**Microgrid**

The features of micro-grid system depend on the type and size of the micro-generation units ,as well as the location ,and the availability of primary energy sources on specified location especially renewable sources.

Evolution in Distributed Generations (DGs) and micro-grids is accompanied by the improvement of different essential power conditioning interfaces and their accompanied control to connect the multiple micro-sources to the micro-grid.with such interconnection operation with the micro-grid tend to be more flexible and can be operating freely in any of the two modes we mentioned in Chapter 2.

To satisfy the research question :What is the availability of interconnecting a number of micro-grids to operate together without the existence of the main utility grid? We designed our system to be consisting of three indistinct micro-grids in three away locations within our study case Sudan.

We used MATLAB/SIMULINK software tool for the identified system components: (Solar System,Wind System,ESS).

**PV Solar System**

To model the PV system within the matlab ,we used datasheet{Fasheer datasheet} as a refrence point for the model paramters to be able to define the system with regards to the three different locations and their conditions (Capacity,Weather Forecast..etc).Henceforth, we were capable to come up with this generalized model for our system that is flexible to change based on your location.

[Matlab Model]

Fig()

As seen in fig ()above we used Maximum Power Point Tracker (MPPT) in our model inorder to output the maximum power of the system ,for that we used Perturb and observe algorthim (P&O) algorthim below:

[P&O ] algorthim

Based on the datasheet used the parameters used for modeling are as follow :

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Location | No.of strings | No. in series | Voc | Isc | Vmp | Imp |
| Hamza\_Elsheikh |  |  |  |  |  |  |
| Tannah |  |  |  |  |  |  |
| Um\_Bader |  |  |  |  |  |  |

Where as the parameters for on PV system are :

For the irradiance and Temperature of the module a dataset GIS was installed based on the identified location and inputted onto our various models.

**Wind Turbine Farm**

Wind turbine is usually composed of a rotor,a generator ,three-blades and a drive train .Pitch angle is used to control the generated output at cases where the there is a high wind speed. The wind turbine extracts the kinetic energy from the blowing wind through the three blades.

Simulink model designed below is of 1.5 MW wind farm system which was installed in the specified locations.

[Wind Farm] model

Fig()

The wind speed forecast GIS dataset was installed from [] taking into consideration the three locations for a 100m wind farm.

**Energy Storage system**

We stated before that the ESS is beneficial for our system as it allows to fill the gap generated between the supply and demand due to the changing conditions of the RES. A desired storage system is expected to provide the required power into the micro-grid and store-up sufficient energy at low consumption.

The storage system that we studied and modeled is of two types:

1. Storage Batteries
2. Super-capacitor

**Battery Banks:**

In Simulink there is a set of predetermined charge behavior for two types of battery :Lead-Acid,Lithium-Ion. For our system we use Lead-Acid and specified the following parameters

|  |  |
| --- | --- |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

The figure below shows the Simulink model:

[Battery Model]

Fig()

**Super-Capacitor**

The Super-capacitor, also known as ultra-capacitor, is the electrochemical capacitor that has higher energy density than common capacitors on the order of thousands of times. The equivalent circuit used for conventional capacitors can also be applied to super-capacitors. If the simulation time is much larger than the self-discharge time, the equivalent parallel resistance might be neglected as well. The actual capacity C varies with quantities as current, voltage and temperature.

The model below illustrates the super-capacitor block :

[Super Capacitor]Model

**Fig()**

**Load**

In Chapter 2 we have mentioned that the microgrid load is of two types :critical and non-critical load (fixed and flexible).Based on the capacity of the system and the geographical location we categorize our load in a way to prioritize the demand of the specified area. In our study we defined three locations and identified the load capacity within each location check the Table below:

Table Below (Load of three microgrid )

**Controller**