THE DOE–2 USER NEWS

PUB-439

DOE-2: A COMPUTER PROGRAM FOR BUILDING ENERGY SIMULATION

Vol. 11, No. 2

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☞ ☞ HANDS ON ☜ ☜

☞ DOE-2's COMBINE Program

COMBINE, a utility program for the VAX and SUN versions of DOE-2.1D, brings together multiple sets of saved SYSTEMS output files into two new files suitable for input to the PLANT subprogram. Right now, COMBINE is only available on a floppy disk, but we plan to incorporate it into DOE-2 in the near future. If you would like to try COMBINE, send either a 5-1/4 or 3-1/2 floppy disk to Fred Buhl at Lawrence Berkeley Laboratory.

☞ Conferences and Workshops

Aug 26-Sep 1 — *ACEEE 6th Summer Study*
to be held at the Asilomar facility in Pacific Grove, California. Sponsor: American Council for an Energy Efficient Economy. Contact Ed Vine for Proceedings, Bldg 90, Rm 4000 Lawrence Berkeley Laboratory, 1 Cyclotron Road, Berkeley, CA 94720.
Phone: (415) 486-7478 or FAX (415) 486-5172.

Sep 10-14, 1990 — *Psychrometric Processes and Load Calculations*
Part of a Ten-Course Series on Air Conditioning Design sponsored by the University of Wisconsin. Contact: Engineering Registration, The Wisconsin Center, 702 Langdon St., Madison, WI 53706. Phone: (608) 262-1299.

Oct 8-12, 1990 — *Refrigeration and Air Handling Equipment*
Part of a Ten-Course Series on Air Conditioning Design sponsored by the University of Wisconsin. Contact: Engineering Registration, The Wisconsin Center, 702 Langdon St., Madison, WI 53706. Phone: (608) 262-1299.

This work was supported by the Assistant Secretary for Conservation and Renewable Energy, Office of Buildings Technology, Building Systems and Materials Division of the U. S. Department of Energy, under Contract No. DE-AC03-76SF00098.

DOE-2.1D Basic Manual

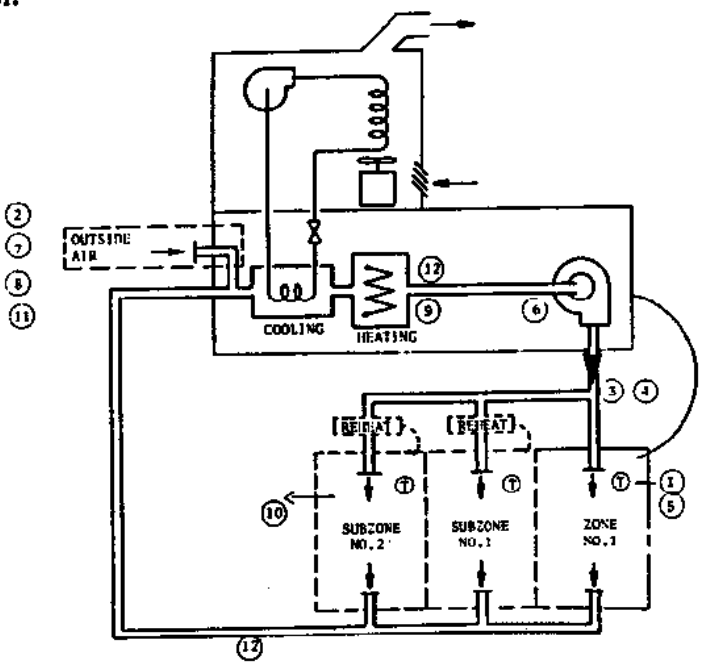
The Simulation Research Group has prepared a *Basic Manual*, which covers the essentials of preparing standard DOE-2 inputs. In late July, the *Basic Manual* was sent out for review; October is the targetted printing date. Availability of the Manual will be announced in the User News.

We are planning to excerpt sections from the *Basic Manual* chapter on System Types in this issue and in the next issue of the User News. For each system type the following information will be presented: (1) a short description of the system; (2) a schematic diagram of the system, on which we have keyed the system components to their associated keywords; (3) a suggested minimal input for a 1-zone building; and (4) a listing of additional capabilities for the system and the keywords that enable them. In this issue we present system types PSZ, PMZS, and PVAVS.

Packaged Single Zone Air Conditioner with Heating and Subzone Reheating Options (PSZ)

This hybrid system/plant, usually larger than a PTAC, cools by the direct expansion of a refrigerant and may optionally heat with gas, hot water, or an electric resistance heater. This unit is normally considered a commercial unit. It provides constant volume air to a control zone and constant- or variable-air volume flow to optional subzones. If the user desires to have variable volume air to all zones, that can be modeled by using the PVAVS system. This forced-air packaged unit may be either a unitary system (roof-top unit or outside-the-wall unit) or it may be a split unit (partially inside and partially outside). It may or may not require ducting. In its most basic configuration the PSZ system consists of a compressor, an air-cooled condenser, an evaporator with a fan supplying cooled air to the indoors, a filter (not shown), and a thermostat. The PSZ unit can optionally be specified with a central heating device, subzone reheating device(s), outside ventilation air, and economizer cooling. The supply fan may be either a blowthrough or a drawthrough fan, with the fan motor either inside or outside the air stream. The condenser fan operates automatically on demand. An exhaust air fan and/or a return air fan may optionally be specified. The thermostat may be specified with night setback and night cycle control.

Items shown within dashed boxes are optional components



SUGGESTED MINIMAL INPUT for PSZ

```
INPUT SYSTEMS  ..
                  $ SYSTEMS SCHEDULES

FANS-ON =    SCHEDULE THRU DEC 31 (WD)   (1,7)(0) (8,18)(1)
                                         (19,24)(0)
                                  (WEH)  (1,24)(0)  ..

COOLSETPT = SCHEDULE THRU DEC 31 (WD)    (1,7)(99) (8,18)(76)
                                         (19,24)(99)
                                  (WEH)  (1,24)(99)  ..

HEATSETPT = SCHEDULE THRU DEC 31 (WD)    (1,7)(55) (8,18)(72)
                                         (19,24)(55)
                                  (WEH)  (1,24)(55)  ..


OFFICE = ZONE        DESIGN-HEAT-T       =   72
                     DESIGN-COOL-T       =   74
                     HEAT-TEMP-SCH       =   HEATSETPT
                     COOL-TEMP-SCH       =   COOLSETPT (1)
                     OA-CFM/PER          =   15 .. (2)

AC-SYST = SYSTEM     SYSTEM-TYPE         =   PSZ
                     MAX-SUPPLY-T        =   110 (3)
                     MIN-SUPPLY-T        =   55 (4)
                     NIGHT-CYCLE-CTRL    =   CYCLE-ON-FIRST (5)
                     FAN-SCHEDULE        =   FANS-ON (6)
                     OA-CONTROL          =   TEMP (7)
                     ECONO-LIMIT-T       =   60 (8)
                     HEAT-SOURCE         =   GAS-FURNACE (9)
                                             $ alternately, use HEAT-PUMP,
                                             $ ELECTRIC, or HOT-WATER
                     ZONE-NAMES          =   (OFFICE) ..
SYSTEMS-REPORT       SUMMARY             =   (SS-A,SS-H,SS-O)

END ..
COMPUTE SYSTEMS ..
INPUT PLANT ..
PLANT-REPORT SUMMARY = (BEPS) ..
SHW = PLANT-EQUIPMENT   TYPE = DHW-HEATER   SIZE = -999 ..
END ..
COMPUTE PLANT ..
```

Additional Capabilities for PSZ system:

1) To enable an exhaust fan add the keywords EXHAUST-CFM = Value (CFM) and EXHAUST-KW = Value (.0001 is typical) to the ZONE keyword list. (10)

2) To disable the economizer change the OA-CONTROL = TEMP to OA-CONTROL = FIXED. (11)

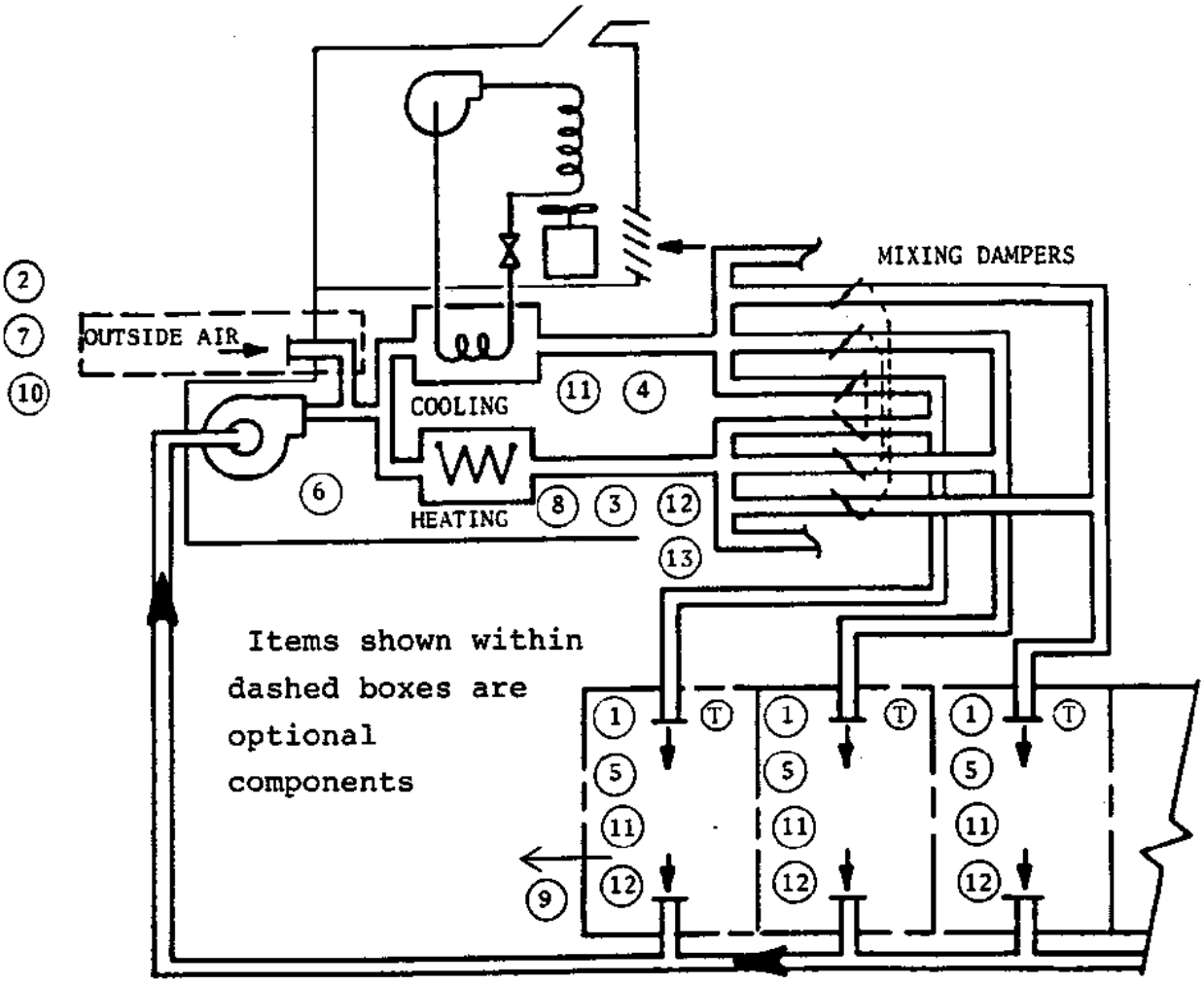
3) To enable control of maximum humidity and use compressor superheat for reheat, insert MAXIMUM-HUMIDITY = Value (60% is allowed under the new ASHRAE 90.1P Standard) and also MAX-COND-RCVRY = Value (.5 is typical) in the SYSTEM keyword list. (12)

4) If HOT-WATER is the type of HEAT-SOURCE selected, the user must also insert a hot water generator in PLANT.

Packaged Multizone Fan System (PMZS)

The PMZS is a multizone constant-volume forced-air system (actually a hybrid system/plant) that cools by the direct expansion of a refrigerant and heats with gas, hot water, or an electric resistance heater. The unit may have heat recovery from condenser coils. The PMZS normally consists of a manufacturer-matched set of components within a single enclosure that is normally rooftop mounted but it may instead be a split unit (partially inside and partially outside.) In its most basic configuration the PMZS consists of one or more refrigeration compressors, one or more air-cooled condensers with a fan discharging heat to the outdoors, one or more evaporators with a fan supplying cooled air to the indoors, a heating device, a filter (not shown), and a thermostat in each zone. The PMZS can optionally be specified with outside ventilation air, economizer cooling, an exhaust fan and a return fan. It has a blowthrough fan, with the fan motor either in the airstream or outside the airstream. The condenser fan operates automatically on demand. The thermostat may be specified with night setback and night cycle control.

In the DOE-2 simulation of the PMZS there is individual control of temperature in the different zones. In the simulation there is no preconditioning of outside ventilation air.



SUGGESTED MINIMAL INPUT for PMZS

```
INPUT SYSTEMS  ..
                  $ SYSTEMS SCHEDULES

FANS-ON =    SCHEDULE THRU DEC 31 (WD)   (1,7)(0) (8,18)(1)
                                         (19,24)(0)
                                  (WEH)  (1,24)(0)  ..

COOLSETPT = SCHEDULE THRU DEC 31 (WD)    (1,7)(99) (8,18)(76)
                                         (19,24)(99)
                                  (WEH)  (1,24)(99)  ..

HEATSETPT = SCHEDULE THRU DEC 31 (WD)    (1,7)(55) (8,18)(72)
                                         (19,24)(55)
                                  (WEH)  (1,24)(55)  ..


OFFICE = ZONE        DESIGN-HEAT-T       =   72
                     DESIGN-COOL-T       =   74
                     HEAT-TEMP-SCH       =   HEATSETPT (1)
                     COOL-TEMP-SCH       =   COOLSETPT
                     OA-CFM/PER          =   15 .. (2)

AC-SYST = SYSTEM     SYSTEM-TYPE         =   PMZS
                     MAX-SUPPLY-T        =   110 (3)
                     MIN-SUPPLY-T        =   55 (4)
                     NIGHT-CYCLE-CTRL    =   CYCLE-ON-ANY (5)
                     FAN-SCHEDULE        =   FANS-ON (6)
                     OA-CONTROL          =   TEMP
                     ECONO-LIMIT-T       =   60 (7)
                     HEAT-SOURCE         =   ELECTRIC (8)
                     ZONE-NAMES          =   (OFFICE) ..
SYSTEMS-REPORT       SUMMARY             =   (SS-A,SS-H,SS-O)

END ..
COMPUTE SYSTEMS ..
INPUT PLANT ..
PLANT-REPORT SUMMARY = (BEPS) ..
SHW = PLANT-EQUIPMENT   TYPE = DHW-HEATER   SIZE = -999 ..
END ..
COMPUTE PLANT ..
```

Additional Capabilities for PMZS system:

1) To enable an exhaust fan add the keywords EXHAUST–CFM = Value (CFM) and EXHAUST–KW = Value (.0001 is typical) to the ZONE keyword list. (9)

2) To disable the economizer change the OA–CONTROL = TEMP to OA–CONTROL = FIXED. (10)

3) To simulate a discriminator control of the cold deck supply air temperature add COOL–CONTROL = WARMEST to the SYSTEM keyword list. (11)

4) To simulate a discriminator control of the hot deck supply air temperature add HEAT–CONTROL = COLDEST to the SYSTEM keyword list. (12)

5) Alternatives to items 3 and 4 above are RESET of cold and hot deck supply air temperature. An example of this control is is covered in the *Sample Run Book* 31-Story Office Building, Run 1.

6) To simulate turning "off" the hot deck whenever the outside temperature is above 65F, insert a new schedule like this: (13)

HEAT–OFF = SCHEDULE THRU DEC 31 (ALL) (1,24) (65) ..

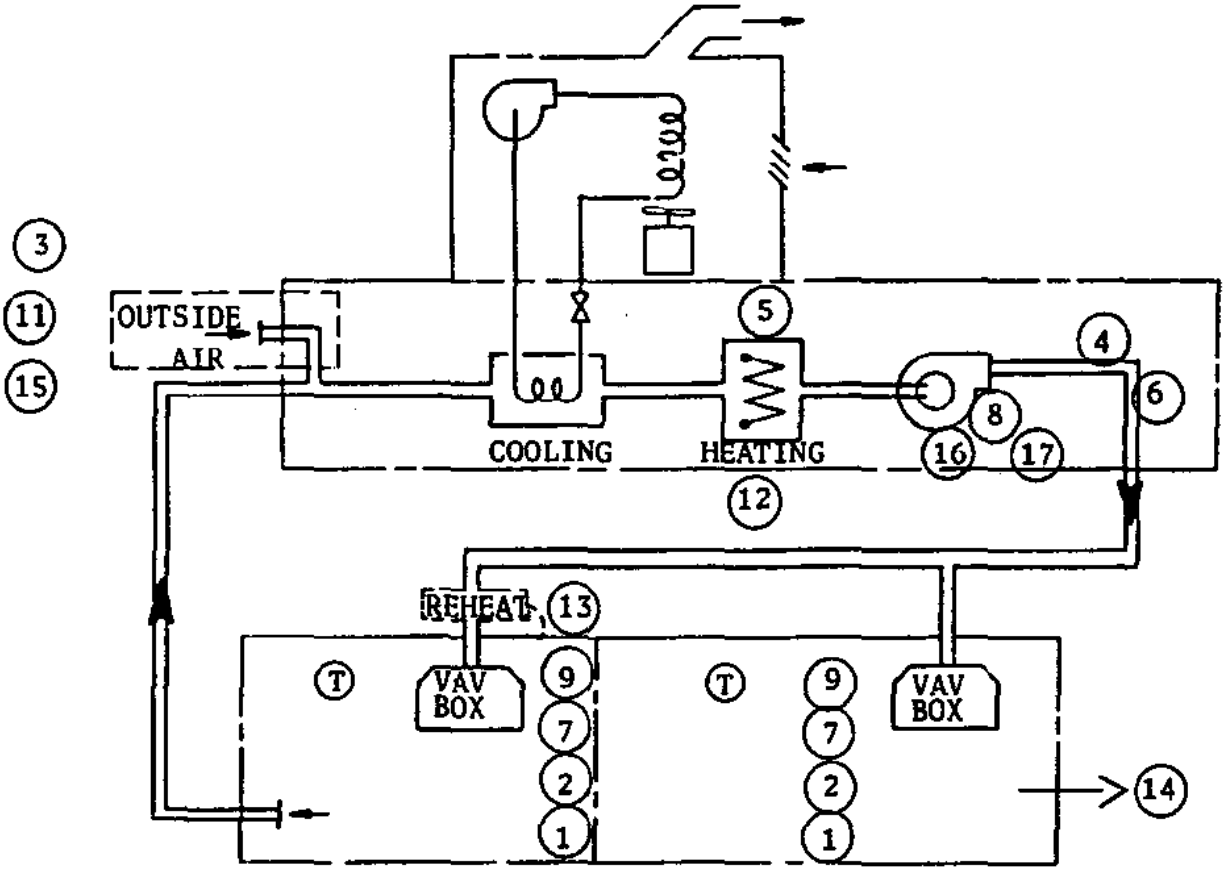
and add

HEATING–SCHEDULE = HEAT–OFF

to the SYSTEM keyword list.

Packaged Variable-Air-Volume System (PVAVS)

This is a variable-volume system/plant that cools the zones by direct expansion of a refrigerant and optionally heats the zones with gas, fuel oil, hot-water, or an electric resistance heater. In the cooling mode the supply air temperature is usually constant and the volume of air is varied from minimum to maximum to satisfy the zone requirements. In the heating mode the supply air temperature is varied in response to the zone requirements and the volume of air is held at the minimum (constant). In its most basic configuration the PVAVS system consists of a compressor, an air-cooled condenser with a fan discharging heat to the outdoors, an evaporator with a fan supplying cooled air to the indoors, reheat coils at the ZONE level, a filter (not shown), variable-volume control boxes, and thermostats. The PVAVS unit can optionally be specified with outside ventilating air, an exhaust fan, a return air fan, and economizer control. The supply fan may be either a blowthrough or a drawthrough fan, with the fan motor either in the airstream or outside the airstream. The thermostat may be specified with night setback and night cycle control.



Items shown within dashed boxes are optional components

SUGGESTED MINIMAL INPUT for PVAVS

```
INPUT SYSTEMS  ..
                $ SYSTEMS SCHEDULES

FANS-ON =    SCHEDULE THRU DEC 31 (WD)   (1,7)(0) (8,18)(1)
                                         (19,24)(0)
                                  (WEH)  (1,24)(0)  ..

COOLSETPT = SCHEDULE THRU DEC 31 (WD)    (1,7)(99) (8,18)(76)
                                         (19,24)(99)
                                  (WEH)  (1,24)(99)  ..

HEATSETPT = SCHEDULE THRU DEC 31 (WD)    (1,7)(55) (8,18)(72)
                                         (19,24)(55)
                                  (WEH)  (1,24)(55)  ..

OFFICE = ZONE          DESIGN-HEAT-T       =   72
                       DESIGN-COOL-T       =   74
                       HEAT-TEMP-SCH       =   HEATSETPT (1)
                       COOL-TEMP-SCH       =   COOLSETPT
                       THERMOSTAT-TYPE     =   REVERSE-ACTION (2)
                       OA-CFM/PER          =   15 .. (3)

AC-SYST = SYSTEM       SYSTEM-TYPE         =   PVAVS
                       MAX-SUPPLY-T        =   110 (4)
                       HEAT-SET-T          =   70 (5)
                       MIN-SUPPLY-T        =   55 (6)
                       NIGHT-CYCLE-CTRL    =   CYCLE-ON-ANY (7)
                       FAN-SCHEDULE        =   FANS-ON (8)
                       MIN-CFM-RATIO       =   .3 (9)
                       REHEAT-DELTA-T      =   55 (10)
                       OA-CONTROL          =   TEMP
                       ECONO-LIMIT-T       =   60 —— (11)
                       HEAT-SOURCE         =   ELECTRIC (12)
                       ZONE-HEAT-SOURCE    =   ELECTRIC (13)
                       ZONE-NAMES          =   (OFFICE) ..
SYSTEMS-REPORT         SUMMARY             =   (SS-A,SS-H,SS-O)

END ..
COMPUTE SYSTEMS ..
INPUT PLANT ..
PLANT-REPORT SUMMARY = (BEPS) ..
SHW = PLANT-EQUIPMENT   TYPE = DHW-HEATER   SIZE = -999 ..
END ..
COMPUTE PLANT ..
```

Additional Capabilities for PVAVS

1) To enable an exhaust fan add the keywords EXHAUST–CFM = Value (CFM) and EXHAUST-KW = Value (.0001 is typical) to the ZONE keyword list. (14)

2) To enable a humidifier which requires heat to evaporate water into the air add MIN-HUMIDITY = Value (25% is typical) to the SYSTEM keyword list.

3) To enable heat recovery to exchange relief air heat with outside air heat add RECOVERY-EFF = Value (0.6% is typical) to the SYSTEM keyword list.

4) To disable the economizer change the OA–CONTROL = TEMP to OA–CONTROL = FIXED. (15)

5) To enable variable speed control of the fan motor, insert FAN–CONTROL = SPEED to the SYSTEM keyword list. (16)

6) To simulate riding the fan curve with neither inlet vanes nor speed control, insert FAN–CONTROL = DISCHARGE to the keyword list. (17)

National Energy Software Center

The National Energy Software Center at Argonne National Laboratory is the software exchange and information center for the U.S. Dept. of Energy and the Nuclear Regulatory Commission. NESC distributes all types of software, including energy simulation programs like DOE-2 and BLAST. NESC has a Software Subscription Service through which organizations may obtain programs. The Software Subscription Service works like this: NESC is required to recover their operating expenses, so they request that organizations with a continuing interest in DOE- and NRC-sponsored software register to participate in the NESC program. Registered installations pay an annual subscription fee to cover the costs of providing NESC publications, special information services, and two library software packages of their choice during the year. Copies of additional packages are supplied to subscribers upon payment of the relevant package charges. NESC breaks down users into three classes of organizations, as follows:

Type of Organization	NESC Classification	Initial Subscription Fee	Annual Renewal Fee
Federal agencies, DOE and NRC cost-type contractors (excluding fixed-price contractors), local and state governments, educational and non-profit organizations in North America.	1	$3,000.	$2,500.
Commercial organizations in North America	2	$3,760.	$3,130.
Organizations outside North America	3	$5,635.	$4,695.

Some of the programs available from NESC are:

PASOLE	a general simulation program for analyzing thermal performance of passive solar heated buildings
TDIST3	analyzes large integrated community total energy systems that supply thermal and electrical energy from one or more power stations
CONTROLITE1.0	a lighting energy analysis program designed to calculate the energy savings and cost benefits from use of lighting controls in buildings
ASEAM2.1	a modified bin temperature program for calculating the energy consumption of residential and simple commercial buildings
SERI-RES	performs thermal analysis of residential and small commercial buildings -- can model passive solar equipment such as rock beds, trombe walls, etc.

For more detailed information on NESC, contact Ms. Margaret Butler, National Energy Software Center, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439; phone: (708) 972-7250.

The Windows and Daylighting Group at LBL has put together a **Daylighting Design Tool Survey**. Periodic updates will be printed in the User News. For more information, contact Michael Wilde, Bldg. 90 -- Room 3111, Windows and Daylighting Group, Lawrence Berkeley Laboratory, Berkeley, CA 94720.

Daylighting Design Tool Survey

MAINFRAMES

- **DOE-2.1D**
  Simulation Research Group, Lawrence Berkeley Laboratory, Berkeley, CA 94720; phone (415) 486-5711. Contact: Kathy Ellington

  Daylighting and glare calculation integrated with hourly energy simulation and window management.
  Hardware: DEC and SUN-4
  Software: FORTRAN
  Cost and Availability: call or write for information

- **MUSES**
  School of Architecture, University of Texas, Austin, TX 78712; phone (512) 471-3148. Contact: Francisco Arumi

  Three levels of energy lighting analysis incorporated into a 3-D solid modeling program. Knowledge-based CAD. Analysis component based on DEROB.
  Hardware: SUN or Unix workstations with X Windows.
  Software: C
  Cost and Availability: call or write for information

- **RADIANCE**
  Lighting Systems Research Group, Lawrence Berkeley Laboratory, 1 Cyclotron Road, Bldg 90-3111, Berkeley, CA 94720; phone (415) 486-4757. Contact: Greg Ward

  A ray tracing program that accurately predicts light levels and produces photo realistic images of architectural space in all sky conditions.
  Hardware: SUN, DEC, CRAY, UNIX, Macintosh II (A/UX)
  Software: C
  Cost and Availability: Free to anyone who wishes to develop further.

- **SUPERLITE 1.0**
  College of Architecture and Environmental Design, Arizona State University, Tempe, AZ 85287; phone (602) 965-8756. Contact: Jong-Jin Kim

  Allows modeling of complex building interior and exterior geometry; accurate calculation of internally reflected daylight component.
  Hardware: CDC, DEC, Apollo
  Software: FORTRAN — 370K
  Cost and Availability: $ 25.00 for manual and program.

- **UWLIGHT**
  Dept. of Architecture, Gould Hall JO-20, University of Washington, Seattle, WA 98105; phone (206) 543-4180. Contact: Brian Johnson

  Useful as an educational tool.
  Hardware: CDC
  Software: FORTRAN 5
  Cost and Availability: call or write for information

MINICOMPUTERS

- **SHIS/DAYLIGHT**
  S&H Information Systems, 11 West 42nd Street, New York, NY 10036; phone (212) 556-3251. Contact: Suro Das.

  Calculates lighting energy savings due to daylight from vertical openings on the basis of ratio of wall to glazing areas.
  Hardware: Microvax 3800
  Software: FORTRAN
  Cost and Availability: $600.00

MICROS

- **AAMASKY1 and SKYLIGHT HANDBOOK**
  AAMA, 2700 River Road, Suite 118, Des Plaines, IL 60018; phone (708) 699-7310.

  Skylight design analysis with emphasis on optimizing for energy efficiency, incorporating both a worksheet and Lotus spread sheet tool.
  Hardware: IBM PC or compatible
  Software: Lotus 1-2-3
  Cost and Availability: $100.00/software package plus $50.00/handbook (half price for AAMA members)

- **AWNSHADE 1.0**
  Florida Solar Energy Center, 300 State Road 401, Cape Canaveral, FL 32920; phone (407) 783-0300. Contact: Ross McCluney

  Calculates the unshaded fraction of a rectangular window shaded by an awning for any given solar position.
  Hardware: DOS-based IBM PC or compatible
  Software: Microsoft, QuickBASIC 3.0
  Cost and Availability: $25.00

- **BUILDING ENERGY ESTIMATION MODULE (BEEM)**
  Ross & Baruzzini, Inc., 1304 Baur Street, St. Louis, MO 63132; phone (314) 241-5001. Contact: Maurice Garoutte

  Useful in early design stages; evaluates energy impact of different types of windows.
  Hardware: IBM PC, IBM PCXT. Needs two disk drives for graphics.
  Software: BASIC, 128K
  Cost and Availability: $350.00

- **CONTROLITE 1.0**
  Lighting Systems Research, Lawrence Berkeley Laboratory, 1 Cyclotron Road, Bldg 90-3111, Berkeley, CA 94720; phone (415) 486-4096. Contact: Francis Rubinstein

  Calculates energy savings and cost-benefit of using lighting controls in buildings. QUICK-LITE incorporated.
  Hardware: IBM PC XT, IBM PC AT or true compatible
  Software: 256K, PCDOS 2.0 or later
  Cost and Availability: $ Free. No support.

- **DAYLIT**
  Southern California Edison, Customer Energy Services, P.O. Box 800, 2244 Walnut Grove Avenue, Rosemead, CA 91770; phone (818) 302-3210. Contact: Gregg D. Ander

  Calculates daylight considering fins, overhangs, skylights and light shelves. Calculates electric light for three zones with five control strategies. Plots hourly and annually data, based on IES method.
  Hardware: IBM PC or compatible
  Software: FORTRAN, 256K - DOS 3.0
  Cost and Availability: $ Free for Beta Testers. Manual on disk. Send two formatted 5 1/4" disks.

- **DAYLITE 2.0**
  Solarsoft, 12672 Skyline Boulevard, Woodside, CA 94062; phone (415) 851-4484. Contact: Bill Ashton

  Daylighting design takes into account overhangs, fins, and skylights; calculates electric lighting demand.
  Hardware: IBM PC or compatible, MacIntosh
  Software: PASCAL
  Cost and Availability: $489.00

- **ENSAR**
  Ensar Group, P.O. Box 1898, Arvada, CO 80001; phone (303) 423-5512. Contact: Greg Franta

  Used with physical model; analysis capability flexible to room configurations.
  Hardware: Custom built
  Software: Custom built
  Cost and Availability: call or write for information

- **LUMEN MICRO**
  Lighting Technologies, 2540 Frontier Street, Suite 107, Boulder, CO 80301; phone (303) 449-5791. Contact: David DiLaura

  Analyzes complex interior lighting systems including daylight, direct/indirect lighting, mixed and even aimed luminaires. User friendly input.
  Hardware: IBM PC or compatible
  Software: FORTRAN
  Cost and Availability: $14.95. Free upgrade of new AutoCAD-based version of program.

- **MICRO-DOE2**
  Acrosoft International, 9745 E. Hampden Avenue, #230, Denver, CO 80231; phone (303) 368-9226. Contact: Gene Tsai.

  Micro version of DOE-2.1D mainframe program, with enhancements.
  Hardware: *Regular DOS Version*, IBM PC, XT, AT or Compaq 386 compatibles, Intel Math-coprocessor
  Software: 640KB RAM, DOS 2.1 or later
  Cost and Availability: $495.00 with two free weather data files.

  Hardware: *Extended DOS Version*, Compaq 386 compatibles Intel or Weitek Math coprocessor.
  Software: 3 MB RAM, DOS 3.0 or later
  Cost and Availability: $625.00 with two free weather data files.

- **MICROLITE 1.0**
  Department of Architecture, Graduate School of Design, Harvard University, 48 Quincy Street, Cambridge, MA 02138; phone (617) 495-9741. Contact: Harvey Bryan

  Analyzes the daylight illumination for rectangular rooms with vertical glazing in exterior walls. Obstructions are not accounted for.
  Hardware: IBM PC, APPLE II
  Software: IBM 128K, APPLE: 40K BASIC
  Cost and Availability: $25.00

- **QUICKLITE 1.0**
  Windows & Daylighting Group, Lawrence Berkeley Laboratory, 1 Cyclotron Road, Bldg 90-3111, Berkeley, CA 94720; phone (415) 486-5605.

  A relatively quick, crude estimator of daylight levels in simple rectangular rooms. See CONTROLITE.
  Hardware: TRS 80, TI-59
  Software: BASIC, FORTRAN
  Cost and Availability: $ Free. No support.

- **SUPERLITE PC 1.0.1**
  College of Architecture and, Environmental Design, Arizona State University, Tempe, AZ 85287; phone (602) 965-8756. Contact: Jong-Jin Kim

  A modularized version of SUPERLITE 1.0; maximum number of nodes on windows and interior surfaces reduced for memory size. See SUPERLITE 1.0.
  Hardware: IBM XT or AT with 8087 math coprocessor chip or compatible.
  Software: FORTRAN 3.2 Compiler, 600 K
  Cost and Availability: $25.00 for manual and program.

- **WINDOW 3.1**
  Bostik Construction Products, P.O. Box 8, Huntingdon Valley, PA 19006; phone (800) 523-6530 toll free, or within PA (215) 674-5600

  A public-domain program developed by Lawrence Berkeley Laboratory for analyzing heat transfer through window systems. U-value and shading co- efficient are calculated.
  Hardware: IBM PC or compatible.
  Software: DOS 2.1 or higher; math coprocessor decreases calculation time. 256 KB RAM
  Cost and Availability: Free

PROTRACTORS/TABLES

- **CLEAR SKY DAYLIGHT TABLES**
  Graduate School of Design, Harvard University, 48 Quincy Street, Cambridge, MA 02138; phone (617) 495-9741. Contact: Harvey Bryan

  Determines sky component contribution to the illumination of an interior point for a given window geometry and glazing description. Most useful at an early design stage, when scale drawings are not available yet.
  Cost and Availability: $25.00

- **CLEAR SKY WALDRAM DIAGRAMS**
  Graduate School of Design, Harvard University, 48 Quincy Street, Cambridge, MA 02138; phone (617) 495-9741. Contact: Harvey Bryan

  Assist in determination of sky component contribution to the illumination of an interior point, accounting for angle of incidence losses for vertical glazing and obstructions. Graphic method is useful in early design stages.
  Cost and Availability: $25.00

- **DAYLIGHT FACTOR DOT CHARTS**
  Concepts and Practice of Architectural Daylighting, by Fuller Moore, Van Nostrand Reinhold Co. New York, NY, 1985, pp. 234-242.

  Determines sky component of the daylight factor at a given interior reference point through overlay with an obstruction mask.
  Cost and Availability: approximately $30.00 for the book

- **LBL PROTRACTORS**
  Graduate School of Design, Harvard University, 48 Quincy Street, Cambridge, MA 02138; phone (617) 495-9741. Contact: Harvey Bryan

  Allows for determination of the sky component contribution to the illumination of an interior point for an interior point of finite height under overcast sky conditions.
  Cost and Availability: $25.00

- **LUME PROTRACTOR**
  Lighting Research Laboratory, P.O.Box 6193, Orange, CA 92613-6193; phone (714) 771-1312. Contact: Bill Jones

  Useful in early design analysis.
  Cost and Availability: $5.00

- **UW GRAPHIC DAYLIGHTING DESIGN METHOD (GDDM)**
  College of Architecture and Urban Planning, Gould Hall JO-20, University of Washington, Seattle, WA 98105; phone (206) 543-4180. Contact: Marietta Millet

  Determines daylight patterns for a room based on the proportions of the window openings, providing illumination level, distribution and gradient.
  Cost and Availability: $ 30.00

NOMOGRAPHS

- **DAYLIGHTING NOMOGRAPHS**
  Windows & Daylighting Group, Lawrence Berkeley Laboratory, 1 Cyclotron Road, Bldg 90-3111, Berkeley, CA 94720; phone (415) 486-5605.

  Assist designers in determining potential daylighting benefits and costs; checking strategy for energy conservation and load management.
  Cost and Availability: Free, no support.

- **ENERGY NOMOGRAPHS**
  Burt Hill Kosar Rittelmann, 400 Morgan Center, Butler, PA 16001; phone (412) 285-4761. Contact: Al Sain

  Useful in early design analysis on commercial buildings; capable of total building energy analysis, including savings from daylight and heating/cooling loads.
  Cost and Availability: $50.00 for notebook and enlarged, reusable nomograph set from: TVA, Div of Conservation and Energy Management, Commercial and Industrial Branch, 35-D Signal Place, Chattanooga, TN 37401.

- **ENERGY NOMOGRAPHS**
  Ross & Baruzzini, Inc., 1304 Baur Street, St. Louis, MO 63132; phone (314) 241-5001. Contact: Maurice Garoutte

  Cost and Availability: See the MICROCOMPUTERS Section

■ ■ ■ ■ DOE-2 DIRECTORY ■ ■ ■ ■

Program Related Software and Services

■■ SOURCE CODE ■■

DOE-2.1C and 2.1D Mainframe
Ms. Margaret Butler
National Energy Software Center
Argonne National Laboratory
9700 South Cass Avenue
Argonne, IL 60439
Phone: (708) 972-7250

■■ SOFTWARE ■■

DOE-2.1D for Micros (MICRO-DOE2)
Acrosoft International
9745 East Hampden Avenue
Denver, CO 80231
Phone: (303) 368-9225

DOE-2.1D for Micros (ADM-DOE2)
ADM Associates, Inc.
3299 Ramos Circle
Sacramento, CA 95827
Phone: (916) 363-8383

■■ VIDEO ■■

DOE-2 Instructional Video and Manual
Prof. Jan Kreider
Joint Center for Energy Management
University of Colorado at Boulder
Campus Box 428
Boulder, CO 80309-0428

■■ UTILITY PROGRAMS ■■

Graphs from DOE-2
Ernie Jessup
4977 Canoga Avenue
Woodland Hills, CA 91364
Phone: (818) 884-3997

■■ CONSULTANTS ■■

Mechanical Engineers, Consulting, DOE-2 Training
Chuck Sherman - Marlon Addison
Energy Simulation Specialists #230
64 East Broadway
Tempe, AZ 85282
Phone: (602) 967-5278

Consulting Engineers
Craig Cattelino
Burns & McDonnell Engineers
8055 E. Tufts Ave. -- #330
Denver, CO 80237
Phone: (303) 721-9292

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

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

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

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

■ ■ ■ ■ DOE-2 PROGRAM DOCUMENTATION ■ ■ ■ ■

National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161

	NTIS Order No.	Shipments Within The U.S.	Shipments Outside The U.S.
[ ] 2.1C source code*	DE-830-48782	$2,490.00	$4,980.00
[ ] Complete 2.1D Documentation [includes PB-901-43074]	PB-852-11449	319.00	635.00
[ ] 2.1D Update Package	PB-901-43074	112.50	225.00
[ ] Engineers Manual (2.1A) [not included with PB-852-11449]	DE-830-04575	45.00	90.00
To Order by Separate Titles:			
[ ] BDL Summary [2.1D]	DE-890-17726	23.00	46.00
[ ] Users Guide [2.1A]	LBL-8689, Rev.2.	53.00	106.00
[ ] Sample Run Book [2.1D]	DE-890-17727	53.00	106.00
[ ] Reference Manual [2.1A]	LBL-8706, Rev.2	109.00	218.00
[ ] DOE-2 Supplement [2.1D]	DE-890-17728	55.95	111.90

* 2.1C and 2.1D Source Code may be also be ordered from the National Energy Software Center in Argonne, IL. Phone Ms. Margaret Butler at (708) 972-7250 for details on obtaining DOE-2 and NESC's Software Purchase plan.

For phone orders using Visa or Mastercard (703) 487-4650 or FAX (703) 321-8547
Overnight Express — 24-hr in-house processing — $22 surcharge per title
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■ ■ Weather Tapes ■ ■

To order TMY or TRY tapes:
National Climatic Data Center
Federal Building
Asheville, North Carolina 28801
Phone: (704) 259-0682

To order CTZ tapes:
California Energy Commission
Attn: Bruce Maeda, MS-25
1516-9th Street
Sacramento, CA 95814-5512
Phone: (404) 636-8400

To order WYEC tapes:
ASHRAE
1791 Tullie Circle N.E.
Atlanta, GA 30329
Phone: (404) 636-8400

■ ■ User News ■ ■

To be put on the newsletter distribution list, to submit articles, corrections or updates to documentation, or for DOE-2 program questions, please call or write:

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