PACKAGE ID - 000218IBMPC02 BPM3.0S

KWIC TITLE - Fossil-Fired Boilers

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LIMITATION CODE -COPY **AUDIENCE CODE -** LIM

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DESCRIPTION - Boiler Performance Model (BPM 3.0S) is a set of computer programs developed to analyze the performance of fossil-fired utility boilers. The programs can model a wide variety of boiler designs, and can model coal, oil, or natural gas firing. The programs are intended for use by engineers performing analyses of alternative fuels, alternative operating modes, or boiler modifications.

PACKAGE CONTENTS - Media Directory; Software Abstract; User's Manual March 1992; Sample Boiler Models Report March 1992; Media Includes Source Code, Executable, Sample Problems, Control Information, Library Data;

SOURCE CODE INCLUDED? - Yes

MEDIA QUANTITY - 6 3.5 Diskettes

METHOD OF SOLUTION - (1) Heat to Steam - this program calculates the total heat to steam using steam and water enthalpies and flow rates into and out of the boiler. (2) Boiler Efficiency - this program performs a combustion calculation and evaluates the boiler efficiency. It also calculates the fuel burn rate and gas production rate that are used by all the other calculation programs. (3) Lower Furnace - this program calculates the heat

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METHOD OF SOLUTION -(CONT) absorbed by the furnace walls. It also calculates the corresponding gas temperature and direct radiation leaving the furnace. The calculation is based on a zonal method in which the furnace is divided into three zones. The heat absorption is calculated for each section. (4) Convective Pass - this program is used to estimate the performance of the convective pass of the boiler. An iterative procedure is used to find the steam and gas temperatures which balance the heat loss by the gas, heat gained by the steam or water, and the heat transferred across the surface. The program estimates the flue gas temperature leaving each section based on the heat exchange area, steam temperature entering the section, and the gas temperature of the previous section. The program calculates a heat transfer coefficient for each section, using its dimensions and gas properties in the section. The convective pass program starts with incoming steam temperatures and the furnace exit gas temperature and iterates until all gas and steam temperatures converge to a consistent set of values. (5) Air Heater - this program calculates the performance of the air heater using an iterative method to solve the following system of three equations: Heat loss by the flue gas, heat gained by the air, and heat transferred based on the heat transfer coefficient and the log mean temperature difference (LMTD).

COMPUTER - IBM PC

OPERATING SYSTEMS - DOS 3.1

PROGRAMMING LANGUAGES - Microsoft QuickBASIC

SOFTWARE LIMITATIONS - The maximum number of sections in the boiler model cannot exceed 70. The package supports most large, utility-type boilers. It is not suitable for stokers, fluidized beds, and cyclones. The package performs only steady-state calculations.

SOURCE CODE AVAILABLE (Y/N) - Y

UNIQUE FEATURES - Shape factor and direct radiation calculations are integrated into the Convective Pass program. The Convective Pass program includes a very flexible method of simulating the various types of steam temperature controls used by different manufacturers.

RELATED SOFTWARE - In upgrading from version 2.0 to version 3.0, several new programs were added to the boiler performance package. Two programs were added to the Reporting Programs section. Three modules were added to the Calculation Programs section. The first new reporting program displays a graph of the clear tube space versus the inlet flue gas temperature for sections of the boiler, including the superheater, the reheater, and the economizer. The second program displays a graph of the exiting flue gas velocity for certain sections of the boiler (superheater, reheater, and

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RELATED SOFTWARE -(CONT) economizer). The first calculation program addition is the DOEADV module which analyzes the temperature of air flowing through tubes along the walls of a high-temperature furnace. The second is the Penn State Industrial Boiler module. It analyzes the furnace performance of the university's industrial boiler. The third new calculation module (which actually consists of two programs, SUPRMGR and RUNAUTO) provides a means of iterating through the calculation program in sequence automatically with no user input. This frees the user from the sometimes tedious process of iterating through the programs manually. In addition to the above programs, two new utility programs were added. The first of these is the Data Consistency Checker program, which checks user input for errors prior to running the calculation programs. The second program, the Results Analyzer, provides feedback and advice (including red flags) on calculation results.

OTHER PROG/OPER SYS INFO - The SOURCE CODE IS AVAILABLE. The program also checks the required minimum average cold end temperature. If the average cold end temperature is less than the allowable minimum, the air inlet temperature is increased until this requirement is met. The printout will show the total increase in the air inlet temperature over the base temperature of 80 degrees Fahrenheit. The estimated heat input to increase the inlet air temperature to the required temperature is also given to show the required duty of a steam coil air preheater. Directories and paths are hard coded in the source code.

HARDWARE REQS - BPM3.0S requires at least 384 Kbytes of RAM memory, a hard disk with at least 2.5 megabytes of free disk space, Epson FX-85 or HP LserJet or compatible printer, CGA, EGA, or VGA adapter cards to display graphics.

TIME REQUIREMENTS - On an IBM type 386 machine or similar, the first complete run through all five boiler programs should take 5-10 minutes, with no errors. The first run with a new model is always the longest, particulary in the convective pass program, which must perform multiple iterations. Successive runs through all five programs should not take longer than 3-4 minutes. Convergence of the model will typically occur after about 25 runs.

REFERENCES - P. Kemeny, J. Lagomarsino, D. Clarke, C. Roccanova, G. Woods, D. Miller, and A. Landry, User's Manual for Boiler Performance Computer Programs (BPM 3.0), Burns and Roe Services Corporation Report, March 1992; Sample Boiler Models for Boiler Performance Computer Programs (BPM 3.0), Burns and Roes Services Corporation Report, March 1992.

ABSTRACT STATUS - Abstract first distributed March 1988. IBM PC version submitted February 1988, replaced August 1988 by revised Edition B. Version 3.0 submitted May 8, 1992. Copyrighted version 3.0S containing SOURCE CODE submitted September 1993. Ready screened

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ABSTRACT STATUS -(CONT) September 23, 1993.

SUBJECT CLASS CODE - T

KEYWORDS -
COMPUTER PROGRAM DOCUMENTATION
B CODES
PERFORMANCE
BOILERS
FOSSIL FUELS
DESIGN
HEAT TRANSFER
STEAM GENERATORS
ELECTRIC UTILITIES
EFFICIENCY
FUEL CONSUMPTION
FURNACES

EDB SUBJECT CATEGORIES -
990200 421000

SPONSOR - DOE/PET

PACKAGE TYPE - SCREENED