



O. T. OTIS

ENGINEERING LTD

PROCUREMENT, ENGINEERING, INSTALLATION AND COMMISSIONING OF SOLAR PV/ WIND HYBRID DEMONSTRATION PLANT

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INTRODUCTION

A Hybrid system is one that utilises two energy sources alongside one another. Solar and Wind energy are renewable, infinite and environmentally friendly. Nigeria, which is located next to the Equator, is blessed with many days of sunlight per year, making the Solar PV technology viable. Also, certain parts of the country have winds with speeds enough to drive wind turbines and hence produce electricity.

For Nigeria's sustainable development and continued recovery, the national power system needs to confront some issues related to training and development of the necessary manpower required to cater for the continued interest in the development of Renewable Energy Projects. This is the main reason for constructing this training facility for the NAPTIN Regional Training Centre in Kainji, Niger State.

The NAPTIN demonstration power plant is completely powered-up by renewable energy sources and consists of 10kWp of Solar energy power and 15kWp of Wind energy power, combined with an energy storage system and all the power electronics required for adapting, managing the electricity output and its injection to the electrical network.

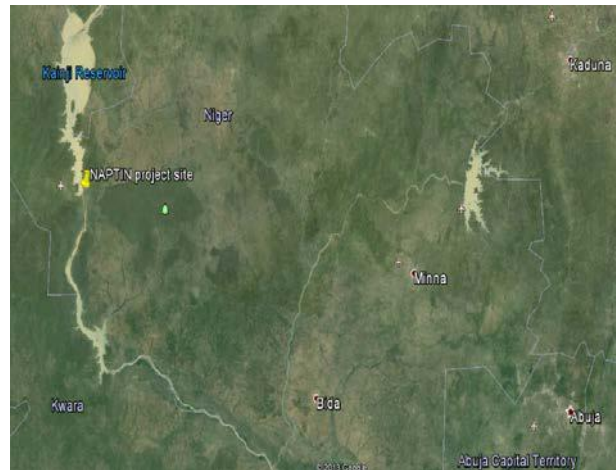
LOCATION

The project site is located in Kainji, Niger State, Nigeria, next to the dam, in the NAPTIN Regional Training Centre.

Latitude: 9° 51' 50.88"N

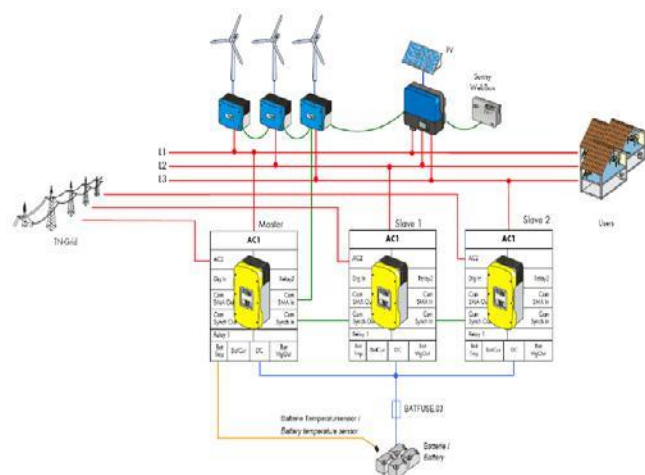
Longitude: 4° 37' 4.87"E

The natural vegetation and crops follow the gradient of the rains. The savanna climate, with marked wet and dry seasons, prevails in this location with a steppe climate and little precipitation.



Map showing the locations of project site at Kainji, Niger State, Nigeria.

TECHNOLOGY



Schematic of the NAPTIN Project, including the Solar PV, the Wind Power, the Energy Storage Systems, and the connection to the National Grid.

SOLAR PV

The PV array consists of poli-sylicon type 240Wp panels. The PV silicon panels convert sunlight into electricity, generating DC current. The power inverters will convert the DC current to AC current and adapt and adjust the voltage and frequency of the current.

The Solar PV is the IBC Solar PV PolySol 240LS, combined with the SAM Sunny Tripower 10,000TL Inverter. There are 46 modules of the PV Array.

Technical Specifications

STC Power Pmax = 240Wp

STC Nominal Voltage Umpp = 1,000V

STC Nominal Current (Impp) = 7.92A

Max. System Voltage = 1,000V

Module Efficiency = 14.6%

The tilt of the solar panels is 10°, and azimuth is 0°, although seasonal modifications of the tilt will be implemented to maximize energy production.



The Solar PV - inverter combination used in this project has a nominal AC voltage output range of 160V - 280V (rated grid frequency and voltage is 50Hz, 230V), a maximum output current of 16A.

The rated power is 10,000W (and maximum apparent AC power is 10,000VA).

Estimated Simulation Results

Produced Energy = 17.77MWh/year

Performance Ratio (PR) = 76.6%

Specific Production = 1,610kWh/kWp/year



WIND

The Wind Turbine System is made up of three (3) wind turbines of 5kWp and 4kWp each, summing up to 15kWp and 12kWp. Each wind turbine is operated independently and has its own inverter and protection, for higher reliability.

The wind turbine is the Siliken Wind Turbine SW 3.5GT with SMA WB5000TL-20 Inverter. The inverter configuration is single-phase grid-tied.



Connected Solar panels arrays installed on the site.



Installation of the wind turbine generators and blades.

Technical Specifications of the Wind Power System

Maximum Power = 5,000Wp

Power at 12m/s = 3,500Wp

Rotor has 3 blades.

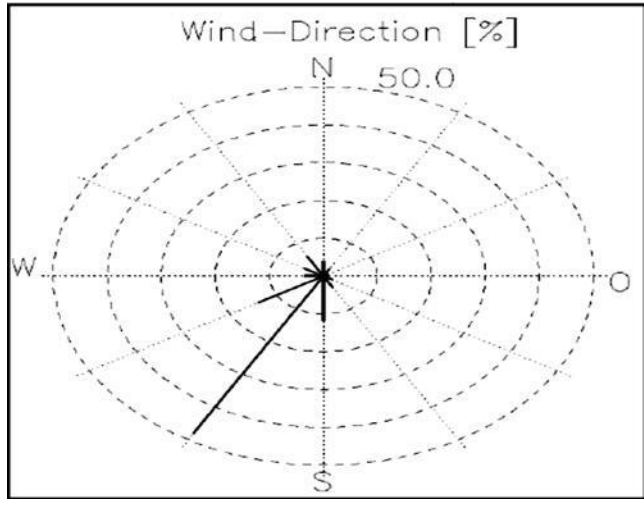
Blade material is made of glass-fibre reinforced



Supporting Tower Height = 12m
 Cut-in Wind Speed = 3.5m/s
 Maximum power wind speed = 17.5m/s
 Rated power frequency and voltage = 50Hz, 230V.
 Maximum output current = 26A
 Rated power = 5,000W (5,500VA)
 Maximum output power = 3,950W

Estimated Simulation Results of the Wind Power System

Average Energy Generation WTGs = 11,332kWh/year
 Total Capacity = 12kW
 Average Output = 1.372kW
 Capacity Factor = 11.43%
 Hours of Operation = 7,537hrs/year



The Wind Direction at the project



Sunny Sensorbox, part of the Solar PV System



Connection of the solar batteries to the inverter in the control room.

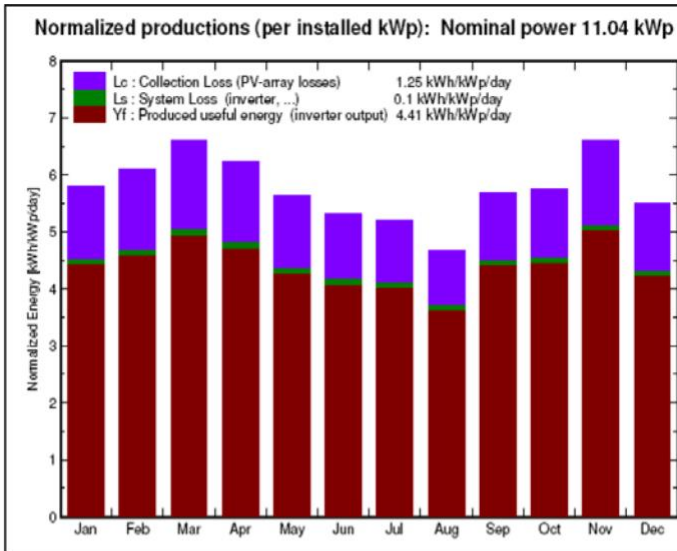


Cable termination in the control room.



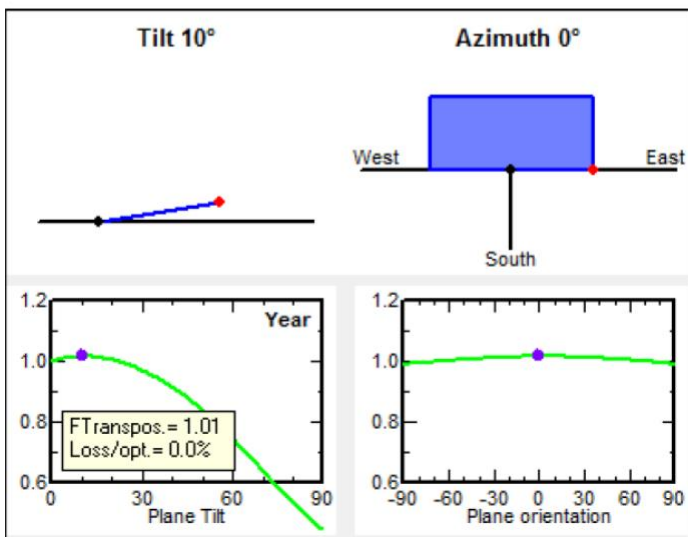
Construction of Solar Modules Foundation





The construction Crane at project site in Kainji

The estimated equivalent amount of energy injected to be injected into electrical grid on a monthly basis

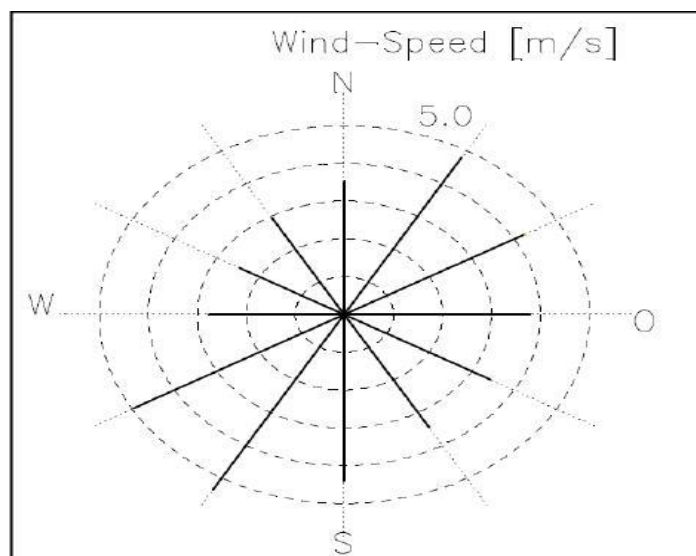


Technical Data of SMA Sunny Tripower 10000 TL



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**Consulting / Engineering Procurement
/ Construction**



The Wind Rose of the project

O.T. OTIS Engineering Ltd is an indigenous Nigerian company with its Head Office at No 30/32, Olu Agabi Close, Cadastral Zone CO2, Gwarinpa 1, Abuja, and branch offices in Warri, Benin, Calabar, Omoku, Yenogoa, and Katsina. It is a multi-disciplinary company primarily established to provide Engineering Services/Support in the energy and allied sectors of the Nigerian economy with particular emphasis on Engineering, Construction and Technical Services.

OTIS Engineering Ltd has successfully completed projects in virtually all the facets of the Industrial sector in Nigeria from Machine Tools/Metal Working through Iron and Steel to Automotive Manufacture, Petroleum Refining and Petrochemicals, Electric Power to Pulp and Paper, in over 20 years of existence.