# DOE-2 USER NEWS PUB-439

*DOE-2: A COMPUTER PROGRAM FOR BUILDING ENERGY SIMULATION*

Volume 7, No. 1
Spring 1986

**Published By The:**

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

Editor: *Kathy Ellington*

*Table of Contents*



## * * * HANDS ON * * *

☞ **Program Tapes** — Please call or write us at LBL for details on how to obtain DOE-2.1C (or any other version) of the program.

☞ **By Any Other Name ...** An internal reorganization within the Applied Science Division at LBL has resulted in a change of name for our group. The Building Energy Simulation Group has been renamed the **Simulation Research Group**. The group's scope of work, staff members, address, phone, etc. remain the same.

☞ **DOE-2 Based PC Programs** — In the Summer issue of the USER NEWS we plan to run articles written by developers and users of DOE-2 based programs for personal computers. Included will be an article on PC-DOE, a PC version of the full DOE-2 program. Information on PC-DOE may be obtained from CA Systems International, phone 1-800-231-4007. **Watch This Space!!**

☞ **Problems with the IBM Version of DOE-2.1C?** 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!

☞ **DOE-2 Verification:** A February 1986 report issued by the Los Alamos National Laboratory presents the final results of the DOE-2 Verification Project — Phase I Tasks. Phase I of the project was an analytical and empirical verification of the DOE-2 computer program as a computational unit rather than as subprograms or as separate algorithms. The report (No. LA-10649-MS, authored by S. C. Diamond, C. C. Cappiello, and B. D. Hunn of LANL) addresses verification of DOE-2.1 and DOE-2.1A. As a user service, we plan to print excerpts of the report in future issues of the USER NEWS. Copies of the complete report may be ordered through NTIS; interested users may also write Charlene Cappiello, Los Alamos National Laboratory, Los Alamos, NM 87545 for more information.

☞ **For Your Reference Library** — We would like to make you aware of a journal which we feel consistently publishes articles of interest to the building energy simulation community. *Energy and Buildings* is an international journal of research applied to the built environment. The journal emphasizes articles related to energy efficient building design and operation. Issues contain regular articles, research communications, book reviews, and an

international conference calendar. Special future issues will deal with building simulation models and ventilation in residences. One year subscriptions cost $129.00 and can be obtained by writing to *Energy and Buildings*, Elsevier Sequoia, P.O. Box 851, 1001 Lausanne Switzerland. Sample copies are available through Elsevier in Switzerland or through the journal's Editor in the U.S. (Alan Meier, Editor, *Ener and Buildings*, Bldg. 90H, Lawrence Berkeley Laboratory, Berkeley, California 94720 USA.)

☞ **SYSTEMS Cross Index** — We had planned to print an index to the SYSTEMS portion of the DOE-2.1C version in this issue of the newsletter. Because of space limitations imposed by the printing process, however, we will have to print it in the next newsletter.

* * *

## THE HEAT EXCHANGER

This section is devoted to questions from users and responses from the Building Energy Simulation Group and its consultants. Your questions and comments are most welcome.

**Question:** **I notice that DOE-2.1C runs about 60% slower than DOE-2.1B, which rather surprises me. There must be a good explanation for this, but at present the same input deck run under both DOE-2.1B and DOE-2.1C give very similar results but have significantly different CPU times. I would like to have any comments on this that your group may have to offer.**

Answer: The primary reason for the slowdown is due to code added to the wall loop in LOAD This code improves the calculation of diffuse radiation from the sky, when the user does not input a SKY-FORM-FACTOR for the wall. The code resides in the FORTRAN function SUN5. The modification given below speeds up the calculation, and is included in any DOE-2.1C tapes sent out by us after December 20, 1985.

```
*/
*/ SPEED UP SUN5 (FCW 12-20-85)
*/
*D SUN3.82
      C(J)=SUN5(WT,SWT,GAMMA,J,I)
*D SUN5.2
      FUNCTION SUN5(T,ST,CT,I,J)
*D SUN5.40,42
C                THE FOLLOWING IS A1+A2*SIN(T)+A3*COS(T)+A4*SIN(2T)+
C                A5*COS(2T)+A6*SIN(3T) REWRITTEN FOR SPEED USING
C                SIN(2T)=2*SIN(T)*COS(T), COS(2T)=1-2*SIN(T)**2, AND
C                SIN(3T)=3*SIN(T)-4*SIN(T)**3
   20 SUN5=AC(1,I,J) + AC(5,I,J) + AC(3,I,J)*CT + ST*(AC(2,I,J) +
     & 3.*AC(6,I,J) + 2.*(AC(4,I,J)*CT-ST*(AC(5,I,J)+2.*AC(6,I,J)*ST)))

----+----1----+----2----+----3----+----4----+----5----+----6----+----7-
```

*[The following article was presented at the Building Energy Simulation Conference, August 20-22, 1985, in Seattle, WA. It is being printed here because we feel that the contents will be of interest to a large number of readers. If you have read (or written!) an article you would like to share with other DOE-2 users, please send it to us.]*

# DISCOVERING THE UNEXPECTED THROUGH THE USE OF THE DOE-2.1 BUILDING ENERGY SIMULATION PROGRAM

by

Mark R. Davenport
Heery Energy Consultants, Inc.
Atlanta, GA 30367

Ling-Sung Wong
Jones Nall Davis, Inc.
Atlanta, GA 30303

## ABSTRACT

Only through use of mainframe building energy simulation programs can some opportunities for reductions in energy and construction cost be uncovered. Case studies showing how surprising results from DOE-2.1B simulations led to the discovery and subsequent implementation of "non-standard practice" design strategies in two different large commercial building projects are presented. One project is a 250,000 sq.ft. speculative office building in Orlando, Florida, and the other is a 300,000 sq.ft. corporate office building in Atlanta, Georgia.

## INTRODUCTION

Despite the great potential that mainframe building energy simulation programs hold for optimizing building energy use, it is often difficult for designers and clients alike to justify the extra time and expense that their use entails. Some of the most compelling arguments for more widespread use of these programs in the design process come to light in applications where they have enabled the discovery of cost savings opportunities which depart from accepted design practice.

Following are case studies of two commercial office projects where results of DOE-2.1B simulations uncovered opportunities for reducing construction expenditures by eliminating planned energy efficiency measures which were mistaken as being cost-effective. Specific benefits accruing to the building owners and others involved in these projects are also discussed under the Conclusions section of the paper.

### Case Study No. 1: Landmark Center, Orlando

Landmark Center in Orlando, Florida, is a six-story, 250,000 sq.ft. atrium office building developed as a joint venture of Capital Holding Company and the Landmarks Group. Heery Energy Consultants, Inc. was engaged by the client, the developer, in the latter stages of the Construction Documents Phase to identify and analyze potential energy cost reduction measures. The building, as of the end of Design Development represented what was considered good, energy cost-efficient design for speculative office buildings in the Orlando area.

**Analysis of Single vs. Double Glazing—** A DOE-2.1B simulation model was developed based on construction drawings and projected occupancies and other operational data provided by the developer. From a review of energy end use figures in the DOE-2.1B BEPS report, it was found that energy use in the base building design was dominated by year-round cooling and connected lighting loads. Together, these two constituted 65% of annual building energy consumption. Heating energy was the smallest energy use component at 13% of total annual consumption.

Because estimated heating loads were so low for this building, single glazing was identified as a possible alternative. It was hypothesized that if a glazing with a shading coefficient equal to or less than that of the specified double glazed units was used, heating energy use would rise substantially, but cooling energy use would remain approximately the same. Any resulting energy cost penalty could then be compared against the sizeable $41,000.00 savings in construction material costs that would be available by substituting single glazing for double glazing. Analysis of base case energy use also revealed high electric demand in the milder winter months. This reflected interaction between chiller, cooling tower, supply fans and electric reheat coils. Air cooled by chilled water, from either the chiller or cooling tower strainer cycle, was reheated by electric reheat coils in perimeter VAV boxes to meet the building's minimum cooling load and heating load. In addition, fan energy use suffered because supply fans had to move more air than was required for cooling under low load conditions. From these observations, it became apparent that a secondary air distribution system, using fan-powered induction boxes, would minimize reheating of previously cooled air at the building perimeter and thus reduce fan energy consumption during heating periods.

Because they would be able to "track" perimeter heating load (i.e. modulate cooled supply air quantities to zero) more closely than VAV reheat terminal units, the fan-powered induction units were selected for the simulation comparison of single glazing versus double glazing. This strategy would minimize the heating penalty incurred by the single glazing

Simulations were conducted for the base glazing, 1" Solarcool Gray (U=0.55/0.57, SC=0.33) to 1/4" TS-20 (U=0.94/0.96, SC=0.30). Both simulations assumed perimeter air distribution through fan-powered induction units.

**Analysis Results**— When applied to the Florida Power & Light commercial electric rate schedule, DOE-2.1B simulation results indicated an annual energy cost savings of $1,950.00, attributable to the single glazing strategy. Peak electric billing demand for the highest month was reduced 21 kW, and total consumption was reduced by 42,000 kWh. A more in-depth review of DOE-2.1B report output was undertaken to determine what different energy use characteristics of the single glazing design led to the savings.

In reviewing the DOE-2.1B Monthly Peak and Total Energy Use Report, it was discovered that the building summer electric peak had shifted from early morning to the afternoon. Apparently, the single glazing reduced the morning pull-down cooling load by allowing building internal heat to escape more readily during the night. Additionally, the BEPS report indicated that although heating energy nearly doubled, cooling energy was reduced by a comparable amount. Some of this reduction, though, was attributed to the single glazing's slightly lower shading coefficient. Based on simulation results, the owner elected to use single glazing in lieu of the originally specified double glazing. By making this substitution, the developer was able to offset much of the additional cost of the more efficient fan-powered induction units with the first cost savings on the glazing system.

### Case Study No. 2: Life of Georgia Home Office

The Life of Georgia Home Office is a new, 300,000 sq.ft. corporate headquarters project located in suburban Atlanta, Georgia. The building is scheduled for occupancy in September, 1985. Energy consulting and analysis services were provided by Heery Energy Consultants to the client, the Life Insurance Company of Georgia, from the Predesign Phase through Construction Documents. A major goal for the project was to achieve the most cost-effective level of energy use, with a minimum 25% Internal Rate of Return as the economic selection criteria for energy conservation measures.

**Analysis of Waterside Economizer Cycle**— Trade-off studies of a number of energy-related alternatives for architectural, mechanical, and electrical systems were conducted throughout design. One such study, conducted during Design Development, was intended to measure any additional energy cost savings that an airside economizer cycle might offer over the base condition of a waterside economizer cycle for providing "free cooling". If the savings were significant, then an argument might be made for moving the fan rooms from the center of the building to the building perimeter, where access to 100% outside air would not require large vertical shafts or horizontal duct runs.

Simulations calculated a $3,700.00 annual savings for the airside economizer over the waterside economizer; this was less than anticipated. Knowing that an airside economizer was generally more effective than a waterside economizer, attention turned to investigating whether a waterside economizer was itself economically justified as a base design feature.

A waterside economizer cycle is far more common than an airside economizer in Atlanta area office projects with chilled water systems. Depending on engineering preferences, either a direct or indirect economizer cycle may be used. A direct economizer cycle provides direct distribution of condenser water to cooling coils whenever the economizer cycle is activated. In this mode, condenser water is typically filtered to remove corrosive and biological elements picked up in the open cooling tower. An indirect system employs a flat plate heat exchanger to transfer heat between condenser and chilled water flow — a more certain method of reducing the possibility of system corrosion and contamination.

The base mechanical system design for the Life of Georgia project included an indirect waterside economizer cycle. The DOE-2.1B program, however, can only simulate a direct waterside economizer, or "strainer cycle" in DOE-2.1B terminology. An indirect waterside economizer cycle will incur a savings penalty in the range of 10% to 20%, depending on the heat exchanger's performance, or "approach". Therefore, it was acknowledged that the savings predicted via the DOE-2.1B computation would be optimistic when applied to the Life of Georgia's indirect waterside economizer.

With a waterside economizer, the savings obtainable are directly proportional to the number of hours during which a waterside economizer can operate. The number of hours, in turn, is a function of the chilled water temperature required to cool and de-humidify the building. A chilled water temperature at the air handling units of 55° was selected for cooling purposes during simulated operation of the waterside economizer. Two-speed cooling tower fans were also assumed.

**Analysis Results**— Energy cost savings predicted by the DOE-2.1B computer simulation with waterside economizer were only $690.00,due to 17,200 ton-hours of chiller operation avoided. Several factors were found to contribute to this surprising result. First, much of the electrical savings from the offset chiller operation were consumed by additional operation of the cooling tower fans to produce the colder water leaving the cooling tower.

The very efficient (0.60 Kw/ton) centrifugal chillers assumed in the simulations were also partially responsible for the diminished dollar savings of the waterside economizer. In the scenario of no waterside economizer, when outdoor temperatures were suitable for economizer operation, the 300 ton base-loaded chiller operated at high part-loads. Thus, the efficiency of the one chiller during the 17,200 ton-hours avoided by the economizer cycle was extremely high, and corresponding energy use relatively low. Finally, the use of the waterside economizer did not affect peak electric billing demand — a significant component of the total electric bill under Georgia Power Company's commercial rate structure.

Given the above results, the waterside economizer cycle was deleted from the mechanical system design for the Life of Georgia Home Office. It should be noted that although the airside economizer cycle yielded much greater energy cost savings than the waterside economizer, fan room access to 100% outside air proved too costly to implement architecturally.

## CONCLUSIONS

The foregoing case studies discuss the discovery and subsequent implementation of design strategies which countered local standard architectural and engineering practice. Without the use of the DOE-2.1B or similar large energy simulation program, it is doubtful that the "discoveries" would have been made. As a result, individuals and firms which were involved in the two projects, as well as the owners, have benefitted in several important ways.

First, performing DOE-2.1B energy simulations has increased the individual users' level of understanding of building energy performance, helped them to better identify potential cost saving measures, and improved their ability to effect a truly integrative approach to energy conservative design. Even on projects where DOE-2.1B simulations have not been part of the scope, DOE-2.1B simulation experience has enabled program users to achieve higher quality results. In this light, DOE-2 has been very much a tool for individual education and professional advancement.

The skills gained by the individuals involved in the example projects, and the success of these projects, have served to enhance the reputation of the firms where they work. These firms have also been successful in using the "discoveries" described in this paper as marketing devices to gain further commissions.

The owners of the above projects benefitted from their consultants' use of DOE-2.1B by being able to re-allocate the budget for two marginally effective conservation techniques (double glazing and waterside economizer) to other measures which proved to be more cost-effective. This more prudent use of capital, and the associated reduction in building operating expenses, have also served to enhance the owners' images in the local marketplace.

Others have also benefitted as a result of the more cost-effective building designs discussed above. For example, the misapplication of conservation techniques and lost opportunities for effective cost-saving measures on previous projects had cost the developer/owner (Case Study No. 1) thousands of dollars every year. Most of these costs were passed directly through to the developer's tenants. Through the refinement of energy efficient building designs, enabled in part by DOE-2.1B, tenants in this developer's buildings have enjoyed pass-through energy costs lower than those of similar office buildings in the area.

## ACKNOWLEDGEMENTS

The work described in this paper was performed under contract with The Landmarks Group and the Life Insurance Company of Georgia.

*[NOTE: This paper is based upon work performed while both authors were employed by Heery Energy Consultants, Inc.]*

## ☞ ☞ ☞ Documentation Update ☜ ☜ ☜

These are documentation corrections to the DOE-2 Engineers Manual.

Page III.24 [Line No. 1, Top of the page]

RAYCOS(2) = [cos(HORANG) cos(DECLN) sin(STALAT)

[change the the line so that it now reads:]

RAYCOS(2) = -[cos(HORANG) cos(DECLN) sin(STALAT)

Page III.27 Table III.1 SOLAR SEASONAL VARIABLES — Please make a note that the values in the table are for the 21st of each month.

Page III.27 Two of the values in Table III.2 need to be changed. The value -0.00527 should be 0.00527 (positive); the value of 0.0344 should be -.0344 (negative). The corrected Table III.2 is shown below:

TABLE III.2

FOURIER COEFFICIENTS FOR THE SOLAR SEASONAL VARIABLES

| | $A_0$ | $A_1$ | $A_2$ | $A_3$ | $B_1$ | $B_2$ | $B_3$ |
|---|---|---|---|---|---|---|---|
| tan(DECLN) | .00527 | -.4001 | -.003996 | -.00424 | .0672 | 0. | 0. |
| EQTIME | $.69610^{-4}$ | .00706 | -.0533 | -.00157 | -.122 | -.156 | -.00556 |
| SOLCON | 368.44 | 24.52 | -1.14 | -1.09 | .58 | -.18 | .28 |
| ATMEXT | .1717 | -.0344 | .0032 | .0024 | -.0043 | 0.0 | -.0008 |
| SKYDFF | .0905 | -.0410 | .0073 | .0015 | -.0034 | .0004 | -.0006 |

Page III.31 Table III.3 (last column) has been changed. The corrected table reads as follows:

TABLE III.3

COEFFICIENTS FOR CLOUD COVER
FROM CLOUD AMOUNT AND CLOUD TYPE
(STRATUS, CIRRUS, AND CIRRO STRATUS CLOUDS)

| ICLDTY→ CLDAMT ↓ | 1,STRATUS <45° | 1,STRATUS >45° | 0,CIRRUS <45° | 0,CIRRUS >45° |
|---|---|---|---|---|
| 1 | .6 | .88 | .84 | 1. |
| 2 | .6 | .88 | .83 | 1. |
| 3 | .58 | .88 | .83 | 1. |
| 4 | .58 | .87 | .82 | 1. |
| 5 | .57 | .85 | .80 | .99 |
| 6 | .53 | .83 | .77 | .98 |
| 7 | .49 | .79 | .74 | .95 |
| 8 | .43 | .73 | .67 | .90 |
| 9 | .35 | .61 | .60 | .87 |
| 10 | .27 | .46 | .49 | .74 |

Page III.31 The final column of TABLE III.4 has been changed. The numbers .00035 and .00059 should be negative. The corrected table reads as follows:

TABLE III.4

COEFFICIENTS FOR CLOUD COVER
FROM CLOUD AMOUNT FOR CLOUD TYPE 2

| ICLDTY | A | B | C | D |
|---|---|---|---|---|
| 1 <45° | .598 | .00026 | .00021 | -.00035 |
| >45° | .908 | -.03214 | .0102 | -.00114 |
| 0 <45° | .849 | -.01277 | .00360 | -.00059 |
| >45° | 1.01 | -.01394 | .00553 | -.00068 |
| 2 <45° | .724 | -.00625 | .00191 | -.00047 |
| >45° | .959 | -.02304 | .00787 | -.00091 |

## BUGS DISCOVERED IN DOE-2.1C, INTERIM SOLUTIONS AND BUG FIXES

As a service to our users, we have decided to print a complete listing of both English and Metric bugs discovered to date in the 2.1C version of the program. Users are urged to document suspected bugs, and report them to us.

We first give a description of each bug, along with its temporary (no code change) solution, and 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.

Following the bug descriptions are the bug corrections in the form of UPDATE modification directives. The 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; that is, all the corrections to BDL are under the heading "FILE BDL.BUG", then all the corrections to the keyword file, etc. Lines beginning with */ are UPDATE comment lines and can be left out.

All users who have received 2.1C versions released before April 4, 1986, should read the descriptions of bugs D-29 and D-30, and fix these bugs or avoid them.

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

### Bug D-1

In the hourly reports the values reported for SUM and AVERAGE summary variables, for temperatures only, will be incorrect if metric units are input and English units output, or vice versa. The conversion between English and metric units is not made correctly when the variable is a sum of temperatures. This bug no longer seems to exist!

Interim solution: None

Date moved to release files:

### Bug D-2

When using window shade management with the MAX-SOLAR-SCH keyword in conjunction with SHADING-COEF (S-C) instead of GLASS-TYPE-CODE, the calculation will be incorrect if the S-C's differ from window to window. Basically S-C was set to GSHACO, not <GSHACO>, resulting in S-C being set to the S-C of the last window in the previous space. For the first space in the building input, S-C would be set to the S-C of the last defined window in the last space in the building. This bug is not a problem if GLASS-TYPE-CODE is used on all windows, since then S-C defaults to 1. This bug was also in 2.1B.

Interim solution: Use GLASS-TYPE-CODE on all windows if MAX-SOLAR-SCH is being used on any window. The fix is in file lds.bug .

Date moved to release file: Before July 1, 1985

### Bug D-3

In the daylighting calculation, windows in exterior walls with SHADING-SURFACE=YES were incorrectly taken to be completely shaded, so that no light from the sky or ground reached entered the windows. Direct light from the sun was not affected. This was a bug in 2.1B also. The fix is in the file lds.bug .

Interim solution: For daylit spaces (DAYLIGHTING=YES), do not use SHADING-SURFACE=YES on exterior walls with windows.

Date moved to release file: 4/10/85

**Bug D-4**

If a sunspace (a SPACE with SUNSPACE=YES) has no interior windows, the solar gain calculation is not functioning correctly. The exterior window pointer is not being set correctly, resulting in incorrect assignment of the solar transfer factors. The fix is in lds.bug .

Interim solution: None.

Date moved to release file: 4/19/85

**Bug D-5**

In a sunspace with more than one exterior window, the pointer to the beginning of the solar transfer factors was incorrectly calculated, resulting in the solar gain calculation being incorrect. The fix is in lds.bug .

Interim solution: None

Date moved to the release file: 4/19.85

**Bug D-6**

If a space has DAYLIGHTING=YES but no LIGHTING-SCHEDULE assigned to it, then the values reported in the LS-G report for AVERAGE and PERCENT ILLUM and GLARE will be incorrect. This is a bug in 2.1B also. The fix is in lds.bug .

Interim solution: Assign a LIGHTING-SCHEDULE to each space with DAYLIGHTING =YES. If the space has no electric lights, specify LIGHTING-KW or LIGHTING-W/SQFT = 0 and use a LIGHTING-SCHEDULE with values of 1.0 for all hours of the run.

Date moved to release file: 4/22/85

**Bug D-7**

For a sunspace with more than one interior wall, the following quantities were incorrectly filled for the second and subsequent interior walls, if these walls are delayed (have response factors): absorbed solar radiation, window conductance, and transmitted solar radiation. The fix is in file sys.bug .

Interim solution: None

Date moved to the release file: Feb., 1985

**Bug D-8**

In the delayed interior wall conduction calculation for sunspaces, there was a sign error in the expression for B1 (+<RFCOMRATIO> instead of -) and the previous-hour rather than the current-hour outside surface temperature was used in calculating QIN, the inside surface heat flux. This is fixed in sys.bug .

Interim solution: None

Date moved to the release file: 2/8/85

**Bug D-9**

In the sunspace calculation, if a sunspace and its adjacent spaces were in different systems, the program would print -NO ZP1-ZP2NXT MATCH IN SUBROUTINE SSFCOR- and then abort. Fixed in sys.bug .

Interim solution: None

Date moved to to the release file: 4/2/85

**Bug D-10**

For systems using a heat pump (HEAT-SOURCE=HEAT-PUMP), the electric heating energy reported in SS-H varies significantly depending on what computer system is being used. The values reported can be as much as a factor of 3 too high in the spring or fall months. The problem is caused by a very small, unphysical heating load ($<<$ 1 Btuh) which turns on the heat pump, and causes it to consume electricity. On some machines these small numbers are rounded to zero, and the heat pump remains off. On other machines the numbers remain non-zero, and the heat pump turns on. Fixed in sys.bug .

Interim solution: None

Date moved to the release file: Before July 1, 1985.

**Bug D-11**

In report LS-L, the quantities for AVERAGE DAILY SOLAR RADIATION INTO SPACE and MAXIMUM HOURLY SOLAR RADIATION INTO SPACE are not those for solar gains (unweighted) as intended. Rather solar loads (weighted) were used. This problem was also present in 2.1B. The fix is in lds.bug .

Interim solution: None

Date moved to the release file: September 11, 1985

**Bug D-12**

In metric runs, the conversion factor for the keyword RADIATIONS in the DAY-SCHEDULE command, used in conjunction with MAX-SOLAR-SCH for window blind control, is incorrect. It converts from $W/ft^2$ to $W/m^2$, using a factor 10.76392. It should convert from $Btu/hr\text{-}ft^2$ to $W/m^2$ using a factor of 3.15248. This is a bug in 2.1B also. The fix is in file bdl.bug .

Interim solution: None

Date moved to the release file: February 5, 1986

**Bug D-13**

In metric runs using LOAD-ASSIGNMENT and LOAD-MANAGEMENT in PLANT, the plant equipment referenced in the LOAD-ASSIGNMENT would not be assigned correctly. Also, if the LOAD-ASSIGNMENT was for a utility, the NUMBER keyword, representing mBtu's, would not be converted to mWh. Both problems were caused by the incorrect placement and argument list of a call to KDIV, the subroutine that does the metric conversion. The problem is in subroutine LMLAO in BDL. This was a problem in 2.1B also. The fix is in bdl.bug .

Interim solution: None

Date moved to release file: February 5, 1986

**Bug D-14**

In the SYSTEM-CONTROL command in SYSTEMS, MAX-HUMIDITY and MIN-HUMIDITY are assigned the wrong units. The units should be percent, not (lbs water)/(lbs dry air), or (kg water)/(kg dry air). This error shows up when the user turns on DIAGNOSTIC COMMENTS. The input should be, and has always benn percent, and the calculations are correct. It is just the label that is wrong. The BDL Summary has the correct units. This was a bug in 2.1B also. The fix is in dkey.bug .

Interim solution: Ignore the label, input in percent.

Date moved to release file: February 5, 1986

**Bug D-15**

In metric runs, some plant report output headings should be labeled kWh/$m^2$-yr, not kWatt/$m^2$-yr. No calculations are affected by this bug. This is a bug in 2.1B also. The fix is in dkey.bug .

Interim solution: None

Date moved to release file: February 5, 1986

**Bug D-16**

When using metric input, the conversion of the response factors was done on the input data, not on the data assembled for writing to the standard file. Thus if the input data was used more than once (via the LIKE command), conversion on the same set of data would occur more than once, and the LIKE'd response factors would be incorrect. This problem was fixed in 2.1C for the response factors which include the inside film coefficient, but not for those which do not (used for calculating weighting factors). This was a bug in 2.1B also. The fix is in bdl.bug .

Interim solution: Do not use LIKE in the LAYERS command.

Date moved to the release file: February 5, 1986

**Bug D-17**

For system types DDS, MZS, and PMZS, the hourly report variable 35 (system level in SYSTEMS) WR, the return air ratio, can be incorrectly reported when it should be at its minimum value. The calculation is not affected. This was a bug in 2.1B also. The fix can be found in file sys.bug .

Interim solution: None

Date moved to the release file: February 5, 1986

**Bug D-18**

If the building AZIMUTH is entered as a negative value between -90 and -360 degrees, the daylighting program will incorrectly calculate interior illuminanace and glare if the sun is between south and the direction of the negative building x-axis. In this case the solar bearing of 20 degrees north of west is used instead of the actual bearing. For example, if building AZIMUTH is -135 degrees, then the building y axis points southwest, the x-axis points northwest, and the negative x-axis points southeast. so solar bearings between south and southeast will have incorrect interior daylight values. This was a bug in 2.1B also. The fix is in lds.bug .

Interim solution: Use only positive values of building AZIMUTH.

Date moved to the release file: December 3, 1985.

**Bug D-19**

*This is not really a bug, but a documentation error. However, since it was submitted on a bug report, it will remain a bug forever!* There are two errors in the description of the daylighting verification report, LV-L. First, the quantity VW-AZ (view azimuth) is given relative to north, not relative to the building y-axis as stated on page 2-65 of the 2.1C Supplement. Note that the corresponding keyword, VIEW-AZIMUTH, is input relative to the space y-axis. Second, the quantity AZIM is the azimuthal angle of the window outward normal relative to north, not relative to the building y-axis as stated on page 2-66 of the 2.1C Supplement. Note that for horizontal windows (skylights), the value of AZIM in this report has no meaning and should be ignored. This "bug" has no mod to fix it.

Interim solution: none

Date moved to release file: No mod, so irrelevant.

**Bug D-20**

In the daylighting calculation, the values of luminous efficacy and direct normal solar illuminance are too high for values of atmospheric turbidity (ATM-TURBIDITY in the BUILDING-LOCATION command) above 0.2. This results in overestimates of interior daylight illuminance. In addition to fixing this problem, an improved calculation of these quantities (from Aydinli) is added, replacing the previous Dogniaux formulation. The fix is in lds.bug .

Interim solution: none

Date moved to the release file: December 13, 1985

**Bug D-21**

This is not actually a bug fix, but an improvement to the daylighting calculation. Previously, sun reaching the reference point directly (without reflecting from an interior or exterior surface or diffusing from a window shade) was omitted from consideration on the assumption that a shading device would be deployed to prevent a sun patch from falling on the work surface. This assumption is, however, too restrictive in some situations; for example, in rooms with reflective glazing and no drapes or blinds, or in atria with transparent glass where direct sun is intentionally allowed to penetrate to floor level. The program has, therefore, been modified so that the illuminance of the sun patch is calculated. In addition the program now calculates the glare due to the solar disk when it is visible from the reference point. The fix is in file lds.bug.

Interim solution: None

Date moved to the release file: December 19, 1985

**Bug D-22**

Bug 22 is missing; please phone home.

**Bug D-23**

The units for WW (moisture change), hourly report variable 38 in SYSTEMS at the SYSTEMS level, are incorrect. The units should be lbs (kg), not "fraction". The fix is in file dric.bug .

Interim solution: None

Date moved to the release file: February 5, 1986

**Bug D-24**

The units for the keyword NIGHT-VENT-DT in the SYSTEM or SYSTEM-FANS command were incorrect. They should be R (K) not F (C). This will result in an incorrect conversion for this keyword when metric input is used. The fix is on file dkey.bug .

Interim solution: None

Date moved to the release file: February 5, 1986

**Bug D-25**

The abreviations for the keywords NATURAL-VENT-SCH (SYSTEM-AIR sub- command) and NIGHT-VENT-SCH (SYSTEM-FANS subcommand) are the same; namely, N-V-SCH. The program will always interpret N-V-SCH as referring to NATURAL-VENT-SCH, since this is first in the keyword file. The abbreviation of NIGHT-VENT-SCH will be changed to NT-V-SCH. The fix is on file dkey.bug .

Interim solution: Do not use the abbreviation for NIGHT-VENT-SCH.

Date moved to the release file: February 5, 1986

**Bug D-26**

TAVE, the average zone temperature, hourly report variable number 31 at the zone level, is not set in SYSTEM = SUM. As a result it is reported as $0^{\circ}$ F for all hours, or $-17.8^{\circ}$ C. This is a bug in 2.1B also. The fix is in sys.bug .

Interim solution: None

Date moved to the release file: February 5, 1986

**Bug D-27**

In report PS-D the column labeled PEAK OVERLOAD is incorrectly given the units MBTU instead of MBTUH. The fix is in file drlc.bug .

Interim solution: None

Date moved to the release tape: February 5, 1986

**Bug D-28**

The daylighting calculation for the Southern hemisphere (LATITUDE $< 0$) is incorrect since the wrong values are used for solar azimuth. This is not a problem in the Northern hemisphere. The fix is in file lds.bug.

Interim solution: None

Date moved to the release tape: February 13, 1986

**Bug D-29**

When there is more than one RUN-PERIOD per month (exclusive of RUN-PERIODS associated with DESIGN-DAY's) the annual quantities reported in the BEPS report from PLANT, and some quantities in PS-D are incorrect. Basically PLANT assumes, when adding up the yearly totals from the monthly

totals, that the end of a run period is the end of a month. If there is more than one run period in a month, double or multiple counting occurs. The error can be large. Incorrect results have occured in the ELECTRICITY column of the BEPS report, and for MBTU SUPPLIED and PCT OF TOTAL LOAD in the ELECTRICAL INPUTS section (input = ELECTRICITY) in PS-D, as well as LOAD SATISFIED in the ELECTRICAL INPUTS section of PS-D. The number for TOTAL LOAD ON PLANT in the ELECTRICAL INPUTS section of PS-D is correct. The fix is on file plt.bug.

Interim solution: Except for RUN-PERIOD's associated with a DESIGN-DAY command, use only one RUN-PERIOD per month, if you are going to use PLANT reports. Hourly reports from PLANT are OK.

Date moved to the release file: April 4, 1986

**Bug D-30**

The packaged systems PSZ, PMZS, and PVAVS will show seriously incorrect seasonal COP's. If the TOTAL under the COOLING ENERGY column in report SS-A is divided by the TOTAL from column ELECTRIC COOLING ENERGY in SS-H, seasonal COP's of around 8 will result, instead of 3. This is because the electricity consumed by cooling is too small, due to the program using only the first 2 coefficients of the relevant COOL-EIR-FPLR curve (the curve is cubic; the program thinks it is linear). **THIS BUG IS SERIOUS!** It should be fixed or avoided on all runs involving PSZ, PMZS, and PVAVS. This bug is in the 2.1C version only. The fix is on file bdl.bug.

Interim solution: The correct curve must input be via the CURVE-FIT command. Namely

REPLACEMENT=CURVE-FIT TYPE=CUBIC
COEF=(.20123007,-.0312175,1.9504979,-1.1205104) ..

and COOL-EIR-FPLR=REPLACEMENT in the SYSTEM command.

Date moved to the release file: April 4, 1986.

**Bug D-31**

Page 3-26 of the DOE-2.1C Supplement mentions that the curves SDL-C117, SDL-C118, and SDL-C119 are alternatives to SDL-C18 for the COOL-EIR-FPLR for system types PSZ, PMZS, and PVAVS in the SYSTEMS program. These curves are cubic in the PLR, but their type is set to zero, which means that the curve is always set to 1.0 in SYSTEMS. Thus there will be no variation of the EIR as a function of the PLR if these curves are used. The fix is in bdl.bug .

Interim solution: Use the CURVE-FIT command to input these curves, or do not use them.

Date moved to the release file: April 4, 1986.

**Bug D-32**

In SYSTEMS input, when the user forgets to include a zone in one of the systems, the obscure message "NO ZP1-ZP2 MATCH IN HOURIN" would appear, and execution would be terminated. Although this message amused many users, and led to many stimulating discussions between users and the developers, we have replaced it with "ZONE ----- IS NOT SERVED BY ANY SYSTEM", where ----- is the actual offending zone name. The fix is in sys.bug .

Interim solution: Dial 415-486-5711 and ask Ender Erdem what the message means.

Date moved to the release file: April 18, 1986

**Bug D-33**

In metric input, when GLASS-CONDUCTANCE in the GLASS-TYPE command in the LOADS input is allowed to default, the second and subsequent uses of the GLASS-TYPE command will have incorrect defaults assigned to GLASS-CONDUCTANCE. The fix is on bdl.bug .

Interim solution: Input a value for GLASS-CONDUCTANCE or use LIKE for the second and subsequent GLASS-TYPE's.

Date moved to the release file: April 18, 1986

**Bug D-34**

Reports EV-A and EV-B could not be produced together when the user used the COMPONENT-COST command in the ECONOMICS input. The fix is on eco.bug .

Interim solution: none

Date moved to the release file: April 18, 1986

**Bug D-35**

When metric output is requested, the ECONOMICS reports remain in English units. This is because the code to do the conversion was never added to ECONOMICS. English units appear only in a few places (most of the output is dollars or hours), and only in EV-B and ES-D. The fix is on eco.bug .

Interim solution: none

Date moved to the release file: April 18, 1986

**Bug D-36**

The weather processor is unable to handle weather for the southern hemisphere. When the packer encounters a negative latitude in the input, it will print an error message (ERROR --- LATITUDE IS OUTSIDE ALLOWED RANGE etc.) and abort. The fix is on wth.bug .

Interim solution: none

Date moved to the release file: April 18, 1986

**Bug D-37**

This fixes a bug in the WYEC section of the weather processor. For at least one WYEC file (Amarillo), the processor needs to look at the next hour solar data, as well as present and previous hour data. The fix is on file wth.bug .

Interim solution: none

Date moved to the release file: April 18, 1986

**Bug D-38**

The metric synonym for the keyword MIN-CFM-SCH in the ZONE command in SYSTEMS is missing. The fix installs the correct synonym MIN-FLOW-SCH. The correction is on file dkey.bug .

Interim solution: use MIN-CFM-SCH.

Date moved to the release file: April 25, 1986

**Bug D-39**

Item 47 in the units table is incorrect. It gives an incorrect conversion from lbs/kw to kg/kw. This conversion is not at present used, but the number should be corrected anyway. The old (incorrect) conversion was dkey.bug .

Interim solution: not relevant

Date moved to the release file: April 25, 1986

**Bug D-40**

A line of code is in the wrong place in the HELP subroutine in KEYWDT, the keyword file producing program. HELP prints the command and keyword summary. The incorrect placement of the line of code may cause a scrambled printed output for those keywords that have a units table pointer of zero. The actual keyword table itself is unaffected by this bug. The fix is on file key.bug .

Interim solution: none

Date moved to the release file: April 25, 1986

**Bug D-41**

Verification reports LV-C and LV-F display a multiplier for interior walls, while this is no longer a legal keyword for the INTERIOR-WALL command. We eliminate the multiplier field in both reports, and add the surface type to LV-F. The fix is on files lds.bug and drlc.bug .

Interim solution: none

Date moved to the release file: April 25, 1986

**Bug D-42**

If system type TPIU or FPIU is chosen in SYSTEMS and the user specifies the primary air flow rate with SUPPLY-CFM, the BASEBOARD-RATING for each zone is added twice to <ERMIND>, the heat addition rate which is reported in SV-A. The fix is on file sys.bug .

Interim solution: none

Date moved to the release file: April 25, 1986

**Bug D-43**

For a sunspace, if WIN-SHADE-TYPE for a window is MOVABLE-EXTERIOR or MOVABLE-INTERIOR and the SHADING-SCHEDULE value is 1.0, the shade will be considered closed and the interior solar radiation will be calculated as completely diffuse. This fix changes the shade status to open under these circumstances, allowing beam radiation to penetrate through the window into the sunspace, and thus increasing the solar gain through interior windows illuminated by direct sun. The fix is on file lds.bug.

Interim solution: none

Date moved to release file: 5-5-86

--- B U G  F I X E S ---

```
*/
*/ ------------------ FILE LDS.BUG ----------------
*/
*IDENT LDSBG1
*/ ---
*/ --- THIS FIXES BUG D-2 (ALSO IN 2.1B).  THE SHADING COEFF (SC) USED
*/ --- IN CALCULATING THE TRANSMITTED SOLAR GAIN FOR SOLAR GAIN CONTROL
*/ --- OF SHADING DEVICES WAS NOT SET CORRECTLY (GSHACO WAS USED INSTEAD
*/ --- OF <GSHACO>).  SC WAS SET TO THE SC OF THE LAST-DEFINED WINDOW OF
*/ --- THE PREVIOUS SPACE (OR, FOR A WINDOW IN THE FIRST SPACE, IT WAS
*/ --- SET TO THE SC OF THE LAST-DEFINED WINDOW OF THE LAST SPACE IN THE
*/ --- BLDG).  THIS COULD GIVE INCORRECT RESULTS IF DIFFERENT SC-S WERE
*/ --- USED ON THE WINDOWS IN THE BLDG.  IT DID NOT CAUSE A PROBLEM IF
*/ --- IF GLASS-TYPE-CODE WAS USED ON ALL WINDOWS (SINCE THEN SC DEFAULTS
*/ --- TO 1.0).
*/ ---
*D CALEXT.116
      QDIR   = (1. - <WGOLGE>) * RDIR * TDIR * <GSHACO>

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--



*/ ---
*/ --- THIS FIXES BUG D-3 (ALSO IN 2.1B).  IN THE DAYLIGHTING CALCULATION,
*/ --- WINDOWS IN EXTERIOR WALLS WITH SHADING-SURFACE=YES WERE INCORRECTLY
*/ --- TAKEN TO BE COMPLETELY SHADED, SO THAT NO LIGHT FROM SKY OR GROUND
*/ --- ENTERED THE WINDOW.  DIRECT LIGHT FROM THE SUN WAS NOT EFFECTED.
*/ --- (FCW 4-10-85)
*/ ---
*I DHITSH.75
C               PREVENT SELF-SHADE OF WINDOW
      IF (MG.EQ.<MXGEOM>) GO TO 240

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--


*/ ---
*/ --- THIS FIXES BUG D-4.  THE EXTERIOR WINDOW POINTER IN SUNSPACES WITH
*/ --- NO INTERIOR WINDOWS WAS NOT SET CORRECTLY.  THIS LED TO INCORRECT
*/ --- ASSIGNMENT OF SOLAR TRANSFER FACTORS. (FCW 4-19-85)
*/ ---
*D SPMISC.287,288
*I SPMISC.277
C               SAVE EXTERIOR WINDOW POINTER
      MWIEXT = MWI

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--


*/ ---
*/ --- THIS FIXES BUG D-5.  FOR A SUNSPACE WITH MORE THAN ONE EXTERIOR
*/ --- WINDOW, THE POINTER TO THE BEGINNING OF THE SOLAR TRANSFER BLOCKS
*/ --- WAS INCORRECTLY CALCULATED. (FCW 4-19-85)
*/ ---
*D SPMISC.297
      <MIWNSTF> = MST + (JIS-1)*MSTLEN*<NEXWIN>

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--
```

```
*/ ---
*/ --- THIS FIXES BUG D-6 (ALSO IN 2.1B).  IF A SPACE HAS NO LIGHTING
*/ --- SCHEDULE, THE AVERAGE ILLUM AND GLARE AND PERCENT ILLUM AND GLARE
*/ --- ABOVE SETPOINT IN REPORT LS-G ARE INCORRECT.  (FCW 4-22-85).
*/ ---
*D DAYCLC.393
*I DAYCLC.394
      IF (<KZLT>.EQ.0) GO TO 21600
*I DAYCLC.421
      IF (<KZLT>.EQ.0) GO TO 21000
*I DAYCLC.431
      IF (<KZLT>.EQ.0) GO TO 21000

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--


*/ --- ************************************************************
*/ --- *************** release tape checkpoint 1 ***************
*/ --- ************************************************************
*/
*/   THIS FIXES BUG D-11.  THE SOLAR QUANTITIES ACCUMULATED FOR
*/   REPORT LS-L SHOULD BE SOLAR GAINS, NOT WEIGHTED SOLAR LOADS
*/
*D DAYCLC.375,379
      ZLSL(1,2,IZONE)=ZLSL(1,2,IZONE)+<QSOL1>
      ZLSL(2,2,IZONE)=ZLSL(2,2,IZONE)+<QSOL1>
C               MAXIMUM SOLAR
      IF(<QSOL1>.GT.ZLSL(1,3,IZONE)) ZLSL(1,3,IZONE)=<QSOL1>
      IF(<QSOL1>.GT.ZLSL(2,3,IZONE)) ZLSL(2,3,IZONE)=<QSOL1>

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--


*/
*/  THIS FIXES BUG D-18.  FOR BUILDING AZIMUTH VALUES BETWEEN
*/  -90 AND -360, IN INTERPOLATING TO GET DAYLIGHT FACTORS
*/  THE PROGRAM INCORRECTLY USES A SUN AZIMUTH OF 20 DEG
*/  NORTH OF WEST IF THE ACTUAL SUN AZIMUTH LIES
*/  BETWEEN SOUTH AND THE DIRECTION OF THE NEGATIVE BUILDING
*/  X-AXIS.  FOR EXAMPLE, IF BLDG AZIMUTH = -135, SUN ANGLES BETWEEN
*/  SOUTH AND SOUTHEAST WILL HAVE INCORRECT INTERPOLATED DAYLIGHT FACTORS.
*/  THIS PROBLEM CAN BE AVOIDED BY ALWAYS SPECIFYING POSITIVE VALUES
*/  FOR BUILDING AZIMUTH.  (FCW 12-3-85)
*/
*D DAYCLC.139
      IF(THSUND.GT.180.)  THSUND=THSUND-360.*(1.+AINT(THSUND/540.))
*/
*IDENT LDSBG2

---------1----+----2----+----3----+----4----+----5----+----6----+----7--
```

```
*/
*/ THIS FIXES BUG D-20.  IN THE DAYLIGHTING CALCULATION, THE VALUES OF
*/ LUMINOUS EFFICACY AND DIRECT NORMAL ILLUMINANCE ARE TOO HIGH FOR
*/ TURBIDITY (BETA) ABOVE 0.2.  IN ADDITION TO FIXING THIS PROBLEM,
*/ AN IMPROVED CALCULATION OF THESE QUANTITIES (FROM AYDINLI) IS ADDED,
*/ REPLACING THE PREVIOUS DOGNIAUX FORMULATION. (FCW 12-13-85)
*/
*I DZENLM.25
      TFAC = AMIN1(TFAC,7.5)
*D DLUMEF.17,30
C               (FIT TO TABULATED VALUES OF DIR NORM LUMINOUS
C               EFFICACY VS SOLAR ALTITUDE,TURBIDITY FACTOR, MOISTURE --
C               AYDINLI, THE AVAILABILITY OF SOLAR RADIATION AND
C               DAYLIGHT, TABLE 4, OCTOBER 1981.)
C
C               RESTRICT BETA TO RANGE OF AYDINLI VALUES (0 TO 0.2)
      BC=AMIN1(0.2,BETA)
      CDIRLW(IHR)=(99.+4.7*W-52.4*BC)*(1.-EXP((24.*BC-8.)*PHSUN))
*D DNSOL.18,22
      ABARS=1.4899-2.1099*CPHSUN+0.6322*COS(2.*PHSUN)+
     &      0.0252*COS(3.*PHSUN)-1.0022*SPHSUN+
     &      1.0077*SIN(2.*PHSUN)-0.2606*SIN(3.*PHSUN)
      BC=AMIN1(0.2,BETA)
C               LUMINOUS EFFICACY
      EFFLUM=(99.4+4.7*W-52.4*BC)*(1.-EXP((24.*BC-8.)*PHSUN))
C               93.73 BELOW IS EXTRATERRESTRIAL LUM EFFICACY (LM/W)
      DNSOL=EFFLUM*(SOLIC(M)/93.73)*EXP(-AM*TFAC*ABARS)

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--


*/
*IDENT LDSBG3
*/
*/ BUG D-21.  THIS IS ACTUALLY NOT A BUG FIX BUT AN IMPROVEMENT TO
*/ THE DAYLIGHTING CALCULATION.  PREVIOUSLY, SUN REACHING THE
*/ REFERENCE POINT DIRECTLY (I.E., WITHOUT REFLECTING FROM AN
*/ EXTERIOR OR INTERIOR SURFACE OR DIFFUSING FROM A WINDOW SHADE)
*/ WAS NOT CALCULATED SINCE IT WAS ASSUMED THAT A SHADING DEVICE
*/ WOULD BE DEPLOYED TO PREVENT A SUN PATCH ON THE WORK SURFACE.
*/ THIS ASSUMPTION IS, HOWEVER, TOO RESTRICTIVE IN SOME SITUATIONS,
*/ FOR EXAMPLE IN ROOMS WITH REFLECTIVE GLASS AND NO WINDOW SHADES
*/ OR IN ATRIA WITH TRANSPARENT GLAZING WHERE DIRECT SUN
*/ IS INTENTIONALLY ALLOWED TO PENETRATE TO FLOOR LEVEL.  THE FOLLOWING
*/ MODIFICATION REMOVES THE RESTRICTION BY CALCULATING THE
*/ ILLUMINANCE OF THE SUN PATCH AT THE REFERENCE POINTS.  IT ALSO
*/ CALCULATES THE GLARE DUE TO THE SOLAR DISK WHEN IT IS VISIBLE
*/ FROM THE REFERENCE POINT.
*/
*I DCOE.757
C
C               ILLUMINANCE FROM (UNREFLECTED) DIRECT SUN
C
      IF(IX.NE.NWX.OR.IY.NE.NWY) GO TO 8010
C               UNIT VECTOR FROM REF. PT. TO SUN
      RAYCOS(1)=CPHSUN*COS(THSUN)
      RAYCOS(2)=CPHSUN*SIN(THSUN)
      RAYCOS(3)=SPHSUN
C               IS SUN ON FRONT SIDE OF WINDOW
      COSI=DDOT(WNORM,RAYCOS)
```

```
      IF(COSI.LE.0.) GO TO 8010
C               DOES RAYCOS PASS THRU WINDOW
      CALL DPIERC(W1,W2,W3,RREF,RAYCOS,IP)
      IF(IP.EQ.0) GO TO 8010
C               DOES RAYCOS INTERCEPT SHADING SURFACE
      CALL DHITSH(RREF,RAYCOS)
      IF(IHIT.NE.0) GO TO 8010
C               SUN REACHES REF. PT.  INCREMENT ILLUMINANCE
      TVISS=AMAX1(0.,<CAM1>+COSI*(<CAM2>+COSI*(<CAM3>+COSI*<CAM4>)))
     &       /TSOLNM
      DNSOLI=DNSOL(IMREF)
      EDIRSU(1,1,IHR)=EDIRSU(1,1,IHR)+DNSOLI*RAYCOS(3)*TVISS
C
C               GLARE FROM SOLAR DISK
C
C               POSITION FACTOR FOR SUN (NOTE THAT AZVIEW IS WRT BLDG
C               Y-AXIS, THSUN WRT BLDG X-AXIS)
      XR=TAN(ABS(0.5*PI-AZVIEW-THSUN)+.001)
      YR=TAN(PHSUN+.001)
      POSFAC=DPFAC(XR,YR)
      IF(POSFAC.EQ.0.0.OR.<OMEGAW>.LT.0.000001) GO TO 8010
C               INCREMENT WINDOW LUMINANCE.  LUMINANCE OF SOLAR DISK
C               (FT-L) IS 46000*DNSOL FOR DNSOL IN FC.  SOLID ANGLE
C               SUBTENDED BY SUN IS .000068 SR.
      AVWLSU(1,1,IHR)=AVWLSU(1,1,IHR)+46000.*DNSOLI*TVISS*
     & SQRT(.000068*POSFAC)*(FLOAT(NWX*NWY)/PI)/<OMEGAW>**.8
 8010 CONTINUE
*I DCOF.910
C               LIMIT SFACSU TO PREVENT PACKING OVERFLOW
      SFACSU=AMIN1(99.,SFACSU)
*/
*/ TO SAVE TIME, AVOID CALLING DHITSH IF NO SHADES
*/
*D DREFLT.94
      MH=0
      IHIT=0
      IF((<NWISHADE>+<NXSHAD>+NGSHAD+NSSHD).NE.0) CALL DHITSH(WC,U)
*D DCOF.676
      MH=0
      IHIT=0
      IF((<NWISHADE>+<NXSHAD>+NGSHAD+NSSHD).NE.0) CALL DHITSH(RREF,RAY)

----------1----+----2----+----3----+----4----+----5----+----6----+----7--


*/
*IDENT LDSBG4
*/
*/ THIS FIXES BUG D-28.  THE DAYLIGHTING CALCULATION IS INCORRECT IN
*/ THE SOUTHERN HEMISPHERE (LATITUDE < 0) SINCE THE WRONG VALUES OF
*/ SOLAR AZIMUTH ARE USED.  THIS IS NOT A PROBLEM IN THE NORTHERN
*/ HEMISPHERE. (FCW 2-13-86)
*/
*D CALEXT.89
*I DCOF.64
C               SET MINIMUM SOLAR AZIMUTH IN SOUTHERN HEMISPHERE
      IF(STALAT.LT.0.0) THSMIN=70.

---------1----+----2----+----3----+----4----+----5----+----6----+----7--
```

```
*/ THIS FIXES BUG D-41.  VERIFICATION REPORTS LV-C AND LV-F REPORT
*/ A MULTIPLIER FOR INTERIOR WALLS, EVEN THOUGH THIS IS NO LONGER
*/ A LEGAL KEYWORD FOR THE COMMAND.  WE ELIMINATE THE MULTIPLIER AND ADD
*/ SURFACE-TYPE TO THE LV-F OUTPUT.  THE REST OF THIS BUG FIX
*/ IS ON FILE DRLC.BUG .
*/
*D RLVC.190
*D RLVC.191,RLVC.192
      WRITE (IREPFL) I24,IUNIQ,IONE,I13,I20,
     1 (<IWNM>,II=1,4),<IWAR>,(<IPRPNM>,II=1,4),
*I RLVF.14
      DIMENSION IWLTYP(2,2), IIWTYP(4,4)
*I RLVF.15
      DATA IWLTYP / 4HQUIC, 4HK    , 4HDELA, 4HYED  /
      DATA IIWTYP / 4HSTAN, 4HDARD, 4H    , 4H    ,
     1              4HAIR , 4H    , 4H    , 4H    ,
     2              4HADIA, 4HBATI, 4HC   , 4H    ,
     3              4HINTE, 4HRNAL, 4H    , 4H    /
*D RLVF.34,RLVF.38
      IWTYP = <IW-TYPE>
      ITYP = 2
      IF (<NRESF> .EQ. 0)  ITYP = 1
      WRITE (IREPFL) I28,ISIX,IONE,ITHREE,I24,
     1 (<IWNM>,II=1,4),<IWAR>,(<IPRPNM>,II=1,4),
     2 (IWLTYP(II,ITYP),II=1,2),(IIWTYP(II,IWTYP),II=1,4),
     3 <UFACTR>,(<IZNM>,II=1,4),(NAME(II),II=1,4)

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--


*/
*/ THIS FIXES BUG D-43.  SET SHADING-FLAG=1 (SHADE ASSIGNED BUT OPEN)
*/ IF WIN-SHADE-TYPE IS MOVABLE-INTERIOR OR MOVABLE-EXTERIOR, AND
*/ SHADING-SCHEDULE VALUE IS 1.0.  ONLY THE SUNSPACE CALCULATION IS
*/ AFFECTED BY THIS CHANGE.  FOR A SUNSPACE A CLOSED SHADE IS CON-
*/ SIDERED TO COMPLETELY DIFFUSE SOLAR RADIATION WHEREAS AN OPEN
*/ SHADE ALLOWS PENETRATION OF BEAM RADIATION. (FCW 5-5-86)
*/
*D CALEXT.84
 6002 MS=<@KGCURT>+ISCHR
C             IF SHADING-SCHEDULE VALUE IS 1.0, SHADING-FLAG IS 1
      IF(AA(MS).EQ.1.0) GO TO 80
      IF(<CONDUCT-TMIN-SCH>.NE.0.OR.<MAX-SOLAR-SCH>.NE.0)

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--
```

```
*/
*/ ------------------ FILE BDL.BUG ---------------
*/
*IDENT BDLBG1
*/
*/ THIS FIXES BUG D-12.  IN METRIC RUNS, THE CONVERSION FACTOR
*/ FOR THE KEYWORD RADIATION IN THE DAY-SCHEDULE COMMAND, USED
*/ IN CONJUNCTION WITH THE MAX-SOLAR-SCH FOR WINDOW CONTROL, IS
*/ INCORRECT.  IT CONVERTS FROM W/SQFT TO W/M**2 USING A FACTOR
*/ OF 10.76392.  IT SHOULD CONVERT FROM BTU/HR/SQFT TO W/M**2,
*/ USING A FACTOR OF 3.15248.
*/
*D SCEDDI.41
     6   4HRADI,4HATIO,4HNS  ,4H    ,4HRADT,4H    ,17,1,24,-1,100,1/
*D SCEDDI.121
      TEMP(25)=1./VKONV(17)

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--


*/
*/ THIS FIXES BUG D-13.  IN METRIC RUNS USING LOAD-ASSIGNMENT AND
*/ LOAD-MANAGEMENT IN PLANT, THE PLANT EQUIPMENT REFERENCED IN THE
*/ LOAD-ASSIGNMENT WOULD NOT BE ASSIGNED CORRECTLY.  ALSO, IF THE
*/ L-A WAS FOR A UTILITY, THE NUMBER KEYWORD, REPRESENTING MBTU'S,
*/ WOULD NOT BE CONVERTED TO MWH.  BOTH PROBLEMS WERE CAUSED BY ,THE
*/ INCORRECT PLACEMENT AND ARGUMENT LIST OF A CALL TO KDIV, THE
*/ SUBROUTINE THAT DOES THE METRIC CONVERSION.  THE PROBLEM WAS
*/ IN THE SUBROUTINE LMLAO IN PLANT.
*/
*I LMLAO.107
      IF(METIN.EQ.1)CALL KDIV(IA(IPTR+4),50,1,METIN)
*D LMLAO.124

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--


*/
*/ THIS FIXES BUG D-16.  WHEN USING METRIC INPUT, THE CONVERSION OF THE
*/ RESPONSE FACTORS WAS DONE ON THE INPUT DATA, NOT ON THE DATA
*/ ASSEMBLED FOR WRITING TO THE STANDARD FILE.  THUS IF THE INPUT
*/ WAS USED MORE THAN ONCE (VIA THE LIKE COMMAND), CONVERSION ON
*/ THE SAME SET OF DATA WOULD OCCUR MORE THAN ONCE, AND THE LIKE'D
*/ RESPONSE FACTORS WOULD BE INCORRECT.  THIS PROBLEM WAS FIXED
*/ IN 2.1C FOR THE RESPONSE FACTORS WHICH INCLUDE THE INSIDE FILM
*/ RESISTANCE, BUT NOT FOR THE SECOND SET, WITHOUT I-F-R.
*/
*D CONSTO.140,142
      CALL MOVEN (AA(IRF+1),AA(IPT+9),NSTOR)
      IF (METIN.EQ.1)  CALL KDIV(AA(IPT+9),6,1,METIN)
      IF (METIN.EQ.1)  CALL KDIV(AA(IPT+12),6,NSTOR-3,METIN)

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--
```

```
*/ THIS FIXES BUG D-30.  FOR SYSTEM = PSZ, PMZS, OR PVAVS, THE ELECTRICITY
*/ CONSUMED FOR COOLING IS SERIOUSLY INCORRECT, DUE TO THE DEFAULT
*/ COOL-EIR-FPLR CURVE HAVING THE WRONG TYPE.  THE CURVE IS CUBIC, BUT
*/ THE TYPE IS LINEAR, SO ONLY THE FIRST 2 COEFFICIENTS OF THE CURVE
*/ ARE USED.
*/
*D DATSDL.274
     $      C15/4/, C16/1/, C17/1/, C18/5/, C19/0/, C20/1/, C21/4/,

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--


*/
*/ THIS FIXES BUG D-31.  CURVES SDL-C117, SDL-C118, AND SDL-C119 ARE
*/ ALTERNATIVES TO SDL-C18, THE DEFAULT COOL-EIR-FPLR CURVE FOR SYSTEM
*/ TYPES PSZ, PMZS, OR PVAVS IN SYSTEMS (SEE PAGE 3-26 OF THE DOE-2.1C
*/ SUPPLEMENT).  THESE CURVES ARE CUBIC, BUT HAVE TYPE=0, WHICH MEANS THEY
*/ WILL ALWAYS HAVE THE VALUE 1.0 .  HERE WE CHANGE THE TYPE TO 5, WHICH
*/ WILL ALLOW THE CURVES TO BE USED CORRECTLY. (FB 4/4/86).
*/
*D DATSDL.288
     $     C113/3/,C114/4/,C115/4/,C116/0/,C117/5/,C118/5/,C119/5/,

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--


*/
*/ THIS FIXES BUG D-33.
*/ FOR METRIC INPUT, WHEN GLASS CONDUCTANCE IN THE GLASS-TYPE
*/ COMMAND (LOADS INPUT) IS ALLOWED TO DEFAULT, THE SECOND AND SUBSEQUENT
*/ GLASS-TYPE COMMANDS WILL BE ASSIGNED INCORRECT GLASS-CONDUCTANCE
*/ DEFAULTS.  THIS IS DUE TO THE CONVERSION BEING DONE ON THE
*/ STORED ENGLISH DEFAULT VALUE.  SUBSEQUENT USES OF GLASS-TYPE
*/ CONVERT THE ALREADY CONVERTED VALUE.  THE FIX DOES THE
*/ CONVERSION ON A LOCAL VARIABLE, WHICH HAS BEEN ASSIGNED THE
*/ ENGLISH DEFAULT VALUE.  THE BUG DISCOVERY AND CORRECTION ARE
*/ FROM T.G. TRUONG AT THE NEW ZEALAND MINISTRY OF WORKS AND
*/ DEVELOPMENT. (APRIL 18, 1986)
*/
*D GLTYPI.88
*I GLTYPI.89
     IF (METIN .EQ. 1)  CON=CON*VKONV(6)

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--



*/
*/ ---------------- FILE DKEY.BUG --------------
*/
*IDENT DKYBG1
*/
*/ THIS FIXES BUG D-14.  IN THE SYSTEM-CONTROL COMMAND IN SYSTEMS, THE
*/ KEYWORDS MAX-HUMIDITY AND MIN-HUMIDITY ARE ASSIGNED THE WRONG UNITS.
*/ THE UNITS SHOULD BE PERCENT, NOT LBS-WATER/LBS DRY AIR.
*/
*D SDLKEY.385
 MAX-HUMIDITY      MAX-H      38    1    1       30.       80.        -77777.
*D SDLKEY.389
 MIN-HUMIDITY      MIN-H      38    1    1        0.       70.        -77777.

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--
```

```
*/
*/ THIS FIXES BUG D-15.  IN METRIC RUNS, SOME PLANT REPORT OUTPUT
*/ HEADINGS SHOULD BE LABELED KWH/M**2-YR, NOT KWATT/M**2-YR .
*/
*D UNITCD.74
  73    KWH/M2-YR            KBTU/SQFT-YR          3.15248
*/
*/ THIS FIXES BUG D-24.  THE UNITS FOR THE KEYWOR NIGHT-VENT-DT IN SYSTEMS
*/ ARE INCORRECT.  THEY SHOULD BE R (K), NOT F (C).  THIS WILL RESULT IN
*/ AN INCORRECT CONVERSION FOR INPUT VIA THIS KEYWORD FOR METRIC RUNS.
*/
*D SDLKEY.559
 NIGHT-VENT-DT     N-V-D      60    5    1        0.0        30.0       5.0

---------1---------2---------3---------4---------5---------6---------7--


*/
*/ THIS FIXES BUG D-25.  THE ABBREVIATIONS FOR THE KEYWORDS NATURAL-VENT-SCH
*/ AND NIGHT-VENT-SCH ARE THE SAME (N-V-SCH).  THE PROGRAM WILL ALWAYS
*/ INTERPRET N-V-SCH AS NATURAL-VENT-SCH, SINCE IT IS FIRST IN THE KEYWORD
*/ FILE.
*/
*D SDLKEY.555
 NIGHT-VENT-SCH    NT-V-SCH    0    3    1        76.0        0.0        -77777.

---------1---------2---------3---------4---------5---------6---------7--


*/
*/ THIS FIXES BUG D-38.  THE KEYWORD MIN-CFM-SCH IN THE ZONE COMMAND
*/ HAS NO METRIC SYNONYM.  WE INSERT THE PROPER SYNONYM: MIN-FLOW-SCH.
*/ THE BUG AND CORRECTION ARE FROM THE MINISTRY OF WORKS AND DEVELOPMENT,
*/ NEW ZEALAND.
*/
*D SDLKEY.925
 MIN-FLOW-SCH      M-F-SCH     0    3    1        76.0        0.0        -77777.
 MIN-CFM-SCH       M-C-SCH     0    3   -1        76.0        0.0        -77777.

---------1---------2---------3---------4---------5---------6---------7--


*/
*/ THIS FIXES BUG D-39.  ITEM 47 IN THE UNITS TABLE IS INCORRECT.
*/ IT GIVES THE CONVERSION FROM LBS/KW TO KG/KW AS .65359, INSTEAD
*/ OF .45359.  THIS UNITS TABLE ITEM IS NOT PRESENTLY BEING
*/ USED.  THIS BUG AND FIX ARE FROM THE NEW ZEALAND MINISTRY OF
*/ WORKS AND DEVELOPMENT.
*/
*D UNITCD.48
  47    KG/KW                LBS/KW                .45359

---------1---------2---------3---------4---------5---------6---------7--
```

```
*/
*/ ----------------- FILE ECO.BUG ----------------
*/
*IDENT ECOBG1
*/
*/ THIS FIXES BUG D-34.  REPORTS EV-A AND EV-B COULD NOT BE PRODUCED
*/ TOGETHER IF COMPONENT COSTS WERE INPUT IN ECONOMICS.  THIS BUG WAS
*/ REPORTED AND FIXED BY T.G. TRUONG AT THE MINISTRY OF WORKS AND
*/ DEVELOPMENT, NEW ZEALAND. (APRIL 12, 1986)
*/
*D EVRPT.67
      GO TO 301
*/
*/ ALSO REMOVE AN UNWANTED PAGE EJECT AT THE END OF EV-B.
*/
*D EVRPT.124,EVRPT.125

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--


*/
*/ THIS FIXES BUG D-35.  WHEN METRIC OUTPUT IS USED, THE ECONOMICS
*/ REPORTS REMAIN IN ENGLISH (THEY WERE NEVER CONVERTED).  THIS
*/ MOD CONVERTS THOSE FEW ITEMS THAT NEED IT.  THIS MOD IS FROM
*/ T.G. TRUONG AT THE MINISTRY OF WORKS AND DEVELPMENT, NEW ZEALAND.
*/ (APRIL 12, 1986)
*/
*AF INPUT,HEADER
*COMDECK /UNITT/
      COMMON /UNITT/   VKONV(80), DUMLOG(4), JUNITT(4,80,2)
*IDENT ECOBG2
*D CTRL.3
     1                IPROG, IFATAL, NAMPRG(3,7), MTRICR
*I EVRPT.2
*CALL,/UNITT/
*D EVRPT.84
      J = 2
      IF (MTRICR .EQ. 1)  J = 1
      WRITE (IOUTPT,320) JUNITT(1,3,J)
*D EVRPT.91
     6       7HCHARGE2,/,14X,1H(,A3,1H),8X,3H($),6X,4HRATE,6X,3H($),
*D EVRPT.118
      EUNIT = UDATA(1,IUT)
      IF (MTRICR .EQ. 1)  CALL KDIV(EUNIT,3,1,0)
      WRITE (IOUTPT,350) (NAMEL(I,IUT),I=1,2),
     1                    EUNIT, (UDATA(I,IUT),I=2,4),
*I ECRPT.289
      IF (MTRICR .EQ. 1)  CALL KDIV(UNIT,3,NUTLTY,0)

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--
```

```
*/
*/ ---------------- FILE DRLC.BUG ---------------
*/
*IDENT DRLCBG1
*/
*/ THIS FIXES BUG D-27.
*/ THE COLUMN LABELED PEAK OVERLOAD IN REPORT PS-D WAS INCORRECTLY
*/ LABELED MBTU INSTEAD OF MBTUH.
*/
*D REPCRD.557
 5000 5000 5000 3400
*D REPCRD.560
10000100001000010000010000   50   50   50   34

---------1---------2---------3---------4---------5---------6---------7--


*/
*/ THIS FIXES BUG D-23.  THE UNITS FOR WW, HOURLY REPORT VARIABLE 38 IN
*/ SYSTEMS AT THE SYSTEMS LEVEL, ARE INCORRECT.  THE UNITS SHOULD BE
*/ LB (KG), NOT FRACTION.
*/
*D HRPCRD.336
  2 10 38 11,1X,F10.1    MOISTURECHANGE     21

---------1---------2---------3---------4---------5---------6---------7--


*/
*/ THIS FIXES BUG D-41.  VERIFICATION REPORTS LV-C AND LV-F SHOW
*/ AN INTERIOR WALL MULTIPLIER, BUT THIS IS NO LONGER A LEGALL
*/ KEYWORD FOR INTERIOR WALLS.  WE ELIMINATE THE MULTIPLIER FROM
*/ BOTH REPORTS AND ADD SURFACE-TYPE TO THE LV-F OUTPUT.  PART
*/ OF THE FIX IS ON LDS.BUG .
*/
*D REPCRD.96,REPCRD.98
(//1X,17HINTERIOR SURFACES//65X,7HU-VALUE/29X,4HAREA/5X,7HSURFACE,14X,
1H(,A4,A1,1H),7X,12HCONSTRUCTION,5X,1H(,3A4,A1,1H),7X,14HADJACENT SPACE,
5X,12HSURFACE-TYPE/)
*D REPCRD.100,REPCRD.103
   1   1   0  20
(5X,4A4,F12.2,7X,4A4,F16.3,7X,4A4,3X,2A4,4A4)
10000100001000010000    91000010000100001000010000    61000010000100001000010000100001000
10000100001000010000
*D REPCRD.205,REPCRD.207
(//100X,15HADJACENT SPACES/1X,7HSURFACE,16X,4HAREA,6X,12HCONSTRUCTION,5X,
12HSURFACE TYPE,20X,7HU-VALUE/1X,4HNAME,16X,1H(,A4,A1,1H),6X,4HNAME,37X,1H(,
3A4,A1,1H),6X,7HSPACE-1,10X,7HSPACE-2/)
*D REPCRD.209,REPCRD.212
   1   1   0  24
(1X,4A4,F11.2,6X,4A4,1X,2A4,4A4,F15.3,6X,4A4,1X,4A4)
10000100001000010000    91000010000100001000010000100001000010000100001000010000    6
10000100001000010000100001000010000100001000010000

---------1---------2---------3---------4---------5---------6---------7--
```

```
*/
*/ ------------------ FILE WTH.BUG ----------------
*/
*IDENT WTHBG1
*/
*/ THIS FIXES BUG D-36.
*/ THE WEATHER PROCESSOR CAN NOT HANDLE SOUTHERN HEMISPHERE WEATHER;
*/ THAT IS, NEGATIVE LATITUDE AND ALL ITS IMPLICATIONS.
*/
*/ ALLOW LATITUDES FROM -90 TO 0.
*/
*D PACKER.152
      CALL VALIDF(XLAT,-90.,90.,NAMS(1,5),STOPIT)
*I STATS.11
*CALL /MONTHC/
*/
*/ FIX THE TIME ZONE FORMAT IN THE STATISTICAL SUMMARY
*/
*D STATS.45
     1        20X,12HTIME ZONE = ,I3)
*/
*/ FIX THE DESIGN TEMPERATURE CALCULATIONS TO WORK FOR BOTH
*/ HEMISPHERES
*/
*D STATS.258,STATS.261
      IF (WLAT .LT. 0.)  GO TO 3020
      GO TO (3000,3000,1040,1040,1040,3050,
     1       3050,3050,3050,1040,1040,3000),I
 3020 GO TO (3050,3050,3050,1040,1040,3000,
     1       3000,3000,1040,1040,1040,3050),I
 3050 DO 1020 J=1,250
*D SUMDT.2
      SUBROUTINE SUMDT(NB,NHRSUM,IT01,IT025,IT05)
*D SUMDT.10
*D WINDT.2
      SUBROUTINE WINDT(NB,NHRWIN,IT99,IT975)
*D WINDT.7,WINDT.8
*D STATS.309,STATS.311
      IF (WLAT .LT. 0.)  GO TO 4000
      NHRSUM = 2928
      NHRWIN = 62 + MDAYS(2)
      NHRWIN = NHRWIN*24
      GO TO 4010
 4000 NHRSUM = 93 + MDAYS(2)
      NHRSUM = NHRSUM*24
      NHRWIN = 2208
 4010 CONTINUE
      CALL SUMDT(NSUMHS,NHRSUM,IT01,IT025,IT05)
      CALL SUMDT(NSMWHS,NHRSUM,ITW01,ITW025,ITW05)
      CALL WINDT(NWINHS,NHRWIN,IT99,IT975)
*D STATS.375
*/
*/ MODIFY THE CLOUD COVER FACTOR TO ALLOW FOR THE SEASON SHIFT IN
*/ THE SOUTHERN HEMISPHERE.
*/
```

```
*I CCEKS.13
      IF (WLAT .LT. 0.)  ISEAS = MOD((ISEAS+1),4) + 1
*/
*/ SHIFT THE EXTINCTION AND DIFFUSE COEFFICIENT CURVES BY 6 MONTHS
*/ IN THE SOUTHERN HEMISPHERE.
*/
*I SUNPRM.19
C
C               SHIFT THE EXINCTION AND DIFFUSE COEFFICIENT CURVES
C               BY 6 MONTHS FOR THE SOUTHERN HEMISPHERE
C
      IF (XLAT .GE. 0.)  GO TO 100
      S1 = -S1
      C1 = -C1
      S3 = -S3
      C3 = -C3
  100 CONTINUE

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--


*/
*/ THIS FIXES BUG D-37.  THE WEATHER PROCESSOR COULD NOT HANDLE
*/ ALL WYEC INPUT FILES.  AT LEAST ONE FILE REQUIRES USING NEXT
*/ HOUR SOLAR DATA, NOT JUST PRESENT AND PREVIOUS HOUR DATA.
*/
*I TRYDCD.26
      DIMENSION ISOLWY(24)
*D TRYDCD.65
      IF (IDOY .NE. IDOYSH(I)) GO TO 1005
      ISHFT = ISSHFT(I)
      IF (ISHFT .GT. 0)  ISHFT = ISHFT - 1
*D TRYDCD.67
*D TRYDCD.105,TRYDCD.106
*D TRYDCD.143,TRYDCD.180
C               STORE THE WYEC SOLAR DATA FOR THE DAY
      ISOLWY(IH) = ITEMP(16)
*D TRYDCD.182
*D TRYDCD.191
*I TRYDCD.192
C               SOLAR FOR WYEC
C               CALCULATE RKT
      DO 1041 IH=1,24
      ISOL(IH) = 0
      IDN(IH) = 0
      RKTS(IH) = 0.
      SOLHOR(IH) = 0.
      DIRN(IH) = 0.
      IF (IH .EQ. 1)  CALL SUNPRM(IDOY,DEABC)
C               GET HOUR ANGLE.  ASSUME SOLAR DATA IS BINNED
C               IN SOLAR TIME.
      UL      = FLOAT(IH) - 12.
      BL      = UL - 1.
C               SUNRISE AND SUNSET HOUR ANGLES
      SSHA    = ACOS(-TAN(STALAT)*TAN(DEABC(1)))/PIOV12
      SRHA    = -SSHA
C               RESET BIN BOUNDARIES TO ALLOW FOR SUNRISE AND SET
      IF ((UL .LE. SRHA) .OR. (BL .GE. SSHA))  GO TO 1041
      IF (SRHA .GT. BL)  BL = SRHA
      IF (SSHA .LT. UL)  UL = SSHA
```

```
      IF ((UL-BL) .LT. 0.02)  GO TO 1041
      IF (ISOLWY(IH+ISHFT) .EQ. 0)  GO TO 1041
      IF (ISOLWY(IH+ISHFT) .EQ. NOTTHR(16))  RKTS(IH) = IUNDEF
      IF (ISOLWY(IH+ISHFT) .EQ. NOTTHR(16))  GO TO 1041
      A       = SIN(DEABC(1))*SIN(STALAT)
      B       = COS(DEABC(1))*COS(STALAT)
C               GET SOLAR CONSTANT.  THIS FORMULA IS FROM DUFFIE AND
C               BECKMAN, PAGE 7.
      SOLCON = 436.8*(1. + 0.033*COS(DTOR*360.*FLOAT(IDOY)/365.))
C               INTEGRATE SOLAR Z DIREC. COSINE OVER BIN
      COSZIN = A*(UL-BL) + B*(SIN(PIOV12*UL)-SIN(PIOV12*BL))/PIOV12
      SOLH   = SOLCON*COSZIN
      SOLHM  = FLOAT(ISOLWY(IH+ISHFT))*0.3686691
      SUNSUM = SUNSUM + SOLHM
      RKTS(IH) = AMIN1(SOLHM/SOLH,0.9)
C               IF (IMNTH .NE. 5)  GO TO 1041
C               PRINT 9004,IH,IDAY,MNAMES(IMNTH),ITEMP(16),ISHFT,IDOY
 9004 FORMAT(1H ,9HIH     = ,I11,10X,9HIDAY   = ,I11,10X,9HMNAMES = ,
     1       7X,A4,10X,9HITMP16 = ,I11/1H ,9HISHFT  = ,I11,10X,
     2       9HIDOY   = ,I11)
 1041 CONTINUE
C               REBIN WYEC SOLAR DATA


----+----1----+----2----+----3----+----4----+----5----+----6----+----7--
```

```
*/
*/ ------------------ FILE SYS.BUG ----------------
*/
*IDENT SYSBG1
*/
*/ THIS FIXES BUG D-7.  FOR A SUNSPACE WITH MORE THAN ONE INTERIOR WALL,
*/ THE FOLLOWING QUANTITIES ARE INCORRECTLY FILLED FOR THE SECOND AND
*/ SUBSEQUENT INTERIOR WALLS IF THESE WALLS ARE DELAYED:  ABSORBED
*/ SOLAR RADIATION, WINDOW CONDUCTANCE, AND TRANSMITTED SOLAR RADIATION.
*/ (ECW 2-85)
*/
*D HOURIN.159
      DO 544 ICW=1,NCW
*D HOURIN.171
  540 CONTINUE
      NRESF = <NRESFAC>
      MTW = MTW + 36 + 7*NRESF
  544 CONTINUE

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--
```

```
*/
*/ THIS FIXES BUG D-8.  IN THE DELAYED INTERIOR WALL CONDUCTION CALC
*/ FOR SUNSPACES, THERE WAS A SIGN ERROR IN THE EXPRESSION FOR B1
*/ (+<RFCOMRATIO> INSTEAD OF -) AND THE PREVIOUS-HOUR RATHER THAN
*/ CURRENT-HOUR OUTSIDE SURFACE TEMP WAS USED IN CALCULATING QIN,
*/ THE INSIDE SURFACE HEAT FLUX. (FCW 2-8-85)
*/
*I SSFCOR.250
C               OUTSIDE SURFACE TEMP THIS HOUR
      TOTNEW = C4 + C5*TINNEW
*D SSFCOR.241,242
      B1 = <TLOADS>*(RFX1-RFY1) + TNEXT*FC - STOUTX + STINY
     1         - <RFCOMRATIO>*QOUTXS + QSUNO
*D SSFCOR.259,260
      QIN = (TOTNEW-<TLOADS>)*RFY1 - (TINNEW-<TLOADS>)*RFZ1
     1          + STOUTY - STINZ + <RFCOMRATIO>*QINXS
*D SSFCOR.266,267
```

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--

```
*/
*/ THIS FIXES BUG D-9.  IN THE SUNSPACE CALCULATION, IF A SUNSPACE AND
*/ ITS ADJACENT SPACES WERE ON DIFFERENT SYSTEMS, THE PROGRAM WOULD
*/ PRINT -NO ZP1-ZP2NXT MATCH IN SUBROUTINE SSFCOR- AND THEN ABORT.
*/ THIS FIX ALLOWS SUNSPACE AND ADJACENT ROOMS TO BE SERVED BY
*/ DIFFERENT SYSTEMS (FCW 4-2-85).
*/
*D SSFCOR.134,144
      NPLSAV = NPL
      NPSSAV = NPS
      IPSSAV = IPS
      NSPSAV = NSP
      DO 200 NP1 = 1,NPLANT
      NPL = IP + (NP1-1)*PSS
      NPS = <NPLSYS>
      IPS = <IPLSYS>
      DO 250 NS1 = 1,NPS
      NSP = IA(IPS+NS1-1)
      NSZ1 = <NZONES>
      ZP1 = <ISZONES>
      DO 301 NZ1 = 1,NSZ1
      IF (<ZP2>.EQ.ZP2NXT) GO TO 302
  301 ZP1 = ZP1 + NZD
  250 CONTINUE
  200 CONTINUE
      CALL MSGSIM(-1,I,I,I,I)
      WRITE (IOUTPT,1301)
 1301 FORMAT(41H NO ZP1-ZP2NXT MATCH IN SUBROUTINE SSFCOR)
      CALL ABT
  302 CONTINUE
      ZP1NXT = ZP1
      ZP1 = IZP1T
      NPL = NPLSAV
      NPS = NPSSAV
      IPS = IPSSAV
      NSP = NSPSAV
```

---------1----+----2----+----3----+----4----+----5----+----6----+----7--

```
*/
*/ THIS FIXES BUG D-10.
*/ PREVENT VERY SMALL HEATING LOADS FROM ACTIVATING THE HEAT PUMP
*/
*D HPUNIT.22
      IF(TLOAD .GE. -1.0)  GO TO 30

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--


*/ --- ************************************************************************
*/ --- ***************** release tape checkpoint 1 ********************************
*/ --- ************************************************************************
*/
*/ THIS FIXES BUG D-17.  FOR SYSTEM TYPES DDS, MZS, AND PMZS, THE
*/ HOURLY REPORT VARIABLE 35 (SYSTEM LEVEL) WR, THE RETURN AIR
*/ RATIO, CAN BE INCORRECTLY REPORTED WHEN IT SHOULD BE AT ITS
*/ MINIMUM VALUE.  THE CALCULATION IS NOT AFFECTED.
*I DDSF.235
      WR = WRMIN

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--


*/
*/ THIS FIXES BUG D-26.  FOR SYSTEM = SUM, TAVE, THE AVERAGE ZONE
*/ TEMPERATURE IS NEVER SET.  THIS MEANS THAT ON THE HOURLY REPORTS
*/ VARIABLE 31 AT THE ZONE LEVEL IN SYSTEMS ALWAYS PRINTS OUT AS
*/ 0 DEGREES F OR -17.8 DEGREES C.
*/
*I SUM.39
      TAVE = (<TNOW>+<TPAST>)*0.5

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--


*/
*/ THIS FIXES BUG D-32.  THIS MOD IMPROVES THE ERROR MESSAGE
*/ GIVEN FROM THE HOURIN SUBROUTINE DUE TO A ZONE NOT BEING
*/ ASSIGNED A SYSTEM.  THE FIX IS FROM T.G. TRUONG, AT THE
*/ MINISTRY OF WORKS AND DEVELOPMENT, WELLINGTON, NEW ZEALAND.
*/ FIX A BUG AND BECOME FAMOUS!
*/
*D HOURIN.141,HOURIN.142
      NMZP2 = ZP2 + 3
      WRITE (IOUTPT,5301)  (IA(N99),N99=ZP2,NMZP2)
 5301 FORMAT(//6H ZONE ,4A4,29H IS NOT SERVED BY ANY SYSTEM. //)

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--
```

```
*/ THIS FIXES BUG D-41.  WHEN AN INDUCTION UNIT (TPIU OR FPIU) WAS
*/ CHOSEN IN SYSTEMS, AND SUPPLY-CFM WAS INPUT, THE BASEBOARD-RATING
*/ WAS ADDED TWICE TO <ERMIND>, PRODUCING AN INCORRECT NUMBER
*/ FOR THE ZONE HEAT ADDITION RATE REPORTED IN SV-A.  THIS BUG
*/ WAS REPORTED AND FIXED BY ISIDORE MARCUS AT EMPA IN SWITZERLAND.
*/ YET ANOTHER FAMOUS USER!
*/
*I DESIGN.1315
      IF (IUNIT .EQ. 3)  GO TO 53

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--

*/
*/ ---------------- FILE KEY.BUG ----------------
*/
*IDENT KEYBG1
*/
*/ THIS FIXES BUG D-40.  THE LINE OF CODE IN THE HELP SUBROUTINE
*/ THAT CHECKS FOR A ZERO UNITS TABLE POINTER IS IN THE WRONG
*/ PLACE.  CONSEQUENTLY THIS POINTER IS NOT RESET, AND THE ZEROTH
*/ ENTRY IS SOMETIMES PRINTED, WHICH INFREQUENTLY SCRAMBLES THE
*/ PRINTED OUTPUT.
*/
*D HELP.45,HELP.46
      IUN    = KONTXT(7,JKEY)
      IF (IUN .LT. 1)  IUN = 1

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--

*/
*/ ----------------- FILE PLT.BUG ---------------
*/
*IDENT PLTBG1
*/
*/ THIS FIXES BUG D-29.  WHEN THERE IS MORE THAN ONE RUN PERIOD
*/ PER MONTH (EXCLUSIVE OF DESIGN DAY RUN PERIODS), SOME YEARLY
*/ QUANTITIES IN THE BEPS AND PS-D REPORTS ARE CALCULATED INCORRECTLY.
*/ THE MONTHLY SUMS ARE ADDED IN MORE THAN ONCE, IE., DOUBLE COUNTING
*/ TAKES PLACE.  THIS BUG IS IN ALL VERSIONS OF DOE-2. (FB 4/3/86)
*/
*D PLANT.558,PLANT.565
      IF (IEODMR .EQ. 3)  GO TO 800
C END OF MONTH; SUM MONTHLY STATISTICS.
      CALL STATSM
C RECORD OPERATION THIS MONTH
      MONRUN(IMO) = 1
      GO TO 30
  800 CONTINUE
C END OF RUN PERIOD (AND POSSIBLY OF MONTH ALSO).
C IF THE NEXT RUN PERIOD STARTS IN THE SAME MONTH, KEEP GOING
      IF ((JRUNPD .LT. NRUNPD) .AND.
     1    (IRUNPD(4,JRUNPD) .EQ. IRUNPD(1,JRUNPD+1)))
     2 GO TO 20
C OTHERWISE SUM THE MONTHLY STATISTICS
      CALL STATSM
      MONRUN(IMO) = 1
      GO TO 20

----+----1----+----2----+----3----+----4----+----5----+----6----+----7--
```