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DOE-2 USER NEWS

A COMPUTER PROGRAM FOR BUILDING ENERGY USE ANALYSIS

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THE CLOUDY CRYSTAL BALL

A large proportion of the calls to the DOE-2 User Coordination Office request advice on how to model an effect that is not explicitly provided for in the DOE-2 program. No matter how many features we have included, the building you are modeling always seems to require a control system or a system configuration that is not present! Often we are able to suggest an approximate approach, but, just as often, the program simply cannot handle the situation appropriately. Many of the new features in each successive edition of the program have been introduced as a response to user demand for the ability to model what could not be modeled in the earlier edition. That process is continuing.

Several modifications of the DOE-2.1 program are being planned to make the program even more useful to the user community. We will make every effort to make these modifications upwardly compatible, i.e., your current input decks will run on the later editions without alteration. Only if you want to take advantage of the new features will you have to make any changes. The list of new features below is not complete nor is it possible at this time to predict exactly which edition of the program will contain them. Our purpose for announcing them now is to allow users to have a chance of influencing their development. We do not promise to adapt the development to everyone's individual taste, but we will try to be responsive to suggestions.

BULLETIN BOARD

- Item: The April 1980 issue of Progressive Architecture marked the beginning of a series of articles by Dr. Vladimir Bazjanac, of the University of California, Berkeley, on the architectural energy analysis of selected buildings using DOE-2.1 in addition to other computer programs. The June, July and October 1980 issues contain continuations of this series.
- Item: For users of DOE-2 on the LBL computer, the revised site manual, Using DOE-2.1 at Lawrence Berkeley Laboratory, is now available. The DOE-2 User Coordination Office has a limited number of copies, which we offer gratis. When our supply runs out, orders for this publication must be made through NTIS, whose address appears on the back page of this issue.
- Item: This office maintains a nation-wide file of computer service bureaus which offer the DOE-2 program and provide consultation on the running of DOE-2. Any independent consultants who wish to be included in our referral files are invited to call or write the DOE-2 User Coordination Office.

- * Monthly component loads reports in LOADS for each zone and for the building as a whole.
- * Expansion of user-created library to include schedules and prepackaged systems and plants.
- * Extension of user-formatted reports from CBS to LOADS, SYSTEMS and PLANT.
- * Modification of LOADS to assess energy credit for natural lighting (daylighting).
- * Addition of passive solar features such as Trombe walls, roof ponds, water walls, solar atriums, night-cycle ventilation, etc.
- * Addition of option to have a cooling tower in direct heat exchange with chilled water.
- * Modification of economic computations to allow various utility rate structures, including time-of-day charges and ratchet pricing and to include cash-flow analysis and tax considerations.

CUSTOM WEIGHTING FACTOR
CAUTION AND ERROR MESSAGES

The following is a guide to the caution and error messages produced by the Custom Weighting Factor generation program. It will be added to the Reference Manual, page III.A.17, preceding the section entitled "c. Creating Custom Weighting Factors from BDLLIB." in the next update to the documentation.

CAUTION MESSAGES

Caution Message (1) INSIDE-FILM-RESISTANCE <input I-F-R> OF DELAYED SURFACE <u-name> IN SPACE <u-name> MUST BE BETWEEN 0.0 AND 1.0. CALCULATION WILL PROCEED USING A VALUE OF 0.68.

Meaning: The inside film resistance (INSIDE-FILM-RES) of a surface is the combined convective plus radiative inside air film resistance. The Custom Weighting Factor program obtains the convective resistance from the user-input value of INSIDE-FILM-RES and a fixed value for the radiative resistance. This convective resistance will be negative, i.e., unphysical, if INSIDE-FILM-RES exceeds $1.0 \text{ ft}^2\text{-hr-}^\circ\text{F/Btu}$. In this case, the above caution message is printed, and the program resets INSIDE-FILM-RES to 0.68, which is typical of horizontal heat flows for vertical walls.

User Action: If 0.68 is acceptable, no action is necessary; otherwise input a value between 0.0 and 1.0. Recommended values are listed in ASHRAE Handbook of Fundamentals, 1977, p.22.11.

Caution Message (2) U-VALUE <input U-VALUE> OF INTERIOR WALL <u-name> IN SPACE <u-name> EXCEEDS 0.709. THIS SPACE WILL NOT BE INCLUDED IN WEIGHTING FACTOR CALCULATION.

Meaning: The Custom Weighting Factor program assumes a combined inside film resistance of $0.68 \text{ ft}^2\text{-hr-}^\circ\text{F/Btu}$ on each side of a quick interior wall. Also, it requires that the surface-to-surface resistance of the wall be greater than $0.05 \text{ ft}^2\text{-hr-}^\circ\text{F/Btu}$. This means that the overall u-value of the wall, including both air films, must be less than $1/(0.68 + 0.05 + 0.68) = .709$.

User Action: A U-VALUE in the 1 - 2 $\text{Btu}/(\text{ft}^2\text{-hr-}^\circ\text{F})$ range is sometimes assigned to an interior wall to account for convective heat transfer through openings in the wall; or the wall may not actually exist, but the user wants to account for convective transfer between zones. In the case of a physical wall, the U-VALUE for the Custom Weighting Factor calculation should be the air-to-air conductance of the surface, even though a larger value may be used in the LOADS input to account for openings in the wall. Also, the wall area in the Custom Weighting Factor input should exclude the area of openings in the wall. In the case of a non-existent interior wall with U-VALUE > .709, it can be removed from the Custom Weighting Factor input or left in. In either case it will be ignored.

Caution Message (3) SPACE <u-name> HAS FURNITURE BUT NO FLOOR SECTIONS. WEIGHTING FACTORS WILL NOT BE CALCULATED FOR THIS SPACE.

Meaning: Furniture has been specified for a space via the FURN-FRACTION, FURNITURE-TYPE, and FURN-WEIGHT keywords. However, none of the surfaces in this space is a floor. Unless a floor is present, the Custom Weighting Factor calculation cannot take the effect of furniture into account in calculating the split of solar radiation between furniture and the part of the floor not covered by furniture.

User Action: Be sure that at least one surface in the space is a floor section. This means that

- (a) for an EXTERIOR-WALL, TILT must be 180° ;
- (b) for an INTERIOR-WALL which is defined in this space, TILT must be 180° ;
- (c) for an INTERIOR-WALL which is defined in another space, but is NEXT-TO this space, TILT must be 0° (i.e., this wall is a ceiling in the space in which it is defined, and therefore is a floor in the adjacent space);
- (d) for an UNDERGROUND-FLOOR or UNDERGROUND-WALL, TILT must be 180° (the default value is 90°).

If SHAPE-BOX is used, the surface with LOCATION=BOTTOM will be a floor section; the surface with LOCATION=TOP will be a floor section in the NEXT-TO space if this surface is an INTERIOR-WALL.

Caution Message (4) SPACE <u-name> HAS WINDOWS, BUT SUM OF SOLAR FRACTIONS IS ZERO. SOLAR FRACTIONS FOR OPAQUE SURFACES WILL BE NORMALIZED TO SURFACE AREA.

Meaning: The user has the option of not specifying any of the SOLAR-FRACTIONS for the surfaces in a space. In this case, the program will assign a SOLAR-FRACTION to each opaque surface equal to the area of the surface divided by the total area of all opaque surfaces. If windows are present, the SOLAR-FRACTIONS so assigned are corrected for the fraction of incoming solar radiation which is reflected back out of the windows. This procedure gives an approximately uniform distribution of absorbed solar radiation.

User Action: No action is required if uniform distribution of absorbed solar radiation is desired. Otherwise specific values of SOLAR-FRACTION should be input for each surface.

Caution Message (5) SUM OF SOLAR FRACTIONS FOR SPACE <u-name> IS <value>. IT SHOULD BE ZERO (FOR AREA NORMALIZATION) OR CLOSE TO 1.0. CHECK INPUT.

Meaning: If SOLAR-FRACTIONS are input for the surfaces of a space, their sum should be close to 1.0. To guard against mis-punches, this caution is printed if the sum is less than 0.9 or greater than 1.1. For example, if SOLAR-FRACTIONS of 0.2, 0.2, 0.02 and 0.4 were entered, the sum would be 0.82 and the caution would be printed. Note that whether or not the sum is in the 0.9 to 1.1 range, the program will adjust the SOLAR-FRACTIONS by dividing by the sum, so the new sum is exactly 1.0.

User Action: Check SOLAR-FRACTION input values.

Caution Message (6) SPACES WERE DEFINED IN THIS RUN BUT NO CUSTOM WEIGHTING FACTOR CALCULATION WAS REQUESTED.

Meaning: Weighting factors will not be calculated for a space unless the WEIGHTING-FACTOR keyword is assigned for the space. This message will appear if none of the spaces in a LIBRARY-INPUT LOADS run has WEIGHTING-FACTOR assigned.

User Action: Assign WEIGHTING-FACTOR = u-name for all spaces for which weighting factors are desired.

ERROR MESSAGES

Error Message (1) SPACE <u-name> HAS LESS THAN TWO OPAQUE SURFACES. WEIGHTING FACTORS CANNOT BE CALCULATED.

Meaning: Radiation exchange cannot be calculated unless at least two opaque surfaces are present.

User Action: This error usually occurs for the perimeter zone of a non-residential building where the only surface described in the Custom Weighting Factor input is an exterior wall. Because heat transfer across interior walls, floor, and ceiling was considered to be unimportant, these surfaces were not input. The result is a space with one opaque surface. The remedy is to include one or all of the originally neglected interior surfaces in the Custom Weighting Factor input, even if these surfaces are not input in LOADS.

Error Message (2) SPACE <u-name> NOW HAS LESS THAN TWO OPAQUE SURFACES; WEIGHTING FACTORS CANNOT BE CALCULATED.

Meaning: This error message may sometimes follow the caution message "U-VALUE <value> OF INTERIOR WALL <u-name> IN SPACE <u-name> EXCEEDS 0.709. THIS WALL WILL NOT BE INCLUDED IN WEIGHTING FACTOR CALCULATION." What has happened is that the original input contained two opaque surfaces, but one of them, an interior wall, had $U > 0.709$, and was therefore dropped by the program. This leaves only one opaque surface, and the calculation cannot proceed (see description of Error Message (1) and Caution Message (2), above).

User Action: Assure that at least one interior wall in the space has $U < 0.709$ Btu/(ft²-hr-F).

Error Message (3) WEIGHTING FACTOR CALCULATION FOR SPACE <u-name>, WEIGHTING FACTOR TYPE <n>, FAILED IN DECONVOLUTION, SUBROUTINE WFDECN.

Meaning: In DOE-2.1, this message indicates that the weighting factors couldn't be calculated because the space had very little thermal mass (e.g. some residential attics) or the space had a surface with zero area. These situations have been avoided in DOE-2.1A by, respectively, doing the calculation with fewer weighting factors for light spaces, and assigning an area of 0.01 ft² to any surface with an input area of zero.

User Action: In DOE-2.1, remove from the input any surface with zero area. If all surfaces have positive area and message occurs, space is probably too light for custom weighting factors to be calculated. In this case, use pre-calculated (ASHRAE) weighting factors by using the FLOOR-WEIGHT keyword in the LOADS input for this space. In DOE-2.1A and subsequent versions of the program, contact the DOE-2 User Coordination Office if this message occurs.

----- P. Winkelmann

WRISC: A COMPUTERIZED SEARCH SERVICE IN ENERGY

The Western Regional Information Service Center (WRISC) at Lawrence Berkeley Laboratory (in conjunction with the National Information Center at Oak Ridge National Laboratory) offers a computerized search service to those interested in energy-related information. About two million bibliographic references from the U.S. Department of Energy RECON Information System energy data bases are accessible through WRISC remote consoles. Two types of service are available: retrospective, and current awareness, with biweekly updates. The user, working together with an information specialist, defines the subject, narrowing or broadening the search by the combination of keywords. User-specified limits, such as type of publication, time-span and/or language can be imposed. The search results in a printed bibliography, with or without abstracts and descriptors, which is forwarded to the user. The DOE-2 User Coordination Office employed this service to produce, in part, the DOE-2 Bibliography found below.

Further information about initiating a retrospective search or subscribing to the biweekly current awareness service is available upon request from:

WRISC
Lawrence Berkeley Laboratory
Building 50, Room 130
Berkeley, CA 94720
(415) 486-6307
PTS 451-6307

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BUGS DISCOVERED IN DOE-2.1 AND INTERIM SOLUTIONS

BDL

- BDL does not make an appropriate substitution when a parameter is set equal to the u-name of a schedule. A misleading error message reading:

<u-name of SCHEDULE> WAS REFERENCED... BUT WAS NEVER DEFINED

is printed. A similar problem does not arise for the u-names of DAY-SCHEDULEs and WEEK-SCHEDULEs.

Interim solution: Do not set a parameter equal to the u-name of a SCHEDULE.

- The command RUN-PERIOD cannot be parameterized. Error messages are produced for month, day and year that advise the user that the values input are incorrect.

Interim solution: None.

- When a command is LIKE'd to itself, the program is supposed to print an error message. It does not. The program will usually abort with a dayfile message,

**SCM BEYOND FLS

This will occur when the sequence <u-name> = command LIKE <u-name> occurs.

Interim solution: Check your input carefully for mistakes of this kind.

- A zero wall area error message prints out with no name and zero for the defined line. This will occur whenever EXTERIOR-WALL is unnamed and the window and door area are equal to or greater than the exterior wall area. The above error message does not provide useful information.

Interim solution: Change the input. Find wall(s) which violate the rule and add a small amount to the area.

- In the MATERIALS section of the library, the materials IN01, IN02, IN03, IN04, IN05, IN11 and IN12 have the wrong density. They are coded as 6.0 lbs/ft³. They should actually be 0.6 lbs/ft³.

Interim solution: Input the above materials in the MATERIAL command with the correct densities.

- LIKEing CONSTRUCTION commands causes an abort in subroutine CONSTI.

Interim solution: Do not LIKE CONSTRUCTION commands.

- In the schedule of U.S holidays, the second Monday in October, Columbus Day, has been omitted.

Interim solution: If desired as a holiday, explicitly input the day in all SCHEDULEs.

WEATHER PROCESSOR

- The EDIT option with the Weather Processor does not work properly when changes are attempted for two different days within the same month. A change is made only for the first day; the second day is left unchanged.

Interim solution: Make two separate EDIT runs, changing one day per month at a time.

WEATHER FILE

- The TRY weather file for Salt Lake City has erroneous data for windspeed and cloud type for the first six months of the year. This is reflected in the weather summary in the Reference Manual.

Interim solution: Do not use the Salt Lake City weather file.

LOADS

- Door loads are not multiplied by the exterior wall multiplier. The infiltration through the door is also not multiplied by the exterior wall multiplier. The portion of the space conductance due to doors and windows does not include the effect of the exterior wall multiplier. This occurs whenever the keyword MULTIPLIER is used in the EXTERIOR-WALL command and the EXTERIOR-WALL has doors or windows. This will affect the extraction rate calculated by SYSTEMS, e.g., Report SS-D.
Interim solution: Use only MULTIPLIER = 1 in EXTERIOR-WALL command.
- TIME ZONE and BUILDING AZIMUTHS are not printed out on the LOADS verification report LV-A.
Interim solution: None.
- Failure to input both SKY-FORM-FACTOR and GROUND-FORM-FACTOR allows the program to substitute -666 for GROUND-FORM-FACTOR, producing absurd solar loads through the roof. This will occur whenever SKY-FORM-FACTOR is specified but GROUND-FORM-FACTOR is not.
Interim solution: Input both SKY-FORM-FACTOR and GROUND-FORM-FACTOR or neither, as the documentation indicates.
- This modification changes the sunup check and adjusts the hour angle calculation for those hourly bins in which sunrise and sunset occur. Previously the hour angle was always calculated at the midpoint of the hourly bin. For bins containing the sunrise or sunset a yes-no decision was made on whether or not the sun was up for the entire bin, and the hour angle of the sun was set to the bin mid-point. This results, for solar calculated in LOADS, in either underestimating or overestimating the solar energy for the day, depending on which decision was made. For the whole year, the effect should average out. For measured solar data, however, the check would always result in throwing solar data away, and thus underestimating the solar gain. The new check sets the sunup flag to yes if the sun is up at any point in the hourly bin. The hour angle is set to a value midway between sunrise or sunset and the bin edge nearest to noon. For calculated solar, the solar energy for the hour is multiplied by the fraction of the hour the sun is up.
Interim solution: None.

SYSTEMS

- In RHFS, VAVS, PVAVS and CBVAV systems with no reheat coils and thermostatically controlled baseboards, the heating capacity of the system is under-estimated. Interim solution: Add reheat coils with REHEAT-DELTA-T chosen to give the same heating capacity as the baseboards.
- The drybulb temperature dependence of the coil bypass factor is incorrectly modeled. The program uses the entering drybulb rather than the outside drybulb.
Interim solution: None.
- The latent load on the system coils is overpredicted when the cfm is very small.
Interim solution: None.
- The return air temperature is calculated incorrectly for the CBVAV system, whenever the zone MULTIPLIER is different from 1.
Interim solution: Do not use MULTIPLIER different from 1 for zones in a CBVAV system.
- The program will abort with a "divide by zero" error in routine DESIGN whenever the calculated SUPPLY CFM for a zone is less than 5 cfm.
Interim solution: Input an ASSIGNED-CFM of 10 cfm for any zone which has peak heating and cooling loads which are both very low.
- The main air handler supply temperature in the TPIU system is set incorrectly, when the terminals are in the cooling mode. The program at present assumes that heating is turned off.
Interim solution: None.
- The average coil surface temperature for packaged DX systems (PSZ, PMZS, PVAVS, RESYS and PTAC) increases, rather than decreases, during compressor cycling (Part-Load-Ratio < MIN-HGB-RATIO).
Interim solution: None. This should not produce a large energy effect.

- The program simulates dehumidification, with its additional energy use, even when the airflow over the cooling coil is zero. This will cause an abort with a "divide by zero" error. This occurs only, and rarely, for dual duct systems.
Interim solution: None. This should not produce a large energy effect.
- There is a slight error in the hourly reported values for the supply and return fan kW, when the cooling coil temperature is depressed for humidity control. The total fan energy is correct. No change is anticipated.
- The MIN-AIR-SCH keyword is not effective for the TPFC and the FPFC systems.
Interim solution: None.
- Multizone RESYS simulation will not work properly.
Interim solution: Model only single zone residential systems.
- In SZCI systems, the induction air temperature calculation does not take into account the zone exhaust. This will underestimate the heating and cooling done by the system, if there is exhaust in the zone.
Interim solution: Do not have zone exhaust with this system type.
- The program will abort with a "divide by zero" error, if it should happen that the wetbulb and drybulb temperatures, entering the coil, are equal. This should be an extremely rare occurrence.
Interim solution: None.
- When using the HP system, the program may abort in routine HTPUMP under the following simultaneous conditions: No outside air, fans on, and cooling scheduled off.
Interim solution: Schedule fans off when cooling is off and on when cooling is on.
- The program will abort in routine DDSF for DDS, MZS or PMZS systems, if there is no outside air, no infiltration and all the air is going through the hot duct.
Interim solution: Schedule at least a small amount of outside air at all times using the keyword MIN-AIR-SCH. E.g.,

ALL-AIR = SCHEDULE THRU DEC 31 (ALL) (1,24) (0.0001) ..

MIN-AIR-SCH = ALL-AIR ..

PLANT

- For an oil furnace, there should be no energy use when the furnace is off. The program, however, uses the keyword FURNACE-AUX to calculate energy consumption of spark ignition systems, even when the furnace is off.
Interim solution: When FURNACE-FUEL=FUEL-OIL is used in the PLANT-PARAMETER command, set FURNACE-AUX=0.
- When the value for INSTALLED-NUMBER in the PLANT-EQUIPMENT command is greater than one, the annual maintenance cost is calculated incorrectly. The program ignores the number of units and calculates the maintenance cost for one unit only.
Interim solution: Specify the keyword MAINTENANCE as the total number of maintenance hours for all units.

DOCUMENTATION UPDATES

BDL Summary

- In the Applicability Tables, pages 23 through 63, all references to the default for BASEBOARD-~~CONTROL SCHEDULE~~ are incorrectly expressed. The default is the codeword OUTDOOR-RESET, not OUTSIDE-RESET. The Reference Manual is also in error; see below.
- On page 52, under the command SYSTEM-EQUIPMENT, the default for the keyword COOLING-CAPACITY should read "Dependent on peak loads", not "No cooling equipment" as now stated. The Reference Manual contains the same error; see below.
- On page 73, under the REFERENCE-COST command, the keyword SIZE-REF should read:

SIZE-REF(S-F)(-;0.0 to 10⁹ Btu/hr)

- It should be pointed out as a footnote in the BDL Summary, page 98, that the program, *and the weather file* uses a 365 day year even for leap years. Therefore, in leap years, the calendar and the program get one day out of step with regard to days of the week after February 29. Thus, when using the perpetual calendar for leap years, remember to shift back one day of the week for dates after February 29.

Users Guide

- On page 10-6, in the third paragraph, the option DIAGNOSTIC LIBRARY is incompletely expressed. The correct syntax is DIAGNOSTIC LIBRARY-CONTENTS.

Sample Run Book

- In the Office Building, Run 10, on page 397, the line numbered 1244 should be deleted. SYSTEM-AIR is not used in this system.

Reference Manual

- In the Table of Contents, Chapter II, BDL, change "6. PARAMETRIC" to "6. PARAMETER."
- On page IV.194, under the command SYSTEM-EQUIPMENT, the default for the keyword COOLING-CAPACITY should read "Dependent on peak loads", not "No cooling equipment" as now stated.
- On page III.101, under the descriptions for VARIABLE-LIST numbers 13 and 14, add at the end of the phrase, "from weather file".
- On page X.B.9, the densities for code-words IN01, IN02, IN03, IN04, IN05, IN11 and IN12 are incorrect. They should all be 0.6, not 6.0. The program is also wrong; see LOADS Bug above.
- On pages IV.51-52, the example inputs for natural ventilation are misleading and erroneous. Starting with the bottom paragraph on page IV.51 and running up to the footnote on page IV.52, the material should read:

To further illustrate, let it be assumed that the occupant arises at 6:00 A.M., goes to work at 8:00 A.M., returns from work at 5:00 P.M., and retires at 10:00 P.M. every day of the year. The DAY-SCHEDULE describing the window management would be:

VENT-DAY = DAY-SCHEDULE (1,6) (0) (7,8) (1) (9,17) (0)
(18,22) (-1) (23,24) (0) ..

The schedule for the year becomes:

VENTING = SCHEDULE THRU DEC 31 (ALL) VENT-DAY ..

Having defined the schedule, the entry under the SYSTEM-AIR command would be:

```
HOME-AIR = SYSTEM-AIR
      .
      .
      .
NATURAL-VENT-SCH = VENTING
      .
      .
      .
```

If the values in VENT-DAY during the sleeping hours were 1's it would imply that the occupant got out of bed, as often as necessary, to open and close the windows, whenever the conditions called for it. Should the user wish to specify "temperature limits" for cooling by natural ventilation, he should specify VENT-TEMP-SCH in the SYSTEM-AIR command. For example, suppose the schedule

```
COOL-DAY = DAY-SCHEDULE (1,8) (78) (9,17) (90) (18,24) (78) ..
MECH-COOL-TEMP = SCHEDULE THRU DEC 31 (ALL) COOL-DAY ..
```

describes the cooling set point of the mechanical system; while the schedule

```
MIN-VENT = DAY-SCHEDULE (1,6) (60) (7,22) (68) (23,24) (60) ..
MIN-VENT-TEMP = SCHEDULE THRU DEC 31 (ALL) MIN-VENT ..
```

describes the minimum below which the windows will be closed. Then under ZONE-CONTROL, the user should specify COOL-TEMP-SCH = MECH-COOL-TEMP, while under SYSTEM-AIR, VENT-TEMP-SCH should be set equal to MIN-VENT-TEMP. The preceding example states the following:

SCHEDULE hours (clock time)	Temperature Range*
1,6 (midnight to 6 A.M.)	78 °F max (provided by mechanical cooling)
7,8 (6 A.M. to 8 A.M.)	78 °F max (provided by mechanical cooling) 68 °F min (provided by occupant operating windows)
9,17 (8 A.M. to 5 P.M.)	90 °F max (provided by mechanical cooling)
18,22 (5 P.M. to 10 P.M.)	78 °F max (provided by mechanical cooling) 68 °F min (provided by occupant operating windows)
23,24 (10 P.M. to midnight)	78 °F max (provided by mechanical cooling)

* In the footnote at the bottom of page IV.52, strike the phrase in last sentence reading "and its associated DAY-SCHEDULE,".

- On the Worksheets for HOURLY-REPORT and REPORT-BLOCK, pages III.98, III.100, IV.102, IV.104, V.101 and V.103, there should be an indication that the U-name is a mandatory entry.
- On page II.25, at the bottom of the page, the last line in Rule 4 for HOURLY-REPORT should be corrected and expanded as follows:

Note that even if DAYLIGHT-SAVINGS = YES, summer hours will not reflect daylight savings time. Therefore, there will be an hour difference between times in LOADS summary reports and hourly reports.

- On page II.22, the list of holidays is incorrect. It should be replaced by the correct list found on page III.26.
- On page III.15 under the heading c. Locating Windows or Doors, add a footnote to the sentence beginning "The user needs to specify X and Y..."

* unless there is no exterior shading, in which case X and Y may be allowed to default to zero.

- On page III.78, in the worksheet for UNDERGROUND-WALL or FLOOR, the input description for SOLAR-FRACTION is incorrect. It does not take a list of 2 fractions; it takes only 1.
- On page IV.80, the description of FURNACE-AUX is incorrect. It should read:

When HEAT-SOURCE=GAS-FURNACE, <FURNACE-AUX> is the energy, expressed in Btu/hr, consumed by the gas pilot light of a gas furnace during the hours when there is no load on the furnace. It is assumed by the program that the pilot light consumption during the hours the furnace is on is included in <FURNACE-HIR-FPLR>.

When HEAT-SOURCE=OIL-FURNACE, <FURNACE-AUX> is related to the energy consumed by the spark ignition and the fuel pumping system during the hours when there is a load on the furnace. The energy consumed is the furnace part-load-ratio times the value of <FURNACE-AUX> in Btu/hr. The program assumes that no energy is consumed when there is no load on the furnace. [NOTE: As indicated in the first PLANT Bug above, the program does not at present make this assumption. Both program and documentation will be corrected in DOE-2.1A.]

- On page IV.49 under MIN-AIR-SCH, in the sentence starting "If EXHAUST-CFM ... " replace the word "cannot" with "should not". In the next sentence, add the word "also" after "should". Delete the last sentence.
- On page IV.106, it would be clearer to state, under VARIABLE-LIST, Number 2: "Latent load at constant temp, excluding infiltration - from LOADS (Btu)."
- On page IV.107, under VARIABLE-LIST Number 29, the codewords "TPPC, FPFC" should read "TPIU, FPIU".
- In the Systems Descriptions Tables 24 through 44, pages IV.134 through IV.211, all references to the default for BASEBOARD-SCHEDULE are incorrectly expressed. The default is the codeword OUTDOOR-RESET, not OUTSIDE-RESET.
- On page IV.183, the keyword HEATING-EIR is missing the hyphen.
- On page V.23 and V.30 the keyword FURNACE-AUX is described incorrectly. Under Furnaces, page V.23, the description should read:

Fuel consumption of pilot light when a gas furnace is not firing.

On page V.30, the description should read:

is the fuel consumption only of a gas furnace pilot-light when the furnace is not firing. (Btu/hr) For an oil furnace, there is no energy consumption when the furnace is off. Therefore, the keyword ELEC-INPUT-RATIO should include both the electrical energy used by the pumps and the ignition systems of an oil furnace.

Also, on page V.44, under FURNACE-HIR-FPLR, the last line of the paragraph should read:

furnace (including the pilot light) as a function of part-load ratio.

- On page V.42, Table V.6, the default values for the five ABSORS keywords are incorrect. They are all zero (0.00000). Also, the u-names for ABSORS-CAP-FT, ABSORS-HIR-PPLR and ABSORS-HIR-FT are wrong. The correct u-names are ACAPT4, HIRPLR4 and HIRFT4, respectively. The footnote should be changed to read:

Appropriate default curves for the ABSORS chiller are not known. Unless the user can supply appropriate data, the user is advised to use ABSOR1 for solar absorption cooling.

- On page V.43, Table V.6, the default values for the cooling tower keywords are incorrect. They should read:

TWR-RFACT-PRT	1.484326	.129479	-.004014	-.054336	.000312	-.000147
TWR-RFACT-FAT	.895328	-.116550	.001917	-.001040	-.000026	.000398
TWR-APP-FRFACT	4.981467	-6.761789	24.709033	.114499	-.000612	-.250651
TWR-FAN-ELEC-FTU	-395.140000	90.990000	-.016000	0.00000	0.00000	0.00000

- On page V.93 and V.94, the units for keyword SIZE-REF are incorrectly expressed. The units should be Btu/hr, not MBtu/hr. Therefore, on page V.93, in the example input, the value for SIZE-REF should read "750000".

In the Worksheet, page V.94, the entry should read:

SIZE-REF S-F = _____ Btu/hr - 0. 10⁹

Note: Some confusion exists about the definition of the curves, FURNACE-HIR-FPLR, HW-BOILER-HIR-FPLR, etc. The confusion arises since at full load, the HIR are inverses of full load efficiencies, whereas the curves above are not simply proportional to the inverse of the efficiency at part load. The relationship between XXX-HIR-FPLR and the efficiency is given by:

$$\langle \text{XXX-HIR-FPLR} \rangle = (\text{PLR}) * \text{EFF}(\text{at full load}) / \text{EFF}(\text{PLR}),$$

and the fuel consumed at part load is:

$$\text{Fuel-used} = \langle \text{XXX-HIR-FPLR} \rangle * \langle \text{XXX-HIR} \rangle * \langle \text{HEATING-CAPACITY} \rangle.$$

THE HEAT EXCHANGER

This section is devoted to common questions from users and responses from the DOE-2 User Coordination Office. Your questions and comments are most welcome.

* * * * *

Question: The default value for RECOVERY-EFF in the SYSTEM-FANS command is given as 0.0, while the minimum and maximum range is given as from 0.2 to 0.8. How can this be?

Answer: The program interprets the value 0.0 for many keywords as meaning that the device described by that keyword does not exist. When a heat exchanger does exist to recover heat from the return air, the effectiveness of that heat exchanger is limited to be in the range from 0.2 to 0.8.

* * * * *

Question: Does describing the capacities (heating and cooling) in the SYSTEM command for PTAC systems simulate individual units in each zone with those capacities, or do those capacities represent the total capacities of all the individual units in the system?

Answer: The capacities in all zonal systems (of which PTAC is one) can be described in the SYSTEM command or in the ZONE command. If described in the SYSTEM command, each zone in the system is assumed to have those same capacities unless for a particular zone those capacities are overridden by capacities entered in the ZONE command.

A footnote to this effect will be added to the Reference Manual, page IV.35, under the discussion of the "zonal systems".

* * * * *

Question: I would like to use steam for the source of heat to my preheat and my reheat coils. How do I model that?

Answer: The code-words HOT-WATER and HOT-WATER/SOLAR for PREHEAT-SOURCE and REHEAT-SOURCE mean merely that the heating load is passed to PLANT to be satisfied. How it is satisfied in PLANT depends upon the equipment, defined in PLANT. If you want steam heat, then you will need to input in PLANT some device like STM-BOILER or GAS-TURBINE or assign the load to a steam utility.

* * * * *

Question: When no RETURN-CFM is entered, the program supposedly calculates that number by subtracting exhaust and the outside air from the supply air quantity. In one case, however, I found that a RETURN FAN KW of 0.0 was reported in the SV-A report, when no RETURN-CFM was entered and the program's calculation should not have been zero.

Answer: Unless the entire supply air is exhausted, there will always be a return air flow, whether or not there is a return fan. The presence of a return air fan is made known to the program by entering a non-zero value for RETURN-KW or both RETURN-STATIC and RETURN-EFF.

* * * * *

Question: How do I model the scheduling of the supply air temperature for a two-pipe induction unit?

Answer: For this system, and indeed for any system where COOL-CONTROL is an allowable keyword, the cooling coil temperature may be scheduled either through setting COOL-CONTROL = RESET and providing a COOL-RESET-SCH or through setting COOL-CONTROL = SCHEDULED and providing a COOL-SET-SCH. For the TPIU system, when the terminals are in the heating mode (INDUC-MODE-SCH < 0), the main supply is reset to MIN-SUPPLY-T.

* * * * *

Question: How do I model a thermostat in the return air duct?

Answer: If the only thermostat regulating the temperature for a set of zones is located in the return air duct from these zones, all of these zones should be modeled as a single zone in DOE-2.

* * * * *

Question: What happens when I forget to input a schedule in LOADS for a schedulable item? Is the schedule always zero or always one? For instance, SOURCE-BTU/HR; if no SOURCE-SCHEDULE is input, what happens? Why is there no information in the Reference Manual or a message from the program?

Answer: For internal loads in a space, specified in the SPACE or SPACE-CONDITIONS commands, the general rule is that the schedule will be zero for all 24 hours of the day. Thus, neglecting to input SOURCE-SCHEDULE will mean no heat from SOURCE-BTU/HR will be put into the space. The exception to the rule is infiltration. If INF-SCHEDULE is not input, but AIR-CHANGES/HR is, the schedule value will be 1.0 for all hours, and the user will get the full AIR-CHANGES/HR for all 24 hours. The general rule also holds for all of the items in the BUILDING-RESOURCE command. In the WINDOW command, the schedules SHADING-SCHEDULE and CONDUCT-SCHEDULE are assumed to be 1.0 if not input.

The Reference Manual does not discuss this problem. The program issues no message if a schedule is missing. Changes will be made to the Reference Manual to document this. We will consider adding messages to BDL.

* * * * *

The DOE-2 User Coordination Office encourages user response to this section. Please send questions and comments to:

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APOLOGIA

The Editor wishes to apologize for two erroneous statements in the maiden issue of this publication. The first occurred on page 1, in the announcement of the availability of the DOE-2.1 program and documentation. It stated that the Reference Manual was published in two volumes, Volumes 3 and 4. In fact, it is one volume, Volume 3, in two parts.

The second erratum, on page 2, concerns the date for the next scheduled update of the program (DOE-2.1A). It is planned for sometime in early 1981, not November of this year.

In addition, the reader will notice that on page 20, in the input for PLANT-EQUIPMENT, the keyword ELEC-STM-BOILER is misspelled.

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