2nd Generation PFBC Systems R&D
Phase 2 AND Phase 3

MONTHLY TECHNICAL REPORT

Reporting Period Start Date: 11/01/1999 End Date: 11/31/1999

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TECHNICAL PROGRESS REPORT NUMBER 21023R48
FOR MONTH 140 (NOVEMBER 1999) -- PHASE 2

No work was performed; the two remaining Multi Annular Swirl Burner test campaigns are on hold pending selection of a new test facility (replacement for the shut down UTSI burner test facility) and identification of associated testing costs.

TECHNICAL PROGRESS REPORT NUMBER 21023R49
FOR MONTH 109 (NOVEMBER 1999) -- PHASE 3

Commercial Plant Design Update

The Second-Generation PFB Combustion Plant conceptual design prepared in 1987 is being updated to reflect the benefit of pilot plant test data and the latest advances in gas turbine technology. The updated plant is being designed to operate with 95 percent sulfur capture and a single Siemens Westinghouse (SW) 501G gas turbine. Using carbonizer and gas turbine data generated by Foster Wheeler (FW) and SW respectively, Parsons Energy and Chemicals Group prepared preliminary plant heat and materials based on carbonizer operating temperatures of 1700 and 1800EF and found the former to yield the higher plant efficiency.

As a result, 1700EF has been selected as the preferred operating condition for the carbonizer. The previous first cut plant heat and material balance was refined and it predicts a 47.7% plant efficiency (HHV) with a net power output of 421 MWe. The latter includes a plant auxiliary load estimated to be 23.48 MWe or 5.26% of the gross plant power and a transformer loss of 1.52 MWe. Coal drying is through natural gas combustion, and the thermal energy input of the natural gas has also been included in the heat rate calculation. Figure 1 presents the plant preliminary full load heat and material balance. In this arrangement, evaporation and primary steam superheating tube surfaces are placed in both the pressurized circulating fluidized bed boiler (PCFB) and the gas turbine heat recovery steam generator (HRSG). The superheated steam from these units is mixed and then heated to 1050EF in the PCFB finishing superheater. With regard to steam reheating, the primary stage is located at the front of the HRSG and the final stage is located in the PCFB. Although this circuitry arrangement appears workable at full load, minimum load must be checked next to see if rearrangement is needed. Plant start up and load following discussions indicated that below about 15 percent gas turbine load, the latter would transition from steam to air cooling. Keeping the gas turbine at 15 percent load to avoid this transition, a minimum load heat and material balance will be prepared next; gas turbine performance data for this condition was being generated by SW as the reporting period ended.

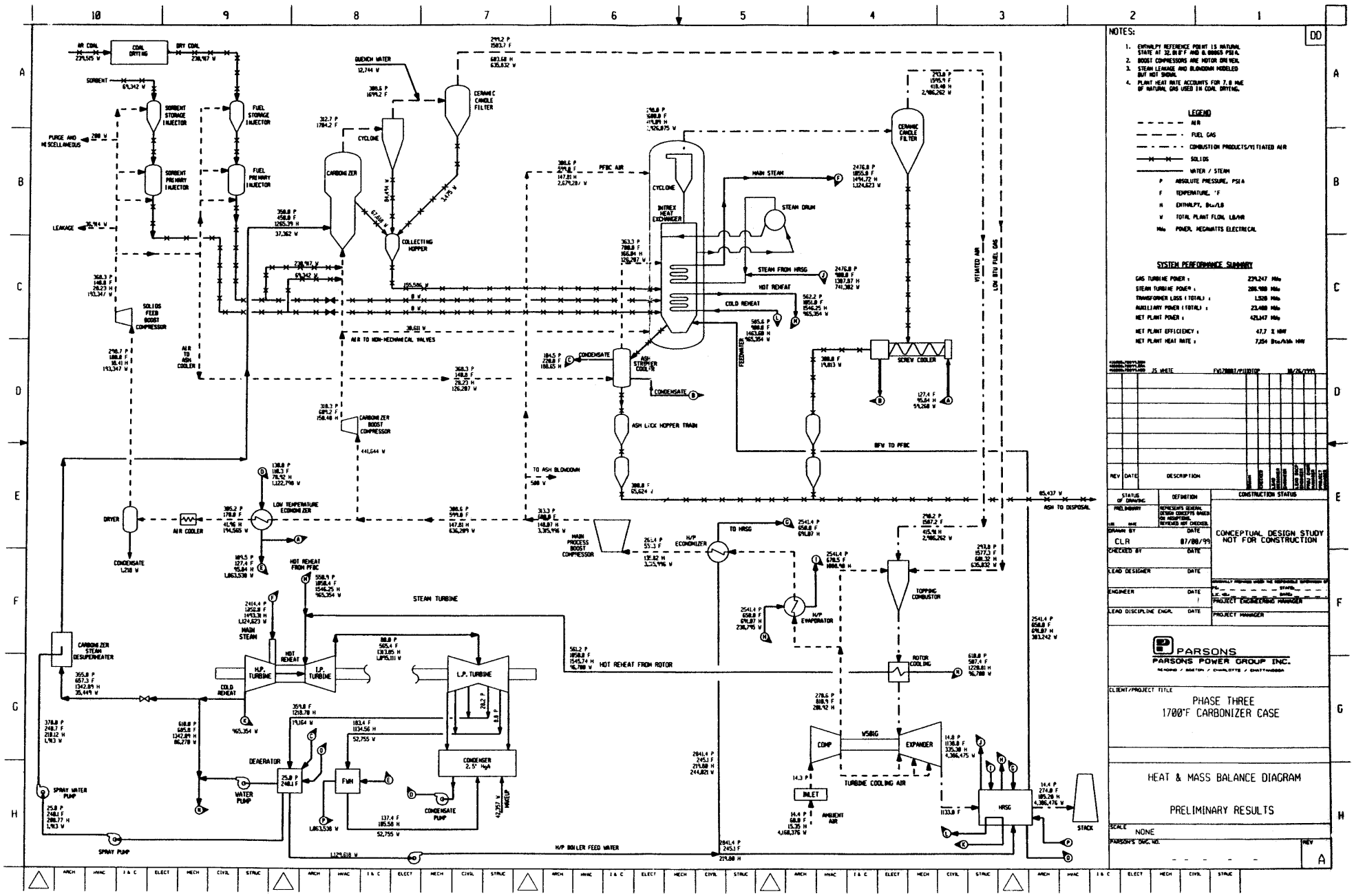
NOTES:
1. ENTHALPY REFERENCE POINT IS NATURAL STATE AT 32.018°F AND 0.08865 PSIA.
2. BOOST COMPRESSORS ARE MOTOR DRIVEN.
3. STEAM LEAKAGE AND BLOWDOWN MODELED BUT NOT SHOWN.
4. PLANT HEAT RATE ACCOUNTS FOR 7.0 MWE OF NATURAL GAS USED IN COAL DRYING.
LEGEND
AIR
FUEL GAS
COMBUSTION PRODUCTS/VITIATED AIR
SOLIDS
WATER / STEAM
P ABSOLUTE PRESSURE, PSIA
T TEMPERATURE, °F
H ENTHALPY, Btu/LB
W TOTAL PLANT FLOW, LB/HR
MWe POWER, MEGAWATTS ELECTRICAL
SYSTEM PERFORMANCE SUMMARY
GAS TURBINE POWER : 279,247 MWe
STEAM TURBINE POWER : 205,188 MWe
TRANSFORMER LOSS (TOTAL) : 1,526 MWe
AUXILIARY POWER (TOTAL) : 23,408 MWe
NET PLANT POWER : 421,147 MWe
NET PLANT EFFICIENCY : 47.7 % HHV
NET PLANT HEAT RATE : 7,154 Btu/kWh HHV
JS WHITE
REV DATE DESCRIPTION
STATUS OF DRAWING
PRELIMINARY
DEFINITION
REPRESENTS GENERAL DESIGN CONCEPTS BASED ON ASSUMPTIONS. REVIEWED NOT CHECKED.
CONSTRUCTION STATUS
DRAWN BY CLR 07/00/99
CHECKED BY
LEAD DESIGNER
ENGINEER
LEAD DISCIPLINE ENGR.
DATE
CONCEPTUAL DESIGN STUDY NOT FOR CONSTRUCTION
PROJECT ENGINEERING MANAGER
PROJECT MANAGER
PARSONS
PARSONS POWER GROUP INC.
CLIENT/PROJECT TITLE
PHASE THREE
1700°F CARBONIZER CASE
HEAT & MASS BALANCE DIAGRAM
PRELIMINARY RESULTS
SCALE NONE
PARSONS DWG. NO.
REV A
COAL DRYING
DRY COAL
SORBENT
SORBENT STORAGE INJECTOR
FUEL STORAGE INJECTOR
SORBENT PRIMARY INJECTOR
FUEL PRIMARY INJECTOR
PURGE AND MISCELLANEOUS
LEAKAGE
SOLIDS FEED BOOST COMPRESSOR
AIR TO ASH COOLER
QUENCH WATER
CERAMIC CANDLE FILTER
CYCLONE
CARBONIZER
COLLECTING HOPPER
AIR TO NON-MECHANICAL VALVES
CARBONIZER BOOST COMPRESSOR
PFBC AIR
INTREX HEAT EXCHANGER
STEAM DRUM
MAIN STEAM
STEAM FROM HRSG
HOT REHEAT
COLD REHEAT
ASH STRIPPER COOLER
CONDENSATE
FEEDWATER
SCREW COOLER
VITIATED AIR
LOW BTU FUEL GAS
ASH LOCK HOPPER TRAIN
BFW TO PFBC
TO ASH BLOWDOWN
ASH TO DISPOSAL
DRYER
AIR COOLER
LOW TEMPERATURE ECONOMIZER
HOT REHEAT FROM PFBC
MAIN PROCESS BOOST COMPRESSOR
H/P ECONOMIZER
TO HRSG
TOPPING COMBUSTOR
H/P EVAPORATOR
STEAM TURBINE
CARBONIZER STEAM DESUPERHEATER
H.P. TURBINE
I.P. TURBINE
L.P. TURBINE
HOT REHEAT FROM ROTOR
ROTOR COOLING
DEAERATOR
CONDENSER 2.5" HgA
CONDENSATE PUMP
MAKEUP
WATER PUMP
SPRAY WATER PUMP
SPRAY PUMP
H/P BOILER FEED WATER
VSBIG
COMP
EXPANDER
TURBINE COOLING AIR
INLET
AMBIENT AIR
HRSG
STACK

Figure 1