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DOE-2: A COMPUTER PROGRAM FOR BUILDING ENERGY SIMULATION

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* * * HANDS ON * * *

☞ **Bugged by 2.1C??** — To date, 56 bugs in 2.1C have been fixed. If you would like to "trade-in" your old 2.1C tape for our bug-free version, please call Kathy Ellington (415-486-5711) for instructions.

☞ **Newsletter Distribution** — Starting with this issue, the USER NEWS will be distributed by the National Energy Software Center at Argonne, IL. The USER NEWS will continue to be written and printed by the Simulation Research Group, and questions or comments should still be directed to the group at LBL. Subscription cost of the USER NEWS is being negotiated and subscribers will be notified of any changes. If you want subscription information, either contact Kathy Ellington or write to Margaret Butler, NESC, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439.

☞ **Skylight Handbook** — The American Architectural Manufacturers Association (AAMA), has published a new design guidelines manual to help the architect or builder use skylights to the maximum advantage in commercial buildings. Based on technical research conducted by the LBL Windows and Daylighting Group under AAMA sponsorship, the 120-page manual is a comprehensive publication on skylights and daylighting. The results on the energy impacts of skylights are based on extensive parametric analysis using DOE-2 daylighting simulation. The *Skylight Design Guidelines Handbook* describes the opportunities for energy savings and good lighting design offered by skylights. It explains how to integrate skylights with other building elements and shows how to estimate the energy and dollar savings possible. Finally, it can help the designer avoid mistakes that could reduce the value of the skylighting design. Price for the *Skylight Design Guidelines Handbook* is $37.50; order from AAMA, 2700 River Road, Des Plaines, IL 60018 — phone (312) 699-7310.

☞ **DOE-2 Course at U.C. Berkeley** — It's not too soon to start making plans to attend the 1988 DOE-2 course, scheduled for late summer at the University of California, Berkeley. It will be sponsored by the U.C. Berkeley Engineering Extension Office. Write to Dick Tsina or Karen Anderson, U.C. Extension Office, 2223 Fulton St., Berkeley, CA 94720 and request enrollment information and course literature.

■ ■ ■ THE HEAT EXCHANGER ■ ■ ■

by

Bruce Birdsall

Question: Is there any way to model the Variable Air Variable Temperature (VVT) system using DOE-2.1C?

Answer: This system is fairly new to the industry and is not one of the system types described in the DOE-2 Reference Manual. One can only approach the action of this system and its response to space heating and cooling loads. Using VAVS as the system type, we recommend the following inputs:

At the Zone Level:

THERMOSTAT-TYPE=REVERSE-ACTION

MIN-CFM-RATIO=0.2

At the System Level:

SUPPLY-STATIC=3.0

SUPPLY-EFF=0.51

SYSTEM-TYPE=VAVS

HEAT-SET-T=75

COOL-CONTROL=WARMEST

FAN-CONTROL=DISCHARGE

OA-CONTROL=TEMP

ECONO-LIMIT-T=65

MAX-SUPPLY-T=105

MIN-SUPPLY-T=55

MIN-FAN-RATIO=0.8 (to simulate minimum airflow bypass damper operation)

ZONE-NAMES (group like zones into a common system)

RETURN-AIR-PATH=DUCT

REHEAT-DELTA-T=50

SIZING-OPTION=NON-COINCIDENT

These inputs give you a system where the supply air temperature is set upward to 75°F to satisfy the "warmest" zone. The fan operates at constant load using a bypass, even though the air delivered to the space is variable volume. The system does not switch to heating using a central air handling unit coil, but if the zones assigned to the system have similar requirements, the difference in energy between heating at the terminal versus at the air handling unit should be negligible.

NEW DOE-2 BUGS, INTERIM SOLUTIONS, AND FIXES

Following are new bugs discovered in the 2.1C version of the program; users are urged to document suspected bugs, and report them to us. Each bug is described and a temporary (no code change) solution is listed along with the date the permanent correction was moved to our 2.1C release files. If you received a tape sent by us after the date given in the bug description, then the bug fix is already on your tape in one of the "mod" files. In any case, before you fix a bug, make sure it has not already been corrected on your DOE-2.1C tape. All users who received DOE-2.1C tapes prior to April 4, 1986, should read the descriptions of bugs D-29 and D-30 (see back issues of the USER NEWS), and fix these bugs or avoid them.

The bug fixes listed below are in the form of UPDATE modification directives. Corrections are independent of each other (they do not interact); therefore, you can fix only those bugs you consider important. All the bugs for one program element are together; i.e., all the corrections to BDL are under the heading "FILE BDL.BUG". Lines beginning with */ are UPDATE comment lines.

Questions or comments should be directed (in writing) to Fred Buhl, Simulation Research Group, 90-3147, Lawrence Berkeley Laboratory, Berkeley, Ca 94720.

Bug D-52

In PIU systems when NIGHT-CYCLE-CTRL=ZONE-FANS-ONLY, the system fans were actually cycling on; that is, it was acting like NIGHT-CYCLE-CTRL=CYCLE-ON-ANY.

Interim solution: none.

Date moved to the release file: February 5, 1988 — Fix is in file: sys.bug

```
*/
*/ THIS FIXES BUG D-52
*/
*/ FOR PIU SYSTEMS, WHEN NIGHT-CYCLE-CTRL=ZONE-FAN-ONLY,
*/ THE SYSTEM FANS WOULD CYCLE ON
*/ (I.E., NIGHT-CYCLE-CTRL=CYCLE-ON-ANY).
*/
*I DAYCLS.187
      IF (<NIGHT-CYCLE-CTRL> .EQ. 3)  GO TO 52
*D PIU.37,39
*I PIU.57
C                SET ZONE FAN FLAG
      ZFONLY = 0.
      IF (<NIGHT-CYCLE-CTRL> .EQ. 3)  ZFONLY = 1.
----+----1----+----2----+----3----+----4----+----5----+----6
```

Bug D-53

In PIU systems, for TERMINAL-TYPE=SERIES, the electricity consumption of the zone fans was not accounted for.

Interim solution: none.

Date moved to the release file: February 5, 1988 — Fix is in file: sys.bug

```
*/
*/ THIS FIXES BUG D-53
*/
*/ FOR PIU SYSTEMS, TERMINAL-TYPE=SERIES, THE KW
*/ FOR THE ZONE FANS WAS NOT ADDED IN TO THE
*/ ELECTRICAL CONSUMPTION, DUE TO <ZFONF> (ZONE
*/ FAN ON FRACTION) WAS NEVER SET.
*/
*I PIU.395
      IF ((<TERMINAL-TYPE> .EQ. 3) .AND. (FON .GT. 0))
     1 <ZFONF> = 1.
----+----1----+----2----+----3----+----4----+----5----+----6
```

Bug D-54

On the VAX, when a DAY-SCHEDULE input, but there are no schedules, the program will die in BDL when attempting to write the schedule record of the standard file.

Interim solution: none.

Date moved to the release file: December 8, 1987 — Fix is on file: bdl.bug

```
*/
*/ THIS FIXES BUG D-54.
*/
*/ BUG IN SCEDO VAX VERSION.  IF ANY DAY-SCHEDULE,
*/ BUT NO SCHEDULE INPUT, SCEDO CALLS WRITTEN WITH
*/ LENY=0 WHICH GETS ADJUSTABLE ARRAY DIMENSION ERROR
*I SCEDO.150
      IF ( LENY .LT. 1 )     LENY = 1
----+----1----+----2----+----3----+----4----+----5----+----6
```

Bug D-55

All the special error messages for the zone command in SYSTEMS would come out incorrectly or not at all. These messages have to do with the PIU system (lack of an INDUCED-AIR-ZONE) and with refrigeration equipment.

Interim solution: none

Date moved to the release file: February 8, 1988 — Fix is on file: bdl.bug

```
*/
*/ THIS FIXES BUG D-55
```

```
*/
*/ THE KEYWORD POINTERS (FOR ERROR MESSAGES) FOR
*/ THE ZONE COMMAND IN SYSTEMS WERE OFF BY 1
*/ POSITION, CAUSING INCORRECT ERROR MESSAGES TO
*/ BE PRINTED.  THESE MESSAGES HAVE TO DO WITH
*/ PIU SYSTEMS AND WITH REFRIGERATION EQUIPMENT.
*/
*D DATSDL.126,127
      DATA IKIAZ/63/,IKTT/61/,IKRZB/65/,IKRDT/67/,IKRET/68/,
     1     IKRZDT/71/,IKRAK/73/,IKRDE/76/,IKRDM/75/
----+----1----+----2----+----3----+----4----+----5----+----6
```

Bug D-56

When dehumidification is required (by specifying a MAX-HUMIDITY) there would be a rarely occurring divide by zero error in SYSTEMS. The known example occurred in a packaged single zone system, but the error could probably occur in any system.

Interim solution: Change the specified MAX-HUMIDITY value slightly.

Date moved to the release file: February 9, 1988 — Fix is on file: sys.bug

```
*/
*/ THIS FIXES BUG D-56
*/
*/ DEHUMIDIFICATION (USING MAX-HUMIDITY) CAN
*/ INFREQUENTLY CAUSE A 0/0 ABORT IN SDSF IN SYSTEMS.
*/
*D SDSF.263
      DTHUM = ((WCOIL-WCOL)/AMAX1(WCOIL-WCOLM,1.E-6))
     1 *(TC-TDM)
*D SDSF.271
      DTSUP = (TR-DTP) - (TC+<DUCT-DELTA-T>)
*D SDSF.274
      CFMC = CFM*AMAX1(0.,AMIN1(PCM,DTSUP/AMAX1
     1 (DTSUP+DTHUM, 1.E-6)))
----+----1----+----2----+----3----+----4----+----5----+----6
```

Bug D-?

This isn't **really** a bug, but you should take note of it (mods to Plant):

```
*/
*/ FIX SYNTAX ERROR IN EQUIVALENCE STATEMENT
*/
*D /NAME/.5,6
     EQUIVALENCE * NAMQ(1,1),NAMES(1)),(NAMEQ(1,1),NAMES(301)
     .      ,(NAMUT(1,1),NAMES(421))
----+----1----+----2----+----3----+----4----+----5----+----6
```

INPUT OUTPUT

Question: We are long-time users of DOE-2 and there are a number of features we would like to see incorporated into the program. Are you amenable to suggestions?

Answer: Yes, we welcome suggestions for adding features to DOE-2; you should write us at the address on page 1 of the User News. However, the addition of new features in DOE-2 depends directly on our level of funding. Users should realize that DOE-2 funding is tight right now, and has been steadily decreasing, along with the rest of the energy conservation budget, under the present federal administration. Our current effort level is about 1.5 person equivalent per year, which covers limited user assistance, bug fixes, new development, testing, documentation, and the User News. So, if we feel that your suggestions for improving DOE-2 are useful and can be implemented without an unreasonable expenditure of time or money, there is a good chance of incorporating them into the program. Something else to bear in mind is that while adding new features makes the program more useful, it may also make the program harder to use and could complicate the documentation. We have to try very hard to satisfy a broad spectrum of users, ranging from novices who want the program to be quick to learn and easy to use, to experts who demand flexibility, sophistication, precision, and comprehensiveness. Be assured, however, that we carefully consider every suggestion for improvements to DOE-2.

Question: I am an expert user of DOE-2 and want to be able to modify it to meet my particular needs. Is there an easy way to do this?

Answer: We have been moving toward allowing direct user modification of the program via a procedure we call *functional input* or *functions.* DOE-2.1C, for example, permits the user to enter FORTRAN-like functions in BDL that replace or enhance standard LOADS program calculations. (See the DOE-2 Supplement, Version 2.1C, pp. 1-1 to 1-11.) Basically, this means you can change LOADS without recompiling the program. However, it does require knowledge of program flow, so this feature is intended only for advanced users. A similar capability for SYSTEMS is planned for DOE-2.1D, due for release this year.

Question: Our company uses both DOE-2.1B and 2.1C; we have difficulty in getting user assistance on 2.1B from your group. Why?

Answer: LBL can only support the current version of DOE-2. Right now, this is DOE-2.1C. We don't have the manpower to fix bugs in DOE-2.1B or earlier versions. Also, many 2.1B bug fixes have been incorporated in DOE-2.1C. So, our recommendation is that you only use the most current version of the program, 2.1C.

■■■■■ DIRECTORY ■■■■■

DOE-2 Related Software, Services, and Publications

■■ SOFTWARE ■■

DOE-2.1B for Micros (PC-DOE)
Lynda Osborn
Tri-Fund Research Corp.
1050-17th Street #900
Denver, CO 80285
Phone: (303) 595-0610

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

■■ TRAINING ■■

Master Classes, Tutorials, Consulting
Bruce Birdsall
"In Support of Energy Software"
166 Caldecott Lane, Suite 113
Oakland, CA 94618

Classes and Consulting
Richard Kuo
Knowledge Laboratory
362 Ripley Court
Naperville, IL 60565

■■ 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 Supl. (2.1C Update)
DE-850-12581 $ 25.95/each

Order from:
N. T. I. S.
U.S. Dept. of Commerce
5285 Port Royal Road
Springfield, VA 22121
Phone: (703) 487-4650

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