Wind Power Integration Projects and the Grid Code in China

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1. The Status of wind power in China

Status of Wind Power Installed Capacity in China

year	2001	2002	2003	2004	2005	2006
The Total Installed Capacity（MW）	338,490	356,570	391,410	440,000	500,000	600,000
The Total Wind Power Installed Capacity（MW）	401.7	445.0	568.4	763.8	1260.0	2560.0
The Proportion of Wind Power Capacity（%）	0.119	0.125	0.145	0.174	0.25	0.43
The World Wind Power Installed Capacity（MW）	24,000	31,000	40,300	47,317	59,004	73,904

1. The Status of wind power in China

Wind Power Development Targets by NDRC

年份 Year	2005	2010	2015	2020
装机(MW) Installed capacity	1,000	5,000	10,000	30,000

NDRC has issued many documents to make wind power development in a sustainable way. preferably the targets should be expressed in energy terms along with targets in capacity terms.

2. Wind power integration projects

In the recent 3 years, the wind power sector and utilities have put attention on integration studies, and the projects done by CEPRI are as following：

1. Study on the wind power development plan targeted for 2006 and 2010 in the Xinjiang autonomous region
2. Study on the ability of Jilin provincial grid to accommodate wind power
3. Study on the ability of Chifeng grid in Inner Mongolia Autonomous Region (IMAR) to accommodate wind power
4. Study on the ability of Tongliao grid in IMAR to accommodate wind power
5. Study on the ability of Heilongjiang provincial grid to accommodate wind power targeted for 2006 and 2010
6. Study on the ability of Beijing-Tianjin-Tangshan grid to accommodate wind power
7. Study on the ability of Ningxia provincial grid to accommodate wind power
8. Study on grid integration of Saihanba Wind Farm in IMAR

2. Wind power integration projects

9. Study on impact of Wind Farm integration on power quality of Chifeng grid in IMAR and the control measures
10. Study on grid integration of Sunjiaying and Wudaogou Wind Farms in Chifeng of IMAR(*)
11. Study of grid integration of Saihanba Wind Farm Ⅰ and Ⅱ and Dongshan Wind Farm Ⅰ in Chifeng of IMAR
12. Study of grid integration of the South Wutaohai Wind Farm in Chifeng of IMAR
13. Analysis and evaluation of the impact of connecting Dafengba Wind Farm in Yunnan Province to the grid
14. Analysis and evaluation of the impact of Zhemoshan Wind Farm in Yunnan Province on the grid
15. Study on the reactive power and stability of Dafengba and Zhemoshan wind farms in Yunnan Province when connected to the grid
16. Study on grid integration of Maanshan Wind Farm in Heilongjiang Province
17. Study on grid integration of Hengdaishan Wind Frm in Heilongjiang Province

* Voltage control equipment developed

3. Wind power grid code in China

- Technical Rule for Wind Farm integration to Power System （GB/Z 19963-2005）

  Submitted on 12 December 2005 by General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China and Standardization Administration of China

- Technical Rule for Wind Farm integration to Power System(state grid development[2006]779)

  Submitted on 15 Sept. 2006(the example in the following slides)

- Both drafted by CEPRI

3. Wind power grid code in China

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4. Wind Farm Reactive Power
5. Wind Farm Voltage
6. Wind Farm Voltage Regulation
7. Wind Farm Operating Frequency
8. Wind Farm Power Quality
9. Wind Farm Test

3. Wind power grid code in China

1. Scope

- This Document sets the technical requirements regarding power system connection of wind farm.
- This Document applies to a new wind farm or an expanded wind farm connected to transmission line or network of 110 kV(66 kV) or higher voltage levels.
- This Document can also be used as a reference for a wind farm connected into the network of other voltage levels.

3. Wind power grid code in China

2. Topics Referred to in the code

GB 12326-2000	Power Quality	Voltage Fluctuation and Flicker
GB/T14549-1993	Power Quality	Utility Network Harmonics
GB/T 12325-2003	Power Quality	Distribution Voltage Tolerance Range
GB/T15945-1995	Power Quality	Power System Frequency Tolerance Range
DL 755-2001	Guidance for Power System Security and Stability	
SD 325-2001	Technical Guidance for Power System Voltage and Reactive Power Techniques	

3. Wind power grid code in China

3. Wind Farm Active Power

- Basic Requirements

  In following conditions, the farm should control its active power output according to the grid dispatch command.

  - The network is affected by a fault or is in a special operating mode;
  - The ramp rate of wind farm output (MW/min) will probably be limited when lack of frequency regulating capacity.
  - The wind farm will probably be required to reduce its active power output when the system frequency is too high.

3. Wind power grid code in China

- Recommended Values of Wind Farm Maximum Power Ramp Rate

Wind Farm Installation Capacity (MW)	10 min Maximum Ramp (MW)	1 min Maximum Ramp (MW)
<30	20	6
30-150	Installation Capacity/1.5	Installation Capacity/5
>150	100	30

- Emergency Disconnection

In emergency faulty condition, the network operator has the authority to temporarily disconnect the wind farm from the grid. Grid connection of the wind farm should be restored as soon as the emergency fault has been fully handled.

3. Wind power grid code in China

4. Wind Farm Reactive Power

- The range and speed of reactive power regulation, which depends on the wind turbine generator system characteristic, grid configuration and feature, should satisfy the requirement of voltage regulation at the connection point.
- Reactive power sources in a wind power plant include wind turbines and reactive power compensation. If the wind farm ’ s reactive power ability can not satisfy the needs of system voltage regulation, reactive power compensation in a wind farm must be considered.
- Reactive power compensation in a wind farm can use capacitor and reactor banks switched in groups. When necessary, static reactive power compensators or other advanced facilities with continuous regulation capability shall be used.

3. Wind power grid code in China

5. Wind Farm Voltage

- The wind farm should be able to operate normally when the voltage deviation at the connection point varies between -10% and 10% of the rated voltage.
- The wind farm should be able to operate for 10s at least when the voltage deviation at the connection point varies between -10% and -15% or between +10% and +15% of the rated voltage.
- The cut-off time depends on the requirement of the wind turbines which have been selected.
- The wind farm should have LVRT ability. If the result of wind farm integration study indicates that LVRT ability is not needed, the requirements for LVRT can be waived.

3. Wind power grid code in China

6. Wind Farm Voltage Regulation

- Wind farm is involved in voltage regulation by means of active and reactive power and main transformer tap changing in the central substation of the wind farm.
- Reactive power of the wind farm should, as much as possible, regulate automatically within certain range, in order to maintain the voltage at the connection point to be within the allowed deviation limits or in a range set by the network operator.
- The main transformers in the wind farm substation should better be of the on-load tap changing type. Tap changing can be set manually or automatically according to the command of the network operator.

3. Wind power grid code in China

7. Wind Farm Operating Frequency

Frequency Range	Requirement
Below 49Hz	Depends on the allowable minimum frequency of the wind turbine generator system.
49Hz－49.5Hz	Be able to operate for at least 10 min each time below 49.5 Hz.
49.5Hz－50.2Hz	Be able to operate continuously.
50.2Hz－51Hz	Be able to operate for at least 2 minutes each time the frequency is above 50.2 Hz. No further turbine should start.
Above 51Hz	Wind turbine generator systems gradually shut down or operate with curtailed power according to dispatch centre instructions.

3. Wind power grid code in China

8. Wind Farm Power Quality

- Voltage Deviation
  - It should be ensured that, after the wind farm is connected to the grid, the deviation of voltage at the connection point should not exceed the limits defined in SD325－1989 or GB/T 12325-2003
- Relative Voltage Change
  - The relative voltage change caused by the wind farm at a point of common coupling should satisfy the requirements of GB 12326-2000.

3. Wind power grid code in China

- Voltage Flicker
  - The voltage flicker caused by the wind farm at a point of common coupling should satisfy the requirement of GB 12326-2000.
- Harmonics
  - When the wind farm has wind turbine generator systems with power electronic converters, the harmonics injected from the wind farm into the power system must be limited.
  - The harmonic current injection at a point of common coupling where the wind farm is should satisfy the requirement of GB/T 14549.

3. Wind power grid code in China

9. **Wind Farm Test**

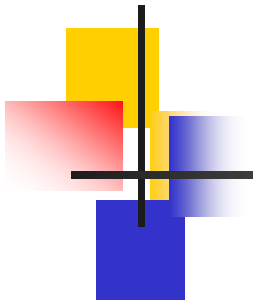
- Basic Requirements
  - Wind farm test must be carried out by a qualified organization. The test plan must be submitted to the management department of the network company for documentation.
  - If the installation capacity of a wind farm exceeds 50 MW, the test report must be submitted. If the installation capacity of a wind exceeds 50 MW after expansion, a new test report must be submitted.
  - The owners of a wind farm must submit test report within the first 6 months of grid connected operation.

3. Wind power grid code in China

- **Content of Test**
  - maximum power ramp rate
  - voltage deviation
  - relative voltage change
  - voltage flicker
  - harmonics

4. WED

- Program duration: 3 years（2006.04-2009.03）
- Host organization: CEPRI
- Project objective:
  - Renewable energy contributes significantly to the energy supply in China
  - Capacities improved on effective exploitation of wind energy at national level and in the NE provinces
- Utility related activities of wind power integration (selected examples):
  - Investigation and study tours of integration issues abroad
  - Modification of the grid code in China
  - Integration study of wind power in NE three provinces
  - Study of wind power planing in NE three provinces



Thank You!