

DOE-2 USER NEWS PUB-439

DOE-2: A COMPUTER PROGRAM FOR
BUILDING ENERGY SIMULATION

Volume 7, No. 2
Summer 1986

Published By The:

Simulation Research Group
Bldg. 90 — Room 3147
Applied Science Division
Lawrence Berkeley Laboratory
University of California
Berkeley, California 94720

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* * * HANDS ON * * *

UNIVAC ?? Oui, Oui !! —

At long last our French collaborators have sent us the UNIVAC mods to 2.1C. However, it will take us a bit of work before we can offer a UNIVAC tape to our users. Interested users are advised to call or write us at LBL for details on obtaining this (or any other) version of the program.

DOE-2, Please Phone Home !! —

The editorial staff of the User News welcomes feature articles that would be of interest to DOE-2 users. If you would like to make a contribution to the "News" (two or three printed pages is the right length), won't you please send an article to the editor?

The Heartbreak of IBM —

As we reported in the Spring '86 User News, several users have encountered a problem installing DOE-2.1C on IBM VM/CMS operating systems. It is claimed that this operating system has an upper limit of 32K bytes per record for disk files. Since several DOE-2 files (keyword file, edit table, standard file for large buildings) have records longer than this, the implementation cannot proceed. Other users using MVS/XA and VM/CMS have reported no such problems. Please contact us if you know of a solution to this problem.

Back to School —

Fred Buhl and Jeff Hirsch of the Simulation Research Group gave a three-day intensive course on the use of DOE-2, August 25-27 on the University of California campus in Berkeley. All subscribers to the User News should have received an announcement of the course and enrollment forms. If you were unable to attend this year and want to get on the mailing list for next year, contact the University Extension office (at (415) 642-4111, ask for Richard Tsina) and request information.

Get an EA&R-ful of This —

Energy Auditor & Retrofitter is a bimonthly publication that provides clear, concise information about making existing housing more energy efficient. The magazine delivers practical information to energy conservation practitioners — the auditors and retrofitters who recommend and install energy conservation devices in residences. *EA&R* is distributed to contractors, auditors, and energy professionals at utilities, weatherization agencies, private firms, and consumers around the country; it is published by a non-profit organization to ensure reliable and objective coverage of energy conservation products and practices. For additional information, contact Peter duPont, *Energy Auditor & Retrofitter*, 2124 Kittredge St. #95, Berkeley, CA 94704 (or phone 415-524-5405).

Simulation Programs for your Microcomputer

Traditionally, the expenses connected with running mainframe building energy simulation programs in smaller architecture and engineering firms had effectively prohibited their use. Consequently, such firms had to resort to time sharing and/or service bureaus in order to use sophisticated building simulation tools. However, due to the "microcomputer revolution" in recent years, several hourly building energy simulation programs are now available. We are featuring two such programs — PC-DOE and ADM-2 — in this issue. If you have used microcomputer simulation programs and would like to share your comments, opinions, praise and/or criticisms of them, please write us.

PC-DOE — A Microcomputer Version of DOE-2.1B

by

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A microcomputer version of the DOE-2 program has been developed for users of the IBM-PC family of computers and compatible microcomputers. This product, called PC-DOE, is a full implementation of DOE-2.1B with the addition of a user-oriented operational shell and a post-processing graphics package. PC-DOE was developed and is being marketed by CA Systems International, Inc., a software engineering company based in Lakewood, Colorado.

The initial release of PC-DOE was made in late January, 1986. It represents the first in a series of PC-DOE product releases designed around enhanced versions of the DOE-2 program. Subsequent releases and upgrades will focus on both computational improvements and user-oriented input-output features. Current plans call for the announcement of significant product additions approximately every four to six months; one of the first upgrades will be to version 2.1C.

All of the computational algorithms, system models, and reporting features of the DOE-2.1B program remain in PC-DOE. Additional features have been added in the microcomputer version to appeal to users in the PC marketplace. These features should also prove valuable to existing DOE-2 users in terms of increased ease of use of the program, improvements in the management of data files, and increased graphical reporting capabilities. Total BDL data file compatibility is maintained between DOE-2 and PC-DOE due to the fact that DOE-2 is a subset of PC-DOE. In practical terms, this compatibility allows all existing DOE-2 BDL files to run with PC-DOE, and allows BDL files created and debugged with PC-DOE on a microcomputer to be run using DOE-2 on a mainframe-type computer. The only exception to this is with respect to very large building models. In this case, PC-DOE may have less modeling capacity in terms of building size than the mainframe DOE-2 version.

A run-time estimate is provided for use as a guideline in the following table. Note that the example problems which were used modeled buildings with two zones and 36 zones, respectively. The time difference between these two examples is not a simple linear function of the number of zones.

BENCHMARK TIMES							
Time (Hrs:Min)							
Problem	Number of Zones	IBM PC	IBM XT	IBM AT	Compaq Deskpro	Compaq Deskpro 286	HP Vectra
EXAMPLE1.BDL	2	3:10	3:09	1:50	1:35	1:30	1:19
EXAMPLE2.BDL	36	12:32	—	9:00	6:22	7:39	6:45

User-oriented features that have been added as enhancements to PC-DOE include:

- An execution shell that controls PC-DOE operations via an easy-to-use menu structure.
- Run-time status screens that display simulation information and bar graph data on the CRT screen during PC-DOE execution.
- A post processing graphics package that provides bar graph and pie chart reports, in monochrome or color, on the CRT screen or plotters and printers.
- A file manager module that provides data and output file management functions.
- A utilities module that provides hardware and software setup capabilities and support.

Users of PC-DOE are provided with a color-coded manual that is designed to complement the DOE-2 documentation set developed at LBL and the Los Alamos National Laboratory. The PC-DOE Manual contains several example data sets with detailed line-by-line explanations of the data. These data sets are color-coded according to conventions that are used throughout the manual.

Software and hardware support are provided by CA Systems International through on-call telephone support lines. Licensed professional engineers with many years of experience in the use of DOE-2 and PC-DOE are available for software support during regular business hours. In addition, computer specialists are available for answering questions regarding hardware compatibility, system setup, and hardware interfacing and communications.

Product literature and pricing information can be obtained by contacting CA Systems International, One Union Square, 149 Union Boulevard, Lakewood, Colorado 80228. Their phone number is 800-291-4007 or (999)980-1796.

Using the PC-DOE Program on a Microcomputer

by

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DOE-2 is now available for microcomputers! Released by CA Systems International, PC-DOE is a full implementation of the DOE-2.1B program and contains all of the algorithms found in the original version. In addition, PC-DOE incorporates a number of enhancements that increase the power and usability of the program (including a Control Shell, a Data File Manager, and a Graphics Post-Processor).

The Control Shell is entered from the operating system by typing the command *PCDOE*. The shell is entirely menu-driven and controls the execution of the BDL input processor as well as the LOADS, SYSTEMS, PLANT and ECONOMICS simulation programs. The Control Shell eliminates the need for the procedures files that are commonly used with mainframe computers.

The Data File Manager is a very useful addition to the program. It automates the SAVE-FILES command and keeps track of all DOE runs. The runs are displayed in a menu format which allows the user to easily attach a new SYSTEMS or PLANT to a previous run. For example, the user can make one or more LOADS runs, review the output, and then make one or more SYSTEMS runs attached to any of the previous LOADS runs. After reviewing the SYSTEMS output, the user can make one or more PLANT runs attached to any of the previous SYSTEMS runs. Of course, the user can choose to execute LOADS, SYSTEMS and PLANT runs sequentially with no stops. When the analysis is complete, the Data File Manager allows the user to select the runs to be deleted from the disk.

The Graphics Post-Processor allows the user to select various LOADS, SYSTEMS and PLANT output reports and display the data graphically on the monitor, a printer, or a plotter.

Both the Data File Manager and the Graphics Post-Processor are executed within the Control Shell.

BDL input files are prepared outside of the Control Shell using either the standard DOS line editor (EDLIN), or, preferably, a word processing program. The main criteria for choosing a word processing program is that it be capable of generating true ASCII files. Any non-ASCII character will cause the BDL processor to abort. For example, the Wordstar program inserts tab characters into the file whenever the tab key is pressed. BDL does not recognize tabs and will abort as a result. Since our office uses Wordstar for all word processing, we solved this problem by writing a filter program which replaces all tab stops in the input file with the correct number of blanks and removes any other non-ASCII characters. There are other word processing programs which will work without modification. CA Systems can provide information on some of these programs.

PC-DOE Output Reports are identical to the mainframe reports (which is to be expected since the programs are the same). The reports can be reviewed before printing by using the same word processor used to prepare the input. The reports can be printed on either a full width 130 column printer, or an 80 column printer set up in the compressed mode.

PC-DOE will run on the IBM-XT, IBM-AT, or any true IBM-compatible machine with a 640K RAM, a math co-processor, and at least a 10 megabyte (MB) hard drive. *The program uses a LOT of disk space!* The program comes on 16 floppies and will occupy 5 MB on the hard drive. The 35-zone example building provided with the PC-DOE package generates approximately 10 MB of data files. The minimum practical drive size to consider is 20 MB. If you intend to use your microcomputer to run other programs as well, consider a 30 MB hard drive or larger.

Run times for the program vary according to the number of zones in the building, the complexity of the simulation (shading, daylighting, etc.), and the microcomputer used. Benchmark times for the 35-zone example building are 12.5 hours on an IBM-PC, 9 hours on the IBM-AT, and 6.3 hours on the Compaq Deskpro. An AT&T 6300 will run the benchmark example in 5.8 hours. In general, for a 10-zone building on the AT&T 6300, a BDL run will take 3-4 minutes, a two-day (summer and winter) debugging run with lots of hourly reports will take less than 10 minutes, and a one-year run will take about 2.5 hours.

While the runtimes on a micro are substantially longer than on a mainframe, the turnaround time can actually be shorter. I used to submit most mainframe runs on the overnight priority to keep the cost reasonable. Now I can make several runs in one day, or let the computer work on a series of parametric runs overnight.

I have streamlined the input file creation time by predefining a series of input modules containing typical schedules, layers and constructions, space conditions, spaces, surfaces, zones, systems, and plants. Data that must be specified for critical keywords is marked by question marks. The word processing program is used to merge the appropriate input modules together and to jump from question mark to question mark so that the data can be filled in. This approach makes input fast and easy, eliminates most input mistakes, and reduces the total analysis time.

My office has made over 100 DOE-2 runs since acquiring PC-DOE six months ago. The cost savings in network computer time have already paid for both the program and the microcomputer. One common problem that we don't worry about any more is the cost of re-running a series of inputs that was missing a critical piece of data, or that needs one more hourly report variable specified to fully explain the results. It is also easy to ask a series of "What if?" questions without worrying too much about the cost.

In summary, PC-DOE brings all of the power of the mainframe version of DOE-2.1B to the microcomputer. It is easy to use and may become the preferred program for many engineering offices.

Steven Gates is a Senior Engineer at Taylor Systems Engineering, a consulting mechanical engineering firm in Fair Oaks, California. He was formerly a member of the DOE-2 development team at Lawrence Berkeley Laboratory. Steve has informed us that he has written a DOE-2 output report post-processor that runs on PC-compatible microcomputers. This program allows the user to specify a large number of reports and hourly-reports from DOE and then to selectively review and print only the relevant reports. The program also allows the user to print only the variables of interest in hourly-reports, does comparisons between reports of different runs, can eliminate the double spacing found in many reports, and can determine whether more than one report will fit on a page. The program will work in conjunction with both PC-DOE as well as any output file downloaded from a mainframe. For more information, contact Steve Gates at (916)698-4675.

ADM-2 — An Hourly Building Energy Analysis Program
for Microcomputers

developed by

ADM ASSOCIATES, INC.

3299 Ramos Circle

Sacramento, CA 95827

The use of building energy analysis computer programs is becoming a standard procedure for estimating energy use in buildings for the purpose of identifying ways to design or modify buildings to be more energy efficient. Both of these energy conservation approaches are promoted by government, utilities, and the private sector. Despite the fact that these building energy computer programs have been available for 10 years, in the past few years the number of users of building energy analysis computer programs has vastly increased. The big change is mainly due to the emergence of microcomputers. Until recently, due to their limitations, only simplified energy calculation methods were available for microcomputers, and complete hourly simulation models were available on mainframe computers.

To simplify input preparation and reduce computer run time, while still retaining the basic capabilities of such detailed programs as DOE-2, ADM-2 was developed to be used for energy auditing purposes and compliance with building energy standards. ADM-2 is structured similarly to DOE-2 and uses many of its subroutines.

ADM-2 consists of three separate sub-models. These sub-models are **BIG**, which generates the building information; **LOAD**, which calculates hourly heating and cooling loads; and **ENERGY**, which simulates the air distribution and the plant for calculation of energy use.

- **BIG** is a menu-driven interactive program that has been designed to make it easy to create and edit data files of the buildings being analyzed. It allows considerable flexibility in describing a building, while maintaining the organization necessary to translate the physical characteristics of the building into a quantitative description. **BIG** overcomes many of the difficulties associated with the data entry for other hourly energy analysis programs.
- In the **LOAD** sub-model, the building loads are calculated at a constant indoor air temperature for every hour of the year. The conduction loads due to walls and roof are determined using exterior surface temperature calculated by using the x -component of response factors selected from a library of response factors, and a set of regression equations developed using the y -component of response factors. The regression equations use the overall U-value and the thermal capacitance of the wall or roof materials. The heat transfer through the thin opaque, glazing and floor areas is calculated based on the surface temperature and thermal properties of the materials. Solar gains and the effect of exterior shading are also calculated on an hourly basis. The hourly available solar radiation for each orientation is determined using hourly total and normal radiation obtained from standard weather data such as the Test Reference Year (TRY) data provided by NOAA. The effect of exterior shading due to window overhang and fins on the solar gains through windows is calculated using the ASHRAE method for the calculation of shading due to horizontal and vertical projections. Internal loads such as lighting, occupants, appliances, and equipment are calculated based on a standard and non-standard daily usage profile. Infiltration rates are determined as a function of windspeed for buildings with no outside air ventilation. The calculated loads are then adjusted by using library weighting factors to account for the building mass. The weighting factors have been calculated by using DOE-2 with custom weighting factors and specifications for

three types of structures: heavy, medium, and light.

- The hourly calculated loads are then passed to the **ENERGY** sub-model. This sub-model initially establishes the system loads through an iterative process. The hourly loads are modified to reflect the variation in the temperature and the characteristics of the thermostats in each zone. The conduction loads due to internal walls are then calculated and added to the zone loads. Based on these loads, the supply temperatures and cfm's are determined, and the final system loads are calculated and passed to the plant section of the sub-model. In the plant section, the energy use by the heating and cooling equipment is calculated. These calculations consider the part-load characteristics and the rated performance of the equipment.

ADM-2 can simulate 11 distribution systems, including the following: Single-Zone, Multi-Zone, Dual Duct, Two-Pipe Fan Coil, Four-Pipe Fan Coil, Variable Air Volume, Constant Volume, Packaged Single-Zone, Packaged Multi-Zone, Packaged Variable Air Volume, and Packaged Terminal Air Conditioner. ADM-2 can simulate the following control options: Dead Band Thermostats, Thermostats Throttling Range, Temperature or Enthalpy Economizer, Preheating, Maximum/Minimum Supply Air Temperature, Heating/Cooling Coil Temperature Reset, VAV Box Minimum CFM, Fan Control Type, Night Fan Cycling, Two-Speed Fans in PTAC, and Summer/Winter Changeover. The code for these systems is based on DOE-2 subroutines.

The calculated system loads are used in calculating energy use for different types of heating and cooling equipment, including: Gas/Oil Furnace, Electric Baseboard/Furnace, Hot Water Boiler, Steam Boiler, Electric Hot Water Boiler, Electric Steam Boiler, and Heat Pump. The types of cooling equipment that can be simulated include: Direct Expansion Air Conditioner, Open Centrifugal Compression Chiller, Hermetic Centrifugal Compression Chiller, Open Reciprocating Compression Chiller, Hermetic Reciprocating Compression Chiller, One-Stage Absorption Chiller, Two-Stage Absorption Chiller, and Double-Bundle Chiller with Heat Recovery.

The ADM-2 program provides a variety of outputs. These outputs are formulated for easy reading and comprehension; samples follow this article. Typical sample run times are shown below.

TYPICAL RUN TIMES				
Time (Min:Sec)				
No. of Zones	No. of Systems*	IBM XT	IBM AT	Disk Space Used
2	2		14:13	147K
10	1		44:54	735K
2	2	38:40		n/a

*ADM-2 handles up to 10 zones and 10 systems

The ADM-2 program has been certified by the Bonneville Power Administration and the California Energy Commission. The System requirements for running the ADM-2 program include: IBM-PC or PC-compatible microcomputer with MS-DOS/PC-DOS 2.0 or higher, 256K RAM, 8087 co-processor, and 5MB (or greater) hard disk.

Product literature and special reduced pricing information for ADM-2 can be obtained by contacting Kwok Lam at ADM Associates, Inc., 9299 Ramos Circle, Sacramento, California 95827. Their phone number is (916) 868-8988.

"ADM-2" continued...

 ADM2-MZ Hourly Energy Analysis Model Page 4
 Hourly Energy Use Report
 InFile = SAMPLE.DAT OutFile = SAMPLE.HRL WthrFile = SACTO.BWF

 * DATE: JAN 2 HOUR: 10 * DRY BULB TEMP: 43.00

 ZONE TEMPERATURE AND SYSTEM LOAD

SYSTEM NUMBER	ZONE NUMBER	ZONE TEMPERATURE (F)	SYSTEM LOAD (KBTU)
1	1	70.40	-20.82

 CONDITIONING ENERGY UTILIZATION (KBTU)

SYS#	HEATING-ELEC	HEATING-FUEL	COOLING-ELEC	COOLING-FUEL	FAN/PUMP-ELEC
1:	26.72	.00	.00	.00	1.22

 NON-CONDITIONING ENERGY UTILIZATION (KBTU)

INLITE	OUTLITE	COOK-E	COOK-F	HW-E	HW-F	REF-E	OTHER-E	OTHER-F
10.75	.00	.00	.00	1.17	.00	.00	6.83	.00

Sample Hourly Report



 ADM-2 Energy Analysis Model SN1000 Page 4
 Monthly Energy Use Report 8-1-85 2:44
 InFile = SAMPLE.DAT OutFile = SAMPLE.OUT WthrFile = SACTO.BWF

Sample Monthly Report



Sys: 1 Month	Heating		Cooling		Fan/Pump	Demand
	Electric (KWH)	Fossil (KBTU)	Electric (KWH)	Fossil (KBTU)	Electric (KWH)	Electric (KW)
JAN	630.56	.00	65.46	.00	31.11	17.93
FEB	458.13	.00	82.53	.00	27.34	14.72
MAR	310.22	.00	144.76	.00	28.71	13.98
APR	164.22	.00	183.16	.00	26.38	11.62
MAY	69.20	.00	347.92	.00	41.98	11.39
JUN	20.77	.00	468.15	.00	54.61	12.56
JUL	9.17	.00	586.27	.00	65.27	12.71
AUG	12.67	.00	604.11	.00	69.19	12.93
SEP	16.89	.00	465.75	.00	55.93	12.66
OCT	47.51	.00	408.40	.00	49.96	12.10
NOV	167.87	.00	191.07	.00	27.66	11.50
DEC	565.06	.00	44.70	.00	27.29	15.44

 Maximum Heating (46.88 KBTU) Time of Occurrence: 1/ 3: 8
 Maximum Cooling (43.14 KBTU) Time of Occurrence: 8/ 7:17

"ADM-2" continued...

Sample Annual Report

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ADM-2 Energy Analysis Model  SN1000                               Page 5
Building Energy Use Summary                                     8- 1-85  2:44
InFile = SAMPLE.DAT      OutFile = SAMPLE.OUT      WthrFile = SACTO.BWF
-----

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SAMPLE INPUT BUILDING FOR THE ADM-2 PROGRAM

Total floor area : 2000.00 sq.ft.

Annual Energy Utilization

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	Electric (KWH)	Fossil (KBTU)
	-----	-----
Non-conditioning:		
Indoor Lighting Energy	9492.0	.0
Outdoor Lighting Energy	1533.0	.0
Hot Water Energy	906.8	.0
Refrigeration Energy	.0	.0
Cooking Energy	.0	.0
Other energy	8842.5	.0
Conditioning:		
Zone Loads - Heating	.0	25867.7
Cooling	.0	59333.2
System # 1 : Type - PTAC		
Heating Load	.0	8437.9
Cooling Load	.0	28843.2
Heating Energy (ELEC)	2472.3	.0
Cooling Energy (DX)	3592.3	.0
Fan/Pump Energy	505.4	.0

Total Energy	27344.2	.0

```

-----
Total Annual Source Energy Use Estimate     140.0 KBTU/Sq.Ft.
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CROSS INDEX BY DOE-2 ABBREVIATION

This index to the SYSTEMS, PLANT, and ECONOMICS portions of the program applies to the DOE-2.1C version. Commands and keywords which do not have abbreviations do not appear in the list. The LOADS index appeared in the Autumn '85 User News.

SYSTEMS

Abbreviation	Command/Keyword
A-C/HR	AIR-CHANGES/HR
A-CFM	ASSIGNED-CFM
B-C	BASEBOARD-CTRL
B-R	BASEBOARD-RATING
B-SCH	BASEBOARD-SCH
BASEB-S	BASEBOARD-SOURCE
C-BF	COIL-BF
C-BF-FC	COIL-BF-FCFM
C-BF-FT	COIL-BF-FT
C-C	COOL-CONTROL
C-C-FT	COOL-CAP-FT
C-C-R	COOL-CTRL-RANGE
C-CAP	COOLING-CAPACITY
C-E-FP	COOL-EIR-FPLR
C-E-FT	COOL-EIR-FT
C-EIR	COOLING-EIR
C-F	CURVE-FIT
C-FT-MIN	COOL-FT-MIN
C-H	CRANKCASE-HEAT
C-M-T	CRANKCASE-MAX-T
C-R-SCH	COOL-RESET-SCH
C-S-C	COOL-SH-CAP
C-S-FT	COOL-SH-FT
C-S-SCH	COOL-SET-SCH
C-S-T	COOL-SET-T
C-SCH	COOLING-SCHEDULE
C-T-SCH	COOL-TEMP-SCH
C-TYPE	COMPRESSOR-TYPE
COEF	COEFFICIENTS
D-A-L	DUCT-AIR-LOSS
D-C-T	DESIGN-COOL-T
D-D	DEFROST-DEGRADE
D-D-T	DUCT-DELTA-T
D-H-T	DESIGN-HEAT-T
D-R-SCH	DAY-RESET-SCH
D-SCH	DAY-SCHEDULE

D-T	DEFROST-T
DEFINE	PARAMETER
E-CFM	EXHAUST-CFM
E-E	EXHAUST-EFF
E-KW	EXHAUST-KW
E-L-L	ECONO-LOW-LIMIT
E-L-T	ECONO-LIMIT-T
E-S	EXHAUST-STATIC
F-A	FURNACE-AUX
F-C	FAN-CONTROL
F-E-FPLR	FAN-EIR-FPLR
F-H-C	FLUID-HEAT-CAP
F-H-FP	FURNACE-HIR-FPLR
F-HIR	FURNACE-HIR
F-M	FLOOR-MULTIPLIER
F-O-L	FURNACE-OFF-LOSS
F-P	FAN-PLACEMENT
F-SCH	FAN-SCHEDULE
H-C	HEAT-CONTROL
H-C-FT	HEAT-CAP-FT
H-CAP	HEATING-CAPACITY
H-E-FP	HEAT-EIR-FPLR
H-E-FT	HEAT-EIR-FT
H-EIR	HEATING-EIR
H-R	HOURLY-REPORT
H-R-SCH	HEAT-RESET-SCH
H-S-SCH	HEAT-SET-SCH
H-S-T	HEAT-SET-T
H-SCH	HEATING-SCHEDULE
H-T-SCH	HEAT-TEMP-SCH
H-TYPE	HUMIDIFIER-TYPE
H-W-FC	HCOIL-WIPE-FCFM
HEAT-S	HEAT-SOURCE
I-A-Z	INDUCED-AIR-ZONE
I-M-SCH	INDUC-MODE-SCH
I-R	INDUCTION-RATIO
L-S-R	LOW-SPEED-RATIOS
LIST	DIAGNOSTIC
M	MULTIPLIER
M-A-SCH	MIN-AIR-SCH
M-C-R (under SYSTEM-EQUIPMENT)	MAX-COND-RCVRY
M-C-R (under ZONE)	MIN-CFM-RATIO
M-C-SCH	MIN-CFM-SCH
M-H-R	MIN-HGB-RATIO
M-H-T	MIN-HP-T
M-O-A	MIN-OUTSIDE-AIR
M-O-F	MAX-OA-FRACTION

M-P	MOTOR-PLACEMENT
M-U-R	MIN-UNLOAD-RATIO
MAX-C-R	MAX-COOL-RATE
MAX-F-R	MAX-FAN-RATIO
MAX-F-T	MAX-FLUID-T
MAX-H	MAX-HUMIDITY
MAX-H-R	MAX-HEAT-RATE
MAX-S-T	MAX-SUPPLY-T
MIN-F-R	MIN-FAN-RATIO
MIN-F-T	MIN-FLUID-T
MIN-H	MIN-HUMIDITY
MIN-S-T	MIN-SUPPLY-T
N-C-C	NIGHT-CYCLE-CTRL
N-V-A	NATURAL-VENT-AC
N-V-C	NIGHT-VENT-CTRL
N-V-D	NIGHT-VENT-DT
N-V-R	NIGHT-VENT-RATIOS
N-V-SCH (under SYSTEM-AIR)	NATURAL-VENT-SCH
N-V-SCH (under SYSTEM-FANS)	NIGHT-VENT-SCH
O	OPTION
O-A-CFM	OUTSIDE-AIR-CFM
O-C	OA-CHANGES
O-CFM P	OA-CFM/PER
O-CTRL	OA-CONTROL
O-F-KW	OUTSIDE-FAN-KW
O-F-M	OUTSIDE-FAN-MODE
O-F-T	OUTSIDE-FAN-T
O-H	OUTSIDE-HI
O-L	OUTSIDE-LO
P-A	PLANT-ASSIGNMENT
P-L-R	PANEL-LOSS-RATIO
P-N	PLENUM-NAMES
P-T	PREHEAT-T
PREHEAT	PREHEAT-SOURCE
R-A-P	RETURN-AIR-PATH
R-B	REPORT-BLOCK
R-C	RATED-CFM
R-CC-FC	RATED-CCAP-FCFM
R-CE-FC	RATED-CEIR-FCFM
R-CFM (under ZONE-AIR)	RATED-CFM
R-CFM (under SYSTEM-AIR)	RETURN-CFM
R-D-T	REHEAT-DELTA-T
R-E	RETURN-EFF
R-F	REPORT-FREQUENCY
R-HC-FC	RATED-HCAP-FCFM
R-HE-FC	RATED-HEIR-FCFM
R-KW	RETURN-KW
R-S	RETURN-STATIC

R-S-FC	RATED-SH-FCFM
R-SCH (under HOURLY-REPORT)	REPORT-SCHEDULE
R-SCH (RESET-SCHEDULE command)	RESET-SCHEDULE
REC-E	RECOVERY-EFF
RET-D-T	RETURN-DELTA-T
S	SUMMARY
S-A	SYSTEM-AIR
S-C	SYSTEM-CONTROL
S-CFM	SUPPLY-CFM
S-E	SUPPLY-EFF
S-EQ	SYSTEM-EQUIPMENT
S-FANS	SYSTEM-FANS
S-FLU	SYSTEM-FLUID
S-H	SUPPLY-HI
S-H-C	HP-SUPP-HT-CAP
S-KW	SUPPLY-KW
S-L	SUPPLY-LO
S-M-E	SUPPLY-MECH-EFF
S-N	SYSTEM-NAMES
S-O	SIZING-OPTION
S-R (under SYSTEMS)	SIZING-RATIO
S-R (SYSTEMS-REPORT command)	SYSTEMS-REPORT
S-S	SUPPLY-STATIC
S-T	SYSTEM-TERMINAL
S-TYPE	SYSTEM-TYPE
SCH	SCHEDULE
SET	SET-DEFAULT
SS-F-SCH	SS-FLOW-SCH
SS-V-CST	SS-VENT-CST
SS-V-KW	SS-VENT-KW
SS-V-L-T	SS-VENT-LIMIT-T
SS-V-SCH	SS-VENT-SCH
SS-V-T-SCH	SS-VENT-T-SCH
SS-V-TEMP	SS-VENT-TEMP
SS-V-WND	SS-VENT-WND
SUP-D-T	SUPPLY-DELTA-T
SUPP-S	HP-SUPP-SOURCE
SYST	SYSTEM
T-R	THROTTLING-RANGE
T-TYPE	THERMOSTAT-TYPE
T-V-SCH	TROM-VENT-SCH
TER-TYPE	TERMINAL-TYPE
V	VERIFICATION
V-L	VARIABLE-LIST
V-T	VARIABLE-TYPE
V-T-SCH	VENT-TEMP-SCH
W-SCH	WEEK-SCHEDULE
Z	ZONE

Z-A	ZONE-AIR
Z-C	ZONE-CONTROL
Z-F	ZONE-FANS
Z-F-CFM	ZONE-FAN-CFM
Z-F-KW	ZONE-FAN-KW
Z-F-R	ZONE-FAN-RATIO
Z-F-SCH	ZONE-FAN-T-SCH
Z-H-S	ZONE-HEAT-SOURCE
Z-N	ZONE-NAMES
Z-TYPE	ZONE-TYPE

PLANT

<i>Abbreviation</i>	<i>Command/Keyword</i>
A-SCH	ASSIGN-SCHEDULE
B	BLOCK*
C (under PLANT-EQUIPMENT)	CONSUMABLES
C (under ENERGY-COST*)	COST
C-B-T	CTANK-BASE-T
C-E	CONSUMABLES-EXP
C-E-T	CTANK-ENV-T
C-F	CURVE-FIT
C-F-T	CTANK-FREEZ-T
C-L-C	CTANK-LOSS-COEF
C-M	COOL-MULTIPLIER
C-R	CONSUMABLES-REF
C-ST-R	COOL-STORE-RATE
C-ST-SCH	COOL-STORE-SCH
C-SU-R	COOL-SUPPLY-RATE
C-T-R	CTANK-T-RANGE
COMP	COMPONENT*
CONN	CONNECT
D-1	DEMAND-1
D-2	DEMAND-2
D-3	DEMAND-3
D-4	DEMAND-4
D-5	DEMAND-5
D-A-SCH	DAY-ASSIGN-SCH
D-R	DISCOUNT-RATE
D-SCH	DAY-SCHEDULE
DEFINE	PARAMETER
E	ESCALATION*

* ENERGY-COST command moved to ECONOMICS in DOE-2.1C.

E-C	ENERGY-COST*
E-I-R	ELEC-INPUT-RATIO
E-L	EQUIPMENT-LIFE
E-M	ELEC-MULTIPLIER
E-Q	EQUIPMENT-QUAD
E-R	ENERGY-RESOURCE
E-S	ENERGY-STORAGE
F-C	FIRST-COST
F-C-E	FIRST-COST-EXP
F-C-R	FIRST-COST-REF
H-B-T	HTANK-BASE-T
H-E-T	HTANK-ENV-T
H-F-T	HTANK-FREEZ-T
H-L-C	HTANK-LOSS-COEF
H-M	HEAT-MULTIPLIER
H-R	HOURLY-REPORT
H-ST-R	HEAT-STORE-RATE
H-ST-SCH	HEAT-STORE-SCH
H-SU-R	HEAT-SUPPLY-RATE
H-T-R	HTANK-T-RANGE
H-U	HOURS-USED
HEAT-R	HEAT-RECOVERY
I	INSTALLATION
I-N	INSTALLED-NUMBER
I-R	INSTALLATION-REF
L	LABOR
L-A	LOAD-ASSIGNMENT
L-E	LIFE-EXP
L-I	LABOR-INFLTN
L-M	LOAD-MANAGEMENT
L-R (under REFERENCE-COST)	LIFE-REF
L-R (under LOAD-ASSIGNMENT)	LOAD-RANGE
LIST	DIAGNOSTIC
M (under PLANT-EQUIPMENT)	MAINTENANCE
M (under ENERGY-COST*)	MULTIPLIER
M-E	MAINTENANCE-EXP
M-I	MATERIALS-INFLTN*
M-M-C	MIN-MONTHLY-CHG*
M-N-A	MAX-NUMBER-AVAIL
M-P-L	MIN-PEAK-LOAD
M-R	MAINTENANCE-REF
MAJ-O-C (under PLANT-COSTS)	MAJ-OVHL-CST-EXP
MAJ-O-C (under REFERENCE-COSTS)	MAJ-OVHL-CST-REF
MAJ-O-C (under PLANT-EQUIPMENT)	MAJOR-OVHL-COST
MAJ-O-I (under PLANT-COSTS)	MAJ-OVHL-INT-EXP
MAJ-O-I (under REFERENCE-COSTS)	MAJ-OVHL-INT-REF
MAJ-O-I (under PLANT-EQUIPMENT)	MAJOR-OVHL-INT
MAX-R	MAX-RATIO

MIN-O-C (under PLANT-COSTS)	MIN-OVHL-CST-EXP
MIN-O-C (under REFERENCE-COSTS)	MIN-OVHL-CST-REF
MIN-O-C (under PLANT-EQUIPMENT)	MINOR-OVHL-COST
MIN-O-I (under PLANT-COSTS)	MIN-OVHL-INT-EXP
MIN-O-I (under REFERENCE-COSTS)	MIN-OVHL-INT-REF
MIN-O-I (under PLANT-EQUIPMENT)	MINOR-OVHL-INT
MIN-R	MIN-RATIO
N	NUMBER
O-M	OPERATION-MODE
O-R	OPERATING-RATIO
P-A	PLANT-ASSIGNMENT
P-C	PLANT-COSTS
P-E	PLANT-EQUIPMENT
P-L	PROJECT-LIFE
P-L-C	PEAK-LOAD-CHG *
P-L-R	PART-LOAD-RATIO
P-P	PLANT-PARAMETERS
P-R	PLANT-REPORT
PRED-L-R	PRED-LOAD-RANGE
R	RESOURCE *
R-B	REPORT-BLOCK
R-C	REFERENCE-COSTS
R-F	REPORT-FREQUENCY
S	SUMMARY
S-1	SUPPLY-1
S-2	SUPPLY-2
S-3	SUPPLY-3
S-4	SUPPLY-4
S-5	SUPPLY-5
S-E	SOLAR-EQUIPMENT *
S-F	SITE-FACTOR
S-R	SIZE-REF
S-S-E	SOURCE-SITE-EFF
SCH	SCHEDULE
U	UNIT *
U-C	UNIFORM-COST *
V	VERIFICATION
V-L	VARIABLE-LIST
V-T	VARIABLE-TYPE
W-SCH	WEEK-SCHEDULE

ECONOMICS

<i>Abbreviation</i>	<i>Command/Keyword</i>
A-C (under COMPONENT-COST)	ANNUAL-COST
A-C (under ENERGY-COST)	ASSIGN-CHARGE
A-SCH	ASSIGN-SCHEDULE
B-C	BLOCK-CHARGE
B-R	BLOCK-RANGE
B-U	BLOCK-UNIT
C-A	CHARGE-ASSIGNMENT
C-A-L	C-A-LINK
C-C	COMPONENT-COST
C-L	COMPONENT-LIFE
C-P (under COST-PARAMETERS)	CAPACITY-PAYMENT
C-P (COST-PARAMETERS command)	COST-PARAMETERS
D-A-M1	DEM-AVERAGE-MON1
D-A-M2	DEM-AVERAGE-MON2
D-C-SCH	DAY-CHARGE-SCH
D-P-T1	DEM-PERIOD-T1
D-P-T2	DEM-PERIOD-T2
D-R-F1	DEM-RATCHET-FRC1
D-R-F2	DEM-RATCHET-FRC2
D-R-T1	DEM-RATCHET-T1
D-R-T2	DEM-RATCHET-T2
DEFINE	PARAMETER
E	ESCALATION
E-C (ENERGY-COST command)	ENERGY-COST
E-C (under BASELINE)	ENERGY-COST
E-R	ECONOMICS-REPORT
E-S-A	ELEC-SALES-ASG
E-S-E	ELEC-SALES-ESCL
E-S-O	ELEC-SALES-OPT
E-S-SCH	ELEC-SALES-SCH
E-U-SITE	ENERGY-USE-SITE
E-U-SRC	ENERGY-USE-SRC
F-C	FIRST-COST
F-M-C1	FIXED-MONTH-CHG1
F-M-C2	FIXED-MONTH-CHG2
I-C	INSTALL-COST
K-D-T	KWH/KW-DEM-TYPE
LIST	DIAGNOSTIC
M-M-C	MIN-MONTHLY-CHG
MAJ-O-C	MAJ-OVHL-COST

MAJ-O-I
MIN-O-C
MIN-O-I

N-O-U

O-B-R
O-C

P-F-C

R
R-C
R-L

S (under CHARGE-ASSIGNMENT)

S (under ECONOMICS-REPORT)

SCH
SET

U
U-C (under CHARGE-ASSIGNMENT)
U-C (under ENERGY-COST)
U-N

V

W-SCH

MAJ-OVHL-INT
MIN-OVHL-COST
MIN-OVHL-INT

NUMBER-OF-UNITS

OVER-BLOCK-RANGE
OPERATIONS-COST

POWER-FACT-CORR

RESOURCE
REPLACE-COST
RATE-LIMITATION

SEASON
SUMMARY
SCHEDULE
SET-DEFAULT

UNIT
UNIFORM-CHARGE
UNIFORM-COST
UNIT-NAME

VERIFICATION

WEEK-SCH

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