```
SYSTEMS-REPORT  SUMMARY = (SS-A) ..

P1              =PLANT-ASSIGNMENT  SYSTEM-NAMES = (AC-SYST)
                                   DHW-GAL/MIN  = .222
                                   DHW-SCH      = DHW ..

END ..
COMPUTE SYSTEMS ..



INPUT PLANT ..

P1              =PLANT-ASSIGNMENT ..

SHW             =PLANT-EQUIPMENT   TYPE = DHW-HEATER
                                   SIZE = -999 .. $ AUTO SIZED

HWG             =PLANT-EQUIPMENT   TYPE = HW-BOILER
                                   SIZE = -999 ..

CHLR            =PLANT-EQUIPMENT   TYPE = HERM-REC-CHLR
                                   SIZE = -999 ..

PLANT-PARAMETERS  HERM-REC-COND-TYPE = AIR .. $ AIR COOLED CONDENSER

PLANT-REPORT      SUMMARY = (BEPS) ..

END ..
COMPUTE PLANT ..



INPUT ECONOMICS ..

BLC             =BLOCK-CHARGE      BLOCK1-TYPE = ENERGY
                                   BLOCK1-DATA = (800,.075,
                                                 1200,.095,
                                                    1,.10) ..

ELECT-RATE      =UTILITY-RATE      RESOURCE = ELECTRICITY
                                   BLOCK-CHARGES = (BLC) ..

GAS-RATE        =UTILITY-RATE      RESOURCE = NATURAL-GAS
                                   ENERGY-CHG = .62 ..

ECONOMICS-REPORT  SUMMARY = (ES-D) ..

END ..
COMPUTE ECONOMICS ..
STOP ..
```

Sample Output

The following pages show the output reports generated by the sample input for Chicago weather.

SIMPLE EXAMPLE FOR DOE-2 BASICS DOE-2.1E-005 Tue Mar 29 13:02:28 1994LDL RUN 1

REPORT- LS-C BUILDING PEAK LOAD COMPONENTS WEATHER FILE- TRY CHICAGO

*** BUILDING ***

FLOOR AREA	5000 SQFT	465 SQMT
VOLUME	40000 CUFT	1133 CUMT

	COOLING LOAD	HEATING LOAD
TIME	JUL 9 4PM	JAN 12 8AM
DRY-BULB TEMP	94F 34C	-7F -22C
WET-BULB TEMP	74F 23C	-7F -22C

	SENSIBLE (KBTU/H)	SENSIBLE (KW)	LATENT (KBTU/H)	LATENT (KW)	SENSIBLE (KBTU/H)	SENSIBLE (KW)
WALL CONDUCTION	4.361	1.278	0.000	0.000	-8.498	-2.490
ROOF CONDUCTION	56.769	16.633	0.000	0.000	-65.669	-19.241
WINDOW GLASS+FRM COND	6.007	1.760	0.000	0.000	-22.272	-6.526
WINDOW GLASS SOLAR	29.400	8.614	0.000	0.000	2.582	0.757
DOOR CONDUCTION	0.766	0.224	0.000	0.000	-1.755	-0.514
INTERNAL SURFACE COND	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURF COND	-1.500	-0.440	0.000	0.000	-7.500	-2.197
OCCUPANTS TO SPACE	10.479	3.070	8.056	2.360	0.525	0.154
LIGHT TO SPACE	21.836	6.398	0.000	0.000	2.744	0.804
EQUIPMENT TO SPACE	11.061	3.241	0.000	0.000	0.889	0.261
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	0.000	0.000	0.000	0.000	-19.196	-5.624
TOTAL	139.182	40.780	8.056	2.360	-118.149	-34.618
TOTAL LOAD	147.238 KBTU/H		43.141 KW		-118.149 KBTU/H	-34.618 KW
TOTAL LOAD / AREA	29.45BTU/H.SQFT		92.873 W /SQMT		23.630BTU/H.SQFT	74.524 W /SQMT

NOTE 1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR LOADS
2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION IN CONSIDERATION

REPORT- SV-A SYSTEM DESIGN PARAMETERS AC-SYST WEATHER FILE- TRY CHICAGO

SYSTEM NAME	SYSTEM TYPE	ALTITUDE MULTIPLIER	FLOOR AREA (SQFT)	MAX PEOPLE
AC-SYST	SZRH	1.020	5000.0	45.

SUPPLY FAN (CFM)	ELEC (KW)	DELTA-T (F)	RETURN FAN (CFM)	ELEC (KW)	DELTA-T (F)	OUTSIDE AIR RATIO	COOLING CAPACITY (KBTU/HR)	SENSIBLE (SHR)	HEATING CAPACITY (KBTU/HR)	COOLING EIR (BTU/BTU)	HEATING EIR (BTU/BTU)
6918.	5.311	2.4	0.	0.000	0.0	0.134	256.389	0.699	-342.822	0.00	0.37

ZONE NAME	SUPPLY FLOW (CFM)	EXHAUST FLOW (CFM)	FAN (KW)	MINIMUM FLOW RATIO	OUTSIDE AIR FLOW (CFM)	COOLING CAPACITY (KBTU/HR)	SENSIBLE (SHR)	EXTRACTION RATE (KBTU/HR)	HEATING CAPACITY (KBTU/HR)	ADDITION RATE (KBTU/HR)	MULTIPLIER
OFFICE	6918.	0.	0.000	1.000	927.	0.00	0.00	141.97	0.00	-283.93	1.0

SIMPLE EXAMPLE FOR DOE-2 BASICS DOE-2.1E-005 Tue Mar 29 13:02:28 1994SDL RUN

REPORT- SS-A SYSTEM MONTHLY LOADS SUMMARY FOR AC-SYST WEATHER FILE- TRY CHICAGO

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.00000					0.000	-35.811	7	8	-1.F	-1.F	-312.633	4632.	16.811
FEB	0.00000					0.000	-28.390	11	8	5.F	4.F	-293.867	4001.	16.811
MAR	0.00000					0.000	-17.126	25	8	14.F	12.F	-262.729	4111.	16.811
APR	1.78727	29	16	68.F	63.F	106.217	-3.525	8	8	30.F	27.F	-189.422	4095.	16.811
MAY	5.14632	21	14	85.F	75.F	166.823	-0.806	13	8	43.F	40.F	-78.441	4106.	16.6
JUN	17.22312	20	16	90.F	77.F	197.350	0.000	17	8	54.F	48.F	-0.084	3754.	16.811
JUL	32.87729	8	16	92.F	74.F	216.134	0.000					0.000	4106.	16.811
AUG	27.99474	19	15	90.F	71.F	199.028	0.000					0.000	4106.	16.811
SEP	11.44625	11	15	87.F	72.F	165.944	-0.435	23	8	36.F	34.F	-116.905	3754.	16.811
OCT	3.03459	30	15	74.F	66.F	87.558	-2.720	21	8	30.F	29.F	-208.883	4106.	16.811
NOV	0.51546	1	15	71.F	59.F	83.303	-15.157	25	8	27.F	25.F	-231.982	3705.	16.811
DEC	0.00000					0.000	-29.037	26	8	15.F	15.F	-279.563	4419.	16.811
TOTAL	100.025						-133.006						48901.	
MAX						216.134						-312.633		16.811

ENERGY TYPE: UNITS: MBTU	ELECTRICITY	NATURAL-GAS
CATEGORY OF USE		
AREA LIGHTS	74.7	0.0
MISC EQUIPMT	35.9	0.0
SPACE HEAT	8.5	204.3
SPACE COOL	30.4	0.0
HEAT REJECT	5.1	0.0
PUMPS & MISC	3.9	0.0
VENT FANS	56.2	0.0
DOMHOT WATER	0.0	51.7
TOTAL	214.8	256.0

TOTAL SITE ENERGY	470.82 MBTU	94.2 KBTU/SQFT-YR GROSS-AREA	94.2 KBTU/SQFT-YR NET-AREA
TOTAL SOURCE ENERGY	900.50 MBTU	180.1 KBTU/SQFT-YR GROSS-AREA	180.1 KBTU/SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.5
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.0

NOTE: ENERGY IS APPORTIONED HOURLY TO ALL END-USE CATEGORIES.

SIMPLE EXAMPLE FOR DOE-2 BASICS DOE-2.1E-005 Tue Mar 29 13:02:28 1994EDL RUN

REPORT- ES-D ENERGY COST SUMMARY

UTILITY-RATE	RESOURCE	METERS	METERED ENERGY UNITS/YR	TOTAL CHARGE ($)	VIRTUAL RATE ($/UNIT)	RATE USED ALL YEAR?
ELECT-RATE	ELECTRICITY	1 2 3 4 5	62939. KWH	5982.	0.0950	YES
GAS-RATE	NATURAL-GAS	1 2 3 4 5	2560. THERM	1587.	0.6200	YES
				7569.		

ENERGY COST/GROSS BLDG AREA: 1.51
ENERGY COST/NET BLDG AREA: 1.51

Structure of DOE-2

DOE-2 has five parts, as shown in Fig. 1.2: one program for translation of the input, and four simulation subprograms. The four simulation subprograms are executed in sequence, with the output of one becoming the input to the next. Each of the four simulation subprograms also produces printed reports of the results of its calculations. The subprograms are summarized below:

1) **BDL - The Building Description Language processor**
reads the flexibly formatted data supplied by you and translates it into computer recognizable form. It also calculates response factors for the transient heat flow in walls and weighting factors for the thermal response of building spaces.

2) **LOADS - the loads simulation subprogram**
calculates the sensible and latent components of the hourly heating or cooling load for each user-designated space in the building, assuming that each space is kept at a constant temperature selected by you. LOADS is responsive to weather and solar conditions, to schedules of people, lighting and equipment, to infiltration, to the time delay of heat transfer through walls and roofs and to the effect of building shades on solar radiation.

3) **SYSTEMS - the secondary* HVAC system simulation subprogram**
LOADS produces a first approximation of the energy demands of a building. SYSTEMS corrects this approximation by taking into account outside air requirements, hours of equipment operation, HVAC equipment control strategies, and the transient response of the building when neither heating nor cooling is required to maintain the temperature and humidity setpoints. The output of SYSTEMS is a list of the actual heating and cooling coil loads at the zone and system levels.

4) **PLANT - the primary* HVAC system simulation subprogram**
simulates the behavior of boilers, turbines, chillers, cooling towers, storage tanks, etc., in satisfying the secondary systems heating and cooling coil loads. PLANT takes into account the part-load characteristics of the primary equipment in order to calculate the fuel and electrical demands of the building.

5) **ECONOMICS - the economic analysis subprogram**
calculates the cost of energy. It can be used to compare the costs of different building designs or to calculate savings for retrofits to an existing building.

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* The words *secondary* and *primary* are historical terminology in the U.S. building industry. The "air side" equipment (fans, ducts and coils) is referred to as the "secondary" system; whereas the boilers, chillers and other energy conversion equipment are called "primary".

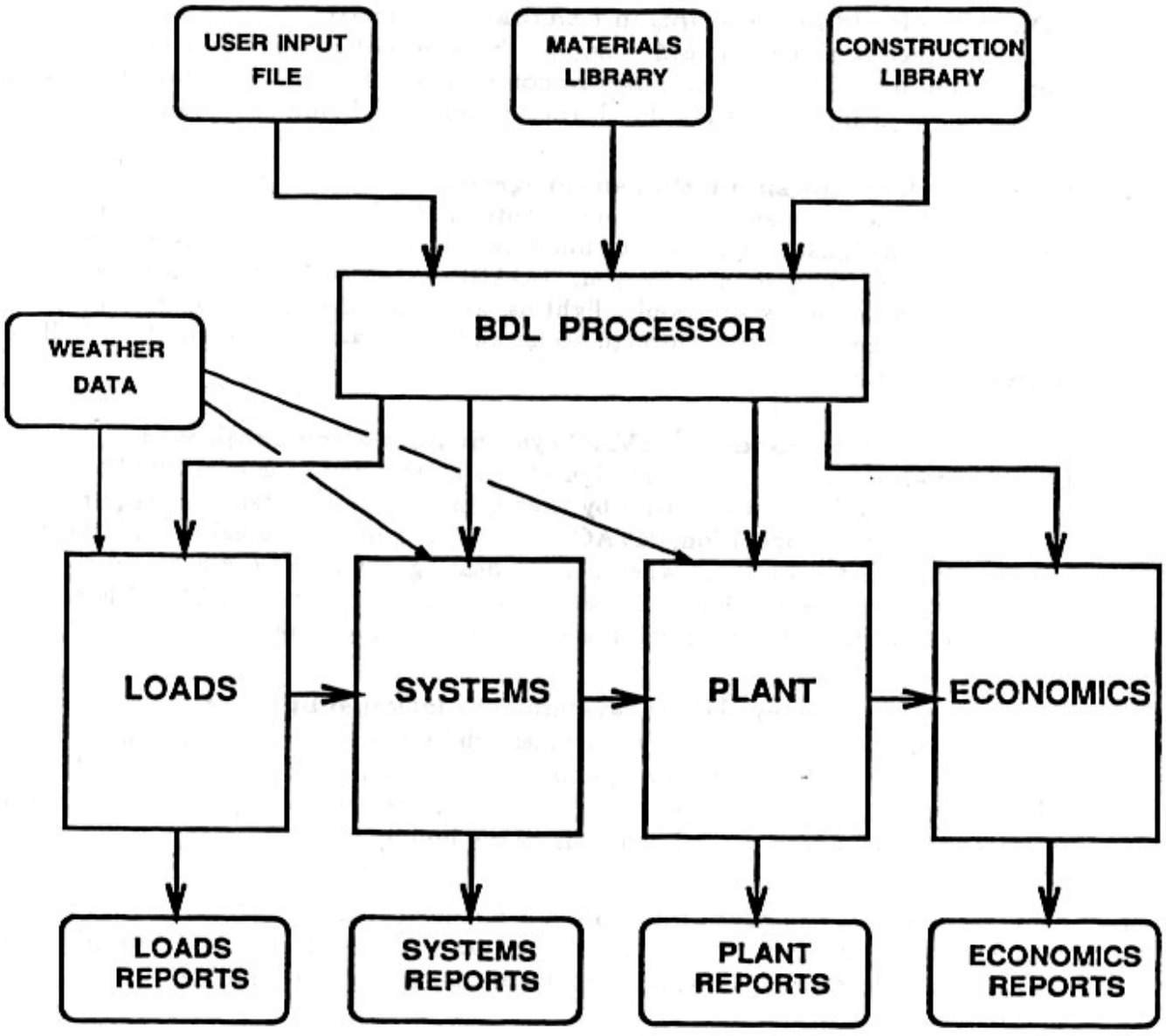

Figure 1.2: DOE-2 Program Flow

Uses for DOE-2

Because of the scope and flexibility of its input, DOE-2 can be used in many applications, especially those involving design of building envelope and systems, and selection of energy conserving or peak demand reduction alternatives. For example:

Energy Conservation Studies

a) Effect of the thickness, order, type of materials, and orientation of exterior walls and roofs;

b) Effect of thermal storage in walls and floors, and in energy storage tanks coupled to HVAC systems;

c) Effect of occupant, lighting, and equipment schedules;

d) Effect of intermittent operation, such as the shutdown of HVAC systems during the night, on weekends, holidays, or for any hour;

e) Effect of reduction in minimum outside air requirements and the scheduled use of outside air for cooling;

f) Effect of internal and external shading, tinted and reflective glass, use of daylighting.

Building Design Studies

a) Initial design selection of the basic elements of the building, primary and secondary HVAC systems, and energy source;

b) During the design stage, evaluating specific design concepts such as system zoning, control strategies, and systems selection;

c) During construction, evaluating contractor proposals for deviations from the construction plans and specifications;

d) A base of comparison for monitoring the operation and maintenance of the finished building and systems;

e) Analysis of existing buildings for cost-effective retrofits.

How Has DOE-2 Been Validated?

DOE-2 has been verified against manual calculations and against field measurements on existing buildings in a DOE-sponsored project conducted by Los Alamos National Laboratory. For more information on program validation, please refer to the following:

- *DOE-2 Verification Project, Phase 1, Interim Report,* Los Alamos National Laboratory, Report No. LA-8295-MS, 1981
- *DOE-2 Verification Project, Phase 1, Final Report,* Los Alamos National Laboratory, Report No. LA-10649-MS, 1986.

These reports are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

Weather Files

The DOE-2 mainframe tape comes with Chicago weather; it also comes with a weather processor program for converting weather tapes into DOE-2 compatible weather files. Users of the PC versions of DOE-2 should contact their vendor for information on weather files. Weather files can be obtained from the following organizations:

TMY or TRY weather tapes

National Climatic Data Center
Federal Building
Asheville, North Carolina 28801
(704) 259-0871 Climate Data
(704) 259-0682 Main Number

CTZ weather tapes

California Energy Commission
Attn: Bruce Maeda, MS-25
1516-9th Street
Sacramento, CA 95814-5512
1-800-772-3300 Energy Hotline

WYEC weather tapes

ASHRAE
1791 Tullie Circle N.E.
Atlanta, GA 30329
(404) 636-8400

Program-Related Software and Services

Each issue of the *User News* contains a directory of software and services pertaining to DOE-2. This listing includes names and addresses of consultants, information on training, where to purchase the PC versions of DOE-2, how to obtain pre- and post-processor software, etc. Because the information is subject to constant change, we decided not to include it in *DOE-2 Basics.*

To get current information, please contact the

Simulation Research Group
Bldg. 90 - Room 3147
Lawrence Berkeley Laboratory
One Cyclotron Road
Berkeley, CA 94720