HYBRID FUEL CELL / GAS TURBINE SYSTEMS

NEXT GENERATION CENTRAL POWER

BACKGROUND

Under the sponsorship of the U.S. Department of Energy/National Energy Technology Laboratory (DOE/NETL), a team led by the APEP is defining system engineering issues associated with integration of key components and subsystems into coal and natural gas based power plant concepts with ultra high efficiency while minimizing the environmental impact. The myriad options of fuel processing, power generation, and emission control technologies (Figure 1) are narrowed down to selected scenarios that identify those combinations having potential to meet the above objectives. The technology levels considered are based on projected technical and manufacturing advances being made in industry and on advances identified in current and future government supported research. The results of this investigation will serve as a guide for the DOE/NETL in identifying research areas and technologies that warrant further support.

GOALS

Conceptualize, introduce, analyze, and optimize various syntheses of components and design configurations for coal and natural gas based central station power plants including H2 coproduction with all criteria pollutants and CO2 emissions controlled.

RESULTS

Fuel cell based hybrids are required to achieve DOE electrical efficiency targets of 60% (HHV) on coal and 75% (LHV) on natural gas.

Coal gasifier with low operating temperature and non-water slurry based feed system is required such as the Advanced Transport Reactor (ATR) while maintaining high carbon conversion. An ATR integrated with a SOFC hybrid can generate electricity at an efficiency > 60% (HHV).

Natural gas fueled SOFC integrated with HAT cycle (Figure 2) can generate electricity at an efficiency > 75% (LHV).

In coal based plants, an SOFC hybrid and high temperature membranes for air and H2 separation can synergistically coproduce H2 while capturing the CO2 (Figure 3).

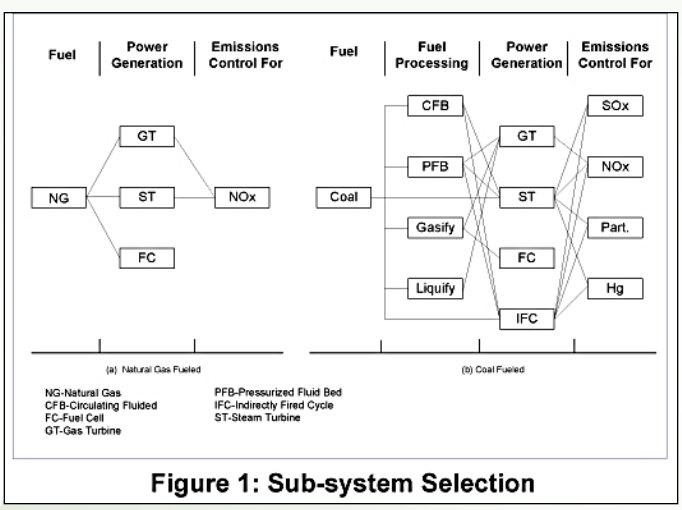

Figure 1: Sub-system Selection

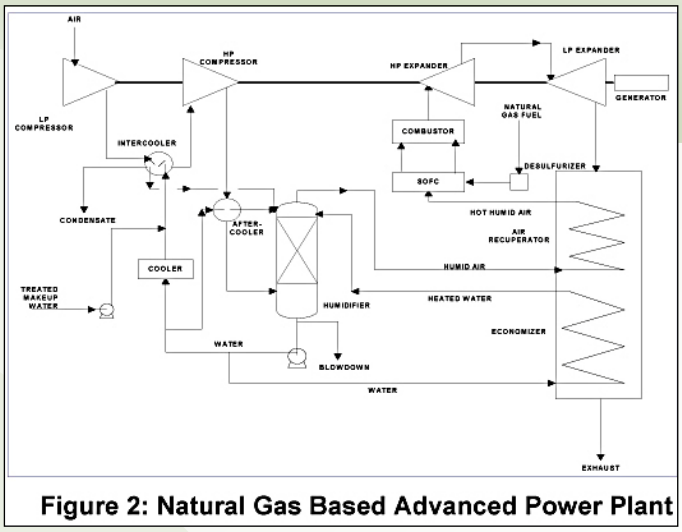

Figure 2: Natural Gas Based Advanced Power Plant

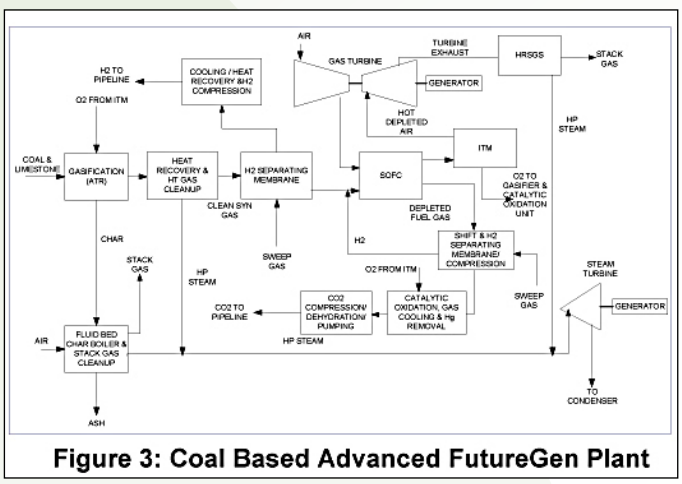

Figure 3: Coal Based Advanced FutureGen Plant

RECENT PUBLICATIONS

- GAS TURBINE BASED HIGH EFFICIENCY "VISION 21" NATURAL GAS AND COAL CENTRAL PLANTS (2003). CAME-GT Int. Gas Turbine Conference, Brussels (A.D. Rao, G.S. Samuelsen, Y. Yi).
- COAL-BASED POWER PLANT SYSTEM CONFIGURATIONS FOR THE 21ST CENTURY (2003). Proceedings of the ASME IGTI Turbo-Expo Conference, Atlanta (A.D. Rao, G.S. Samuelsen, F. Robson and R. Geisbrecht).
- POWER PLANT SYSTEM CONFIGURATIONS FOR THE 21ST CENTURY (2002). Proceedings of the ASME IGTI Turbo-Expo Conference, Amsterdam (A.D. Rao, G.S. Samuelsen, F. Robson and R. Geisbrecht).

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