MINISTRY OF INDUSTRY AND TRADE ----------	SOCIALIST REPUBLIC OF VIETNAM Independence - Freedom - Happiness ----------
No. 30/2019/TT-BCT	*Hanoi, November 18, 2019*

CIRCULAR

AMENDMENTS AND SUPPLEMENTS TO SEVERAL ARTICLES OF CIRCULAR NO. 25/2016/TT-BCT DATED NOVEMBER 30, 2016 OF MINISTER OF INDUSTRY AND TRADE ON ELECTRICITY TRANSMISSION SYSTEM AND CIRCULAR NO. 39/2015/TT-BCT DATED NOVEMBER 18, 2015 OF MINISTER OF INDUSTRY AND TRADE ON ELECTRICITY DISTRIBUTION SYSTEM

Pursuant to the Law on Electricity dated December 3, 2004 and the Law on Amendment to certain Articles of the Law on Electricity dated November 20, 2012;

Pursuant to the Government's Decree No. 98/2017/ND-CP dated August 18, 2017, defining the functions, tasks, powers and organizational structure of the Ministry of Industry and Trade;

Pursuant to the Government's Decree No. 137/2013/ND-CP dated October 21, 2013 elaborating on the implementation of certain articles of the Law on Electricity and the Law on Amendments to certain Articles of the Law on Electricity;

Upon the request of the Director of the Electricity Regulatory Authority,

The Minister of Industry and Trade hereby promulgates the Circular on amendments and supplements to several Articles of Circular No. 25/2016/TT-BCT dated November 30, 2016 of Minister of Industry and Trade on electricity transmission system and Circular No. 39/2015/TT-BCT dated November 18, 2015 of Minister of Industry and Trade on electricity distribution system.

Article 1. Amendments and supplements to several Articles of the Circular No. 25/2016/TT-BCT dated November 30, 2016 of the Minister of Industry and Trade on electricity transmission system

1. Clause 5a and 6a shall respectively come after clause 5 and clause 6 of Article 3 as follows:

"5a. *Power plant's rated capacity* refers to total rated capacity of machine sets within a power plant which is determined when these machine sets are running at the steady and normal operation mode, and is announced by the manufacturer of these machine sets based on their design. The rated capacity of a solar power plant refers to the maximum generatable output of alternating current of the plant which is calculated, announced and commensurate with the direct current output of the solar power plant according to a planning scheme.

6a. *DIM (Dispatch Instruction Management)* refers to an information system for management of dispatch instructions between a dispatch unit having controlling authority and a power plant or the control center of power plants."

2. Clause 10, 35, 49 and 53 of Article 3 shall be amended as follows:

"10. *Frequency control in a power system* (hereinafter referred to as frequency control) refers to the process of controlling a power system to maintain its stable operation, including primary, secondary and tertiary frequency control:

a) Primary frequency control refers to the process of instantly controlling electricity system frequency by a large number of generator sets equipped with a governor;

b) *Secondary frequency control* refers the control process following the primary frequency control carried out through the impact of AGC system in order to bring frequency back to the permanent permissible range of operation.

c) Tertiary frequency control refers to the control process following the secondary control carried out by using dispatch instructions to restore system frequency according to regulations currently in force and ensure economic distribution of generating capacity of generator sets.

35. *Short-term flicker perceptibility (P_{st}) and long-term flicker perceptibility (P_{lt})* refers to value measured according to applicable national standards. If measurement values of P_{st} and P_{lt} have not yet been prescribed in national standards, they shall be valued according to IEC standard currently in force which is announced by International Electrotechnical Commission.

49. *Power system stabilizer (PSS)* refers to a device added to the automatic voltage regulator (AVR) to damp power output fluctuation in the electricity system.

53. *Automatic load shedding* refers to the act of switching off loads automatically by relays based on indicators for frequency, voltage or electric power output level of a power system when each of these indicators drops below the permissible limits defined by an Electricity system and market operator.”.

3. Article 7 shall be amended as follows:

“Article 7. Phase balance

1. In the normal operation mode, a negative sequence voltage component is not allowed to exceed 3% of nominal voltage with respect to specific nominal voltage grades on a transmission grid.

2. It shall be permissible that a negative sequence voltage component may exceed the value prescribed in clause 1 of this Article in certain points of time, but must ensure that the value measured for at least 1 week and at the sampling rate of 10 minutes does not exceed the prescribed limit.".

4. Clause 1 and 2 of Article 8 shall be amended and clause 6 shall be added to Article 8 as follows:

1. Voltage harmonics

a) Total harmonic distortion is a ratio of the root-sum-square value of the voltage harmonic to the root-mean-square value of the fundamental voltage, which is calculated according to the following formula:

$$THD = \sqrt{\frac{\sum_{i=2}^{N} V_i^2}{V_1^2}} \, x100\,\%$$

Where:

- THD: Total voltage harmonic distortion;

-V_i: Root-sum-square value of the voltage harmonic at level i and N is the highest level of the voltage harmonic in question;

-V_1: Root-mean-square value of the fundamental voltage (50 Hz frequency).

b) Permissible maximum value of total harmonic distortion caused by high-level harmonic components to the voltage level 220 kV and 500 kV is less than or equal to 3%.

2. Current harmonics

a) Total demand distortion is a ratio of the root-sum-square value of the current harmonic to the root-mean-square value of the fundamental current in the load and maximum generating capacity mode, which is calculated according to the following formula:

$$TDD = \sqrt{\frac{\sum_{i=2}^{N} I_i^2}{I_L^2}} \times 100\%$$

Where:

- TDD: Total current demand distortion;

- I_i: Root-sum-square value of the current harmonic at level i and N is the highest level of the current harmonic in question;

- I_L: Root-mean-square value of the fundamental current (50 Hz frequency) in load and maximum generating capacity mode (load and maximum generating capacity are average values of 12 loads and maximum generating capacities corresponding to preceding 12 months. In case of new connection points or failure to collect values of load or maximum generating capacity corresponding to preceding 12 months, value of load and maximum generating capacity during the entire duration of measurement will be used).

b) Permissible maximum value of total demand distortion caused by high-level harmonic components to the voltage level 220 kV and 500 kV is less than or equal to 3%.

6. It shall be accepted that the unusual peak of harmonic on a transmission grid exceeds total harmonic distortions specified in clause 1 and 2 of this Article, but it shall be obligatory that 95% of value of voltage and current harmonic measured during at least 01 week and at the sampling rate of 10 minutes is not allowed to exceed the prescribed limit”.

5. Article 12 shall be amended as follows:

"Article 12. Short-circuit currents and fault clearing time

1. Permissible maximum value of short-circuit current

a) Permissible maximum values of short-circuit current and fault clearing time by main protection on the electrical power transmission system are stipulated in Table 6 below:

Table 6

Permissible maximum value of short-circuit current and fault clearing time by main protection

Voltage level	**Permissible maximum short-circuit current (kA)**	**Maximum fault clearing time by main protection** (ms)
500 kV	50	80
220 kV	50	100

b) Main protection for an electrical device is a major security measure, is installed and configured in order to make first response, meet criteria concerning selectivity, reliability of a response and response time in case of breakdown falling within the scope of protection for such electrical device;

c) 110 kV busbars of 500 kV and 220 kV electrical substations in an electricity transmission grid may use the permissible maximum short-circuit current equaling 40 kA.

2. Switchgears on a electricity transmission grid must be able to de-energize maximum short-circuit current running through them for at least the next 10 years from the proposed date on which an electrical device is brought into operation and withstand this short-circuit current for at least 01 second.

3. With respect to hydropower and thermopower generator sets having capacity of greater than 30 MW, Total value of unsaturated sub transient reactance of a generating set (X_d''-%) and short-circuit reactance of a terminal transformer (U_k-%) according to the per-unit system *pu* (converted into rated apparent power of a generator set) are not allowed to be less than 40%.

If the aforesaid requirements cannot be met, the investor shall be responsible for installing further power reactance so that total value of Xd'', Uk and electrical reactance according to the per-unit system pu (converted into rated apparent power of a generator set) is not less than 40%.

4. If value of short-circuit current at connection point of any electrical works to an electricity transmission system is greater than permissible maximum short-circuit as stipulated in Table 6, owners of electrical projects shall take measures to restrict the short-circuit current at connection points to a level lower or equal to permissible maximum short-circuit current as stipulated in Table 6.

5. The transmission network operator shall be responsible for informing the customer using transmission grid about maximum value of short-circuit current at connection point for coordination during the investment and installation of equipment, ensuring that the switchgears are able to de-energize maximum short-circuit current at connection point for at least the next 10 years from the proposed date on which electrical equipment is brought into operation.".

6. Clause 3 of Article 28 shall be amended as follows:

"3. The transmission network operator shall be responsible for making notification to the electricity customer of any connection proposed by such customer which is in opposition to the approved electricity development planning in order to make any amendment and supplement to such planning.".

7. Clause 1 of Article 31 shall be amended as follows:

"1. The customer using transmission grid shall be responsible for investing, installing and managing operation of the information system under their delegated authority, and ensuring it is connected to the information system under the control of the transmission network operator and the dispatch level having controlling rights; ensuring that data (including data of SCADA, PMU and fault recorder) are communicated and transmitted in a full, reliable and continuous manner for the purposes of operation of electrical power system and markets. Means of communications serving dispatching and operation activities in an electricity transmission system, including direct communication channel, telephone, facsimile and DIM, must operate in a reliable and continuous manner.".

8. Clause 1 and 2 of Article 32 shall be amended as follows:

"1. Transformers from 220 kV and on, power plants with installed capacity greater than 30 MW and power plants connected to the transmission grid which is not yet connected to the Control Center must

be equipped with a Gateway or RTU, and must be set up with two connections physically independent of the SCADA system of the dispatch level vested with controlling rights.

2. Transformers from 220 kV and on, power plants with installed capacity greater than 30 MW and power plants connected to the transmission grid which is connected to, controlled and manipulated remotely by the Control Center must be equipped with a Gateway or RTU, and must be set up with an connection to the SCADA system of the dispatch level vested with controlling rights and two connections to the control system at the Control Center.

9. Article 36 shall be amended as follows:

"Article 36. Automatic load shedding system

1. The customer using transmission grid shall be responsible for cooperating with relevant units in unifying the installation of the automatic frequency load shedding system and ensuring that it operates in accordance with calculations and requirements of the dispatch level vested with controlling rights.

2. The system must be designed and configured to meet following requirements:

a) Reliability not less than 99%;

b) Any unsuccessful load shedding must not affect operation of the entire electricity system;

c) Load shedding procedures and amount of shed power must be in compliance with level of distribution by the dispatch level vested with controlling rights, and must not be changed in any case without consent from the dispatch level vested with controlling rights.

3. Load recovery procedures must be in compliance with dispatch instructions of the dispatch level vested with controlling rights.

10. Clause 2 of Article 37 shall be amended as follows:

"2. Requirements for connection from the Control Center

a) Requirements for connection to communications system

- There is a data transmission line to be connected to the information system of the dispatch level vested with controlling rights. If multiple dispatching levels with control authority exist, an information sharing method must be agreed by all the dispatching levels;

- There are two data transmission lines (working and standby) to be connected to the control and information system of power plants or stations remotely controlled by the Control Center;

- Means of communications serving dispatching activities, inter alia, including direct communication channel, telephone, facsimile, DIM and computer network, must be in good working condition.

b) Requirements for connection to SCADA system

- There is a connection to the SCADA of the dispatch level vested with controlling rights. If multiple dispatching levels with control authority exist, all the dispatching levels shall be responsible for sharing information;

- There are two connections to RTU/Gateway, control system of power plants, electricity stations and switchgears on the electrical grid remotely controlled by the Control Center;

c) The Control Center must install a monitoring screen and make connection to closed-circuit television cameras at power plants, electricity stations and switchgears on the electrical grid to send information to the Control Center.

11. Clause 3 of Article 38 shall be amended as follows:

"3. The generating set must be capable of adjusting primary frequency which falls outside of the dead band of the governor, meeting all of its demands for capacity for controlling primary frequency within 15 seconds and maintaining such capacity for at least 15 seconds. Primary frequency controlling capacity of a generating set may vary depending on actual frequency deviations and set parameters requested by electricity system and market operator.".

12. Article 42 shall be amended as follows:

"Article 42. Technical requirements of wind and solar power plants

1. Wind and solar power plants must be capable of maintaining generation of active power in the following modes:

a) Free generation mode: Generating possible highest power, depending on transformation of primary energy source (wind or solar energy);

b) Generating capacity control mode:

Wind and solar power plants must be capable of restricting electric output according to dispatch instructions in the following cases:

- If primary energy source deviates to the degree lower than the value limited according to dispatch instructions, possible highest power must be generated;

- If primary energy source deviates to the degree equal to or greater than the value limited according to dispatch instructions, electrical power output equaling the value limited according to dispatch instruction shall be produced provided that tolerance falls within the band ±01% of the rated capacity.

2. Wind and solar power plants which are, at any time, connected to transmission grids must be capable of maintaining generation of power for a minimum period of time in proportion to power-generating frequency band prescribed in Table 8 below:

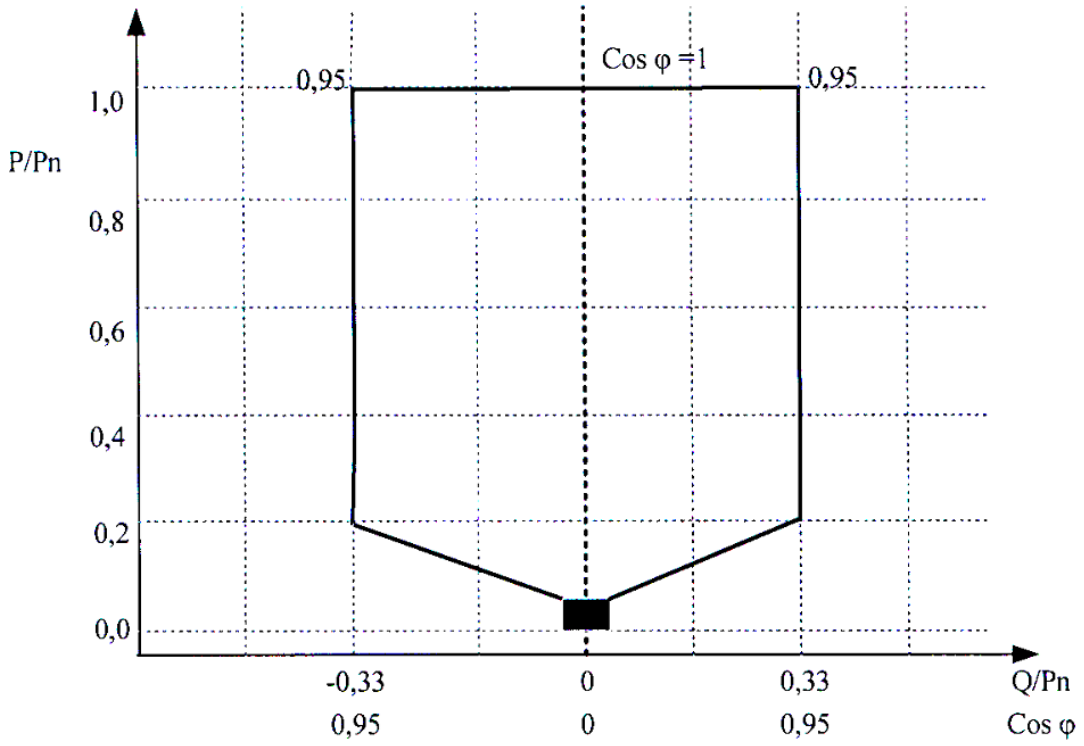
Table 8

Required minimum timelength for maintenance of power generation at wind and solar power generation plants in proportion to frequency bands of electricity systems

Frequency band	Required minimum timelength
From 47.5 Hz to 48.0 Hz	10 minutes
Greater than 48 Hz to less than 49 Hz	30 minutes
From 49 Hz to 51 Hz	Continuous generation
Greater than 51 Hz to 51.5 Hz	30 minutes
Greater than 51.5 Hz to 52 Hz	01 minute

3. When the electricity system's frequency is greater than 50.5 Hz, wind and solar power plants may reduce active power on the comparative slope of droop characteristics within the steep gradient range of between 2% and 10%. Set value of the slope of droop characteristics is calculated and determined by the dispatch level vested with controlling rights.

4. Wind and solar power plants must be capable of adjusting reactive power according to characteristics shown in the following diagram and described in point a and b of this clause:



a) If a power plant generates an active power greater or equal to 20% of rated active power and voltage at a connection point in the nominal voltage band of ± 10%, such power plant must be capable of adjusting reactive power continuously in the power factor range from 0.95 (corresponding to reactive power generation mode) to 0.95 (corresponding to reactive power receiving mode) at the connection point in proportion to rated power;

b) If a power plant generates an active power less than 20% of rated power, such power plant may reduce ability to receive or generate reactive power in accordance with characteristics of the generating set.

5. Voltage control mode and reactive power:

a) Wind and solar power generation plants must be capable of controlling voltage and reactive power in the following modes:

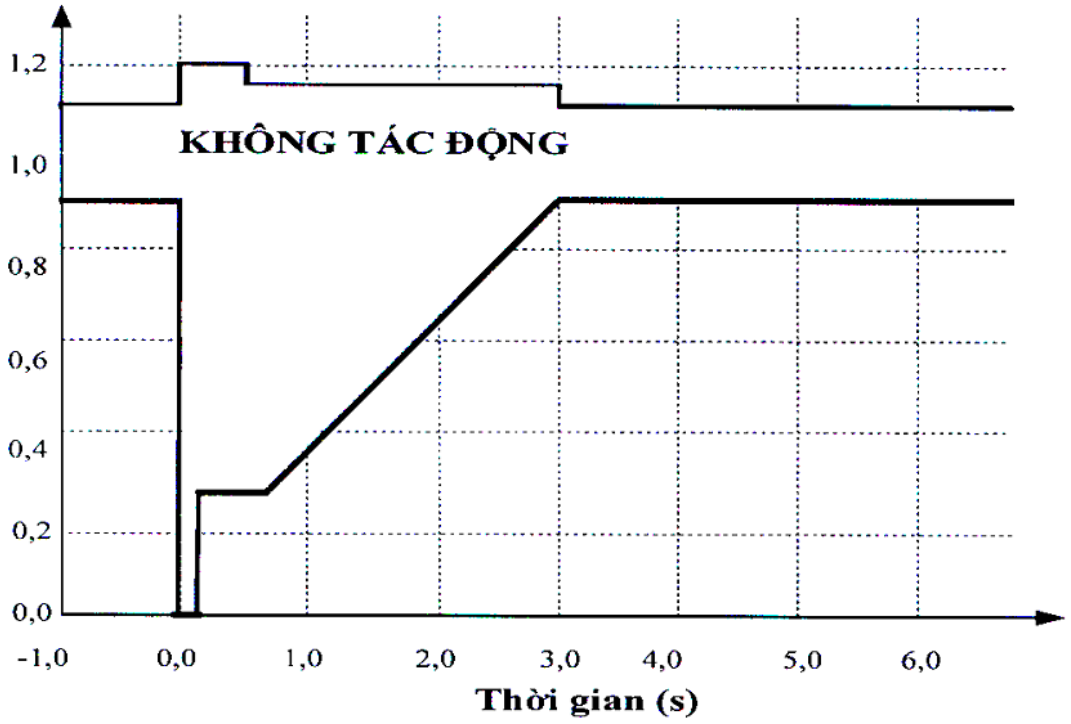
- Mode of controlling voltage according to voltage-adjusting droop characteristics (characteristics of the relation between voltage and reactive power);

- Mode of control according to the set value of reactive power;

- Mode of control according to power factors

b) If voltage at connection point is within the band of ± 10 % of rated voltage, a wind or solar power plant must be capable of adjusting voltage at the low-voltage side of the step-up transformer with deviation no more than ± 0.5 % of rated voltage (compared to set voltage value) whenever reactive power of the generating set is within the permissible working band for no longer than 05 seconds.

6. Wind and solar power plants which are, at any time, connected to transmission grids must be capable of maintaining generation of power commensurate with the voltage band at the connection point within the following specific time points:



a) If voltage is less than 0.3 pu, minimum maintenance time will be 0.15 seconds;

b) If voltage ranges from 0.3 pu to under 0.9 pu, minimum maintenance time will be calculated according to the following formula:

$$T_{min} = 4 \times U - 0.6$$

Where:

- T_{min} (second): Minimum time required to maintain power generation;

- U (pu): Actual voltage at connection point calculated by pu (relative value).

c) If voltage ranges from 0.9 pu to under 1.1 pu, wind and solar power plants must maintain continuous generation;

d) If voltage ranges from 1.1 pu to under 1.15 pu, wind and solar power plants must maintain power generation for 3 seconds;

dd) If voltage ranges from 1.15 pu to under 1.2 pu, wind and solar power plants must maintain power generation for 0.5 seconds.

7. The level of phase unbalance, total harmonic distortion and flicker perceptivity caused by wind or

solar power plants at connection points shall not be allowed to exceed values specified in Article 7, 8 and 9 herein.

8. Wind or solar power plants must invest in control and automatic equipment and systems to ensure stable, reliable and confidential connection to Automatic Generation Control (AGC) of the electricity system and market operator serving remote control of their power generation capacity according to the dispatch instruction received from the electricity system and market operator".

13. Point a of clause 2 of Article 59 shall be amended as follows:

"a) Secondary frequency regulation reserve and quick-start reserve levels are lower than required in normal operation mode".

14. Point b of clause 3 of Article 64 shall be amended as follows:

"b) Carry out load shedding on each line through an automatic shedding relay or under dispatch instruction."

15. Clause 2a shall be inserted after clause 2 of Article 69 as follows:

"2a. Provide information about primary energy source (hydrographical information necessary for hydropower plants, information about coal – oil – combustible substances necessary for thermopower plants, meteorological monitoring information necessary for wind or solar power plants), forecast power generation plant's capacity and output, and transmitting data to the electricity system and market operator."

16. Article 72 shall be amended as follows:

"Article 72. Ancillary services

Ancillary services in the electricity system shall comprise:

1. Secondary frequency control (Secondary frequency regulation).

2. Quick start.

3. Voltage adjustment.

4. Must-run operation reserves used for electricity system security purposes.

5. Black start."

17. Article 73 shall be amended as follows:

"Article 73. Technical requirements of ancillary services

1. Secondary frequency regulation: The generating sets providing secondary frequency regulation services must be capable of starting to provide frequency regulation capacity within 20 seconds of receipt of AGC signals from the electricity, providing registered secondary frequency regulation capacity within 10 minutes, and maintaining this capacity level within at least 15 minutes.

2. Quick start. Generating sets providing quick-start reserve must be capable of increasing to the rated power within 25 minutes and maintaining it for a minimum of 08 hours.

3. Voltage adjustment: Generating sets providing voltage adjustment service must be capable of changing reactive power outside the adjustment band prescribed in Clause 2, Article 38 herein, meeting requirements of the electricity system and market operator.

4. Must-run operation reserves used for electricity system security purposes: Generating sets providing must-run operation for electricity system security purposes must be capable of increasing to a rated power within one hour and maintaining such rated power for a minimum of eight hours (excluding the time of starting).

5. Black start: Generating sets providing black start must be capable of self-starting in a cold state without power supply from the national electricity system and capable of connecting and supplying electricity to the power system after successful start."

18. Article 74 shall be amended as follows:

"Article 74. Determination of demands and provision of ancillary services

1. General principles for determining demands for ancillary services, including:

a) Maintain electrical power and capacity reserve levels of the electricity system in order to meet power system operation and security standards;

b) Ensure minimum expenses in accordance with conditions and obligations of the national electricity

system.

2. Power system and market operator shall be responsible for calculating and reporting to the Vietnam Electricity Corporation on demands for ancillary services for the national electricity system according to Procedures for determination of demands and provision of ancillary services, which are issued by the Electricity Regulatory Authority.

3. Before November 1 each year, the Vietnam Electricity Corporation shall be responsible for petitioning the Electricity Regulatory Authority to approve ancillary service demands of the national electricity system in the next year as a basis for formulation of plans to purchase and call for ancillary services in the next year's plan for operation of the national electricity system."

19. Point b of clause 1 of Article 85 shall be amended as follows:

"b) In case of the unbalancing state of the power system, the electricity system and market operator must have recourse to other generating sets to provide ancillary services and adjust the existing power output, based on the mobilization sequence of generating sets in the power system, in order to restore the power system to the balanced state and maintain the prescribed reserve level."

20. Clause 4 shall be added to Article 90 as follows:

"4. The electricity transmission system operator shall be responsible for submitting written reports under clause 1, 2 and 3 of this Article by post and electronic mail.".

21. Clause 5 shall be added to Article 91 as follows:

"5. The power system and market operator shall be responsible for submitting written reports prescribed in clause 1, 2, 3 and 4 of this Article by post and electronic mail.".

Article 2. Amendments and supplements to several Articles of the Circular No. 39/2015/TT-BCT dated November 18, 2015 of the Minister of Industry and Trade on electricity distribution system

1. Clause 3a shall be inserted after clause 3 of Article 3 as follows:

"3a. Power plant's rated capacity refers to total rated capacity of machine sets within a power plant which is determined when these machine sets are running at the steady and normal operation mode, and is announced by the manufacturer of these machine sets based on their design. The rated capacity of a solar power plant refers to the maximum generatable alternating current power of the plant which is calculated, announced and commensurate with the direct current power of the solar power plant according to a planning scheme.".

2. Article 5 shall be amended and supplemented as follows:

"Article 5. Voltage

1. Nominal voltage levels in a power distribution system comprise 110 kV, 35 kV, 22 kV, 15 kV, 10 kV, 06 kV and 0.38 kV.

2. The permissible operating voltage deviation in a power distribution grid in the normal operation mode:

a) The permissible operating voltage deviation at busbar installed on the power distribution grid of a power distributor compared to the nominal voltage ranges between + 10% and - 05%;

b) The permissible operating voltage deviation at a connection point compared to the nominal voltage shall be as follows:

- Such deviation at a connection point to a customer is ± 05%;

- Such deviation at a connection point to a factory is between + 10% and - 05%;

- If a power plant and customer are connected to the same busbar or the same line in the power distribution grid, voltage at a connection point shall be decided by the power distributor operating the regional power grid, ensuring conformance to technical requirements of operation of power distribution systems and voltage quality for customers in accordance with regulations in force.

3. If a power grid is in the normal state after facing failure, it shall be permissible that the deviation of voltage at a connection point to a customer who is directly affected by such failure falls within the range from + 5% to - 10% in comparison to the nominal voltage.

4. In the failure or recovery mode, it shall be permissible that the deviation of voltage in a power distribution grid falls within the ± 10% range compared to the nominal voltage.

5. During the failure time, voltage at the happening site and adjacent areas is likely to decrease

transiently to the zero value at the affected phase or increase by 110% of the nominal voltage at the unaffected phases until such failure is ruled out.

6. Voltage fluctuation occurring at a connection point in an electricity distribution grid which is caused by a fluctuation arising from a load of a user or manipulation of a switchgear inside a power plant shall not exceed 2.5% of the nominal voltage and fall within the permissible operating voltage range prescribed in clause 2 of this Article.

7. In case where a customer using power distributed from a power distribution grid needs higher quality voltage compared to the voltage quality prescribed in clause 2 herein, such customer may agree with the power distributor or the power distribution grid and retailing operator. The power distributor or the power distribution grid and retailing operator shall be responsible for consulting with the dispatch level vested with control rights before reaching an agreement with the customer".

3. Article 6 shall be amended as follows:

"Article 6. Phase balance

1. In normal operation mode, negative sequence voltage components are not allowed to exceed 03% of the nominal voltage with respect to the voltage level of 110 kV, or 05% of the nominal voltage with respect to the medium and low voltage level.

2. It shall be permissible that a negative sequence voltage component may, at any point of time, exceed the value prescribed in clause 1 of this Article, but must ensure that the value measured for at least 1 week and at the sampling rate of 10 minutes does not exceed the prescribed limit.".

4. Article 7 shall be amended and supplemented as follows:

"Article 7. Harmonics

1. Voltage harmonics:

a) Total harmonic distortion is a ratio of the root-sum-square value of the voltage harmonic to the root-mean-square value of the fundamental voltage, which is calculated according to the following formula:

$$THD = \sqrt{\frac{\sum_{i=2}^{N} V_i^2}{V_1^2}} \, x100\,\%$$

Where:

- THD: Total voltage harmonic distortion; V_i: Root-sum-square value of the voltage harmonic at level i and N is the highest level of the voltage harmonic in question;

- V_1: Root-mean-square value of the fundamental voltage (50 Hz frequency).

b) The permissible maximum voltage harmonic distortion in the power distribution grid prescribed in Table 1a shall be as follows:

Table 1a

Permissible maximum voltage harmonic distortion

Voltage level	THD	Individual distortion
110kV	3.0%	1.5%
Medium voltage	5%	3.0%
Low voltage	8%	5%

2. Current harmonics:

a) Total demand distortion is a ratio of the root-sum-square value of the current harmonic to the root-mean-square value of the fundamental current in the load/maximum generating capacity mode, which is calculated according to the following formula:

$$TDD = \sqrt{\frac{\sum_{i=2}^{N} I_i^2}{I_L^2}} \times 100\%$$

Where:

- TDD: Total current demand distortion;

- I_i: Root-sum-square value of the current harmonic at level i and N is the highest level of the current harmonic in question;

- I_L: Root-mean-square value of the fundamental current (50 Hz frequency) in load and maximum generating capacity mode (load and maximum generating capacity are average values of 12 loads and maximum generating capacities corresponding to preceding 12 months. In case of new connection points or failure to collect values of load or maximum generating capacity corresponding to preceding 12 months, value of load and maximum generating capacity during the entire duration of measurement will be used).

b) Power plants connected to power distribution grids shall not cause current harmonic distortion to exceed the values prescribed in Table 1b hereunder:

Table 1b

Permissible maximum current harmonic distortion of power plants

Voltage level	Total distortion	Individual distortion
110kV	3%	2%
Medium and low voltage	5%	4%

c) Electrical loads connected to power distribution grids shall not cause current harmonic distortion to exceed the values prescribed in Table 1c hereunder:

Table 1c

Permissible maximum current harmonic distortion of electrical loads

Voltage level	Total distortion	Individual distortion
110kV	4%	3.5%
Medium voltage	8%	7%
Low voltage	12% with respect to a load with a power of ≥ 50 kW 20% with respect to a load with a power of <50 kW	10% with respect to a load with a power of ≥ 50 kW 15% with respect to a load with a power of <50 kW

3. It shall be accepted that the unusual peak of harmonic on a transmission grid exceeds total harmonic distortions specified in clause 1 and 2 of this Article, but it shall be obligatory that 95% of value of voltage and current harmonic measured during at least 01 week and at the sampling rate of 10 minutes is not allowed to exceed the prescribed limit.".

5. Article 8 shall be amended as follows:

"Article 8. Voltage flicker perceptivity

1. In the normal operating mode, flicker perceptivity levels at all connections shall not be allowed to exceed the limits prescribed in Table 2 hereunder:

Table 2

Voltage flicker perceptivity

Voltage level	Permissible flicker perceptivity
110kV	$P_{st95\%}$ = 0.80 $P_{lt95\%}$ = 0.60
Medium voltage	$P_{st95\%}$ = 1.00 $P_{lt95\%}$ = 0.80

Low voltage	$P_{st95\%}$ = 1.00 $P_{lt95\%}$ = 0.80

2. Short-term flicker perceptivity (P_{st}) and long-term flicker perceptivity (P_{lt}) are values measured according to existing national standards. If measurement values of P_{st} and P_{lt} have not yet been prescribed in national standards, they shall be valued according to IEC standard currently in force which is announced by International Electrotechnical Commission.

6. Article 9 shall be amended as follows:

"Article 9. Short-circuit currents and fault clearing time

1. Permissible maximum values of short-circuit current and fault clearing time by main protection on electrical power distribution systems are stipulated in Table 3 below:

Table 3

Permissible maximum value of short-circuit current and fault clearing time

Voltage levels	Permissible maximum short-circuit current (kA)	Maximum fault clearing time by main protection (ms)
110kV	31.5	150
Medium voltage	25	500

2. Switchgears on a electricity distribution grid must be able to de-energize maximum short-circuit current running through them for at least the next 10 years from the proposed date on which an electrical device is brought into operation and withstand this short-circuit current for at least 01 second.

3. As for a medium-voltage distribution line that is divided into multiple segments and is difficult to be protected by a coordination between switchgears on a power grid, it shall be permissible that timelength of elimination of failure by main protection at several switching points is greater than the timelength prescribed in clause 1 but must be less than 1 second, provided that safety for equipment and power grid must be assured.

4. If value of short-circuit current at connection point of any electrical works to an electricity distribution system is greater than permissible maximum short-circuit as stipulated in Table 3, owners of electrical projects shall take measures to restrict the short-circuit current at connection points to a level lower or equal to permissible maximum short-circuit current as stipulated in Table 3.

5. The distribution network operator shall be responsible for informing the customer using distribution grid about maximum value of short-circuit current at connection point for coordination during the investment and installation of equipment, ensuring that the switchgears are able to de-energize maximum short-circuit current at connection point for at least the next 10 years from the proposed date on which electrical equipment is brought into operation.".

7. Article 17a shall be added after Article 17 as follows:

Article 17a. Dissemination of information about reliability of power supply, electrical energy loss and customer service quality

1. By the 10th day of each month, the power distribution grid operator shall be responsible for posting on its website information about reliability of power supply, electrical energy loss and customer service quality in the preceding month.

2. By the 31st day of January each year, the power distribution grid operator shall be responsible for posting on its website information about reliability of power supply, electrical energy loss and customer service quality in the preceding year.".

8. Clause 2 of Article 28 shall be amended as follows:

"2. If the plan for power connection proposed by a customer is not relevant to the approved power development plan, the distribution network operator or the power distribution and retailing operator shall be responsible for making notification to the electricity customer of any amendment and supplement to the planning scheme in accordance with regulations in force.".

9. Article 32 shall be amended as follows:

"Article 32. Harmonic distortion requirements

Permissible harmonic distortion at connections to a power distribution grid must conform to requirements set out in Article 7 herein.”.

10. Clause 1 and 2 of Article 38 shall be amended as follows:

“1. Power plants connected to distribution grids with the capacity of at least 10 MW (irrespective of connection voltage levels) and transformer substations of 110 kV not yet connected to the Control Center must be equipped with a Gateway or RTU, and must be set up with two connections physically independent of the SCADA system of the dispatch level vested with controlling rights. If power plants or transformer substations operate at multiple levels vested with controlling rights, dispatch levels shall be responsible for sharing information necessary for coordination in operation of the power system.

2. Power plants connected to distribution grids with the capacity of at least 10 MW and transformer substations of 110 kV already connected to the Control Center must be equipped with a Gateway or RTU, and must be set up with one connection to the SCADA system of the dispatch level vested with controlling rights, and two connections to the control system at the Control Center.”.

11. Article 40 shall be amended and supplemented as follows:

“Article 40. Requirements of wind power plants, solar power plants connected to power distribution grids at the minimum level of medium voltage

1. Wind and solar power plants must be capable of maintaining generation of active power in the following modes:

a) Free generation mode: Generating possible highest power, depending on transformation of primary energy source (wind or solar energy);

b) Generating capacity control mode:

Wind and solar power plants must be capable of restricting electric output according to dispatch instructions in the following cases:

- If primary energy source deviates to the degree lower than the value limited according to dispatch instructions, possible highest power must be generated;

- If primary energy source deviates to the degree equal to or greater than the value limited according to dispatch instructions, electrical power output equaling the value limited according to dispatch instruction shall be produced provided that tolerance falls within the band ± 01% of the rated capacity.

2. Wind and solar power plants which are, at any time, connected to transmission grids must be capable of maintaining generation of power for a minimum period of time in proportion to power-generating frequency band prescribed in Table 8 below:

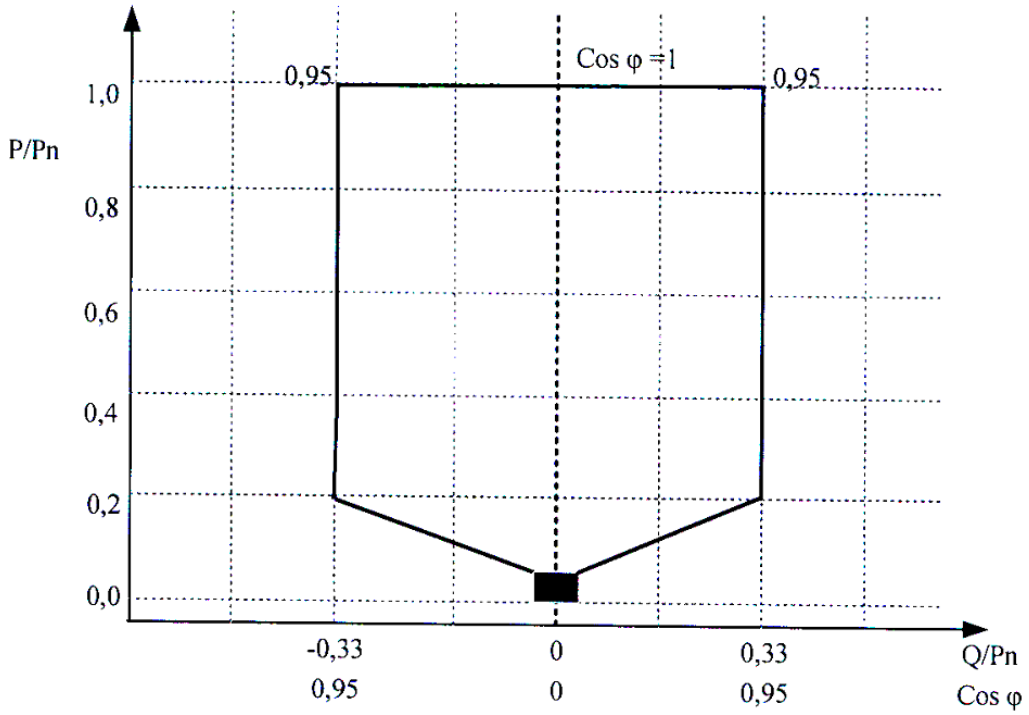
Table 8

Required minimum timelength for maintenance of power generation at wind and solar power generation plants in proportion to frequency bands of electricity systems

Frequency band	Required minimum timelength
From 47.5 Hz to 48.0 Hz	10 minutes
From greater than 48 Hz to less than 49 Hz	30 minutes
From 49 Hz to 51 Hz	Continuous generation
From greater than 51 Hz to 51.5 Hz	30 minutes
From greater than 51.5 Hz to 52 Hz	01 minute

3. When the electricity system’s frequency is greater than 50.5 Hz, wind and solar power plants may reduce active power on the comparative slope of droop characteristics within the steep gradient range of between 2% and 10%. Set value of the slope of droop characteristics is calculated and determined by the dispatch level vested with controlling rights.

4. Wind and solar power plants must be capable of adjusting reactive power according to characteristics shown in the following diagram and described in point a and b of this clause:



a) If a power plant generates an active power greater or equal to 20% of rated active power and voltage at a connection point in the nominal voltage band of ± 10%, such power plant must be capable of adjusting reactive power continuously in the power factor range from 0.95 (corresponding to reactive power generation mode) to 0.95 (corresponding to reactive power receiving mode) at the connection point in proportion to rated power;

b) If a power plant generates an active power less than 20% of rated power, such power plant may reduce ability to receive or generate reactive power in accordance with characteristics of the generating set.

5. Voltage control mode and reactive power:

a) Wind and solar power generation plants must be capable of controlling voltage and reactive power in the following modes:

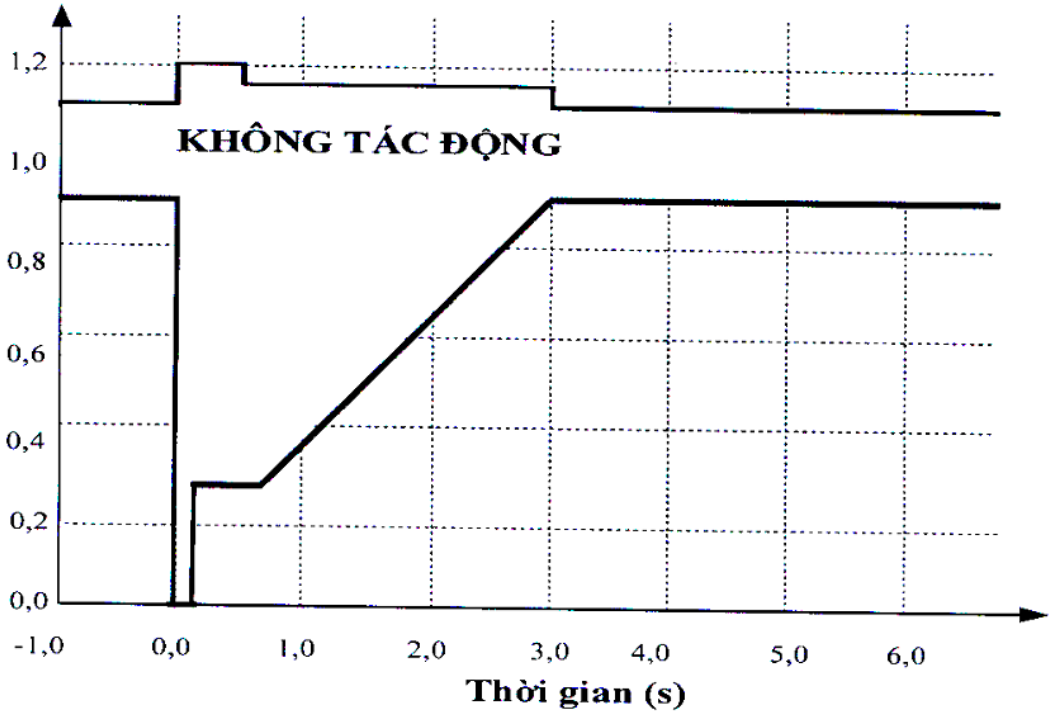
- Mode of controlling voltage according to voltage-adjusting droop characteristics (characteristics of the relation between voltage and reactive power);

- Mode of control according to the set value of reactive power;

- Mode of control according to power factors

b) If voltage at connection point is within the band of ± 10 % of rated voltage, a wind or solar power plant must be capable of adjusting voltage at the low-voltage side of the step-up transformer with deviation no more than ± 0,5 % of rated voltage (compared to set voltage value) whenever reactive power of the generating set is within the permissible working band for no longer than 05 seconds.

6. Wind and solar power plants which are, at any time, connected to transmission grids must be capable of maintaining generation of power commensurate with the voltage band at the connection point within the following specific time points:



a) If voltage is less than 0.3 pu, minimum maintenance time will be 0.15 second;

b) If voltage ranges from 0.3 pu to under 0.9 pu, minimum maintenance time will be calculated according to the following formula:

$$T_{min} = 4 \times U - 0.6$$

Where:

- T_{min} (second): Minimum time required to maintain power generation;

- U (pu): Actual voltage at connection point calculated by pu (relative value).

c) If voltage ranges from 0.9 pu to under 1.1 pu, wind and solar power plants must maintain continuous generation;

d) If voltage ranges from 1.1 pu to under 1.15 pu, wind and solar power plants must maintain power generation for 03 seconds;

dd) If voltage ranges from 1.15 pu to under 1.2 pu, wind and solar power plants must maintain power generation for 0.5 seconds.

7. The level of phase unbalance, total harmonic distortion and flicker perceptivity caused by wind or solar power plants at connection points shall not be allowed to exceed values specified in Article 6, 7 and 8 herein.

8. Wind or solar power plants must invest in control and automatic equipment and systems to ensure stable, reliable and confidential connection to Automatic Generation Control (AGC) of the electricity system and market operator serving remote control of their power generation capacity according to the dispatch instruction received from the electricity system and market operator.".

12. Article 41 shall be amended and supplemented as follows:

"Article 41. Requirements of solar power plants connected to power distribution grids at the minimum level of low voltage

In order to make connection to low-voltage power grids, solar power systems must meet the following requirements:

1. Connection capacity

a) Total installed capacity of the solar power system connected to the low voltage level of the step-down transformer substation shall not be allowed to exceed the installed capacity of that transformer substation;

b) Solar power system with the maximum capacity of less than 20 kWp may be connected to the 1-phase or 3-phase power grid according to an agreement with the power distribution grid operator, the

power distribution grid and retailing operator;

c) Solar power system with the minimum capacity of 20 kWp must be connected to the 3-phase power grid.

2. Solar power systems which are, at any time, connected to low-voltage power grids must be capable of maintaining generation of power for a minimum period of time in proportion to power-generating frequency band prescribed in Table 5a hereunder:

Table 5a

Minimum time of maintenance of generation in proportion to frequency bands of power systems

Frequency band	Required minimum timelength
From 48 Hz to 49 Hz	30 minutes
From 49 Hz to 51 Hz	Continuous generation
From 51 Hz to 51.5 Hz	30 minutes

3. If frequency is greater than 50.5 Hz, the solar power system with the minimum capacity of 20 kWp must reduce active power according to the following formula:

$$\Delta P = 20\ x\ P_m\ x\ \frac{50{,}5 - f_n}{50}$$

Where:

- ΔP: Level of reduction in active power (MW);

- P_m: Active power consistent with that determined at the time prior to power reduction (MW);

- f_n: Frequency of the power system prior to power reduction (Hz).

4. Solar power systems must be capable of maintaining continuous generation of power within voltage bands at connections as prescribed in Table 5b hereunder:

Table 5b

Minimum time of maintenance of generation in proportion to voltage bands at connections

Voltage at connections	Required minimum timelength
50% less than the nominal voltage	Not required
From 50% to 0.85 of the nominal voltage	2 seconds
From 85% to 110% of the nominal voltage	Continuous generation
From 110% to 120% of the nominal voltage	2 seconds
120% greater than the nominal voltage	Not required

5. Solar power systems connected to low-voltage power grids shall not export reactive power to power grids and shall operate in the mode of consumption of reactive power with the capacity factor (cosφ) greater than 0.98.

6. Solar power systems shall not cause invasion of direct current into power distribution grids to the extent that such current is 0.5% higher than the rated current at a connection point.

7. Solar power systems connected to low-voltage power grids must conform to regulations on voltage, phase balance, harmonics, flicker perceptivity and earthing mode prescribed in Article 5, 6, 7, 8 and 10 herein.

8. Solar power systems shall be equipped with security devices meeting the following requirements:

a) Automatically disconnect power distribution grids in case of failure occurring inside a solar power system;

b) Automatically disconnect power distribution grids in case of loss of power supplied from power distribution grids and do not generate power on power distribution grids in case of loss of electricity currently taking place on power distribution grids;

c) Do not automatically reconnect power grids due to inconformity with the following requirements:

- Power grid's frequency is maintained within the band from 48Hz to 51Hz during the minimum period of 60 seconds;

- Voltage of all phases at connections is maintained within the band from 85% to 110% of the nominal voltage during the minimum period of 60 seconds

d) With respect to solar power systems connected to 3-phase low-voltage power grids, customers demanding connection must negotiate and agree on requirements regarding security systems with the power distribution grid operator, inter alia including at least protections specified in point a, b and c of this clause, over-voltage, low-voltage and frequency protection".

13. Clause 2 of Article 42 shall be amended as follows:

"2. Requirements for connection from the Control Center

a) Requirements for connection to communications systems:

- There is a data transmission line to be connected to the information system of the dispatch level vested with controlling rights. If multiple dispatching levels with control authority exist, an information sharing method must be agreed by all the dispatching levels;

- There are two data transmission lines (working and standby) to be connected to the control and information system of power plants or stations remotely controlled by the Control Center;

- Means of communications serving dispatching activities, inter alia, including direct communication channel, telephone, facsimile, DIM and computer network, must be in good working condition.

b) Requirements for connection to the SCADA system:

- There is a connection to the SCADA of the dispatch level vested with controlling rights. If multiple dispatching levels with control authority exist, all the dispatching levels shall be responsible for sharing information;

- There are two connections to RTU/Gateway, control system of power plants, electricity stations and switchgears on the electrical grid remotely controlled by the Control Center.

c) The Control Center must install a monitoring screen and make connection to closed-circuit television cameras at power plants, electricity stations and switchgears on the electrical grid to send information to the Control Center.

14. Clause 3 shall be added to Article 43 as follows:

"3. If there is a shortage of information and documents prescribed in clause 2 of this Article at the time of submitting application for connection to medium-voltage and 110 kV distribution grids, customers using distribution grids shall be responsible for making an agreement with the power distribution grid operator on provision of information, documents and specifying such agreement in the connection agreement.".

15. The title of Article 44 shall be revised as follows:

"Article 44. Steps in reaching a connection agreement with customers using power distribution grids who apply for connection at the level of 110 kV voltage and customer owning generating sets who apply for connection to medium-voltage power grids"

16. Point c of clause 2 of Article 44 shall be amended as follows:

"c) Collect opinions from the dispatch level vested with controlling rights and units related to connection about any impact of connection on power systems, regional power grids, requests for connection to communications systems and SCADA systems of the dispatch levels vested with controlling rights, requirements concerning protection relays, automatization and other matters regarding technical requirements of devices at connection points;".

17. Clause 2 of Article 45 shall be amended as follows:

"2. Customers using power who install their own power substations connected to medium-voltage power grids: Within the maximum duration of 02 working days of receipt of all valid documentation from customers, the power distribution grid operator or the power distribution and retailing operator shall be responsible for surveying the site, negotiating and signing connection agreements with these customers.".

18. Clause 2 of Article 51 shall be amended as follows:

"2. Customers using power who install their own power substations connected to medium-voltage power grids: Within 05 working days of receipt of all application documentation for full completion of power connection at valid points of customers using power that install their own power stations connected to medium-voltage power grids in accordance with Article 48 herein, the power distribution grid operator shall be responsible for cooperating with customers in completing power connection for

trial test, carrying out commissioning and completing power connection for official distribution of power to customers applying for connection.".

19. Clause 2 and 6 of Article 52 shall be amended as follows:

"2. If two parties involved do not agree on test results and causes of any violation, they must negotiate on the scope of inspection in order for customers to hire independent testing bodies to carry out repeated inspection and test. If test results of independent testing bodies indicate violations are caused due to customer's devices, and customers refuse to remedial actions or fail to complete these actions within the duration agreed upon with the power distribution grid operator, this operator may disconnect customer's devices from power distribution grids. Remedial duration shall be agreed upon by two parties. If two parties do not agree on such duration, they may resolve dispute according to regulations on inspection of power activities, use of power and handling of dispute arising from power purchase agreements issued by the Ministry of Industry and Trade.".

6. During the operation period, if there is any risk to operational safety of the power system which is caused by customer's devices, the power distribution grid operator must immediately inform the dispatch level vested with controlling rights, customers using power distribution grids that install their own power stations in order to take remedial actions and eliminate any risk to operational safety for the power system. If such risk to operational safety is caused by technical errors which are unable to be corrected or there is any suspect that customers cause adverse impacts during use of power distribution grids, the power distribution grid operator may request customers to carry out re-inspection or retesting of devices within customer's remit in accordance with clause 1 and 2 of this Article.".

20. Point d of clause 2 of Article 64 shall be amended as follows:

"d) The power generating unit shall be responsible for providing information about primary energy source (hydrographical information necessary for hydropower plants, information about coal – oil – combustible substances necessary for thermopower plants, meteorological monitoring information necessary for wind or solar power plants), forecast power generation plant's capacity and output, and transmitting data to the electricity system and market operator."

21. Article 79 shall be amended as follows:

"Article 79. Electrical load control

1. Control of electrical loads in a power system shall comprise the following measures:

a) Suspension and decrease of power supply;

b) Load shedding;

c) Adjustment in loads of customers using power during their participation in programs for management of power demands.

2. Dispatch levels vested with controlling rights and the power distribution grid operator shall take control of loads according to procedures for dispatch of the national electricity system and Regulations on contents and procedures for implementation of programs for load adjustment adopted by the Ministry of Industry and Trade.".

22. Clause 1 of Article 82 shall be amended as follows:

"1. Automatic load shedding is an act by a frequency, voltage and power relay to selectively get rid of a load in order to keep a power system operate within the permissible limit and prevent any large-scale losses in electricity.". 23. Clause 4 shall be added to Article 99 as follows:

"4. The Electricity Corporation of Vietnam and the electricity distribution system operator shall be responsible for submitting written reports under clause 1, 2 and 3 of this Article by post and electronic mail.".

Article 3. Repeal of several articles and clauses of the Circular No. 25/2016/TT-BCT dated November 30, 2016 of the Minister of Industry and Trade on electricity transmission system and Circular No. 39/2015/TT-BCT dated November 18, 2015 of Minister of Industry and Trade on electricity distribution system

1. Repealing clause 8 and 9, clause 36 of Article 3 and Chapter IV in the Circular No. 25/2016/TT-BCT dated November 30, 2016 of the Minister of Industry and Trade on electricity transmission system.

2. Repealing Chapter IV and Article 101 of Circular No. 39/2015/TT-BCT dated November 18, 2015 of the Minister of Industry and Trade on electricity distribution system.

Article 4. Entry into force

1. This Circular shall enter into force on January 3, 2020.

2. In the course of implementation of this Circular, if there is any difficulty that may arise, entities concerned shall send feedbacks to the Electricity Regulatory Authority to seek its decision within its jurisdiction or for its reporting to the Ministry of Industry and Trade to consider any possible solutions./.

MINISTER

Tran Tuan Anh