Suggested minimal input for SZRH system with an economizer:

```
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) ..

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         =   SZRH
                        MAX-SUPPLY-T        =   110  [3]
                        MIN-SUPPLY-T        =   55  [4]
                        NIGHT-CYCLE-CTRL    =   CYCLE-ON-FIRST  [5]
                        FAN-SCHEDULE        =   FANS-ON  [6]
                        ECONO-LIMIT-T       =   68  [7]
                        OA-CONTROL          =   TEMP  [7]
                        ZONE-NAMES          =   (OFFICE) ..  [8]

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 ..
HWG = PLANT-EQUIPMENT   TYPE = HW-BOILER       SIZE = -999 ..
CHR = PLANT-EQUIPMENT   TYPE = HERM-REC-CHLR   SIZE = -999 ..

PLANT-PARAMETERS   HERM-REC-COND-TYPE = AIR ..

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 ZONE keyword list. [9]

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. [10]

3) To enable heat recovery to exchange relief air heat with outside air heat add RECOVERY-EFF = Value (0.6 is typical) and RETURN-KW= Value (.0003 is typical) to the SYSTEM keyword list. [11]

4) To disable the economizer change OA-CONTROL = TEMP to OA-CONTROL = FIXED. [7]

5) To enable reheat coils at subzones add REHEAT-DELTA-T = Value (°F) to the SYSTEM keyword list. [12]

6) To disable the mechanical cooling year-round, so that the system operates as a Heating and Ventilating Unit, insert a schedule like this:

```
COOL-OFF  =  SCHEDULE THRU DEC 31 (ALL)  (1,24) (0) ..
```

and add

```
COOLING-SCHEDULE  =  COOL-OFF
```

to the SYSTEM keyword list.

Constant-Volume Reheat Fan System (RHFS)

In its most basic configuration, RHFS provides constant volume forced-flow heating and cooling to a number of individually controlled zones from an air-handling unit consisting of a filter (not shown), heating and cooling coils, and a draw-through supply fan. Exhaust fans are optional for any or all zones. A reheat coil is installed in the supply air distribution duct serving each individual zone. Space temperature is controlled by throttling heating fluid flow to these reheat coils. The Btu equivalent of moisture added to the air stream to maintain a minimum humidity is passed to the PLANT program as a heating load.

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

BM009

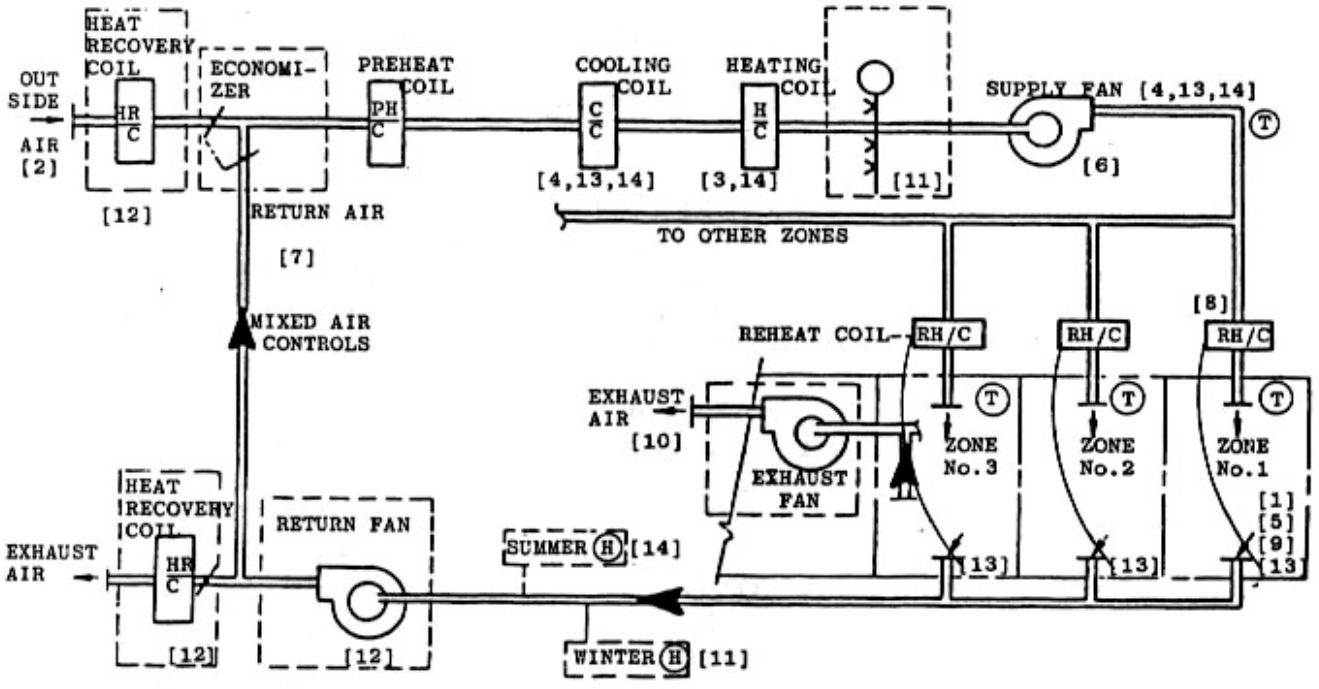

Figure 3.6: Constant-Volume Reheat Fan System (RHFS)

Suggested minimal input for RHFS system with an economizer:

```
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) ..

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     =   RHFS
                           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   =   68  [7]
                           REHEAT-DELTA-T  =   55  [8]
                           ZONE-NAMES      =   (OFFICE) ..  [9]

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 ..
HWG = PLANT-EQUIPMENT   TYPE = HW-BOILER       SIZE = -999 ..
CHR = PLANT-EQUIPMENT   TYPE = HERM-REC-CHLR   SIZE = -999 ..

PLANT-PARAMETERS   HERM-REC-COND-TYPE = AIR ..

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 ZONE keyword list. [10]

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. [11]

3) To enable heat recovery to exchange relief air heat with outside air heat add RECOVERY-EFF = Value (0.6 is typical) and RETURN-KW= Value (.0003 is typical) to the SYSTEM keyword list. [12]

4) To disable the economizer change the OA-CONTROL = TEMP to OA-CONTROL = FIXED. [7]

5) To enable supply air temperature reset using a discriminator control insert COOL-CONTROL = WARMEST in the SYSTEM keyword list. [13]

6) An alternative method to item 5 above is to reset the supply air as a function of outside air temperature. An example of this control is covered in the *Sample Run Book (2.1E)*, 31-Story Office Building, Run 1.

7) To enable control of maximum humidity whenever the supply air temperature is reset, insert MAXIMUM-HUMIDITY = Value (60% is allowed in the new ASHRAE 90.1 Standard) in the SYSTEM keyword list. [14]

Multizone Fan System (MZS)

In its most basic configuration MZS provides constant flow, forced-air heating and cooling to multiple, individually controlled zones from an air-handling unit containing a filter (not shown), blow-through type supply fan, heating and cooling coil (each located in a separate casing on the discharge side of the fan), and one set of mixing dampers per zone served. Exhaust fans are optional for any or all zones. The program assumes there is a preheat coil and calculates a preheat load, if and when the mixed air temperature falls below the required PREHEAT–T. To control the temperature in each zone, two air streams at different temperatures (hot deck and cold deck) are mixed by dampers located in the air-handling unit and ducted separately from the discharge of the air-handling unit to each zone.

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

BM010

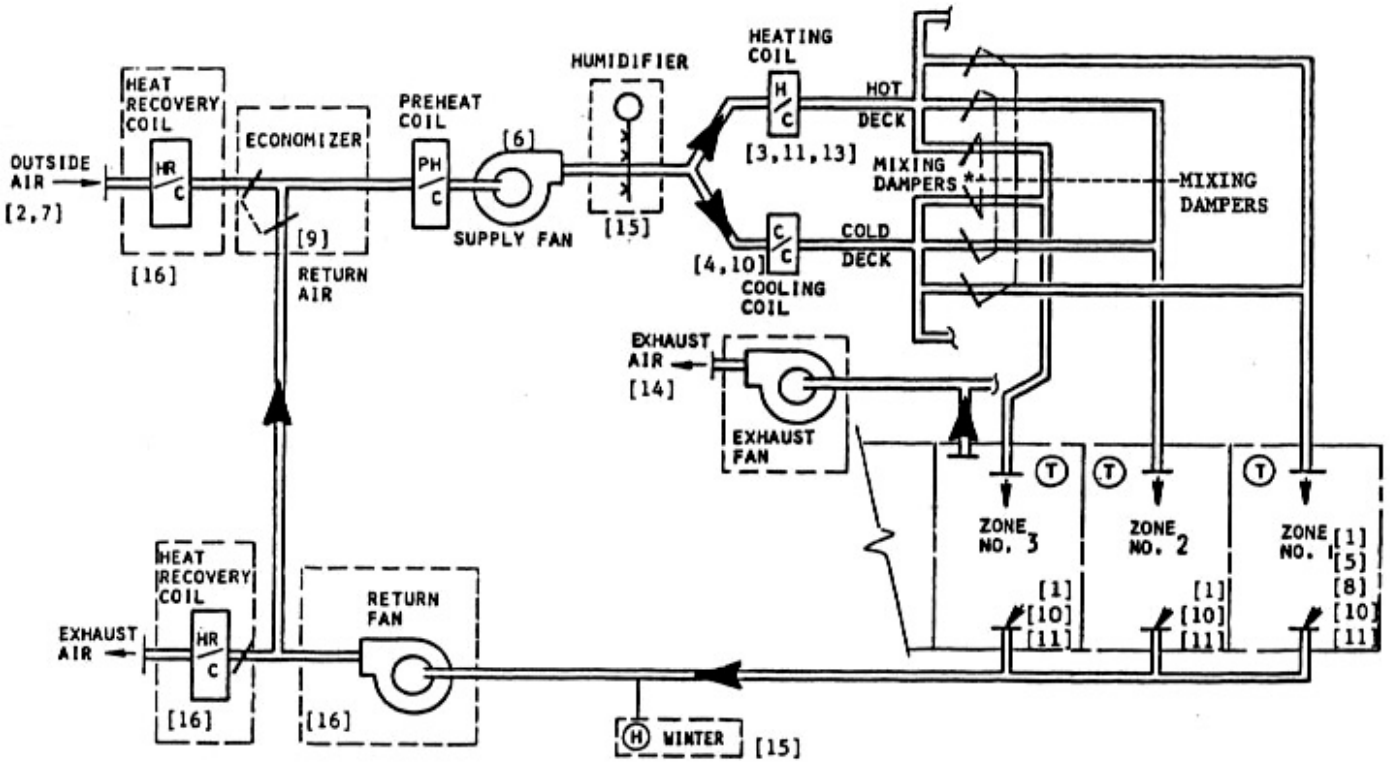

Figure 3.7: Multizone Fan System (MZS)

Suggested minimal input for MZS 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) ..

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      =  MZS
                       MAX-SUPPLY-T     =  110   [3]
                       MIN-SUPPLY-T     =  55    [4]
                       NIGHT-CYCLE-CTRL =  CYCLE-ON-FIRST  [5]
                       FAN-SCHEDULE     =  FANS-ON   [6]
                       OA-CONTROL       =  FIXED   [7]
                       ZONE-NAMES       =  (OFFICE) ..  [8]

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 ..
```

```
HWG = PLANT-EQUIPMENT   TYPE = HW-BOILER        SIZE = -999 ..
CHR = PLANT-EQUIPMENT   TYPE = HERM-REC-CHLR    SIZE = -999 ..

PLANT-PARAMETERS   HERM-REC-COND-TYPE = AIR ..

END ..

COMPUTE PLANT ..
```

Additional capabilities for this system:

1) To enable an economizer, add OA-CONTROL = TEMP and ECONO-LIMIT-T = 60 to the SYSTEM keyword list. [9]

2) To simulate a discriminator control of the cold deck supply air temperature add COOL-CONTROL = WARMEST to the SYSTEM keyword list. [10]

3) To simulate a discriminator control of the hot deck supply air temperature add HEAT-CONTROL = COLDEST to the SYSTEM keyword list. [11]

4) 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 (2.1E)*, 31-Story Office Building, Run 1.

5) To simulate turning off the hot deck whenever the outside temperature is above 65°F, 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.

6) 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]

7) 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. [15]

8) To enable heat recovery to exchange relief air heat with outside air heat add RECOVERY-EFF = Value (0.6 is typical) and RETURN-KW= Value (.0003 is typical) to the SYSTEM keyword list. [16]

Dual-Duct Fan System (DDS)
DDS can be either *constant volume* or *variable volume.*

Constant-volume is identical to the multizone type of system (see the description for MZS), except that the hot and cold air streams (from the warm air duct and cold air duct) are extended to individual mixing boxes, located in the zone being served, where the two air streams are mixed.

The *variable volume* dual duct system is similar to the constant-volume except that the type of mixing box used in this system is capable of reducing flow in response to a decrease in cooling demand. Mixing of the cold and hot air streams occurs only after flow has been reduced to a prescribed minimum; thus, total energy usage is reduced.

Exhaust fans are optional for any or all zones. DOE-2 assumes there is a preheat coil and calculates the preheat load, if and when the mixed air temperature falls below the required PREHEAT–T.

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

BM011

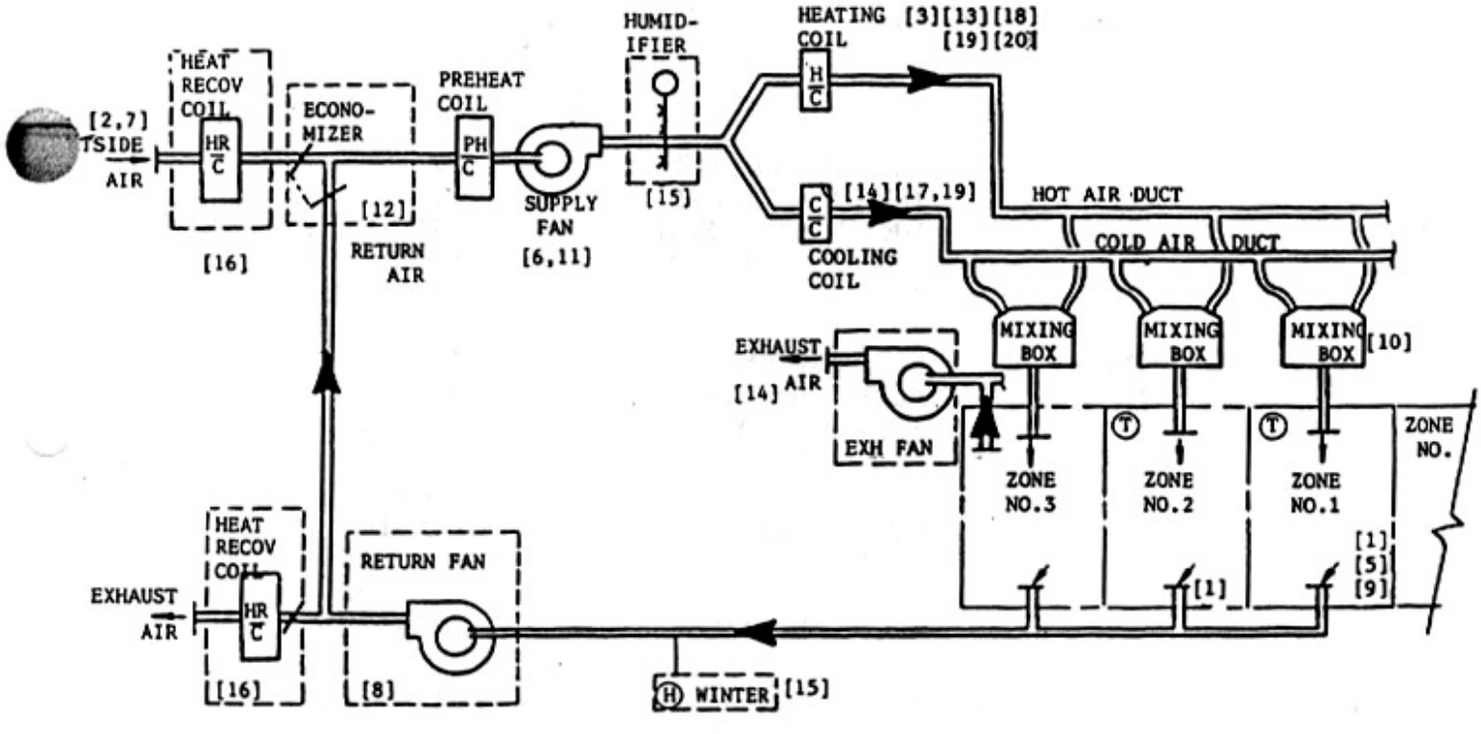

Figure 3.8: Dual-Duct Fan System (DDS)

Suggested minimal input for DDS 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) ..

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      =  DDS
                       MAX-SUPPLY-T     =  110    [3]
                       MIN-SUPPLY-T     =  55    [4]
                       NIGHT-CYCLE-CTRL =  CYCLE-ON-FIRST    [5]
                       FAN-SCHEDULE     =  FANS-ON    [6]
                       OA-CONTROL       =  FIXED    [7]
                       RETURN-STATIC    =  1.0    [8]
                       RETURN-EFF       =  .55    [8]
                       ZONE-NAMES       =  (OFFICE) ..    [9]

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

END ..
COMPUTE SYSTEMS ..
INPUT PLANT ..
P1 = PLANT-ASSIGNMENT ..
```