

Fossil Boiler Model Overview

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HALLIBURTON NUS Environmental Corproation

PEPSE[®] BOILER MODELING PROCEDURE

- ***DEFINE OBJECTIVES***
- ***COLLECT INFORMATION***
- ***SIMPLIFIED MODEL***
- ***DETAILED MODEL***
- ***FINE TUNING***
- ***CONTROL SYSTEM***
- ***LOAD GENERALITY***

DEFINE OBJECTIVES

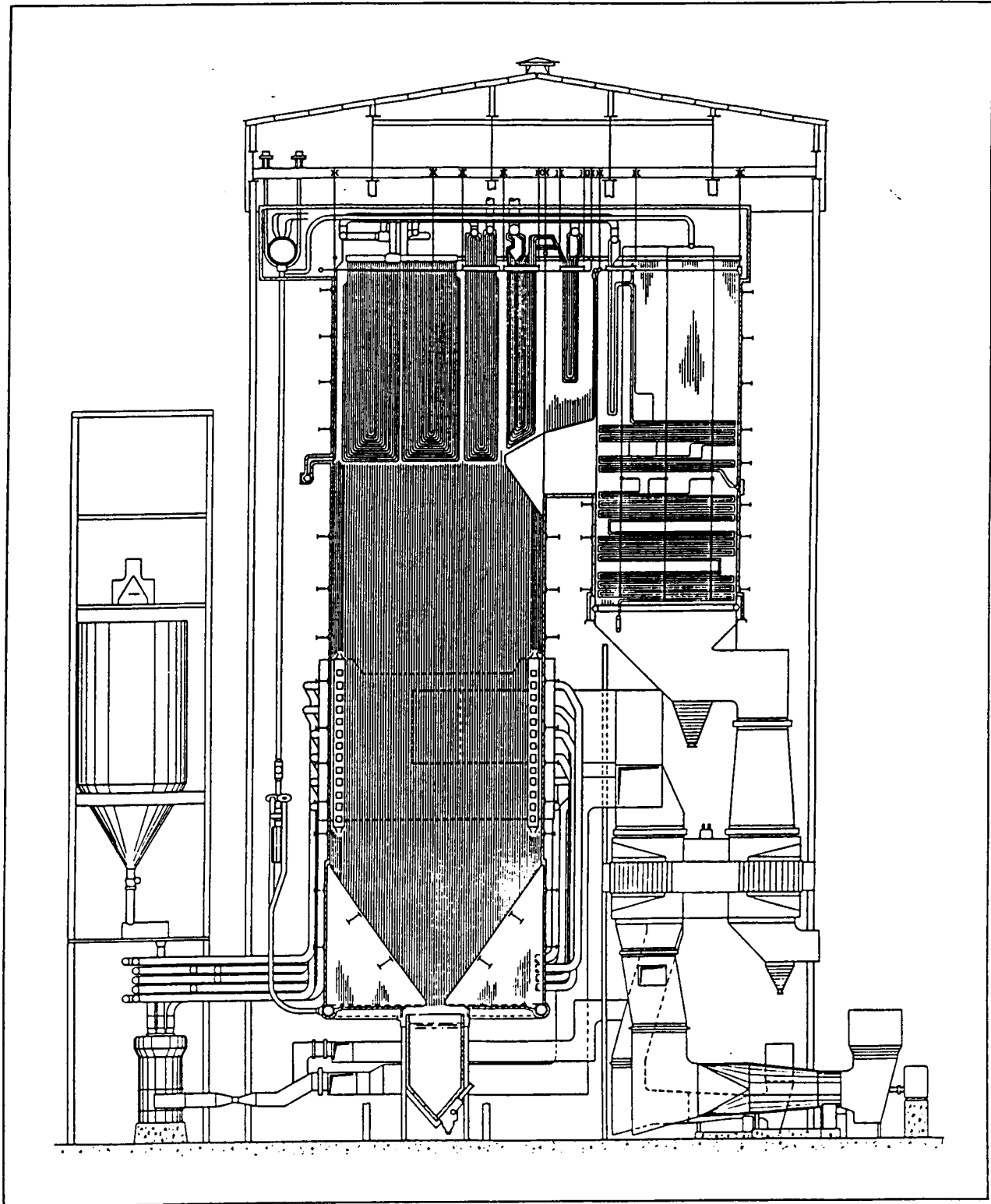
FOR EXAMPLES

- ***CALCULATE EFFICIENCY FROM TEST DATA***
- ***LOOK AT GROSS CHARACTERISTICS***
 - ***MASS***
 - ***ENERGY FLOWS***
- ***CONSIDER SYSTEM OR OPERATION CHANGES***

COLLECT INFORMATION

VENDOR

- ***DRAWING(S)***
- ***NARRATIVE DESCRIPTION***
- ***PERFORMANCE SUMMARIES***
- ***DESIGN SPECIFICATIONS***
- ***CONTROL SYSTEM DESCRIPTION/
SPECIFICATIONS***
- ***OPERATING CONSTRAINTS***



COLLECT INFORMATION (CONT'D)

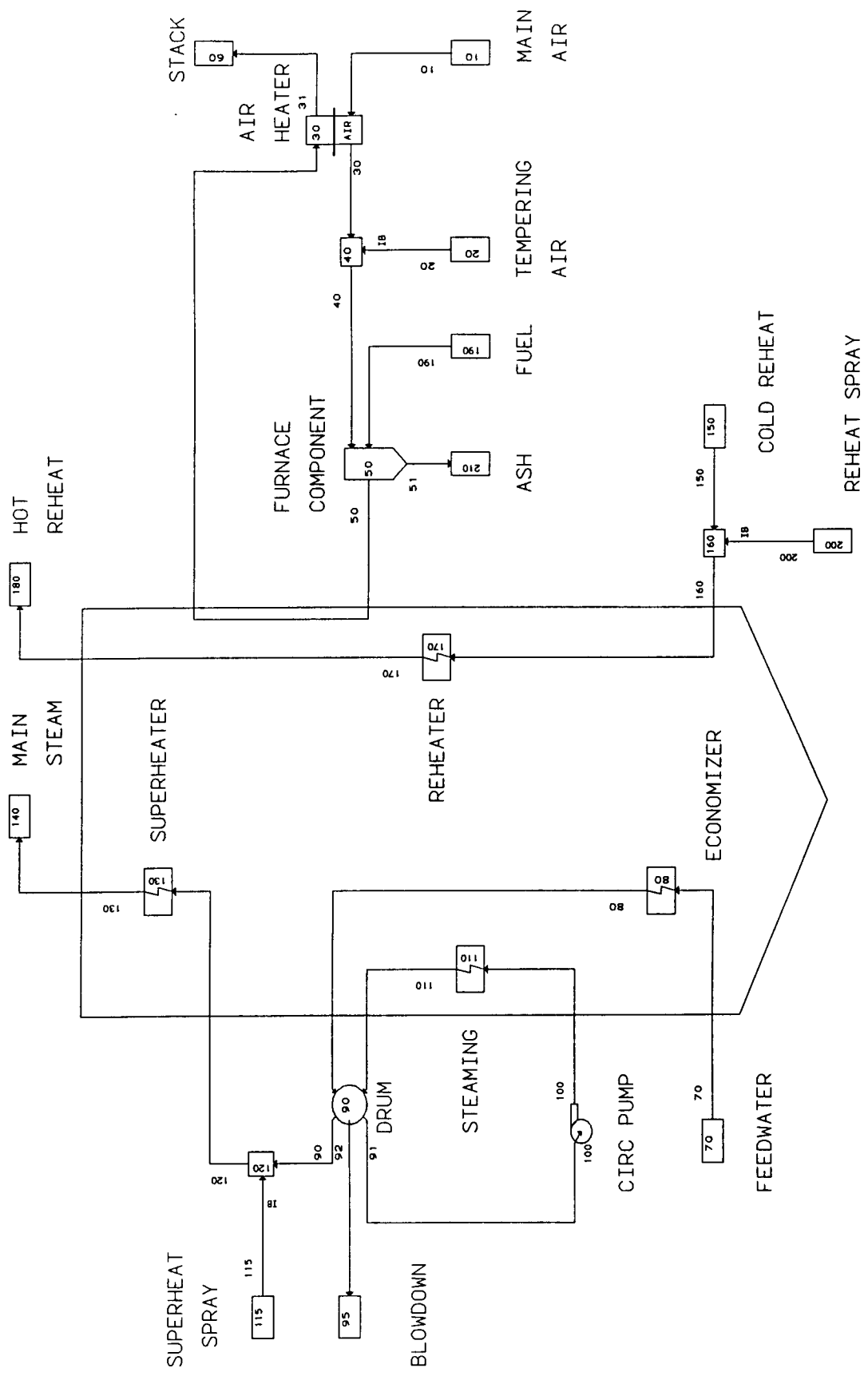
FOR PEPSE

- ***FLOWS***
- ***TEMPERATURES***
- ***COMPOSITIONS***
- ***EXCESS AIR***
- ***HEAT LOSSES AND CREDITS***
- ***OTHERS***

SIMPLIFIED MODEL

- ***PURPOSE***
 - ***SYSTEM BOUNDARY CONSISTENCY***
 - ***DISCOVER UNDERLYING ASSUMPTIONS***

- ***SCHEMATIC - ACCOUNT***
 - ***WORKING FLUID IN AND OUT***
 - ***FUEL/GAS-SIDE FLOWS IN AND OUT***
 - ***PRIMARY CIRCUIT***
 - ***REHEAT CIRCUITS***

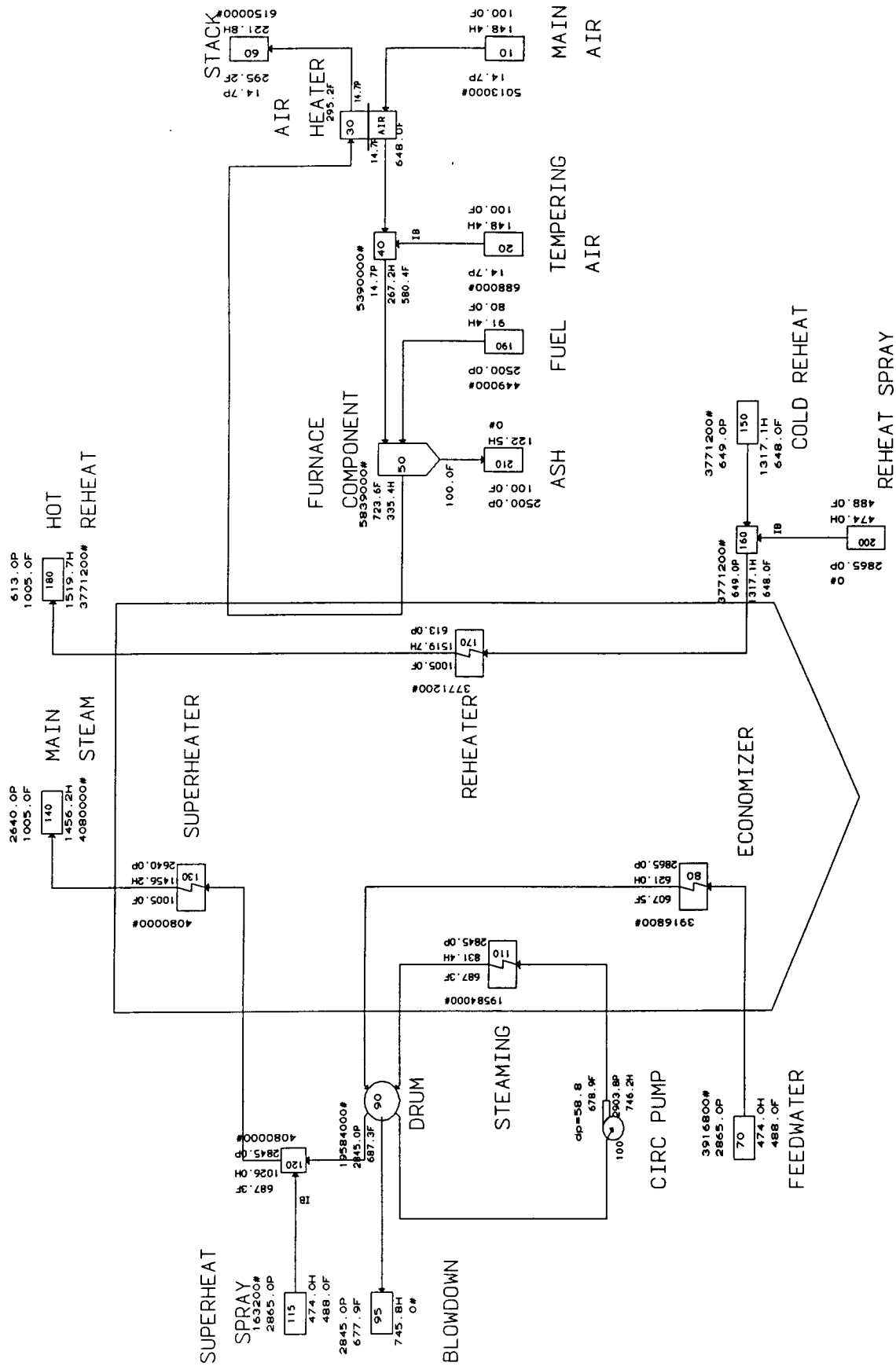


PEPSE SIMPLIFIED BOILER MODEL

SIMPLIFIED MODEL (CONT'D)

- ***PEPSE DATA SET***
 - ***FLOWS, TEMPERATURES IN AND OUT***
 - ***COMPOSITION***
 - ***HEAT LOSSES/CREDITS***
 - ***CALCULATE EFFICIENCIES***
 - I/O***
 - HEAT LOSS***

- ***RESULTS VERIFICATIONS***
 - ***FLOWS***
 - ***TEMPERATURES, ENERGIES***
 - ***EXCESS AIR***
 - ***EFFICIENCIES***

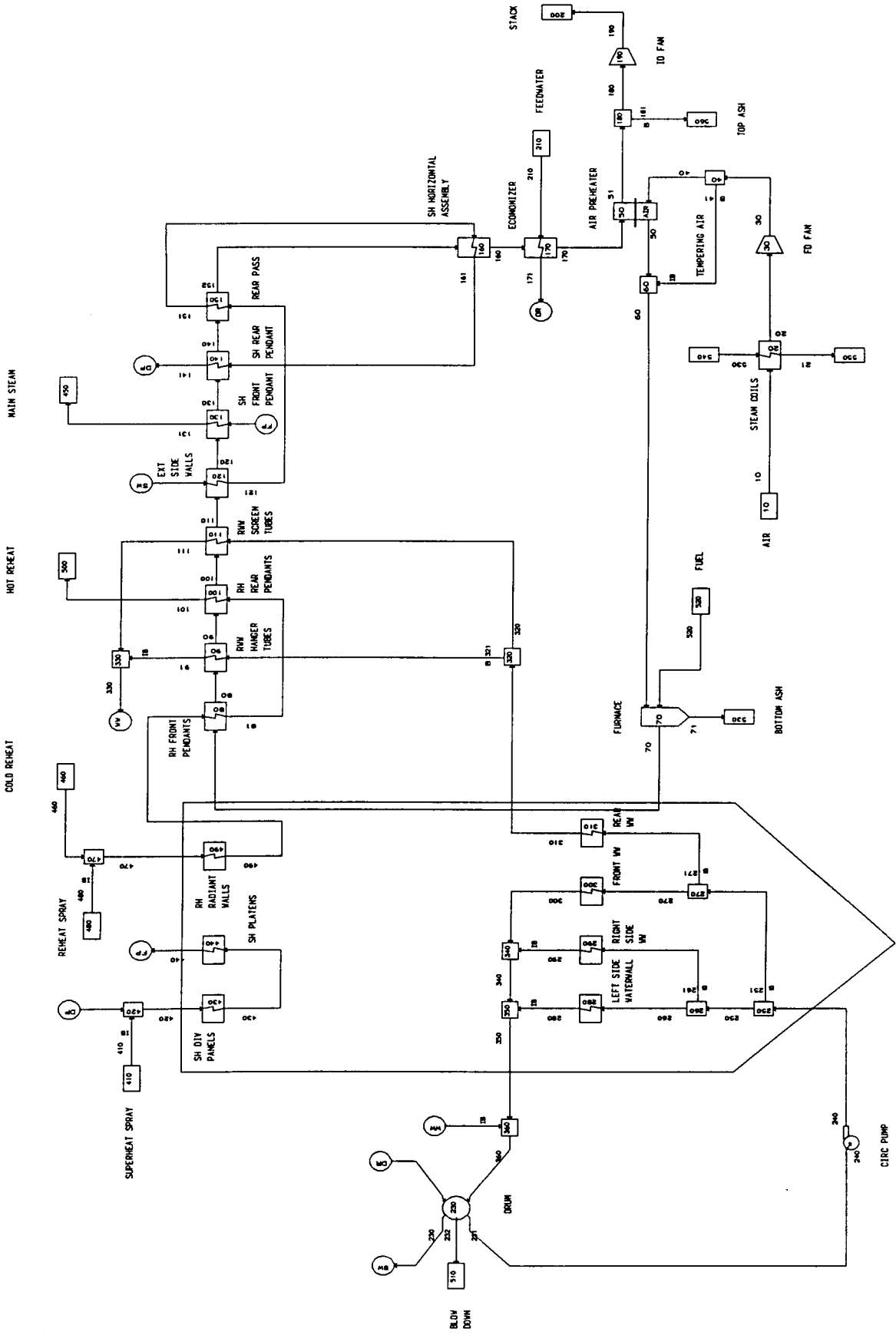


PEPSE SIMPLIFIED BOILER MODEL

DETAILED MODEL

- ***PURPOSE***
 - ***ADAPTIVE, RESPONSIVE, PREDICTIVE***

- ***SCHEMATIC***
 - ***BOUNDARIES FROM SIMPLIFIED***
 - ***INTERNAL DETAILS***
(e.g., Primary, Secondary Superheater, etc.)



DETAILED BOILER MODEL

DETAILED MODEL (CONT'D)

- ***PEPSE INPUT DESCRIPTION***
 - ***DESIGN MODE DESCRIPTIONS OF HX's***
 - ***ALL SIGNIFICANT DETAILS***
(e.g., Circ Elevations)
 - ***BOUNDARY VALUES FROM SIMPLIFIED MODEL***
 - ***BOTH EFFICIENCY CALCULATION METHODS***
 - ***DRUM CALCULATION PROVISION***
- ***MAKE IT RUN***
- ***RESULTS NOT NECESSARILY DESIRED VALUES***

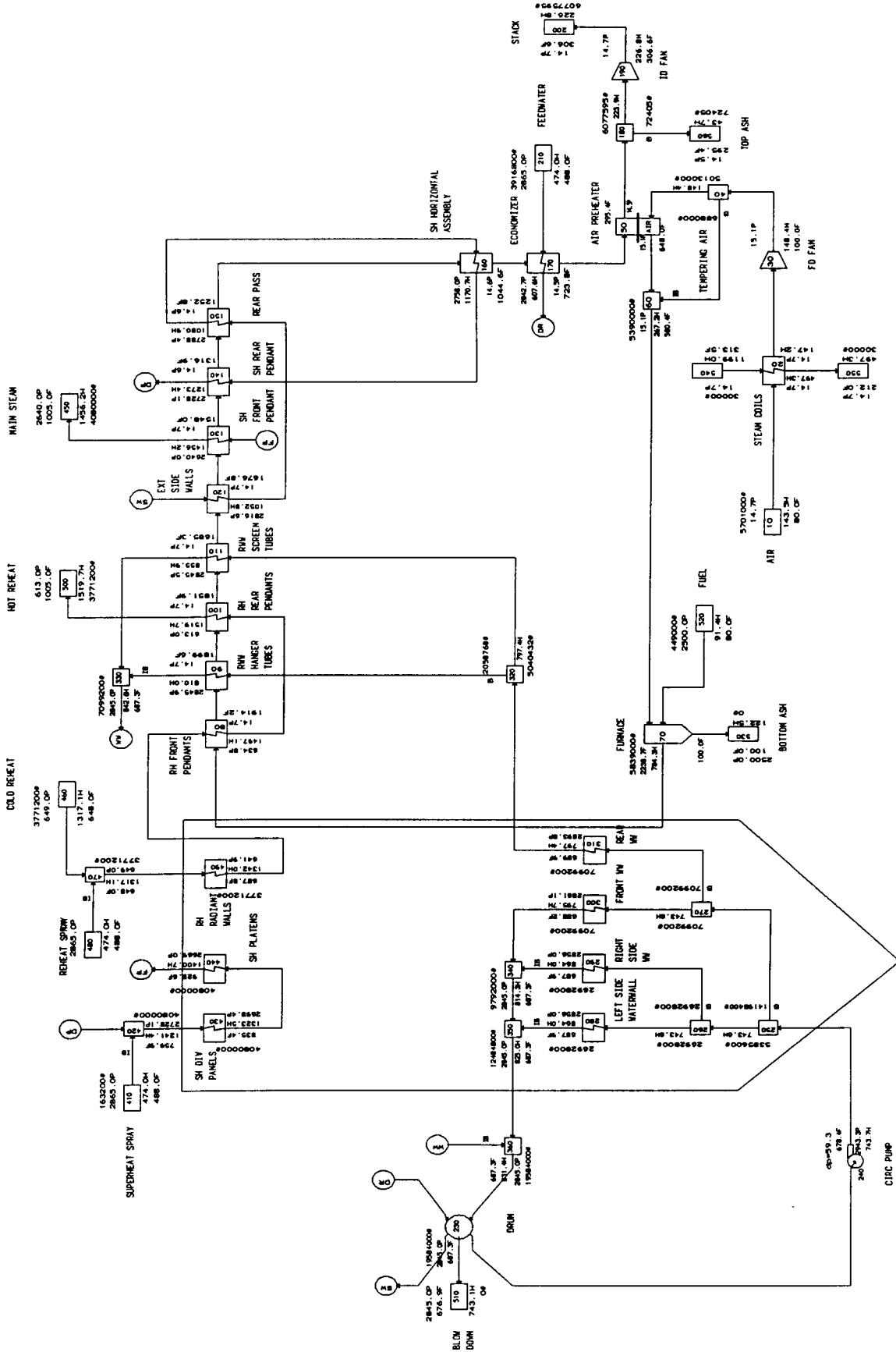
FINE TUNING

- ***PURPOSE***
 - ***CUSTOMIZE TEXT BOOK CALCULATIONS TO MATCH REALITY***
 - ***HEAT TRANSFER (TEMPERATURE)***
 - ***HYDRAULICS (PRESSURE)***
- ***SCHEMATIC - SAME AS DETAILED MODEL***

FINE TUNING (CONT'D)

- ***INPUTS - ADD PEPSE CONTROLS FOR TUNING***
 - ***HEAT TRANSFER COEFFICIENT MULTIPLIERS FOR TEMPERATURE***
 - ***FORM LOSS FACTOR MULTIPLIERS FOR PRESSURE***
 - ***MOST LIKELY NEED CONTROL BLOCK***
 - ***ALSO KNOWN CONSTRAINING CONDITIONS***

- ***RESULTS - AFTER MANY ITERATIONS***
 - ***VALUES OF TUNING FACTORS THAT SHOULD BE INSERTED DIRECTLY AND CONFIRMED***



DETAILED BOILER MODEL

CONTROL SYSTEM

- ***PURPOSE***
 - ***SATISFY MAIN STEAM AND REHEAT SET POINTS AUTOMATICALLY***
- ***SCHEMATIC***
 - ***SAME AS DETAILED MODEL***

CONTROL SYSTEM (CONT'D)

- ***PEPSE INPUT DESCRIPTION***
 - ***INCLUDES TUNING FACTORS***
 - ***PEPSE CONTROLS TO SIMULATE BOILER CONTROL SYSTEM, e.g.,***
 - ***FIRING FOR DRUM ENERGY BALANCE (EVAPORATION)***
 - ***FURNACE EXIT TEMPERATURE FOR REHEAT TEMPERATURE***
 - ***SUPERHEAT SPRAY FLOW FOR MAIN STEAM TEMPERATURE***
 - ***DRUM PRESSURE FOR MAIN STEAM PRESSURE***
 - ***CONTROL BLOCK PROBABLY REQUIRED***

CONTROL SYSTEM (CONT'D)

- ***RESULTS***
 - ***MODEL ADAPTIVE, MEETS SET POINT, CONSISTENT FLOWS, TEMPERATURES***
 - ***VALID SENSITIVITY STUDIES***

LOAD GENERALITY

- ***PURPOSE***
 - ***ALLOW EASY LOAD VARIATION ANALYSES***
- ***METHOD***
 - ***ACCOUNT FOR KNOWN LOAD VARIATION PARAMETERS VIA SCHEDULES WHERE POSSIBLE***
 - ***USE AVAILABLE ALTERNATE DESIGN LOADS TO SOLVE FOR A SET OF TUNING FACTORS THAT SATISFY MORE THAN ONE LOAD***

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