High Speed Differential Smart DC Distribution System

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Abstract— In day to day life electrical energy has evolved as one of the most basic needs of human being. As we know that electricity generated at generating station will be transferred to required location accounting into various losses. Though still it is not assured to transfer with required efficiency it is proved to be economical. Further, the present power distribution system is established on the principle of alternating power that provides supply to the AC powered loads such domestic and industrial, but with the ongoing revolution in electronics industry, many smart devices are powered by DC. For the smooth functioning of this AC supply should be rectified and regulated. This process of this conversion incurs many losses and heavy investments. Hence, as a solution to this a separate independent DC micro-grid can be designed consisting of DC regulated power requiring DC loads. The proposed thesis work reveals that DC micro-grid could be installed as per requirement of load using hybrid energy source such as solar and wind energy there by decreasing transmission losses to some amount and proven to be economical.


I. INTRODUCTION

Energy is one of the major inputs for the economic development of any country. In the case of the developing countries, the energy sector assumes a critical importance in view of the ever-increasing energy needs requiring huge investments to meet them. It is assumed that by the end of 2020 the global demand for electricity are expected to increase by 15-25% with the existing demand .It is challengeable to the countries like developing nations like India to look for alternate solutions so as overcome the shortcomings.

The electrical grid has been cited as the greatest engineering achievement of the 20th century, but it now faces new challenges of sustainability, energy security, reliability, etc. Developed countries have a well-developed grid, and seek to improve it, while developing regions are still expanding their grids.

Over the past decade, the electricity generation, transmission and distribution landscape around the globe has changed drastically – in the traditional grid of the 20th century there were relatively few points of power generation or injection and millions of points of power consumption. With rapid proliferation of distributed and renewable generation, the 21st century grid will have numerous points of power injection as well as millions of points of consumption. Electric Vehicle (EV) roll out has further increased the complexity of the traditional electricity grid. To manage a grid with such increasing number of intermittent energy sources and EVs, smarter automation and IT systems are Imperative. Peak load management through control of loads (such as through demand response, which can be considered a dynamic form of Demand Side Management, or DSM) has assumed high priority for electric utilities as there is a growing peak demand, leading to a supply gap during peak hours of consumption in many parts of the world. Beyond such drivers, increased deregulation, consumer choice for green power, which is inherently variable [6], and many more factors are giving thrust for the transition to smarter grids that can address all these issues [4].

A smart grid is an electrical grid with automation, communication and IT systems that can monitor power flows from points of generation to points of consumption (even down to the appliances level) and control the power flow or curtail the load to match generation in real time or near real-time. Their increased visibility, predictability, and even control of generation and demand bring flexibility to both generation and consumption and enable the utility to better integrate intermittent renewable generation and also reduce costs of peak power. If the traditional grid was made secure only through over-engineering, a smart grid is cost-effective, nimble, responsive, and better engineered for reliability and self-healing operations. The traditional electric grid will need to build additional layers of automation, communication and IT systems to transform it to a smarter grid. Some of the applications or building blocks of a smart grid are

- Supervisory Control and Data Acquisition Systems (SCADA) with Energy Management
- Systems (EMS) and Distribution Management Systems (DMS)

Enterprise IT network covering all substations and field offices with reliable communication systems

- Enterprise Resource Planning (ERP)/Asset Management Systems
- Electronic Billing Systems and Customer Care Systems
Energy can be classified into several types based on the following criteria.

- Primary and Secondary energy
- Commercial and Non-commercial energy
- Renewable and Non-Renewable energy

Primary energy sources are those that are either found or stored in nature. Common primary energy sources are coal, oil, natural gas, and biomass (such as wood). Other primary energy sources available include nuclear energy from radioactive substances, thermal energy stored in earth's interior, and potential energy due to earth's gravity. The major primary and secondary energy sources are shown in Figure 1. Primary energy sources are mostly converted in industrial utilities into secondary energy sources; for example coal, oil or gas converted into steam. The energy sources that are available in the market for a definite price are known as commercial energy [2]. By far the most important forms of commercial energy are electricity, coal and refined petroleum products. Commercial energy forms the basis of industrial, agricultural, transport and commercial development in the modern world. In the industrialized countries, commercialized fuels are predominant source not only for economic production, but also for many household tasks of general population.
Fig 3 Block Diagram of Hybrid DC Distribution System.

Block Diagram Description
In this arrangement we use hybrid grid of the i.e. solar & wind grid. The renewable sources like solar and wind are used to generate the electricity. The main function of the battery in this project is to store the energy generated from the solar and wind power plants. Solar & wind panel is connected to battery through diode. Next the regulator is connected at the output of the battery. The main function of the voltage regulator is to regulate i.e. to give the constant output voltage to the output of the circuit. The main grid is from the single phase supply of the 230V. These is the generation of the electricity from the conventional sources like Thermal, Hydro or nuclear power plants. The main grid is from the single phase supply which is converted into constant DC source by using a voltage rectifier circuit. A voltage rectifier is consisting of the transformer and the rectifier unit. The ADC is the analog to digital converter which is connected at the output of the grids. The output coming out from the grids which is in the analog form, ADC converts that output into the digital form which is readable by the microcontroller.

III. RESULTS & CONCLUSION
1. When Mains supply is OK, both Loads, ON.
2. When Mains supply is OK, but little bit less on power, then only Industrial load ON and Domestic Load ON using Battery (solar, wind).
3. When Battery (solar, wind) supply is OK, both Loads, ON.
4. When Mains Supply is FAILED completely, the industrial Load is turned ON using battery and Domestic Load is Turned OFF completely.

Calculations
To calculate the energy it can supply to the battery, multiply Watts by the hours exposed to sunshine, then multiply the result by 0.85 (this factor allows for natural system losses).
\[ WH = W \times Hr. \times K \]
\[ 10 \times 1 \times 0.85 = 8.5WH. \]
Where \( W \) = Wattage of solar panel.
\( Hr. = \) Hours
\( K = \) factor for natural system losses (0.85)
This is the amount of energy the Solar panel can supply to the battery.

IV. CONCLUSION
The DC distribution concept represents a decentralization of the idea of the grid, and one that advances the goals of the current Smart Grid overhaul. The DC distribution begins to change the paradigm from a centralized generation and distribution system of power delivery to a system that is more flexible and more accommodating of the load that has come to be one that is more electronic, more ubiquitous, and more essential to our economy and our culture. DC distribution can create power systems that are more efficient and more compatible with the fastest growing segment of the load today: electronic devices. In turn, by catering to the needs of digital devices, we naturally expand the networks in which they operate (both power and control) to benefit from indeed require redundant operation that is primarily available today through the other ubiquitous DC device, the battery. But widespread deployment of DC distribution will not happen automatically the impediments to deployment
identified above need to be dealt with our recommendations can be a first step in doing that.

V. APPLICATIONS, ADVANTAGES & DISADVANTAGES.

Applications
1. DC Distribution System for the House.
2. Telecommunication.
3. Vehicles.
4. Traction.
5. Ships.

Advantages
1. Flexibility
   - Faster moves, ads changes.
   - None rewiring.
   - Future proof for new technologies like LED’s.
2. Sustainability
   - Simpler devices fewer AC-DC.
   - Plug & Play modularity.
   - High recycle content grid.
   - Connect to alternator energy like Solar & Wind.

Disadvantages
1. Wholesale power production in large plants was cheaper than many distributed small ones.
2. AC could travel long distances with low losses, unlike DC.
3. Incandescent lamps were the majority of the load and they operated on AC or DC.
4. Semi-conductors had not yet been invented.

VI. REFERENCES

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