ELG2336: Case Study Hybrid Electricity Generation System Design (Max: 10 pages)

Generating System: Diesel Driven Generator Photovoltaic Cells, Modules, and Arrays Wind Turbine Storage System Loads: Typical Home and a Small Industrial Plant

Communities without Access to the Grid

- In this case study, we look at communities that do not have access to the grid.
- They will have to be self-sufficient, in regard to their energy requirements.
- Because wind and solar energy is always available due to variations in wind speeds and availability of solar energy, a comprehensive strategy is needed where wind turbines and photovoltaic systems are an important piece of the solution.
- For these communities need to plan for initiating a profitable hybrid (photovoltaic (50 kW) + diesel (75 kW) + wind (75 kW)] standalone distributed generation system.

Steps of Building the Electricity Hybrid System

- Identify the location of the hybrid system (200 kW).
- Draw a block diagram for the entire hybrid system showing the three sources of energy and the required supporting equipment.
- Select a suitable synchronous based diesel generator from a manufacturer that meets the need of the project.
- Select a suitable photovoltaic system that meets the need of the project and show its components.
- Select a suitable induction based wind turbine from a manufacturer that meets the need of the project.
- Write the mechanical and electrical specifications of photovoltaic system, diesel generator, and wind turbine. Make your **OWN** three tables, one for each system (photovoltaic; diesel; and wind).
- Propose a storage system!
- Estimate the number of homes the above system can supply with electric energy in addition to a small industrial plant (10 kW) that works for 8 hours only.

Overview of the system



Photovoltaic System

- Expected capacity of 50 kW.
- Select and specify photovoltaic panels (use the Internet for manufacturers) and make a table for the panel specifications including:
 - Maximum output power, voltage, and current per module; short circuit current; dimension; weight; maximum output power, voltage, and current per array system; gradient angle; frequency; and grid voltage.
- Draw a complete circuit diagram for the entire array of the photovoltaic system that supplies 50 kW.

Synchronous Based Diesel Generator

- Expected capacity of about 75 kW.
- Select a suitable three phase diesel generator.
- Write its mechanical and electrical characteristics.
- Draw the equivalent circuit of the synchronous generator.



Induction-based Wind Turbine

- Expected capacity of about 75 kW.
- Select a suitable wind turbine.
- You may see the Ottawa-based ZEC Wind Power:
- http://www.greenengineers.ca/REMLab/ZECWP%20-%20Customer%20Package%20v5.3.pdf
- Write its mechanical and electrical characteristics including:
 - Rated power; rotor diameter; hub height; rated wind speed; cut in wind speed; cut out wind speed; survival wind speed; rated rotational speed; maximum rotational speed; tower; frequency, grid voltage.
- Draw the equivalent circuit of the induction generator.
- What is architecture (structure) of an induction generator?