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Replacing GB/Z 19964-2005

Technical requirements for connecting photovoltaic power station to power system

光伏发电站接入电力系统技术规定

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Foreword

This Standard was drafted in accordance with the rules given in GB/T 1.1-2009.

This Standard replaces GB/Z 19964-2005 *Technical rule for connecting PV power station to electric power systems*.

This Standard was proposed by and shall be under the jurisdiction of China Electricity Council.

Drafting organizations of this Standard: China Electric Power Research Institute, China Institute of Electrical Engineering, State Grid Electric Power Research Institute.

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This Standard replaces the following previous standard:

- GB/Z 19964-2005.

Technical requirements for connecting photovoltaic power station to power system

1 Scope

This Standard specifies the technical requirements for connecting photovoltaic power station to power system.

This Standard is applicable to new, rebuilt and expanded photovoltaic power stations which are connected via 35 kV-and-above voltage grid, 10 kV voltage level and public grid.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 12325 *Power quality - Deviation of supply voltage*

GB/T 12326 *Power quality - Voltage fluctuation and flicker*

GB/T 14549 *Quality of Electric Energy Supply - Harmonics in Public Supply Network*

GB/T 15543 *Power quality - Three-phase voltage*

GB/T 19862 *General requirements for monitoring equipment of power quality*

GB/T 24337 *Power quality - Interharmonics in public supply network*

DL/T 448 *Technical administrative code of electric energy metering*

DL/T 1040 *The grid operation code*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 photovoltaic (PV) power station

3.10 anti-islanding

Prevention of unplanned islanding phenomenon.

4 Active power

4.1 General requirements

4.1.1 PV power station shall have ability to participate in frequency modulation and peaking of power system in accordance with relevant provisions of DL/T 1040.

4.1.2 PV power station shall be equipped with active power control system, ability to continuously and smoothly adjust active power and ability to participate in active power control of system.

4.1.3 PV power station active power control system shall be able to receive and automate the control orders of active power and active power change released by grid scheduling mechanism.

4.2 Active power change under normal operation

4.2.1 During the process of PV power station interconnection, normal shutdown and growth of solar irradiance, PV power station active power change rate shall meet requirements for power system's safe and stable operation. Its limits shall be determined by grid scheduling mechanism according to the frequency adjustment characteristics of power system accessed.

4.2.2 PV power station active power change rate shall not exceed 10% capacity / min. PV power station active power change rate is allowed to exceed the limits caused by reduction of solar irradiance.

4.3 Emergency control

4.3.1 In case of power system accident or emergency, PV power station shall be operated according to the following requirements:

a) In power system accident or a special operating mode, it shall reduce PV power station active power in accordance with requirements of grid scheduling mechanism;

b) When power system frequency is greater than 50.2 Hz, it shall reduce PV power station active power according to instructions of grid scheduling mechanism OR cut off the whole PV power station if it is serious;

c) If PV power station's operation endangers the safety and stability of

power system, the grid scheduling mechanism shall temporarily cut off PV power station according to relevant provisions.

4.3.2 After accident and recovery of power system, PV power station shall be paralleled in according to scheduling instructions.

5 Power prediction

5.1 General requirements

PV power station with capacity of 10 MW and greater shall be equipped with photovoltaic power prediction system. The system shall have 0h ~ 72h short-term prediction of photovoltaic power generation and 15 min ~ 4h ultra-short-term photovoltaic power prediction.

5.2 Report of prediction curve

5.2.1 PV power station automatically report in roll to grid scheduling mechanism in every 15 min about PV power station generation power prediction curve of future 15 min ~ 4h. The time resolution of the predicted value is 15 min.

5.2.2 PV power station reports PV power station generation power prediction curve of 0h~ 24h of next day according to grid scheduling mechanism specified time every day. The time resolution of the predicted value is 15 min.

5.3 Prediction accuracy

Monthly average absolute error of short term prediction of PV power station generation time (excluding output controlled period) shall be less than 0.15. Monthly passing-rate shall be greater than 80%, The monthly average absolute error of the fourth hour of ultra-short-term prediction shall be less than 0.10. The monthly passing-rate shall be greater than 85%.

6 Reactive capacity

6.1 Reactive power supply

6.1.1 Reactive power supply of PV power station includes PV interconnection inverter and reactive power compensation device of PV power station.

6.1.2 Interconnection inverter of PV power station shall make power factor under rated active power be dynamically adjustable within the range of advance-0.95 ~ hysteresis-0.95, within the rectangle as shown in Figure 1.

750 kV), the reactive capacity configuration shall comply with the following requirements:

a) Capacitive reactive capacity can compensate the sum of inductive reactive power of site collection line, main transformer when PV power station is in full output and all inductive reactive power of PV power station transmission line;

b) Inductive reactive capacity can compensate the sum of capacitive charge reactive power of PV power station and all charge reactive power of PV power station transmission line.

6.2.5 Reactive device type and capacity range of PV power station shall combine with the actual access of PV power station and be determined by reactive voltage thematic studies of PV power station's access power system.

7 Voltage control

7.1 General requirements

7.1.1 PV power station interconnected by 10 kV ~ 35 kV voltage grade, within its reactive power output range, shall have ability to adjust reactive output according to voltage level of point of interconnection of PV power station, participate in grid voltage regulation. The adjustment method, reference voltage, voltage adjustment ratio and other parameters shall be set by grid scheduling mechanism.

7.1.2 PV power station interconnected by 110 (66) kV and greater shall be equipped with reactive voltage control system, with capability of reactive power control and voltage control. In accordance with instructions of grid scheduling mechanism, PV power station shall automatically adjust the reactive power it sends (or absorbs), so as to realize the voltage control for point of interconnection. Its adjustment speed and control precision shall meet requirements of voltage adjustment of power system.

7.2 Control objectives

7.2.1 When public grid voltage is within the normal range, the PV power station interconnected by 110 (66) kV voltage shall be able to control the voltage of point of interconnection of PV power station within the range of 97% ~ 107% of nominal voltage.

7.2.2 When public grid voltage is within the normal range, the PV power station interconnected by 220 kV and greater voltage shall be able to control the voltage of point of interconnection of PV power station within the range of 100% ~ 110% of nominal voltage.

Table 2 Operation provisions for PV power station in different voltage range of point of interconnection

Voltage range	Operation requirements
< 0.9 Pu	It shall comply with requirements for low voltage ride through in Clause 8 of this Standard
0.9 Pu ≤ U_T ≤ 1.1 Pu	Shall operate as normal
1.1 Pu ≤ U_T ≤ 1.2 Pu	Shall operate continuously for at least 10 s
1.2 Pu ≤ U_T ≤ 1.3 Pu	Shall operate continuously for at least 0.5 s

9.2 Power quality range

When harmonic values of point of interconnection of PV power station comply with provisions of GB/T 14549, three-phase voltage unbalance complies with provisions of GB/T 15543, and inter-harmonics values comply with provisions of GB/T 24337, the PV power station shall be able to operate as normal.

9.3 Frequency range

PV power station shall operate according to provisions within power system frequency range shown in Table 3.

Table 3 Operation provisions for PV power station in different power system frequency range

Frequency range	Operation requirements
< 48 Hz	Determine according to the minimum frequency allowed by inverter of PV power station
48 Hz ≤ f ≤ 49.5 Hz	When frequency per time is less than 49.5 Hz, PV power station shall operate for at least 10 min.
49.5 Hz ≤ f ≤ 50.2 Hz	Continuously operate
50.2 Hz ≤ f ≤ 50.5 Hz	When frequency per time is less than 50.2 Hz, PV power station shall operate for at least 2 min and perform the strategy of reducing output or high circumferential cutting machine; PV power station out of service is not allowed for interconnection.
> 50.5 Hz	Immediately terminate the grid lines of transfers; PV power station out of service is not allowed for interconnection.

10 Power quality

10.1 Voltage deviation

After PV power station is connected, the voltage deviation of accessed public point of connection shall comply with requirements of GB/T 12325.

10.2 Voltage fluctuation and flicker

After PV power station is connected, the values of voltage fluctuation and flicker of accessed public point of connection shall comply with requirements of GB/T 12326.

10.3 Harmonic wave

10.3.1 Harmonic current injection of accessed public point of connection of PV power station shall comply with requirements of GB/T 14549. Harmonic current allowable value injected by point of interconnection of PV power station into power system shall be distributed according to the ration between the installed capacity of PV power station and total capacity of generation / supply equipment with harmonic source on common connection point.

10.3.2 After PV power station is connected, the inter-harmonics of accessed public connection point shall comply with requirements of GB/T 24337.

10.4 Voltage unbalance

After PV power station is connected, the voltage unbalance of accessed public connection point shall comply with requirements of GB/T 15543.

10.5 Monitoring and management

PV power station shall be equipped with real-time power quality monitoring equipment. The installed power quality monitoring equipment shall comply with requirements of GB/T 19862. When power quality Index of PV power station cannot meet requirements, PV power station shall install power quality management equipment.

11 Simulation model and parameters

11.1 Simulation model

PV power station shall establish photovoltaic power generation unit (including photovoltaic modules, inverters, step-up transformer unit, etc.), photovoltaic power station collection line, photovoltaic power station control system model and parameters, used for planning and dispatching of PV power station connection to power system.

11.2 Parameter change

PV power station shall follow the change of its element model and parameters, and send the latest feedback to grid dispatching mechanism at any time.

12 Secondary system

12.1 General requirements

12.1.1 Secondary equipment and system of PV power station shall comply with secondary power system technical specifications, secondary power

single-phase failure in collection system in station.

12.3.5 PV power station connected by 110 (66) kV and greater voltage grade shall be equipped with disturbance equipment. The equipment shall have enough recording channels to record the situation 10 s prior to failure and 60 s after failure. It shall be also equipped with data transmission channel to grid scheduling mechanism.

12.4 Dispatching automation of PV power station

12.4.1 PV power station shall be equipped with computer monitoring system, electric energy remote terminal equipment, secondary system, safety equipment, dispatching data network access device, in accordance with technical management specifications of secondary power system equipment.

12.4.2 Remote information collection range of dispatching automation of PV power station shall be accessed into information, according to remote information access requirements of dispatching automation energy management system (EMS).

12.4.3 Energy metering point (pass) of PV power station shall be set at property boundary between PV power station and the grid. Property boundary shall be determined in accordance with the relevant national provisions. If property boundary point is not suitable to install energy metering device, the metering point shall be determined by PV power station owner and power grid enterprise. The metering device configuration shall comply with requirements of DL/T 448.

12.4.4 PV power station's dispatching automation, electrical energy information transfer shall use master / slave channel communication method which directly sends information to grid scheduling mechanism.

12.4.5 Scheduling jurisdiction device power supply of PV power station shall use uninterruptible power supply (UPS) or site dc power supply system of power supply. After AC power supply disappears, UPS load running time shall exceed 40 min.

12.4.6 PV power station connected by 220 kV and greater voltage grade shall be equipped with phasor measurement unit (PMU).

12.5 PV power station communication

12.5.1 For PV power station connected by 110 kV (66 kV) and greater voltage grade, till scheduling end, it shall be equipped with two-way communication channel, of which one is cable channel.

12.5.2 Communication equipment of which PV power station is directly

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