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# THE DOE-2 USER NEWS

PUB-439

DOE-2: A COMPUTER PROGRAM FOR BUILDING ENERGY SIMULATION Volume 9, No. 2  
Summer 1988

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## HANDS ON

**Bugged by 2.1C??** — To date, 56 bugs in 2.1C have been fixed. Vol. 9, No. 3 of the User News will print all bugs and fixes found to date in DOE-2.1C. This is the last time all bugs/fixes will be printed for 2.1C.

**DOE-2 Course at U.C. Berkeley** — A three-day intensive course titled "Building Energy Performance Analysis Using the DOE-2 Computer Program" is scheduled for September 7-9 at the University of California Berkeley campus. For registration information, write to Dick Tsina or Karen Anderson, U.C. Extension Office, 2223 Fulton St., Berkeley, CA 94720; phone (415) 642-4111. Cost of the course is \$645, including all materials; lodging and meals are not included. If you would like to visit the group when you attend the course, please notify us ahead of time.

## Newsletter Distribution

With the Spring 1988 issue, the USER NEWS started being distributed by the National Energy Software Center at Argonne, IL. The USER NEWS continues to be written and printed by the Simulation Research Group, and questions or comments should still be directed to LBL. NESC has decided to distribute the USER NEWS free of charge. If you want your name put on the distribution list, write to Ms. Jan Carter, NESC, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439.

## Directory of Services

The DOE-2 program, and its position as benchmark software in the A/E community, has generated a number of program-related software and services. A Directory of DOE-2 related software, services, and documentation is printed on the inside back page of this newsletter. All readers are urged to contact us with other sources for inclusion.

## Conferences

August 28-Sept 1, 1988 -- *CLIMA 2000, Second World Congress on Heating, Ventilation, Refrigeration and Air Conditioning*, Sarajevo, Yugoslavia. Contact Branislav Todorovic, CLIMA 2000/KGH, Knez Mihailova 7/II, 11000 Belgrade, Yugoslavia.

September 5-8, 1988 -- *CIB Conference — Healthy Buildings '88*, Stockholm, Sweden. Organized by the Swedish Council for Building Research in collaboration with the National Institute of Environmental Medicine, and with the co-sponsorship of the World Health Organization. Contact Mr. Goran Hellsten, The Swedish Council for Building Research, S:t Goransgatan 66, S-112 33 Stockholm, Sweden.

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# ■ ■ ■ THE HEAT EXCHANGER ■ ■ ■

**Question:** Sometimes when I'm running 2.1C the program aborts in BDL and I get an error message "Symbol Table Full" and/or "Exceeded Max for This Item of n". HELP!!

**Answer:** To increase the maximum number of SCHEDULEs, EXTERIOR-WALLs, WINDOWs, LAYERs, CONSTRUCTIONs:

1. Add the changes below [between the dashed lines] to the end of file "DKEY.vax".
2. Rebuild the file "BDLKEY.bin" by running the command file "@uv1 key bdlkey".

**NOTE:** max INTERIOR-WALLs is 112 and cannot be increased

```

1          2          3          4          5          6          7          8
1234567890123456789012345678901234567890123456789012345678901234567890
*/ ----- start file: DKEY.vax -----
*IDENT DKEYbig
*/
*/ --- allow more SCHEDULEs, EXTERIOR-WALLs, WINDOWs, LAYERs, CONSTRUCTIONs
*/
*/ ---- allow 100 SCHEDULEs, WEEK-SCHEDULEs, 200 DAY-SCHEDULEs
*D LDLKEY.73,LDLKEY.75
1SCHEDULE          SCH          1    76    0          100.    0.0    0.0
1WEEK-SCHEDULE     W-SCH        2    75    0          100.    0.    0.
1DAY-SCHEDULE      D-SCH        3    74    0          200.    0.    0.
*D SDLKEY.259,SDLKEY.261
1SCHEDULE          SCH          1    76    0          100.    0.0    0.0
1WEEK-SCHEDULE     W-SCH        2    75    0          100.    0.    0.
1DAY-SCHEDULE      D-SCH        3    74    0          200.    0.    0.
*/ ---- allow 256 EXTERIOR-WALLs
*D LDLKEY.245
1EXTERIOR-WALL     E-W          12   20    2          256.    0.    0.
*/ ---- allow 256 WINDOWs
*D LDLKEY.271
1WINDOW            WI           14   50    3          256.    0.    0.
*/ ---- allow 64 LAYER commands
*D LDLKEY.389
1LAYERS            LA           23   24    0          64.     0.    0.
*D LDLKEY.126
*/ ---- allow 64 CONSTRUCTION commands
1CONSTRUCTION      CONS         8    22    0          64.     0.    0.
*/ ---- increase max u-names to 800
*D LDLKEY.2
$LDL              800
*D SDLKEY.2
$SDL              800
*/ ---- increase constants table for functions processor to 500
*/ --- 200 : lsymt , 500 : lcont , 1000 : llitt , 200 : llabt
*D GTBL.26
$LDS 200 500 1000 200
*/ ----
*/ -----
*/ --- max INTERIOR-WALLs must be 112 = (900/(2*4)) , see READSS
*D LDLKEY.316
1INTERIOR-WALL     I-W          15   46    2          112.    0.    0.
*/ ----- end file: DKEY.vax -----
1          2          3          4          5          6          7          8
1234567890123456789012345678901234567890123456789012345678901234567890

```

# New Features in DOE-2.1D

Summarized below are major enhancements to the DOE-2 program. These changes will appear in version 2.1D, scheduled for official release at the end of 1988.

## Generalized Library

In the past it has only been possible to create DOE-2 libraries of materials, envelope constructions, and weighting factors. A new general library feature has been designed which will allow the users of DOE-2.1D to create custom libraries containing descriptions of any building component or system of components. This will allow definition of libraries containing data which might consist, for example, of standard operation schedules for different zone types or of complex component descriptions. Even libraries of entire zone descriptions can be created. This new library capability will greatly facilitate input preparation.

## User Defined Functions in SYSTEMS

In DOE-2.1C, direct user interface with the operation of DOE-2 is possible in the LOADS section of the program through the use of the FUNCTION command. This feature allows direct modification, enhancement, or replacement of DOE-2 calculations without requiring recompilation of the computer code. Users can write their own algorithms in a FORTRAN-like language and place this information in the BDL input, along with information indicating how and where these new algorithms are to be used. This is a major step forward in allowing designers and researchers to "fine tune" the simulation program to their specific needs. In the past this was not feasible without a major investment of time. In DOE-2.1D, this capability has been added to the SYSTEMS portion of the program, making it possible for an advanced user to add new HVAC simulation features such as innovative control schemes.

## Fenestration

Because heat gain and loss through windows has a large impact on energy performance of most buildings, the DOE-2 window thermal calculations have been improved. This includes (1) an automatic calculation of the shading of *diffuse* solar radiation by neighboring buildings and by architectural elements such as overhangs (previously only the shading of direct solar radiation was calculated); (2) an improved calculation of infra-red radiation loss from the building envelope to the sky, taking into account atmospheric conditions (atmospheric moisture, cloud coverage) and blocking by architectural obstructions; (3) an improved calculation of the amount of sky diffuse radiation falling on windows and walls.

## Desiccant Cooling

Several companies are developing desiccant cooling systems in which a hygroscopic material such as lithium bromide is used to remove moisture from the supply air stream. The desiccant is "regenerated" for further use by drying it with hot air from a gas-fired heater. Gas-fired desiccant systems of this type have the potential for being a replacement for, or a supplement to, conventional electric-driven cooling systems. However, very little is known about the economics of desiccant systems for different climates, building types, and utility rate structures. For this reason, the SRG (with funding from the Gas Research Institute via the GARD Division of the Chamberlain Manufacturing Corporation) has developed models for DOE-2.1D that can be used to simulate the performance of a variety of desiccant systems that are on the market now or are under development.

### Gas-Engine Driven Chillers & Hitachi Heater/Chiller

Two new PLANT equipment simulations will be available in DOE-2.1D: a direct fired, double effect absorption chiller-heater model, and an engine driven chiller model. The former will be familiar to most DOE-2 users. Direct fired absorption chillers have enjoyed a strong market in Japan, due to a national energy policy mandating gas cooling. Since 1979 units built by Hitachi have been available in the U.S. Despite high first cost and COPs of only 1.0 to 1.1, the equipment has attained considerable popularity. We have received many requests to include a model of this equipment in DOE-2.

The engine driven chiller, on the other hand, is "new" to the market. Engine driven chillers were available in the 1960's, but for a variety of reasons the market for these units dried up in the 70's. The Gas Research Institute, in collaboration with some equipment manufacturers (Tecogen Inc. and Thermo King Corp.), is attempting to reintroduce this equipment to the market. These units offer good COPs, excellent part load performance, and the capability to overspeed to meet peak loads above the rated capacity. Hot water can be recovered from the engine exhaust and coolant to provide space heating or to run an absorption chiller for extra cooling and greater overall efficiency.

### Ice-Storage Simulation

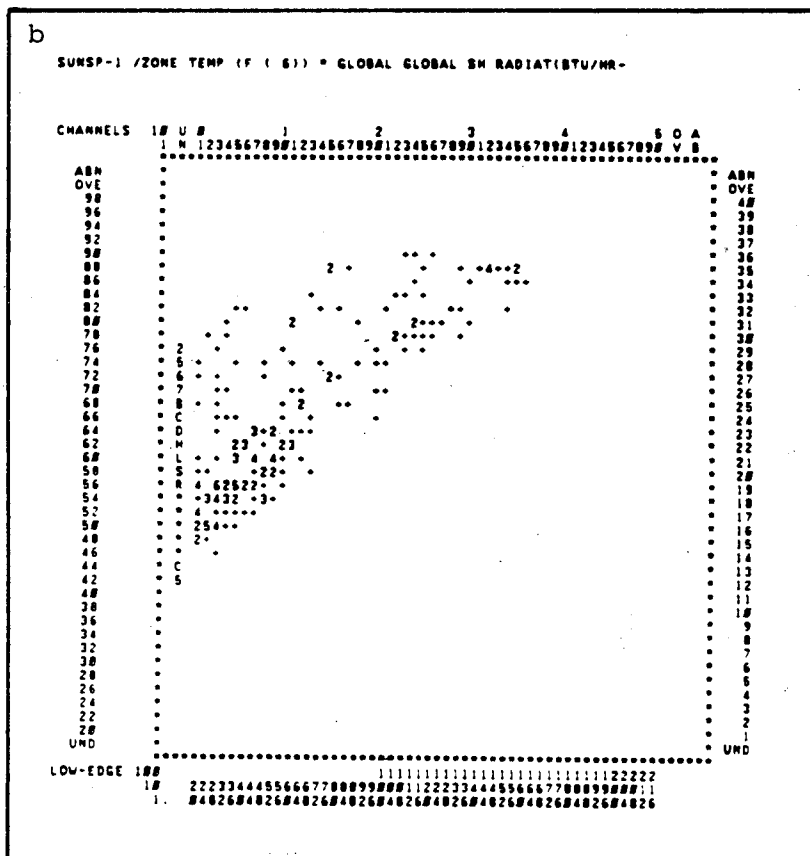
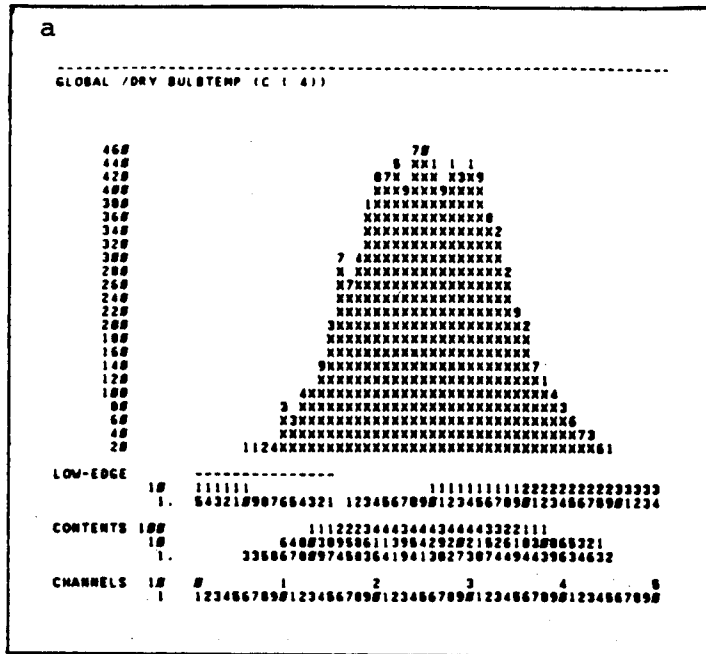
Off-peak production and storage of ice is attracting considerable interest as a way of reducing high daytime electricity costs for cooling. The PLANT program in DOE-2.1D will contain a new, component-based ice-storage model called CBS/ICE, developed for ASHRAE by Bruce Hunn's group at the University of Texas Center for Energy Studies. With CBS/ICE, users can configure a large variety of static (ice-on-coil) systems by linking together system components (evaporator, ice-tank, compressor, condenser, expansion valve, controller, etc.).

### Histograms and Scatterplots

A new statistical analysis package developed by our collaborators in France at the University of Paris-South allows DOE-2.1D to plot "frequency of occurrence" distributions for any of the program's 200 hourly thermal and climatic variables. The distributions can be in the form of histograms (which show how often particular values of a variable occur) or scatterplots (which show frequency-of-occurrence correlations between two different variables). These plots will make it possible for users to see trends and inter-dependencies which would be difficult to determine from the conventional tabular reports in DOE-2. For example, a scatterplot of cooling coil power vs. outside air temperature (or enthalpy) could be used to study the performance of an economizer cycle. Examples of the plots that can be printed are shown on the next two pages.



Examples of frequency-of-occurrence distributions that can be printed with DOE-2.1D:  
 (a) histogram of outside temp ( $^{\circ}\text{C}$ ); (b) scatterplot of inside temp ( $^{\circ}\text{F}$ ) vs exterior total horizontal solar radiation ( $\text{Btu/h-F}^2$ ); (c) monthly min, max, and avg values of outside temp ( $^{\circ}\text{C}$ ); (d) monthly frequency-of-occurrence of outside temp ( $^{\circ}\text{C}$ ).







■ ■ ■ ■ **DOE-2 DIRECTORY** ■ ■ ■ ■

of

Program Related Software, Services, and Publications

■ ■ NOTE ■ ■

Any user of the DOE-2 program who offers related software, training in the use of DOE-2, consulting, or program support should contact Kathy Ellington for inclusion in this directory.

■ ■ SOFTWARE ■ ■

*DOE-2.1C for Micros (MICRO-DOE2)*

Gene Tsai  
Acrosoft International  
3120 S. Wadsworth Blvd.  
Denver, CO 80227  
Phone: (303) 969-0170

■ ■ UTILITY PROGRAMS ■ ■

*Pre- and Post-Processor Software*

James Trowbridge  
Trowbridge Software Engineering  
4884-D Sunset Terrace  
Fair Oaks, CA 95628  
Phone: (916) 962-3001

*Graphs from DOE-2*

Ernie Jessup  
E. Jessup & Associates  
4977 Canoga Avenue  
Woodland Hills, CA 91364  
Phone: (818) 884-3997

■ ■ SERVICE BUREAUS ■ ■

*DOE-2 Computer Service*

Dashka Slater  
Berkeley Solar Group  
P.O. Box 3289  
Berkeley, CA 94703  
Phone: (415) 843-7600

■ ■ CONSULTANTS ■ ■

*Computer-Aided Mechanical Engineering*

Mike Roberts  
Roberts Engineering Co.  
11946 Pennsylvania  
Kansas City, MO 64145  
Phone: (816) 942-8121

*Large Facility Modelling*

George F. Marton, P.E.  
1129 Keith Avenue  
Berkeley, CA 94708  
Phone: (415) 841-8083

*Master Classes, Tutorials, Consulting*

Bruce Birdsall  
"In Support of Energy Software"  
166 Caldecott Lane, Suite 113  
Oakland, CA 94618  
Phone: (415) 841-2050

*Classes and Consulting*

Richard Kuo  
Knowledge Laboratory  
362 Ripley Court  
Naperville, IL 60565  
Phone: (312) 416-1696

*Consulting and Training*

Jeff Hirsch  
2138 Morongo  
Camarillo, CA 93010  
Phone: (805) 482-5515

■ ■ ■ ■ DOCUMENTATION ■ ■ ■ ■

— Complete 2.1C Documentation	PB-852-11449	\$288.00/each *
— 2.1C Update Package	PB-852-11431	\$ 87.00/each *
— Engineers Manual	DE-830-04575	\$ 39.50/each *

**To Order by Separate Titles:**

— BDL Summary (2.1C)	DE-850-12580	\$ 14.95/each *
— Users Guide (2.1A)	LBL-8689, Rev.2.	\$ 44.95/each *
— Sample Run Book (2.1C)	DE-850-12582	\$ 50.95/each *
— Reference Manual (2.1A)	LBL-8706, Rev.2	\$ 92.95/each *
— DOE-2 Supplement (2.1C Update)	DE-850-12581	\$ 25.95/each *

**To Order Documentation, Write or Call:**

National Technical Information Service, U.S. Dept. of Commerce,  
5285 Port Royal Road, Springfield, VA 22121  
For Credit Card Purchases, Phone: (703) 487-4650

**To Be Put On The USER NEWS Distribution List, Write:**

Ms. Jan Carter, National Energy Software Center,  
9700 South Cass Avenue, Argonne, IL 60439

**Questions Or Comments About DOE-2 Or The User News, Write:**

Kathy Ellington, Simulation Research Group, 90-3147,  
Lawrence Berkeley Laboratory, Berkeley, CA 94720

\* For delivery to addresses outside the United States, please double the price of the documentation.

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Argonne, IL 60439  
U.S.A.

**For Reference**

**Not to be taken from this room**

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