

Course Project Assignment: Conventional Electric Power Generation

Background: Renewable electric power continues to displace conventional electric power in the USA and the rest of the World, although renewable electric power (wind, solar, geothermal, and hydroelectric) contributes only a fraction of total electric power generation, with hydroelectric contributing the largest fraction of renewable power. Depending on circumstances, electric power generation from conventional energy sources (fossil fuel and nuclear) will likely continue to dominate electric power generation for some time.

Purpose of course project: To characterize conventional electric power generation from fossil fuel energy and nuclear energy as it is applied on utility scale today, within the USA and the World. All the conventional power generation sources considered within the scope of this project are applied in the USA, while some of these conventional technologies dominate in some countries in the rest of the world.

Project Assignment: Part 1 (20 pages or less)

Consider each of the following conventional electric power generation technologies:

- Pulverized coal, dual unit
- Dual unit Integrated Coal Gasification Combined Cycle IGCC
- Conventional natural gas combustion turbine CT
- Advanced natural gas combustion turbine CT
- Conventional natural gas combined cycle CC
- Advanced natural gas combined cycle CC
- Diesel generation, MW scale
- Pressurized water dual unit nuclear reactor PWR
- Boiling water dual unit nuclear reactor BWR

For each of these, provide the following information:

- Description of the power cycle (Rankine cycle, Brayton cycle, Diesel cycle (2 and 4 stroke cycles), Combined cycles)
- Temperatures achieved in the power cycle (higher temperature, condenser temperature)
- Range of power capacities (MW) of commercial power plants
- Capacity factors for base load and peaking load, if applicable
- Range of cycle efficiency (heat to electric power) (Separate and combined in the case of combined cycles)
- Cooling rate of water condensers
- Heat value of the fuel (kJ/kg, or Btu/lb, or Btu/scf of natural gas)
- Sources and composition of coal fuel, nuclear fuel, natural gas

- Heat rate (Btu/kWh) for fossil energy generation
- Emission rates (NO_x, CO₂, coal particulate) of fossil energy generation
- Emission treatment (Include description of proposed Carbon Capture and storage CCS)
- Waste treatment (Coal ash, nuclear fuel storage and reprocessing)
- Capital cost (\$/kW installed)
- Fixed O&M costs (\$/kW-year)
- Variable O&M costs (\$/MWh) (This cost includes the price of the fuel.)

Decide how best to organize the information. Summarize the information so that a reader can look at it and understand it. Make it simple so that a person can read your report and understand conventional electric power generation – how it operates, what it costs, and what are issues associated with it. This report will serve as a reference for you throughout your career as an Electrical Engineer.

Project Assignment: Part 2 (10 pages or less)

For each of the conventional electric power conversion sources listed above, provide the following information:

- Factors that influence location of the power source
- Factors that influence price of electricity from the power source
- Important new and planned conventional power plants, in the USA and the rest of the World.
- Factors that may influence the future of these electric power sources.

Project report: 30 or fewer pages of report, and references.

Many different references will need to be consulted for the project report. List the important references of information. Note that there no exact values of any of the characteristics of the conventional power plants – so try to give a range of values of the information.

Your Instructor is available to provide any help you need.