Translation from Romanian

OFFICIAL GAZETTE OF ROMANIA, PART I, No. 312/30.V.2013

ACTS OF THE NATIONAL REGULATORY AUTHORITY FOR ENERGY DOMAIN

ORDER
Approving the Technical norm 'Technical conditions to connect photovoltaic power parks to the public electricity networks'

Taking into account the provisions of article 36 par (1) letter n) and of article 70 from the Electricity and natural gas law 123/2012,

Based on the provisions of article 5 par (1) letter d) and of article 9 par (1) letter h and par (3) from the Governmental Emergency Ordinance 33/2007 on the organisation and operation of the National Regulatory Authority in the Energy Domain, approved with amendments and additions under Law 160/2012,

The **president of the National Regulatory Authority in the Energy Domain** issues the following order:

Article 1- The Technical norm Technical conditions to connect photovoltaic (PV) power parks to the electricity networks of public interest is approved, being provided in the annex that is integrant part of this order.
Article 2- Within 3 months from the enactment of this order the National Power Grid Company Transelectrica SA, in its capacity of transmission and system operator, will transmit the procedure provided in article 19 par (2) from the technical norm mentioned in article 1 to the Regulatory Authority for Energy for endorsement.
Article 3- Network operators and the users of electricity networks apply the provisions of this order, and the specific departments in the National Regulatory Authority in the Energy Domain supervise their compliance.
Article 4- This order is published in Romania's Official Gazette, Part I.

The president of the National Regulatory Authority in the Energy Domain
Niculae Havrilet

Bucharest, 17 May 2013
No. 30

ANNEX

TECHNICAL NORM
Technical conditions to connect photovoltaic (PV) power parks to the electricity networks of public interest

CHAPTER I
Purpose

Article 1- (1) This technical norm sets the minimum technical requirements that photovoltaic power parks should comply with as connected to electricity networks of public interest, so that secure operation of the electric power system can be provided as well as proper conditions for the power plant safe operation.
(2) This technical norm constitute component part of the Technical Code of the electricity transmission grid, approved by Order 20/2004 of the president of the Regulatory Authority for Energy, as well as of the Technical Code of electricity distribution networks, approved by Order 128/2008 of the president of the Regulatory Authority for Energy.

CHAPTER II
Domain of application

Article 2- This technical norm is applied in the relationships between network operators and the users that request connection of photovoltaic power parks to electricity networks of public interest.

CHAPTER III
Glossary

Article 3- (1) This technical norm uses the terms and phrases defined in the Technical Code of the electricity transmission grid. Moreover, in the NPS of this norm the terms and acronyms shown below are defined.
(2) Acronyms

ANRE	Regulatory Authority for Energy Domain
ATR	Technical connection approval
PVPP	Photovoltaic power park (synonym: photo electric plant)
DPVPP	Dispatchable photovoltaic power park, with installed capacity higher than 5 MW
NDPVPP	Non-dispatchable photovoltaic power plant, with installed capacity lower than or equal to 5 MW
EMS	Energy management system
DSO	Distribution operator (DO)
TSO	Transmission and system operator (TSO)
CP	connection point
PIF	Commissioning
SCADA	IT monitoring, control and data acquisition system for a technological process or installation (Supervisory Control and Data Acquisition)
DMS-SCADA	SCADA Distribution Management System
EMS-SCADA	SCADA Energy Management System

NPS	National Power System
STC	Standard test conditions- 100 W/m^2 radiance, atmospheric mass AM = 1.5 and photovoltaic cell temperature 25°C

(3) Definitions

Inverter	Piece of equipment changing direct voltage into alternating voltage
Photovoltaic module (PM)	The smallest component of a photo-electric panel, which captures and converts sun energy into electric power
Network operator	The transmission and system operator, a distribution operator or another holder of electricity network of public interest
Photovoltaic panel	Group of pre-assembled electrically equipped photovoltaic modules designed as installable unit within the photovoltaic power park
Available power (of one PVPP)	The maximum electric power that can be generated by the PVPP (depending on the number of operational inverters and of photovoltaic panels) under nominal sun radiation conditions
Installed capacity (of one PVPP) - Pi	The minimum between the sum of nominal powers of inverters and the sum of nominal powers of photovoltaic panels within the PVPP
Nominal power of one inverter	The active nominal power of one inverter at the alternating voltage terminals, as provided by the manufacturer
Momentary power (of one PVPP) - Pm	Active momentary electric power that can be generated by the PVPP under momentary circumstances of sun radiance
Nominal power of one photovoltaic panel	Electric power of uninterrupted operation which a photovoltaic panel can generate under standard operational conditions, as shown by the manufacturer. The delimiting point of a PVPP is set in the ATR.
Delimiting point	Place where the user's installations are delimited as property from the installations of the network operator. The delimiting point of a PVPP is set in the ATR.
Common point of connection	The point of an electricity network, closest to an user in electric terms, where other users are or can be connected, usually represented by the delimiting point or by the metering point, as set in the ATR.

CHAPTER IV
Reference documents

Article 4- (1) This methodology is applied by corroboration with the provisions of the following norms:

a) Electricity and natural gas law 123/2012;

b) Regulation on users' connection to electricity networks of public interest, approved by Governmental Decision (GD) 90/2008;

c) Technical Code of the electricity transmission grid, approved under Order 20/2004 of the president of the Regulatory Authority for Energy;

d) Technical Code of electricity distribution networks- revision I, approved under Order 128/2008 of the president of the Regulatory Authority for Energy;

e) Regulation setting the connection solutions for users to the electricity networks of public interest, approved by Order 129/2008 of the president of the Regulatory Authority for Energy;

f) Methodology to issue location endorsements for network operators, approved under Order 48/2008 of the president of the Regulatory Authority for Energy;

g) Technical norm on delimiting the protection and safety areas for power capacities- revision I, approved under Order 4/2007 of the president of the Regulatory Authority for Energy, with later amendments and additions;
h) Performance standard for electricity transmission and system services, approved by Order 17/2007 of the president of the Regulatory Authority for Energy;
i) Performance standard for electricity distribution services, approved by Order 28/2007 of the president of the Regulatory Authority for Energy;
(2) The following standards are recommended to be taken into account when applying this norm:
a) SR CEI 61836 Systems of photovoltaic conversion of sun energy; Terms and symbols, applicable edition;
b) SR EN 62446 (CEI 62446) Photovoltaic systems of network connection; Minimum guidelines for system documentation, commissioning tests and inspection, applicable edition;
c) SR EN 61724 (CEI 61724) Monitoring the operational capabilities of photovoltaic systems, applicable edition;
d) SR CEI / TS 62257-7-1 Recommendations for renewable and hybrid power systems of low capacity for rural electrification, Part 7-1: Generators – Photovoltaic panels, applicable edition;

CHAPTER V
Requirements for the DPVPP

Article 5- The DPVPP should fully observe the requirements from the Technical Code of the electricity transmission grid, approved under Order 20/2004 of the president of the Regulatory Authority for Energy; from the Technical Code of electricity distribution systems, approved under Order 128/2008 of the president of the Regulatory Authority for Energy, and from this technical norm.

Article 6- The DPVPP should be capable to generate for indefinite term, in the common point of connection, simultaneously maximum active and reactive power corresponding to the meteorological conditions, in accordance with the equivalent P-Q diagram within the frequency range 49.5÷50.5 Hz and in the admissible voltage range.

Article 7- All inverter components of a DPVPP should be capable of:
a) Remaining connected to the network and operating continuously, with no time limit, within the frequency range (47.5÷52 Hz);
b) Remaining connected to the electricity network when frequency variations occur by rate up to 1 Hz / sec;
c) Operating continuously in the voltage range of (0.90÷1.10 Un) in the CP;

Article 8- (1) DPVPP and its component inverters should remain operational when voltage drops and variations occur like those shown in figure 1*) (they should provide fault ride through) in one or all phases in the delimiting point.

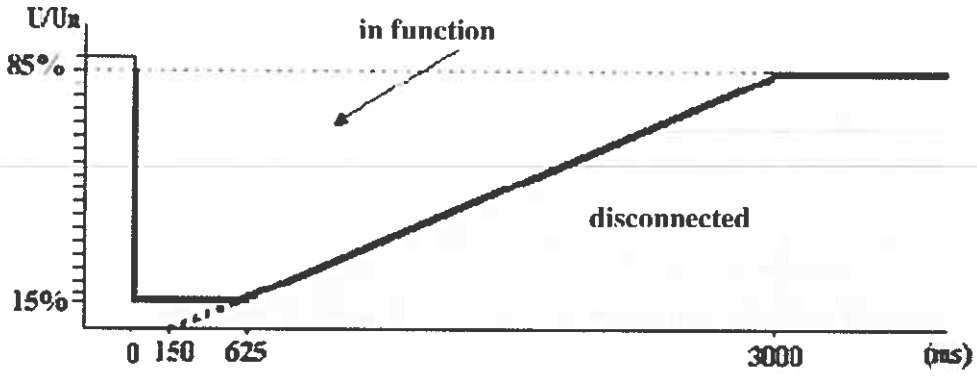

Figure 1- Amplitude of voltage drops when PVPP and inverters should remain operational

(2) During voltage drops all inverters within the DPVPP should inject the minimum reactive electric current for minimum 3 sec, without exceeding the operational limits of the DPVPP.

Article 9- (1) DPVPP will be provided with an automated control system of active power depending on the frequency level (frequency/power automatic control). This will operate according to some frequency/active power response curve shown in figure 2*), where Pm represents the momentary power.

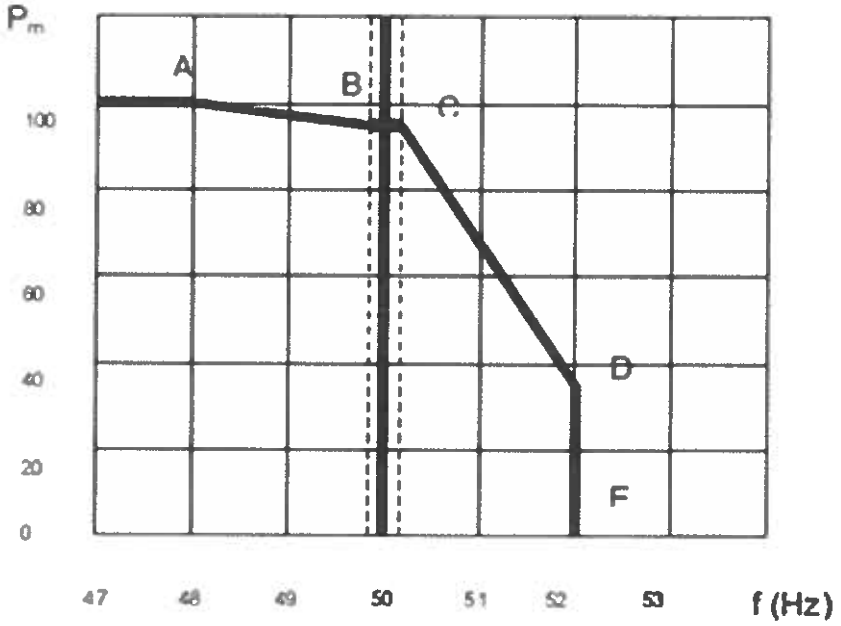

Figure 2- Variation of DPVPP power depending on frequency

(2) The active power generated because of frequency variations will be modified to the extent possible under the temporary conditions of sun radiance, by changing proportionally the active power generated by DPVPP inverters.

(3) It is admitted to disconnect the DPVPP if the frequency level reaches to a value higher than the proper one for the D-E segment from the characteristic curve shown in figure 2.

Article 10- (1) The active power generated by one DPVPP should be possible to limit to a set value.

(2) The set value of the active power should be possible to get remotely in automatic mode.

(3) DPVPP should provide active power control in the common point of connection within the ±5% range of the installed capacity of the PVPP against the set power.

(4) DPVPP should be capable to set the variation speed of the generated active power to the level set by the TSO (MW/minute) as well as upon faults in the NPS.

Article 11- (1) DPVPP should be endowed with reliable safe protection systems both against defects in the network and against faults in the NPS.

(2) The network operator can ask in the technical connection approval for additional installation of automation systems within the DPVPP, which are meant to quickly decrease power or even disconnect it, in justified circumstances, in order to protect the installations, people and the environment.

Article 12 - (1) The DPVPP owner is obliged to protect the photovoltaic panels, the component inverters and auxiliary installations against damages that can be generated by defects in its installations or by the electricity network impacting such installations upon the correct actuation of protections tripping the DPVPP or upon network incidents (grounded or ungrounded short-circuits, trip of network protections, transient overvoltage etc.), as well as in case of occurrence of exceptional/abnormal technical conditions of operation.

(2) The DPVPP owner should provide the network operator with the types of protections, the connection mode to voltage and current circuits and tripping, the driving matrix of protection functions set in the project at the DPVPP - NPS interface.

Article 13- (1) Upon voltage values within the admissible range in the common point of coupling the reactive power generated / taken-in by one operational DPVPP should be continuously controlled according to a power factor of maximum absolute value of 0.90 capacitive and 0.90 inductive.

(2) DPVPP should be capable to provide the automatic voltage-reactive power control in the CP in any mode (with full utilisation of reactive power resources of the PVPP):

a) Voltage control in the CP;

b) Control of reactive power exchanged with the NPS in the CP;

(3) DPVPP should provide exchange of null reactive power with the system in the CP in case the DPVPP does not generate active power (when the generated active power is null).

Article 14- Under normal operation of the network the DPVPP should not provide fast voltage variations in the common point of connection higher than ±4% of the nominal voltage upon medium and high voltage and higher than ±5% of the nominal voltage upon low voltage in the network it is connected to.

Article 15- The connection solution of the DPVPP should not allow DPVPP operation under island regime, therefore protections should be included that can trip the DPVPP upon occurrence of such regime.

Article 16- (1) Component inverters of the DPVPP, accompanied by standard certificates as per the applicable European norms, are guaranteed to comply with the requirements of this technical norm regarding the behaviour upon frequency and voltage variations, as well as upon fault ride through.

(2) Regardless of the number of operational inverters and auxiliary installations and irrespective of the generated power the DPVPP should provide qualitative electricity in the CP according to applicable standards.

Article 17- (1) The ATR applicant places to the disposal of the TSO or of the DSO (as the case may be) a simulation model of the plant operation with a view to enable solution studies for connection.

(2) The model should be provided in the format required by the TSO or by the DSO.

(3) Such model should point out- the effect of ride through mode (low voltage ride through- LVRT), the behaviour upon symmetrical and asymmetrical defects in the network operator's grid, the DPVPP parameters necessary for calculations of-steady-state regimes, dynamic / transient regimes, short-circuit currents required in order to set the parameters of protection installations.

Article 18- DPVPP is monitored in terms of power quality in the CP during tests. The DPVPP connected in the electricity transmission grid will provide permanent monitoring of power quality by being integrated in the TSO's monitoring system for power quality.

Article 19- (1) DSO and TSO, as the case may be, check-up and make sure that DPVPP connection & operation do not lead to breaching the applicable norms with respect to the operation in the frequency, voltage, fault ride through capability and power quality terms in the CP.

(2) Such verification takes place according to a procedure elaborated by the TSO with consultation of the DSO and everything endorsed by ANRE. The procedure covers the commissioning stages, test period and acceptance for long term operation.

Article 20- (1) In justified circumstances the network operator can require additional or more restrictive conditions for the DPVPP with a view to provide safe operation of the electricity network.

(2) DPVPP with installed capacity of over 5 MW but smaller or equal to 10 MW are exempted from the application of provisions from article 9, article 10 par (4), article 13 par (2) letter a) and article 17 par (1) and (2).

CHAPTER VI
Requirements for the NDPVPP

Article 21- (1) All NDPVPP, regardless of the installed capacity, should comply with the requirements of article 5, article 7 letter a), article 12 par (1) and article 15.

(2) In addition to the requirements in par (1), the NDPVPP with installed capacity higher than 0.4 MW and lower or equal to 1 MW should observe the requirements from article 7, article 8 par (1), article 12 par (2) and article 16.

(3) In addition to the requirements in par (1) the NDPVPP with installed capacity higher than 1 MW and lower or equal to 5 MW should observe the requirements from articles 6, 7, 8, 11, article 12 par (2), article 13 par (1), par (2) letter b) and articles 14, 16, 18 and 19.

(4) In justified circumstances the network operator can require additional or more restrictive conditions for the NDPVPP in order to provide safe operation of the electricity network.

CHAPTER VII
Requirements for telecommunication equipment

Article 22- The PVPP owner should provide continuous transmission of condition & operation values to the network operator and to the TSO, as follows:

a) DPVPP connected to the TSO grid, are integrated only in the EMS-SCADA system and provide at least the following exchange of signals: P, Q, U, f, the set values for P, Q and U; condition signals and controls: positions of the circuit breaker and of disconnectors. Redundancy is provided when signals are transmitted by means of two independent communication paths, of which at least the main one will be provided with optical fibre;

b) DPVPP connected to the electricity distribution network, except for those from letter c), are integrated both in the EMS-SCADA and in the DMS-SCADA. The EMS-SCADA integration is provided for at least the following exchange of signals: P, Q, U, f and the set values for P, Q and U; the condition signals and controls for the circuit breaker position. EMS-SCADA integration is provided by redundancy in signal transmission by means of two independent communication paths, of which at least the main one will be provided with optical fibre. DMS-SCADA integration is provided for at least the following exchange of signals: P, Q, U, f, condition signals and controls for the position of circuit breaker and of disconnectors. DSO asks for his own requirements on the communication paths between the DPVPP and the DMS-SCADA for them integration;

c) PVPP with installed capacity higher than 1 MW and lower or equal to 10 MW are integrated in the DMS-SCADA system of the DSO and provide at least the following exchange of signals: active power, while the DSO is entitled to ask for other values to be integrated in the DMS-SCADA. The communication path is specified by the DSO; NDPVPP with installed capacity higher than 0.4 MW and lower or equal to 1 MW provide at least DSO's access to reading of generated energy at time intervals specified by the DSO;

Article 23- (1) All DPVPP should provide remote supervision and control.

(2) The control functions and the P, Q, U, and f metered values should be placed at the network operator's disposal, in an agreed interface point with the EMS-SCADA system.

CHAPTER VIII
Information that PVPP should transmit

Article 24- (1) The PVPP owner with installed capacities higher than 1 MW will send the technical data given in table 1 to the network operator, for each power plant he asks connection or commissioning tests for; the symbols in the table:

S - standard planning data notified in the connection request, in order to elaborate the solution study;

D – detailed planning data transmitted at least 6 months before PIF (commissioning);

T – determined (recorded) data after tests, which are habitual for testing, control and monitoring activities. Such data are determined during PIF tests and are transmitted to the network operator in maximum 10 days from the PIF;
(2) In case of power parks with installed capacities lower or equal to 1 MW the owner will transmit only the standard planning data from table 1.

Table 1 Data for photovoltaic power parks higher than 1 MW

Data description (symbol)	Measuring units	Data category
In the photovoltaic power park		
Network connection, location of bus bar and delimiting point	Text, diagram	S
Nominal voltage in the delimiting point	kV	S
Electric diagram of the entire photovoltaic power park	Diagram	D
Nominal active power of the PVPP	MW	S
Maximum apparent power of PVPP in the CP	MVA	S
Net maximum active power of PVPP in the CP	MW	D
Frequency range of operation at nominal parameters	Hz	S
Maximum/minimum fluctuation rate of active power that can be achieved at PVPP level	MW/min	D, T
Consumption of auxiliary services at maximum active power of the PVPP in the CP	MW	D, T
Special connection/disconnection conditions for photovoltaic parks, others than those of inverters and component PV panels	Text	S, D
Mathematical model of photovoltaic parks, including the inverter and type of photo-electric panel accompanied by simulations	Text	S
Active power control in the CP (control loop)	Control diagram	D
Voltage control in the CP (control loop)	Control diagram	D
Reactive power control in the CP (control loop)	Control diagram	D
PQ diagram in the CP	Graphical data	D, T
Parameters of the line connecting to the NPS		S
Minimum operational frequency	Hz	S
Maximum operational frequency	Hz	S
Minimum operational voltage	kV	S
Maximum operational voltage	kV	S
Data about the photovoltaic panels included in the photovoltaic park		
Number of photovoltaic panels constituting the PVPP	Number	S
Manufacturing company of photovoltaic panels	Name	D
Type of photovoltaic panels	Description	D
Surface area of the photo-electric panel	m2	S
Nominal power of the photo-electric panel (dc)	kW	S
Maximum power of the photo-electric panel (dc)	kW	S
Nominal electric current of the photo-electric panel (dc)	A	S
Nominal voltage of the photo-electric panel (dc)	V	S
Data about the inverters used in the photovoltaic park		
Number of inverters	Number	S
Type of inverter	Description	S
Type certificates for inverters accompanied by results of the tests made in European acknowledged labs for- frequency & voltage variation and fault over-ride	Certificates	D
Nominal input power (dc)	kW	S
Recommended maximum input power (dc)	kW	S
Range of input voltage (dc)	V	S
Maximum input voltage (dc)	V	S
Maximum input current (dc)	A	S
Output nominal active power (ac)	kW	S
Output maximum active power (ac)	kW	S

Output nominal reactive power (ac)	kVAr	S
Output nominal voltage (ac)	V, kV	S
Output nominal current (ac)	A	S
Range of working frequency	Hz	S
Control range of power factor		D
Maximum productivity	%	D, T
Maximum own consumption (ac)	W	D
Night consumption (ac)	W	D
Transformer units whereby the PVPP is connected to the NPS		
Number of windings	Text	S
Nominal power of each winding	MVA	S
Nominal transformer ratio	kV/kV	S
Voltage values on the medium, maximum and minimum plot (as required for short-circuit calculations)	% of U_{nom}	S, D
Idle operation losses	kW	D
Losses on load	kW	D
Magnetising electric current	%	D
Connection group	Text	D
Control range	kV-kV	D
Control diagram (longitudinal or long-transversal)	Text, diagram	D
Size of the control step	%	D
On load control	YES/NO	D
Saturation curve	Diagram	D
Quality parameters of electricity within the PVPP		
Maximum number of power variations (ΔS/Ssc) per minute		S, T
Maximum value of fast voltage fluctuations		S, T
Total distortion factor of electric current		T
Electric current harmonics (up to 50)		T
Total distortion factor of voltage		T
Voltage harmonics (up to 50)		T
Non-symmetry factor of negative voltage sequence		T

CHAPTER IX
Final provisions

Article 25- (1) DSO is responsible to transmit in real time to the TSO the active powers produced by non-dispatchable plants connected in its network, in an aggregated manner.

(2) With a view to carry out the requirements in par (1) the DO develops its own DMS-SCADA system within maximum 3 years from the enforcement of this norm, and provides inter-connection of such system with the EMS-SCADA.

(3) Holders of NDPVPP with installed capacity higher than 1 MW and lower or equal to 5 MW that will become operational in the next 3 years from the enactment of this norm will transmit the active power values into the EMS-SCADA according to the solution agreed with the TSO.

(4) Holders of DPVPP which were commissioned or got the establishment permit before the enforcement of this technical norm are obliged to comply with the requirements applicable to DPVPP-s from this norm by 31 December 2013.

Article 26- (1) TSO will monitor the installed capacity in the connected PVPP and in those under connection to the NPS; it will assess the effects of such connection over NPS safety and will take measures in order to maintain the safe operation of the NPS.

(2) The proposed measures will be transmitted to ANRE for approval.

*

This technical norm was passed observing the notification procedure provided in GD 1016/2004 on the measures to organise and make exchange of information in the domain of technical standards and regulations, as well as the rules about the services of IT company between Romania and the EU member states, as well as the European Commission, with later amendments, published in Romania's Official Gazette no. 664 of 23 July 2004, which transposes Directive 98/34/EC of the European Parliament and Council of 22 June 1998 determining a procedure for provision of information in the domain of technical standards and regulations, published in the Official Journal of the European Communities L 204 of 21 July 1998, amended by Directive 90/48/EC of the European Parliament and Council of 20 July 1998, published in the Official Journal of the European Communities L 217 of 5 August 1998.