STANDARDIZED TARIFF METHODOLOGY

FOR THE SALE OF ELECTRICITY TO THE MINI-GRIDS

IN TANZANIA

UNDER

STANDARDIZED SMALL POWER PURCHASE AGREEMENTS

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This is one of three documents that define the Small Power Purchase Scheme in Tanzania for the mini-grids.

1. Standardised Small Power Purchase Agreement (SPPA) for the Mini-grids
2. Standardised Tariff Calculation Methodology (STM) for the Mini-grids [this document]
3. Detailed Tariff Calculations under the SPPA for the Mini-grids for year 2009 [Accompanying document]

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1 DEFINITION OF A SMALL POWER PLANT (SPP)

An SPP is defined as a power plant using a renewable energy source or waste heat, or cogeneration of heat and electricity, with an export capacity up to ten (10) MW.

2 PRINCIPLES OF TARIFF SETTING

Tariffs for the purchase of electricity from SPPs to the mini-grids should not cause excessive costs to the mini-grid operator or electricity users, above the costs of other options. Therefore, the tariffs are established on the principle of avoided costs. Mini-grids are proposed to be eventually connected to the main grid in Tanzania over a target period of fifteen years ahead.

The tariff is calculated to reflect both the costs of investment and operation of diesel power plants in mini-grids and the Long-run Marginal Cost (LRMC) of the TANESCO main grid.

3 TARIFFS FOR SPPS ON MINI-GRIDS

3.1 Responsibility and Timing of Tariff Calculations

Tariffs will be calculated and annually revised by the Small Power Development Working Group (SPDWG). Tariffs for the subsequent year will be calculated in the month of September every year, and submitted for regulatory review by 30th September. Tariffs for the subsequent year will be published on or before 30th November every year.

The tariffs are based on the avoided cost of the mini-grids and TANESCO grid at the medium voltage level, suitably adjusted to reflect market conditions. Tariffs are re-calculated and published every year. All SPPs operating on any mini-grid will be paid at this tariff, subject to the floor price and the price cap described in this document.

3.2 Calculation of Tariffs

As the mini-grids would eventually be merged with the main-grid (except in special cases), the *Long-run Marginal Cost (LRMC)* of Tanzania's main grid would be the basis for the calculation of the avoided costs in the long-term. LRMC is the cost of providing an additional kWh of energy and the corresponding kW of capacity from the generating system in the long-run.

However, because all the min-grids are presently served using diesel engines at a cost significantly higher than the costs of the main-grid supply, certain adjustments would be made to the main-grid LRMC, to calculate the tariffs for min-grid SPPs.

3.2.1 Calculation LRMC of the Main Grid

The *Long-run Marginal Cost (LRMC)* is the basis for the calculation of the avoided cost. LRMC is the cost of providing an additional kWh of energy and the corresponding kW of capacity from the generating system in the long-run.

The WGSPD will calculate the LRMC using the following method:

A. Calculation of LRMC at the Generation Level

Step 1: The base-case long-term generation expansion plan to cover at least twenty years ahead is optimized. This plan is the most likely scenario out of all the different scenarios that may be modelled, and this should be the long-term generation expansion plan that is recommended for implementation and accepted by TANESCO. It should be a least-cost plan. In keeping with TANESCO practice, this plan will be based on economic costs. The net present value of all costs of this base-case expansion plan is NPV_1.

In preparing the expansion plans the following will be adhered to:

(a) The ACRES™ model already available with TANESCO will be used. Alternatively the WASP[1] model may be used.
(b) Investments on new candidate generating plants will be updated to the most recent figures available, based on the latest feasibility studies.
(c) Transmission investments required to interconnect each candidate generating plant will be included in the costs of each such plant presented to the planning model.
(d) Commitments to existing Independent Power Producers (IPPs) will be reflected in the fixed and variable costs of such power plants. Commitments to Emergency Power Plants (EPPs) will be reflected similarly.
(e) Non-fuel operating and maintenance costs of other existing power plants will be updated to the most recent figures.
(f) Fuel prices for existing gas, oil and coal-fired power plants will be based on the existing contract prices. In the absence of contract fuel prices for new gas and coal-fired power plants, they will be equal to the highest price paid for the same fuel in existing power plants.
(g) The studies will be conducted in constant USD prices.

[1] Wien Automatic System Planning Model, IAEA, Vienna. Current version is WASP IV. This model is already installed in the Ministry of Energy and Minerals.

Step 2: A demand increment is given to the load forecast, to a level adequate to disturb the investment plan. This disturbance may be in terms of certain power plants being advanced or new power plants from the candidate list of power plants being picked-up for implementation. This plan should also be optimised, and be a least-cost plan. In the case of Tanzania, the demand may have to be increased by about 50 MW, to enable some planned power plants to be advanced. Advancing demand growth by one year may provide the adequate marginality to the system. The net present value of all costs of this expansion plan for increased demand is NPV_2.

Step 3: The present value of energy delivered in the base case plan developed in Step 1 is E_1. The present value of the energy delivered in the "demand increased plan" developed in Step 2 is E_2. Therefore, the long-run marginal cost will be,

$$\text{LRMC} = \frac{NPV_2 - NPV_1}{E_2 - E_1} \text{ USD/kWh}$$

LRMC calculated will be separated into the capacity component ($LRMC_c$) and the energy component ($LRMC_e$). The facility to do this is provided in the model, and the following are the guidelines to separate the costs:

$LRMC_c$ are the costs related to investments, less salvage value, plus the fixed operating maintenance costs and the costs of unserved energy.

$LRMC_e$ is the cost related to fuel and other non-fuel operating costs.

B. Converting LRMC from Economic Costs to Financial Costs

The LRMC so calculated has to be adjusted from economic costs to financial costs, as follows:

(a) The capacity component of the LRMC will be adjusted upwards to reflect the average taxes and duties imposed on TANESCO's capital equipment. These will include customs duty and other taxes and levies on investments, averaged-out to the investments of TANESCO, but would exclude recoverable taxes such as value added tax.

(b) The fuel-related component of LRMC will be adjusted upwards to reflect any taxes imposed on fuels, excluding recoverable sales taxes such as value added tax.

Composite average tax rate for capital investments = T_c
Composite tax rate for fuel (if any) = T_e

Financial LRMC at generation level $CA_G = LRMC_c \times (1+T_c) + LRMC_e \times (1+T_e)$ USD/kWh

The USD costs occurring in any calculation will be converted to TZS at the average selling rate of USD[2] published by the Bank of Tanzania (BOT) for all business days over one year ending 31st August. This is because the calculations are done by the end of August. Exchange rate information is available in the official website of BOT http://www.bot-tz.org

The adjusted LRMC calculated above is defined as the avoided cost at the generation level.

3.2.2 Adjustment to Reflect Avoided Transmission Losses

SPPs are connected to the isolated networks. Electricity produced by SPPs would be distributed through the medium and low voltage networks within isolated networks, thus saving high voltage transmission losses otherwise incurred by TANESCO to produce electricity at the main power plants and transfer to the medium voltage network. LRMC of the grid calculated in section 3.2.1 will be adjusted upwards to reflect the avoided transmission losses.

C. Adjustment for Avoided Transmission Losses

Transmission losses (as a share of net generation) = TLOSS

Avoided cost of supply from the main grid, $CA'_G = \frac{CA_G}{(1-TLOSS)}$

3.2.3 Calculation of Average Incremental Costs in Mini-grids

The average incremental costs of generation into mini-grids will be calculated on the basis of a new diesel engine-generator being fully displaced by the SPP.

D Incremental Capacity Cost of Mini-grids

Investment cost of a diesel engine-generator (typically 1 MW)	C_d per kW
Economic life of a diesel engine-generator	T_e years
Annual maintenance cost of a generator as a share of investment	m
Real discount rate	d
Annual capacity factor	CF

Present Worth Factor $PW = \sum_{r=1}^{T_e}\left(\frac{1}{1+d}\right)^r$

Annuity Factor $AF = \frac{1}{PW}$

Annualised capacity cost $= AF \times C_d$

Annual maintenance cost $= m \times C_d$

[2] The selling rate means the amount of TZS required to buy a USD.

Energy delivered $= 8760 \times CF$ kWh

Incremental capacity cost $= \frac{AF \times C_d + m \times C_d}{8760 \times CF}$ per kWh

E. Incremental Fuel, Lubrication and Maintenance Costs of Mini-grids

Fuel consumption rate for full-load operation of a diesel engine-generator $= F_r$ litre/kWh

Adjustment factor to account for part-load operation $= f$

Actual fuel consumption rate per unit of electricity generated $= F_r \times (1+f)$ litre/kWh

Adjustment to reflect lubrication oil and variable maintenance costs $= g$

Price of fuel inclusive of all costs including delivery $= F_c$ per litre

Incremental fuel cost $= [F_r \times (1+f) \times (1+g)] \times F_c$ per kWh

Average Incremental cost CI_G = Incremental capacity cost + Incremental fuel cost

3.2.4 Tariff for SPPs Connected to Mini-grids

The tariff for SPPs connected to mini-grids shall be the average of

(a) Avoided cost of supply from the main grid CA'_G, and
(b) Total Incremental Cost of mini-grids CI_G

Tariff for SPPs connected to mini-grids $T_{SPP} = \frac{1}{2}[CA'_G + CI_G]$

3.3 Floor Price and the Price Cap

The *floor price* is established at the signing of the SPPA to protect SPPs from possible reduction in the standardised tariff in future years, owing to external factors such as reduction in fuel prices and appreciation of the value of TZS against international currencies.

The *price cap* is established at the signing of the SPPA to protect the Buyer from possible increases in standardised tariffs in future years far in excess of initial tariffs, caused by external factors such as fuel price increases and depreciation of the TZS against international currencies.

Floor price for all SPPs signed during the year = Standardised Tariff announced for the year

Price cap for all SPPs signed during the year = 1.5 × Standardised Tariff announced for the year.

The price cap will be adjusted based on the published Consumer Price Index (CPI) for Tanzania.

Floor price in year n, FT_n = T_{SPP} for year 0

Note: Year 0 is the year of signing the SPPA
Price cap in year n, CT_n

$$= (1+CPIA_1) \times (1+CPIA_2) \times .....\times (1+CPIA_n) \times 1.5 \times TD_{SPP} \text{ for year 0}$$
$$= (1+CPIA_1) \times (1+CPIA_2) \times .....\times (1+CPIA_n) \times 1.5 \times TW_{SPP} \text{ for year 0}$$

where year 0 is the year of signing the SPPA. $CPIA_i$ in year i is the five-year moving average of the annual change of CPI, described by the following formula:

$$CPIA_i = 0.2 \times \sum_{r=i-5}^{i-1} \left(\frac{CPI_r}{CPI_{r-1}} - 1 \right)$$

where CPI_r is the consumer price index published by the National Bureau of Statistics, Tanzania (NBS) for year r. This information is available in the official website of NBS http://www.nbs.go.tz/

To be consistent with the time-frame used in the exchange rate calculations, the five year moving average too, will be based on a year ending 31st August of the current year.

For each SPPA signed, the Buyer will maintain a record of the floor price, and the CPI-adjusted price cap for every year for the term of the SPPA. Before making the first payment in any year, the Buyer shall check whether the tariff of each SPPA has reached the floor price or the price cap, and make payments accordingly.

3.4 Decimal Accuracy

Quantity	Decimal accuracy
System costs in UScts/kWh	2
Tax rate (%)	1
Exchange rate in TZS/USD	2
System costs in TZS/kWh	2
Transmission loss in %	1
Generation forecast in GWh	1
System costs in million TZS	1
Quantities stated as a %	1
Fuel consumption rate stated in litre/kWh	3
Fuel price in TZS/litre	2
Change in consumer price index stated in %	2
SPP tariff in TZS/kWh	**2**

3.5 Annual Tariff Announcement

The public announcement of the SPP tariffs for mini-grids will be of the following form:

Prices payable in year xxxx to Small Power Producers operating under the standardised Small Power Purchase Agreements (SPPAs) to supply mini-grids will be as follows:

Tariff paid = T_{SPP} per kWh

The above tariff will be subject to the limitations of the floor price and the price cap stated in the respective SPPAs.

For new SPPAs signed during the year xxxx, the floor price will be the tariffs stated above. The price cap will be 1.5 times the tariffs stated above. The price cap applicable to all SPPAs signed in any previous year shall be increased by $CPIA_i$.

The above tariffs are non-negotiable. More information of the process of application and developments of small power projects, the standardised SPPA and the calculation of tariffs for year xxxx can be obtained from:
xxxxxxx
xxxxxxx
xxxxxxx

This additional information is also available on www.xxx.xxxx