Packaged Terminal Air Conditioner (PTAC)
PTAC systems are designed primarily for commercial installations to provide total heating and cooling for a room or zone; they are specifically designed for through-the-wall installation. These hybrid system/plant units are mostly used in hotel/motel guest rooms, apartments, hospitals, nursing homes, and office buildings. All PTAC units discharge air directly into the space without ductwork.

PTAC with DX Cooling and Electric Resistance Heating
This particular PTAC provides cooling by the direct expansion of a refrigerant and heating by an electric resistance heater. In its most basic configuration it consists of a compressor, air-cooled condenser with a fan discharging heat to the outdoors, evaporator usually with a two-speed fan supplying cooled air to the indoors, electric heater, filter (not shown), and thermostat. The unit may be specified with outside ventilation air. This PTAC unit has no return fan option and the supply fan is assumed to be a blowthrough type with the fan motor located in the airstream. Optionally, the unit may be specified with a thermostat with night setback.

Note: On the schematic, items shown in dashed boxes are optional components.

BM024

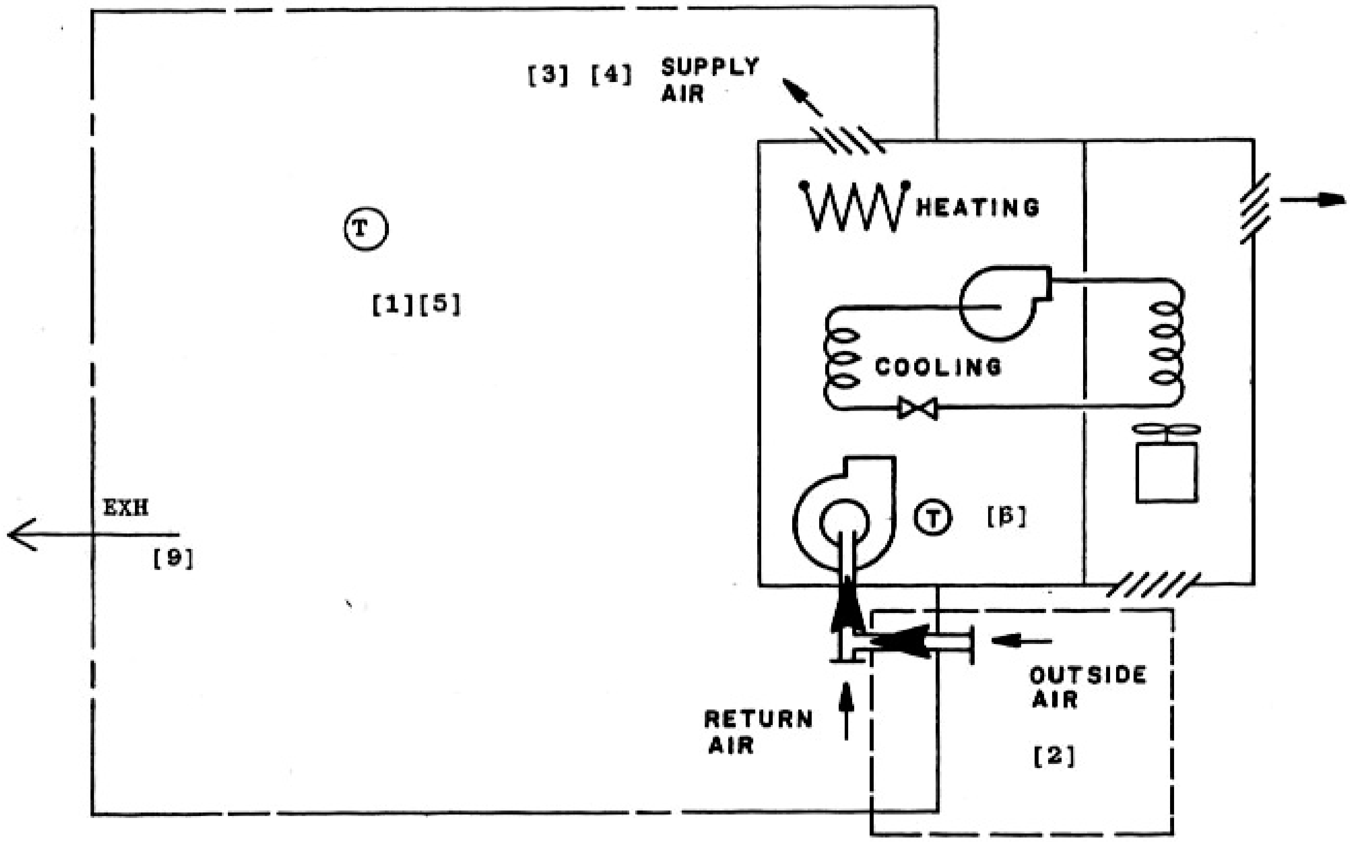

Figure 3.21: PTAC with DX Cooling

PTAC with Air-to-Air Heat Pump:

This type of PTAC provides year-round forced-air heating and cooling. It consists of a single air-to-air heat pump. In its basic configuration the heat pump unit consists of a compressor, four-way valve for reversing the refrigerant flow direction, condenser with fan, evaporator usually with a two-speed fan, filter (not shown), and thermostat. The condenser also serves as an evaporator and the evaporator as a condenser, depending upon whether the unit is in the heating or cooling mode of operation. The unit may be specified with outside ventilation air, in which case the supply fan runs continuously rather than cycling with the compressor. This PTAC has no return fan option; the supply fan is assumed to be a two-speed blowthrough type with the fan motor located in the airstream. Optionally, the unit may be specified with a thermostat with night setback.

Note: On the schematic, items shown in dashed boxes are optional components.

BM025

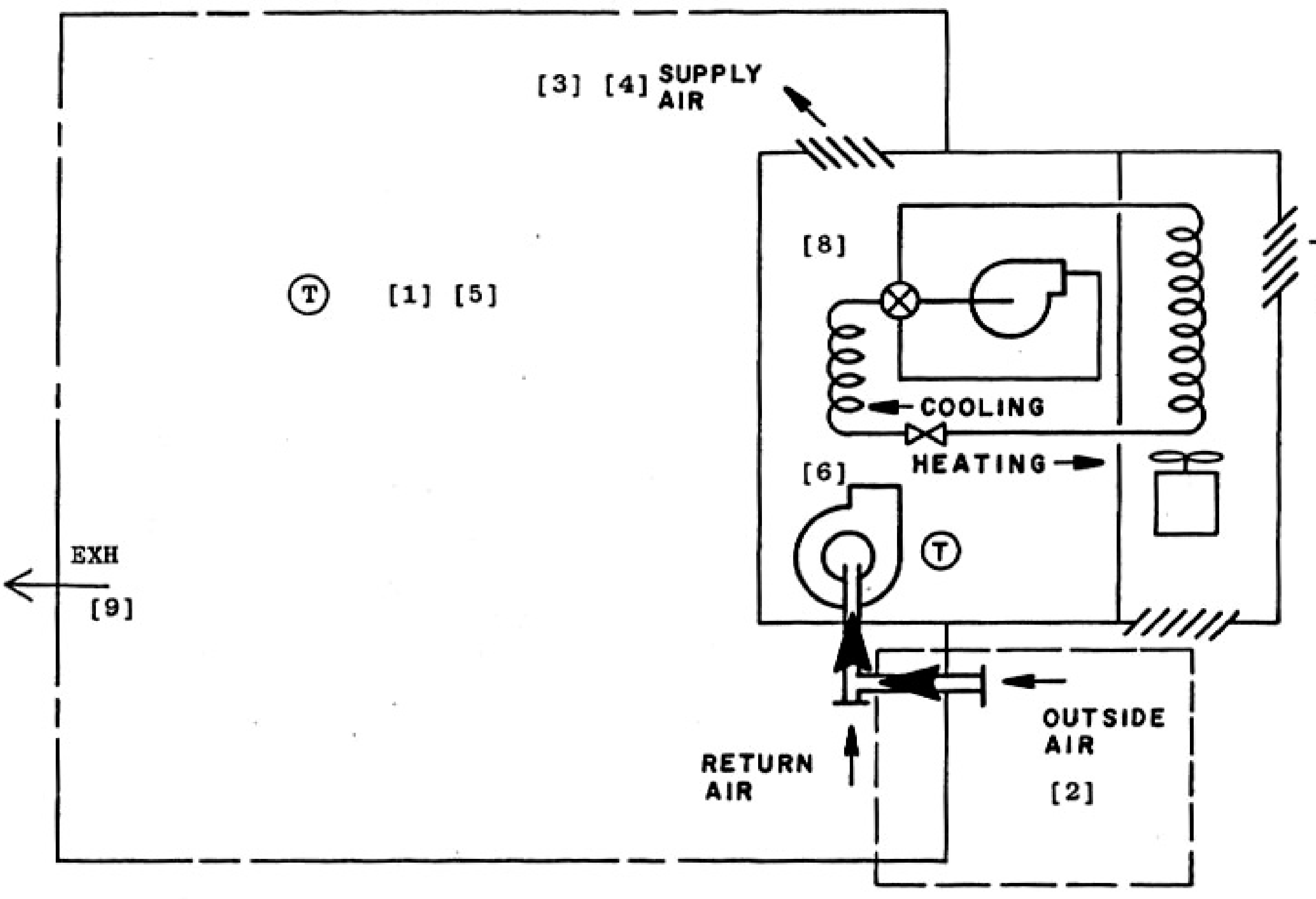

Figure 3.22: PTAC with Air-to-Air Heat Pump

Suggested minimal input for PTAC system:

```
INPUT SYSTEMS ..

SYSTEMS-REPORT   SUMMARY=(SS-A,SS-H,SS-O) ..

                        $ 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) ..

DHW = SCHEDULE THRU DEC 31              (WD)    (1,7)(0)
                                                (8,18)(1.0) (19,24)(0)
                                        (WEH)   (1,24)(0) ..

OFFICE = ZONE             DESIGN-HEAT-T       =   72
                          DESIGN-COOL-T       =   74
                          HEAT-TEMP-SCH       =   HEATSETPT     [1]
                          COOL-TEMP-SCH       =   COOLSETPT     [1]
                          OA-CFM/PER          =   15 ..    [2]
AC-SYST = SYSTEM          SYSTEM-TYPE         =   PTAC
                          MAX-SUPPLY-T        =   110    [3]
                          MIN-SUPPLY-T        =   55     [4]
                          NIGHT-CYCLE-CTRL    =   CYCLE-ON-ANY     [5]
                          FAN-SCHEDULE        =   FANS-ON    [6]
                          HEAT-SOURCE         =   ELECTRIC    [7]
                                                  $ alternatively
                                                  $ HEAT-PUMP      [8]
                          ZONE-NAMES          =   (OFFICE) ..

P1 = PLANT-ASSIGNMENT     SYSTEM-NAMES        =   (AC-SYST)
                          DHW-BTU/HR          =   10000
                          DHW-SCH             =   DHW ..

END ..
COMPUTE  SYSTEMS ..
INPUT  PLANT ..
P1 = PLANT-ASSIGNMENT ..
PLANT-REPORT  SUMMARY = (BEPS) ..
```

```
SHW = PLANT-EQUIPMENT   TYPE = DHW-HEATER   SIZE = -999 ..
END ..
COMPUTE PLANT ..
```

Additional capability for this 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]

Packaged Total Gas Solid Desiccant System (PTGSD)*

This is a new system that has recently appeared on the market. It is a small (5 to 10 ton, 1800 - 3600 cfm) packaged unit that uses a desiccant wheel in conjunction with direct and indirect evaporative cooling, instead of the usual DX coils. It uses a gas-fired hydronic heater to regenerate the desiccant and to provide heating. The result is a unit that primarily consumes gas to provide heating and cooling.

The unit consists of supply and return air fans, a lithium chloride impregnated desiccant wheel, an indirect evaporative cooler, a heating coil, a direct evaporative cooler, and a reactivation air heater coil (see schematic). In the cooling mode, the supply fan blows 100% outside air onto the dry half of the desiccant wheel. Hot, dry air emerges from the other side of the wheel. This air is then cooled by an air-to-air heat exchanger, the other air stream being evaporatively cooled return air. Finally, the air is cooled even further by a direct evaporative cooler. The resulting supply air is then ducted to the zones. Return air is drawn through a direct evaporative cooler and is then heated by passing through the air-to-air heat exchanger (taking heat from the supply air emerging from the desiccant wheel). More heat is added by the reactivation air heater coil. Then, the return air passes through the other half of the wheel, regenerating the desiccant by carrying off the moisture absorbed by the lithium chloride. Finally the return air is exhausted to the outside.

The supply and return fans are assumed to be variable speed. The zone air temperature is controlled by varying the flow of the supply air; the system is a variable air volume system. The first named zone in the ZONE-NAMES list is the control zone.

In the heating mode, the fans are assumed to be at minimum speed. The minimum amount of outside air is brought in, mixed with return air, and heated by the heating coil. The wheel motor, reactivation heater coil, and both humidifiers (direct evaporative coolers) and their pumps are, of course, turned off.

The unit is simulated as operating in several intermediate modes. One such mode is to operate the unit as an evaporative cooler. Only the supply air humidifier and the indirect evaporative cooler (return air humidifier and air-to-air heat exchanger) are operated, no dehumidifying is done, and no gas is consumed. Another mode is to cool with outside air only, or with a mixture of outside and return air. You have no control over which operating mode is selected for each hour time step. The simulation determines which modes are capable of meeting the load and, of these, which is most efficient. Thus, the unit is simulated to use the minimum possible energy.

The PTGSD system MUST be sized by you. The DOE-2 design routine will not estimate a size from the LOAD peaks as it does for other system types. The two keywords required are SUPPLY-CFM (or SUPPLY-FLOW) and HEATING-CAPACITY in the SYSTEM command.

* The desiccant cooling system simulation in DOE-2.1D was developed with the support and collaboration of the Gas Research Institute and the GARD Division of the Chamberlain Manufacturing Corporation.

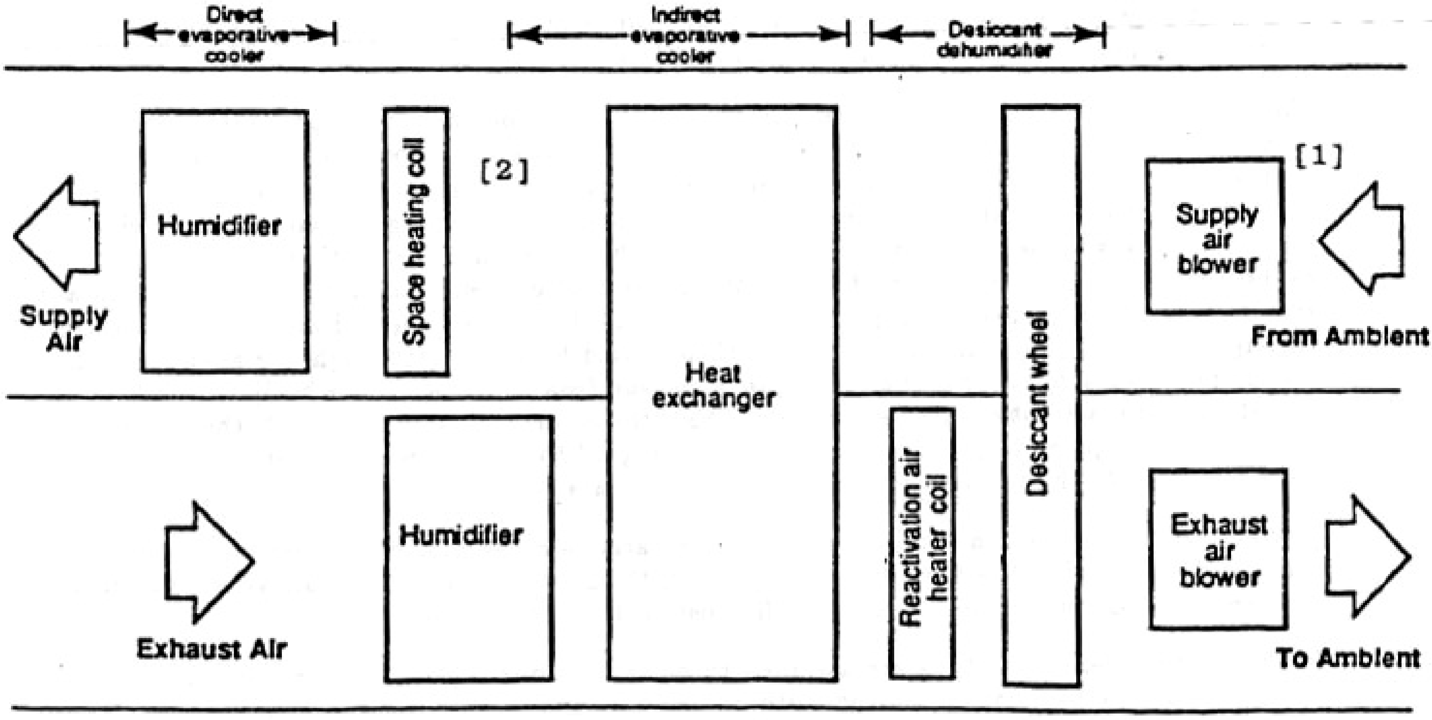

Figure 3.23: Packaged Total Gas Solid Desiccant System

Suggested minimal input for PTGSD system with an economizer:

INPUT SYSTEMS ..

SYSTEMS–REPORT SUMMARY (SS-A,SS-H,SS-O) ..

$ 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) ..

```
DHW = SCHEDULE THRU DEC 31          (WD)    (1,7)(0)
                                            (8,18)(1.0) (19,24)(0)
                                    (WEH)   (1,24)(0) ..

OFFICE = ZONE              DESIGN-HEAT-T        = 72
                           DESIGN-COOL-T        = 74
                           HEAT-TEMP-SCH        = HEATSETPT
                           COOL-TEMP-SCH        = COOLSETPT
                           OA-CFM/PER           = 15
                           BASEBOARD-CTRL       = THERMOSTATIC
                           BASEBOARD-RATING     = -30000 ..

AC-SYST = SYSTEM           SYSTEM-TYPE          = PTGSD
                           FAN-SCHEDULE         = FANS-ON     [1]
                           SUPPLY-CFM           = 5000
                           HEATING-CAPACITY     = -100000    [2]
                           NIGHT-CYCLE-CTRL     = STAY-OFF
                           ZONE-NAMES           = (OFFICE) ..

P1 = PLANT-ASSIGNMENT      SYSTEM-NAMES          =
                           DHW-BTU/HR            =
                           DHW-SCH               =

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

Additional capabilities for this system:

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

2) To limit the maximum humidity level insert MAX-HUMIDITY = 60 (typical) to the SYSTEM keyword list.

3) A fixed outside air system without an economizer is not compatible because the system uses 100% outside air on full cooling.

4) Baseboard heating is advisable because it can provide night heating without cycling the fan on. However, you can enable the unit fan to control the night setback by changing the keyword

NIGHT-CYCLE-CTRL = STAY-OFF

to

NIGHT-CYCLE-CTRL = CYCLE-ON-ANY.

Unit Heater (UHT)
This simulation is for a unit heater serving one zone. Multiple systems, that is, multiple zones with one unit heater each, may be simulated. This unit is not capable of introducing outside air. Space temperature control is accomplished by on-off cycling control of the fan.

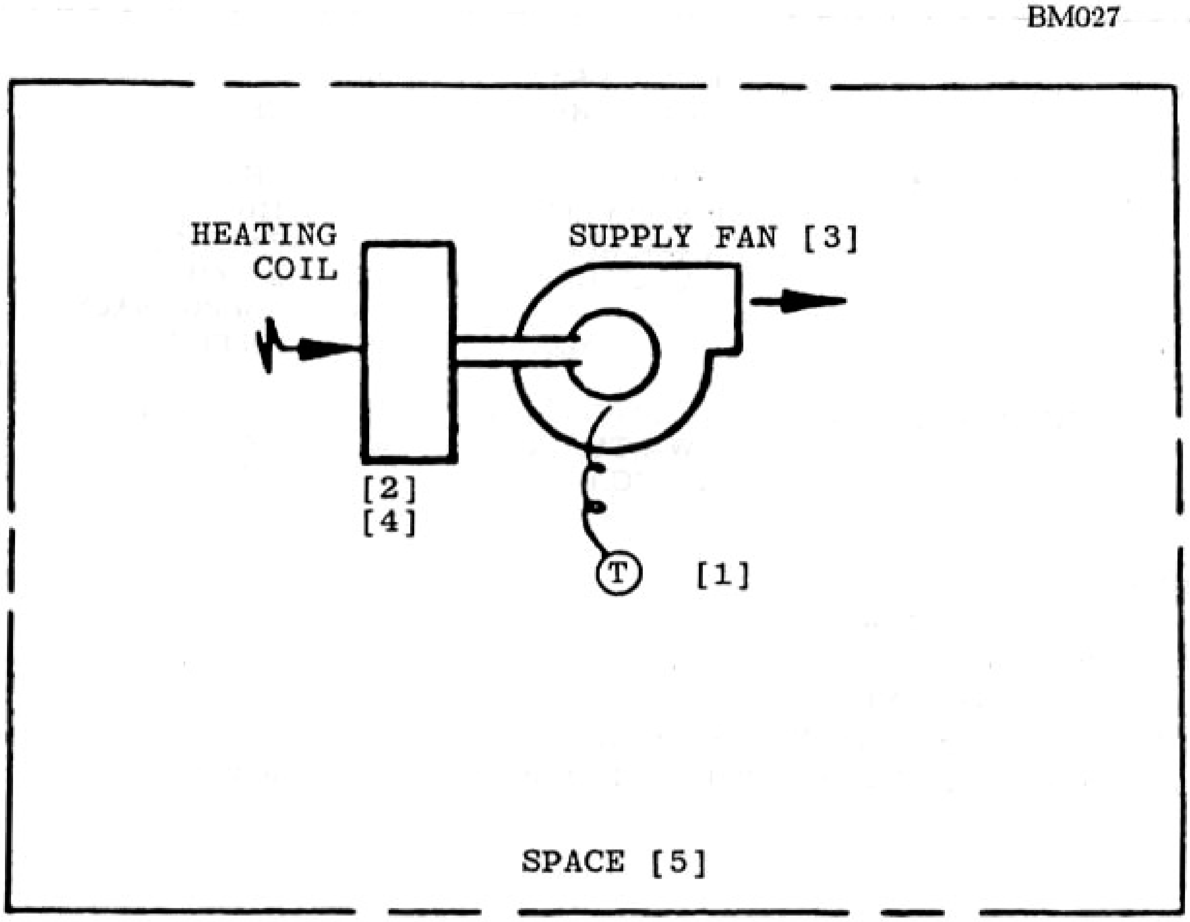

Figure 3.24: Unit Heater (UHT)

Suggested minimal input for UHT system:

```
INPUT SYSTEMS ..

SYSTEMS-REPORT   SUMMARY=(SS-A,SS-O) ..

                  $ SYSTEMS SCHEDULES

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

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

```
                                    (WEH)   (1,24)(55) ..

DHW = SCHEDULE THRU DEC 31          (WD)    (1,7)(0)
                                            (8,18)(1.0) (19,24)(0)
                                    (WEH)   (1,24)(0) ..

OFFICE = ZONE              DESIGN-HEAT-T   =   72
                           HEAT-TEMP-SCH   =   HEATSETPT ..   [1]

AC-SYST = SYSTEM           SYSTEM-TYPE     =   UHT
                           MAX-SUPPLY-T    =   110   [2]
                           FAN-SCHEDULE    =   FANS-ON   [3]
                           HEAT-SOURCE     =   ELECTRIC
                                               $ or FURNACE   [4]
                           ZONE-NAMES      =   (OFFICE) ..

P1 = PLANT-ASSIGNMENT      SYSTEM-NAMES    =   (AC-SYST)
                           DHW-BTU/HR      =   10000
                           DHW-SCH         =   DHW ..

END ..
COMPUTE  SYSTEMS ..
INPUT  PLANT ..
P1 = PLANT-ASSIGNMENT ..
PLANT-REPORT  SUMMARY = (BEPS) ..
SHW = PLANT-EQUIPMENT   TYPE = DHW-HEATER   SIZE = -999 ..
```