USAID | GEORGIA
FROM THE AMERICAN PEOPLE

USAID ENERGY PROGRAM

DRAFT AMENDMENT ON GRID CODE

USAID ENERGY PROGRAM

4 May 2020

DRAFT AMENDMENT ON GRID CODE

USAID ENERGY PROGRAM

CONTRACT NUMBER: AID-OAA-I-13-00018

DELOITTE CONSULTING LLP

USAID | GEORGIA

USAID CONTRACTING OFFICER'S

REPRESENTATIVE: NICHOLAS OKRESHIDZE

AUTHOR(S): VALERIY VLATCHKOV

LANGUAGE: ENGLISH

4 MAY 2020

DATA

Reviewed by:	Daniel Potash, Ivane Pirveli, Davit Mujirishvili, Tamar Jaliashvili
Practice Area:	Grid Integration of Variable Energy Resources
Key Words:	Grid Code, Variable Renewable Energy, Wind Power Forecasting

ACRONYMS

CAPEX	Capital Expenditure
EnCT	Energy Community Treaty
ENTSO-E	European Network of Transmission System Operators for Electricity
GNERC	Georgian National Energy and Water Supply Regulatory Commission
GoG	Government of Georgia
GSE	Georgian State Electrosystem
MW	Megawatt
OPEX	Operational Expenditure
SCADA	Supervisory Control and Data Acquisition
USAID	United States Agency for International Development

CONTENTS

1. INTRODUCTION

USAID Energy Program is a $7.5 million 3-year project aimed at supporting Georgia in the energy market development per Georgia's obligations under the Energy Community Treaty (EnCT). The ultimate goal of this program is to enhance the integration of variable renewable energy resources through improved legal and regulatory framework and increased investments in the energy sector.

The country needs to invite increased investments in a more diversified mix of energy generation from renewable resources, open its market to trade with neighboring countries in the region, appropriately plan and project its infrastructure investments, and prevent unnecessary energy losses in the process of generation and supply.

The objective of USAID Energy Program is to support Georgia's efforts to facilitate increased investment in power generation capacity as a means to increase the share of renewable energy resources and facilitate economic growth. The Program will have a significant impact on the energy market reform efforts of the Government of Georgia (GoG) to comply with the country's obligations under the EnCT. The investment objective will be achieved through the provision of technical assistance to a variety of stakeholders in the energy sector.

The ultimate expected outcome of the program is viable legal and regulatory framework that complies with European requirements and encourages competitive energy trade and private sector investments.

The report "Regulation on Wind Power Forecasting" provides input to USAID Energy Program in support of the ongoing reform implementation in the energy system. Grid Integration of Variable Renewable Energy Resources is one of the key components of the contract.

A large-scale introduction of wind power causes a number of challenges for electricity market and power system operators who will have to deal with the variability and uncertainty in wind power generation when making their scheduling and dispatch decisions. Wind power forecasting is frequently identified as an important tool to address the variability and uncertainty in wind power and to more efficiently operate power systems with large wind power penetrations. Moreover, in a market environment, the wind power contribution to the generation portofolio becomes important in determining the daily and hourly prices, as variations in the estimated wind power will influence the clearing prices for both energy and operating reserves.

2. EXECUTIVE SUMMARY

The draft regulation on “Wind Power Forecasting” is based on recommendations from the report “Grid Code Provisions for Integration of Variable Renewable Energy”, prepared by USAID Energy Program. Wind power forecasting is frequently identified as an important tool to address the variability and uncertainty in wind power and to efficiently operate power systems with large wind power penetrations.

In a market environment, the wind power contribution to the generation portfolio becomes important in determining the daily and hourly prices, as variations in the estimated wind power will influence the clearing prices for both energy and operating reserves. An introduction of large-scale wind power causes challenges for the electricity market and power system operators who must deal with the variability and uncertainty in wind power generation when making scheduling and dispatch decisions. For the connection of new renewable generators to the power network, the system operator needs to define the needed grid reinforcements, to consider the grid stability, and to enhance the dispatchability of the power network through an adequate level of forecasting.

JSC Georgia State Electrosystem (GSE) and Georgian National Energy and Water Supply Regulatory Commission (GNERC) support the development of better, more reliable and accurate forecasting. Wind power plant owners and operators will also benefit from improved wind power prediction in terms of supporting competitive participation in electricity markets against more stable and dispatchable energy sources. In general, wind power forecasting can be used for several purposes, such as planning and reinforcement of the power networks, generation, and transmission maintenance planning, determination of operating reserve requirements, unit commitment, economic dispatch, energy storage optimization (e.g., pumped storage hydropower plants), and energy trading. The regulation assigned wind power generators to provide necessary meteorological data and information to electricity network operators. The Chapters from the draft Regulation on Wind Power Forecasting are listed below:

CONTENT

1. Applicability;
2. Functional Specification;
3. Meteorological Equipment as a means of data input to forecasting models;
4. Data transfer technical specifications;
5. Notification of unavailability, suspected failure or data error;
6. Exceptions;
7. Pre-commissioning meteorological data requirements;
8. Data requirements for wind power forecasting.

RESULTS OF REGULATION

Anticipated results of the new regulation are listed below:

1. This Regulation establishes procedures for generating forecasts;
2. This Regulation will contribute to decreasing the uncertainty of wind power production through better wind power forecasting;
3. Through the implementation of this Regulation, GSE will increase security, reliability, and safety of the whole power system through:
    a. Increasing the flexibility of the power system;
    b. Improving the operation ability of the power system;
    c. Providing necessary ancillary services.
4. This Regulation will contribute to increasing the economic efficiency of the power system through:
    a. Reducing the necessity of reserve capacity;
    b. Reducing the prices in the day ahead, intraday and balancing markets by facilitating the participation of wind power plants in the day ahead, intraday and balancing power markets;
    c. Improving planning and reinforcement of the power system.
5. With the creation of a stable and transparent regulatory framework for wind power forecasting, this Regulation may support in an increase of investments in renewable energy;

6. This Regulation may support integration of large-scale renewable energy into the power system which will contribute to the diversification of the energy supply;
7. With the implementation of this Regulation, Georgia may achieve a significant reduction of greenhouse gas emissions by increasing the share of wind energy in the power market.

After the reinforcement of this regulation both capital and operating & maintenance costs, that may be incurred by the operator and/or developer of the wind farm, are insignificant compared to the Capital Expenditure (CAPEX) and Operational Expenditure (OPEX) of wind farm.

Turbine manufactures, practicing commissioning of the turbines with the two sets of wind speed and direction measurement sensors are mounted on nacelles of turbines. In some cases, wind turbines are equipped with the complete meteorological station for the measurement of the wind speed, direction, ambient temperature, barometric pressure and precipitation.

Real time measurement data is continuously delivered to control applications of wind farm through the plant Supervisory Control and Data Acquisition (SCADA) system. High class, reliable, maintenance free, and calibrated sensors existence is of prime interest for operator and developer.

In case of the existing wind farm operator, the meteorological data measurement is utilized as an input for performance test, as well as pitch and yaw control to optimize energy production and reduce fatigue loads on components of wind turbine.

In the case of a developer, the reliability and the preciseness of the meteorological parameters measurement is directly tied to the prediction of Annual Energy Production and bankability of the project. Hence, it’s the primary interest of the developer.

The most significant cost which may be incurred by the developer in case of measurements, performed at the met mast, is related to the communication and power supply cost. Delivery of measurement data with 10-minute intervals may require more power supply comparative to the case where the measurement data has to be retrieved from datalogger once in a day or several days.

3. BACKGROUND

The purpose of this Regulation is to establish procedures for generating and sharing forecasts with the appropriate Georgian energy sector entities. A Transmission System Operator (Dispatch Licensee), and other stakeholders including wind power plant developers and owners, have the rights and responsibilities towards wind power forecasting such as measurements, data transfer process, and onboarding instructions to comply with forecasting requirements set in Network Rules.

The Transmission System Operator hires a third-party forecaster. A third-party forecaster sets up a system to receive forecasts from wind generators. Wind generators need to learn the forecast system to upload their product and forecasts. The third party will set up an onboarding process for wind generators. The transmission system operator will also be available for support during the onboarding process. Each legal owner is responsible for providing Subject Matter Experts to meet the requirements of this Regulation.

Onboarding will be required for the wind power plant owner of a wind aggregated generating facility that has not previously provided forecast data for the aggregated generating facility under the Regulation on Wind Power Forecasting requirements. This may include the wind power plant owner of a new aggregated generating facility, or a new owner of an existing aggregated wind power generating facility, or a legal owner of an existing aggregated generating facility that was connected in accordance with the Network Rules but is transitioning to the new Regulation on Wind Power Forecasting requirements.

The structure and numbering (alphabetical order) used for draft regulation complies to the requirement of Georgian law “On Normative Acts” Article 16[1] – Structure of Normative acts, Paragraph 11 as well as structure and numbering of existing Network Rules.

The Article 2 Definition of Terms in existing Network Rules ends up with the paragraph Z58). In case the draft amendments will be enforced, it may bring 11 new “terms definition” to the Article 2 Definition of Terms of Network Rules. To comply numbering of Network Rules, for the numbering (alphabetical order) it is kept same letter “Z” whilst new terms indicated with superscripts from Z^{58} to Z^{69}.

Except the definition of new terms draft lays down the technical specifications for meteorological data collection and the rights and responsibilities of the transmission system operator (Dispatch licensee), wind power plants connected to the transmission and distribution network and declarant/applicant which has signed connection agreement.

Those are draft rules which are most suitable to amend the Operational Rules of existing Network Rules. Chapter IV Operational Management Rules from Network Rules ends up with the Article 49. Chapter V and its Article 50 has been revoked. Because of that for the numbering of articles from draft regulation its utilized superscripts.

[1] 11. If a section (a book), a chapter, an article, a paragraph (a part) or a sub-paragraph is added to a normative act, in order to maintain continuity of numbering (alphabetical order) the number of the respective previous section (book), chapter, article, paragraph (part) or the letter of the sub-paragraph with an additional numeral shall be indicated (superscript section (book), chapter, article, paragraph (part) or sub-paragraph).

4. DRAFT AMENDMENT ON GRID CODE

1. AMENDMENTS ON GRID CODE SHOULD BE EXECUTED AND READ AS:

1.1. The following terms shall be amended in Article 2 and read as the following:

Z[59]) Accuracy - The degree of closeness of measurements of a quantity to that quantity's true value.

Z[60]) Hub Height - Height of the center of the swept area of the wind turbine rotor above the ground at the tower.

Z[61]) Precision - The random spread of measured values around the average measured values.

Z[62]). Resolution - The smallest to be distinguished magnitude from the measured value.

Z[63]) Data Transfer - The entire process of measuring, collecting, storing, and transmitting of meteorological data, including the Computer Systems, Forecast Data and Data Communications Interface.

Z[64]) Gross Real Power - The sum of the real power capability of the generating units behind the wind power plant aggregated generating facility. The reduction may be due to unscheduled outages.

Z[65]) Meteorological Data - The meteorological information required from the wind power plant as it is outlined and defined under Table 1 of this Regulation.

Z[66]) Net to Grid Real Power Production - Real power output at the point of connection.

Z[67]) Real Power Limits - This is the transmission system operator power limit sent from the transmission system operator to a wind power plant aggregated generating facility, which is the current value in the power limiting control system at the wind power plant aggregated facilities.

Z[68]) Turbine Power Curves - Manufacturer's turbine power curve in table (MW m/s wind speed) format.

Z[69]) Wind Power Forecast - The prediction, based upon the use of a forecasting method, of the amount of power in MW that could be generated by wind energy at a specific time by a specific aggregated generating facility (an "Individual Forecast") and at a specific time by all of the operating wind power facilities combined (the "Aggregate Forecast").

1.2. Chapter IV[1] should be added to chapter IV and read as the following:

CHAPTER IV[1] - WIND POWER FORECASTING

Article 49[1]. Scope, Purpose and Applicability

1. The aim of this chapter is to establish the general regulatory framework for wind power forecasting in accordance with the Georgian Law on Energy and Water Supply, EnCT, European Network of Transmission System Operators for Electricity (ENTSO-E) Network Codes and the existing legislation of Georgia.

2. This chapter regulates the rights and responsibilities of the transmission system operator (Dispatch licensee), wind power plants connected to the transmission and distribution network , declarant which has signed connection agreement, electricity market operator in relation to wind power forecasting and data requirements for secure, reliable, and safe operation of the Georgian power system.

3. This chapter lays down the technical specifications for meteorological data collection equipment and data requirements for wind power forecasting for wind power plants in operation and pre-commissioning plant data and records requirements.

4. This Regulation applies to:

a. B, C and D category of power plants connected to the Transmission and Distribution system;

b. Those Applicants seeking to connect to the Transmission and/or the Distribution network, and/or Declarant who submits application to the relevant Transmission or Distribution Licensee regarding new connection or modification of the existing connection and which plant design falls under B, C and D category;
c. The Transmission System Operator (Dispatch Licensee).

Article 49[2]. Measuring Units

Units	Description
ºC	Degrees Celsius
HPa	Hectopascals
m	Meter
min	Minute
mm	Millimeter
mm/min	millimeters per Minute
m/s	Meters per second
s	Second
W	Watt
W/m^2	Watts per square meter

Article 49[3]. Successor to Prior Requirements and Compliance Timeframe

1. The generation licensee of a wind power plant must bring its wind power plant into compliance with this chapter by no later than two (2) months after reinforcement of the rules defined herein.

2. Applicants and/or Declarants must bring its measurement system of meteorological parameters into compliance with this chapter, by no later than two (2) months after reinforcement of the defined rules.

Article 49[4]. Meteorological Data Collection Equipment and Availability Requirements

1. The generation licensee of a wind power plant must ensure that the facility is equipped with meteorological data collection equipment and related devices that are installed and maintained in accordance with the provisions of Articles **49[4]** and **49[5]**.

2. Declarant and/or Applicant must ensure that either the facility or the met mast is equipped with meteorological data measurement and collection equipment and related devices, that are installed and maintained in accordance with the provisions of Articles **49[4]** and **49[5]**.

3. The generation licensee of a wind power plant, must ensure that it is equipped with instruments and sensors for the measurement of each meteorological parameter in accordance with the requirements of Article **49[9]** annex 32.

4. Declarant and/or applicant must ensure that the mat mast is equipped with instruments for the measurement of each meteorological parameter in accordance with the requirements of Article 49[9] annex 32.

5. The generation licensee of a wind power plant, declarant and/or applicant must ensure that the meteorological data collection equipment and related devices described in Articles **Article 49[4]** sub articles 2 and 3 take measurements of instantaneous values at the interval of 15 seconds or less.

6. The generation licensee of a wind power plant, declarant and/or applicant must measure, collect and submit to the Transmission System Operator (Dispatch licensee) the meteorological data in annex 32.

7. The generation licensee of a wind power plant must determine, at 30 minutes intervals, and submit to the transmission system operator (dispatch licensee), the gross real power capability with precision to the nearest 0.1 MW.

8. The generation licensee of a wind power plant must determine and submit to the transmission system operator (dispatch licensee), the following data:

a. any real power limits in megawatts (MW), with precision for instantaneous measurements to the nearest 0.1 MW; and
b. actual net to grid real power production in megawatts (MW), with precision for instantaneous measurements to the nearest 0.1MW.

Please Note: The content of Paragraphs 7 and 8 of this Article **49[4]**.will be discussed with vendors of forecasting services and if needed modified appropriately.

Article 49[5]. Data Transfer Technical Specification

1. The generation licensee of a wind power plant, must submit to the Transmission System Operator (Dispatch licensee) the data specified in Article **49[4]**. using one-minute average and at least five-minute data transfer intervals.

2. The declarant and/or applicant must submit to the Transmission System Operator (Dispatch licensee) the data specified in Article **49[4]** using ten-minute average data and at least ten-minute data transfer intervals.

3. The generation licensee of a wind power plant, declarant and/or applicant must submit to the transmission system operator (dispatch licensee) the data specified in Article **49[4]** 4 in the method and format the transmission system operator (dispatch licensee) specifies.

6. The generation licensee of a wind generating facilities, Declarant and/or Applicant must keep seven (7) days of back up data for any data that has been submitted in accordance with Article **49[5]**and must provide it to the Transmission System Operator (Dispatch licensee) upon request within three (3) days.

Article 49[6]. Notification of Unavailability, Suspected Failure or Data Error

1.If any component in the meteorological data collection equipment and related devices including data transfer equipment becomes unavailable due to an unplanned event, is suspected to have failed, or to be providing erroneous data, the generation licensee of a wind power plant, Declarant and or/Applicant must notify the transmission system operator (dispatch licensee) immediately, in writing, after identifying the unavailability, suspected failure or data error.

2. The generation licensee of a wind power plant, Declarant and or/Applicant must provide the Transmission System Operator (Dispatch licensee), in writing after 7 days from notice according to the Article **49[6]**.1، the expected date when the equipment will be repaired, and the required measurements will be restored.

3. if an equipment failure described in Article **49[6]** sub article 2 is not repaired and required measurements are not restored by the expected date, before or right after that date, the generation licensee of a wind power plant, Declarant and or/Applicant must, notify the Transmission System Operator (Dispatch licensee) in writing, of the revised date and the reason the component in the equipment was not repaired by the expected date.

4. The generation licensee of a wind power plant, Declarant and or/Applicant must notify the transmission system operator (dispatch licensee) immediately in writing ,after an equipment failure described in Article **49[6]** sub article 2 is repaired and the required measurements are restored.

Article 49[7]. Exceptions

2. Notwithstanding articles **49[5]** and **49[6]**, Declarant or applicant will be exempted from the obligation on meteorological data measurement and delivery to Transmission System Operator (Dispatch Licensee) if the measurement of meteorological parameters not started yet at the site proposed for wind farm development.

Article 49[8].Pre-Commissioning Facility Data and Records Requirements

1. The generation licensee of a wind power plant must provide to the transmission system operator (dispatch licensee) the pre-commissioning data and records referred to in this **Article 49[8]**, in a method and format approved by the transmission system operator (dispatch licensee).

2. Subject to the provisions of Article **49[8]**, the generation licensee of a wind power plant, Declarant and/or Applicant must retain and provide within twenty (20) days of the Transmission System Operator (Dispatch licensee)'s written request the following averaged meteorological data and records at ten (10) minute intervals or less, covering the two (2) calendar years prior to the commissioning of the wind power plant or to the extent the data is available:

a. details on the height of the measurements;
b. wind speed;
c. wind direction;
d. temperature;
e. barometric pressure.

3. The generation licensee of a wind power plant, Declarant and/or Applicant must in response to request of Transmission System Operator (dispatch licensee) under Article **49[8]**.2, provide the following data:

a. meteorological tower data collection height in meters (m), with precision for instantaneous measurements to the nearest 1 m;
b. turbine model name;
c. turbine model capacity in megawatts (MW), with precision to the nearest 0.1 MW;
d. turbine wind speed cut-in in meters per second (m/s), with precision to the nearest 0.1 m/s;
e. turbine wind speed cut-out in meters per second (m/s), with precision to the nearest 0.1 m/s;
f. turbine temperature cut-out lower in degrees Celsius (◦C), with precision for instantaneous measurements to the nearest 1 ◦C and an indicator is required to confirm that the numbers are ambient temperature within the rotor or air temperature;
g. turbine temperature cut-out upper in degrees Celsius (◦C), with precision for instantaneous measurements to the nearest 1 ◦C and an indicator is required to confirm that the numbers are ambient temperature within the rotor or air temperature;
h. site latitude and longitude in degrees; and
i. turbine power curves.

Article 49[9].Wind Power Plant Meteorological Data Requirements

1. For the purposes of chapter IV[1], wind power plant meteorological data requirements shall be defined in accordance with the table given in Annex 32.

ANNEX 32

Table 1. Meteorological Data Requirement

Measurement Type	Measured at	Units	Resolution	Accuracy	Range	Height of the Instrument	
						Set 1	Set 2
Wind Speed	**Nacelle**	**Meters/Second (m/s)**	0.1 m/s or better	± 0.5 m/s or better	0.3m/s-50m/s or Better	At Hub Height	At Hub height
	Met Mast	**Meters/Second (m/s)**	0.1 m/s or better	± 0.5 m/s or Better	0.3m/s-50m/s or better	Met Mast Top/ boom mounted primary Anemometer	Met Mast Top/ boom mounted Primary Anemometer or control anemometer
Wind Direction	**Nacelle**	**Degrees from true North**	1 degree	± 5 º or better	0 º to 360 º	At Hub Height ± 2M	At Hub Height ± 2M
	Met Mast			± 5 º or better		Met Mast Top/boom mounted wind vane	Met Mast Top/boom mounted wind vane
Barometric Pressure	**Nacelle**	**Hecto Pascals (HPa)**	1 HPa	± 1 HPa at - 20 to 50ºC; and ±1.5 HPa at below -20ºC	800 to 1000	At convenient location and Height/ if available preference is given to the nacelle mounted sensor or sensor mounted on the met mast boom	N/A
	Met Mast						
Ambient Temperature	**Nacelle**	**Degree Celsius (°C)**	0.1ºC	± 0.2 ºC	-50 ºC +50 ºC or Better	At convenient location and Height/ if available preference is given to the nacelle mounted sensor or sensor mounted on the met mast boom	N/A
	Met Mast						

USAID Energy Program

Deloitte Consulting Overseas Projects LLP

Address: 29 I. Chavchavadze Ave.,0179, Tbilisi, Georgia

Phone: +(995) 595 062505

E-mail: info@uep.ge