FORECAST ENERGY SALES REPORT

40 MW PV PLANT –LEPHALALE

(South Africa)

Content

1 OBJECT

The purpose of this document is to establish the estimated Annual Production of the design for the 45.996MWp PV plant located in Lephalale, province Limpopo (South Africa).

2 DESIGN DESCRIPTION

The Design suggest is described below:

a) Solar Photovoltaic Modules Technology

The Design suggested based on modules poly-crystalline (p-Si) technology. YINGLI SOLAR 295W (YL295-35b) as a total amount of 155.920 modules that means an installed power 45.99 MWp.

The modules will be fixed on steel structures, hot-dip galvanized, designed to gather 20 modules per string. The modules will be installed in portrait configuration.

b) DC/AC Ratio. Inverters and Transformer Centers

The DC/AC ratio in order to accomplish with the South Africa Grid, the type of inverter and the number of transformer Centers will be as follow:

- **Inverters and transformer** . Apis 1500
  - 20' metal enclose, including
    - **2 GPtech inverters PV750 WD, working a 872 kW , fp 1 and 32ºC**
    - **2 Combiner boxes**
    - **LV Switchboard**
    - **MW Switchgea 2l+p(f), 24 kv**
  - 1800 kVA Ourtdoor dry type Transformer

c) DC-AC Cabling

The type of cable used the most for this kind of power plant is unarmored XLPE-Al type installed under duct, due to that, our proposal is use this kind of cable in the DC part between the string monitoring boxes and the transformer centers and also for the MV ring.

3 METEO DATA SOURCE

The radiation and temperature data used for the present calculations are PVGIS (Photovoltaic Geographical Information System) is an instrument for geographical assessment of the solar energy resource developed by Joint Research Centre (JRC) of the European Commission.

These are the radiation and temperature data for the site of the plant:

SOURCE	Irradiation on horizontal plane (kWh/m^2)	Irradiation on plane of array (kWh/m^2)	Ambient Temperature (ºC)
January	211.1	196.4	25.1
February	186.8	184.5	25.0
March	182.0	195.4	24.3
April	152.1	181.0	21.5
May	143.8	188.6	17.9
June	126.3	174.0	14.4
July	136.7	185.9	14.2
August	164.3	204.9	17.6
September	184.5	208.2	21.7
October	208.0	212.1	23.8
November	195.9	185.6	24.1
December	216.7	198.0	24.3
Total (kWh/m^2)	**2108.19**	**2314.4**	**21.13**

4 PERFORMANCE RATIO CALCULATION

The Performance Ratio Calculation has been based on the PVSYST V5.65 Software, and completed with simple hourly calculations for the losses between the inverters and the MV Switchgear (AC-LV losses, LV/MV Transformer losses and AC-MV ohmic losses).

In the table below are shown the estimated values for the main losses typically affecting the PV plant performance:

Estimated losses	YL295P-35b module (%)
Losses due to the shadows	2,40%
Losses due to angular and spectral reflectance	2,60%
Losses due to Irradiance level	1,10%
Losses due to temperature	8,60%
Losses due to non-uniformity and dispersion of parameters (mismatching and quality)	1,60%
Soiling losses (dust, sand, etc.)	2,10%
Ohmic wiring losses (DC - LV)	1,10%
Losses associated with the output of the inverter+ Consumption	1,60%
Ohmic wiring losses (AC - LV)	0,15%
Transformer losses	1,40%
Ohmic wiring losses in MV	0,40%
Other losses that can not be shown by PVSYST (Ancillary System, Evacuation Line, on Site Substation)	1,00%

The PVSYST Simulation has been carried for the whole plant for each option, as stated in the next pages. Likewise, the model that has been used in the PVSYST Simulation to obtain the irradiation on inclined plane is the Perez-Ineichen one..

The Guaranteed PR after adding the losses after the inverter up to the point of interconnection:

	YL295P-35 module
Guaranteed PR at POI *	**78%**
Contracted Capacity	**40MW**

*These results do not include the degradation losses and unavailability Facility losses. The Grid unavailability is an external factor that the EPC Contractor cannot be controlled and this value is not included but the recommend value shall be a 98%

5 ANNUAL YIELD CALCULATION

The following table shows the estimated energy yield for the years 1 to 20 of the lifetime of the PV Plant, based on the degradation rate guaranteed by the PV module supplier and the availability :

Year	*Module degradation*	*Plant Availability*	*Energy Yield YL295P(GWh)*
1	**2.5%**	**99.00%**	**79.5**
2	0.8%	99.00%	78.8
3	0.8%	99.00%	78.2
4	0.8%	99.00%	77.6
5	0.8%	99.00%	77.0
6	0.8%	99.00%	76.4
7	0.8%	99.00%	75.7
8	0.8%	99.00%	75.1
9	0.8%	99.00%	74.5
10	**0.8%**	**99.00%**	**73.9**
11	0.8%	99.00%	73.3
12	0.8%	99.00%	72.8
13	0.8%	99.00%	72.2
^6	0.8%	99.00%	71.6
15	0.8%	99.00%	71.0
16	0.8%	99.00%	70.5
17	0.8%	99.00%	69.9
18	0.8%	99.00%	69.3
19	0.8%	99.00%	68.8
20	0.8%	99.00%	68.2