Second Generation PFBC Systems R&D

Monthly Report
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TECHNICAL PROGRESS REPORT NUMBER 21023R66
FOR MONTH 149 (AUGUST 2000) -- 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 21023R67
FOR MONTH 118 (AUGUST 2000) -- PHASE 3

Commercial Plant Design Update

Introduction

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 Infrastructure & Technology prepared preliminary plant heat and material balances based on carbonizer operating temperatures of 1700 and 1800EF; the former yielded the higher plant efficiency and has been selected for the design update.

The 501G gas turbine has an air compressor discharge temperature of 811EF and an exhaust temperature of 1140EF. Both of these streams represent high sources of heat and must be cooled, the air to 600EF to be compatible with a 650EF PCFB pressure vessel design temperature and the exhaust for a 275EF stack gas temperature. Because of their relatively high temperature, they can be used for feed water heating, steam generation and/or steam superheating and reheating. As a result, the plant could have one boiler (the PCFB boiler), or as many as three boilers if their cooling is used to generate steam. Three different plant arrangements using one, two and then three boilers were considered with the three-boiler arrangement minimizing the feedwater flow/steam turbine size and maximizing the plant efficiency. After reviewing the three arrangements it was felt the operating complexity associated with a three-boiler plant did not justify the ½ point increase in plant efficiency it provided and a two-boiler plant was selected.

Parsons generated a preliminary full load heat and material balance for the plant shown in Fig. 1. The estimated performance of the plant is:

Gross Power, MWe	
Gas Turbine	239.25
Steam Turbine	267.46
Total	506.71
Auxiliary Power, MWe	24.89
Net Power, MWe	481.82
Plant HHV Efficiency, %	47.5
Plant HHV Heat Rate, Btu/kwhr	7184

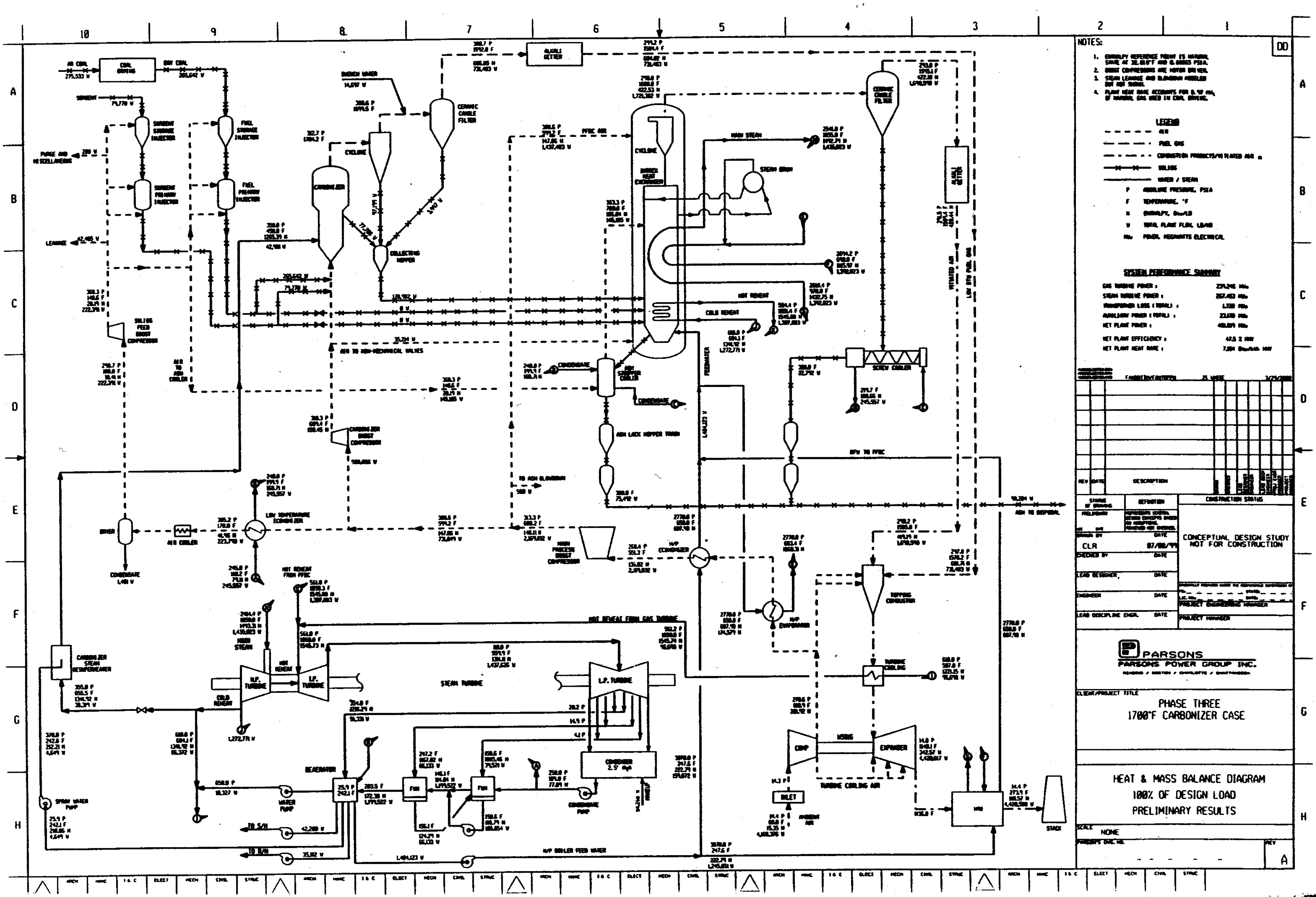

Figure 1 Preliminary Full Load Plant Heat and Material Balance

The carbonizer required by the plant is shown in Fig. 2; it is a 15-ft ID vertical, refractory-lined pressure vessel approximately 47 ft high, with a conical bottom. The unit operates with a 25-ft-deep jetting fluidized bed, a superficial gas velocity of approximately 3.5 ft/s, a 20-ft tall freeboard, and is described in greater detail in the April Progress Report.

Process flow diagrams for the carbonizer and PCFB legs of the plant are shown in Figures 3 and 4 respectively. Coal and dolomite will be fed as a blend to both the carbonizer and the PCFB by lock hopper type systems. The carbonizer and PCFB both have two gas outlet lines. To control gas alkali levels minus 325 mesh emathlite will be injected into each of these lines downstream of their respective cyclones. The injected emathlite will become part of the filter dust cake thereby assuring alkali removal, and it will be injected as a 25% solids – 75% water slurry via the slurry system shown in Fig. 3. The slurry will be injected at a rate of about 3 gpm into each of two carbonizer syngas lines and at about 0.6 gpm into each of the two PCFB flue gas lines. Each gas line contains two slurry spray nozzles, one of which is a spare.

The char-sorbent residue generated in the carbonizer leg of the plant will be collected from the carbonizer bottom bed, top of bed, cyclone, and filter drain lines and temporarily stored in two collecting/surge vessels. A nitrogen aerated N-valve provided under each collecting vessel will transfer the char to the PCFB. The coal ash-sorbent residue generated in the PCFB will be similarly collected from the two bottom bed and four filter vessel drain lines in a surge vessel, depressured via a restricted pipe discharge arrangement and cooled to 300EF by water cooled screws operating at atmospheric pressure for ultimate transport to ash storage silos.

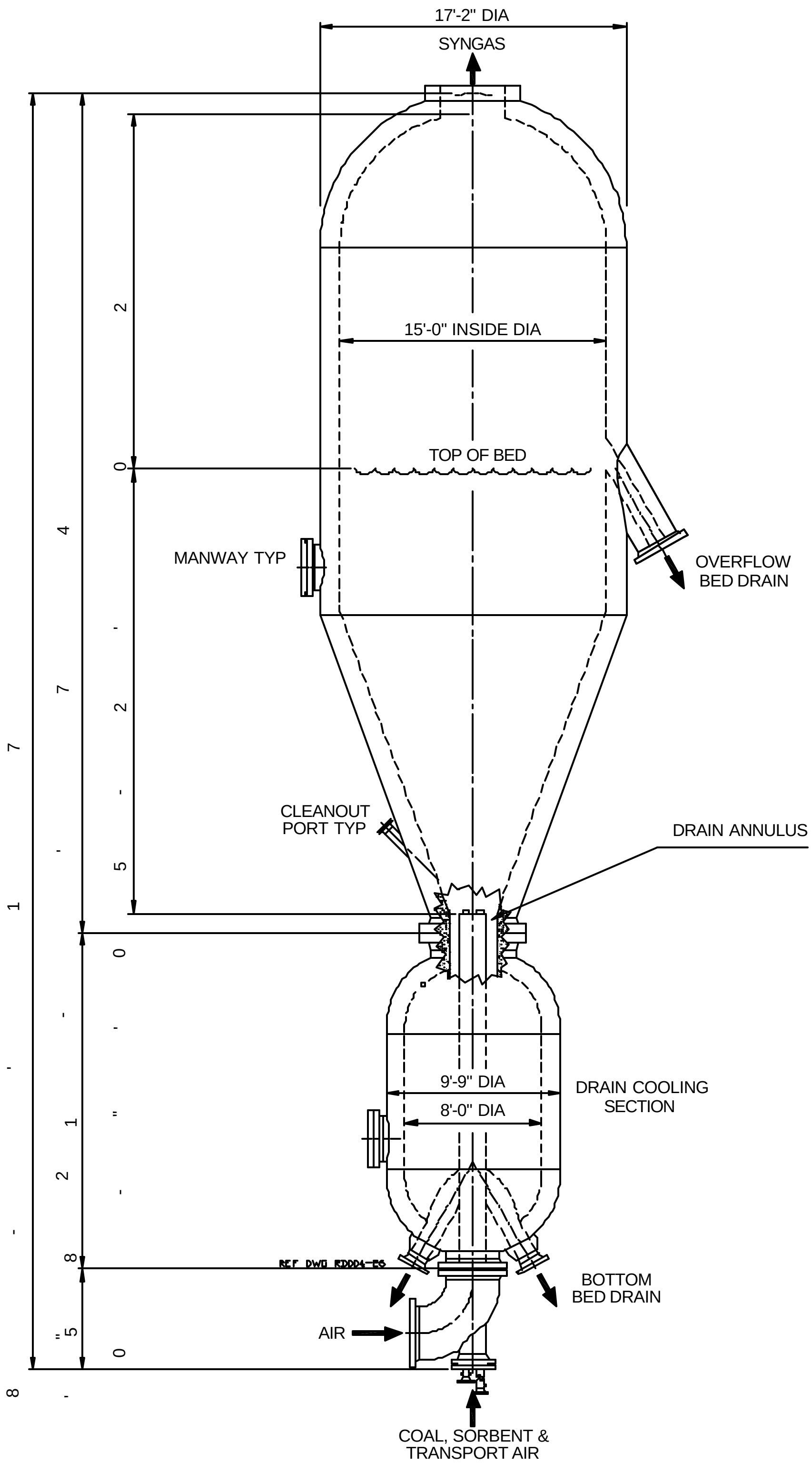

Figure 2 Carbonizer Arrangement

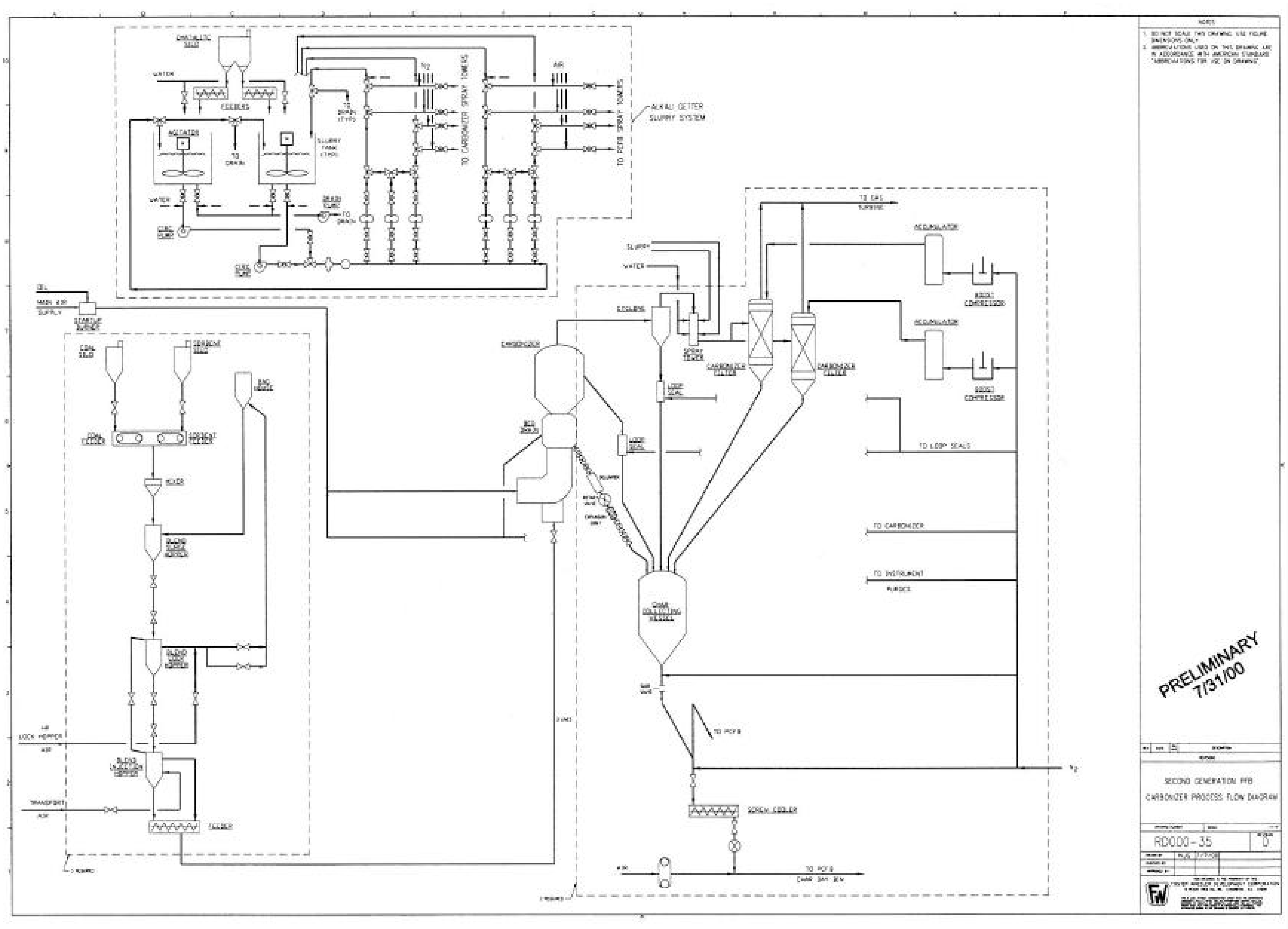

Figure 3 Carbonizer Process Flow Diagram

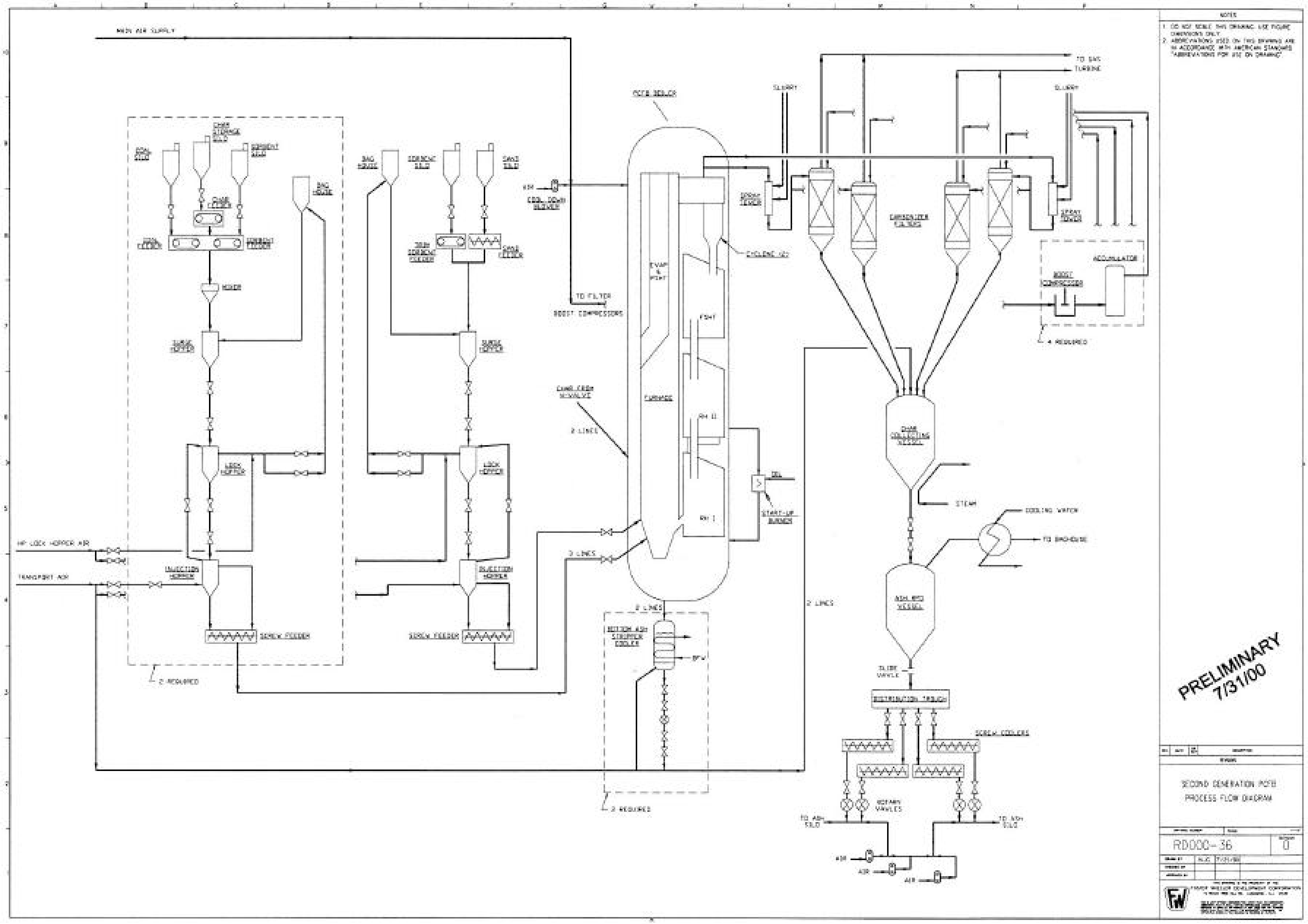

Figure 4 PCFB Process Flow Diagram

Work Performed in August 2000

Development of a general plant equipment arrangement was begun. In addition, pressure drop analyses were conducted for the compressed air, syngas, and vitiated air flows through the gas turbine's different manifold systems. The establishment of projected maintenance schedules for the gas turbine was begun.

Schedule: The project is proceeding in accordance with the Fig. 5 schedule.

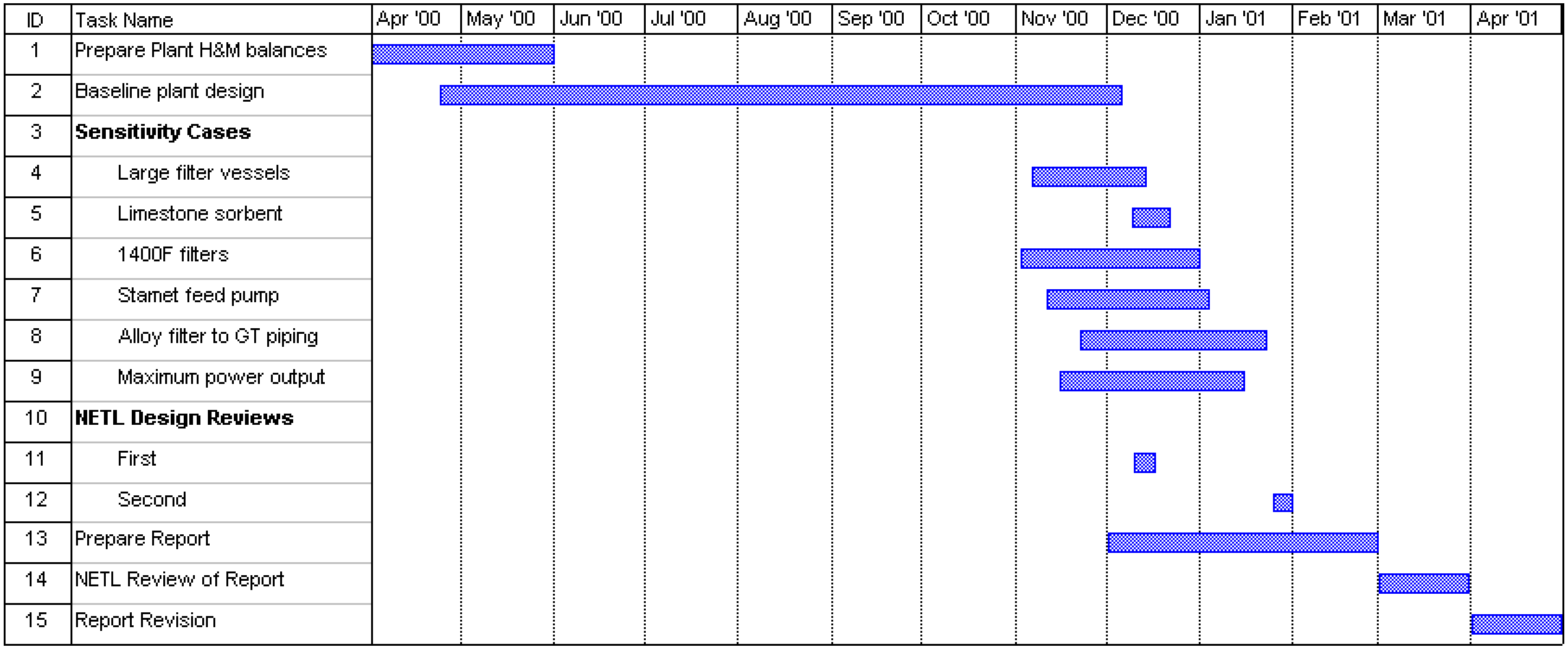

Figure 5 Schedule for Commercial Plant Design Update (revised 8/1/00)