

A Review on Various Optimal Microgrid Sources and Modelling Using HOMER

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Abstract—Demand of the electricity is growing day by day due to industrial growth and increase in living standards of human beings. The requirement of electricity can't be satisfied alone by fossil fuels as they are reducing with passage of time. We have to find out other alternatives to fulfil the energy demand. There is research going on in the field of renewable energy which gives the impression to be achieving a great height day by day along with expansion of distributed generation under smart and microgrid. Current studies in electrical grids and networks society are focused in the direction of the integration of Microgrid technologies across the consumer's end. Microgrid technology can efficiently integrate the advantages of distributed generation, and also carry a technical way for generation and application of renewable energy. Microgrid can not only boost up the efficiency of energy cascade utilization, but also improve the reliability of power supply and quality power supply. This review article firstly elaborates the background and the basic concept of microgrid, control structure & functionality, system components & resources, system modelling, various field study, then finally describes the cost analysis for a typical microgrid.

Keywords—Microgrid, Renewable energy, Solar system, Wind Energy, HOMER

I. INTRODUCTION

A microgrid (MG) is a lonely estimated unit in a power system that can be worked as a single joined load. The unit is done up of generators, energy volume, load regulator and power electronic connection points like inverters. The MG has two hazardous parts a static switch and miniature source, which contains of generator, stockpiling and an inverter.

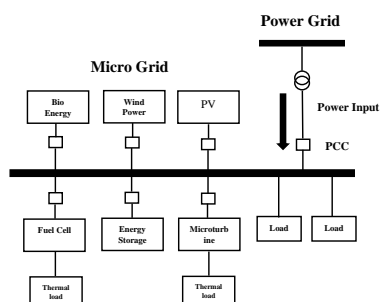


Fig.1 Basic structure of microgrid

The microgrid is the most up to date in a long queue of innovative creation on the power system. Presenting to the U.S. Division of Energy, a microgrid is "a assembly of interconnected loads and circulated energy resources inside obviously characterized electrical limits that goes about as a single manageable unit regarding the system and that connections and isolates from such grid to permit it to work in similarly network associated or island mode." at the end of

the day, a microgrid is various age and capacity resources that can link and separate from the grid.

Individuals in developed nations, approach reliable and top quality power supply however in arising nations like India, individuals from many of the states are fronting different issues connected with oppressed nature of power supply like normal blackouts, inadequate grid limit and enormous power misfortunes from transmission and conveyance organization. These challenges are extremely normal almost in all areas of India. These issues can be fixed by changing to microgrids which won't just convey all the more efficient and dependable power yet in addition convey opportunity to individuals of non-industrial nations to carry on with a better life, liberated from perilous and contaminating emissions.

The goal of the microgrids is to acquire power tolerable, conservative and economical way by smart checking, control and self-healing advancements. To the utility microgrid can be a sort of load which can call for power whenever e.g., around evening time as in circumstance of a solar cell which doesn't have power around evening time or at cloudy day Microgrids seems like a new, local and limited scope lattice which take full advantage of its nearby assets accessible in a geological region and limits the AT&C losses [3].

II. CONTROL STRUCTURE AND FUNCTIONALITY

Microgrids highlight better control necessities and methodologies than accomplish local reciprocal and to boost their financial advantages. There is general agreement that microgrid controls should bring the accompanying useful requirements: current the microgrid to the utility network as single self-controlled unit so it can convey frequency control like a synchronous generator; keep away from power stream past line evaluations; control voltage and frequency inside good jumps through islanding; dispatch resources to proceed with energy balance; island proficiently; and securely re-join and resynchronize with the central grid. Microgrids can in a general sense be controlled similarly as the central grid, i.e., through a three-level progressive control.

Control of recurrence and voltage - alleged primary and secondary control - can be achieved either beneath the direction of a microgrid central controller (MGCC) that sends clear orders to the disseminated energy resources or in an appropriated way, similar to CERTS, in which every resource answers to local circumstances [4].

As per the ongoing state of the improvement of power system and the specialized highlights of the microgrid, it is extremely pivotal and important to progress microgrid innovation quickly.

A. AC Microgrids

The term AC Microgrids, as presented in figure 2, refers to the Microgrids with AC power. The majority of the associated or accessible construction connects to AC. Every of the loads and sources are related at the purpose in like manner coupling (PCC). Discussion of power between the sources and loads and furthermore grid related activity can be done through the PCC. In relations of grid solidness, with the imaginative power electronic converters with the capacity of variable the dynamic and responsive power, AC Microgrids are feasible to contribute. Additionally, unsurprising sources like diesel generators can likewise be utilized in a joint effort with different sources to settle the grid under hazards. The majority of the safety devices fabricated by the organization's consideration on the AC frameworks, accordingly likelihood of having an AC Microgrid is continuously more in the present circumstance. Inferable from high utilization of force electronic inverters, the DC power delivered by the sources can be productively switched over completely to AC ability to be utilized in the AC grid.

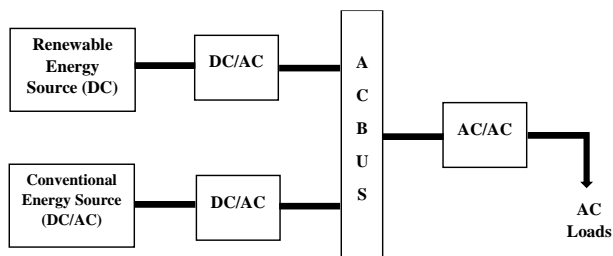


Fig 2. Schematic representation of an AC Microgrid

Sources like PV system, a primary measure of the sources in DGs, create power in DC. Additionally, through the utilization of DC generators in the micro wind and micro hydro components can be a decision towards DC Microgrids. In literature, many writers have suggested utilization of control instruments for the respectable power trade for Microgrid. Smart power switches in can be a fair helper to the incorporated Microgrid central controller (MCC). SPSS can assume a unique part in the impending networks in checking the power stream as well as in association of the expense of the power of the holder.

B. DC Microgrids

In such networks, the loads are regularly all DC loads and the degree of functional voltage can likewise fluctuate in the range of 48V to 310V or different levels reliant upon the loads, correspondence system utilized or the makers.

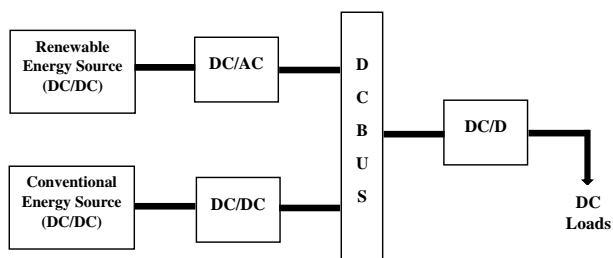


Fig 3. Schematic representation of a DC Microgrid

As opposed to the AC Microgrid, the DC Microgrid is humbler as it doesn't have actual measures like reactive power, and frequency. Additionally, stage reflection is

missing which makes the association of DC gadgets and sources less difficult. A basic representation of the DC Microgrid can be addressed as in figure 3.

The schematic diagram of the DC microgrid is represented in Fig. 3. One end of the bus is connected to the grid through transformer and AC-DC converter however the further end is associated with the distributed power, like battery energy capacity unit, photovoltaic power generation unit, energy component, and wind power generation unit and so on and DC or AC loads through DC, AC-DC and DC-AC units.

C. Hybrid Microgrids

In hybrid Microgrids, both AC and DC loads and sources can exist. PCC will play a critical part in controlling the power stream. In, process with AC/DC loads and generation is portrayed. Divergent control calculations can be utilized relying on the site of the establishments. Home Area Network (HAN), or Wide Area Network (WAN) presence utilized by the Smart Home Management Systems or MCC correspondingly are a few broad instances of current day developments of the Microgrids. Likewise, the control system of cross breed lattices is complex than that of basically AC or DC Microgrid because of the ascent in the control restrictions like reactive power, phase compensation and frequency.

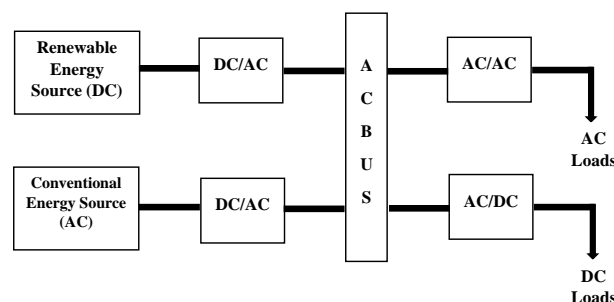


Fig 4. Schematic representation of a Hybrid Microgrid

A few authors have considered the continuous course of the hybrid Microgrid and examined the control structures as in. Taking into account this explanation, figure 4 is the means by which a crossover Microgrid structure seems to be.

III. SYSTEM COMPONANT AND RESOURCES FIELD STUDY

A. HOMER® Software

Simulation, Optimization and Sensitivity Analysis are the three most critical undertakings executed by HOMER®.

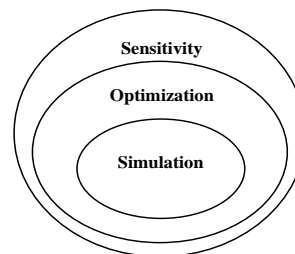


Fig 5. Conceptual relationship between simulation, optimization, and sensitivity analysis

These three parameters estimate technoeconomic possibility of different accessible innovative choices subsequent to bookkeeping

all potential varieties in electric load, energy asset accessibility, innovation cost, and so on.

Figure 5. shows the association between simulation, optimization, and sensitivity examination. The optimization curved incorporates the simulation circular to address the way that a solitary improvement contains of numerous simulation. Likewise, the sensitivity investigation oval incorporates the enhancement oval since a solitary sensitivity investigation contains of different advancements

HOMER® figures out the ideal outcomes established on various sizes and measures of the hardware's alongside restrictions as characterized by user. If the modeler isn't affirmed about the best worth of a particular variable, then through the assistance of sensitivity investigation modeler can show up various possible upsides of that variable and sensitivity investigation shows how the simulation results be dependent upon these qualities.

B. Resources

- *Solar Resource*

To display a system covering a PV array, the HOMER® user should convey solar source information for the site of interest. Solar data information determines how much worldwide sun powered radiation (pillar radiation drawing nearer straightforwardly from the sun, in addition to tedious radiation coming from all pieces of the sky) that strikes Earth's surface in a trademark year. The data can be in one of three structures: hourly normal worldwide sun powered radiation on the level surface (kW/m²), month to month normal worldwide sunlight-based radiation on the level surface (kWh/m² day), or month to month normal clearness file. The clarity index is the proportion of the sunlight-based radiation capturing Earth's surface to the sun powered radiation capturing the highest point of the air. A number among nothing and 1, the clarity index is a measure of the clearness of the climate.

- *Wind Resource*

To show a system including one or additional wind turbines, the HOMER® user should convey wind data information representative the wind speeds the turbines would association in a characteristic year. The user can convey estimated hourly wind speed information if available. Then, at that point, HOMER® can produce synthetic hourly information from 12 monthly normal wind speeds and four valuable measurable impediments: the Weibull shape factor, the autocorrelation factor, the daytime design strength, and the hour of most high wind speed.

The Weibull shape factor is a measure of the dissemination of wind speeds throughout the year. The autocorrelation factor is a measure of how strongly the wind speed in one hour grades to be dependent upon the wind speed in the earlier hour. The diurnal plan strength and the hour of peak wind speed assign the extent and the phase, correspondingly, of the typical everyday plan in the wind speed. HOMER® conveys default norms for separately of these boundaries.

- *Hydro Resource*

To model a system including a run-of-river hydro turbine, the HOMER® client should bear the cost of

stream information addressing how much water existing to the turbine in a characteristic year. The user can bear the cost of estimated hourly stream information if existing. Then, HOMER® can utilize month to month midpoints under the assumption that the stream rate extras steady inside every month. The user additionally requires the leftover stream, which is the smaller stream that should stay away from the hydro turbine for biological goals. HOMER® deducts the excess stream from the stream information to manage the stream existing to the turbine.

IV. SYSTEM MODELLING

The hydro microgrid system model is considered through various power age bases like, i.e., Grid association, Wind Generation, and sun oriented photovoltaics. The energy storage device i.e., batteries for sun based photovoltaics. Separately month of the year, the simulation reflects into concentrate on the sun oriented radiation.



Fig. 6. Standalone microgrid [1]

Microgrid system model is viewed as utilizing three different power age sources, i.e., diesel generators, energy components, and sun oriented photovoltaics. The energy storage devices contain the hydrogen storing for the power modules and the batteries for sun based photovoltaics. Two disparate sorts of loads are taken in to consideration of, i.e., 1) Primary and 2) Deferrable Load. The essential load is for the most part the electric lights, bulb, fans or the minor evaluated apparatus. The microgrid system is thought about for the most part for the water system so the DC water pump is the deferrable load. The sources, energy storage systems and the loads are connected to a similar DC voltage bus. The microgrid is considered in independent mode development and is simulated in HOMER® is displayed in Fig. 6.

The sun oriented PV produce power made on temperature, while energy units utilize the kept hydrogen energy. The diesel generators use diesel as a fuel and can deliver power whenever with practically no limitations of climate or putting away. Additional power is put away in the battery bank and the water is utilized as an electrolyzers that conveys hydrogen gas which is stored in hydrogen tank. In the event of high load demand and low power generation, the battery conveys power to the load. In light of the load interest and the sun oriented illuminations the ideal gathering of the sources and load is examines by using through the HOMER® climate simulation.

V. COST ANALYSIS FOR TYPICAL MICROGRID

This part conveys the numerical expense meaning evaluation of a microgrid. The evaluation of microgrid

interaction can be gone through its expense and emission investigation. Since, a common microgrid contains of fundamentally two sorts of generators dispatchable and non-dispatchable generators, an electric power stream on an ordinary microgrid can be connoted as displayed in Fig. 3. It is to be notable that proper expense for various Distributed Energy Resources (DERs) supported because of essential equipment cost and connection doesn't rely on power dispatch and can be preserved as a constant.

A. Cost of PV Generator

The PV generator shows no running expense/fuel cost meanwhile the sun based radiation is available all around the day with next to no disbursement. However, a maintenance cost for the PV board, rely upon its power generation as well as the static expense is considered as the functioning expense for the PV generator.

B. Cost of Wind Generator

The wind generator working expense comprises basically of repaired setting cost, device cost and the expense of maintenance support for power conveys from the wind generator.

C. Cost of Deisel Generator

Taking into account the activity time span for the diesel generator to be 't' (in hours), cost of fuel to be in INR, the maintenance cost of the diesel generator set, at that point the all out cost of activity for generator is the piece of the power delivered by diesel generator multiplied with the productivity of diesel generator set fixed cost of diesel generator containing of gear and installation cost.

D. Cost of Battery Storage

The battery storage (BS) is a critical piece of the microgrid since it stores overabundance energy and supplies lack energy and keeps up with steadiness in microgrid functionality. It is to be noted when the battery storage supplies deficiency energy to the microgrid then the power surged into the battery system is negative represents benefits for the battery holder.

VI. CONCLUSION

Micro Grids have been focusing its way out to be a significant part of future Smart Grids (SGs). It highlights many benefits over conventional power grid network like better flexibility in control outcome, further developed system reliability, improve power quality, cost active, no environmental risks, and flexibility. The system expansion and power distribution executives' approaches show a significant role in permitting smooth working of a Microgrid either independent or network tied mode. In this paper a fundamental construction of microgrid system is made sense of with control construction and usefulness having plan examination with demonstrating of AC microgrid, DC microgrid and Hybrid microgrid utilizing various generations. Additionally in this paper component part i, e. HOMER® is given resources utilized in field study for the investigation of various ideal arrangement of the microgrid like sun based resource, wind resource, hydro source and so on. Further the review contains system modelling and the cost examination study for average microgrid is introduced.

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