Order no. 214 of 19.12.2018

amending and supplementing Order no. 72/2017 of the President of the National Energy Regulatory Authority approving the technical norm on the technical requirements to connect synchronous power-generating modules to public electrical grids

In view of the provisions of Article 36 (7) (n) of the Electricity and Natural Gas Act no. 123/2012, as subsequently amended and supplemented, of Article 7 (1) and (4) of Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators, of Article 6 (11) of the Regulation (EC) No. 714/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No. 1228/2003,

pursuant to the provisions of Article 5 (1) (c) and (d) and of Article 9 (1) (h) of the Emergency Government Ordinance no. 33/2007 on the organization and functioning of the National Energy Regulatory Authority, approved as subsequently amended and supplemented by Law no. 160/2012, as subsequently amended and supplemented,

the President of the National Energy Regulatory Authority hereby issues the present order:

Article I. Order no. 72/2017 of the President of the National Energy Regulatory Authority approving the technical norm on the technical requirements to connect synchronous power-generating modules to public electrical grids, published in the Official Journal of Romania, Part I, no. 688 and 688 bis of 24 August 2017, is hereby amended and supplemented as follows:

1. Article 4 is amended and shall have the following contents:

"Article 4. On the date of entry into force of this order, the following shall be abrogated:

a) Article 40, provisions of chapter 5.4.1. "Dispatchable generating units connected to public interest grids", the provisions of chapter 5.4.2. "Requirements for the telecommunication equipment", except Article 176 and the provisions of chapter 5.4.4. "Telecom, data

acquisition and tele-metering systems", except Article 187, of the Technical Transmission Grid Code, Part I – General basic rules, approved by Order no. 20/2004 of the President of the National Energy Regulatory Authority, published in the Official Journal of Romania, Part I, no. 828 of 8 September 2004, as subsequently amended and supplemented;

b) the provisions of chapters 4.4.1. "Dispatchable generating units" and 4.4.3. "Telecom and data acquisition systems", except points 4.4.3.1. and 4.4.3.2. from the Technical Code of Electrical Distribution, approved by Order no. 128/2008 of the President of the National Energy Regulatory Authority, published in the Official Journal of Romania, Part I, no. 43 of 26 January 2009."

2. The annex shall be amended and supplemented as follows:

a) In Article 3, paragraph (1) letter (a), point **(iv)** is amended and shall have the following contents:

"iv) the modernization/refurbishment works are the following:

1. replacement of the synchronous alternator or modification of the voltage regulator type (including excitation systems), speed controller, PSS and modification of the synchronous and transient reactance respectively, modification of the P-Q-profile introducing new compensation equipments, the modification of the reactive/active power control systems, provided that such modifications allow compliance with the provisions of this technical norm;

2. modification of the generation capacity of the synchronous power-generating module which leads to an increase in maximum capacity of at least 10% for C type synchronous power-generating modules and of at least 5% for D type modules respectively;

3. increasing the category of the synchronous power-generating module to a higher category."

b) In Article 3, **paragraph (2),** letter **(b)** is amended and shall have the following contents:

"(b) the synchronous power-generating module owner concluded a firm contract for purchasing the main generating plant, within a maximum of two years from the date of entry into force of the Regulation, namely until 17.05.2018. The power-generating facility owner has the obligation to notify the relevant system operator (TSO or DSO, as the case may be) regarding the conclusion of the contract no later than 30 months from the date of entry into force of the Regulation. The notification submitted by the power-generating facility owner to

the RSO and to the TSO shall at least indicate the contract title, its date of signature and date of entry into force and the specifications of the main generating plant to be constructed, assembled or purchased."

c) After Article 7 a new Article is introduced – Article 7^1, which shall have the following contents:

"Article 7^1. (1) For synchronous generating units connected to networks related to industrial platforms, their classification is based on their maximum capacity (power), irrespective of the voltage level to which they are connected.

(2) The owner of the industrial platform networks, in coordination with the DSO or the TSO, as the case may be, may request (via the tender specifications) additional connection requirements specific to the D type (if the voltage of the industrial platform's connection point is higher than or equal to 110 kV), accompanied by a technical justification clarifying that such requirements aim at ensuring the operational security of the industrial platform."

d) In **Article 9, letter (b)** is amended and shall have the following contents:

"(b) With regard to the capability of supporting frequency variation rates:

i) the synchronous power-generating module must remain connected to the network and must operate at frequency variation rates of no more than ±2 Hz/sec for a time period of 500 ms, of no more than ±1.5 Hz/s for a time period of 1000 ms and of no more than ±1.25 Hz/s for a time period of 2000 ms, depending on the technology type and the short-circuit power of the system at the connection point, as well as the inertia available at synchronous area level.

ii) the values provided in point (i) shall be notified to the synchronous power-generating module owner when issuing the TCA.

iii) the relevant system operator shall coordinate the protection control at the connection point at the frequency variation rate of the synchronous power-generating module, at the time of commissioning."

Table 1A. Minimum duration for which a synchronous power-generating module has to be capable to remain connected to the network and to operate at different frequencies, deviating from the nominal value

Frequency range	Duration for operation
47.5 Hz – 48.5 Hz	Minimum 30 minutes
48.5 Hz – 49 Hz	Minimum 30 minutes
49 Hz – 51 Hz	Unlimited
51.0 Hz – 51.5 Hz	30 minutes

e) Article 10 is amended and shall have the following contents:

"Article 10. Type A synchronous power-generating modules shall be capable to ensure a limited frequency response, namely to frequency increases above the nominal value of 50 Hz (LFSM-O), thus:

(a) at overfrequencies, the synchronous power-generating module shall decrease the active power output according to the frequency variation, in accordance with figure 1A and with the following parameters:

i) the frequency threshold from which the synchronous power-generating module ensures overfrequency response is 50.2 Hz;

ii) the droop settings shall be between 2% and 12% and shall be disposed by the relevant system operator via dispach instructions, at the synchronous power-generating module's commissioning. Usually, the droop value equals 5%;

iii) the synchronous power-generating module shall be capable of decreasing the active power related to the frequency variation with an initial delay that is lower than 2 seconds. If that delay is greater than two seconds, the synchronous power-generating module owner shall justify the delay, providing technical evidence to the TSO. The time for power decrease in the event of overfrequency shall be lower than or equal to 8 seconds for a power variation of 45% from the maximum active power.

(b) when reaching the power corresponding to the frequency deviation (under automated control) up to the minimum control power, the synchronous power-generating module shall be capable:

i) to stabilize the activated power within the admissible tolerance range (usually ±5% P_n), within a duration of no more than 30 seconds and continuing its operation at this level; or

ii) continuing to reduce the active power output according to the dispach instructions and in accordance with its own technical particularity submitted together with the technical data and which does not deviate from the

functional particularities of synchronous power-generating modules of the same type.

(c) the admissible deviation for reaching the minimum control level equals to ±5% P_n;

(d) the synchronous power-generating module shall be stable during operation in the LFSM-O mode during frequency increases over 50.2 Hz. So long LFSM-O is active, the LFSM-O setpoint shall prevail over any other active power setpoints."

f) Article 12 is amended and shall have the following contents:

"Article 12. The TSO sets the active power output reduction of the synchronous power-generating module compared to the maximum active power output following the frequency decrease, within the admissible limits specified in figure 2A, hence:

(a) at underfrequencies below 49 Hz, an active power output reduction from the maximum power output is admitted at a percentage of 2% from the maximum active power output at the frequency of 50 Hz, for every 1 Hz of frequency decrease. The maximum time needed for system frequency containment and for active power reduction equals to 30 seconds (t2). Any maximum active power output reduction curve depending on the frequency, situated above the dotted line, is admitted;

(b) at underfrequencies below 49.5 Hz, an active power output reduction from the maximum active power output is admitted at a percentage of maximum 10% from the maximum active power output at the frequency of 50 Hz, for every 1 Hz of frequency decrease, if the frequency is lower than 49.5 Hz for a duration of over 30 s. The maximum time for maintaining the generated (reduced) active power at underfrequency equals to 30 minutes (t3), in the absence of dispatch instructions, provided that the frequency does not drop below 47.5 Hz. Any maximum active power reduction curve depending on the frequency, situated above the continuous line is admitted.

(c) in the particular case of gas turbine-fueled synchronous power-generating modules, t3 has the value provided in letter (b)."

g) Article 13 is amended and shall have the following contents:

"Article 13. (1) The admissible active power reduction compared to the maximum active power output in case of frequency deviations under 49.5 Hz is established:

(a) under standard environmental conditions related to a temperature of 20 degrees Celsius;

(b) depending on the technical capability of synchronous power-generating modules.

(2) The synchronous power-generating module owner shall provide the relevant system operator and the TSO the dependency diagram of the active power in terms of temperature factors, for at least one set of temperatures: -10^{0}C, 0^{0}C, 15^{0}C, 25^{0}C, 30^{0}C, 40^{0}C and the technical data regarding the synchronous power-generating module's technical capability as set forth in Annex no. 1 to this technical norm.

(3) In the particular case of gas turbine-fueled synchronous power-generating modules, the synchronous power-generating module owner shall provide the relevant system operator and the TSO the dependency diagram of the active power in terms of temperature factors, for at least one set of temperatures: -10^{0}C, -5^{0}C, 0^{0}C, 5^{0}C, 10^{0}C, 15^{0}C, 25^{0}C, 30^{0}C, 35^{0}C ,40^{0}C, 45^{0}C and 50^{0}C, as well as the technical data regarding the synchronous power-generating module's technical capability as set forth in Annex no. 1 to this technical norm.

(4) When specifying the admissible active power reduction compared to the maximum active power output, the relevant system operator considers the technical limitations of the synchronous power-generating module.

(5) The data provided in paragraphs (2) and (3) shall be submitted during the commissioning stage within the connection process. "

h) Article 14 is amended and shall have the following contents:

"Article 14. (1) The synchronous power-generating module shall be equipped with a logic interface in order to reduce the active power output to the point of shut-down in a time period of no more than five seconds after receiving the disconnect command.

(2) During grid operation in normal state, the synchronous power-generating module shall:

a) not produce fast voltage fluctuations at the connection/interface point, as the case may be, greater than ±5% of the nominal voltage of the network to which it is connected;

b) ensure, at the connection/interface point, as the case may be, the power quality according to applicable standards (European standards and the performance standards for the transmission or distribution grid, as the case may be), irrespective of the operational auxiliary installations and regardless of the active power output.

(3) The synchronous power-generating module is monitored in terms of power quality at the connection point during tests performed for verifying the compliance with the connection technical requirements."

i) In **Article 15, paragraph (2)** is amended and shall have the following contents:

"(2) Requirements set forth in paragraph (1) include:

(a) the frequency range in which the automatic connection is accepted, namely (47.5÷51) Hz, the voltage range (0.9-1.1) U_n, the observation period (including the synchronization time) of maximum 300 seconds;

(b) the slope admitted for the active power increase after connection, of maximum 20% of P_n/min (indicated by the synchronous power-generating module manufacturer)."

j) Article 17 shall be abrogated.

k) Article 20 is amended and shall have the following contents:

"Article 20. Type B synchronous power-generating modules shall fulfil the following requirements in relation to frequency stability:

(a) the synchronous power-generating module shall be capable of remaining connected to the network and operate within the frequency ranges and time periods specified in table 1B;

(b) With regard to the capability of supporting frequency variation rates:

i) the synchronous power-generating module must remain connected to the network and must operate at frequency variation rates of no more than ±2 Hz/sec for a time period of 500 ms, of no more than ±1.5 Hz/s for a time period of 1000 ms and of no more than ±1.25 Hz/s for a time period of 2000 ms, depending on the technology type and the short-circuit power of the system at the connection point, as well as the inertia available at synchronous area level.

ii) the values provided in point (i) shall be notified to the synchronous power-generating module owner when issuing the TCA.

iii) the relevant system operator shall coordinate the protection control at the connection point at the frequency variation rate of the synchronous power-generating module, at the time of commissioning."

Table 1B. Minimum duration for which a synchronous power-generating module has to be capable to remain connected to the network and to operate at different frequencies, deviating from the nominal value

Frequency range	**Duration for operation**
47.5 Hz – 48.5 Hz	Minimum 30 minutes
48.5 Hz – 49 Hz	Minimum 30 minutes
49 Hz – 51 Hz	Unlimited
51.0 Hz – 51.5 Hz	30 minutes

l) Article 21 is amended and shall have the following contents:

"**Article 21.** Type B synchronous power-generating modules shall be capable to ensure a limited frequency response, namely to frequency increases above the nominal value of 50 Hz (LFSM-O), thus:

(a) at overfrequencies, the synchronous power-generating module shall decrease the active power output according to the frequency variation, in accordance with figure 1B and with the following parameters:

i) the frequency threshold from which the synchronous power-generating module ensures overfrequency response is 50.2 Hz;

ii) the droop settings shall be between 2% and 12% and shall be provided by the relevant system operator via dispatch instructions, at the synchronous power-generating module's commissioning. Usually, the droop value equals 5%;

iii) the synchronous power-generating module shall be capable of decreasing the active power related to the frequency variation with an initial delay that is lower than 2 seconds. If that delay is greater than two seconds, the synchronous power-generating module owner shall justify the delay, providing technical evidence to the TSO. The time for power decrease in the event of overfrequency shall be lower than or equal to 8 seconds for a power variation of 45% from the maximum active power.

(b) when reaching the power corresponding to the frequency deviation (under automated control) up to the minimum control power (set minimum power), the synchronous power-generating module shall be capable:

i) to stabilize the activated power within the admissible tolerance range (usually ±5% P_n), within a duration of no more than 30 seconds and continuing its operation at this level; or

ii) continuing to reduce the active power output according to the dispatch instructions and in accordance with its own technical particularity submitted together with the technical data, which does not deviate from the functional particularities of synchronous power-generating modules of the same type.

(c) the admissible deviation for reaching the minimum control level equals to ±5% P_n;

(d) the synchronous power-generating module shall be stable during operation in the LFSM-O mode during frequency increases over 50.2 Hz. So long LFSM-O is active, the LFSM-O setpoint shall prevail over any other active power setpoints."

m) Article 23 is amended and shall have the following contents:

"Article 23 The TSO sets the active power output reduction of the type B synchronous power-generating module compared to the maximum active power output following the frequency decrease, within the admissible limits specified in figure 2B, hence:

(a) at underfrequencies below 49 Hz, an active power output reduction from the maximum power output is admitted at a percentage of 2% from the maximum active power output at the frequency of 50 Hz, for every 1 Hz of frequency decrease. The maximum time needed for system frequency containment and for active power reduction equals to 30 seconds (t2). Any maximum active power output reduction curve depending on the frequency situated above the dotted line is admitted;

(b) at underfrequencies below 49.5 Hz, an active power output reduction from the maximum active power output is admitted at a percentage of maximum 10% from the maximum active power output at the frequency of 50 Hz, for every 1 Hz of frequency decrease. The maximum time for maintaining the generated (reduced) active power at underfrequency equals to 30 minutes (t3), in the absence of dispatch instructions, provided that the frequency does not drop below 47.5 Hz. Any maximum active power reduction curve depending on the frequency situated above the continuous line is admitted.

(c) in the particular case of gas turbine-fueled synchronous power-generating modules, t3 has the value provided in letter (b)."

n) Article 24 is amended and shall have the following contents:

"Article 24 (1) The admissible active power reduction compared to the maximum active power output in case of frequency deviations under 49.5 Hz is established:

(a) under standard environmental conditions related to a temperature of 20 degrees Celsius;

(b) depending on the technical capability of synchronous power-generating modules.

(2) The synchronous power-generating module owner shall provide the relevant system operator and the TSO the dependency diagram of the active power in terms of temperature factors, for at least one set of temperatures: -10^0C, 0^0C, 15^0C, 25^0C, 30^0C, 40^0C and the technical data regarding the synchronous power-generating module's technical capability as set forth in Annex no. 2 to this technical norm.

(3) In the particular case of gas turbine-fueled synchronous power-generating modules, the synchronous power-generating module owner shall provide the relevant system operator and the TSO with the dependency diagram of the active power in terms of temperature factors, for at least one set of temperatures: -10^0C, -5^0C, 0^0C, 5^0C, 10^0C, 15^0C, 25^0C, 30^0C, 35^0C, 40^0C,

45^0C and 50^0C, as well as the technical data regarding the synchronous power-generating module's technical capability as set forth in Annex no. 2 to this technical norm.

(4) When specifying the admissible active power reduction compared to the maximum active power output, the relevant system operator considers the technical limitations of synchronous power-generating modules.

(5) The data provided in paragraphs (2) and (3) shall be submitted during the commissioning stage within the connection process."

o) In **Article 26, paragraph (2)** is amended and shall have the following contents:

"(2) Requirements set forth in paragraph (1) include:

(a) the frequency range in which the automatic connection is accepted, namely (47.5÷51) Hz, the voltage range (0.9-1.1) U_n, the observation period (including the synchronization time) of maximum 300 seconds;

(b) the slope admitted for the active power increase after connection, usually of maximum 20% of P_n/min (indicated by the synchronous power-generating module manufacturer)."

p) Article 27 is amended and shall have the following contents:

"Article 27. Type B synchronous power-generating modules shall fulfil the following requirements in relation to active load-frequency control:

(a) in order to control active power output, the synchronous power-generating module shall be equipped with an interface (input port) in order to be able to receive a setpoint for the purposes of reducing power. The synchronous power-generating module shall perform the power target within no more than 60 seconds, with a precision of ±5% P_n; and

(b) the relevant system operator shall have the right to specify the requirements for further equipment to allow active power output to be remotely operated."

q) In Article 35, letter (b) is amended and shall have the following contents:

"(b) With regard to the capability of supporting frequency variation rates:

i) the synchronous power-generating module must remain connected to the network and must operate at frequency variation rates of no more than ±2 Hz/sec for a time period of 500 ms, of no more than ±1.5 Hz/s for a time period of 1000 ms and of no more than ±1.25 Hz/s for a time period of 2000 ms, depending on the technology type and the short-circuit power of the

system at the connection point, as well as the inertia available at synchronous area level.

ii) the values provided in point (i) shall be notified to the synchronous power-generating module owner when issuing the TCA.

iii) the relevant system operator shall coordinate the protection control at the connection point at the frequency variation rate of the synchronous power-generating module, at the time of commissioning."

Table 1C. Minimum duration for which a synchronous power-generating module has to be capable to remain connected to the network and to operate at different frequencies, deviating from the nominal value

Frequency range	**Duration for operation**
47.5 Hz – 48.5 Hz	Minimum 30 minutes
48.5 Hz – 49 Hz	Minimum 30 minutes
49 Hz – 51 Hz	Unlimited
51.0 Hz – 51.5 Hz	30 minutes

r) Article 36 is amended and shall have the following contents:

"Article 36. Type C synchronous power-generating modules shall be capable to ensure a limited frequency response, namely to frequency increases above the nominal value of 50 Hz (LFSM-O), thus:

(a) at overfrequencies, the synchronous power-generating module shall decrease the active power output according to the frequency variation, in accordance with figure 1C and with the following parameters:

i) the frequency threshold from which the synchronous power-generating module ensures overfrequency response is 50.2 Hz;

ii) the droop settings shall be between 2% and 12% and shall be provided by the relevant system operator via dispatch instructions, at the synchronous power-generating module's commissioning. Usually, the droop value equals 5%;

iii) the synchronous power-generating module shall be capable of decreasing the active power related to the frequency variation with an initial delay that is lower than 2 seconds. If that delay is greater than two seconds, the synchronous power-generating module owner shall justify the delay, providing technical evidence to the TSO. The time for power decrease in the event of overfrequency shall be lower than or equal to 8 seconds for a power variation of 45% from the maximum active power.

(b) when reaching the power corresponding to the frequency deviation (under automated control) up to the minimum control power, the synchronous power-generating module shall be capable:

i) to stabilize the activated power within the admissible tolerance range (usually ±5% P_n), within a duration of no more than 30 seconds and continuing its operation at this level; or

ii) continuing to reduce the active power output according to the dispatch instructions and in accordance with its own technical particularity submitted together with the technical data, which does not deviate from the functional particularities of synchronous power-generating modules of the same type.

(c) the admissible deviation for reaching the minimum control level equals to ±5% P_n;

(d) the synchronous power-generating module shall be stable during operation in the LFSM-O mode during frequency increases over 50.2 Hz. So long LFSM-O is active, the LFSM-O setpoint shall prevail over any other active power setpoints."

s) Article 38 is amended and shall have the following contents:

"Article 38. The TSO sets the active power output reduction of the type C synchronous power-generating module compared to the maximum active power output following the frequency decrease, within the admissible limits specified in figure 2C, hence:

(a) at underfrequencies below 49 Hz, an active power output reduction from the maximum power output is admitted at a percentage of 2% from the maximum active power output at the frequency of 50 Hz, for every 1 Hz of frequency decrease. The maximum time needed for system frequency containment and for active power reduction equals to 30 seconds (t2). Any maximum active power output reduction curve depending on the frequency situated above the dotted line is admitted;

(b) at underfrequencies below 49.5 Hz, an active power output reduction from the maximum active power output is admitted at a percentage of maximum 10% from the maximum active power output at the frequency of 50 Hz, for every 1 Hz of frequency decrease. The maximum time for maintaining the generated (reduced) active power at underfrequency equals to 30 minutes (t3), in the absence of dispatch instructions, provided that the frequency does not drop below 47.5 Hz. Any maximum active power reduction curve depending on the frequency situated above the continuous line is admitted.

(c) in the particular case of gas turbine-fueled synchronous power-generating modules, t3 has the value provided in letter (b)."

t) Article 39 is amended and shall have the following contents:

"Article 39. (1) The admissible active power reduction compared to the maximum active power output in case of frequency deviations under 49.5 Hz is established:

(a) under standard environmental conditions related to a temperature of 20 degrees Celsius;

(b) depending on the technical capability of synchronous power-generating modules.

(2) The synchronous power-generating module owner shall provide the relevant system operator and the TSO with the dependency diagram of the active power in terms of temperature factors, for at least one set of temperatures: -10^0C, 0^0C, 15^0C, 25^0C, 30^0C, 40^0C and the technical data regarding the synchronous power-generating module's technical capability as set forth in Annex no. 3 to this technical norm.

(3) In the particular case of gas turbine-fueled synchronous power-generating modules, the synchronous power-generating module owner shall provide the relevant system operator and the TSO with the dependency diagram of the active power in terms of temperature factors, for at least one set of temperatures: -10^0C, -5^0C, 0^0C, 5^0C, 10^0C, 15^0C, 25^0C, 30^0C, 35^0C ,40^0C, 45^0C and 50^0C, as well as the technical data regarding the synchronous power-generating module's technical capability as set forth in Annex no. 3 to this technical norm.

(4) When specifying the admissible active power reduction compared to the maximum active power output, the relevant system operator considers the technical limitations of synchronous power-generating modules.

(5) The data provided in paragraphs (2) and (3) shall be submitted during the commissioning stage within the connection process."

u) In Article 40, paragraph (2) is amended and shall have the following contents:

"(2) The time to reach the active power setpoint or the rate of change of active power output when adjusting the setpoint falls within the (2÷40)% P_n/min range depending on the technology, while the time delay (the time elapsed until the movement of the primary motor) equals 2 seconds and the setpoint fulfillment tolerance is of 5% P_n."

v) In Article 42, paragraph (2) is amended and shall have the following contents:

"(2) Requirements set forth in paragraph (1) include:

(a) the frequency range in which the automatic connection is accepted, namely (47.5÷51) Hz, the voltage range (0.9-1.1) U_n, the observation period (including the synchronization time) of maximum 300 seconds;

(b) the slope admitted for the active power increase after connection, usually of maximum 20% of P_n/min (indicated by the synchronous power-generating module manufacturer)."

x) Article 43 is amended and shall have the following contents:

"Article 43. Type C synchronous power-generating modules shall be capable to ensure a limited frequency response, namely to frequency decreases (LFSM-U), thus:

(a) it must be capable to mobilize active power response at underfrequencies below the 49.8 Hz frequency threshold and with a droop set by the TSO for every synchronous power-generating module at the time of PIF or via instructions within the (2÷12)% limits, usually at the 5% value, according to figure 3C.

(b) the activation of active power frequency response by the power-generating module shall not be unjustified delayed. If this delay (called time delay and marked with t_1 in figure 5C) is greater than two seconds, the synchronous power-generating module owner shall justify the delay towards the TSO.

(c) while operating in the LFSM-U mode, the synchronous power-generating module shall ensure a power increase up to the maximum power. Usually, a power increase of 20% of P_n following a frequency drop shall be performed within maximum 5 minutes;

(d) the synchronous power-generating module shall operate stably during the LFSM-U mode at frequencies lower than 49.8 Hz. Power maintaing within the tolerance range of 2.5% P_n shall be performed within a time period of maximum 6 minutes."

w) In Article 44, letter (b) and table 2C are amended and shall have the following contents:

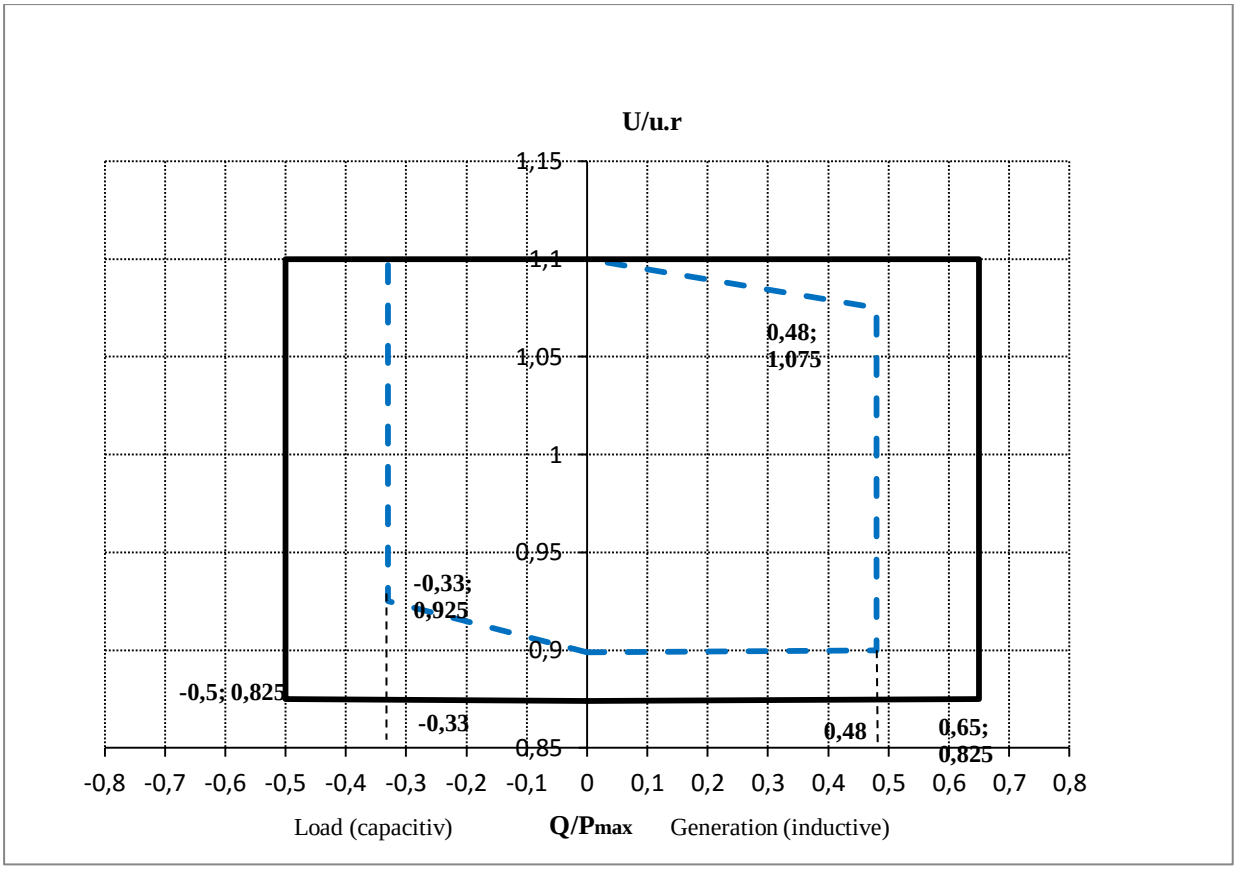
"(d) the delay in the activation of active power frequency response (time delay) shall not be greater than 2 seconds and shall not be unjustified delayed. If the delay in initial activation is greater than two seconds, the synchronous power-generating module owner shall provide technical evidence demonstrating why a longer time is needed;"

Table 2C. Parameters for active power frequency response in FSM (see figure 5C)

Parameters		Ranges
Active power range related to maximum power $\frac{\lvert\Delta P_1\rvert}{P_{\max}}$		1.5 – 10%
Frequency response insensitivity	$\lvert\Delta f_i\rvert$	10 mHz
	$\frac{\lvert\Delta f_i\rvert}{f_n}$	0.02 – 0.06%
Frequency response deadband * *After the qualification of groups for the provision of frequency containment reserves (FCR), this value is set at 0 mHz for FCR providing groups, and for other groups the TSO shall decide to set the value different to 0 mHz so that the impact on the frequency control is kept at a minimum		0 mHz
Droop s_1 depending on the power park type (hydropower plant, thermal power plant, mixed-cycle etc.)** **The droop of groups is specified by the TSO at the values necessary to cover the control reserve for frequency containment, set at NPS level (only in groups providing frequency containment control). Usually, for hydropower plants, the droop equals to (4÷5)%, ensuring a reserve of (10÷8)% of P_n, and for thermal power plants, the droop equals to (5÷8)%, ensuring a reserve of (8÷5)% of P_n.		2 – 12%

y) In Article 49, figure 7C is amended and shall have the following contents:

Figure 7C. U-Q/P_{max}-profile of a synchronous power-generating module



z) In Article 53, letter (b) and table 1D are amended and shall have the following contents:

"(b) With regard to the capability of supporting frequency variation rates:

i) the synchronous power-generating module must remain connected to the network and must operate at frequency variation rates of no more than ±2 Hz/sec for a time period of 500 ms, of no more than ±1.5 Hz/s for a time period of 1000 ms and of no more than ±1.25 Hz/s for a time period of 2000 ms, depending on the technology type and the short-circuit power of the system at the connection point, as well as the inertia available at synchronous area level.

ii) the values provided in point (i) shall be notified to the synchronous power-generating module owner when issuing the TCA.

iii) the relevant system operator shall coordinate the protection control at the connection point at the frequency variation rate of the synchronous power-generating module, at the time of commissioning."

Table 1D: Minimum duration for which a type D synchronous power-generating module has to be capable to remain connected to the network and to operate at different frequencies, deviating from the nominal value

Frequency range	Duration for operation
47.5 Hz – 48.5 Hz	Minimum 30 minutes
48.5 Hz – 49 Hz	Minimum 30 minutes
49 Hz – 51 Hz	Unlimited
51.0 Hz – 51.5 Hz	30 minutes

aa) Article 54 is amended and shall have the following contents:

"Article 54. Type D synchronous power-generating modules shall be capable to ensure a limited frequency response, namely to frequency increases above the nominal value of 50 Hz (LFSM-O), thus:

(a) at overfrequencies, the synchronous power-generating module shall decrease the active power output according to the frequency variation, in accordance with figure 1D and with the following parameters:

i) the frequency threshold from which the synchronous power-generating module ensures overfrequency response is 50.2 Hz;

ii) the droop settings shall be between 2% and 12% and shall be provided by the relevant system operator via dispatch instructions, at the synchronous power-generating module's commissioning. Usually, the droop value equals 5%.

iii) the synchronous power-generating module shall be capable of decreasing the active power related to the frequency variation with an initial delay that is lower than 2 seconds. If that delay is greater than two seconds, the synchronous power-generating module owner shall justify the delay, providing technical evidence to the TSO. The time for power decrease in the event of overfrequency shall be lower than or equal to 8 seconds for a power variation of 45% from the maximum active power.

(b) when reaching the power corresponding to the frequency deviation (under automated control) up to the minimum control power, the synchronous power-generating module shall be capable:

i) to stabilize the activated power within the admissible tolerance range (usually ±5% P_n), within a duration of no more than 30 seconds and continuing its operation at this level; or

ii) continuing to reduce the active power output according to the dispatch instructions and in accordance with its own technical particularity submitted together with the technical data, which does not deviate from

the functional particularities of synchronous power-generating modules of the same type.

(c) the admissible deviation for reaching the minimum control level equals to ±5% P_n;

(d) the synchronous power-generating module shall be stable during operation in the LFSM-O mode during frequency increases over 50.2 Hz. So long LFSM-O is active, the LFSM-O setpoint shall prevail over any other active power setpoints."

ab) Article 56 is amended and shall have the following contents:

"**Article 56.** The TSO sets the active power output reduction of the type D synchronous power-generating module compared to the maximum active power output following the frequency decrease, within the admissible limits specified in figure 2D, hence:

(a) at underfrequencies below 49 Hz, an active power output reduction from the maximum power output is admitted at a percentage of 2% from the maximum active power output at the frequency of 50 Hz, for every 1 Hz of frequency decrease. The maximum time needed for system frequency containment and for active power reduction equals to 30 seconds (t2). Any maximum active power output reduction curve depending on the frequency situated above the dotted line is admitted;

(b) at underfrequencies below 49.5 Hz, an active power output reduction from the maximum active power output is admitted at a percentage of maximum 10% from the maximum active power output at the frequency of 50 Hz, for every 1 Hz of frequency decrease. The maximum time for maintaining the generated (reduced) active power at underfrequency equals to 30 minutes (t3), in the absence of dispatch instructions, provided that the frequency does not drop below 47.5 Hz. Any maximum active power reduction curve depending on the frequency situated above the continuous line is admitted.

(c) in the particular case of gas turbine-fueled synchronous power-generating modules, t3 has the value provided in letter (b)."

ac) Article 57 is amended and shall have the following contents:

"**Article 57.** (1) The admissible active power reduction compared to the maximum active power output in case of frequency deviations under 49.5 Hz is established:

(a) under standard environmental conditions related to a temperature of 20 degrees Celsius;

(b) depending on the technical capability of synchronous power-generating modules.

(2) The synchronous power-generating module owner shall provide the relevant system operator and the TSO with the dependency diagram of the active power in terms of temperature factors, for at least one set of temperatures: -10^0C, 0^0C, 15^0C, 25^0C, 30^0C, 40^0C and the technical data regarding the synchronous power-generating module's technical capability as set forth in Annex no. 4 to this technical norm.

(3) In the particular case of gas turbine-fueled synchronous power-generating modules, the synchronous power-generating module owner shall provide the relevant system operator and the TSO with the dependency diagram of the active power in terms of temperature factors, for at least one set of temperatures: -10^0C, -5^0C, 0^0C, 5^0C, 10^0C, 15^0C, 25^0C, 30^0C, 35^0C ,40^0C, 45^0C and 50^0C, as well as the technical data regarding the synchronous power-generating module's technical capability as set forth in Annex no. 4 to this technical norm.

(4) When specifying the admissible active power reduction compared to the maximum active power output, the relevant system operator considers the technical limitations of synchronous power-generating modules.

(5) The data provided in paragraphs (2) and (3) shall be submitted during the commissioning stage within the connection process.

ad) In **Article 58, paragraph (2)** is amended and shall have the following contents:

"(2) The time to reach the active power setpoint or the rate of change of active power output when adjusting the setpoint falls within the (2÷40)% P_n/min range depending on the technology, while the time delay (the time elapsed until the movement of the primary motor) equals 2 seconds and the setpoint fulfillment tolerance is of 5% P_n."

ae) Article 60 is amended and shall have the following contents:

"Article 60. Type D synchronous power-generating modules shall be capable to ensure a limited frequency response, namely to frequency decreases (LFSM-U), thus:

(a) it must be capable to mobilize active power response at underfrequencies below the 49.8 Hz frequency threshold and with a droop set by the TSO for every synchronous power-generating module at the time of PIF or via instructions within the (2÷12)% limits, usually at the 5% value, according to figure 3D.

(b) the activation of active power frequency response by the power-generating module shall not be unjustified delayed. If this delay (called time delay and marked with t_1 in figure 5D) is greater than two seconds, the synchronous power-generating module owner shall justify the delay towards the TSO;

(c) while operating in the LFSM-U mode, the synchronous power-generating module shall ensure a power increase up to the maximum power. Usually, a power increase of 20% of P_n following a frequency drop shall be performed within maximum 5 minutes;

(d) the synchronous power-generating module shall operate stably during the LFSM-U mode at frequencies lower than 49.8 Hz. Power maintaing within the tolerance range of 5% P_n shall be performed within a time period of maximum 6 minutes."

af) In Article 61, letter (b) and table 2D are amended and shall have the following contents:

"(d) the delay in the activation of active power frequency response (time delay) shall not be greater than 2 seconds and shall not be unjustified delayed. If the delay in initial activation is greater than two seconds, the synchronous power-generating module owner shall provide technical evidence demonstrating why a longer time is needed;"

Table 2D. Parameters for active power frequency response in FSM (see figure 5D)

Parameters		**Ranges**
Active power range related to maximum power $\frac{\lvert\Delta P_1\rvert}{P_{\max}}$		1.5 – 10%
Frequency response insensitivity	$\lvert\Delta f_i\rvert$	10 mHz
	$\frac{\lvert\Delta f_i\rvert}{f_n}$	0.02 – 0.06%
Frequency response deadband * *After the qualification of groups for the provision of frequency containment reserves (FCR), this value is set at 0 mHz for FCR providing groups, and for other groups the TSO shall decide to set the value different to 0 mHz so that the impact on the frequency control is kept at a minimum		0 mHz
Droop s_1 depending on the power park type (hydropower plant, thermal power plant, mixed-cycle etc.)** **The droop of groups is specified by the TSO at the values necessary to cover the control reserve for frequency containment, set at NPS level (only in groups providing frequency containment control). Usually, for hydropower plants, the droop equals to (4÷5)%, ensuring a reserve of (10÷8)% of P_n, and for thermal power plants, the droop equals to (5÷8)%, ensuring a reserve of (8÷5)% of P_n.		2 – 12%

ag) In Article 63, letter (c) is amended and shall have the following contents:

"c) post-fault active power recovery; for synchronous power-generating modules powered by turbines with fast closing valves, this starts when the voltage recovers over the 85% U_n value

and within a time interval specified by the TSO of up to 10 seconds, with a tolerance of 10% of the pre-fault metered active power."

ah) In Article 65, letter (d) is amended and shall have the following contents:

"d) the relevant system operator and the synchronous power-generating module owner shall agree upon and specify, prior to commissioning, the settings of synchronization devices in order to allow the synchronization of the synchronous power-generating module, as follows:

i) voltage range, ±10% U_n (at terminals);

ii) frequency range, (47.5-51) Hz;

iii) phase angle range, smaller than 10º;

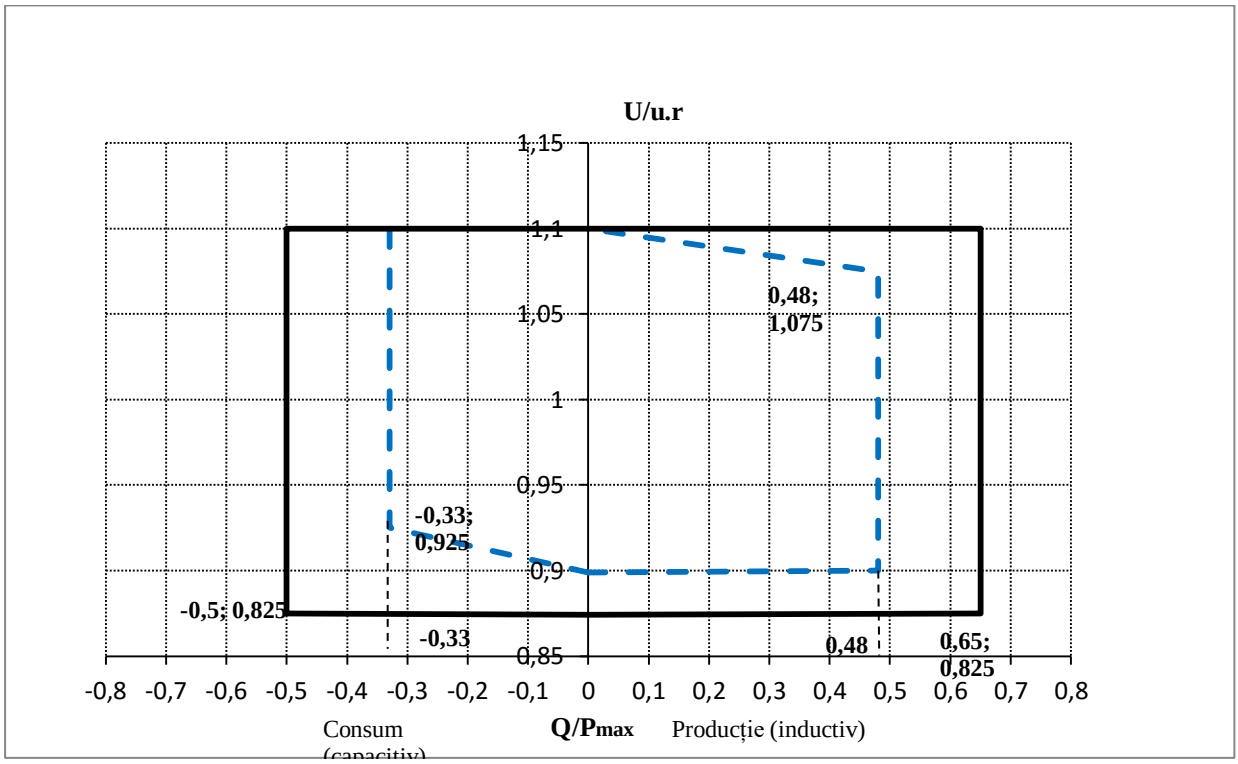
iv) phase sequence;

v) deviation of voltage smaller than 10% U_n and deviation of frequency smaller than 50 mHz;

vi) observation/validation period (including the synchronization time) and the period for maintaining the metered parameters within the determined range."

aj) In Article 66, figure 7D, table 6D and table 7D are amended and shall have the following contents:

Figure 7D. U-Q/P_{max}-profile of a synchronous power-generating module



"**Table 6D.** Minimum time for operation of a synchronous power-generating module connected at the 110 kV and 220 kV voltage level respectively

Voltage range	Time period for operation
0.85 r.u. – 0.90 r.u.	60 minutes
0.90 r.u. – 1.118 r.u.	Unlimited
1.118 r.u. – 1.15 r.u.	20 minutes

Note: Table 6D shows the minimum time periods during which a synchronous power-generating module must be capable of operating without disconnection, for voltages deviating from the reference 1 r.u. value at the connection/interface point, as the case may be. Usually, the unlimited maximum value for operation for a nominal voltage of 110 kV equals to 123 kV and for a nominal voltage of 220 kV it equals 245 kV, as absolute values. For network areas where time periods for operation longer than 20 minutes are agreed, for voltage values exceeding 1.118 r.u., the duration cannot exceed 60 minutes. The values shall be agreed upon based on bilateral agreements concluded between the RSO and the users."

"Table 7D. Minimum time for operation of a synchronous power-generating module connected at the 400 kV voltage level

Voltage range	Time period for operation
0.85 r.u. – 0.90 r.u.	60 minutes
0.90 r.u. – 1.05 r.u.	Unlimited
1.05 r.u. – 1.10 r.u.	**20** minutes

Note: Table 7D shows the minimum time periods during which a synchronous power-generating module must be capable of operating without disconnection, for voltages deviating from the reference 1 r.u. value at the connection/interface point, as the case may be, for the case where the setpoint equals 400 kV. For network areas where time periods for operation longer than 20 minutes are agreed, for voltage values exceeding 1.05 r.u., the duration cannot exceed 60 minutes. The values shall be agreed upon based on bilateral agreements concluded between the RSO and the users."

aj) Article 75 shall be abrogated.

Article II. The economic operators in the electricity sector fulfill the provisions of this order, and the organizational entities within the National Energy Regulatory Authority supervise the compliance therewith.

Article III. This order shall be published in the Romanian Official Journal, Part I, and enters into force on 27 April 2019.

on behalf of the President of the National Energy Regulatory Authority,

Henorel - Florin Soreață