Royal Government of Bhutan

Ministry of Energy and Natural Resources

Department of Energy

Guideline for Development of Distributed Energy Resources Systems

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OFFICE OF THE DIRECTOR DEPARTMENT OF ENERGY THIMPHU : BHUTAN

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List of Acronyms

ERA	Electricity Regulatory Authority
BPC	Bhutan Power Corporation
DER	Distributed Energy Resource
DERS	Distributed Energy Resource System
DoE	Department of Energy
EA	Electricity Act 2001
EPC	Engineering Procurement and Construction
FiT	Feed-in Tariff
HT	High Tension
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
KVA	Kilo Volt Amperes
kW	Kilo Watt
kWh	Kilo Watt Hour
LoA	Letter of Agreement
LT	Low Tension
MoENR	Ministry of Energy and Natural Resources
MU	Million Units
NB	Net Billing
NM	Net Metering
PPA	Power Purchase Agreement
RE	Renewable Energy

1 Guideline for Development of Distributed Energy Resources Systems, 2023

1.1 Introduction

The Department of Energy (DoE), hereby, issues the "Guideline for Development of Distributed Energy Resources Systems (DERS), 2023".

1.2 Title and Commencement

This guideline shall:

i. Be cited as the “Guideline for Development of Distributed Energy Resources Systems (DERS), 2022”; and,
ii. Come into force with effect from 12 November 2023

1.3 Objectives

The objectives of this Guideline are to:

i. Provide an opportunity to a consumer in Bhutan to be self-reliant in the production of electricity for self-consumption and supply of excess electricity from its DERS into the distribution system of distribution licensee and,
ii. Set out principles and approach that a Prosumer and the relevant stakeholders shall adopt in discharge of their role and responsibilities towards installation of DERS.
iii. Set out an approach and methodology that will be used to determine the buyout tariff for electricity injected into grid by prosumers from DERS and,
iv. Promote the installation of DERS in Bhutan duly considering the financial and technical interests of all the stakeholders such as Prosumers, Distribution Licensee, Demand Aggregator etc.

1.4 Scope of the Guideline

This Guideline will apply to:

i. Electricity Regulatory Authority (ERA) responsible for laying down appropriate regulation for the development of DERS in Bhutan,
ii. Distribution Licensee responsible for regulated network services over the low voltage and medium voltage distribution system, and supply and sale of energy to consumers in Bhutan,
iii. DERS with solar as the source of electricity generation, owned by a Prosumer or by a Renewable Energy Service Provider (RESP) and located in the premise of Prosumer and,
iv. Distributed Energy Resource System (DERS) other than solar based renewable sources of electricity generation, owned by a Prosumer or by a RESP and installed in its premises and,
v. Any Prosumer installing and operating DERS for self-consumption and located in its premises.

1.5 Amendment

This Guideline may be amended as and when deemed necessary by the Department of Energy (DoE).

1.6 Licensing Requirement

Any consumer interested in installing and generating electricity from DERS in its premises under Prosumer scheme shall be required to comply with Electricity Act 2001 and any other policy and regulatory directives that may be issued in this regard.

1.7 Institutional Framework

1.7.1 Role of ERA

ERA in accordance with this Guideline may appropriately develop the regulatory framework including the technical and safety standards for connectivity of DERS with the distribution system of the distribution licensee, and metering and billing arrangement applicable to prosumers, and the buyout tariffs to be paid by the distribution licensee for the electricity exported by a prosumer to its distribution system.

1.7.2 Role of the Distribution Licensee

The Distribution Licensee shall:

i. Develop in detail the application process and procedure for grant of connection to prosumers with timelines for installation, commissioning, and operation of DERS,
ii. Develop a Prosumer Agreement to be signed with the prosumer,
iii. Undertake regular technical studies to assess the impact of penetration of DERS in its distribution system and share these studies.

1.8 Technical and Safety Standards, Metering Infrastructure for prosumers

1.8.1 Connection with the Distribution System: Technical and Safety Standards

The technical and safety standards for connection of DERS with the distribution system will be specified by ERA. These standards shall duly consider the following:

i. Provisions of Distribution Code 2022, related to technical standards applicable to a consumer and its embedded generator,
ii. Provisions of Safety Regulation 2008, Safety Code 2021 and the rules framed by the distribution licensee in compliances to the Safety Regulation 2008, applicable to a consumer and its embedded generator,
iii. The voltage level of the distribution system at which DERS shall be connected,
iv. Role and responsibilities of prosumer related to planning, design, construction, reliable and safe operation of DERS, and adherence to relevant industry standards and best practices,
v. DERS both with and without battery backup, to cease energisation of the circuit in case of any fault in the circuit, shall have appropriate arrangement to sense voltage and frequency, time delay function, prevent the formation of unintended island and automatic synchronization with grid supply,

vi. Permissible supply standards for DERS for electricity injected into the distribution system of the distribution licensee and,
vii. DERS shall have a must run status.

The specified standards should provide distribution licensee and prosumers, the right to disconnect DERS at any time in the event of threat/damage from such DERS to distribution system and or vice versa to prevent any accident or damage to equipment and personnel, without any prior notice.

1.8.2 Metering Infrastructure

Standards required for the infrastructure and metering the exchange of electricity between a prosumer and the Distribution Licensee at the connection point shall be established by ERA. The applicable standards requirement should duly consider the following:

i. Compliance with the provisions of the metering section of the Distribution Code 2022,
ii. Provision of Advanced Metering Infrastructure (AMI) facility with appropriate communication port,
iii. Energy meter to have the capability to separately record both import and export of electricity to the distribution system at the connection point under various metering and billing arrangements for prosumers,
iv. Provisions for operational metering as well as tariff and commercial metering as per the procedure specified in the Distribution Code 2022 and,
v. In case if time-of-day retail tariff is applicable to consumer, then the meter shall be capable of recording the time of day of electricity consumption, export of electricity and or/generation by Prosumer.

ERA will specify the time frame within which the Distribution Licensee shall modify its existing metering and billing infrastructure to facilitate billing and metering arrangements as envisaged by it in compliance with this Guideline.

1.9 Eligible Consumer and Permissible DERS Capacity

1.9.1 Eligible consumer

Eligibility criteria for consumers to be eligible to install DERS shall include the following:

i. DERS shall be established in the premises of the consumer only at the rooftop or elevated areas on land, building or infrastructure or part or combination thereof and,
ii. A consumer may enter in a contract with RESP for the establishment of DERS within its premises.

1.9.2 Permissible Individual DERS Capacity

Individual DERS capacity to be established by an eligible consumer shall be as per the following criteria:

i. The maximum size of DERS that can be set up to be specified with due consideration of the interconnecting distribution transformer and power system's capacity,
ii. The minimum size of DERS that can be set up to be specified with due consideration of ease of metering and billing them and,

iii. The cumulative capacity of DERS that may be allowed to be connected with the distribution system (feeder/distribution transformer) shall not exceed the specified capacity of the feeder and or distribution transformer hosting capacity.

1.10 Metering and Billing Arrangements

1.10.1 Metering Arrangement

One or more of the following metering arrangements along with criteria for consumers to be eligible for these metering and billing arrangements shall be specified:

- Net Metering
- Net Billing
- Gross Metering

i. Net Metering arrangement will imply adjustment of energy generated by prosumer against energy consumed at the end of each billing cycle by the distribution licensee,

ii. Net Billing arrangement will imply adjustment of energy supplied by prosumer against energy consumed at the end of the billing cycle by the distribution licensee. In case energy supplied by prosumer exceeds energy supplied by the distribution licensee, the net energy supplied shall be monetized at the buyout tariff but in case the energy supplied by the distribution licensee exceeds the energy supplied by DERS, the prosumer shall be billed for this consumption as per the retail tariff applicable to prosumer as a consumer,

iii. Gross Metering arrangement will imply separate accounting of energy supplied by prosumer and energy consumed by it from the distribution system. Energy supplied shall be monetized at the buyout tariff and the energy consumed shall be monetized at the retail tariff applicable to prosumer as a consumer,

iv. Metering and billing arrangement(s) to be specified by duly considering the following:
    - Consumer categories and their consumption profile,
    - Retail Tariff applicable to consumers,
    - Levelized Cost of Electricity (LCoE) generated by DERS,
    - Technical and other issues arising out of export of power by prosumer into the distribution system,
    - Implications of loss of revenue on the financial sustainability of distribution licensee,
    - Subsidy scheme of RGoB and,
    - Policy directions from RGoB to promote DERS within Bhutan.

1.10.2 Energy Accounting and Settlement Under the Three Metering Arrangements

Principles and procedure for energy accounting and settlement for the three metering arrangements as described in section 1.10.1 of this guideline should be specified by duly considering the following:

i. Applicable billing and settlement period for energy accounting and billing and the principle and mechanism for settlement of billing credit and debit,

ii. Applicable buyout tariff for energy exported to the distribution licensee,

iii. Principles and mechanism for settling of energy consumption and excess energy generation against fixed/demand charges, government taxes and levies, and energy charges,
iv. Information to be provided in the bill of a prosumer and,
v. Accounting and billing mechanism for electricity exported or imported from the distribution system including the mechanism when Time of Day tariff is applicable to the prosumer.

1.11 Determination of Buyout Tariff

1.11.1 General principles for determination of buyout tariff

The buyout tariff including the terms and conditions applicable to prosumers under various metering and billing arrangements for energy exported to the distribution system shall be determined by ERA. The buyout rates may vary for different categories of prosumers, time of the day/season and geographic regions of Bhutan.

While determining the buyout tariff all quantifiable costs and benefits that accrue to various stakeholders such as Prosumers, Distribution Licensee, DGPC, RGoB etc consequent to installation of DERS should be considered so that these stakeholders do not gain or lose financially at the expense of other stakeholders. However, ERA may consider the feasibility to share these gains and losses, if any, which accrue to the stakeholders, with the consumers during the determination of the buyout tariff.

In particular, following design principles for determining the buyout tariff may be considered:

- Levelized Cost of Energy (LCoE) generated by DERS
- Applicable retail tariff and the regulatory mechanism for settlement of energy consumed from grid and DER,
- Full recovery of the wheeling cost of Distribution Licensee with appropriate consideration of savings in operational cost due to generation at the energy consumption point,
- Consideration of financial gains or losses of Bhutan Power System on account of energy generated by DERS and,
- Financial and/or other support that may be provided by RGoB/other donors to Prosumers, Distribution Licensee and/or any other Stakeholder.

1.11.2 Principles for Determination of Levelized Cost of Energy (LCoE)

The levelized cost of energy (LCoE) generated by DERS is cornerstone of the design principles for determination of buyout tariff. LCoE should be determined by duly considering the following project and operational parameters:

- ✓ Investment cost,
- ✓ Project life,
- ✓ Operation & Maintenance cost,
- ✓ Capacity Utilization Factor (at ex-bus),
- ✓ Financing Cost (cost of debt and equity),
- ✓ Debt and Equity ratio and

- ✓ Nature and quantum of Subsidy if any provided to DERS.

A uniform LCoE for Bhutan or a region specific LCoE can be determined if there are reasons to believe that underlying cost drivers differ significantly but duly considering the ease of implementation of buyout tariff so determined, by the Distribution Licensee. Buyout tariff can also be differentiated to account for difference in size and technology of DERS.

1.11.3 Approach And Methodology for Design of Buyout Tariff

For determination of the buyout tariff, the design methodology provided in the

Table 1 to quantify the costs incurred and benefits that accrue to Prosumers and the stakeholders on installation of DERS may be considered.

Table 1: Buyout tariff design approach and methodology

Sl.No	Stakeholder	Approach for computing costs and benefits
1.	Prosumers	Costs • Consumption from the grid at the applicable retail tariff and, • Self-generation at LCoE. Benefits • Export to grid at buyout tariff.
2.	Other consumers (those who have not installed DERS)	Costs and Benefits • Receive or pay same cross subsidies as before and after the installation of DERS. Design Methodology • They remain financially unaffected from the decision of a prosumer to install DERS.
3.	Distribution Licensee	Costs • Purchase cost of electricity consumed by prosumer from grid (cost of quantum of power purchased for meeting the power consumed by the prosumer from the grid), • Wheeling cost irrespective of the quantum of consumption by prosumer from the grid (fixed cost) and, • Buyout tariff paid for the quantum of electricity injected into grid from DERS.

		Benefits • Savings in power purchase quantum equivalent to generation by DERS, • Savings in power purchase cost due to avoided transmission and distribution losses,
4.	DGPC	Costs • Generation costs remains the same irrespective of quantum of consumption by BPC, Benefits • Gains on avoided consumption by BPC (equivalent to grossing of self-generation by prosumers) @ export price or @ import price during the hours of self-generation as the case may be.

The investment by a Prosumer on DERS must be protected with appropriate return on investment duly considering the subsidy/grant that the Prosumer may have received. Return on investment by a Prosumer should be same irrespective of the relative consumption (off-take) from or export to the grid and to the extent possible changes in its retail tariff should not lead to either under or over recovery of return on its investment.

Distribution Licensee must be compensated for any increase in its operational cost due to interconnection of DERS with its distribution network and supply of surplus energy to it so that it is not financially adversely impacted by installation of DERS.

Different buyout tariffs for different categories of Prosumers, time of the day/season and geographic regions of Bhutan may be designed duly considering the differences in the underlying factors and the approach and methodology illustrated in section 1.11.3.

1.11.4 Revision of Buyout Tariff

The buyout tariff should be regularly evaluated, and it may be revised when there are reasons to believe that the underlying factors which have an impact on the buyout tariff such as project cost, its financing cost and operational parameters of DERS, and retail tariffs applicable to Prosumers have changed substantially. Frequent and quick revisions should be avoided but revisions may be done on the occurrence of predefined events such as:

- Project cost, its financing cost and operational parameters change significantly from the values considered for LCoE determination and,
- Market penetration of DERS.

Such events on the occurrence of which the buyout tariff may be revised should be predefined and these events shall be made public for knowledge of all the stakeholders.

Stability in the buyout tariff is necessary to provide appropriate financing signals to stakeholders for investment in DERS and protect the investment once committed. It would be desirable that buyout rate:

- Remains same during the project life of such DERS or,
- Increases at a rate which is predefined (indexed to appropriate indices) for the project life of such DERS.

Changes in the buyout tariff should not be carried out with retrospective effect and shall be made applicable to consumers installing DERS after coming into effect of revised buyout tariff.

2 Annex 1: Definitions

(a) "Buyout tariff" means the tariff as determined by ERA for payment by the Distribution Licensee to a Prosumer for the energy injected into its network by the Prosumer from DERS installed in its premises,

(b) **"Distributed Energy Resource System" (DERS)** means the grid interactive power generator from renewable energy sources including its power system installed on Prosumer Premises and connected to the distribution system of the distribution licensee,

(c) **"Prosumer"** means an electricity consumer that produces part of electricity needs from DERS installed in its Premises and uses the Distribution System to inject excess production for sale and to withdraw electricity when self-production is not sufficient to meet own needs from the same Distribution System,

(d) **"Renewable Energy Service Provider"** means a developer who designs, builds, arrange finances for developing the DERS and generates renewable energy in the premises but does not own the premises, and enters into a lease/commercial agreement with the consumer who owns the premises,

(e) **"Prosumer Agreement"** means an agreement between a Prosumer and a Distribution Licensee for connection and terms and conditions for sale and purchase of power from the Distribution System,

(f) **"Premises"** means rooftops or/and elevated areas on the land, building or infrastructure or part or combination thereof in respect of which a separate meter or metering arrangements have been made by the Distribution Licensee for the supply of electricity,

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