PLANT-PARAMETERS

PLANT-PARAMETERS is used to change the value of many of the variables used by the PLANT program in the simulation of plant components. Detailed descriptions of how the variables represented by each keyword are used in the PLANT program calculations are provided in the *DOE-2 Engineers Manual*, p.V.12ff. Following is additional discussion of specific keywords.

Chillers

CHILL-WTR-T — is the chilled water temperature at the middle of the throttling range for chillers. Default is 44°F.

MIN-COND-AIR-T — is the minimum entering air temperature allowed for an air-cooled condenser (°F). This is the minimum operating temperature below which control action is initiated to maintain at least this temperature.

ABSOR1-HIR — is the full-load heat input ratio for a 1-stage absorption chiller. The heat input ratio is the ratio of heat energy input to cooling energy output.

ABSOR2-HIR — is the full-load heat input ratio for a 2-stage absorption chiller with an economizer (see ABSOR1-HIR).

ABSORG-HIR — is the full-load heat input ratio for a direct gas fired absorption chiller.

ABSORG-HEAT-XEFF — is the efficiency of the hot water heat exchanger used in the heating mode. The default is 0.8.

ENG-CH-COP — is the overall COP of the engine driven reciprocating chiller, or the evaporator capacity of the chiller divided by the heat input of the engine. The default is 1.4, which is appropriate when the engine operates at nominal speed to meet its design load. A COP in the range of 1.1 to 1.2 should be entered for a machine that is anticipated to operate at full speed to meet the design load.

ENG-CH-COND-TYPE — accepts a code-word that specifies how heat is rejected from the chiller. The default is TOWER and the alternative is AIR (for air cooled).

HERM–CENT–COND–TYPE — accepts a code-word that specifies the condenser heat rejection method for a hermetic centrifugal chiller. The default code-word is TOWER, used when heat is rejected through an evaporative cooling tower. The alternative is AIR, which implies an air-cooled condenser.

HERM–REC–COND–TYPE — is the code-word that specifies the condenser type for a hermetic reciprocating chiller (see HERM–CENT–COND–TYPE keyword description).

DBUN–COND–T–REC — is the leaving condenser temperature when the chiller is in the heat recovery mode. This parameter is used in calculating adjustment factors for the capacity and power consumption. The leaving condenser temperature in both the heat-recovery mode and the non-heat-recovery mode at the design point (calculated from DBUN–COND–T–ENT, ELEC–INPUT–RATIO, and DBUN–TO–TWR–WTR) is used to calculate the condenser temperature rise in the heat recovery mode. The temperature rise is then used in the functions DBUN–CAP–FTRISE and DBUN–EIR–FTRISE.

Towers

MIN–TWR–WTR–T — specifies the minimum temperature for leaving tower cooling water when TWR–SETPT–CTRL = WETBULB–RESET. If the temperature falls below this minimum operating temperature, control action is initiated to maintain at least this temperature. The default is 65°F.

TWR–DESIGN–WETBULB — is the wet-bulb temperature used in the cooling tower design calculations. The default is 78°F.

TWR–CAP–CTRL — accepts a code-word that specifies the control method for regulating the tower water exit temperature. Acceptable values are ONE–SPEED–FAN (the default), TWO–SPEED–FAN, VARIABLE–SPEED–FAN, and FLUID–BYPASS.

TWR–PUMP–HEAD — is the pressure head in the tower water circulation loop. The default is 60ft.

TWR–SETPT–CTRL — accepts a code-word that defines how the exiting water temperature is to be determined. FIXED (the default) controls the tower to the fixed setpoint specified by TWR–WTR–SETPT. WETBULB–RESET causes the setpoint to drop as the wet bulb drops.

TWR–SETPT–T — specifies the exiting water temperature setpoint when TWR–SETPT–CTRL is set to FIXED. The default is 80°F.

Boilers

HW-BOILER-HIR	For a hot-water boiler it is the ratio of fuel input (Btu) to heat energy output at full load.
STM-BOILER-HIR	for a steam boiler it is the ratio of fuel input (Btu) to heat energy output.

Domestic Hot-Water Heaters

DHW-HIR	For a domestic water heater at full load it is the ratio of fuel input (Btu) to heat energy produced.

Pumps

CCIRC-DESIGN-T-DROP	is the temperature drop in the chilled water circulation loop at design; it is used to establish the appropriate water flow rate.
CCIRC-HEAD	is the head pressure in the chilled water circulation loop. Setting this keyword to zero will result in a circulation pump power of zero.
CCIRC-LOSS	is the fraction of the design load in the chilled water circulation loop that is lost to the environment and therefore does no useful cooling.
HCIRC-DESIGN-T-DROP	is the temperature drop in the hot water circulation loop at design conditions. It is used to establish the appropriate water flow rate. This keyword is ignored if you have input a STM-BOILER, ELEC-STM-BOILER, or FURNACE. Note also that the heating load satisfied by a DHW-HEATER or ELEC-DHW-HEATER is not considered to be a part of this heating circulation loop.
HCIRC-HEAD	specifies the head pressure in the hot water circulation loop. If this is set equal to 0., circulation pump power will also be set to zero.
HCIRC-LOSS	is the fraction of the design load that is lost to the environment from the hot water circulation loop and therefore does no useful heating. In the case of a hot water boiler, this value does not include heat gain caused by pump energy. If you have input a FURNACE, this keyword is ignored.
CCIRC-SIZE-OPT	accepts a code-word that indicates how much load the chilled water circulation pumps will be sized to meet. The allowable code-words are SYSTEM-PEAK (the default) and INST-PLANT-EQUIP. Specifying SYSTEM-PEAK will

result in the pumps being sized to meet the peak load passed from SYSTEMS. Specifying INST–PLANT–EQUIP will result in the pumps being sized to meet the total installed capacity of PLANT–EQUIPMENT specified (regardless of whether this equipment was specified by default or input by you).

HCIRC–SIZE–OPT

accepts a code-word that indicates how much load the hot water circulation pumps will be sized to meet. The allowable code-words and definitions are identical to those available for CCIRC–SIZE–OPT.

CCIRC–PUMP–TYPE

accepts a code-word that specifies whether the chilled water circulation pumps are fixed- or variable-speed pumps. The allowable code-words are FIXED–SPEED (the default) and VARIABLE–SPEED. If this keyword is set equal to VARIABLE–SPEED, then losses will be determined on the basis of the actual loads being served by the pumps.

HCIRC–PUMP–TYPE

accepts a code-word that specifies whether the hot water circulation pumps are fixed- or variable-speed pumps. The allowable code-words and definitions are identical to those available for CCIRC–PUMP–TYPE.

CCIRC–MIN–PLR

accepts a numeric value between 0.0^{+} and 1.0 that places a low limit on the electricity consumption of the chilled water circulation pumps. It is expressed as as a fraction of the full load electricity consumption of the pumps. The default is 0.50.

HCIRC–MIN–PLR

accepts a numeric value between 0.0^{+} and 1.0 that places a low limit on the electricity consumption of the hot water circulation pumps. It is expressed as fraction of the full load electricity consumption of the pumps. The default is 0.50.

HEAT–RECOVERY

The HEAT–RECOVERY instruction specifies the equipment or process from which energy can be recovered and directs that energy to a process or other equipment. Only one HEAT–RECOVERY instruction is allowed per PLANT run. If a double-bundle chiller is specified without defining a HEAT–RECOVERY instruction, the heat rejected from the double bundle is delivered only to space heating. See p.V.77ff of the *DOE-2 Engineers Manual* for a description of heat recovery in equipment simulations.

SUPPLY–1 thru SUPPLY–5

You enter a list of code-words that describes the equipment or process that *supplies* recoverable heat. For example

SUPPLY–1 = (DBUN–CHLR)

assigns the waste heat from the double bundle chiller to the highest temperature level to meet demands. Among the chillers in DOE-2, heat can also be recovered from the gas engine chiller, ENG–CHLR.

DEMAND–1 thru DEMAND–5

You enter a list of code-words that describes the equipment or process that *demands* recoverable heat. For example,

DEMAND–1 = (SPACE–HEAT, PROCESS HEAT)

specifies that the heat from the sources indicated in SUPPLY–1 is to go to fulfill the unmet demand for space heating and for domestic hot water or process heat, which will be done in proportion to their corresponding loads.

ENERGY–RESOURCE

ENERGY–RESOURCE allows you to enter information about the types of energy used in PLANT. The instruction can be used to specify up to seven different types of energy. An ENERGY–RESOURCE command must be entered if a steam/hot-water (code-word STEAM) or a chilled water (code-word CHILLED–WATER) utility is to be used.

RESOURCE

accepts a code-word that tells the simulation which fuel or utility will be used. It is assumed that only one type of fuel is used. However, the *Supplement (2.1E)*, p.4.5-6, describes how multiple fuel types may be simulated. Acceptable code-words are these:

CHILLED–WATER
COAL
DIESEL–OIL
ELECTRICITY
FUEL–OIL
LPG
METHANOL
NATURAL–GAS
STEAM

SOURCE–SITE–EFF

is the generating efficiency of the fuel or utility prior to its use in the building being simulated. Failure to specify an ENERGY–RESOURCE command for a fuel or utility will result in the use of the default values for SOURCE–SITE–EFF listed below.

TABLE 4.3
Source-to-Site Generating Efficiency
Default Values for ENERGY–RESOURCE

RESOURCE	SOURCE–SITE–EFF
CHILLED–WATER	1.5*
COAL	1.0
DIESEL–OIL	1.0
ELECTRICITY	0.333
FUEL–OIL	1.0
LPG	1.0
METHANOL	1.0
NATURAL–GAS	1.0
STEAM	0.60**

* Efficient electrically-driven chillers in a central chilled-water plant.

** Steam produced by heat-only boiler in a central steam generation plant.

PLANT–REPORT
This instruction defines which PLANT reports will be output. Users can select from *verification* reports and *summary* reports. Verification reports echo your input; summary reports show calculation results, usually monthly and annually.

Format:

```
PLANT–REPORT    VERIFICATION = (code-word list)
                SUMMARY = (code-word list)  ..
```

Example:

```
PLANT–REPORT    VERIFICATION = (PV–A)
                SUMMARY = (PS–D, BEPS)  ..
```

will print verification report PV–A, "Equipment Sizes", and summary reports PS–D, "Plant Loads Satisfied", and BEPS, "Building Energy Performance Summary".

A definition of all reports, with corresponding code-words, is given in Appendix C.