Evolution of Grid Code Requirements
并网导则要求的进展

Renewable Energy Integration:
可再生能源接入
International Experiences and Implications for China
国际经验和对中国的启示

Beijing, China
December 2010
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Utility Wind Integration Group

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Outline of Topics
主要内容

- Background
  背景
- Evolution of US Grid Code Activities
  美国并网导则的发展历程
- Current Activities in NERC IVGTF
  北美电力可靠性委员会波动电源接入工作组的当前活动
- Summary of Wind Interconnection Best Practices
  风电并网最佳工程实践综述

Alphabet Soup
字母缩写表

DOE: Department of Energy 能源部
NREL: National Renewable Energy Laboratory 国家可再生能源实验室
EPRI: Electric Power Research Institute 电力科学研究院
FERC: Federal Energy Regulatory Commission 联邦能源管理委员会
NERC: North American Electric Reliability Council 北美电力可靠性协会
AWEA: American Wind Energy Association 美国风能协会
UWIG: Utility Wind Integration Group 公用风电接入组织
IEEE: Institute of Electrical and Electronics Engineers 电气与电子工程师协会
PES: Power Engineering Society 电力工程学会
ERO: Electric Reliability Organization 电力可靠性组织
WECC: Western Electricity Coordinating Council 西部电力协调委员会
MISO: Midwest Independent System Operator 中西部独立系统运营商
MRO: Midwest Reliability Organization 中西部地区可靠性组织
CANWEA: Canadian Wind Energy Association 加拿大风能协会
POI: Point of interconnection 并网点
LVRT: Low Voltage Ride Thru 低电压穿越

Wind Plant Interconnection History
风电场并网的发展史

Early (1980's into 1990's)
- Wind generation viewed as "curiosity"
- Special care taken to design and protect grid interface
- Preferred action for turbines during grid disturbance was to disconnect
- "California thing"

Mid 1990's
- Development of large wind generation facilities outside of California
- Increasing plant sizes crossed threshold for interconnection evaluations
- Control area penetration still negligible, so studies were many times more of a formality

2000 to present
- Continued growth of wind generation led to questions that could no longer be prudently neglected
  - » West Texas voltage and transmission capacity questions
  - » Growing awareness of wind plant sensitivity to grid disturbances, and possible consequences (with further growth)
- Recognition of need to treat wind generation more like conventional power plants

初期（80年代至90年代）
- 风电被认为是一个新鲜事物。
- 非常重视电网接入的设计和保护。
- 电网发生扰动故障时倾向于选择切风机
- “加州大停电事件”

90年代中期
- 加州之外建了大量风电场。
- 不断增加的风电场容量，超过了联网评估得出的限值。
- 控制区域风电并网容量仍可以忽略不计，因此相关研究更大程度上只是一个形式。

2000年至今
- 风电规模的持续扩大使得以下问题不能再忽视：
  - » 西德克萨斯州的电压和输电容量问题
  - » 越来越清晰的意识到风电场对电网扰动的敏感性及可能产生的后果（随着风电容量的进一步增长）。
- 意识到需要把风力发电看作常规电厂。

Energy Policy Act of 2005
2005年能源政策法案

Required mandatory and enforceable electric system reliability standards

Electric Reliability Organization (ERO) was required to be established to administer the standards

FERC has oversight of the ERO

NERC was certified as ERO in August 06

NERC Version 0 reliability standards (91 standards for planning and operation) adopted by FERC

Previous to EPACT 05, NERC was a voluntary industry organization

Ongoing tension between NERC and FERC

要求制定具有强制性和可实施性的电力系统可靠性标准

要求成立电力可靠性组织来管理相关标准

FERC（联邦能源管理委员会）负责监管ERO（电力可靠性组织）

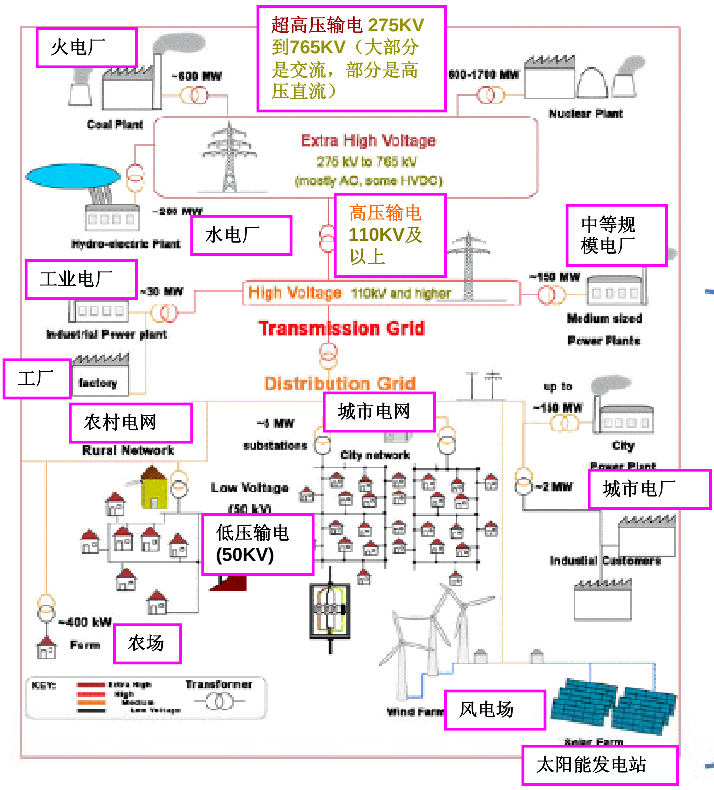
NERC（北美电力可靠性委员会）于8月6日被认定为ERO（电力可靠性组织）

联邦能源管理委员会通过了NERC（北美电力可靠性委员会）第0版可靠性标准（含有关规划和运行的91条标准）

在2005能源政策法案颁布之前， NERC（北美电力可靠性委员会）为自发性工业组织。

NERC（北美电力可靠性协会）和FERC（联邦能源管理委员会）之间气氛紧张。

Interconnection Standards and Requirements for ‘Variable’ Generation
“波动性”电源的并网标准和要求

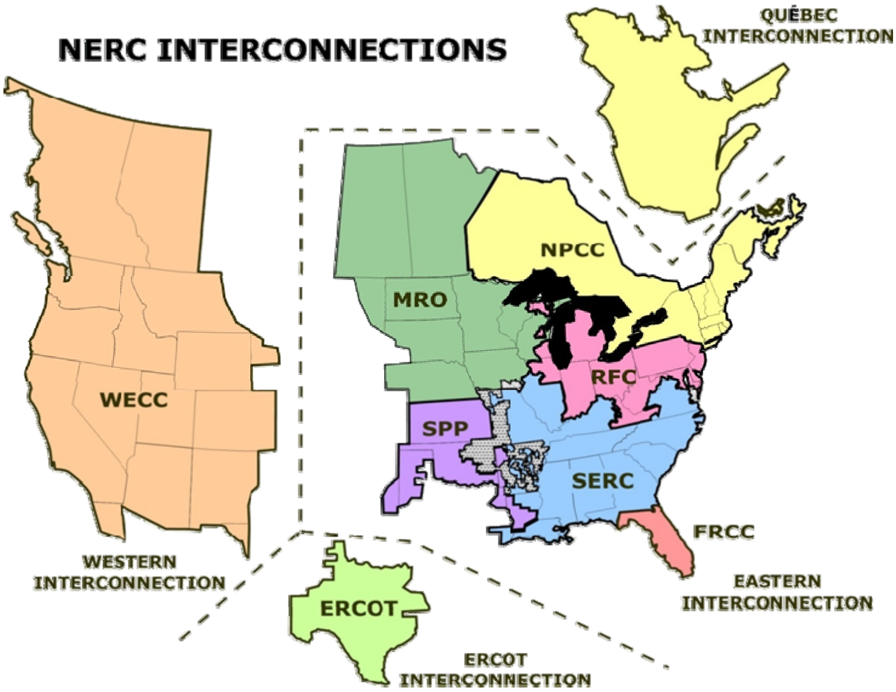


大系统相关导则
Bulk System Guidelines
NERC, FERC
IEEE, ANSI, IEC
NESC

在技术上和管辖范围上存在大量重叠，混乱，矛盾…
Plenty of technical and jurisdictional overlap, confusion, contradiction…

配电系统相关导则
Distribution System Guidelines
IEEE 1547, PUC/PRC
IEEE, ANSI, IEC
NEC

North American Interconnections
北美互联电网



FERC Grid Code Chronology
FERC并网导则时间表

July 2003: FERC Order 2003

March 04: FERC Order 2003 – A

September 04: Grid Code Technical Conference

July 2005: FERC Order 661

July 2005: NERC Request for Rehearing

December 2005: FERC Order 661 – A

2003年7月：FERC 条例2003

2004年3月：FERC条例2003-A

2004年9月：并网导则技术讨论会

2005年7月：FERC条例661

2005年7月：NERC要求复审

2005年12月：FERC条例661-A出台

FERC Order 2003
FERC条例2003

FERC Order on Large Generator Interconnection

- Issued in July 2003
- Addressed lack of uniformity in interconnection procedures for generators larger than 20 MW
- Large Generator Interconnection Procedure
- Large Generator Interconnection Agreement
- No distinction between interconnection requirements for synchronous and induction machine or those with power electronic converters

关于大型发电机组并网的FERC条例

- 2003年7月实施。
- 其颁布是为了解决容量大于20MW的机组并网过程中缺乏统一标准的问题。
- 大容量机组并网过程 。
- 大容量机组并网协议 。
- 对于同步发电机、异步发电机以及带有电力电子换流器的发电机，其并网要求没有不同。

FERC Order 2003 – A
FERC条例2003-A

Amendment to FERC Order 2003

Issued in March 2004

Result of stakeholder comments

Recognized that electrical machine technology differences affected interconnection requirements

Included Appendix G – blank sheet of paper to accommodate unique concerns of wind plant developers

FERC条例2003修正案。

2004年3月颁布实施。

各利益相关方意见结果。

认识到发电机技术的差异会影响并网要求。

含附录G-文件的空白表格用于记录风电场开发商关心的特殊问题。

FERC Order 661
FERC条例661

Addresses technical requirements for interconnection left open in Appendix G

针对附录G中未作明确规定的部分提出并网技术要求。

AWEA filed Petition for Rulemaking in May 2004 covering basic elements of grid code for wind plants

AWEA于2004年5月提交规章制定申请，内容涵盖风电场并网导则的基本内容。

FERC held Technical Conference in Sept. 2004

2004年9月，FERC举办技术大会。

Order issued in July 2005

2005年7月条例颁布实施

Order 661 Provisions
条例661中的相关规定

LVRT 低电压穿越

- Generator stays on line for up to .625 sec during a voltage dip as low as .15 pu at the POI, if needed for safety or reliability

  当并网点电压跌至0.15 p.u 时，为了保证电网的安全性和可靠性，发电机应保持并网至少0.625s。

Reactive power 无功功率

- Provide power factor of +/- .95, and dynamic voltage support, if needed for safety or reliability

  为了保证电网的安全性和可靠性，功率因数应在+/- 0.95范围内可调，并提供动态电压支撑。

SCADA 数据采集与监视控制系统

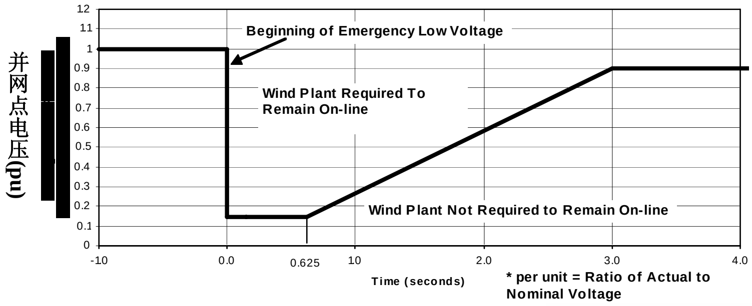
- Provide necessary information, as agreed with transmission provider

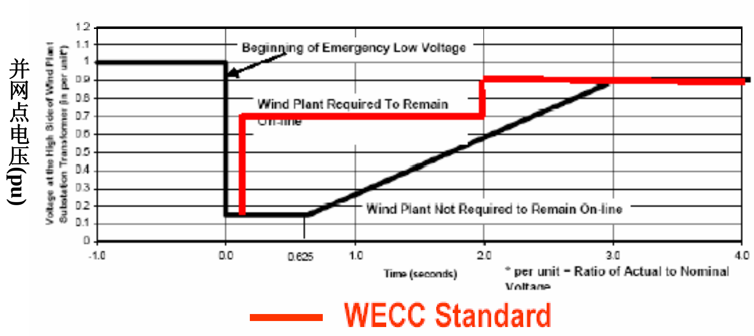
  根据与输电网运营商之间的协议，提供必要的信息。

FERC Order 661 and WECC LVRT Standards
FERC条例661和WECC低电压穿越标准

Minimum Required Wind Plant Response to Emergency Low Voltage

对风电场在电压突然跌落时的最低要求响应





Reference: Zavadil *et al*, IEEE Power & Energy Magazine, November/December 2005
To be published

FERC Order 661 – A
FERC条例661-A

NERC immediately filed Request for Rehearing in July 2005

NERC于2005年7月 立即提出复审请求。

FERC ordered NERC and AWEA to resolve their differences and report back to FERC

FERC要求NERC和AWEA负责解决这些分歧问题，并将结果汇报给FERC。

Order issued in December 2005 as amendment to FERC Order 661 refining the provisions of the original order

该条例对原条例中的条款进行了改善，并于2005年12月作为FERC条例661的修订案颁布实施。

Order 661–A Provisions
条例661-A中的规定

LVRT 低电压穿越

- Generator stays on line during a 3 phase fault for normal fault clearing time up to 9 cycles and SLG faults with delayed clearing during a voltage dip as low as .15 pu at the high side of the GSU for units in service before 2008
- 2008年前，风机在故障发生最长9个周波后才能清除的三相故障时，和发生在GSU（发电机升压变）高压侧电压暂降0.15pu并且故障延迟清除的单相对地短路故障时，能够保持并网运行。
- Voltage dip requirement extends to 0.0 pu in 2008
- 至2008年，电压跌落要求扩展至0.0pu

Reactive Power 无功功率

- Provide power factor of +/- .95, including dynamic voltage support, if needed for safety and reliability
- 为了保证电网的安全性和可靠性，应具备功率因数在+/- 0.95范围内可调、并提供动态电压支撑的能力。
- Partial dissent by Chairman Kelliher over lack of mandatory requirement, ie placing burden of proof on transmission provider
- 主席Kelliher对于缺乏强制性要求的问题提出部分异议，比如需要将举证责任交给电网运营商。

SCADA

- Provide necessary information, as agreed with transmission provider
- 根据与输电网运营商之间的协议，提供必要的信息。

Evolving Grid Code Requirements
并网导则相关要求的发展

Increased power control capability

功率控制能力提高

- Output limit 出力极限
- Ramp rate limit 爬坡率极限

Voltage control capability 电压控制能力

Standard communication protocols (IEC 61400-25)

标准通讯协议（IEC 61400-25）

Governor droop characteristic 调速器下降特性

Inertial response 惯量响应

Rethinking definition of contingency necessary to activate reserves

重新考虑需要启动备用容量的突发事故的定义。

Evolution of Wind Turbine Technology
风机技术的进展

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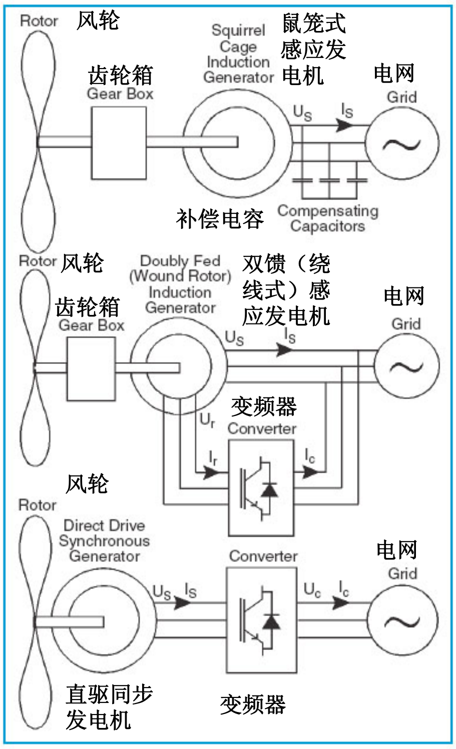
Past
过去

Present
现在

Future
将来



Source: IEEE Power & Energy Magazine

How Does Wind Plant Performance Compare?
风电场特性比较

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	Past（过去）	Present（现在）	Future（将来）
Voltage Control（电压控制）	√-	√	√+
Short Circuit Contribution（短路电流贡献）	√-	√	√+
Flicker（闪变）	√-	√	√+
Low Voltage Ride-Through（低电压穿越）	√-	√	√+
Stability Behavior（稳定性）	√-	√	√+
AGC Participation（AGC参与情况）	√-	√	√+

Turbine Technology Advances Reduce Impacts
风机技术的提升能降低不利影响

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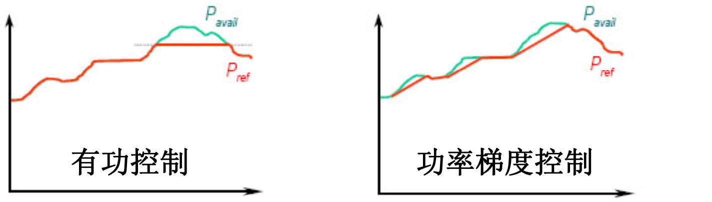
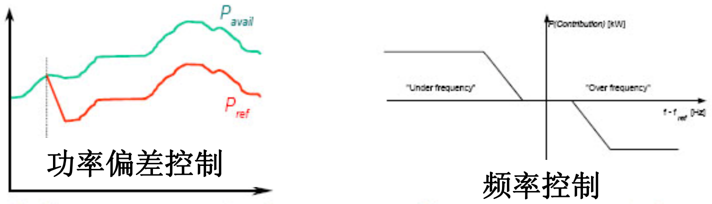
SCADA控制功能用于改善电网运行

SCADA Control Functions For Improved Grid Operations



Active power control　　Gradient power control



Delta power control　　Frequency control

Wind Plant Control Capability
风电场控制能力

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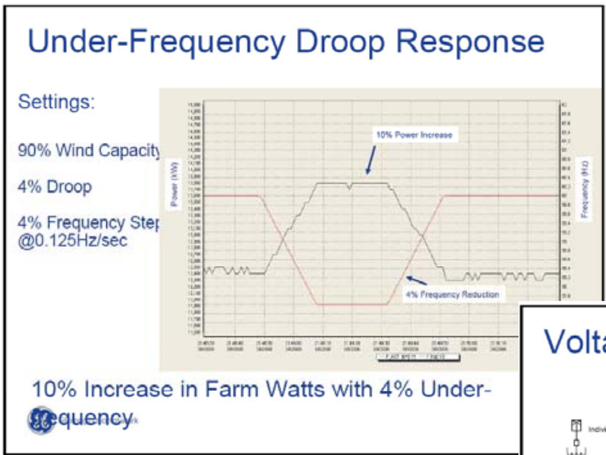
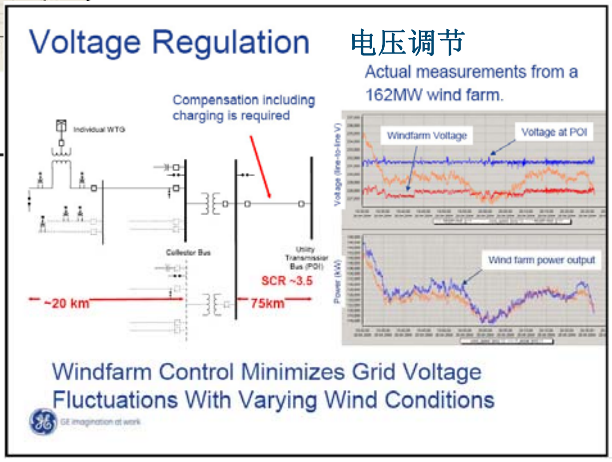


低频下垂响应



Source: GE Energy

NERC IVGTF
NERC波动电源接入工作组

"Integrating Variable Generation Task Force"

Formed in wake of NERC 2007 Long-Term Reliability Assessment

- *"Integration of wind & solar resources requires special considerations in planning, design, and operation"*

High Industry Interest

- 50 Nominations received

Liaisons being built with Industry Groups

- American Wind Energy Association (AWEA)
- Utility Wind Integration Group (UWIG)
- IEEE-PES IEEE
- EPRI
- U.S. Department of Energy

波动电源接入工作组(IVGTF)

在NERC2007年长期可靠性评估之后成立

- *风电和太阳能的接入需要在规划、设计和运行方面进行特殊考虑*

备受工业界的关注

- 收到50多个候选人提名

与工业组织建立联系

- 美国风能协会
- 公用风电接入组织
- IEEE电力与能源协会
- 电力科学研究院
- 美国能源部

IVGTF Scope
IVGTF的工作范围

The Task Force was directed to prepare:

- A concepts document that includes the philosophical and technical considerations for integrating variable resources
- Specific recommendations for practices and requirements, including reliability standards, that cover the planning, operations planning, and real-time operating timeframes.

The Task Force Report covers:

- Planning timeframe issues, such as contribution to reserve margins and modeling requirements to test system reliability,
- Operational Planning and Real-time operating timeframe issues, including Interconnection frequency, and primary and secondary generation control
- Review of NERC Standards for any gaps
- Conclusions and recommendations.

Published in April

工作小组负责准备：

- 一份概念性文档，内容包括接入波动性电源的理论和技术考虑。
- 对实践和要求的建议，包括涉及规划、运行计划和实时运行时间框架的可靠性标准。

工作小组报告涉及：

- 规划时间框架问题，例如对备用边际的贡献和对系统可靠性测试的建模要求。
- 运行计划和实时运行时间框架问题，包括并网频率和一次、二次发电控制。
- 对NERC标准的缺失进行评估。
- 结论和建议。

2009年4月出版。

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IVGTF Recommendations – 1
IVGTF建议-1

1. Power system planners must consider the impacts of variable generation in power system planning and design and develop the necessary practices and methods to maintain long-term bulk power system reliability (NERC's Planning Committee)

- 1.1. Standard, valid, generic, non-confidential, and public power flow and stability models (variable generation) are needed and must be developed, enabling planners to maintain bulk power system reliability.
- 1.2. Consistent and accurate methods are needed to calculate capacity values attributable to variable generation
- 1.3 Interconnection procedures and standards should be enhanced to address voltage and frequency ride-through, reactive and real power control, frequency and inertial response and must be applied in a consistent manner to all generation technologies.

1. 电力系统规划人员在进行电力系统规划时必须考虑波动性电源的影响，并设计和开发出必要的实践和方法来维持大系统的长期可靠性（NERC的规划委员会）。

- 1.1为保持大电力系统的可靠性，必须发展标准的、有效的、通用的、非机密性和公开的系统潮流和稳定性模型（波动性电源）。
- 1.2 需要可靠、准确的方法来计算波动性电源的容量置信度水平。
- 1.3 强化并网程序和标准，以解决电压和频率穿越能力、无功和有功控制，频率和惯量响应问题；并且统一应用于所有发电技术。

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IVGTF Recommendations – 1 (cont.)
IVGTF建议-1(续)

- 1.4. Resource adequacy and transmission planning approaches must consider needed system flexibility to accommodate the characteristics of variable resources as part of bulk power system design.
- 1.5. Integration of large amounts of plug-in hybrid electric vehicles, storage and demand response programs may provide additional resource flexibility and influence bulk power system reliability and should be considered in planning studies.
- 1.6. Probabilistic planning techniques and approaches are needed to ensure that system designs maintain bulk power system reliability.
- 1.7. Existing bulk power system voltage ride-through performance requirements and distribution system anti-islanding voltage drop-out requirements of IEEE Standard 1547 must be reconciled.
- 1.8. Variable distributed resources can have a significant impact on system operation and must be considered and included in power system planning studies.

- 1.4 资源充裕度和输电规划方法必须把接纳波动电源所需的系统灵活度看做大电力系统设计的一部分。
- 1.5 大量即插式混合动力电动汽车、储能和需求响应项目可以提供额外的资源灵活性，并影响大电力系统的可靠性；在规划研究中需要考虑这些因素。
- 1.6 为了确保系统设计能够维持大电力系统的可靠性，必须采用概率规划技术和方法。
- 1.7 已有大电力系统的低电压穿越性能要求和配电系统反孤岛电压切出要求（IEEE的1547标准）必须一致 。
- 1.8 波动的分布式电源可能会对电力系统的运行带来重大影响，因此在电力系统规划研究阶段必须加以考虑。

IVGTF Recommendations – 2
IVGTF建议-2

2. Operators will require new tools and practices, including enhanced NERC Standards to maintain bulk power system reliability (NERC's Operating Committee)

- 2.1. Forecasting techniques must be incorporated into day-to-day operational planning and real-time operations routines/practices including unit commitment and dispatch.
- 2.2. Balancing areas must have sufficient communications for monitoring and sending dispatch instructions to variable resources.
- 2.3. Impact of securing ancillary services through larger balancing areas or participation in wider-area balancing management on bulk power system reliability must be investigated.
- 2.4. Operating practices, procedures and tools will need to be enhanced and modified.

2.运营商将需要新的工具和实践，包括升级NERC标准以维持大电力系统可靠性（NERC的运行委员会）。

- 2.1 必须将预测技术运用于日间运行规划和实时运行程序/管理（包括开机安排和调度）。
- 2.2 平衡区域必须配备足够的通讯设备，以便对波动电源进行监控和发送调度指令。
- 2.3 有必要研究更大平衡区域或参与广域平衡管理的安全辅助服务对大电力系统可靠性的影响。
- 2.4 需要提高和改进运行管理、程序和工具。

IVGTF Recommendations – 3
IVGTF建议-3

3. **Planners and operators would benefit from a reference manual which describes the changes required to plan and operate the bulk power and distribution systems to accommodate large amounts of variable generation (NERC's Operating and Planning Committees)**

参考手册对规划人员和运行人员都非常有帮助。参考手册应详细说明大电力系统和配电系统在规划和运行方面需要做哪些改变，使其能够消纳大规模波动电源（NERC的运行与规划委员会）。

- 3.1. NERC should prepare a reference manual to educate bulk power and distribution system planners and operators on reliable integration of large amounts of variable generation.

  NERC应编写一份参考手册，用来对大系统和配电系统规划人员和运行人员进行大规模波动电源可靠接入培训。

Preliminary Outline of Task 1.3 Report
任务1.3 基本报告大纲

Recommendations for Interconnection of Power Plants *(recognizing technology differences of variable generation)*

Executive Summary

1. Introduction
2. Similarities and Differences between Variable Generation and Conventional Plants
3. Variable Generation Interconnection Requirements

3.1. Voltage and Reactive Power Capabilities

3.2. Performance During and After Disturbances

3.3. Active Power Control Capabilities

电厂并网建议（*波动性电源的技术差异认识*）

执行摘要

1. 引言

2. 波动电源与常规电厂之间的相同点和不同点

3. 波动电源并网要求

3.1. 电压和无功功率能力

3.2. 故障期间和故障后的特性

3.3. 有功控制能力

Task 1.3 Preliminary Report Outline cont.
任务1.3 基本报告大纲

3.4. Other Issues (PQ, control/resonance interactions, etc)

3.5. Models for Facility Connection Studies

3.5.1. Discussion of Generator Unit/Facility Size Applicability

3.5.2. NERC Standard FAC-001-0 Modifications

3.5.3. Review of Utility Facility Connection Requirements or Grid Codes

3.5.4. Summary of Facility Connection Model Grid Code Requirements

3.6. Communication Between Plants and Grid Operators

4. Distribution Connected Variable Generation

4.1. Reference **ongoing activities** in Task 1.7 and 1.8

5. Summary & Recommended Actions – Standards Implications

3.4. 其它问题(PQ、控制/谐振相互影响等)

3.5. 用于设备连接研究的模型

3.5.1. 关于发电机组或设备型号适用性的讨论

3.5.2. NERC标准FAC-001-0修改

3.5.3. 公共设备连接要求或并网导则的综述

3.5.4. 设备连接模型并网导则要求的总结

3.6. 风电场和电网运营商之间的通信

4. 分布接入的波动电源

4.1. 参考任务1.7和1.8中的正在进行的活动

5. 总结和建议-标准的启示

Emerging Best Practices on Interconnection Requirements
并网要求最佳实例

Proven technology, already implemented internationally
- Voltage regulation at the Point-of-Interconnection, with a guaranteed power factor range
- Low voltage ride
- A specified level of monitoring, metering, and event recording
- Power curtailment capability
- Wind plant forecasting capability

Features emerging in response to system needs
- Ability to set power ramp rates
- Zero-power voltage regulation
- Reserve functions
- Governor functions
- Inertial response functions

被验证的技术，在国际上得到应用
- 并网点电压调节，采用确保的功率因数范围
- 低电压穿越
- 监测、计量和事件记录的指定水平
- 减出力能力
- 风电场功率预测能力

系统需求响应的特性
- 设置爬坡率的能力
- 零功率电压调节
- 备用功能
- 调速器功能
- 惯量响应功能

Grid Code Summary
并网导则综述

Wind plant terminal behavior is different from conventional machines, but compatible and improving

风电场并网点特性不同于常规电源，但是具有兼容性并可以改善。

Better dynamic models of wind turbines required for system studies

电力系统研究需要更好的风电机组动态模型。

Increased demands will be placed on wind plant performance (LVRT, reactive control, output and ramp rate control, inertial and governor response)

将对风电场特性提出更高要求（低电压穿越、无功控制、输出和爬坡率控制、惯量和调速响应）。

System reliability can be enhanced by wind plants

风电场可以提高系统的可靠性。

Wind Turbine Modeling Initiative … as time permits
风电机组建模的发起…

Wind generation is no longer “invisible” 风电不再是“可忽略”的

- US has more than 36 GW of wind generation capacity installed
  美国的风电装机容量超过36GW。
- Some areas are experiencing high saturation levels 某些地区风电容量到了饱和水平。
- Significant expansion expected in the near future
  未来需要大规模的扩建。

Adequate simulation models are indispensable 恰当的仿真模型必不可少。

- Identify and address impact of new generator additions 确定和解决新型发电机的影响
- Perform planning studies to maintain system reliability at the local and regional level
  进行规划研究，以维持当地和区域系统的可靠性

The status quo is not acceptable 不可以维持现状

- One-of-a-kind and proprietary models are incompatible with the current system modeling practice
- 单一和专用模型与当前系统建模活动相矛盾。
- Difficult and confusing for users 对用户来说有困难和困惑
- Cannot be maintained in base cases once plant is built
  一旦风电场建成，现有的方案无法维持。

Wind Turbine Modeling
风电机组建模

WECC Wind Generator Modeling Group WECC风机建模小组

Mission 任务

- Develop a set of generic (non-vendor specific), non-proprietary, positive-sequence power flow and dynamic models suitable for representation of the major commercial, utility-scale WTG technologies
- 开发一系列通用的（不针对某一制造商）、非专有的、正序潮流和动态模型，适用于模拟主要的商业化的、适用于规模开发的风电机组。
- Develop a set of best practices to represent wind plants using generic models as basic building blocks
- 用通用的风机模型作为基本构建模块，开发系列很好的用于实际工程的风电场模型

Model types based on characteristics of grid interface 基于电网接口特性的模型类型

- Type A – conventional induction generator 类型1-常规感应发电机
- Type B – wound rotor induction generator with variable rotor resistance
  类型2-可变转子电阻的绕线式感应发电机
- Type C – doubly-fed induction generator 类型3-双馈感应发电机
- Type D – full converter interface 类型4-带有全额变频器的感应发电机

Model validation important requirement 模型验证的重要要求

Working with IEEE, AWEA, UWIG, and industry

与电气与电子工程师协会、美国风能协会、公用风电接入组织和工业界合作

Proposed standard models
建议的标准模型

Based on characteristics of grid interface 基于电网接口特性

- Type A – conventional induction generator 类型1-常规感应发电机
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- 类型2-可变转子电阻的绕线式感应发电机
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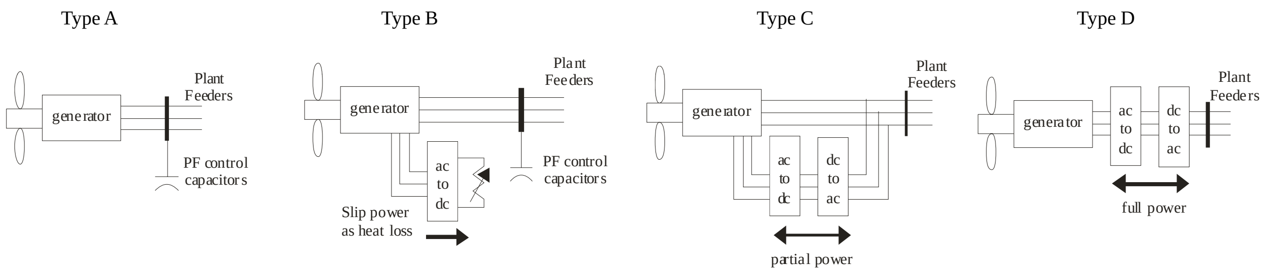

Turbine Modeling Status
风机建模现状

Generic model implementation 通用模型的应用

underway in PSS/E, PSLF 正用于PSS/E, PSLF

- Phase 1 completion in Q1 ’08 08年第一季度，完成第一期。

CEC validation project completed in 2009

CEC的验证项目在2009年完成

- Directed by NREL 由国家可再生能源实验室指导完成
- Objective was to validate generic models 目的是验证通用模型(的有效性)
- Existing measurement data used 使用了现有的测量数据
- Field testing conducted as part of parallel effort 现场进行了测试

WECC initiative expanding 西部电力协调委员会提倡推广

- MRO utilizing WECC efforts as basis
- MRO利用西部电力协调委员会已取得成就
- IEEE PES Wind Generation Modeling TF
  电气与电子工程师协会电力与能源协会风力发电模型工作组

UWIG Modeling Initiative
UWIG 提出的建模

Builds off ongoing activities in Modeling & Interconnection UG
在建模与并网活动基础上继续进行，

Received DOE grant in June 2009　2009年6月获得美国能源部资助

"Documentation, User Support, and Verification of Wind Turbine and Plant Models"
"文件、用户支持、风电机组及风电场模型验证"

Objective is to further the development and use of generic and vendor-specific wind turbine models
目的是进一步深化通用与厂商特定风机模型的开发与利用；

Multi-party project　多方参与项目

– EnerNex is prime contractor　EnerNex 是主承包商
– GE (PSLF) and Siemens PTI (PSS/E) are major subcontractors
  通用电气公司（PSLF）和西门子PTI （PSS / E）是主要分包商
– Turbine vendors will be formally engaged to solicit participation
  风机制造商将要正式加入
– Formal TRC　正式的TRC

For More Information
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