressed in SO-35.
Schedule	Each year:

	November: DWG requests TSPs for input models. December: TSPs submit models. February: DWG assembles the base case and checks it. March: ERCOT performs study. June: ERCOT reports results
Follow-Up	SO-35.
Status	Issue closed. Follow-up activity may be tracked in Issue S0-35.

SP-05 Impact of Wind Turbines on System Inertia: Determine the potential impact on system reliability of large amounts of wind turbine generating capacity on ERCOT's system inertia requirements. This is one of two entries on this topic. The other is SO-08 which was resolved in October 2008 by a PDCWG (Performance, Disturbance, Compliance Working Group) presentation to ROS. This issue looks to the future problem of maintaining system frequency as installed wind power capacity approaches the level of system minimum load.	
Priority	Medium
Considerations	Policy: Policy decisions have led to market changes which give rise to this technical challenge. There are technical limitations upon other resource owners to maintain ERCOT frequency fluctuations associated with intermittent resources, particularly if a lower percentage of such other resources are dispatched as a larger percentage of renewable generation is connected and dispatched.
	Reliability: The reliability concern is that wind plants do not automatically respond to frequency deviations in the same way synchronous generators do. As the proportion of synchronous generation decreases, maintaining frequency will require more operator action, or additional under-frequency load-shed relay settings, or in real-time reaction by the operators at the Frequency Desk The inertia of the ERCOT Interconnection impacts the rate of change of grid frequency during normal operation and during contingencies. As the ratio of non-synchronous generation increases, the rotating mass of synchronous generators and rotating loads will decrease. Inertia of the grid helps limit the rate of change of frequency to allow conventional synchronous generators time to deliver Primary Frequency Response and stabilize grid frequency. During contingencies, load dampening provided by synchronized rotating loads and initial Primary Frequency Response (PFR) from conventional synchronous generators provide Primary Frequency Response to stabilize frequency at the NERC C point. On the ERCOT grid this traditionally occurs in 4.5 to 6 seconds following the NERC A point. As grid inertia decreases, frequency rate of change will increase causing lower stabilizing frequencies at Point C. This is caused by the time delay in delivery of Primary Frequency Response from conventional generators. Compound reheat steam turbines will typically provide 25 to 30% of their PFR within 4 to 6 seconds due to the time required for additional steam flow to travel through the high pressure turbine and be converted to energy. Combustion turbines will also be limited by the addition of air to support combustion that must be coordinated to prevent flame-out. These physical limitations are technology specific. An EPRI study performed on the WECC and Eastern Interconnections determined that frequency rate of change increases the risk of voltage collapse.
	Technical: The technical challenge is how to operate the grid reliably with fewer synchronous generators available to respond automatically to frequency deviations.

	Market Design: There is a long-term question whether units which provide spinning mass or stabilize system frequency will continue to be installed in the ERCOT system and whether such units will be able to remain online during periods of high wind production and correspondingly low prices. Additionally, a new Ancillary Service that provides quick ramp response to the grid during frequency deviations may be required since the full value of such service may not be compensated in the energy-only market. This market design issue is more fully explored in MD-04.
	Performance/Compliance: ERCOT: NERC CPS1 and DCS criteria and Balancing Authority ACE limit and Interconnection minimum Frequency Response. QSEs with synchronous generators: Correct SCE bias settings, correct implementation and delivery of Primary Frequency Response (PFR) from all generators. This includes correct Governor Dead-Band, droop setting, proportional response (no step response at the Dead-Band) and continuous delivery of PFR for the duration of the frequency deviation. Wind-only QSEs: None now. Develop a standard on delivery of "initial" and "sustained" PFR.
	Cost Allocation: To be determined.
Strategy	For each significant contingency on the ERCOT grid, evaluate Primary Frequency Response (PFR) delivery at the NERC C point. This includes calculation of the percent of Load Dampening at point C, time difference between Point A and Point C and the rate of change of frequency between Point A and Point C. Correlate this data to the ratio of non-synchronous generation providing energy at the time of the contingency. This study may be addressed in SP-10.
Activities	ERCOT: ERCOT Planning staff will study the problem. ERCOT Operations should evaluate whether a targeted fast ramping Ancillary Service would cost-effectively aid WGR integration.
	Market Participants: Work with ERCOT to consider developing a fast ramping Ancillary Service that will support system security and frequency response. This response must be delivered during the transition from Point A to Point C to stabilize frequency above UFLS. Determine other sources of PFR that can be delivered between Point A and Point C to replace the reduced inertia of the system. This could be fly wheel or other technologies.
Schedule	ERCOT already provided data to NERC. When the NERC study is completed it will inform ERCOT's study. ERCOT staff will start this study when the VRT study is done (June 2010).
Follow-Up	This will be a periodically recurring study as the percentage of wind as compared to all ERCOT generation increases.
Status	Open.

SP-06 Use of Variable Frequency Transformers to Solve Stability Problems: This issue was added to the Renewable Technologies Issues List early in RTWG process but was never fully defined.	
Status	Closed.

SP-07 Voltage Control Process: This issue has been raised in recognition of the fact that the West Texas and Panhandle areas will have many different transmission providers serving a large concentration of wind-powered generation. Voltage is coordinated by Resources, TSPs, and ERCOT in response to daily load and generation variations. Transmission Service Providers (TSPs) have designed, installed, and operated some reactive devices for their systems. Historically, ERCOT has conducted seasonal studies to establish required voltage profiles at the point of generator interconnection. Then the TSPs manage the day to day and hour to hour variations by calling on Generators to increase or decrease output to maintain their voltage profiles.

The eight TSPs involved in the CREZ projects must coordinate voltage control expectations. One TSPs voltage control efforts could have a large impact on another TSP's facilities and on other generators. The large concentration of wind-power served by eight different TSPs requires a detailed and coordinated design effort and operating strategy. Thus this issue has both a planning and operations component. SP-07 addresses the planning function and SO-10 addresses the operational impacts.

Priority	High
Considerations	Policy: None
	Reliability: Voltage control is a key reliability issue. The coordinated reactive design effort will determine a holistic solution.
	Technical: Currently available technology will provide the needed reactive components.
	Market: None.
	Performance/Compliance: Existing performance and compliance should be adequate to direct the design effort.
	Cost Allocation: ERCOT Protocols 6.5.7.1 requires generators to maintain a set voltage profile. All costs of complying with the required voltage profile fall to the generator. Although no new cost allocation issues are anticipated, there may be some issues when determining appropriate TSP to purchase and operate a particular reactive device.
Strategy	Recommendation. Initiate a reactive design study involving all TSPs in West Texas / Panhandle coordinated by ERCOT. Another option may be to develop a VAR Ancillary Service to allow resources that do not have the capability to comply with the Protocols to "provide services in kind" by buying from the market or bilaterally.
Activities	ERCOT: Assist in study development and oversight.
	Market Participants: Consider development of a VAR Ancillary Service to allow resources that do not have the capability to comply with the Protocols to "provide services in kind" by buying from the market or bilaterally.

	TSPs should actively participate in developing and conducting study and implementing the study design requirements.
Follow-Up	Normal planning, design, and certification processes provide the needed follow up procedures for the design effort. Additional follow up is needed for the operations component of this issue (see SO-10)
Schedule	The reactive design study is currently underway. May 2010 – reactive device requirements portion of the study completed. 2010-2013 TSPs specify, purchase, and install needed reactive devices.

SP-08 Voltage Ride-Through (VRT) Study: System reliability requires that during short circuit conditions (transmission system faults) that generators stay on line during the short circuit and after it clears. As more WGRs were added to the ERCOT system, a process was initiated to establish fault tolerance standards for new WGRs. The process was expanded to include a study of system needs for existing WGRs during fault conditions. SP-03 identifies the VRT issue for WGRs. The issue was divided into two parts for follow through; SO-12 dealing with establishing new standards for new WGRs and SP-08 dealing with studies related to existing WGRs. A portion of the discussion is repeated in these three issue write-ups to allow each to be complete.	
Priority	High
Considerations	Policy: Yes. At issue is whether the application of new technical requirements to existing equipment is appropriate or, conversely, whether the establishment of higher technical standards for new market entrants than those applicable to existing market participants is equitable. The policy decision reached by the Board on this issue was to establish a VRT requirement for new WGRs and to conduct a study to determine which, if any, existing WGRs should also meet the new standard to ensure system reliability.
	Reliability: The ability of generators to have a reasonable level of fault tolerance is critical to system reliability. During system fault conditions, voltages electrically close to the fault are depressed and generators may come off line if the depressed voltages last too long. The fault tolerance requirements can be met by designing the transmission system to clear faults quickly and by designing generators to remain on line for certain low voltage situations. WGR fault tolerance must be evaluated / designed to function for typical transmission fault clearing times.
	Technical: There is no significant technical challenge to designing new WGRs to meet fault tolerance requirements. The studies needed to evaluate fault tolerance of existing WGRs require extremely detailed modeling of the WGRs. The software and data needed are generally available but the technical challenge results from the volume of data needed from many different organizations. Consistency in interpreting the data needs of the software and fidelity of the representation will require intense, centralized data review efforts. In some cases, existing WGRs are not easily modified to meet new fault tolerance requirements. In most cases, new WGRs can meet fault tolerance requirement by buying certain options in the wind-powered turbine equipment. In most cases, options available for new resources cannot be retrofit onto existing wind-powered turbines; thus, the ability of existing resources to meet new requirements may provide significant technical challenges. It is possible

	that design changes to the transmission system will be the most effective and economical solution to any problems that are found.
	Market: For existing WGRs the possible expense of retrofitting existing equipment could be significant. Compliance may require the addition of very expensive dynamic reactive devices in the WGR substation to make up for the lack of capability of the generation equipment itself. The expense could cause some WGRs to be retired rather than be upgraded. For all WGRs there could be increased capital cost and operating cost as a result of complying with new standards. There are also commercial issues with inability to control single source prices and with warranty terms and conditions as well as warranty cost. These technical, cost, and commercial issues raise compliance with new standards by existing generators to a policy level.
	Performance/Compliance: The WGR VRT standards established by OGRR 208 will utilize the standard ERCOT/TRE event-driven compliance regime.
	Cost Allocation: The cost of meeting the WGR VRT standard for new WGRs will be borne by WGR owners. Results of the study applicable to existing WGRs may raise cost allocation issues depending on whether generator or TSP solutions are identified.
Strategy	Develop a VRT standard for new WGRs. For existing WGRs, evaluate need for any VRT related design changes by performing detailed studies using validated data to evaluate exiting WGR capability to ride through system faults. The study scope shall include detailed modeling. A major effort to collect consistent and correct detailed data needs to be a part of the study effort.
Activities	ERCOT: Specify scope and contract for studies to evaluate the need for system design changes related to faults affecting existing WGRs. Provide staff to oversee the study.
	Market Participants: WGRs and TSPs should respond to ERCOT/contractor data requests to support study efforts.
Follow-Up	A Nodal Operating Guide Revision Request is needed to synchronize OGRR 208 to the Nodal Operating Guide following the results of the VRT study for existing WGRs.
Schedule	Studies for existing WGRs were reported in June 2010. No VRT needs were identified for existing WGRs. NOGRR 043 is under consideration in the stakeholder process to synchronize the OGRR 208 WGR VRT requirement in the Nodal Operating Guide.

SP-09 Wind Turbine Dynamic Model Validation: ERCOT Operations, ERCOT Planning, and the Dynamics Working Group perform a variety of studies that require dynamic models of individual wind generator turbines and entire wind farms. The existing dynamic models are of mixed vintage and quality. The behavior of the models in time-simulations should be compared to the in-service behavior of wind farms to provide assurance that the studies utilizing the dynamic models are accurate.	
Priority	Medium
Considerations	Policy: What are the criteria that ERCOT should or could use to disallow interconnection or energization of equipment absent a validated operational model. The policy challenge is to strike the appropriate balance between maintaining an "open access" network while ensuring system reliability.
	Reliability: Yes, if appropriate and complete data are not available to ERCOT, ERCOT's studies are necessarily impacted.
	Technical: Revisit this item as it relates to NERC definition.
	Market: : Could be a market issue. If appropriate and complete data are not available to ERCOT, ERCOT's studies are necessarily impacted. Thus, operational information is not as complete as it could be and this could potentially lead to out of market actions to resolve unanticipated issues.
	Performance/Compliance: To be determined.
	Cost Allocation: Unknown
Strategy	RTWG should monitor EPRI Project No. 173 and communicate developments in that model validation effort to ERCOT Planning Staff and the Dynamics Working Group.
Activities	ERCOT: None.
	Market Participants: ERCOT stakeholders are encouraged to participate in / monitor the EPRI validation effort.
Follow-Up	To be determined.
Schedule	Unknown.

SP-10 DOE Long-Term Planning Study: ERCOT secured federal Department of Energy funding to conduct a Long-Term Planning Study to evaluate reliability impacts and system planning considerations related to various scenarios for future penetration levels of emerging technologies and other considerations.	
Priority	Medium
Considerations	Policy: As part of the study effort, all participants must be mindful of existing PUCT policy regarding the energy only market and transmission cost of service.
	Reliability: ERCOT shall evaluate reliability outcomes in the scenarios studied.
	Technical: A technical challenge to establishing the study parameters will be the development of long-range scenarios to and the appropriate assumptions to use for grid-connected equipment and system topology.
	Market Design: The study may suggest market design issues to be considered by stakeholders.
	Performance/Compliance: None.
	Cost Allocation: The study effort is funded by the U.S. Department of Energy and supplemented by ERCOT Admin Fee-funded ERCOT Planning Staff resources and market participant efforts.
Strategy	Utilize a robust, collaborative process between ERCOT Staff and market participants to develop the Long-Term study and evaluate the results.
Activities	ERCOT: ERCOT will lead the study.
	Market Participants: Participate in scenario development.
Follow-Up	To be determined.
Schedule	To be determined.
Status	Open. Study scenarios are under development in the ERCOT Planning Staff-led Long-Term Study Task Force.

SP-11 Sub-Synchronous Interactions: A sub-synchronous interaction issue was experienced on the ERCOT grid in late November 2009. As stakeholders work through CREZ implementation issues, there is some concern that planned series compensated transmission lines, particularly those which are radially interconnected to Generation Resources, may experience sub-synchronous resonance issues.	
Priority	High
Considerations	Policy: Many of the transmission elements of concern were specifically identified in the PUCT CREZ Order (Docket No. 33672).
	Reliability: Sub-synchronous interactions between Generation Resources are a serious reliability concern which could result in major equipment damage if not addressed.
	Technical: Highly technical studies with specialized resources are needed to fully scope sub-synchronous interaction concerns. ERCOT may need to contract outside resources to address this issue.
	Market Design: To be determined.
	Performance/Compliance: To be determined.
	Cost Allocation: To be determined.
Strategy	Engage a consultant to evaluate potential issues related to sub-synchronous interactions on series compensated transmission lines.
Activities	ERCOT: Develop a study scope and issue a Request for Proposals (RFP) to recognized experts in sub-synchronous events.
	Market Participants: Work with ERCOT to analyze issue and develop RFP for study.
Follow-Up	To be determined.
Schedule	After TNMID and before 2014 (i.e., before completion of CREZ lines).
Status	Open. ERCOT staff and market participants have not yet identified issues; ERCOT staff will not be available until after TNMID.

SP-12 Distributed Generation Interconnection Tracking: Distributed Generation (DG) will impact load shapes, increase load variability and create complications for ERCOT load forecasting and operations. Significant penetration of DG technologies may impact system frequency control and increase the total amount of Variable Energy Resources. Prior to the point at which DG achieves sufficient penetration to impact system operations or market efficiencies, it will become important to understand the amount and type of interconnected DG technologies.	
Priority	Medium
Considerations	Policy: Can the PUCT coordinate the transfer of information from TDSPs, NOIEs, REPs or other participants with direct knowledge of customer DG installation activities to ERCOT?
	Reliability: Incomplete or inaccurate information regarding the amount and type of DG technology on the system will likely increase short- and long-term load forecast errors, increase error in renewable generation forecasting, and may result in over- or under-procurement of ancillary services.
	Technical: There should be no technical impediments to tracking DG installations.
	Market Design: N/A
	Performance/Compliance: None.
	Cost Allocation: Once an information accumulation process is established, no performance metrics or compliance measures should be required.
Strategy	Engage market participants through the Demand-Side Working Group (DSWG) to work with ERCOT to develop a process to track DG capacity additions.
Activities	ERCOT: ERCOT will manage a DG capacity tracking function in conjunction with its existing function to track other renewable generation capacity in its role as Renewable Energy Credit trading program administrator.
	Market Participants: Develop a way to secure information on DG without compromising confidentiality issues or DG owner concerns.
Follow-Up	To be determined.
Schedule	Begin work after TNMID.

SP-13 Monitor Technologies that Impact Load: Numerous emerging technologies have the potential at significant penetration levels to noticeably impact the accuracy of ERCOT load forecasting and present Real Time challenges to system operations. ERCOT does not currently actively monitor the development of such technologies, their adoption, or their impact on load forecasting or system operations. Such knowledge may be needed in the future.	
Priority	Low. It will take some time before significant penetration levels of new technologies dramatically impact load shape relative to historical norms.
Considerations	Policy: It is not anticipated there will be policy impacts related to gathering information on emerging load management technologies, EVs, or other relevant technologies that impact electricity demand or load shape. However, in the development of a tracking process, care should be taken to ensure the privacy of customer information as required by PUCT rules.
	Reliability: At significant penetration levels, the failure to account for such technologies could impact system reliability.
	Technical: It is anticipated the challenges to monitoring such emerging technologies development and deployment are primarily procedural, not technical.
	Market Design: At significant penetration levels, the failure to account for such technologies could impact market efficiencies, such as through the over- or under-procurement of ancillary services. Additionally, market efficiencies may be realized through the facilitation of more robust demand response in ERCOT markets. Retail demand response currently participates in other markets in response to FERC mandates under Order 719. ERCOT market rules changes may be considered to enable wider demand response and/or distributed generation market participation.
	Performance/Compliance: At this stage of load-impacting technologies knowledge development, no performance or compliance issues are anticipated. However, as more information is gathered or market rules enabling new market entrants are established, performance measures may require consideration.
	Cost Allocation: At this stage of load-impacting technologies knowledge development, no cost allocation issues are anticipated. However, as more information is gathered or market rules enabling new market entrants are established, such issues may require consideration.
Strategy	Work with TDSPs and REPs to determine a process to track quantities of demand-side programs and their impacts on customer peak demand and energy usage
Activities	ERCOT: Develop a process to track impacts of demand-side programs initiated by TDSPs and REPs

	Market Participants: Provide information related to demand-side programs impacts and participation
Follow-Up	To be determined.
Schedule	2012 or beyond
Status	Open.

3.2 System Operations Issues

SO-01 Inventory of Wind Generation Facilities: As wind-power was added to the ERCOT system it became apparent that there were inconstancies in the communications and understanding between WGRs, ERCOT, and Transmission Service Providers. ERCOT launched a number of initiatives to address the communication and interpretation inconsistencies. The Inventory of Wind Generation Facilities was initiated by ERCOT to insure that ERCOT and the WGRs were communicating correctly about voltage control capability, reactive devices, and operating procedures. ERCOT staff engaged in an effort to contact each WGR in writing and by phone to answer specific questions about the WGR's voltage control equipment and procedures. Written responses from the WGRs were all followed up with site visits and/or phone calls by ERCOT staff to insure there was a common understanding and interpretation of the questions and responses. The inventory process led to many follow up initiatives including changes in data collection forms and procedures (SP-01, SP-02, SP-09), workshops (WT-02, WT-05), and better coordination with Transmission Service Providers (TSPs)(SO-15). The actual inventory has been completed so this issue is closed. However, Follow-Up activities are still ongoing. See related issues below.	
Priority	Medium
Considerations	Policy: Yes. Inconsistent understanding led to existing disputes about various Protocol requirements –for example those around requirement to supply reactive power.
	Reliability: Consistent interpretation of requirements and communications is fundamental to reliable operations. The lack of familiarity with ERCOT by the new WGRs and the lack of familiarity with wind-power by ERCOT and TSPs can result in miscommunication.
	Technical: This issue is primarily considered with educational and procedural, ratehr than technical, issues.
	Market: No market design issues are raised as this issue is focused only on ensuring ERCOT has an accurate inventory of certain WGR equipment, configurations, and technical capabilities. Other related issues may have market design considerations.
	Performance/Compliance: No new compliance considerations, but better understanding and communications will result in a higher standard of compliance.
	Cost Allocation: No
Strategy	The basic issue that was identified was the need for ERCOT to ensure WGR capabilities were accurately recorded for ERCOT use and for improved communication and common understanding of ERCOT requirements and WGR characteristics.

	ERCOT and WGR owners should develop a common understanding of ERCOT requirements and procedures and WGR equipment characteristics through direct verbal communication between ERCOT and WGRs.
Activities	ERCOT: Directly communicate in person or by phone with each WGR to establish a common understanding of the WGRs characteristics.
	Market Participants: WGRs must respond to ERCOT questions and should proactively communicate with ERCOT to ensure information is understood.
Follow-Up	SP-01 Verify Wind Turbine Technical Data SP-02 Wind Turbine Computer Models SP-09 Wind Turbine Model Validation WT-02 and WT-05 Wind-power Workshops SO-15 Communications Between Wind Farms and TSPs A project to create a common generator data base for use by ERCOT planning, ERCOT operations, ERCOT dispatch software, and TSPs is scheduled to start soon after the Nodal go live date. This project may require its own issue number to be tracked in the ETIP process.
Schedule	This issue is closed. The inventory process is completed.

SO-02 Nodal Tools to Integrate Wind Generation: Determine tools applicable to the Nodal Protocols to successfully integrate wind generation into the ERCOT markets. Recommend changes in ERCOT Protocols as well as possible computerized tools to help ERCOT better manage variable wind generation.	
Priority	Medium
Considerations	Policy: This issue does not impact policy.
	Reliability: Integration of large amounts of wind generation will significantly impact system operations and system reliability.
	Technical: Wind generation can impact voltage control, reactive capability, frequency control and transmission line congestion.
	Market Design: Potential need for additional ancillary service markets and/or ancillary service products (*e.g.*, quick-start service)
	Performance/Compliance: Wind generation must perform or provide appropriate voltage control, frequency control
	Cost Allocation: There could be cost allocation implications if ancillary service requirements are significantly increased due solely to the integration of wind.
Strategy	Engage ERCOT operations staff and market participants to identify pressing issues that need immediate attention; develop and implement solutions in the form of new operations tools and/or changes in Protocols or Operating Guides to obtain desired results.
Activities	ERCOT: ERCOT operations staff will identify critical operations issues caused by increased wind penetration and work with market participants to develop solutions.
	Market Participants: Work with ERCOT staff to develop Protocol and Operating Guide revisions to address operational issues raised by the staff that are caused by increased wind penetration.
Follow-Up	None.
Schedule	Numerous Protocol and Operating Guide changes were developed and implemented by the ERCOT market stakeholder process in 2008 through 2010.
Status	Complete. A large number of specific issues related to wind have been dealt with in the development of the Nodal Protocols. Any remaining wind issues are included in other issues on this list.

SO-03 : Wind-powered Generation Response to Down Balancing Instructions It is difficult for ERCOT to determine compliance with a Down Balancing instruction because there is confusion about whether the instruction is based off of real time output level or the Resource Plan value. This problem is a result of the zonal market design and specific software limitations that do not exist in the nodal market. A process has been developed (PRR 812) requiring all WGRs to update their resource plan every hour and to use the best forecast available. This new procedures will improve ERCOT's ability to accurately calculate the appropriate Balancing Energy Offset instructions without requiring Zonal market software changes.	
Priority	Medium
Considerations	Policy: None
	Reliability: Every 15 minutes ERCOT operations calculates a Balancing Energy Offset amount to account for the differences between what the software thinks WGRs are doing and what they are actually doing. Extreme errors in calculating the offset can lead to reliability issues, but this happens rarely.
	Technical: There is no real technical impediment to resolving this issue; the proposed solution requiring WGR owners to provide hourly Resource Plan updates is the most cost effective way to improve the accuracy of the Balancing Energy Offset without spending considerable time and money to change Zonal market software that is about to be replaced. The nodal software completely resolves this issue.
	Market: Market impacts arise from inaccurate forecasts and from the Balancing Energy Offset process. Effectively, Balancing Energy Service and Regulation Service are used to make up the difference between forecasted and actual WGR output. In special circumstances, out of merit instructions are employed by ERCOT to mitigate potential reliability issues. ERCOT can also deploy Responsive Reserve and NonSpin if conditions warrant.
	Performance/Compliance: This new process imposes new requirements on WGRs. The requirements are clear and enforceable.
	Cost Allocation: No cost allocation issues.
Strategy	Develop a workable solution for the Zonal market which does not require system changes. The issue should be fully resolved with Nodal market implementation. Require all WGRs to update their resource plan every hour using the best available forecast.
Activities	ERCOT: Monitor the accuracy of WGR forecasts as needed.
	Market Participants: WGR QSEs changed procedures to ensure Resource Plans are updated hourly.

Follow-Up	None. PRR 812 is deemed an adequate solution for the remainder of the Zonal market. This issue is resolved by the Nodal market design.
Schedule	This issue is closed. PRR 812 was approved on Sept. 15, 2009.

SO-04 – Smart Grid Implications for Renewable Resources – Determine how development of a "smart grid" might benefit and improve integration of renewable resources into the ERCOT grid. Specifically, determine if there are new technical capabilities associated with electronic metering and monitoring systems that would allow higher penetration of renewable resources, particularly at the customer (i.e., distribution) level.	
Priority	Low
Considerations	Policy: This issue might involve policy considerations depending on the type and level of "smart grid" deployment.
	Reliability: This issue involves reliability considerations, particularly if it encourages deployment of additional renewable resources at or near a customer's premises.
	Technical: This issue involves the technical feasibility considerations associated with deployment of a "smart grid" and its associated hardware and software.
	Market Design: This issue may impact market design because as the penetration of renewables and smart technologies change the composition of the market changes. This could lead to changes in market design, including changes to the structure of the Ancillary Service markets.
	Performance/Compliance: This issue includes performance or compliance considerations, particularly if new generation resources are connected at the distribution level.
	Cost Allocation: This issue does not directly involve cost allocation considerations.
Strategy	Examine hardware and software capabilities of electronic metering equipment and other electronically-controlled devices associated with a "smart grid" deployment to determine if they will benefit integration of additional renewable generation resources, particularly at the distribution voltage level.
Activities	ERCOT: Assist market participants in the preparation of a whitepaper examining the various technologies associated with deployment of "smart grid" technology in ERCOT.
	Market Participants: Prepare a whitepaper examining the various technologies associated with deployment of a "smart grid" and assess the capability of such technologies to improve or enhance integration of additional renewable generation technologies.
Follow-Up	If the concepts presented in the final whitepaper gain market acceptance, then individual market participants should follow-up with appropriate changes in the ERCOT Protocols and/or Operating Guides to facilitate the deployment of "smart

	grid" technology in the ERCOT market.
Schedule	Topics for whitepaper are under discussion at RTWG; a draft whitepaper should be available for review by the end of 2010.

SO-05 Operational Studies Related to Wind-powered Generation: This issue is essentially a follow up to the GE Ancillary Services study. ERCOT now has a growing data base of actual wind-power operations at a significant level of penetration. Using that data base, new studies should use actual data rather than assumed data to evaluate the need for new ancillary services or operational procedures. Key areas for further study might include evaluation of actual WGR ramping history, and evaluation of particular operational scenarios, such as high wind penetration during low load conditions. The objective of the studies is to further refine operational tools to manage further increases in installed wind capacity.	
Priority	Low
Considerations	Policy: None.
	Reliability: As additional wind-power is added to ERCOT, there may be new and unfamiliar operating situations. Anticipating and studying those situations can prepare ERCOT staff to handle the situations reliably.
	Technical: There may be some issues in how WGRs can provide reliability services.
	Market: There could be a large market impact if operational needs are not investigated ahead of time to determine the most effective methods of ensuring system reliability.
	Performance/Compliance: There may be new operational requirements or new services that are defined which need follow up to establish Performance/Compliance requirements.
	Cost Allocation: None.
Strategy	ERCOT has initiated a variety of much needed studies having to do with stability, voltage control, ancillary services, and voltage ride through. It is critical that ERCOT continue to anticipate and study future operational issues in order to avoid entering an unfamiliar operating situation unprepared. ERCOT should consider performing an follow-up to the GE Ancillary Services study using actual WGR data with an emphasis on fleshing out any operational procedures and resource changes that may be needed.
Activities	ERCOT: ERCOT should exercise a leadership role in the effort to determine needed studies and identify the study resources.
	Market Participants: As appropriate, the stakeholder process support ERCOT study efforts and facilitate market participant engagement in identifying needed studies and providing input on study scope.
Follow-Up	The results of the studies will dictate any follow up that is needed. Possible outcomes include new procedures, mechanisms for WGRs to provide regulation, or modifications to ancillary service market design.

Schedule	The need for this update is not immediate. Operational data from the Nodal market may be required for a meaningful study. The updated study and some of the follow up should be completed before the completion of CREZ Plan construction at the end of 2013, at which time it can be anticipated that installed WGR capacity will exceed 15,000 MW (the installed WGR capacity level analyzed in the GE study).

SO-06 – Testing Reactive Capability of Wind Generation – Determine the appropriate testing methodology to measure the reactive capability of wind generation	
Priority	Medium
Considerations	Policy: This issue does not involve policy considerations.
	Reliability: This issue involves reliability considerations, particularly if a wind generator cannot meet the reactive capability requirements.
	Technical: This issue involves the technical feasibility considerations associated field testing reactive capability of wind turbine generation.
	Market Design: None.
	Performance/Compliance: This issue does include performance or compliance considerations.
	Cost Allocation: None.
Strategy	Review reactive capability testing methodologies used by other power regions (domestic and foreign) to determine an appropriate testing methodology
	ERCOT: Review reactive capability testing methodologies used by other power regions (domestic and foreign) as well as ERCOT's existing methodology and recommend, if necessary, changes to the ERCOT Protocols and/or Operating Guides to accommodate the new validation process.
	Market Participants: Provide input and guidance to ERCOT during its review of testing methodologies and implement any subsequent recommendations as necessary in either the ERCOT Protocols or Operating Guides.
Follow-Up	None at this time.
Schedule	Develop any proposed changes in testing methodology by the end of the second quarter of 2011.

SO-07 Wind Generation and High System Frequency: Wind turbines in ERCOT do not provide primary frequency control through "governor-like" mechanisms. Energy production from wind generation can impact system frequency during periods of increasing wind speeds, in particular during periods when frequency exceeds 60 Hertz. This issue seeks to address the types of controls and/or requirements available or necessary for wind turbines to provide the required governor-like response during periods of high system frequency.	
Priority	Medium
Considerations	Policy: This issue may have broad impacts across all resources and the market. Key policy issues include whether existing units should be required to upgrade/retrofit with new technical capabilities and, if so, how to address those existing units for which upgrades/retrofits are not technically feasible. Another key policy issue is whether all Resources should be required to provide all of the same services and/or functions which contribute to system reliability (such as primary frequency response). One view may hold that such universal standards create a level playing field amongst competing Resources and ensures the functionality necessary to maintain reliable system operations is available from whichever resources are On-Line. Another view may hold that such universal standards are unnecessarily discriminatory against new technologies which may provide system and market benefits but which may not have all of the attributes and/or capabilities of conventional generation technologies.
	Reliability: This is a key reliability issue, particularly in the future as wind generation is predicted to comprise a greater percentage of On-Line generation during certain time periods. Frequency control is indispensable to system reliability and primary frequency response from On-Line generation is essential to frequency control.
	Technical: Early vintage wind turbines were designed with primary frequency response capability. More recently introduced wind turbines (those with advanced control systems and blade pitch capability) can be programmed to provide a "governor-like" response to frequency excursions. The purpose of this issue is to assess whether primary frequency response can/should be required from WGRs and, if so, how to apply such a requirement to machines of varying designs and capabilities.
	Market: Is primary frequency response better provided by imposing technical requirements on WGRs or by devising a market mechanism to provide the service?
	Performance/Compliance: Performance criteria should be specified in any PRR or NPRR requiring primary frequency response. Compliance will be done on a spot-check (event-driven) basis.
	Cost Allocation: If primary frequency response capability is required of WGRs, each WGR will bear the cost of such capability.

Strategy	Develop a Protocol Revision Request to require wind generator control systems to be programmed to respond to frequency deviations by controlling WGR real power output in a way that is similar to governor response for conventional steam generators.
Activities	ERCOT: None
	Market Participants: The Wind Operations Task Force of the ERCOT Reliability and Operations Subcommittee (ROS) developed a Protocol Revision Request (PRR) 824 – Primary Frequency Response to add a requirement for wind generator control systems to be programmed to respond to frequency deviations by controlling WGR real power output in a way that is similar to governor response for conventional steam generators. This PRR was approved by the ERCOT Board of Directors in December, 2009 and it applies to new wind generators with Standard Generation Interconnection Agreements signed after January 1, 2010. Another PRR, PRR 833 – Primary Frequency Response from Existing WGRs was approved by the ERCOT Board in May 2010 and requires primary frequency response from WGRs with an SGIA executed on or prior to January 1, 2010 unless ERCOT approves an attestation that the provision of such service is technically infeasible.
Follow-Up	It is expected that normal and ongoing PDCWG review of system frequency disturbances will reveal if there is still a concern regarding the adequacy of primary frequency response on the ERCOT system.
Schedule	This issue is closed. PRRs 824 and 833 were approved by the ERCOT Board.

SO-08 Impact of Wind Turbines on System Inertia: Determine the potential impact on system inertia and develop possible solutions. This is one of two entries on this topic. The other one is SP-05 which will be addressed by ERCOT Planning staff after the VRT study is done (June 2010). SO-08 was resolved in October 2008 by a PDCWG (Performance, Disturbance, Compliance Working Group) presentation to ROS.	
Priority	Medium
Considerations	Policy: No policy considerations
	Reliability: The reliability concern is that wind plants do not automatically respond to frequency deviations in the same way synchronous generators do. As the proportion of synchronous generation decreases, maintaining frequency may require more operator action.
	Technical: The technical challenge is how to operate the grid reliably with fewer synchronous generators available to respond automatically to frequency deviations.
	Market Design: The challenge is to ensure the appropriate mix of Resources is available in Real Time to respond to frequency variations and that market rules reflect proper compensation for those services out of merit that represent premium "must have" unit committments. .
	Performance/Compliance: ERCOT's control of system frequency is measured by the NERC CPS1 and DCS criteria and the Balancing Authority ACE limit. Market Participant Qualified Scheduling Entities with synchronous generators are scored on the Schedule Control Error metric. As the On-Line Resource mix changes the level of system inertia, QSEs with synchronous generators may need to further adjust fleet bias settings. At this time, Wind-only QSEs are exempt from the SCE performance measure. However, the resolution of issue SO-07 may partially address future concerns about a lack of system inertia when significant levels of wind generation are On-Line if the WGRs are providing primary frequency response.
	Cost Allocation: None.
Strategy	PDCWG reported to ROS in October 2008 without making a recommendation.
Activities	ERCOT: None.
	Market Participants: Issue review by the PDCWG.
Follow-Up	This will be a recurring study for ERCOT Planning staff as the wind percentage of all ERCOT generation increases.
Schedule	Issue closed. See follow-up activity above.

SO-09 SCADA Control of Generator Circuit Breakers: Unlike conventional generation resources WGR technology and operating characteristics allow for considerable automation and operation from remote sites. As a result, there is often no staff at the WGR site. Transmission Service Provider (TSP) and ERCOT operators assume people are available on site to perform certain operations. The lack of onsite staff can be accommodated as long as the needed operations can be handled remotely. Not all WGRs have the same level of remote control and/or automation. A task force of TSP, ERCOT, and WGR operators was formed to identify the required operations and the standard for compliance. The task was expanded to include all generators since the newly specified requirements were appropriate for all technologies. This issue has been addressed and is now complete.	
Priority	Low
Considerations	Policy: None
	Reliability: Limited impact on reliability but certain local situations could lead to out of tolerance operation if the issue were not addressed.
	Technical: None
	Market: Some increase in cost for WGRs.
	Performance/Compliance: Clearly establishes uniform performance requirements.
	Cost Allocation: None
Strategy	Specifying requirements that are generally assumed to be in place provides a clear and uniform compliance regime. Recommendation : Develop clear written specifications for operational needs heretofore simply assumed to be in place.
Activities	ERCOT: Participate in establishing the operational requirements.
	Market Participants: All market participants, but especially generators and TSPs participate with ERCOT to establish the requirements.
Follow-Up	None
Schedule	This issue is closed. Operating Guide Revision Request 226 was approved December 2009.

SO-10 Voltage Control Process: This issue has been raised in recognition of the fact that the West Texas and Panhandle areas will have many different transmission providers serving a large concentration of wind-powered generation. Voltage is coordinated by Resources, TSPs, and ERCOT in response to daily load and generation variations. Transmission Service Providers (TSPs) have designed, installed, and operated some reactive devices for their systems. Historically, ERCOT has conducted seasonal studies to establish required voltage profiles at the point of generator interconnection. Then the TSPs manage the day to day and hour to hour variations by calling on Generators to increase or decrease output to maintain their voltage profiles.

The eight TSPs involved in the CREZ projects must coordinate voltage control expectations. One TSPs voltage control efforts could have a large impact on another TSP's facilities and on other generators. The large concentration of wind-power served by eight different TSPs requires a detailed and coordinated design effort and operating strategy. Thus this issue has both a planning and operations component. SP-07 addresses the planning function and SO-10 addresses the operational impacts.

Priority	Medium for the operations component
Considerations	Policy: None.
	Reliability: Voltage control is a key reliability issue.
	Technical: Currently available technology will provide the needed reactive components. However new operating practices and requiring new coordination strategies may be needed.
	Market: None.
	Performance/Compliance: Existing performance and compliance should be adequate unless radically different operating procedures are developed.
	Cost Allocation: ERCOT Protocols 6.5.7.1 requires generators to maintain a set voltage profile. All costs of complying with the required voltage profile fall to the generator.
Strategy	Recommendation. Include an operational analysis in the reactive design study to evaluate the level of coordination needed to respond to load and generation changes in West Texas / Panhandle. Evaluate the adequacy of current voltage control procedures. Stakeholders may wish to consider establishing a VAR Ancillary Service similar to those provided for in other markets to ensure that the grid has sufficient reactive capability online at all times.
Activities	ERCOT: ERCOT assist in developing a study scope and procuring study resources. ERCOT lead the effort to assess the adequacy of standard voltage control procedures when operating the CREZ system.
	Market Participants: Assist ERCOT in developing summary of VAR compensation methodologies used in other markets.

	TSPs, generators, and all other market participants actively participate in the evaluation of voltage control procedures for the CREZ system.
Follow-Up	The Reliability and Operations Subcommittee needs to review ERCOT and TSP plans for voltage control of the CREZ system. WMS may wish to consider to develop information for ERCOT on the VAR services in place in other markets.
Schedule	The reactive design study is currently underway. November 2010 – reactive operational review portion of the study completed. November 2011 – ERCOT, TSPs, and other Market Participants address study findings and revise or establish new voltage control operational practices and procedures as necessary.

SO-11 Technology-Specific Procedures and Protocols Changes: Early in the process of brainstorming the universe of issues associated with wind integration, a philosophical divide was identified between stakeholders who urged that binding requirements on various generation technologies be tailored to recognize technology-specific capabilities and limitations and others who urged that technical standards and other requirements be universally applied across technology types. Issue SO-11 was created as a placeholder for that discussion.	
Priority	Low.
Considerations	Policy: SO-11 attempts to frame a policy question.
	Reliability: Proponents of technology-neutral standards argue reliability considerations demand universally applicable requirements, such as the provision of a minimum reactive power capability from all generation Resources while proponents of technology-specific requirements argue such standards may create unnecessary barriers to market entry for new technologies and that the "one-size-fits-all" approach to provision of reliability services should be reconsidered.
	Technical: While Issue SO-11 is generally philosophical, application of the question to specific issues is highly technical. It is no small commitment of resources on the part of ERCOT or the stakeholders to perform the detailed studies needed to consider adjustments to Resource requirements such as voltage ride-through, reactive power capability, ramp rate limitations, primary frequency response, and others. Changes the to operational characteristics of one class of Resources can often impact other Resources and transmission system equipment and the interaction of many system elements. A technology-specific approach would require detailed examination of equipment characteristics and configurations relative to other equipment on the system.
	Market: Proponents of a technology-specific approach argue there are numerous market implications to the policy direction adopted on this issue – barriers to market entry, potential market efficiencies, and issues of fairness in technical standards (*i.e.*, not requiring equipment to perform in ways it was not designed to perform), among others. Proponents of the technology-neutral approach also argue there are numerous market implications to the policy direction adopted on this issue – maintenance of a "level playing field" for competitive Market Participants, cost-shifting amongst Market Participants for reliability requirements, and adequate compensation for provision of reliability services, among others. Particular market design issues may include re-thinking the definitions of ancillary services or the allocation of costs related to

	the provision of certain reliability services.
	Performance/Compliance: Issue SO-11 has significant implications for the performance metrics applicable to particular Resources and the compliance requirements for numerous market participants.
	Cost Allocation: Depending on the specific technical issue being addressed, there may cost allocation issues to consider. In particular, a common question may be whether particular technologies granted specialized requirements or lesser obligations should be assigned the cost of ERCOT or other Market Participants acquiring or providing certain technical capabilities.
Strategy	N/A.
Activities	ERCOT: None.
	Market Participants: Text.
Follow-Up	None.
Schedule	N/A.
Status	This issue is closed. The stakeholder process is not well suited to debating theoretical policy concerns. The question of varying technical requirements has been addressed on an issue-specific basis numerous times in the past few years as various technical standards were clarified, established, or considered for WGRs. The high-level answer to the question posed by SO-11 varied in different applications. For example, stakeholders recommended a uniform standard for the provision of reactive power capability (PRR 830) but recommended WGR-specific standards for provision of primary frequency response (PRRs 824 and 833). While the core question of SO-11 will likely be raised and debated numerous times as different emerging technology issues are addressed, it would likely be unproductive to spend considerable stakeholder effort to attempt resolution of the question on theoretical grounds since it will likely be repeatedly addressed on a fact-specific basis as individual technical issues are identified and resolved.

SO-12 Low Voltage Ride Through (VRT) for Wind Generators: System reliability requires that during short circuit conditions (transmission system faults) that generators stay on line during the short circuit and after it clears. As more WGRs were added to the ERCOT system, a process to establish fault tolerance standards for new WGRs was initiated. This process has been completed. SP-03 identifies the VRT issue for WGRs. The issue was divided into two parts for follow through; SO-12 dealing with establishing new standards for new WGRs and SP-08 dealing with studies related to existing WGRs. A portion of the discussion is repeated in these three issue write-ups to allow each to be complete.	
Priority	High
Considerations	Policy: Not for new WGRs. A policy issue did develop for existing WGRs (see Sp-03 and SP-08).
	Reliability: The ability of generators to have a reasonable level of fault tolerance is critical to system reliability. During system fault conditions, voltages electrically close to the fault are depressed and generators may come off line if the depressed voltages last too long. The fault tolerance requirements can be met by designing the transmission system to clear faults quickly and by designing generators to remain on line for certain low voltage situations. WGR fault tolerance must be evaluated / designed to function for typical transmission fault clearing times.
	Technical: There is no significant technical challenge to designing new WGRs to meet fault tolerance requirements.
	Market: Market issues relating to retrofitting VRT capability on existing units is discussed in SO-08. For new WGRs, there is anticipated to little to no market impact.
	Performance/Compliance: Detailed WGR VRT performance criteria must be incorporated into the Operating Guide. Compliance will likely be monitored on an event-driven basis.
	Cost Allocation: There is no cost allocation issues associated with new WGRs, costs will be borne by the new WGR.
Strategy	Establish new requirements for new WGRs that balance WGR capabilities and transmission system design requirements. Adopt an Operating Guide Revision Request establishing new standards for WGR Voltage Ride Through to provide WGR fault tolerance capability.
Activities	ERCOT: Participate in the process of establishing new standards.
	Market Participants: TSPs, generators and all market participants actively participate in the development of new standards for WGRs.

Follow-Up	None
Schedule	This issue is closed. Operating Guide Revision Request 208 establishing new Voltage Ride Through standards for WGRs was approved on November 17, 2008 (see SO-12).

SO-13 Performance Metrics for Wind Generation: For some Protocol and Operating Guide requirements applicable to Resources, performance metrics are established to facilitate regular compliance monitoring. Some of the performance metrics applicable to other Resource types are applicable to WGRs. In other cases, WGRs are held to technology-specific standards. For some Resource performance metrics, WGRs are exempted. Perhaps the most visible measure from which WGRs are exempt is the Schedule Control Error (SCE) performance metric. The ERCOT Board and TAC requested stakeholders survey the performance metrics applicable to WGRs and consider whether existing requirements are appropriate or whether additional performance metrics are needed. Issue SO-13 is the first of two issues on this topic. SP-13 addresses those metrics applicable to WGRs under the zonal Protocols and whether additional measures can or should be established in the zonal market. A similar review applicable to the nodal market can be found in Issue MD-10.	
Priority	High.
Considerations	Policy: When evaluating the suitability of various performance metrics, questions will arise whether technology-neutral or technology-specific approaches are best, a common policy challenge.
	Reliability: Regularly monitored performance metrics are typically applied to generator and QSE functions which directly affect system reliability.
	Technical: Reviewing and developing operational requirements and accompanying performance metrics will require detailed technical knowledge.
	Market Design: Performance metrics can affect Market Participant behaviors and affect market outcomes. New or modified metrics should be examined to ensure the requirements align with desired market incentives.
	Performance/Compliance: This issue directly addresses performance metrics and compliance monitoring. Where certain WGR actions are important to reliable system operations, performance metrics can be a cost-effective tool for ensuring compliance with standards and procedures.
	Cost Allocation: Whether performance requirements are or are not applied to WGRs can raise cost allocation issues. However, those issues are addressed elsewhere.
Strategy	Stakeholders will consider the broad issue of WGR performance metrics on an issue-specific basis as a number of Revision Requests addressing various technical issues are addressed. As technical standards and operating procedures are developed, stakeholders will consider the creation of accompanying performance metrics to enable compliance monitoring. Restrictions on implementing performance metrics may include the availability of ERCOT resources to implement such metrics, the cost-benefit analysis of such efforts in the remaining life of the zonal market, the significance of reliability impacts associated with the standards, or other factors as appropriate.

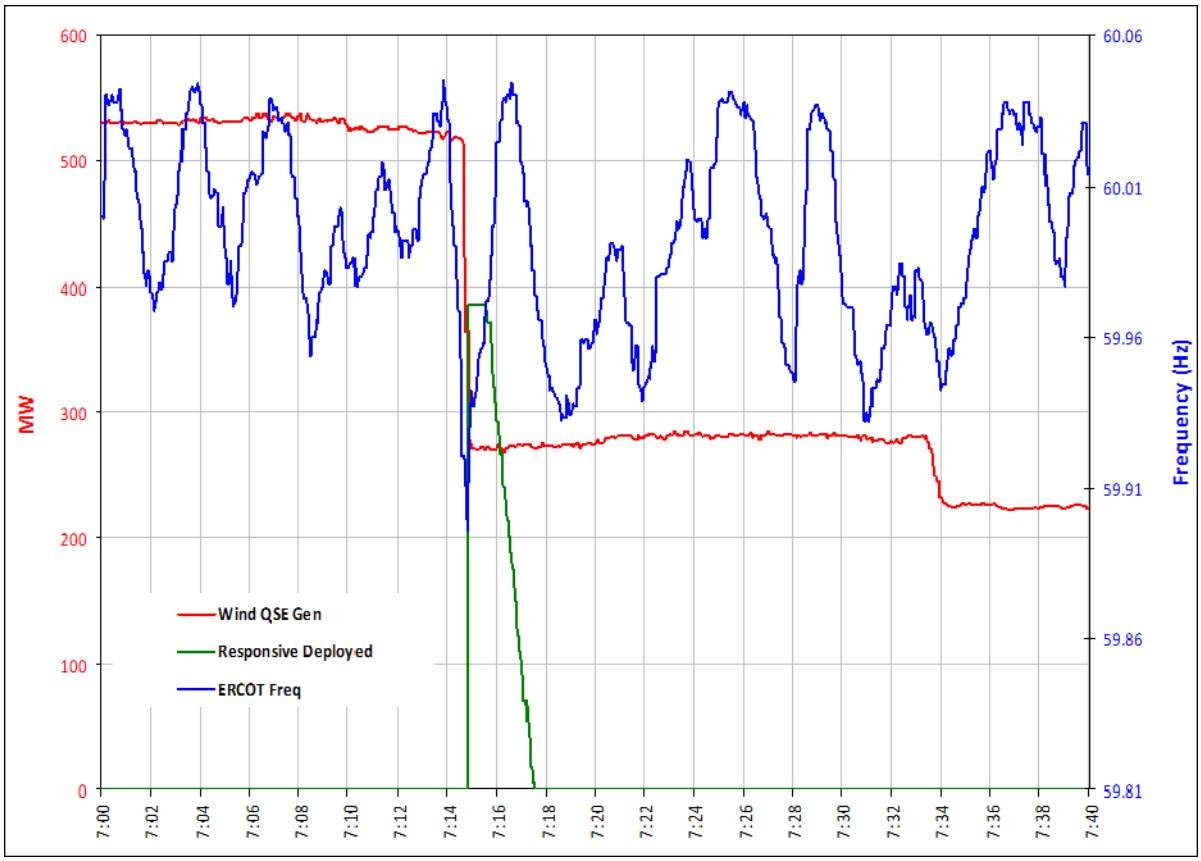
Activities	ERCOT: Inform and participate in development of related Revision Requests as appropriate.
	Market Participants: Several stakeholder groups will assume leadership roles in the review and development of WGR performance metrics.
Follow-Up	None. After the nodal market conversion, performance metrics specific to the nodal market design will be in place. See Issue MD-10 for a discussion of performance metrics applicable to WGRs in the nodal market.
Schedule	This issue is to be completed prior to the zonal PRR "pens down" date.
Status	This issue is closed, having reached the point at which no further zonal market changes will be implemented. The following zonal market WGR performance metrics were evaluated: 1. Schedule Control Error (SCE): PRR 828 would have applied the SCE performance metric to WGRs. The PRR was rejected by PRS. 2. Resource Plan Performance Metrics: PRR 800, approved in May 2009, modified the Day Ahead Zonal Schedule Measure applicable to all QSEs, including WGR QSEs. This PRR eliminated an exemption from this performance metric for WGRs in certain intervals which was established earlier by PRR 777. QSE scores on the measure are compiled and reported monthly. 3. Voltage Ride-Through (VRT): New technical standards were established by OGRR 208 for new WGRs. Existing WGRs were exempted from the standard pending the outcome of a VRT Study, which concluded no retrofitting was required. NOGRR 043, which will extend the new VRT standard to the Nodal Operating Guide is pending. No performance metric was established. Compliance will be event-driven. 4. Resource Plan updates: A number of changes were made to the procedures applicable for WGR QSEs to update their Resource Plans. PRR 763 required the substitution of a particular wind forecast for certain hours and detailed timelines for the Resource Plan updating methodology and process were incorporated into ERCOT Procedures. Performance metrics were not established for any of these activities, largely due to ERCOT resource constraints and the pending nodal market transition. However, ERCOT can spot-check compliance.

SO-14 Impact of Transmission Outage Planning on Wind-powered Generation: Transmission outages can affect all generators at one time or another. In ERCOT, it is common practice of TSPs to schedule outages in the spring and the fall so as to avoid high load seasons. This period is when WGRs produce much of their power. Concentrating outages at these times increases the potential market impact on WGRs. Discussions were initiated in the Regional Planning Group to address these two issues. The basic idea is to provide TSPs sufficient information to know when extra ordinary measures to mitigate market impacts are warranted. ERCOT staff did an excellent job of bringing forward possible methods of including market impacts when considering transmission outage scheduling issues. It was noted that the software needed to estimate market impacts was part of the nodal package. These discussions resulted in the identification of additional transmission issues that needed attention (SO-20, SO-29, SO-31, and SO-34). The discussions also focused on CRR study assumption stability. Despite significant discussion, no progress has been made on identifying market impacts that justify mitigation.	
Priority	Medium
Considerations	Policy: Yes, there are a number of policy issues raised in the discussion that most likely need to be addressed to allow the issue to be resolved. Is it appropriate to consider such a construct solely for a certain class of generators? Will TSPs be allowed to recover the cost of extra ordinary mitigation efforts? What will be the standard of accuracy required of the market impact estimation process?
	Reliability: This is primarily an efficiency issue and properly done, there are no reliability impacts. There is some fear that once the market cost of transmission outages is known there will be pressure on TSPs to defer maintenance or delay inspections.
	Technical: Market impact estimation processes exist but increasing the accuracy could be a challenge. Mitigation measures do exist but developing better ways to work on energized facilities and doing more predictive maintenance may require new technology.
	Market: This is a major market issue. Transmission outages have always had a huge impact on production costs. Some Market Participants argue even modest improvements in efficiency could result in large reductions in production cost.
	Performance/Compliance: There could be new performance requirements for TSPs and/or Resource owners as well as compliance measures associated with any change in transmission outage scheduling.
	Cost Allocation: There may be ways to identify generation Resources that would benefit from the mitigation and assign the cost of mitigation to them. This would raise many issues since identifying what level of mitigation is “normal” will be subjective.
Strategy	Evaluate the outage scheduling and outage mitigation practices in other markets and consider the possible benefits and/or consequences of any modifications to

	such practices in ERCOT.
Activities	ERCOT: ERCOT provided considerable subject matter expertise to the stakeholder deliberations on this issue
	Market Participants: Considerable effort was made by the Congestion Management Working Group to evaluate other ISO/TSP practices and identify key issues related to outage scheduling during peak wind production seasons. The CMWG recommended changes to outage scheduling practices in the Zonal market were impractical and outage scheduling procedures in the Nodal market should not be modified prior to TNMID. Additionally, the CMWG recommended key policy issues be addressed prior to any concerted stakeholder effort to modify outage scheduling and outage mitigation practices.
Follow-Up	There are no scheduled Follow-Up activities for Issue SO-14.
Schedule	This issue is closed.

SO-15 Communication Between Wind-power Ranches and Transmission Service Providers (TSPs): The newness of the WGR technology and the lack of familiarity with ERCOT and TSP procedures have led to multiple communication issues. A portion of the needed resolution focused on more complete and clear written requirements (see SO-09). In addition, a key component was familiarizing all parties with the procedures and issues of the other parties. A series of management level meetings between TSPs and WGRs developed strategies to increase communication effectiveness. The result was a series of workshops and proactive efforts to become more familiar with WGRs were another way to address the lack of knowledge. As an example one TSP, ONCOR, sent all of their transmission operators to WGR sites with specific learning objectives so that the TSP and WGR operators could improve their working relationship.	
Priority	Medium
Considerations	Policy: None
	Reliability: Poor understanding of each other can lead to incorrect results when operating the ERCOT system.
	Technical: None
	Market: None
	Performance/Compliance: Better understanding and working relationships can result in better performance.
	Cost Allocation: None
Strategy	Continue with ERCOT's long history of face to face contact between various operating groups. Recognize that WGRs represent a new technology not familiar to electric system operators. Take proactive steps to remove barriers to effective communication.
Activities	ERCOT: Perhaps schedule workshops or develop system operator training material to communicate specific information and practices.
	Market Participants: TSPs and WGRs engage in direct communications regarding best communication practices
Follow-Up	None.
Schedule	Immediate action has been taken and this issue is closed.

SO-16 Wind Generation Ramp Limits: Operational challenges and market impacts related to unconstrained WGR ramping activity were explored during Wind Workshop I in March 2008. ERCOT provided the graphic example below of a WGR ramp which triggered a deployment and subsequent recall of Responsive Reserve Service (RRS) and impacts on system frequency.



Subsequent to Wind Workshop I, the Wind Operations Task Force (WOTF) and QSE Managers Working Group (QMWG) contributed to development of Protocol language requiring limitations on WGR ramp rates.

Priority	High. The reliability and market implications of unconstrained WGR ramping may be significant.
Considerations	Policy: Some market participants argue there are policy impacts related to any decision to require retrofitted ramping controls on some older WGRs which currently have limited unit control capabilities.
	Reliability: Unconstrained WGR ramping capability has raised reliability concerns which will only intensify as additional WGRs are interconnected unless a lilmitation is placed on WGR ramp rates.
	Technical: There appear to be no technical impediments to imposing ramp rate

	limits on newer wind turbine technologies. However, some of the older existing wind turbines interconnected to the ERCOT system have very limited unit control capabilities.
	Market Design: Unconstrained WGR ramping can have market impacts which may need to be addressed if ramp rate limits are not established.
	Performance/Compliance: WGR ramp rate limits should be detailed in the Protocols. Compliance will likely be event-driven.
	Cost Allocation: Cost allocation issues may be identified if no ramp rate limits are imposed on WGRs.
Strategy	Explore the establishment of ramp rate limitations on new and existing WGRs.
Activities	ERCOT: Participate in the development of appropriate WGR ramp rate limits.
	Market Participants: Participate in the development of appropriate WGR ramp rate limits.
Follow-Up	Ramp rate limits were established in both the Zonal (PRRs XXX and XXX) and Nodal (NPRR 239) markets. Subsequent to TNMID, an examination of WGR ramping under various system conditions should be conducted to determine if the NPRR 239 ramp rate limit is appropriate or should be modified.
Schedule	Follow-Up activity should be conducted during the latter half of 2011.
Status	This issue remains open pending the completion of post-TNMID Follow-Up activity. Ramp rate limitations applicable to new WGRs were adopted in PRR 771 in December 2008. Ramp rate limitations applicable to some existing WGRs were adopted in PRR 788 in February 2009. Ramp rate limits applicable to WGRs in the Nodal market were adopted in NPRR 239 in July 2010.

SO-17 – Mid-Term and Short-Term Load Forecast Weather Sensitivity – Determine if sensitivity of the ERCOT mid-term and short-term weather forecasts were a major reason for the February 26, 2008 wind event that caused ERCOT to interrupt load due to a drop in system frequency resulting from a rapid reduction in wind generation while customer loads were rapidly increasing. Issue SO-17 was identified during WInd Workshop I in March 2008.	
Priority	Medium
Considerations	Policy: This issue does not involve policy considerations.
	Reliability: This issue involves reliability considerations related to operation, voltage control, reactive capability, frequency response, and power production forecasting for wind generation resources.
	Technical: This issue involves the technical capabilities of ERCOT to accurately forecast load and of WGR market participants to accurately forecast wind generation output during weather events.
	Market Design: This issue does not impact market design.
	Performance/Compliance: This issue may include performance or compliance considerations applicable to all wind generation facilities regarding scheduling and operations.
	Cost Allocation: This issue does not directly involve cost allocation considerations.
Strategy	Analyze the circumstances surrounding the February 26, 2008 wind event to determine if ERCOT's weather forecast, which impacts both the load forecast and the wind generation output, was a contributing factor.
Activities	ERCOT: Provide forecast and operational data related to the February 26, 2008 wind event to market participants to the Wind Operations Task Force for analysis.
	Market Participants: Analyze data provided by ERCOT related to the weather, load and wind production forecasts for the February 26, 2008 wind event and make any necessary recommendations for changes to prevent a reoccurrence.
Follow-Up	None necessary
Schedule	Issue closed. The Wind Operations Task Force (WOTF) analyzed data provided by ERCOT related to the February 26, 2008 wind event and determined that weather forecast sensitivity was not a major factor. The WOTF recommended to the ERCOT Reliability and Operations Subcommittee (ROS) that no changes were necessary and ROS concurred.

SO-18 Evaluate Transmission Line and Wind Power Production Outage Criteria: This issue was added to the Renewable Technologies Issues List early in RTWG process. As it became defined, this issue was merged into SO-14.	
Status	Closed.

SO-19 Improve Competitively Sensitive Constraint (CSC) Process: This issue was added to the Renewable Technologies Issues List early in RTWG process but was never fully defined.	
Status	Closed.

SO-20 Dynamic Transmission Line Ratings: Transmission costs can be reduced through dynamic, or temperature adjusted, ratings which can allow the transfer capability of transmission lines to be maximized due to weather-related cooling effects on the conductors. However, there are practical limitations to the number of lines which can be monitored and dynamically rated. This issue is designed to explore dynamic line rating practices, system operations applications, and related issues.	
Priority	Low.
Considerations	Policy: None.
	Reliability: Line rating practices must conform to reliability standards.
	Technical: There are a number of technical considerations associated with use of dynamic line ratings including the methodologies used for ratings and the practical issues of incorporating such ratings into the ERCOT network model.
	Market Design: None.
	Performance/Compliance: None, as long as practices conform with applicable reliability standards.
	Cost Allocation: None.
Strategy	Explore whether ERCOT and TSP dynamic line rating capabilities and practices can be improved.
Activities	ERCOT: None.
	Market Participants: The Network Data Support Working Group reviewed this issue and commented that for the TSPs which use temperature-adjusted ratings, practices were developed which consider each TSPs operational experience and equipment specifications. ERCOT accepts temperature-adjusted transmission equipment ratings from the TSPs and uses these Real-Time ratings in its SCADA alarming, real-time security analysis, and congestion management processes. TSPs have the choice whether to statically rate or dynamically rate lines in their areas. NDSWG recommends no further activity on this issue at this time as dynamic ratings have been incorporated into both the zonal and nodal market designs and due to attention to nodal market implementation issues.
Follow-Up	None.
Status	Issue closed.

SO-21 Evaluate Emergency Electric Curtailment Plan (EECP) Steps: Evaluate whether the EECP steps should be modified to incorporate factors related to rapid significant changes in WGR output.	
Priority	High.
Considerations	Policy: None.
	Reliability: Examine whether reliability would be enhanced by specifically incorporated WGR-related steps into the EECP.
	Technical: None.
	Market Design: None.
	Performance/Compliance: None.
	Cost Allocation: None.
Strategy	
Activities	ERCOT: None.
	Market Participants: Review EECP steps.
Follow-Up	None.
Status	Closed. EECP steps were not modified specifically to address rapid changes in WGR output.

SO-22 Open: This issue was an accidental duplicate. See Issues SO-13 and MD-10. Issue number SO-22 may be reused or skipped.

SO-23 – Impact of Advanced Meters on Integration of Renewable Resources – This issue was merged into issue SO-04.	
Status	Closed.

SO-24 Settlement of Advanced Meters in the Nodal Market: This issue has not been fully defined.	
Priority	Low.
Status	Open.

SO-25 Generator Governor Response for Wind-powered Generators: When system frequency deviates from the planned frequency of 60 Hz, then conventional, synchronous generators and loads automatically respond. If frequency goes up motors run faster so load goes up. When frequency goes up, all generators tend to reduce their output to bring frequency back down. Both of these automatic actions have the effect of reducing the high frequency and getting the system headed back to 60 Hz. The opposite occurs when frequency goes below 60 Hz. These automatic responses to frequency are called primary frequency response. Primary frequency response is currently provided by a subset of the generation Resources in ERCOT without compensation. Sufficient primary frequency response is needed to keep the ERCOT system stable, especially when generators or loads trip off suddenly.

WGRs are not synchronously connected to the transmission system. There is no automatic response to frequency unless it is created artificially. For some WGR turbine technologies, there is no way to create a response to frequency at all (except tripping them off line). As the installed capacity of WGRs grows above 15,000 MW there will be many hours when a substantial amount of the generation on line will be WGRs. At these times, it will be efficient for WGRs to provide a portion of the needed primary frequency response. If the WGRs do not provide the needed response, then WGRs may have their production curtailed to allow more conventional units to be on line or to increase their output in order to insure the response is available. A process has been completed to require all new WGRs to provide primary frequency response which culminated in the adoption of Protocol Revision Request 824. The newer technology WGRs can modify their control systems to provide primary frequency response. On a going forward basis, the cost and commercial issues are quite manageable and no study is needed to justify the change in requirements.

Priority	High.
Considerations	Policy: No policy issue is raised on establishing a new requirement for new WGRs. An issue does arise if a new technical requirement is placed upon existing WGRs.
	Reliability: Reliability could be an issue if sufficient frequency response is not available when needed
	Technical: The newest WGR technologies can provide primary frequency response capability. The cost of retrofitting such capability, where possible, on older WGRs will vary.
	Market: There are market implications related to the Resource mix necessary to provide sufficient primary frequency response.
	Performance/Compliance: New performance standards and compliance metrics will be required.
	Cost Allocation: None, the costs will be borne by the WGRs.
Strategy	Develop a method for WGRs to provide primary frequency response similar to conventional generator “governor response”.

Activities	ERCOT: Participate in developing the new requirement and performance standards.
	Market Participants: Developing the new requirement and performance standards. Implement required changes and comply with the new standards.
Follow-Up	Monitor system performance and WGR performance to frequency deviations.
Schedule	PRRs 824 and 833 are approved. Issue remains open while an Operating Guide Revision Request to establish performance requirements is developed.

SO-26 – Impact of Solar Generation on System Operations – Determine potential impact of new solar generation on ERCOT system operations and reliability through appropriate studies of solar ramp rate capabilities, forecasting of solar energy production, and voltage and reactive control capabilities of both solar photovoltaic and solar thermal technologies.	
Priority	Low
Considerations	Policy: This issue does not involve policy considerations.
	Reliability: This issue does involve reliability considerations because of the potential impact of significant additions of solar PV and solar thermal generating resources on ERCOT system reliability and operations.
	Technical: This issue involves technical considerations of two very different types of solar technology (PV and solar thermal) and their capability to provide necessary reliability services, such as voltage and frequency control, reactive control, ramp rates, etc.
	Market Design: This issue could impact market design considerations since solar generation resources might be able to participate in ERCOT ancillary services markets.
	Performance/Compliance: This issue does include performance or compliance considerations because of the inherent differences between solar PV, solar thermal and conventional generating technologies.
	Cost Allocation: This issue does not directly involve cost allocation considerations.
Strategy	Develop a whitepaper to examine the capabilities and technical issues applicable to solar PV and solar thermal technologies.
Activities	ERCOT: Assist market participants in the preparation of a whitepaper examining the various solar technologies and their potential impacts on ERCOT operations and reliability.
	Market Participants: Through the work of the RTWG, prepare a whitepaper examining the various solar technologies associated and assess the capability of such technologies to improve or enhance integration of additional renewable generation without compromising operations flexibility and system reliability.
Follow-Up	None necessary
Schedule	A draft whitepaper should be available for review by the end of 2010.

SO-27 Manual Curtailment of Wind Generation to Resolve Local Congestion: Issue requires definition.	
Priority	To be determined.
Status	?

SO-28 SPS actuation for N-0 Conditions: A SPS is a Special Protection Scheme which is an automatic system designed to trip a generator off line when needed to protect the transmission system. If an SPS is actuated for an N-0 condition that means it is tripping the generator off even though there has been no transmission contingency. This can occur when a new generator is connected to a transmission system that can handle some of its output all of the time and all of its output only some of the time. Since line flows are determined by more than that generator's output, a SPS is employed to take the generator off line when the total flow, which the generator is not allowed to know, is reaching the transmission lines limit.

The initial issue is that generation capability that the system could not fully support was interconnected to the grid. A secondary problem arose with coordinating ERCOT operations directions to the generator with the generators actions to avoid being tripped. The SPS warning signal, before the trip, was being used by the generator to cut production to avoid the trip. All parties agreed that this was appropriate; however it was unclear whether a complete SPS investigation and report to the Regional NERC Reliability Entity was needed when the warning signal activated but the SPS never tripped the unit. The investigation and reporting was a considerable burden on the Transmission Service Provider (TSP), ERCOT, and the Texas Reliability Entity (TRE). All parties agreed that the investigation and report were needed only if the SPS actually tripped the unit and the Operating Guides were modified to clarify the requirements.

This issue affects WGRs almost exclusively since several WGRs have been connected to the transmission system ahead of the needed improvements. While this is normally a temporary situation, the design and construction of CREZ has become part of the solution for many of the WGRS. Other, more timely transmission upgrades are not being pursued since they would become redundant once CREZ construction is complete. The reporting issue has been resolved through procedural changes.

Priority	Low
Considerations	Policy: None
	Reliability: None
	Technical: None
	Market: None
	Performance/Compliance: his issue is associated with compliance procedures.
	Cost Allocation: None
Strategy	Ensure that there are no reliability issues associated with the N-1 SPS operating procedures and modify the Operating Guides to clarify requirements.
Activities	ERCOT: Assist in review and resolution of the issue.
	Market Participants: Develop appropriate resolution of the reporting issue.

Follow-Up	None.
Schedule	Issue closed. Operating Guide Revision Request 224 clarifying SPS reporting requirements was approved in September 2009.

SO-29 Transmission Outage Planning for CREZ: This is a specific issue under the broader issue of transmission outage planning (see SO-14). This issue has been raised due to the fact there will be many transmission outages needed to construct the CREZ lines. CREZ construction outages are unique because of number of outages needed and the number of different entities involved in the construction. The issue is further exacerbated by the short time frame to complete all of the construction. No outages will be taken until construction which will be after regulatory approvals and designs are completed. The CREZ build out has a deadline of 2013. The front end time required and the quick build out will concentrate the bulk of the outages into 2011 and 2013. The outages are further concentrated by the practice of scheduling transmission outages only in the spring and fall months. These are the very times when WGRs are able to produce the most power.

Originally market participants sought to have ERCOT provide the market impact of outages to the Transmission Service Providers (TSPs) in order to allow them to evaluate the need for extraordinary mitigation. One particular project was selected for such review, but any further market impact evaluation was put on hold pending the resolution of the general issue (SO-14). ERCOT Planning staff has identified the likely outages needed and they are very numerous. The focus now is to coordinate the outages needed by the various parties doing the construction. Normal procedures allow the TSPs to start scheduling their outages no sooner than 90 days after the granting of regulatory approval since the outages will be somewhat dependent on the specifics of the route. There is no practical way to get better information sooner, thus ERCOT must await scheduling information from the TSPs to start any coordination of the schedules. Altering procedures and beginning a coordination process with less than perfect information may be needed to insure that transmission construction is not delayed due to limitations on outages.

Priority	High
Considerations	Policy: Is it appropriate for the TSPs to coordinate only a subset of outages that advantage or disadvantage only a single class of generators? How does this comport with open access policies? What is the burden of proof required for TSPs to allow extra ordinary mitigation costs to be recovered by the TSPs?
	Reliability: Planned outage cannot be allowed to affect reliability.
	Technical: None,
	Market: The construction outages associated with CREZ will have a significant market impact.
	Performance/Compliance: None
	Cost Allocation: None. The allocation of extraordinary mitigation costs will be allocated in accordance with TSP tariffs.
Strategy	Given the tight schedule and the limitations on available outage information the focus needs to be on coordinating outages in order to avoid construction delays and meet the PUCT target date for CREZ implementation. There does not seem to be any practical way to “optimize” the outages to reduce market impacts.

Activities	ERCOT: Ensure that staff and systems are available to coordinate CREZ transmission outages as information from the TSPs becomes available. Explore techniques for anticipating possible outage needs to identify possible conflicts ahead of time.
	Market Participants (MP X): TSPs consider providing a planning estimate of the outages needed.
Follow-Up	None. The longer-term and more fundamental issues associated with the market impact of transmission outage scheduling is addressed in Issue SO-14.
Schedule	This is an ongoing issue until the completion of the CREZ construction.

SO-30 Application of Wind Generator Forecasts to PASA: This issue requires definition.	
Status	?.

SO-31 Tension Monitors on Transmission Lines: The rating of a transmission line, that is to say, the amount of current it can carry is very dependent upon the environmental conditions at the moment. Three major factors affect the current carrying capability: wind, ambient temperature, and sun. Many Transmission Service Providers (TSPs) vary their transmission line ratings used by ERCOT based upon temperature. Wind can have a much larger impact on line ratings than temperature. However, it is much more difficult to estimate line ratings for different wind conditions since the wind varies along the line due to topography and wind direction. One possible way to consider all the effects on the transmission line is to use real-time measurements on the condition of the line itself to determine how much current it can carry. Several vendors provide a way of measuring the tension on the line which is directly related to the cumulative effects of all environmental conditions along the length of the line and the current loading of the line. The vendor's equipment then can provide the TSP with the instantaneous rating of the monitored section of the line. However, the effects of the environmental factors are not captured on unmonitored lines, so the approach does not provide complete information. Two transmission lines in ERCOT are equipped with such devices.

There is potentially a particular value for this technology when a WGR's output is being limited by a nearby line. When the wind is strong enough for the WGR to increase its output it is very likely that the wind will also be cooling the nearby transmission line increasing its ability to handle the WGR's increased output. However, the extent to which the WGR output correlates to cooling of the transmission line conductor depends upon the geographic prevalence of the amount of wind (is it windy across the entire length of the line, or just in the vicinity of the WGR) and the direction of the wind relative to the transmission line conductor (is the wind blowing across the conductor or is it blowing in parallel to the conductor). This second factor (direction of the wind relative to the conductor) can be different for different line sections as the transmission line turns or if the wind direction is variable. The purpose of this initiative is to have ERCOT and the TSPs consider using the tension monitoring technology when economically justified. Current planning processes do not specifically evaluate this solution to curtailment issues. The tension monitor system can be expensive to install and maintain. The equipment is not a standard part of a TSP's inventory thus requiring special training and procedures. However the potential value in reduced production costs may justify overcoming these obstacles.

Priority	Low.
Considerations	Policy: What policy issues are raised by use of advanced technical equipment in some parts of the grid and not others? Are there policy issues around "grid equity"?
	Reliability: The use of sophisticated specialized equipment can introduce additional complexity and uncertainty to system operations.
	Technical: Tension monitors are available but increasing reliability of the devices and simplicity of operation may require additional development.
	Market: This could have value to the market.
	Performance/Compliance: None
	Cost Allocation: Potentially. It may be beneficial to review TSP tariffs for tension

	monitor cost allocation provisions..
Strategy	Identify policy issues associated with selective application of advanced equipment for only part of the grid. Identify Resources curtailed due to local transmission constraints and evaluate the possible value of using a tension monitor to increase the transmission line rating.
Activities	ERCOT: Develop and document a screening process to identify possible candidates for use of tension monitors. Evaluate identified candidate facilities, perhaps under a process detailed in the Operating Guide (would require OGRR).
	Work with ERCOT Planning will identify and prioritize candidate applications and collaborate with TSPs to evaluate additional applications and work to resolve compliance responsibilities in the event that impacts to unmonitored line segments impacts compliance with reliability and safety requirements.
Follow-Up	To the extent line tension monitoring is used, periodic evaluation of its value could inform the discussion of possible future monitoring additions.
Schedule	Issue closed. Separate issue may be opened in the future if review of practices is undertaken.

SO-32 Real Time Wind-powered Generation Capacity: At certain times it will be necessary to estimate the potential output capability of WGRs when they are being curtailed. Experience using an estimation process that possibly includes the effects of wind velocity, direction, losses, and wind-powered turbine production efficiencies could be useful in developing the final estimation process needed. Estimating WGR output from wind measurements is not straight forward. The results are dependent upon many different factors and the experience in the industry is limited and inconsistent.

Requiring all WGRs to estimate their output when not curtailed using the same process as would be used when curtailed allows the process to be compared with actual meter readings when curtailed. The comparison process will allow the WGRs to evaluate alternative algorithms and data sources in order to provide the best estimate. The process to require all WGRs to supply real time production potential telemetry has been completed. The data sent to ERCOT has some immediate, limited operational value in the Zonal system but is not needed in the nodal system. This is essentially a process to gain experience with estimating techniques.

Priority	Low
Considerations	Policy: None
	Reliability: Providing a reasonable estimate of WGR potential capability when the WGR is curtailed is needed to allow ERCOT to reschedule the WGR when it is no longer curtailed.
	Technical: There are many issues about measurement processes, averaging times, and data sources that need to be explored.
	Market: None
	Performance/Compliance: None
	Cost Allocation: None
Strategy	Develop a protocol revision requiring WGRs to telemeter an estimate of production potential to ERCOT using a consistent averaging time for the data.
Activities	ERCOT: Develop procedures and systems to capture the new data and analyze as needed.
	Market Participants: WGRs develop systems needed to telemeter the new estimate of production potential to ERCOT. Compare the estimates with meter readings and experiment with alternative data sources, averaging times and algorithms to develop the best estimate.
Follow-Up	Share experience of WGRs in developing reasonable estimation methods.
Schedule	Issue closed. January 2010 Protocol revision 811 requiring estimated Real Time Production Potential to be telemetered to ERCOT was adopted. The Nodal

	Market has a requirement for WGR HSL to be set on a capacity calculation during curtailments.

SO-33 Real Time Wind-powered Turbine Availability: WGRs are comprised of many, sometimes hundreds, of individual wind-powered turbines. At any given time some of the wind-powered turbines may be out of service on a planned or a forced outage basis. The maximum output of the WGR is dependent upon the available wind and the number of wind-powered turbines currently in operation. In addition, the reactive control capability of the WGR is dependent upon the number of wind-powered turbines in service. This initiative is intended to provide ERCOT with real time information about the actual number of wind-powered turbines available for service, out of service, and whose status is uncertain.	
Priority	Low
Considerations	Policy: None
	Reliability: Provides additional detail to improve modeling and thus will have some positive effect on reliability.
	Technical: None
	Market: None
	Performance/Compliance: New telemetry requirements will require additional compliance by WGRs with existing telemetry standards
	Cost Allocation: None. Any costs will be borne by WGRs.
Strategy	Develop proposed Protocols change requiring Real Time telemetry of individual wind turbine availability.
Activities	ERCOT: Participate in PRR development.
	Market Participants: Develop PRR. WGRs will have implementation activities to comply with the new requirements.
Follow-Up	None
Schedule	Closed. November 2009 - Protocol Revision 830 establishing reactive standards and including wind-turbine availability telemetry requirements was adopted (pending PUCT action regarding the appeal). The HSL in Nodal will reflect turbine availability and an Outage Scheduler is used in Nodal for the turbine availability for forecasting.

SO-34 SCED Line Ratings: The Security Constrained Economic Dispatch (SCED) software determines the allowed output level of all generators in ERCOT respecting transmission line limits. The transmission line limits are provided by the Transmission Service Providers (TSPs) and in many cases are periodically modified based on expected temperatures. The temperatures used must be the highest temperature reasonably possible during the time period and for the region of the estimate. It is possible to provide actual temperatures in local geographic areas on a real-time basis. The use of the higher temperature estimate insures that the rating of the line will be conservative since a high temperature limits the current carrying capability of the line. If the more local real-time temperatures can be used to give SCED updated line ratings then it may be possible to increase the use of the transmission system reliably since a more realistic line rating will be used. Increased use of existing facilities is a benefit to all parties. Nodal software accepts dynamic line ratings and the network model update process accommodates dynamic changes. It is possible that improvements in dynamic rating procedures, monitoring systems, telemetry, and software can be applied after TNMID.	
Priority	Medium
Considerations	Policy: None
	Reliability: None
	Technical: None
	Market: This could impact production costs.
	Performance/Compliance: Stakeholders may consider a requirement that TSPs publish line rating methodologies so Market Participants understand the verying practices of the various TSPs.
	Cost Allocation: None
Strategy	Maximize the value of existing transmission assets. Establish procedures and systems to allow TSPs to update line ratings near to real time and to publish rating methodologies so that differences in practices across TSPs can be identified.
Activities	ERCOT: After nodal go live, commit resources to evaluate the cost and the schedule to implement real time updating of transmission line ratings.
	Market Participants: TSPs assist in specifying procedures and systems to allow real-time updating of transmission line ratings and coordinate with ERCOT to implement such a system. A NPRR or NOGRR may be required.
Follow-Up	To be determined.
Schedule	After nodal go live and no later than July 2011, identify the scope, schedule, and cost of updating line ratings near real time.

SO-35 Operational Checklist for Resource Interconnection: There appear to be gaps in the generation Resource interconnection process through which certain capabilities of some Resources may not be adequately demonstrated or certain Resource information in the Resource Asset Registration Form may not be verified by an appropriately objective party, such as a TSP or ERCOT. At a minimum, the Resource interconnection process should be reviewed for the purpose of identifying any such gaps. Additionally, ERCOT and stakeholders may wish to more thoroughly define the process such that Resource capabilities to meet key requirements of the Protocols and Operating Guide and RARF data accuracy can be verified.	
Priority	High. Developing an operational checklist for Resource interconnection will take some time and there is both a current need to address potential gaps as well as a need to provide clarity and identify issues for emerging technologies.
Considerations	Policy: No policy issues are identified at this time. It is envisioned that an operational checklist would be an "other binding document," and would be a tool for implementing relevant sections of the Protocols and Operating Guide. Stated another way, the checklist should enforce policy, not make policy.
	Reliability: An operational checklist for Resource interconnection should improve system reliability by confirming the validity of Resource data used for ERCOT planning and operational functions and by ensuring Resources meet the performance requirements essential for reliable operations.
	Technical: The operational checklist may need to address a range of technical requirements which are specific to different Resource technologies. Examples include WGR-specific Protocols requirements, issues related to the various possible configurations of combined cycle units, or the telemetry required for LaaRs participation. Additionally, it may not be desirable to test all required Resource capabilities for various technical reasons, such as creating risks to other grid-connected equipment or due to limitations set by actual system conditions.
	Market: No market design issues are known at this time.
	Performance/Compliance: An operational checklist for Resource interconnection will provide an opportunity for new Resources to demonstrate the ability to meet key performance criteria and demonstrate compliance with Protocols requirements.
	Cost Allocation:
Strategy	Review current Resource interconnection procedures and identify any gaps in Resource testing or RARF data verification needs. Consider whether additional testing procedures or data verification procedures are desirable and which party(ies) should be responsible for performing such activities. Consider whether Protocols or other binding documents should be amended to specify new procedures or whether internal ERCOT procedures are adequate.

Activities	ERCOT: The development of an operational checklist for Resource interconnection will likely require input from ERCOT Planning and Operations divisions. Implementation of such a checklist will likely require some training of both Operations and Client Relations personnel.
	Market Participants: Collaborate with ERCOT through the stakeholder process to review the current procedure, identify unit testing/data verification gaps and develop recommedation to address gaps.
Follow-Up	To be determined.
Schedule	Although this is a high priority item, both the ERCOT and Market Participant subject matter experts are on this topic are very engaged in both the nodal market transition and CREZ implementation. Perhaps the review could begin in late 2010.

3.3. Market Design Issues

MD-01 – Ancillary Services Cost Allocations Applicable to Wind: ERCOT's Ancillary Services procurement methodology has been modified to address some of the risks associated with changes in net load (load minus wind). Some parties argue that the modification of Ancillary Services procurement methodologies to account for significant wind penetration levels requires stakeholders to consider allocating some portion of Ancillary Services costs to wind generators.	
Priority	High
Considerations	Policy: This issue touches upon a number of ERCOT policy and public policy areas. Allocating Ancillary Services costs to WGRs would change the existing ERCOT policy of assigning costs of Ancillary Services to loads (based on load ratio share). Questions have been raised regarding the alignment of cost re-allocation with state and federal policies encouraging the installation of renewable generation technologies, many of which do not have all of the dispatchable, grid-supporting characteristics of conventional units.
	Reliability: This issue does not directly impact system reliability.
	Technical: This issue does not entail any technical considerations.
	Market Design: Presently Ancillary Services costs are borne by loads on a load ratio share. Allocation of Ancillary Services costs to various other Market Participants would be a fundamental market design change. Proponents of such a change argue that market design is improved by properly assigning costs to all components of the system net load summation and that rational economic decisions cannot be made by Market Participants unless costs are accurately allocated to the party responsible for them. Others argue that while the different Ancillary Services are procured for a number of reasons, the benefits of all Ancillary Services procured and deployed accrue to the loads served by them and that any cost allocation methodology changes which assign costs to new and different Resource technologies creates unnecessary barriers to entry for potentially beneficial emerging technologies.
	Performance/Compliance: This issue does not involve any performance or compliance considerations.
	Cost Allocation: Primary consideration of this issue.
Strategy	Develop one or more methodologies with supporting rationales for allocating the cost of Ancillary Services to Intermittent Renewable Resources, specifically, WGRs, with further expansion in the future to other components to the Net Load summation such as new intermittent renewable resources. Present possible methodologies to TAC and the ERCOT Board for their consideration.
Activities	ERCOT: Inform the stakeholder consideration of this issue with relevant data as

	possible and appropriate.
	Market Participants: The Wind Cost Allocation Task Force (WCATF) of the ERCOT Wholesale Markets Subcommittee (WMS) was created in November 2009 to examine this issue and develop a cost allocation methodology with supporting rationale. The WCATF developed 2 possible cost allocation methodologies, which were presented to TAC. TAC has not taken action on the proposed methodologies.
Follow-Up	To be determined
Schedule	TAC awaits direction from the ERCOT Board before proceeding futher on this issue.

MD-02 – Ancillary Services Procurement Optimization for 2009 – Annually, ERCOT produces its plan for procuring Ancillary Services for the coming calendar year. With the increasing influx of variable wind generation, the amounts and types of Ancillary Services needed to maintain system reliability may change. This issue examines potential impact of wind generation on ERCOT's plan for Ancillary Service procurements for 2009.	
Priority	High.
Considerations	Policy: This issue does not include any policy considerations.
	Reliability: The amounts and types of Ancillary Services procured by ERCOT do impact system reliability.
	Technical: This issue does not entail any technical considerations.
	Market: Since all Ancillary Services involve markets in one way or another, market impacts are considerations.
	Performance/Compliance: This issue does not directly involve any performance or compliance considerations.
	Cost Allocation: Whether or not to change Ancillary Cost allocations is a consideration of this issue.
Strategy	The Wind Operations Task Force (WOTF) of the ERCOT Reliability and Operations Subcommittee (ROS) reviewed ERCOT's proposed Ancillary Services Procurement Plan for 2009 to ensure that it maintains adequate reliability while ensuring optimum market participation.
Activities	ERCOT: Prepare 2009 proposed Ancillary Service Procurement Methodology.
	Market Participants: WOTF reviewed ERCOT's proposed 2009 Ancillary Services Procurement plan and made recommendation to ROS.
Follow-Up	In future considerations of the Ancillary Services procurement methodology, stakeholders may wish to address whether out of merit dispatches necessary for controlling system security, such as Fleet OOMs, are included in the requirements algorithm for Regulation Services.
Schedule	Issue closed. WOTF completed its review of the proposed 2009 Ancillary Services Procurement Methodology in December 2008, which was subsequently approved by the ERCOT Board in February 2009.

MD-03 – Non-Spin Requirements: Determine if additional amounts of Non-Spin Service procurements by ERCOT are necessary to reliably accommodate increased amounts of wind generation in ERCOT. Historical events indicate that there is increased risk to reliability due to the variable output of wind generation and the difficulties in predicting when such variations will occur.	
Priority	High
Considerations	Policy: This issue does not directly involve policy.
	Reliability: This issue will improve ERCOT reliability by ensuring that adequate amounts of Non-Spin Service are procured by ERCOT to deal with increased risk from variable output wind generation.
	Technical: This issue does involve some technical issues related to revisions of the Non-Spin Service procurement methodology
	Market Design: Procurement and deployment of NSRS can impact market outcomes and modifications to procurement and deployment methodologies or practices can raise market design questions.
	Performance/Compliance: This issue does impact performance or compliance.
	Cost Allocation: The issues relating to Ancillary Services cost allocation are addressed in Issue MD-01.
Strategy	Examine methods to ensure that adequate Non-Spin capacity is available to ERCOT from the market to deal with increasing amounts of variable wind generation.
Activities	ERCOT: Analyze and recommend revisions to the Ancillary Service Procurement methodology, specifically focusing on Non-Spin Service procurements to address concerns about increased amounts of variable wind generation entering the ERCOT market.
	Market Participants: Review and provide guidance to the ERCOT analysis of the NSRS procurement methodology.
Follow-Up	Periodically review historical Non-Spin Service procurements and deployments to ensure that reliability is maintained at the lowest possible cost to the market.
Schedule	Issue closed. In December, 2009, the ERCOT Board approved the proposed 2010 Ancillary Services Procurement methodology which was revised from the previous year's methodology to specifically increase Non-Spin Service procurements to deal with the increased risk posed by increasing amounts of variable wind generation in the ERCOT market.

MD-04 New Ancillary Services Products for Reliability: The increasing diversity of On-Line Resources and accompanying variability in technical capabilities and limitations of the ERCOT generation mix under different operating scenarios raises questions about whether the current definitions and market constructs of Ancillary Services products will best serve the needs of the ERCOT system in the future. Should new Ancillary Services, such as Quick Start NSRS or Fast Ramp RRS be created? Should uncompensated Ancillary Services such as Voltage Support Service or primary frequency response become compensated services for the units which can provide them? The related issue whether units which cannot provide all Ancillary Services should be required to purchase those services from other Market Participants of allocated some portion of Ancillary Services costs is addressed in Issue MD-01. From a long-term planning perspective, this issue may have some overlap with Issue SP-10.	
Priority	High
Considerations	Policy: Potential policy issues, particularly regarding cost allocation issues and creation of new reliability services for which loads could be assigned the costs.
	Reliability: Reliability could be enhanced through provision of additional Ancillary Services.
	Technical: Technical considerations abound in the possible creation of a more granular and/or flexible suite of Ancillary Services products available to grid operators – product definition, unit eligibility, unit technical capabilities and limitations, necessary quantities, deployment methodology, etc.
	Market Design: Reliability services are provided today through a mix of market mechanisms and technical standards. Modifications to existing constructs or creation of new services could constitute a significant market design change. Some Market Participants argue that the energy-only market design fails to adequately compensate some service providers and that development of more granular market-based services could encourage investment in the types of Resources needed by the system to provide key reliability functionality.
	Performance/Compliance: Performance requirements and compliance mechanisms would likely need to be developed along with any modification or creation of Ancillary Services products.
	Cost Allocation: Costs can be allocated in accordance with the existing methodology or an alternative methodology developed under Issue MD-01.
Strategy	Include the consideration of this issue during the process of developing the 2012 Ancillary Services Procurement Methodology. Begin the process of developing the 2012 methodology earlier than usual to accommodate this discussion. Include reasonably anticipated increases in renewable generation as one of the 2012 methodology development considerations. Include review of Ancillary Services procurement and deployment data from early nodal market operations as one of the 2012 methodology development considerations.

Activities	ERCOT: ERCOT Staff is responsible for reviewing the Ancillary Services Procurement Methodology at least annually.
	Market Participants: Should develop proposals for discussion and timely interaction in the annual ERCOT review process.
Follow-Up	To be determined.
Schedule	Begin discussions of possible Ancillary Services modifications in late 2010/early 2011. Begin development of the 2012 procurement methodology in the Spring of 2011, which is a few months ahead of the normal methodology review schedule.

MD-05 – Benefits of Storage Technologies – A number of different energy storage technologies are entering service in various markets. Some are becoming increasingly cost competitive and others are aided by government subsidies. Energy storage technologies may improve grid stability and reliability at both the transmission and distribution level. Energy storage technologies may also aid the integration of renewable resources. In many respects, the ERCOT market rules and related regulatory constructs are silent on treatment of energy storage technologies - as Resources or transmission devices, as Renewable Energy Credit generators, as Ancillary Services providers, in the Unaccounted For Energy calculation methodology, etc. Some Market Participants argue that before stakeholders can meaningfully and usefully delve into the myriad issues surrounding introduction of energy storage technologies into the ERCOT system, stakeholders should first identify the range of possible benefits such technologies can provide to the ERCOT grid and/or ERCOT markets to prioritize areas of focus going forward.

Priority	Medium.
Considerations	Policy: Settlement of energy from storage devices may raise policy issues to be elevated to the PUCT. Optimal utilization of storage technologies may require modifying Ancillary Services product definitions and/or performance requirements. Successful integration of storage devices may require stakeholders to revisit interconnection procedures, which may raise policy questions around non-discriminatory (or preferential) grid access..
	Reliability: Storage has the potential to increase reliability due to rapid and highly controllable response to system conditions or dispatch instructions.
	Technical: This entails many technical considerations related to the capabilities and limitations of various energy storage technologies.
	Market: As possible energy storage device benefits are explored and identified, market design considerations are likely to emerge.
	Performance/Compliance: As energy storage devices are interconnected to the ERCOT system, specific performance requirements and/or compliance monitoring mechanisms will likely need to be developed.
	Cost Allocation: To be determined.
Strategy	Consider utilizing a workshop format to explore energy storage device opportunities and challenges. Consider formation of a task force to explore energy storage issues.
Activities	ERCOT: Participate as appropriate in the exploration of energy storage technology issues through the stakeholder process. ERCOT facilitated Storage Workshop I in April 2010.
	Market Participants: Invite representatives of the energy storage industry to engage in the stakeholder exploration of storage issues; participate in workshop

	and task force activities; and identify potential energy storage device benefits and/or challenges. Elevate issues as appropriate to TAC and/or the ERCOT Board. Under TAC direction, the WMS created the Power Storage Working Group in June 2010.
Follow-Up	Follow-Up activities will be conducted by the PSWG.
Schedule	Issue closed. Initial exploration of energy storage benefits and challenges has begun. More detailed sets of issues will be identified and addressed through the Power Storage Working Group.

MD-06 – Ancillary Services Procurement Methodology: This issue is deleted as the various topics associated with this discussion are addressed in Issues SP-10, MD-03, and MD-04.	
Status	Closed.

MD-07 Wind Generation Resources Providing Ancillary Services: WGRs currently provide a more limited set of Ancillary Services than many other Resources. As more WGRs are added to the ERCOT system (or, more specifically, as the percentage of total On-Line capacity comprised of WGRs increases in the future), it may be economically efficient or system reliability concerns may require that WGRs provide additional Ancillary Services. An area of particular concern is "shoulder month" high-wind, low-load scenarios when wind penetration is high and On-Line conventional Resources may be operating at or near their Low Sustainable Limit (LSL), thus limiting their ability to provide certain services, such as Down Regulation. This issue and related issues were identified in the Ancillary Services study performed for ERCOT by General Electric in 2006. Some Market Participants argue that certain Ancillary Services definitions may need to be revised to enable WGR participation. Others counter that Ancillary Services definitions are, and should remain, technology-neutral and that all qualified resources can compete to supply them through ERCOT-managed markets. thus enabling qualifying WGRs, like other Resources, to provide Ancillary Services. The following issues may warrant exploration:

1. What changes, if any, are needed to the nodal protocols to allow or require WGRs to provide certain Ancillary Services?
2. What changes, if any, are needed in WGR operating capabilities or procedures to enable Ancillary Services provision to ERCOT?

Priority	Medium
Considerations	Policy: The question of technology-neutral vs. technology-specific Ancillary Services definitions may have policy implications.
	Reliability: There are a variety of reliability considerations related to the exploration of the availability of various Ancillary Services during various system operating conditions, particularly high-wind, low-load scenarios.
	Technical: The specific technical capabilities and/or limitations of particular wind turbines will likely be important considerations in the resolution of this issue.
	Market: There are always market impacts from new entrants or revised product definitions. There could be inicreased market efficiencies if WGRs are further integrated into the provision of Ancillary Services. However, additional Ancillary Services provided by WGRs could raise other market impacts which raise long-term Resource adequacy issues or energy-only market design sustainability issues. Ancillary Services market design can have significant impacts on the overall efficiency of unit commitment in the market.
	Performance/Compliance: For any Ancillary Service for which WGRs are allowed or required to provide, there may be a need for specific performance measures and/or a compliance monitoring plan.
	Cost Allocation: None identified at this time.
Strategy	Start a process of reviewing and discussing the mechanisms for WGRs to provide

	ancillary services. Anticipate issues to provide sufficient time to analyze, resolve, and implement as needed. QMWG will explore these issues in early 2011 after Nodal Go-Live.
Activities	ERCOT: Engage in stakeholder deliberations as possible and appropriate. Provide relevant data, analysis, or study resources as possible and appropriate.
	Market Participants: Consider possible changes to allow and/or require the provision of various Ancillary Services by WGRs. QMWG will explore these issues in early 2011 after Nodal Go-Live.
Follow-Up	May need protocol revisions depending on the results of the analysis.
Schedule	QMWG will explore these issues after Nodal Go-Live.

MD-08 – Reactive and Voltage Requirements Applicable to Wind: A Protocol Interpretation Request seeking clarification of the Reactive Power capability requirements for WGRs prompted the filing of PRR 830 and an in-depth review of the reactive power and voltage support requirements applicable to WGRs.	
Priority	High
Considerations	Policy: This issue may involve policy concerns related to the issue of requiring retrofitting of existing units and whether each type of generating technology should provide a uniform amount of reactive and voltage control capability to ensure adequate reliability of the ERCOT system or whether technology-specific requirements can or should be developed which adequately support system reliability needs.
	Reliability: Adequate provision of reactive and voltage control capability is critical to maintaining system reliability.
	Technical: This issue involves technical issues related to the specific technical capability of an unconventional generation technology (e.g., wind turbine) to provide reactive and voltage control capability similar to that of conventional generation.
	Market Design: Market design issues may include the technology-neutral vs. technology-specific approach issue and the questions whether an unconventional generation technology is allowed or required to purchase reactive or voltage control capability from a third-party provider, either bilaterally or through an ERCOT market.
	Performance/Compliance: Resolution of this issue will directly impact performance criteria.
	Cost Allocation: This issue may have cost allocation considerations such as retrofit costs, cost-shifting issues between Resource types due to varying technical standards, or indirect cost allocation by requiring unconventional technologies to purchase or otherwise arrange the provision of reactive or voltage control capability.
Strategy	Review relvant sections of the ERCOT Protocols and Operating Guide to clarify reactive and voltage control requirements for all generating technologies.
Activities	ERCOT: Review and comment on any proposed changes in existing ERCOT Protocols or Operating Guides related to reactive and voltage control capability of generation resources.
	Market Participants: Review existing ERCOT Protocols and Operating Guides and recommend changes, if necessary, to clarify reactive and voltage control capability requirements.

Follow-Up	None.
Schedule	Issue closed. PRR 830 "Reactive Power Capability Requirement" was approved by the ERCOT Board in November, 2009. However, this PRR has been appealed to the Public Utility Commission of Texas in Docket Nos. 37817, 37818, 37819, 37823, 37824 and 37827. If necessary as a result of a PUCT Order relating to the appeals of PRR 830, a new Issue can be opened to address the specific requirements of the PUCT Order.

MD-09 Wind Generation Dispatch in the Nodal Protocols: The current nodal protocols call for WGRs to follow ERCOT Base Point instructions when the Security Constrained Economic Dispatch (SCED) calculation indicate they must be curtailed below their High Sustained Limit (HSL) to maintain system reliability. The trigger to indicate that the WGR must curtail its output is when the Base Point it receives from SCED is more than 2 MW below the HSL used by SCED. The HSL for a WGR is dependent upon wind conditions and could change routinely. The current nodal protocols call for WGRs to routinely update their HSL by real-time telemetry to ERCOT. The WGRs do not know which HSL update to use. One solution is to have SCED send out a curtailment flag to signal to the WGR when it must curtail. While this could be the best resolution for the issue it would require software changes and would not be available until after nodal go live. In the interim, a change in the WGR telemetry procedure has been developed to ensure that the WGR and SCED are using the same HSL for their curtailment trigger. This requires a temporary software change in all of the WGRs control centers. The process requiring all WGRs to modify their software is in progress.	
Priority	High
Considerations	Policy: None
	Reliability: This modified procedure maintains the synchronization between SCED and the WGRs in order to maintain reliable operations.
	Technical: None
	Market: None
	Performance/Compliance: Clarifies the performance requirement for the WGR.
	Cost Allocation: None
Strategy	Recommendation: Develop a nodal protocol revision to temporarily resolve the issue by changing the WGR HSL telemetry procedure. Develop an additional nodal protocol revision, to be implemented after go live, for SCED to send a curtailment flag when needed; coordinate with other WGR related nodal revisions requiring software changes (MD-10, MD-11).
Activities	ERCOT: Assist in analyzing and resolving the issue. Implement the needed changes for the long-term solution after nodal go-live.
	Market Participants: WGRs implement the temporary fix in their software and procedures..
Follow-Up	NPRR 214 is a parking deck item requiring implementation post-TNMID.
Schedule	Issue closed with Follow-up noted above. Nodal Protocol Revision Request 214 specifying a revised WGR HSL update process was approved in May 2010.

MD-10 – Wind Generation Performance Metrics in the Nodal Protocols: This issue relates to a review of the ERCOT Nodal Protocols to ensure proper treatment of wind generation in regard to performance metrics. Wind generators may be different from conventional generation in many ways. Because of these differences, it may be appropriate to develop special performance metrics for WGRs that recognize their specific technical capabilities and/or limitations.	
Priority	Medium
Considerations	Policy: This issue includes policy considerations on whether or not to impose the same performance standards on all generation technologies or whether technology-specific standards are appropriate.
	Reliability: Proper operation of wind generation resources can impact system reliability. Measurement of performance of wind generation, like that of conventional generation, is necessary to ensure adequate system reliability.
	Technical: There are some technical considerations related to how wind turbines can or cannot respond to certain system conditions or dispatch instructions..
	Market: Performance requirement exemptions for certain Resource types or rules that provide differing incentives for different types of generators can affect market outcomes. Proposals for any revised performance standards should be evaluated for both intended and unintended consequences.
	Performance/Compliance: This issue directly involves performance and compliance considerations.
	Cost Allocation: to the extent that system performance needs are shifted from all technology types to particular technology types stakeholders may wish to consider assigning the cost offsets to the WGRs..
Strategy	Review the ERCOT Nodal Protocols to determine what performance measures and metrics currently apply to wind resources and make recommendations for any changes to better measure wind resource generation operations and responses during reliability events.
Activities	ERCOT: Provide operational and performance data for wind resources for evaluation of various performance metrics applicable to wind generation.
	Market Participants: This issue was assigned to the ERCOT Wholesale Market Subcommittee (WMS), which in turn, assigned the issue to its QSE Managers Working Group (QMWG), which is currently reviewing the performance metrics applicable to wind generation in the existing ERCOT Nodal Protocols. Upon completion of this review, the QMWG may make recommendations to the WMS for changes in the Nodal Protocols to recognize any inherent technological differences between wind turbine generators and conventional generators in

	regard to generator performance metrics.
Follow-Up	WGRs are the primary focus of the effort today. At some point in the future it may be necessary to open a new issue and consider this issue for a broader set of Variable Energy Resources.
Schedule	The QMWG will complete its review of the Nodal Protocols and provide any recommendations to ROS by August, 2010. The GREDP with the settable X, Y, and Z values is sufficient for nodal go-live. The Z value is for WGRs. Set the initial values based on Nodal testing (LFC tests.) Review after Go-Live in no more than 3 month increments.

MD-11 Wind-powered Generation and Base Point Deviation in the Nodal Protocols: The nodal protocols specify that WGRs shall be held accountable for deviations from their base point when the Security Constrained Economic Dispatch (SCED) calculations must curtail them below the High Sustained Limit (HSL) used by SCED. The need to curtail is signaled by the fact that the base point received by the WGR is 2 MW or more below the HSL sent to ERCOT by the WGR. Ensuring that the HSL used by the WGR and that used by SCED is the subject of issue MD-09. This issue has resulted from the fact that the settlement equations use the HSL from the current operating plan and not the HSL used by SCED to trigger base point settlement charge calculations. The settlement trigger needs to be changed to use the HSL used by SCED. Since a software change is required to fix this issue, resolution will have to wait for nodal revisions implemented after go live. The possible effect of this error is inappropriate charges to WGRs that must be resolved by a routine dispute process. Dispute processes for settlement issues may be considered routine, but they do take up market participant and ERCOT staff time.

Priority	Low
Considerations	Policy: None
	Reliability: None
	Technical: None
	Market: Can expose WGRs to higher costs if not resolved.
	Performance/Compliance: None
	Cost Allocation: None
Strategy	Recommendation: Prepare a nodal revision request fixing this and other WGR related issues requiring a software change (see MD-09, MD-10)
Activities	ERCOT: Assist with analyzing and resolving the issue. Implement needed changes.
	Market Participants: Fix the settlements equations and the negative pricing issue. For QSEs with WGRs, watch the base point deviation charges from the LFC test. WGRs assist with analyzing and resolving the issue.
Follow-Up	None
Schedule	Initiate the nodal revision request in late 2010. May need immediate action to resolve if this settlement equation which uses the HSL from the COP instead of the HSL from SCED results in charges to QSEs with WGRs even during intervals of no curtailment.

MD-12 – Wind Generation Resource LSL as a Percentage of HSL – Determine the appropriate minimum percentage for the Low Sustained Limit (LSL) of the High Sustained Limit (HSL) for a wind generation resource and incorporate those values in the ERCOT Protocols.	
Priority	High
Considerations	Policy: None.
	Reliability: This issue may have some impact on reliability because ERCOT systems use the LSL and HSL to determine resource capability on the system.
	Technical: This issue involves the technical feasibility of a wind generation facility to determine the appropriate minimum and maximum level of generation capability.
	Market Design: None.
	Performance/Compliance: Resolution of this issue will clarify performance requirements for setting LSL and HSL.
	Cost Allocation: None.
Strategy	Determine the appropriate levels of LSL and HSL for wind generation facilities.
Activities	ERCOT: Review and comment on any proposed changes in existing ERCOT Protocols or Operating Guides related to LSL and HSL for wind generation resources.
	Market Participants: Review existing ERCOT Protocols and Operating Guides and recommend the appropriate LSL and HSL standards for wind generation facilities.
Follow-Up	None necessary since the performance metric associated with the percentage of LSL to HSL will cease to exist when the ERCOT Nodal Market is implemented in December, 2010.
Schedule	Issue closed. PRR 773 "Setting the LSL Requirement for WGRs " was approved by the ERCOT Board in December, 2008. This PRR sets the LSL as a percentage of HSL at 10% for all wind generators installed on or after January 1, 2003. Wind generators installed prior to that date are excluded from the measure.

MD-13: Use of State-of-the-Art Wind Forecast – An accurate wind power generation forecast is essential to the reliable and efficient integration of wind generation into the ERCOT grid. It is important for ERCOT and wind resources to be able to accurately forecast wind energy production on a day-ahead up to an hour-ahead timeframe to reliably and efficiently dispatch its resources to serve load. However, state-of-the-art forecasts require significant amounts of meteorological (site-specific and region-wide) and operating data (i.e., wind turbine availability) in order to accurately forecast energy production from wind generators. Such data is only available from Wind Generation Resource (WGR) owners.	
Priority	High
Considerations	Policy: None.
	Reliability: Proper forecasting of wind generation output can impact system reliability. This new requirement will allow ERCOT to perform its Day Ahead Replacement Reserve Service (RPRS) procurement using a consistent state-of-the-art forecast of the output from WGRs rather than relying on forecasts from varying sources (i.e., individual wind farms) with varying degrees of sophistication and accuracy.
	Technical: There are some technical considerations related to the inputs necessary to populate the data required for a state-of-the art wind power production forecast.
	Market: None.
	Performance/Compliance: This issue directly involves compliance considerations.
	Cost Allocation: None. .
Strategy	Establish a requirement in the ERCOT Protocols for a Qualified Scheduling Entity (QSE) representing Wind Generation Resources (WGRs) to use a state-of-the-art wind production forecast provided by ERCOT in their daily resource plan submittals unless their own forecasts are consistently more accurate. .
Activities	ERCOT: Develop a state-of-the-art wind power production forecast through collaboration with a recognized forecast provider. File a Protocol Revision Request (PRR) to establish data reporting requirements for QSEs representing WGRs to populate the state-of-the-art wind forecast model.
	Market Participants: Establish processes to collect and transmit required meteorological data to ERCOT to feed into the state-of-the-art wind power production forecast.
Follow-Up	Monitor the accuracy of the forecasts. Get regular updates from the forecast provider (AWS Truewind) on the models they are using. Recommend AWST present results of back cast against actual. Verify that it continues to be state of

	the art. Follow up on MET data requirements with WGR's and AWS Truewind.
Schedule	Issue closed for zonal market duration with Follow-Up noted above for nodal market. Protocol Revision Request 763 - Use of WGRPP as Planned Operating Level in Day-Ahead Resource Plan for WGRs was submitted by ERCOT staff in May of 2008 and approved by the ERCOT Board of Directors in July of 2008.

3.4. Workshop / Training Issues

WT-01 – Resource Plan and Schedule Update Process: Determine potential improvements to the existing Resource Plan and Resource Schedule update process to improve performance and reliability. Because of the pending implementation of the Nodal market design, this issue should be addressed after the Nodal Market implementation as a topic for a future workshop.	
Priority	Low
Considerations	Policy: This issue does not directly involve policy.
	Reliability: This issue will improve ERCOT reliability by providing ERCOT with more timely and accurate information regarding the status and operation of wind generation resources.
	Technical: This issue does involve some technical issues related to implementation within the Nodal market design as planned.
	Market Design: This issue does not impact market design.
	Performance/Compliance: The Resource Plan and Schedule Update process may require performance measures or compliance activities.
	Cost Allocation: This issue does not directly impact cost allocation.
Strategy	Solicit input and ideas from Market Participants and ERCOT staff through a workshop.
Activities	ERCOT : Host a workshop dealing with potential improvements to the scheduling of both conventional and variable renewable resources that could be implemented into the Nodal market design after initial Go-Live (i.e., after December, 2010).
	Market Participants: Provide speakers and/or suggested improvements for discussion at the workshop.
Follow-Up	None at this time.
Schedule	Hold workshop after Nodal Go-Live (2011 or beyond).

WT-02 – Wind Workshop III (Summer 2009): Develop list of topics and speakers for the ERCOT Wind Workshop III to be held in the summer of 2009.	
Priority	High
Considerations	Policy: This issue does not directly involve policy.
	Reliability: This issue will improve ERCOT reliability by providing ERCOT with better tools to address issues being experienced as the penetration of variable wind generation on the ERCOT system continues to increase.
	Technical: This issue does involve some technical issues related to various types of wind turbine designs.
	Market Design: This issue could result in development of new market-based tools to help ERCOT deal with increased penetration of variable wind generation.
	Performance/Compliance: Any tools developed as a result of this issue could impact performance or compliance.
	Cost Allocation: This issue could impact cost allocation if certain costs are incurred due to increased penetration of variable wind generation
Strategy	Make the market participants aware of issues that ERCOT has experienced as variable wind generation penetration has increased to stimulate new ideas and methods of reliably integrating such resources into the ERCOT system.
Activities	ERCOT: Host a workshop for interested parties to discuss methods of improving system operations and reliability in an environment of ever-increasing use of variable wind generation resources.
	Market Participants: Provide speakers and/or suggested improvements for discussion at the workshop.
Follow-Up	None at this time.
Schedule	Issues closed. The workshop was held on June 29, 2009 and was well-attended.

WT-03 – Wind Turbine Operator Training: Develop list of topics for use in development of a future training session for wind turbine generator operators.	
Priority	Low
Considerations	Policy: This issue does not directly involve policy.
	Reliability: This issue will improve ERCOT reliability by providing new wind turbine operators with the information necessary to properly operate their wind farms in accordance with ERCOT Protocols and Operating Guides and respond to ERCOT instructions in the ERCOT Nodal Market.
	Technical: This issue may involve some technical issues related to the specific operational characteristics of various types of wind turbine designs in use in the ERCOT market.
	Market Design: This issue does not directly involve market design.
	Performance/Compliance: Wind turbine operational performance and compliance will be enhanced by properly trained wind turbine operators.
	Cost Allocation: This issue does not impact cost allocation.
Strategy	Educate new wind farm operators prior to commencement of commercial operation in the ERCOT market.
Activities	ERCOT : Develop and host training sessions as appropriate to instruct wind turbine operators on the various requirements for reliable and efficient operation in the ERCOT Nodal Market
	Market Participants: Work with ERCOT to develop a list of topics to be covered in the training class. Owners of wind turbine facilities in ERCOT should send their operating personnel to the ERCOT training sessions to ensure compliance with ERCOT Protocols and Operating Guides.
Follow-Up	None at this time.
Schedule	Schedule training classes to begin in 2012 to provide training for operators of new wind farms that are likely to be coming on-line as the CREZ transmission facilities become operational in 2013 and beyond.

WT-04 – Wind in the Nodal Market: Develop presentation materials for use in ERCOT On-Line Training course for Wind describing how wind generation resources will be treated in the Nodal Market design.	
Priority	High
Considerations	Policy: This issue does not directly involve policy.
	Reliability: This issue will improve ERCOT reliability by providing new wind turbine operators with the information necessary to understand how wind generation resources will be treated in the ERCOT Nodal Market.
	Technical: This issue does not involve any technical issues.
	Market Design: This issue does not directly involve market design.
	Performance/Compliance: Wind turbine operational performance and compliance will be enhanced by wind turbine operators who understand ERCOT's treatment of wind generation.
	Cost Allocation: This issue does not impact cost allocation.
Strategy	Provide an opportunity for wind farm operators to become familiar with how wind generation will be treated in the ERCOT Nodal Market.
Activities	ERCOT: Develop materials for use in ERCOT's On-Line Nodal Training program to educate students on how variable wind generation resources will be treated in the ERCOT Nodal Market.
	Market Participants: Work with ERCOT to develop a list of topics to be covered in the training materials for wind generation operators in the ERCOT Nodal Market.
Follow-Up	Review training materials after Nodal Go-Live to determine if changes are necessary to improve wind generator operator understanding of ERCOT treatment of wind in the Nodal Market.
Schedule	Issue closed. Information is included in ERCOT's On-Line Wind Generation 101 Training Class related to treatment of wind generation in the ERCOT Nodal Market.

WT-05 – Wind Workshop IV: Develop list of topics and speakers for the ERCOT Wind Workshop IV to be held in mid- to late 2011 focusing on educating wind turbine vendors and facility engineers on ERCOT Nodal Protocols and Operating Guides related to wind generation.	
Priority	Medium
Considerations	Policy: This issue does not directly involve policy.
	Reliability: This issue will improve ERCOT reliability by providing new ERCOT market participants using wind generation resources with knowledge of the requirements and expectations related to their generating facilities in the ERCOT Nodal market.
	Technical: This issue may involve some technical issues related to specific types of wind turbine designs.
	Market Design: There are no market design considerations related to this issue.
	Performance/Compliance: Increased understanding of market rules by potential wind generation resource owners will enhance ERCOT's integration of variable wind generation into the ERCOT Nodal Market.
	Cost Allocation: There are no cost allocation considerations related to this issue.
Strategy	Educate potential market participants with wind generation resources before they enter the ERCOT market.
Activities	ERCOT: Host a workshop for interested parties to educate wind turbine vendors and facility engineers on ERCOT Nodal Protocols and Operating Guides related to wind generation.
	Market Participants: Provide speakers and/or suggested topics for discussion at the workshop.
Follow-Up	None at this time.
Schedule	The workshop should be scheduled after Nodal Go-Live (December 2010) and after the relevant Nodal Protocols and Nodal Operating Guide revisions have been approved following the results of system planning studies currently underway.

WT-06 Solar Workshop - Workshop to focus on existing market rules and how those rules might impact particular solar technologies. Target audience: manufacturers, developers, operators, other ISOs that have solar generating facilities in operation.	
Priority	Medium
Considerations	Policy: Does solar energy generation technology differ from wind generation technology enough to warrant different policies to be applied to solar?
	Reliability: Determine if other ISOs with experience in solar generation technologies have experienced reliability problems different from those encountered with wind generation.
	Technical: Are there technical differences in various solar technologies related to voltage control, frequency control, ramp rate from conventional generation technologies?
	Market Design: Are new or additional ancillary service products or markets necessary to accommodate large penetrations of solar technologies?
	Performance/Compliance: What performance measures are appropriate to ensure that solar generation does not adversely impact the overall system reliability at
	Cost Allocation: To be determined.
Strategy	Engage experts in solar technologies and ISOs with experience operating solar facilities to identify issues specific to solar generation and determine best practices to apply to the ERCOT Nodal market.
Activities	ERCOT: Seek out technical experts from solar manufacturers and other ISOs with experience operating solar facilities to participate in the workshop. Schedule and develop an agenda for the Solar Workshop.
	Market Participants: Provide input to ERCOT regarding potential speakers for the Solar Workshop and participate in the workshop to ensure that Market Participants are aware of the issues related to solar technologies.
Follow-Up	None at this time.
Schedule	First Quarter 2011
Status	The workshop should be scheduled after Nodal Go-Live (December 2010).

WT-07 Storage Workshop I: Workshop to seek input from interested parties regarding potential storage technologies that might be appropriate for use in the ERCOT market.	
Priority	Medium
Considerations	Policy: Should energy storage be developed in the ERCOT market to enhance system operations and reliability with large penetrations of variable renewable resources? If so, what policy changes are necessary to provide the proper financial incentives to ensure that storage technologies are developed?
	Reliability: Do storage technologies improve system reliability? If so, how much and are there other reliability considerations?
	Technical: What are the technical capabilities of various storage technologies to provide ancillary services, voltage support, frequency response and local transmission congestion management?
	Market Design: Are changes in the ERCOT Nodal market design necessary to accommodate or induce development of storage technologies?
	Performance/Compliance: Specific performance or compliance requirements for storage technologies are undetermined at this time.
	Cost Allocation: To be determined.
Strategy	Engage experts in storage technologies to determine best practices to apply to the ERCOT Nodal market.
Activities	ERCOT: Seek out technical experts from storage manufacturers to participate in the workshop. Schedule and develop an agenda for the Storage Workshop.
	Market Participants: Provide input to ERCOT regarding potential speakers for the Storage Workshop and participate in the workshop to ensure that Market Participants are aware of the issues related to storage technologies.
Follow-Up	Following Storage Workshop I, a new Power Storage Working Group (PSWG) was created under the Wholesale Market Subcommittee to further examine issues related to energy storage devices. PSWG may schedule a follow-up workshop to further examine potential uses of storage technology and how such technology could be developed in the ERCOT market.
Schedule	Workshop was held on April 13, 2010 at the Public Utility Commission of Texas and was well-attended.
Status	Issue closed. New, more specific issues will be opened as they are defined.

WT-08 Ancillary Services Evaluation Workshop: ERCOT to host a post Nodal Implementation Date (4-6 months) workshop focusing on the effectiveness of ancillary service products in the nodal market design. Discussion of whether additional or restructured services or ancillary products are desirable or necessary. See also MD-04 and SO-5.	
Priority	Medium
Considerations	Policy: This issue does not directly involve policy.
	Reliability: Are different or additional ancillary services needed to maintain adequate system reliability in the ERCOT Nodal Market?
	Technical: What types of new or additional ancillary services could be implemented in the ERCOT Nodal Market?
	Market Design: Are changes in the existing ERCOT Nodal Market design necessary to accommodate new, restructured, or additional ancillary services?
	Performance/Compliance: What are the appropriate performance measures and compliance requirements for any new or additional ancillary services?
	Cost Allocation: This issue does not seem to directly involve cost allocation.
Strategy	Examine various system reliability measures and indices resulting from the early operation of the ERCOT Nodal Market (at least 4-6 months) and explore whether system reliability can be improved under the Nodal Market design by restructuring or creating additional ancillary services.
Activities	ERCOT: Provide relevant statistics for the first few months of operation of the ERCOT Nodal Market and schedule a workshop to review such statistics and seek input from interested parties as to possible new or additional ancillary services that could be implemented. Invite speakers from other ISOs that utilize an LMP market to see what other markets may be doing or planning in regard to ancillary services.
	Market Participants: Review statistics and provide input to ERCOT regarding potential topics and speakers for the workshop. Actively participate in the workshop.
Follow-Up	None at this time.
Schedule	To be determined (at least 6 months after TNMID).
Status	Open.

WT-09 Storage Workshop II: Follow-up workshop to Storage Workshop I in light of the work of the PSWG and after experience with the nodal market. The workshop may focus on existing market rules and how those rules might impact particular storage technologies. Target audience: manufacturers, developers, operators, other ISOs that have storage.	
Priority	Medium
Considerations	Policy: Should energy storage be developed in the ERCOT market to enhance system operations and reliability with large penetrations of variable renewable resources? If so, what policy changes are necessary to provide the proper financial incentives to ensure that storage technologies are developed?
	Reliability: Do storage technologies improve system reliability? If so, how much and are there other reliability considerations?
	Technical: What are the technical capabilities of various storage technologies to provide ancillary services, voltage support, frequency response and local transmission congestion management?
	Market Design: Are changes in the ERCOT Nodal market design necessary to accommodate or induce development of storage technologies?
	Performance/Compliance: Specific performance or compliance requirements for storage technologies are undetermined at this time.
	Cost Allocation: To be determined.
Strategy	Engage experts in storage technologies to determine best practices to apply to the ERCOT Nodal market.
Activities	ERCOT: Seek out technical experts from storage manufacturers to participate in the workshop. Schedule and develop an agenda for the Storage Workshop.
	Market Participants: Provide input to ERCOT regarding potential speakers for the Storage Workshop and participate in the workshop to ensure that Market Participants are aware of the issues related to storage technologies.
Follow-Up	None at this time.
Schedule	The workshop should be scheduled after TNMID (Second Quarter 2011 at the earliest).
Status	Open.

WT-10 Periodic Renewable Resource Seminar: ERCOT to host a periodic seminar to identify a means of engaging or learning from other ISOs' experience operating with renewable resources.	
Priority	Medium
Considerations	Policy: This issue does not directly impact policy.
	Reliability: How do renewable resources impact system operations and reliability in other areas of the country?
	Technical: What technical requirements are various renewable resource technologies required to meet in other ISO's?
	Market Design: What market designs are being used in areas with large penetrations of renewable technologies? What changes in those market designs have been made to accommodate higher penetrations of renewable technologies?
	Performance/Compliance: What performance or compliance issues have occurred in other areas with large penetrations of renewable resources?
	Cost Allocation: Are costs allocated differently for areas with large penetrations of renewable resources?
Strategy	Coordinate with other ISOs and NERC to engage experts in systems operations and reliability, particularly those areas where renewable resources are in operation, to share their experiences and knowledge gained with operating renewable resources in a large power grid.
Activities	ERCOT: Seek out knowledgeable experts on system operations and reliability from other ISOs and from NERC to participate in the seminar.
	Market Participants: Provide input and suggestions to ERCOT regarding potential participants in the seminar and actively participate in the seminar.
Follow-Up	None at this time.
Schedule	Periodic workshops, beginning in late 2011 to early 2012.
Status	Open.

WT-11 Wind Ramp Simulator: Develop Wind Ramp Rate Simulator for Operator Training. ERCOT has developed a Wind Ramp tool that provides ERCOT Operators with a forecast of the potential for a wind ramp event in future time periods. In order to better train ERCOT Operators, ERCOT should develop a simulation tool that could be included in the normal ERCOT Operator training program to provide Operators with a better understanding of the Wind ramp events and how best to manage system resources during such events.	
Priority	Medium
Considerations	Policy: This issue does not directly involve policy, although ERCOT management and the Board will likely wish to consider whether development of such a tool is a cost-effective dedication of ERCOT resources.
	Reliability: Improved system reliability when ERCOT operators are better able to anticipate and react to wind ramp events.
	Technical: How does a wind ramp simulator work and how can it be added to the existing Operator training program?
	Market Design: This issue does not directly involve market design.
	Performance/Compliance: None.
	Cost Allocation: This issue does not directly involve cost allocation.
Strategy	Seek out experts in simulation/training systems and work with them to develop a training module to simulate wind ramp events.
Activities	ERCOT: Develop a project scope and issue a Request for Proposal (RFP) to solicit bids from recognized experts in simulation/training to develop a training program to simulate wind ramp events.
	Market Participants: Assist ERCOT with development of the project scope and the RFP.
Follow-Up	None at this time.
Schedule	Sometime in 2012.
Status	Open.

4. Summary Tables

4.1. ETIP Goals

1. Process	Improve the stakeholder processes for identifying, organizing, deliberating, resolving, and tracking issues of importance regarding the integration of emerging technologies into the ERCOT system.
2. Awareness	Increase ERCOT and stakeholder awareness of emerging technologies which may impact ERCOT functions or ERCOT market functionality.
3. Education	Increase ERCOT and stakeholder education on those technical issues related to emerging technologies which are anticipated to have meaningful impact on ERCOT functions or ERCOT market functionality.
4. Preparedness	Ensure ERCOT is sufficiently prepared to resolve integration challenges associated with emerging technologies.
5. Communication	Provide timely and effective communication to policy makers, decision makers, and stakeholders regarding the issues arising from the integration of emerging technologies and the progress and effectiveness of strategies to resolve such issues.

4.2. ETIP Recommendations

1.	Revise and expand the scope of and rename the Renewable Technologies Working Group.
2.	Place the new Emerging Technologies Working Group under the Wholesale Market Subcommittee.
3.	Improve the Emerging Technologies issues tracking system.
4.	Provide ERCOT Staff support for Emerging Technologies Working Group activities.

4.3. WGR/CREZ-related Revision Requests March 2008-October 2010

RR	Title	Status
PRR 763	Use of WGRPP as Planned Operating Level in Day-Ahead Resource Plan for WGRs	Approved
PRR 771	Ramp Rate Limitation of 10% per minute of On-Line Installed Capability for WGRs	Approved
PRR 773	Setting the LSL Requirement for WGRs	Approved
PRR 777	WGR QSE Metric Correction	Approved
PRR 778	Ramp Rate Limits for Existing WGRs	Approved
PRR 793	WGR QSE Scheduling Metric	Approved
PRR 794	Meteorological Data Required from QSEs Representing Wind-powered Generation Resources	Approved
PRR 800	QSE Day Ahead Metric	Approved
PRR 810	Remove McCamey Congestion Management	Approved
PRR 811	Real Time Production Potential	Approved
PRR 812	Wind Generator Forecast Scheduling	Approved
PRR 824	Primary Frequency Response from WGRs	Approved
PRR 828	Remove QSE SCE Performance Exemption for QSEs with only Uncontrollable Renewable Resources On-Line	Rejected
PRR 830	Reactive Power Capability Requirement	Approved (Appeal pending before PUCT)
PRR 833	Primary Frequency Response Requirement from Existing WGRs	Approved
PRR 835	Reactive Capability Requirement	Rejected
PRR 841	Revise Total ERCOT Wind Power Forecast	Approved
OGRR 208	Voltage Ride-Through Requirement	Approved
OGRR 223	Real Time Production Potential	Approved
OGRR 226	Generation Resource Response Time Requirement	Approved

OGRR 237	Clarify WGR Voltage Ride-Through Requirement	Approved
OGRR 238	WGR Primary Frequency Response	Approved
OGRR 240	CREZ Facility Protection and Control Requirements	Approved
NPRR 159	Resource Category Startup Offer Generic Cap for WGRs	Approved
NPRR 195	Removal of McCamey Congestion from Nodal Protocols	Approved
NPRR 210	Wind Forecasting Change to P50	Approved
NPRR 214	WGR HSL Update Process	Approved
NPRR 239	Ramp Rate Limitation of 10% per minute for WGRs	Approved
NOGRR 043	Synchronization with OGRR 208, VRT Requirement	Approved
NOGRR 048	Synchronization with OGRR 240, CREZ Facility Protection	Pending

Total Revision Requests filed	30
Total approved	27
Total rejected	2
Total pending	1
Subtotal zonal RRs filed	23
Zonal approved	21
Zonal rejected	2
Zonal pending	0
Subtotal Nodal RRs filed	7
Nodal approved	6
Nodal rejected	0
Nodal pending	1

4.4. Emerging Technologies Issues Grouped by Category and Status

Category	Total	Open	Closed
System Planning	13	10	3
System Operations	35	12	21
Market Design	13	5	8
Workshop / Training	11	8	3
Total Issues	72*	35	34

* Three issues are neither Open nor Closed as they were inadvertant duplicates of other issues or merged into other issues but their place in the list was retained to avoid confusion over Issue numbering.

4.5. Open Issues Grouped by Priority and Category

High Priority – 11 Open Issues				
SP-02	Wind Turbine Computer Models			
SP-03	Wind Turbine Fault Tolerance			
SP-07	Voltage Control Process			
SP-08	Voltage Ride-Through Study			
SP-11	Sub-synchronous Interactions			
SO-16	Wind Generation Ramp Limits			
SO-25	Generator Governor Response for Wind Generators			
SO-29	Transmission Outage Planning for CREZ			
SO-35	Operational Checklist for Resource Interconnection			
MD-01	Ancillary Services Cost Allocation Applicable to Wind			
MD-04	New Ancillary Services Products Needed for Reliability			
Subtotals	SP: 5	SO: 4	MD: 2	WT: 0

Medium Priority – 14 Open Issues				
SP-05	Impact of Wind Turbines on System Inertia			
SP-09	Wind Turbine Dynamic Model Validation			
SP-10	DOE Long-Term Planning Study			
SO-06	Testing Reactive Capability of Wind Generation			
SO-10	Voltage Management Practices Applicable to Wind Generators			
SO-34	SCED Line Ratings			
MD-07	Wind Generation Resources Providing Ancillary Services			
MD-10	Wind Generation Performance Metrics in the Nodal Protocols			
WT-05	Wind Workshop IV			
WT-06	Solar Workshop			
WT-08	Ancillary Services Evaluation Workshop			
WT-09	Storage Workshop II			
WT-10	Periodic Renewable Resources Seminar			
WT-11	Develop Wind Ramp Rate Simulator for Operator Training			
Subtotals	SP: 3	SO: 3	MD: 2	WT: 6

Low Priority – 8 Open Issues				
SP-13	Monitor Technologies That Impact Load			
SO-04	Smart Grid Implications for Renewable Resources			
SO-05	Operational Studies Related to Wind Generation			
SO-24	Settlement of Advanced Meters in the Nodal Market			
SO-26	Impact of Solar Generation on System Operations			
MD-11	Wind Generation and Base Point Deviation in the Nodal Protocols			
WT-01	Resource Plan and Schedule Update Process			
WT-03	Wind Turbine Operator Training			
Subtotals	SP: 1	SO: 4	MD: 1	WT: 2

Open Issues with No Priority – 1 issue	
SO-30	Application of Wind Generation to PASA

4.6. Closed Issues Grouped by Priority and Category

High Priority – 12 Closed Issues				
SP-01	Verify Wind Turbine Technical Data			
SO-12	Low-Voltage Ride-Through for Wind Generators			
SO-13	Performance Metrics for Wind Generation			
SO-21	Evaluate Emergency Electric Curtailment Plan Steps			
MD-02	Ancillary Services Procurement Optimization for 2009			
MD-03	Non-Spinning Reserve Service Requirements			
MD-08	Reactive and Voltage Requirements Applicable to Wind Generators			
MD-09	Wind Generation Dispatch in the Nodal Protocols			
MD-12	Wind Generation Resource LSL as a Percentage of HSL			
MD-13	Use of State of the Art Wind Forecast			
WT-02	Wind Workshop III			
WT-04	Wind in the Nodal Market			
Subtotals	SP: 1	SO: 3	MD: 6	WT: 2

Medium Priority – 11 Closed Issues				
SP-04	Voltage Transient and Small Signal Stability Study			
SO-01	Inventory of WInd Generation Facilities			
SO-02	Nodal Tools to Integrate Wind Generation			
SO-03	Wind-powered Generation Response to Down Balancing Instructions			
SO-07	Wind Generation and High System Frequency			
SO-08	Wind Generation and System Inertia			
SO-14	Impact of Transmission Outage Planning on Wind Generation			
SO-15	Communications Between WGRs and TSPs			
SO-17	Mid-Term and Short-Term Load Forecast Weather Sensitivity			
MD-05	Benefits of Storage Technologies			
WT-07	Energy Storage Workshop			
Subtotals	SP: 1	SO: 8	MD: 1	WT: 1

Low Priority – 8 Closed Issues				
SP-06	Use of Variable Frequency Transformers to Solve Stability Problems			
SO-09	SCADA Control of Generation Circuit Breakers			
SO-11	Technology-Specific Procedures and Protocols Changes			
SO-20	Dynamic Transmission Line Ratings			
SO-28	SPS Actuation for N-0 Conditions			
SO-31	Tension Monitors on Transmission Lines			
SO-32	Real-Time Wind Generation Capacity			
SO-33	Real-Time Wind Turbine Availability			
Subtotals	SP: 1	SO: 7	MD: 0	WT: 0

Closed Issues with No Priority – 5 Issues				
SO-18	Evaluate Transmission Line and Wind Power Production Outage Criteria			
SO-19	Improve Commercially Significant Constraint Process			
SO-22	Open			
SO-23	Impact of Advanced Meters on Integration of Renewable Resources			
MD-06	Ancillary Services Procurement Methodology			
Subtotals	SP: 0	SO: 4	MD: 1	WT: 0

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6. Appendices

6.1. Proposed Emerging Technologies Issue Submission Form

6.2. Proposed Emerging Technologies Issue Comment Form

Appendix 6.1. Emerging Technologies Issue Submission Form (draft)

ETIP Number	XX-XX	**Issue Title**	Instructions: Replace this text with a short title for proposed issue
Date Posted			

Short Description of Proposed Emerging Technology Issue	Instructions: Replace this text with a brief (one or two sentence) description of the proposed issue.	
Proposed Priority (High, Medium, or Low)	Instructions: Replace this text with proposed priority for proposed issue (High, Medium, or Low). High priority items are typically those which present immediate challenges to the ERCOT market or ERCOT system reliability or require near-term action by ERCOT or Market Participants. Medium priority items are those which	
Proposed ETIP Classification (SO, SP, MD, or WT)	Instructions: Replace this text with proposed classification for proposed issue. Classifications are System Operations (SO), System Planning (SP), Market Design (MD), or Workshops/Training (WT). Provide supporting statement for proposed classification if desired. Upon acceptance of the proposed issue, the ETWG will assign a classification and issue tracking number.	
Considerations	Policy	Instructions: Replace this text with statement of policy considerations related to proposed issue. "N/A" is an acceptable entry if there are no relevant policy considerations.
	Reliability	Instructions: Replace this text with statement of reliability considerations related to proposed issue. "N/A" is an acceptable entry if there are no relevant reliability considerations.
	Technical	Instructions: Replace this text with statement of technical considerations related to proposed issue. "N/A" is an acceptable entry if there are no relevant technical considerations.
	Market Design	Instructions: Replace this text with statement of market design considerations related to proposed issue. "N/A" is an acceptable entry if there are no relevant market design considerations.
	Performance / Compliance	Instructions: Replace this text with statement of performance or compliance considerations related to proposed issue. "N/A" is an acceptable entry if there are no relevant performance or compliance considerations.
	Cost Allocation	Instructions: Replace this text with statement of cost allocation considerations related to proposed issue. "N/A" is an acceptable entry if there are no relevant cost allocation considerations.

	ERCOT Resources	Instructions: Replace this text with statement of ERCOT resource considerations related to proposed issue. “N/A” is an acceptable entry if there are no relevant ERCOT resource considerations.

Sponsor	
Name	
E-mail Address	
Company	
Phone Number	
Cell Number	
Market Segment	

Market Rules Staff Contact	
Name	
E-Mail Address	
Phone Number	

Full Description of Proposed Emerging Technology Issue

Instructions:

Replace this text with a full description of the proposed emerging technology issue. Clearly state the nature of the issue to be addressed, whether it is currently being addressed in the ERCOT stakeholder process or another relevant process, and why the issue merits the application of ERCOT and/or stakeholder resources. Provide as much detail as possible to enable full discussion of the issue. For ease of consideration, please adhere to the style of the ERCOT Revision Request and Comment Submission Guidelines, which can be accessed at the following link:

http://www.ercot.com/mktrules/protocols/prr_process

Please remember the following:

- When referencing Protocol or Guide language, use the most current version. Current versions are available on the ERCOT website.
- When proposing Protocol or Guide revisions, show original Protocol or Guide baseline language in black.
- Present the entire titled Section or subsection as the baseline, not just the paragraph(s) subject to revision.
- Make all revisions in redlined format, using the “Track Changes” feature. Be sure to change the user/author name to the appropriate individual or company name. Do not show revisions by changing font color or font strikethrough.
- Use the “Comment” feature when inserting non-Protocol language comments (like questions) into Protocol language.
- Ensure that proposed changes are reflected in both boxed and unboxed Sections, if appropriate.

Appendix 6.2. Emerging Technologies Issue Comment Form (draft)

ETIP Number		**Issue Title**	

Date	

Submitter's Information	
Name	
E-mail Address	
Company	
Phone Number	
Cell Number	
Market Segment	

Comments

Insert comments here.