A STUDY OF OCCUPANCY-BASED SMART BUILDING CONTROLS IN COMMERCIAL BUILDINGS- SUPPORTING DOCUMENT

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DISCLAIMER

EXECUTIVE SUMMARY

These days, building energy performance simulation (BEPS) is widely used to predict building energy use in the process of building designs. Thermal zones in BEPS impacts building system efficiency and (i.e., HVAC, lighting, and equipment systems) and performance as a basic unit to control indoor space. For the modeling of thermal zones, conventional design methods have been used to determine thermal zone designs in practice. However, the advances of building technology and control require more sophisticated zoning methods in BEPS to be wise in controls and reduce energy waste.

In previous research, many studies discussed the importance of thermal zoning methods. However, the details of the impact of thermal zoning were not fully investigated, especially in different HVAC systems, occupant usage intensities, and climates. These factors would significantly affect the energy efficiency in building operations. Therefore, Kim (2020) explored the impact of thermal zoning methods under different buildings and climate conditions (i.e., hot-humid, and cold-humid) to support proper thermal zoning determination.

Therefore, this report contains detailed information of the reference simulation models used in Kim (2020), including thermal zoning methods (i.e., single-zone, five-zone, and detailed zone models), HVAC systems (i.e., Packaged Single Zone (PSZ) system, Packaged Variable Air Volume (PVAV) system), and Occupant usage Intensity (i.e., : 100%-for-24hrs / 0%-for-24hrs / ASHRAE Standard 90.1-2016 schedule).

The reference models (i.e., single-zone, five-zone models) for DOE-2.1e were developed based on the USDOE prototype parameters (PNNL and U.S.DOE 2019), which were used to compare the impact on energy use due to thermal zone models. The detailed zone models were modeled based on the Oak Ridge National Laboratory (ORNL) research (Im et al. 2019; Im and New 2018) to represent a detailed space programs and usage in an office building.

The four reference simulation models are described in Section 2 and Appendix A for the DOE-2.1e program, including the BDL descriptions and simulation boundary and input conditions.

TABLE OF CONTENTS

LIST OF TABLES

1   INTRODUCTION

In building energy performance simulations (BEPS), thermal zoning determines which parts of a building are controlled by a single thermostat (i.e., heating, cooling, lighting, and ventilation). Therefore, proper thermal zoning impacts building energy use and efficiency. This report provides detailed information to support the previous study conducted by Kim (2020). In this report, details about simulation cases are included for different HVAC systems and occupant usage intensities in hot-humid and cold-humid climates (i.e., Houston, TX, and Chicago, IL), including:

- Thermal zoning method: single-zone, five-zone, and detailed zone model
- HVAC system type: Packaged Single Zone (PSZ) system, Packaged Variable Air Volume (PVAV) system
- Occupant usage Intensity: 100%-for-24hrs / 0%-for-24hrs / ASHRAE Standard 90.1-2016 schedules

In this study, the USDOE prototype parameters (PNNL and U.S.DOE 2019) were adopted and modified to compare the energy performance depending on thermal zone designs. The detailed zone models were developed based on the Oak Ridge National Laboratory (ORNL) research (Im et al. 2019; Im and New 2018) to represent a detailed office building.

In this report, four reference simulation models are presented for the DOE-2.1e program, including for the BDL descriptions in Section 2 to provide detailed information of thermal zoning models.

2   SIMULATION DESCRIPTION

2.1   DOE-2.1E Simulation Cases for the Small Office Building

In this study, three types of thermal zoning models were analyzed using the PSZ and PVAV systems. These models were operated using three occupant usage intensities to control the HVAC, lighting, and equipment systems. Table 1 shows the simulation combinations for the small office building in the DOE-2.1E program.

Table 2-1 Simulation Cases used for the analysis

Location	Zoning Model	HVAC Type	Modeling Schedule Type (Weekdays)					Avg. WWR
			Occupancy	Lighting	Equipment	Set-point	Set-back	
Houston TX	· Single- zone · Five-zone · Detailed-zone	PSZ	1) 90.1-2016 2) 100%24hrs 3) 0% 24 hrs	1) 90.1-2016 2) 100%24hrs 3) 0% 24 hrs	1) 90.1-2016 2) 100%24hrs 3) 0% 24 hrs	H: 70ºF C: 75ºF	H: 60ºF C: 85ºF	21%
		PVAV	1) 90.1-2016 2) 100%24hrs 3) 0% 24 hrs	1) 90.1-2016 2) 100%24hrs 3) 0% 24 hrs	1) 90.1-2016 2) 100%24hrs 3) 0% 24 hrs	H: 70ºF C: 75ºF	H: 60ºF C: 85ºF	21%
Chicago IL	· Single- zone · Five-zone · Detailed-zone	PSZ	1) 90.1-2016 2) 100%24hrs 3) 0% 24 hrs	1) 90.1-2016 2) 100%24hrs 3) 0% 24 hrs	1) 90.1-2016 2) 100%24hrs 3) 0% 24 hrs	H: 70ºF C: 75ºF	H: 60ºF C: 85ºF	21%
		PVAV	1) 90.1-2016 2) 100%24hrs 3) 0% 24 hrs	1) 90.1-2016 2) 100%24hrs 3) 0% 24 hrs	1) 90.1-2016 2) 100%24hrs 3) 0% 24 hrs	H: 70ºF C: 75ºF	H: 60ºF C: 85ºF	21%

* Weekend schedules set to minimum operating rates in the simulation schedules (i.e., occupancy=0.0; lighting=0.18; equipment=0.20; infiltration=off; ventilation fan=0.0; set-temperature: heating 60ºF, cooling 85ºF) (PNNL & U.S.DOE, 2019b).
* Window-to-wall (WWR) ratio in the small office models was 21% on average. Window fraction was 24.4% for the South and 19.8% for the other three orientations (e.g., east, west, north).

In this section, among hundreds simulation combinations, the DOE-2 BDL input files for five-zone models using the PSZ and PVAV systems in Houston, TX, and Chicago, IL are selected and listed to provide more modeling information in the DOE-2.1e program.

- Reference Model 1: Five-Zone Model in Houston, TX (PSZ System)
- Reference Model 2: Five-Zone Model in Houston, TX (PVAV System)
- Reference Model 3: Five-Zone Model in Chicago, IL (PSZ System)
- Reference Model 4: Five-Zone Model in Chicago, IL (PVAV System)

2.2   Houston, TX: Thermal Zoning Models

2.2.1   Reference Model 1: Five-Zone Model in Houston, TX (PSZ System)

In this section, the DOE-2 BDL input file for the PSZ system for "Case 1: Single-Zone Model in Houston, TX" is described. The DOE-2 reference model is based on the U.S.DOE commercial prototype models with five zones (PNNL and U.S.DOE 2019).

```
1    $============================= SIMULATION ZONING ================================
2
3    INPUT LOADS   ..
4
5    TITLE           LINE-1 *SAMPlE PROVIDED BY PROF.JEFF HABERL*
6                    LINE-2 *HOUSTON, TX, CLIMATE ZONE 2A*
7                    LINE-3 *ASHRAE 90.1-2016 REQUIREMENTS SATISFIED*
8                    LINE-4 *STUDY FOR BUILDING OCCUPANCY PROFILE ANALYSIS*  ..
9
10                   RUN-PERIOD      JAN 1 2019 THRU DEC 31 2019    ..
11
12                   ABORT           ERRORS  ..
13                   DIAGNOSTIC      WARNINGS  ..
14                   LOADS-REPORT    SUMMARY = (ALL-SUMMARY)
15                                   REPORT-FREQUENCY = HOURLY
16                                   HOURLY-DATA-SAVE = FORMATTED
17                                   VERIFICATION = (ALL-VERIFICATION) ..
18
19                   BUILDING-LOCATION  LATITUDE=30.0
20                                   LONGITUDE=95.37
21                                   GROUND-T = (69.314, 69.224, 69.368, 69.512,
22                                   69.692,73.634,74.3, 74.444, 74.48, 70.448,
23                                   69.818, 69.458)
24                                   DAYLIGHT-SAVINGS =
                                     NO
25                                   ALTITUDE=95.14
26                                   TIME-ZONE=6
27                                   AZIMUTH=0.0   ..
28
29
30    $   BUILDING DESCRIPTION
31
32    $============================= BUILDING CONSTRUCTION ===========================
33
34
35    $   CONSTRUCTION AND GLASS-TYPES
36
37    $   MATERIAL PROPERTY (IP UNITS)
38    $   ALL VALUES CONVERTED FROM SI UNITS IN PNNL SMALL OFFICE MODEL FOR 90.1-2016
39    $   ROOF AND CEILING PROPERTY
40    ROOF_BUIL      = MAT          THICKNESS = 0.03116798
41                                  CONDUCTIVITY = 0.092446272
42                                  DENSITY = 69.9193264
43                                  SPECIFIC-HEAT = 0.348715014  ..
44
45    ROOF_INS_1     = MAT          RESISTANCE = 24.52377767  ..
46
47    ROOF_INS_2     = MAT          RESISTANCE = 35.40275850  ..
48
49    ROOF_SUR_1     = MAT          THICKNESS = 0.002624672
50                                  CONDUCTIVITY = 26.16229498
51                                  DENSITY = 488.4364373
52                                  SPECIFIC-HEAT = 0.11942295  ..
53
54    CEIL_MAT       = MAT          THICKNESS = 0.041666668
55                                  CONDUCTIVITY = 0.032933984
56                                  DENSITY = 17.97925536
57                                  SPECIFIC-HEAT = 0.31981466  ..
58
59    ROOF_ASPHT     = MAT          THICKNESS = 0.010498688
60                                  CONDUCTIVITY = 0.023111568
61                                  DENSITY = 69.9193264
62                                  SPECIFIC-HEAT = 0.300945834  ..
63
64    ROOF_WOOD      = MAT          THICKNESS = 0.052165356
65                                  CONDUCTIVITY = 0.069334704
66                                  DENSITY = 33.96081568
67                                  SPECIFIC-HEAT = 0.289003539  ..
68
69
70    $  SLAB PROPERTY
71    SLAB_CONC200   = MAT          THICKNESS = 0.666666688
72                                  CONDUCTIVITY = 1.334693052
```

```
 73                                         DENSITY = 144.9577463
 74                                         SPECIFIC-HEAT = 0.198719789  ..
 75
 76    SLAB_CONC100   = MAT                 THICKNESS = 0.333333344
 77                                         CONDUCTIVITY = 1.334693052
 78                                         DENSITY = 144.9577463
 79                                         SPECIFIC-HEAT = 0.198719789  ..
 80
 81    SLAB_CARP      = MAT                 RESISTANCE = 1.22923033  ..
 82
 83
 84    $  WALL PROPERTY
 85    WALL_STU       = MAT                 THICKNESS = 0.083333336
 86                                         CONDUCTIVITY = 0.416008224
 87                                         DENSITY = 115.8663123
 88                                         SPECIFIC-HEAT = 0.200630556  ..
 89
 90    WALL_GYP1      = MAT                 THICKNESS = 0.052165356
 91                                         CONDUCTIVITY = 0.092446272
 92                                         DENSITY = 49.942376
 93                                         SPECIFIC-HEAT = 0.260342031  ..
 94
 95    WALL_GYP2      = MAT                 THICKNESS = 0.041666668
 96                                         CONDUCTIVITY = 0.092446272
 97                                         DENSITY = 49.942376
 98                                         SPECIFIC-HEAT = 0.260342031  ..
 99
100    WALL_INS_1     = MAT                 RESISTANCE = 9.72589032  ..
101
102    WALL_INS_2     = MAT                 RESISTANCE = 9.05708346  ..
103
104
105    $  WINDOW PROPERTY
106    WIN_GLS3       = GLASS-TYPE          GLASS-CONDUCTANCE = 0.6535
107                                         VIS-TRANS = 0.312
108                                         SHADING-COEF =
                                            0.286206897
109                                         PANES = 2                    ..
110
111    DOOR1          = GLASS-TYPE          GLASS-CONDUCTANCE = 0.370
112                                         SHADING-COEF = 0.7  ..
113
114    AIR-LAYER      = CONSTRUCTION        U = 1.11 ..
115
116
117
118    $  MATERIAL LAYERS
119    ATTIC-R1  =LAYERS =MAT=(AR02,PW04)  ..
120
121    ATTIC-R2  =LAYERS =MAT=(PW04)   ..
122
123    ROOF_1    =LAYERS =MAT=(ROOF_INS_2,GP02)  ..
124    EX_SLAB_1 =LAYERS =MAT=(SLAB_CONC200,CP02)  ..
125    EX_WALL_1 =LAYERS =MAT=(SC01,GP02,WALL_INS_2,GP02)  ..
126    IN_WALL_1 =LAYERS =MAT=(GP01,GP01)  ..
127    IN_SLAB_1 =LAYERS =MAT=(SLAB_CONC100,CP02)  ..
128    CEIL_MAT1 =LAYERS =MAT=(AC02,GP01)  ..
129
130
131    $  MATERIAL CONSTRUCTION
132    EXT_SLAB              =CONSTRUCTION     LAYERS = EX_SLAB_1
133                                           ABSORPTANCE = 0.7      ..
134    NONRES_EXT_WALL       =CONSTRUCTION     LAYERS = EX_WALL_1
135                                           ABSORPTANCE = 0.7      ..
136    INT_WALL              =CONSTRUCTION     LAYERS = IN_WALL_1
137                                           ABSORPTANCE = 0.7      ..
138    CEIL_MAT2             =CONSTRUCTION     LAYERS = ROOF_1
139                                           ABSORPTANCE = 0.7      ..
140    ATTIC-ROOF            =CONSTRUCTION     LAYERS = ATTIC-R1
141                                           ABSORPTANCE = 0.7      ..
142    ATTIC-SOFFIT          =CONSTRUCTION     LAYERS = ATTIC-R2
143                                           ABSORPTANCE = 0.7      ..
144    DOOR2                 =CONSTRUCTION     U = 1.2139351092
```

```
145                                                 ABSORPTANCE = 0.7  ..
146
147    $ OCCUPANCY SCHEDULE
148    OC-1               =DAY-SCHEDULE       (1,6)  (0.0)
149                                           (7)  (0.11)
150                                           (8)  (0.21)
151                                           (9,12)  (1.0)
152                                           (13)  (0.53)
153                                           (14,17)  (1.0)
154                                           (18)  (0.32)
155                                           (19,22)  (0.11)
156                                           (23)  (0.05)
157                                           (24)  (0.0)   ..
158
159    OC-2               =DAY-SCHEDULE       (1,6)  (0.0)
160                                           (7,8)  (0.1)
161                                           (9,12)  (0.3)
162                                           (13,17)  (0.1)
163                                           (18,19)  (0.05)
164                                           (20,24)  (0.0)   ..
165
166    OC-3               =DAY-SCHEDULE       (1,6)  (0.0)
167                                           (7,18)  (0.05)
168                                           (19,24)  (0.0)   ..
169
170    OC-4               =DAY-SCHEDULE       (1,24)  (0.0)   ..
171    OC-5               =DAY-SCHEDULE       (1,24)  (1.0)   ..
172
173
174    OC-WEEK            =WEEK-SCHEDULE      (WD) OC-1 (SAT) OC-4 (SUN) OC-4 (HOL) OC-4 ..
175    OC-WEEK2           =WEEK-SCHEDULE      (WD) OC-4 (SAT) OC-4 (SUN) OC-4 (HOL) OC-4 ..
176    OC-WEEK3           =WEEK-SCHEDULE      (WD) OC-5 (SAT) OC-5 (SUN) OC-5 (HOL) OC-5 ..
177
178    OCCUPY-1           =SCHEDULE           THRU DEC 31 OC-WEEK   ..
179    OCCUPY-2           =SCHEDULE           THRU DEC 31 OC-WEEK2  ..
180    OCCUPY-3           =SCHEDULE           THRU DEC 31 OC-WEEK3  ..
181
182
183
184    $ LIGHTING SCHEDULE
185
186    LT-1               =DAY-SCHEDULE       (1,5)  (0.18)
187                                           (6,7)  (0.23)
188                                           (8)  (0.42)
189                                           (9,12)  (0.9)
190                                           (13)  (0.8)
191                                           (14,17)  (0.9)
192                                           (18)  (0.61)
193                                           (19,20)  (0.42)
194                                           (21,22)  (0.32)
195                                           (23)  (0.23)
196                                           (24)  (0.18)   ..
197
198    LT-2               =DAY-SCHEDULE       (1,6)  (0.05)
199                                           (7,8)  (0.1)
200                                           (9,12)  (0.3)
201                                           (13,17)  (0.15)
202                                           (18,24)  (0.05)  ..
203
204    LT-3               =DAY-SCHEDULE       (1,24)  (0.18)  ..
205    LT-4               =DAY-SCHEDULE       (1,24)  (0.0)   ..
206    LT-5               =DAY-SCHEDULE       (1,24)  (1.0)   ..
207
208
209    LT-WEEK            =WEEK-SCHEDULE      (WD) LT-1 (SAT) LT-3 (SUN) LT-3 (HOL) LT-3 ..
210    LT-WEEK2           =WEEK-SCHEDULE      (WD) LT-3 (SAT) LT-3 (SUN) LT-3 (HOL) LT-3 ..
211    LT-WEEK3           =WEEK-SCHEDULE      (WD) LT-5 (SAT) LT-5 (SUN) LT-5 (HOL) LT-5 ..
212
213
214    LIGHTS-1           =SCHEDULE           THRU DEC 31 LT-WEEK   ..
215    LIGHTS-2           =SCHEDULE           THRU DEC 31 LT-WEEK2  ..
216    LIGHTS-3           =SCHEDULE           THRU DEC 31 LT-WEEK3  ..
217
```

```
218
219
220    $ OFFICE EQUIPMENT SCHEDULE
221    EQ-1            =DAY-SCHEDULE       (1,5)  (0.5)
222                                       (6,12) (1.0)
223                                       (13)   (0.94)
224                                       (14,17) (1.0)
225                                       (18)   (0.5)
226                                       (19,24) (0.2)   ..
227
228
229    EQ-2            =DAY-SCHEDULE       (1,6)  (0.3)
230                                       (7,8)  (0.4)
231                                       (9,12) (0.5)
232                                       (13,17) (0.35)
233                                       (18,24) (0.3)   ..
234
235    EQ-3            =DAY-SCHEDULE       (1,24) (0.2)    ..
236    EQ-4            =DAY-SCHEDULE       (1,24) (0.0)    ..
237    EQ-5            =DAY-SCHEDULE       (1,24) (1.0)    ..
238
239
240    EQ-WEEK         =WEEK-SCHEDULE      (WD) EQ-1 (SAT) EQ-3 (SUN) EQ-3 (HOL) EQ-3 ..
241    EQ-WEEK2        =WEEK-SCHEDULE      (WD) EQ-3 (SAT) EQ-3 (SUN) EQ-3 (HOL) EQ-3 ..
242    EQ-WEEK3        =WEEK-SCHEDULE      (WD) EQ-5 (SAT) EQ-5 (SUN) EQ-5 (HOL) EQ-5 ..
243    EQ-WEEK4        =WEEK-SCHEDULE      (WD) EQ-0 (SAT) EQ-4 (SUN) EQ-4 (HOL) EQ-3 ..
244    EQ-WEEK5        =WEEK-SCHEDULE      (WD) EQ-6 (SAT) EQ-7 (SUN) EQ-7 (HOL) EQ-7 ..
245
246
247    EQUIP-1         =SCHEDULE           THRU DEC 31 EQ-WEEK   ..
248    EQUIP-2         =SCHEDULE           THRU DEC 31 EQ-WEEK2  ..
249    EQUIP-3         =SCHEDULE           THRU DEC 31 EQ-WEEK3  ..
250
251
252    $ INFILTRATION SCHEDULE
253    IF-1            =DAY-SCHEDULE       (1,6)  (1.0)
254                                       (7,19) (0.25)
255                                       (20,24) (1.0)   ..
256
257    IF-2            =DAY-SCHEDULE       (1,7)  (1.0)
258                                       (8,18) (0.25)
259                                       (19,24) (1.0)   ..
260
261    IF-3            =DAY-SCHEDULE       (1,24) (0.0)    ..
262    IF-4            =DAY-SCHEDULE       (1,24) (1.0)    ..
263    IF-5            =DAY-SCHEDULE       (1,24) (0.25)   ..
264
265
266    IF-WEEK         =WEEK-SCHEDULE      (WD) IF-1 (SAT) IF-2 (SUN) IF-4 (HOL) IF-4 ..
267    IF-WEEK2        =WEEK-SCHEDULE      (WD) IF-4 (SAT) IF-4 (SUN) IF-4 (HOL) IF-4 ..
268    IF-WEEK3        =WEEK-SCHEDULE      (WD) IF-5 (SAT) IF-5 (SUN) IF-5 (HOL) IF-5 ..
269
270
271    INFIL-SCH       =SCHEDULE           THRU DEC 31 IF-WEEK   ..
272    INFIL-SCH2      =SCHEDULE           THRU DEC 31 IF-WEEK2  ..
273    INFIL-SCH3      =SCHEDULE           THRU DEC 31 IF-WEEK3  ..
274
275
276
277    $======================= SPACE DEFAULTS & DESCRIPTION =======================
278
279
280    $ SET DEFAULT VALUE
281
282                    SET-DEFAULT FOR SPACE   FLOOR-WEIGHT = 0 ..
283                    SET-DEFAULT FOR WINDOW  HEIGHT=5.0
284                                            GLASS-TYPE=WIN_GLS3  Y=1 ..
285                    SET-DEFAULT FOR EXTERIOR-WALL  CONSTRUCTION=NONRES_EXT_WALL ..
286
287
288    $ GENERAL SPACE DEFINITION
289
290    OFFICE          =SPACE-CONDITIONS  PEOPLE-SCHEDULE       =OCCUPY-1
```

```
291                                            NUMBER-OF-PEOPLE        =31
292                                            PEOPLE-HEAT-GAIN        =450
293                                            LIGHTING-SCHEDULE      =LIGHTS-1
294                                            LIGHTING-W/SQFT        = 0.79
295                                            EQUIP-SCHEDULE         = EQUIP-1
296                                            EQUIPMENT-W/SQFT       = 0.63
297                                            INF-METHOD             = AIR-CHANGE
298                                            AIR-CHANGES/HR         = 0.0
299                                            INF-SCHEDULE           =INFIL-SCH2  ..
300
301
302                            $ SPECIFIC SPACE DETAILS
303
304     $ ATTIC
305     ATTIC-SC    = SPACE-CONDITIONS
306                   ZONE-TYPE   = UNCONDITIONED
307                   FLOOR-WEIGHT  = 0 ..                 $ CUSTOM WEITING FACTOR
308                                                        $ SEE p. III.141+
309     ATTIC     = SPACE    S-C = ATTIC-SC  AREA = 6113.686  VOLUME = 24533.31
310             X = 0  Y = 0  Z = 0  AZ = 0 ..
311     N-ROOF = POLYGON
312             (92.81,62.53) (-1.97,62.53) (30.28,32.03) (60.56,32.03)..
313     S-ROOF = POLYGON
314             (-1.97,-1.97) (92.81,-1.97) (60.56,32.03) (30.28,32.03) ..
315     E-GABLE = POLYGON
316             (0,0) (64.5,0) (32.25,34)  ..
317     W-GABLE = POLYGON
318             (-1.97,62.53,10) (-1.97,-1.97,10) (30.28,30.28,20.77)  ..
319
320
321
322     $ ROOF RAISED
323     N-ROOF-EXT = ROOF              CONSTRUCTION = ATTIC-ROOF
324                                    POLYGON = S-ROOF
325                                    TILT =18.5, AZ = 0,
326                                    X= 90.84 Y = 60.56 Z = 10.0  ..
327
328     S-ROOF-EXT = ROOF              CONSTRUCTION = ATTIC-ROOF
329                                    POLYGON = S-ROOF
330                                    TILT =18.5, AZ = 180, Z = 10.0  ..
331
332     E-GABLE-EXT = ROOF             CONSTRUCTION = ATTIC-ROOF
333                                    POLYGON = E-GABLE
334                                    TILT =18.2, AZ = 90
335                                    X = 92.81 Y = -1.97 Z = 10.0 ..
336
337     W-GABLE-EXT = ROOF             CONSTRUCTION = ATTIC-ROOF
338                                    POLYGON = E-GABLE
339                                    TILT =18.2, AZ = 270
340                                    X = -1.97 Y = 62.53 Z = 10.0 ..
341
342
343     N-ROOF-SOFFIT = BUILDING-SHADE  HEIGHT = 1.97  WIDTH = 94.78
344                                    X=-1.97  Y=60.6  Z=10
345                                    TRANSMITTANCE = 0.0
346                                    AZIMUTH = 180  TILT = 180  ..
347     S-ROOF-SOFFIT = BUILDING-SHADE  HEIGHT = 1.97  WIDTH =
        94.78
348                                    X=-1.97  Y=0  Z=10
349                                    TRANSMITTANCE = 0.0
350                                    AZIMUTH = 180 TILT = 180  ..
351     E-ROOF-SOFFIT = BUILDING-SHADE  HEIGHT = 1.97  WIDTH =
        60.56
352                                    X=90.85  Y=0  Z=10
353                                    TRANSMITTANCE = 0.0
354                                    AZIMUTH = 90  TILT = 180  ..
355     W-ROOF-SOFFIT = BUILDING-SHADE  HEIGHT = 1.97  WIDTH =
        60.56
356                                    X=0  Y=0  Z=10
357                                    TRANSMITTANCE = 0.0
358                                    AZIMUTH = 90  TILT = 180  ..
359
360
```

```
361
362   SPACE1-1      =SPACE              SPACE-CONDITIONS = OFFICE
363                                     AREA = 1221.28925  VOLUME = 12221.4264
364                                     NUMBER-OF-PEOPLE = 7    ..
365      FRONT-1    =EXTERIOR-WALL      HEIGHT = 10   WIDTH = 90.8
366                                     X=0   Y=0   Z=0  AZIMUTH = 180   ..
367
368       WF-1     =WINDOW             WIDTH = 6   X = 4.56   Y = 2.95   ..
369       WF-2     =WINDOW             WIDTH = 6   X = 19.72   Y = 2.95   ..
370       WF-3     =WINDOW             WIDTH = 6   X = 34.84   Y = 2.95   ..
371       WF-4     =WINDOW             WIDTH = 6   X = 50.00   Y = 2.95   ..
372       WF-5     =WINDOW             WIDTH = 6   X = 65.12   Y = 2.95   ..
373       WF-6     =WINDOW             WIDTH = 6   X = 80.28   Y = 2.95   ..
374       DF-1     =WINDOW             WIDTH = 6   HEIGHT = 7
375                                     X = 42.42   Y = 0
376                                     GLASS-TYPE=WIN_GLS3  ..
377
378      C1-1      =INTERIOR-WALL      AREA = 1221.28925  NEXT-TO ATTIC
379                                     CONSTRUCTION = CEIL_MAT2   ..
380
381      F1-1      =UNDERGROUND-FLOOR  AREA = 1221.28925  CONSTRUCTION = EXT_SLAB ..
382
383      SB12      =INTERIOR-WALL      AREA=231.931  NEXT-TO SPACE2-1
384                                     CONSTRUCTION = INT_WALL    ..
385
386      SB14      =INTERIOR-WALL      LIKE SB12  NEXT-TO SPACE4-1   ..
387      SB15      =INTERIOR-WALL      AREA 580   NEXT-TO  SPACE5-1
388                                     CONSTRUCTION = INT_WALL    ..
389
390   SPACE2-1      =SPACE              SPACE-CONDITIONS = OFFICE
391                                     AREA = 724.4845   VOLUME = 7249.7832
392                                     NUMBER-OF-PEOPLE = 4    ..
393
394      RIGHT-1    =EXTERIOR-WALL      HEIGHT = 10   WIDTH = 60.5
395                                     X=90.8  Y=0    Z=0  AZIMUTH = 90   ..
396
397       WR-1     =WINDOW             WIDTH = 6   X = 4.56   Y = 2.95   ..
398       WR-2     =WINDOW             WIDTH = 6   X = 19.72   Y = 2.95   ..
399       WR-3     =WINDOW             WIDTH = 6   X = 34.84   Y = 2.95   ..
400       WR-4     =WINDOW             WIDTH = 6   X = 50.00   Y = 2.95   ..
401
402      C2-1      =INTERIOR-WALL      AREA = 724.4845  NEXT-TO ATTIC
403                                     CONSTRUCTION = CEIL_MAT2   ..
404
405      F2-1      =UNDERGROUND-FLOOR  AREA = 724.4845  CONSTRUCTION = EXT_SLAB ..
406
407      SB23      =INTERIOR-WALL      AREA = 231.931  NEXT-TO SPACE3-1
408                                     CONSTRUCTION = INT_WALL    ..
409
410      SB25      =INTERIOR-WALL      AREA = 277  NEXT-TO SPACE5-1
411                                     CONSTRUCTION = INT_WALL    ..
412
413   SPACE3-1      =SPACE              SPACE-CONDITIONS = OFFICE
414                                     AREA  = 1221.28925  VOLUME = 12221.4264
415                                     NUMBER-OF-PEOPLE = 7    ..
416
417      BACK-1     =EXTERIOR-WALL      HEIGHT = 10   WIDTH = 90.8
418                                     X=90.8  Y=60.5  Z=0  AZIMUTH = 0    ..
419
420       WB-1     =WINDOW             WIDTH = 6   X = 4.56   Y = 2.95 ..
421       WB-2     =WINDOW             WIDTH = 6   X = 19.72   Y = 2.95 ..
422       WB-3     =WINDOW             WIDTH = 6   X = 34.84   Y = 2.95 ..
423       WB-4     =WINDOW             WIDTH = 6   X = 50.00   Y = 2.95 ..
424       WB-5     =WINDOW             WIDTH = 6   X = 65.12   Y = 2.95 ..
425       WB-6     =WINDOW             WIDTH = 6   X = 80.28   Y = 2.95 ..
426       DB-1     =DOOR               WIDTH = 3   HEIGHT = 7
427                                     X = 28.08   Y = 0
428                                     CONSTRUCTION = DOOR2   ..
429       DB-2     =DOOR               WIDTH = 3   HEIGHT = 7
430                                     X = 41.92   Y = 0
431                                     CONSTRUCTION = DOOR2    ..
432
433      C3-1      =INTERIOR-WALL      AREA = 1221.28925  NEXT-TO ATTIC
```

```
434                                        CONSTRUCTION = CEIL_MAT2   ..
435
436      F3-1       =UNDERGROUND-FLOOR  AREA = 1221.28925
437                                     CONSTRUCTION = EXT_SLAB    ..
438
439      SB34       =INTERIOR-WALL      AREA = 231.931  NEXT-TO SPACE4-1
440                                     CONSTRUCTION = INT_WALL    ..
441
442      SB35       =INTERIOR-WALL      AREA = 580  NEXT-TO SPACE5-1
443                                     CONSTRUCTION = INT_WALL    ..
444
445  SPACE4-1       =SPACE              SPACE-CONDITIONS = OFFICE
446                                     AREA = 724.4845  VOLUME = 7249.7832
447                                     NUMBER-OF-PEOPLE = 4   ..
448
449      LEFT-1     =EXTERIOR-WALL      HEIGHT = 10  WIDTH = 60.5
450                                     X=0   Y=60.5  Z=0   AZIMUTH = 270  ..
451
452        WL-1     =WINDOW             WIDTH = 6  X = 4.56  Y = 2.95  ..
453        WL-2     =WINDOW             WIDTH = 6  X = 19.72  Y = 2.95  ..
454        WL-3     =WINDOW             WIDTH = 6  X = 34.84  Y = 2.95  ..
455        WL-4     =WINDOW             WIDTH = 6  X = 50.00  Y = 2.95  ..
456
457      C4-1       =INTERIOR-WALL      AREA = 724.4845  NEXT-TO ATTIC
458                                     CONSTRUCTION = CEIL_MAT2   ..
459
460      F4-1       =UNDERGROUND-FLOOR  AREA = 724.4845
461                                     CONSTRUCTION = EXT_SLAB    ..
462
463      SB45       =INTERIOR-WALL      AREA = 277  NEXT-TO SPACE5-1
464                                     CONSTRUCTION = INT_WALL    ..
465
466  SPACE5-1       =SPACE              SPACE-CONDITIONS = OFFICE
467                                     AREA = 1611.0899  VOLUME = 16122.1672
468                                     NUMBER-OF-PEOPLE = 9   ..
469
470      C5-1       =INTERIOR-WALL      AREA = 1611.0899  NEXT-TO ATTIC
471                                     CONSTRUCTION = CEIL_MAT2   ..
472
473      F5-1       =UNDERGROUND-FLOOR  AREA = 1611.0899
474                                     CONSTRUCTION = EXT_SLAB ..
475
476  END  ..
477  COMPUTE  LOADS   ..
478
479
480  $============================= SYSTEM DESCRIPTION ==============================
481
482  INPUT SYSTEMS   ..
483
484                 SYSTEMS-REPORT  SUMMARY=(ALL-SUMMARY)
485                 REPORT-FREQUENCY = HOURLY
486                 HOURLY-DATA-SAVE = FORMATTED   ..
487
488
489  $ SYSTEMS SCHEDULES
490
491  FAN-1          =DAY-SCHEDULE       (1,6)(0)(7,19)(1)(20,24)(0)
     ..
492  FAN-2          =DAY-SCHEDULE       (1,24)(0)    ..
493  FAN-3          =DAY-SCHEDULE       (1,24)(1)    ..
494  FAN-4          =DAY-SCHEDULE       (1,6)(0)(7,23)(1)(24)(0)   ..
495  FAN-5          =DAY-SCHEDULE       (1,8)(0)(9,17)(1)(18,24)(0)  ..
496
497  FAN-WEEK       =WEEK-SCHEDULE      (WD) FAN-1 (WEH) FAN-2
     ..
498  FAN-WEEK2      =WEEK-SCHEDULE      (WD) FAN-2 (WEH) FAN-2
     ..
499  FAN-WEEK3      =WEEK-SCHEDULE      (WD) FAN-3 (WEH) FAN-3
     ..
500  FAN-WEEK4      =WEEK-SCHEDULE      (WD) FAN-4 (WEH) FAN-2
     ..
501  FAN-WEEK5      =WEEK-SCHEDULE      (WD) FAN-5 (WEH) FAN-2
```

```
     . .
502
503  FAN-SCHED       =SCHEDULE          THRU DEC 31   FAN-WEEK
     . .
504  FAN-SCHED2      =SCHEDULE          THRU DEC 31   FAN-WEEK2
     . .
505  FAN-SCHED3      =SCHEDULE          THRU DEC 31   FAN-WEEK3
     . .
506  FAN-SCHED4      =SCHEDULE          THRU DEC 31   FAN-WEEK4
     . .
507  FAN-SCHED5      =SCHEDULE          THRU DEC 31   FAN-WEEK5
     . .
508
509
510  $ THERMOSTAT SET-POINTS FOR HEATING AND COOLING
511  $ SET TEMPERATURES CONVERTED TO IP UNITS FROM SI UNITS
512
513  HEAT-1          =DAY-SCHEDULE      (1,6) (60.01) (7)
     (69.98)
514                                     (8,19) (69.98)  (20,24) (60.01)
                                        . .
515  HEAT-2          =DAY-SCHEDULE      (1,5) (60.01)  (6) (64.04)  (7) (68.0)
516                                     (8,17) (69.98)  (18,24) (60.01)  . .
517  HEAT-3          =DAY-SCHEDULE      (1,24) (60.01)   . .
518  HEAT-4          =DAY-SCHEDULE      (1,24) (69.98)   . .
519
520  HEAT-WEEK       =WEEK-SCHEDULE     (MON,FRI)  HEAT-1   (SAT) HEAT-3   (SUN) HEAT-3
521                                     (HOL) HEAT-3 . .
522  HEAT-WEEK2      =WEEK-SCHEDULE     (MON,FRI)  HEAT-3   (SAT) HEAT-3   (SUN)
     HEAT-3
523                                     (HOL) HEAT-3 . .
524  HEAT-WEEK3      =WEEK-SCHEDULE     (MON,FRI)  HEAT-4   (SAT) HEAT-4   (SUN)
     HEAT-4
525                                     (HOL) HEAT-4 . .
526
527
528  HEAT-SCHED      =SCHEDULE          THRU DEC 31   HEAT-WEEK
     . .
529  HEAT-SCHED2     =SCHEDULE          THRU DEC 31   HEAT-WEEK2
     . .
530  HEAT-SCHED3     =SCHEDULE          THRU DEC 31   HEAT-WEEK3
     . .
531
532
533  COOLOFF         =SCHEDULE          THRU DEC 31 (ALL) (1,24) (1)
     . .
534  HEATOFF         =SCHEDULE          THRU DEC 31 (ALL) (1,24) (1)
     . .
535
536
537  COOL-1          =DAY-SCHEDULE      (1,6) (84.99)  (7)
     (75.00)
538                                     (8,18) (75.00)  (19,24) (84.99)
                                        . .
539  COOL-2          =DAY-SCHEDULE      (1,5) (84.99)  (6) (78.08)  (7) (77.0)
540                                     (8,17) (75.00)  (18,24) (84.99)  . .
541  COOL-3          =DAY-SCHEDULE      (1,24) (84.99)   . .
542  COOL-4          =DAY-SCHEDULE      (1,24) (75.00)   . .
543
544  COOL-WEEK       =WEEK-SCHEDULE     (MON,FRI)  COOL-1   (SAT) COOL-3   (SUN) COOL-3
545                                     (HOL) COOL-3 . .
546  COOL-WEEK2      =WEEK-SCHEDULE     (MON,FRI)  COOL-3   (SAT) COOL-3   (SUN)
     COOL-3
547                                     (HOL) COOL-3 . .
548  COOL-WEEK3      =WEEK-SCHEDULE     (MON,FRI)  COOL-4   (SAT) COOL-4   (SUN)
     COOL-4
549                                     (HOL) COOL-4 . .
550
551
552  COOL-SCHED      =SCHEDULE          THRU DEC 31   COOL-WEEK
     . .
553  COOL-SCHED2     =SCHEDULE          THRU DEC 31   COOL-WEEK2
     . .
```

```
554   COOL-SCHED3 =SCHEDULE        THRU DEC 31   COOL-WEEK3
      ..
555
556
557   HVAC-HEAT   =SCHEDULE        THRU DEC 31 (ALL) (1,24) (1)
      ..
558   HVAC-COOL   =SCHEDULE        THRU DEC 31 (ALL) (1,24) (1)
      ..
559
560   24HR-OFF    =SCHEDULE        THRU DEC 31 (ALL) (1,24) (0)
      ..
561
562   DHW-SCHED   =SCHEDULE        THRU DEC 31 (ALL) (1,24) (1)
      ..
563   DHWINLETSCH-1 =SCHEDULE      THRU DEC 31 (ALL) (1,24) (140)
      ..
564
565   INT-1       =DAY-SCHEDULE    (1,7) (0)  (8) (0.35)  (9) (0.69)  (10)
      (0.43)
566                               (11) (0.37)  (12) (0.43)  (13) (0.58)  (14) (0.48)
567                               (15,16) (0.37)  (17) (0.46)  (18) (0.62)
568                               (19) (0.12)  (20,21) (0.04)  (22,24) (0)
                                  ..
569   INT-2       =DAY-SCHEDULE    (1,7) (0)  (8) (0.16)  (9) (0.14)  (10) (0.21)
570                               (11) (0.18)  (12) (0.25)  (13) (0.21)  (14) (0.13)
571                               (15) (0.08)  (16) (0.04)  (17) (0.05)
572                               (18) (0.06)  (19,24) (0)     ..
573   INT-3       =DAY-SCHEDULE    (1,24) (0)    ..
574   INT-WEEK    =WEEK-SCHEDULE   (MON,FRI)  INT-3   (SAT) INT-3  (SUN) INT-3
575                               (HOL) INT-3 ..
576   INT-SHED    = SCHEDULE       THRU DEC 31   INT-WEEK
      ..
577
578
579   $ SYSTEM DESCRIPTION
580
581   ZAIR        =ZONE-AIR     OA-CFM/PER=
      17
582                            EXHAUST-CFM =
                               0
583                            EXHAUST-EFF =
                               0.75
584                            EXHAUST-STATIC = 0
                               ..
585
586
587   CONTROL   = ZONE-CONTROL    DESIGN-HEAT-T =
      70
588                              DESIGN-COOL-T =
                                 75
589                              HEAT-TEMP-SCH = HEAT-SCHED
590                              COOL-TEMP-SCH = COOL-SCHED
591                              THERMOSTAT-TYPE =
                                 PROPORTIONAL
592                              THROTTLING-RANGE = 0.1
                                 ..
593
594
595   SPACE1-1    =ZONE         ZONE-AIR=ZAIR
596
                               SIZING-OPTION=ADJUST-LOADS
597                            ZONE-CONTROL=CONTROL   ..
598
599   SPACE2-1    =ZONE         LIKE SPACE1-1   ..
600   SPACE3-1    =ZONE         LIKE SPACE1-1   ..
601   SPACE4-1    =ZONE         LIKE SPACE1-1   ..
602   SPACE5-1    =ZONE         LIKE SPACE1-1   ..
603
604   ATTIC       =ZONE         ZONE-TYPE=UNCONDITIONED
      ..
605
```

```
606
607
608    S-AIR          =SYSTEM-AIR      MAX-OA-FRACTION =
       1.0
609                                    OA-CONTROL = TEMP
                                       ..
610
611

612    S-CONT         =SYSTEM-CONTROL  COOLING-SCHEDULE=
       COOLOFF
613                                    HEATING-SCHEDULE=
                                       HEATOFF
614                                    PREHEAT-T =
                                       45

615
                                       MAX-SUPPLY-T=104

616                                    MIN-SUPPLY-T=55
                                       ..
617
618    S-FAN          =SYSTEM-FANS     FAN-SCHEDULE=FAN-SCHED
619
                                       FAN-CONTROL=CONSTANT-VOLUME

620                                    MOTOR-PLACEMENT =
                                       IN-AIRFLOW
621                                    FAN-PLACEMENT =
                                       BLOW-THROUGH
622
                                       SUPPLY-EFF=0.55575

623                                    MAX-FAN-RATIO =
                                       1.1
624                                    MIN-FAN-RATIO =
                                       0.3
625
                                       NIGHT-CYCLE-CTRL=STAY-OFF

626                                    SUPPLY-DELTA-T =
                                       1.815
627                                    SUPPLY-KW = 0.000587
                                       ..
628
629
630    $ PNNL COOLING COIL CURVE-FIT
631    HPACCoolCapFT =
       CURVE-FIT
632                    TYPE = BI-QUADRATIC
633                    COEFFICIENTS = (0.766956,0.0107756,-0.0000414703,0.00134961,
634                    -0.000261144,0.000457488) ..
635    HPACCoolCapFFF =
       CURVE-FIT
636                     TYPE = QUADRATIC
637                     COEFFICIENTS = (0.8,0.2,0) ..
638    HPACCOOLEIRFT =
       CURVE-FIT
639                    TYPE = BI-QUADRATIC
640                    COEFFICIENTS = (0.297145,0.0430933,-0.000748766,0.00597727,
641                    0.000482112,-0.000956448) ..
642    HPACCOOLPLFFPLR =
       CURVE-FIT
643                     TYPE = QUADRATIC
644                     COEFFICIENTS = (0.85,0.15,0) ..
645
646
647    S-EQUIP   =SYSTEM-EQUIPMENT    COOL-CAP-FT =
       SDL-C3
648                                    COOLING-EIR  =
                                       0.242745131
649                                    COOL-EIR-FT =
```

```
                                    SDL-C13
650                                 COOL-EIR-FPLR =
                                    SDL-C18
651                                 COOL-SH-FT
                                    =SDL-C23

652                                 COIL-BF-FT =
                                    HPACCoolCapFT

653                                 COIL-BF-FCFM =
                                    HPACCoolCapFFF
654                                 COIL-BF-FPLR =
                                    HPACCOOLPLFFPLR
655
                                    COIL-BF=0.19

656                                 COOL-FT-MIN=
                                    70
657                                 HEAT-CAP-FT =
                                    SDL-C55
658                                 HEATING-EIR  =
                                    0.29751543
659                                 HEAT-EIR-FT =
                                    SDL-C60
660                                 HEAT-EIR-FPLR =
                                    SDL-C65
661                                 DEFROST-FRAC-FT =
                                    HPACCOOLEIRFT
662                                 OUTSIDE-FAN-T =
                                    45
663                                 OUTSIDE-FAN-MODE =
                                    INTERMITTENT
664                                 COMPRESSOR-TYPE =
                                    SINGLE-SPEED
665                                 RATED-CCAP-FCFM =
                                    SDL-C78
666                                 RATED-SH-FCFM=
                                    SDL-C85
667                                 RATED-CEIR-FCFM=
                                    SDL-C93
668                                 RATED-HCAP-FCFM=
                                    SDL-C100
669                                 CRANKCASE-HEAT=
                                    0.05
670                                 CRANKCASE-MAX-T= 39.92
                                    ..
671
672
673    S-TERM       =SYSTEM-TERMINAL REHEAT-DELTA-T=
       50
674                                 MIN-CFM-RATIO= 1.0
                                    ..
675
676    SYST-1       =SYSTEM         SYSTEM-TYPE=
       PSZ

677                                 SYSTEM-CONTROL= S-CONT
678                                 SYSTEM-FANS= S-FAN
679                                 SYSTEM-TERMINAL= S-TERM
680                                 SYSTEM-EQUIPMENT=
                                    S-EQUIP
681                                 HEAT-SOURCE=
                                    HEAT-PUMP

682                                 PREHEAT-SOURCE=
                                    HEAT-PUMP
683                                 ECONO-LIMIT-T=
                                    82.4
684                                 ECONO-LOW-LIMIT=
                                    32
685                                 RETURN-AIR-PATH= DIRECT
686                                 SIZING-OPTION =
                                    NON-COINCIDENT
```

```
687
                              ZONE-NAMES=(SPACE5-1,SPACE1-1,SPACE2-1
688                                   SPACE3-1,SPACE4-1,ATTIC)
                                        ..
689
690
691   HP-1        = PLANT-ASSIGNMENT  SYSTEM-NAMES = (SYST-1)
692                              HP-LOOP-HEATING = FROM-SYSTEMS
693                              HP-LOOP-COOLING = FROM-SYSTEMS
694                              DHW-SIZE         = 40
695                              DHW-GAL/MIN     =
                                 0.0486
696                              DHW-SCH         = DHW-SCHED
697                              DHW-INLET-T-SCH = DHWINLETSCH-1
698                              DHW-SUPPLY-T    =
                                 131
699                              DHW-TYPE         = ELECTRIC
700                              DHW-EIR          = 1
701                              DHW-EIR-FT       = DHWHPEIRFT
702                              DHW-HEAT-RATE-FT = DHWHPCAPFT
703                              DHW-EIR-FPLR     = DHWGEIRFPLR
704                              DHW-PUMP-ELEC   = 0
705                              MAX-FLUID-T     = 140
706                              MIN-FLUID-T     = 50
707                              FLUID-VOLUME    = 15
                                 ..
708
709
710   $=========================== HOURLY-REPORT FOR SYSTEM
      ===============================
711
712   $ HOURLY-REPORT FOR SYSTEM PART
713   HRSCH-2        = SCHEDULE
714                    THRU DEC 31 (ALL)(1,24)(1) ..
715
716   S1_ZT          = REPORT-BLOCK
717                    VARIABLE-TYPE=SPACE1-1
718                    VARIABLE-LIST=(6,14)
                       ..

719
720   S2_ZT          = REPORT-BLOCK
721                    VARIABLE-TYPE=SPACE2-1
722                    VARIABLE-LIST=(6,14)
                       ..

723
724   S3_ZT          = REPORT-BLOCK
725                    VARIABLE-TYPE=SPACE3-1
726                    VARIABLE-LIST=(6,14) ..
727
728   S4_ZT          = REPORT-BLOCK
729                    VARIABLE-TYPE=SPACE4-1
730                    VARIABLE-LIST=(6,14)
                       ..
731
732   S5_ZT          = REPORT-BLOCK
733                    VARIABLE-TYPE=SPACE5-1
734                    VARIABLE-LIST=(6,14)
                       ..

735
736   SYS1           = REPORT-BLOCK
737                    VARIABLE-TYPE=SYST-1
738                    VARIABLE-LIST=(1,2) ..
739
740   PPRT1          = HOURLY-REPORT
741                    REPORT-SCHEDULE = HRSCH-2
742                    REPORT-BLOCK = (S1_ZT,S2_ZT,S3_ZT,S4_ZT,S5_ZT,SYS1)  ..
743
744   $=============================================================================
745
```

```
746
747   END    ..
748   COMPUTE SYSTEMS    ..
749
750
751   INPUT PLANT    ..
752
753                 PLANT-REPORT   SUMMARY=(ALL-SUMMARY)
754                 REPORT-FREQUENCY = HOURLY
755                 HOURLY-DATA-SAVE = FORMATTED  ..
756
757   $========================= HOURLY-REPORT FOR PLANT
      =============================
758
759   HRSCH-3         = SCHEDULE
760                     THRU DEC 31 (ALL)(1,24)(1) ..
761
762   PLT            = REPORT-BLOCK
763                    VARIABLE-TYPE=PLANT
764                    VARIABLE-LIST=(3) ..
765
766   ENDU           = REPORT-BLOCK
767                    VARIABLE-TYPE=END-USE
768                    VARIABLE-LIST=(1,3,5,6,9)
                        ..
769
770   PPRT1          = HOURLY-REPORT
771                    REPORT-SCHEDULE = HRSCH-3
772                    REPORT-BLOCK = (PLT,ENDU)  ..
773
774   $===============================================================================
775
776   END  ..
777   COMPUTE PLANT    ..
778
779   STOP ..
780
```

2.2.2   Reference Model 2: Five-Zone Model in Houston, TX (PVAV System)

In this section the DOE-2 input file for "Case 2: Five-Zone Model in Houston, TX" is described.

```
1    $=========================== SIMULATION ZONING ===========================
2
3    INPUT LOADS   ..
4
5    TITLE           LINE-1 *SAMP1E PROVIDED BY PROF.JEFF HABERL*
6                    LINE-2 *HOUSTON, TX, CLIMATE ZONE 2A*
7                    LINE-3 *ASHRAE 90.1-2016 REQUIREMENTS SATISFIED*
8                    LINE-4 *STUDY FOR BUILDING OCCUPANCY PROFILE ANALYSIS*  ..
9
10                   RUN-PERIOD       JAN 1 2019 THRU DEC 31 2019   ..
11
12                   ABORT            ERRORS  ..
13                   DIAGNOSTIC       WARNINGS  ..
14                   LOADS-REPORT     SUMMARY = (ALL-SUMMARY)
15                                    REPORT-FREQUENCY = HOURLY
16                                    HOURLY-DATA-SAVE = FORMATTED
17                                    VERIFICATION = (ALL-VERIFICATION) ..
18
19                   BUILDING-LOCATION  LATITUDE=30.0
20                                    LONGITUDE=95.37
21                                    GROUND-T = (69.314, 69.224, 69.368, 69.512,
22                                    69.692,73.634,74.3, 74.444, 74.48, 70.448,
23                                    69.818, 69.458)
24                                    DAYLIGHT-SAVINGS = NO
25                                    ALTITUDE=95.14
26                                    TIME-ZONE=6
27                                    AZIMUTH=0.0   ..
28
29
30   $  BUILDING DESCRIPTION
31
32   $=========================== BUILDING CONSTRUCTION ===========================
33
34
35   $  CONSTRUCTION AND GLASS-TYPES
36
37   $  MATERIAL PROPERTY (IP UNITS)
38   $  ALL VALUES CONVERTED FROM SI UNITS IN PNNL SMALL OFFICE MODEL FOR 90.1-2016
39   $  ROOF AND CEILING PROPERTY
40   ROOF_BUIL       = MAT            THICKNESS = 0.03116798
41                                    CONDUCTIVITY = 0.092446272
42                                    DENSITY = 69.9193264
43                                    SPECIFIC-HEAT = 0.348715014  ..
44
45   ROOF_INS_1      = MAT            RESISTANCE = 24.52377767  ..
46
47   ROOF_INS_2      = MAT            RESISTANCE = 35.40275850  ..
48
49   ROOF_SUR_1      = MAT            THICKNESS = 0.002624672
50                                    CONDUCTIVITY = 26.16229498
51                                    DENSITY = 488.4364373
52                                    SPECIFIC-HEAT = 0.11942295  ..
53
54   CEIL_MAT        = MAT            THICKNESS = 0.041666668
55                                    CONDUCTIVITY = 0.032933984
56                                    DENSITY = 17.97925536
57                                    SPECIFIC-HEAT = 0.31981466  ..
58
59   ROOF_ASPHT      = MAT            THICKNESS = 0.010498688
60                                    CONDUCTIVITY = 0.023111568
61                                    DENSITY = 69.9193264
62                                    SPECIFIC-HEAT = 0.300945834  ..
63
64   ROOF_WOOD       = MAT            THICKNESS = 0.052165356
65                                    CONDUCTIVITY = 0.069334704
66                                    DENSITY = 33.96081568
67                                    SPECIFIC-HEAT = 0.289003539  ..
68
69
70   $  SLAB PROPERTY
71   SLAB_CONC200    = MAT            THICKNESS = 0.666666688
72                                    CONDUCTIVITY = 1.334693052
73                                    DENSITY = 144.9577463
```

```
74                                                 SPECIFIC-HEAT = 0.198719789  ..
75
76    SLAB_CONC100    = MAT            THICKNESS = 0.333333344
77                                    CONDUCTIVITY = 1.334693052
78                                    DENSITY = 144.9577463
79                                    SPECIFIC-HEAT = 0.198719789  ..
80
81    SLAB_CARP       = MAT            RESISTANCE = 1.22923033  ..
82
83
84    $  WALL PROPERTY
85    WALL_STU        = MAT            THICKNESS = 0.083333336
86                                    CONDUCTIVITY = 0.416008224
87                                    DENSITY = 115.8663123
88                                    SPECIFIC-HEAT = 0.200630556  ..
89
90    WALL_GYP1       = MAT            THICKNESS = 0.052165356
91                                    CONDUCTIVITY = 0.092446272
92                                    DENSITY = 49.942376
93                                    SPECIFIC-HEAT = 0.260342031  ..
94
95    WALL_GYP2       = MAT            THICKNESS = 0.041666668
96                                    CONDUCTIVITY = 0.092446272
97                                    DENSITY = 49.942376
98                                    SPECIFIC-HEAT = 0.260342031  ..
99
100   WALL_INS_1      = MAT            RESISTANCE = 9.72589032  ..
101
102   WALL_INS_2      = MAT            RESISTANCE = 9.05708346  ..
103
104
105   $  WINDOW PROPERTY
106   WIN_GLS3        = GLASS-TYPE     GLASS-CONDUCTANCE = 0.6535
107                                   VIS-TRANS = 0.312
108                                   SHADING-COEF =
                                       0.286206897
109                                   PANES = 2                    ..
110
111   DOOR1           = GLASS-TYPE     GLASS-CONDUCTANCE = 0.370
112                                   SHADING-COEF = 0.7  ..
113
114   AIR-LAYER       = CONSTRUCTION   U = 1.11 ..
115
116
117
118   $  MATERIAL LAYERS
119   ATTIC-R1  =LAYERS =MAT=(AR02,PW04)
      ..
120   ATTIC-R2  =LAYERS =MAT=(PW04)  ..
121   ROOF_1    =LAYERS =MAT=(ROOF_INS_2,GP02)  ..
122   EX_SLAB_1 =LAYERS =MAT=(SLAB_CONC200,CP02)  ..
123   EX_WALL_1 =LAYERS =MAT=(SC01,GP02,WALL_INS_2,GP02)  ..
124   IN_WALL_1 =LAYERS =MAT=(GP01,GP01)  ..
125   IN_SLAB_1 =LAYERS =MAT=(SLAB_CONC100,CP02)  ..
126   CEIL_MAT1 =LAYERS =MAT=(AC02,GP01)  ..
127
128
129   $  MATERIAL CONSTRUCTION
130   EXT_SLAB              =CONSTRUCTION      LAYERS = EX_SLAB_1
131                                           ABSORPTANCE = 0.7    ..
132   NONRES_EXT_WALL      =CONSTRUCTION      LAYERS = EX_WALL_1
133                                           ABSORPTANCE = 0.7    ..
134   INT_WALL             =CONSTRUCTION      LAYERS = IN_WALL_1
135                                           ABSORPTANCE = 0.7    ..
136   CEIL_MAT2            =CONSTRUCTION      LAYERS = ROOF_1
137                                           ABSORPTANCE = 0.7    ..
138   ATTIC-ROOF           =CONSTRUCTION      LAYERS = ATTIC-R1
139                                           ABSORPTANCE = 0.7    ..
140   ATTIC-SOFFIT         =CONSTRUCTION      LAYERS = ATTIC-R2
141                                           ABSORPTANCE = 0.7    ..
142   DOOR2                =CONSTRUCTION      U = 1.2139351092
143                                           ABSORPTANCE = 0.7  ..
```

```
144
145     $ OCCUPANCY SCHEDULE
146     OC-1            =DAY-SCHEDULE        (1,6) (0.0)
147                                          (7) (0.11)
148                                          (8) (0.21)
149                                          (9,12) (1.0)
150                                          (13) (0.53)
151                                          (14,17) (1.0)
152                                          (18) (0.32)
153                                          (19,22) (0.11)
154                                          (23) (0.05)
155                                          (24) (0.0)  ..
156
157     OC-2            =DAY-SCHEDULE        (1,6) (0.0)
158                                          (7,8) (0.1)
159                                          (9,12) (0.3)
160                                          (13,17) (0.1)
161                                          (18,19) (0.05)
162                                          (20,24) (0.0)  ..
163
164     OC-3            =DAY-SCHEDULE        (1,6) (0.0)
165                                          (7,18) (0.05)
166                                          (19,24) (0.0)  ..
167
168     OC-4            =DAY-SCHEDULE        (1,24) (0.0)  ..
169     OC-5            =DAY-SCHEDULE        (1,24) (1.0)  ..
170
171     OC-WEEK         =WEEK-SCHEDULE       (WD) OC-1 (SAT) OC-4 (SUN) OC-4 (HOL) OC-4 ..
172     OC-WEEK2        =WEEK-SCHEDULE       (WD) OC-4 (SAT) OC-4 (SUN) OC-4 (HOL) OC-4 ..
173     OC-WEEK3        =WEEK-SCHEDULE       (WD) OC-5 (SAT) OC-5 (SUN) OC-5 (HOL) OC-5 ..
174
175     OCCUPY-1        =SCHEDULE            THRU DEC 31 OC-WEEK   ..
176     OCCUPY-2        =SCHEDULE            THRU DEC 31 OC-WEEK2  ..
177     OCCUPY-3        =SCHEDULE            THRU DEC 31 OC-WEEK3  ..
178
179
180     $ LIGHTING SCHEDULE
181
182     LT-1            =DAY-SCHEDULE        (1,5) (0.18)
183                                          (6,7) (0.23)
184                                          (8) (0.42)
185                                          (9,12) (0.9)
186                                          (13) (0.8)
187                                          (14,17) (0.9)
188                                          (18) (0.61)
189                                          (19,20) (0.42)
190                                          (21,22) (0.32)
191                                          (23) (0.23)
192                                          (24) (0.18)  ..
193
194     LT-0            =DAY-SCHEDULE        (1,6) (0.0)
195                                          (7) (0.11)
196                                          (8) (0.21)
197                                          (9,12) (1.0)
198                                          (13) (0.53)
199                                          (14,17) (1.0)
200                                          (18) (0.32)
201                                          (19,22) (0.11)
202                                          (23) (0.05)
203                                          (24) (0.0)  ..
204
205     LT-2            =DAY-SCHEDULE        (1,6) (0.05)
206                                          (7,8) (0.1)
207                                          (9,12) (0.3)
208                                          (13,17) (0.15)
209                                          (18,24) (0.05) ..
210
211     LT-3            =DAY-SCHEDULE        (1,24) (0.18)  ..
212     LT-4            =DAY-SCHEDULE        (1,24) (0.0)  ..
213     LT-5            =DAY-SCHEDULE        (1,24) (1.0)  ..
214
215
216     LT-WEEK         =WEEK-SCHEDULE       (WD) LT-1 (SAT) LT-3 (SUN) LT-3 (HOL) LT-3 ..
```

```
217  LT-WEEK2         =WEEK-SCHEDULE    (WD) LT-3 (SAT) LT-3 (SUN) LT-3 (HOL) LT-3 ..
218  LT-WEEK3         =WEEK-SCHEDULE    (WD) LT-5 (SAT) LT-5 (SUN) LT-5 (HOL) LT-5 ..
219
220
221  LIGHTS-1         =SCHEDULE         THRU DEC 31 LT-WEEK  ..
222  LIGHTS-2         =SCHEDULE         THRU DEC 31 LT-WEEK2  ..
223  LIGHTS-3         =SCHEDULE         THRU DEC 31 LT-WEEK3
     ..
224
225
226  $ OFFICE EQUIPMENT SCHEDULE
227  EQ-1             =DAY-SCHEDULE     (1,5)  (0.5)
228                                     (6,12)  (1.0)
229                                     (13)  (0.94)
230                                     (14,17)  (1.0)
231                                     (18)  (0.5)
232                                     (19,24)  (0.2)  ..
233
234  EQ-0             =DAY-SCHEDULE     (1,6)  (0.0)
235                                     (7)  (0.11)
236                                     (8)  (0.21)
237                                     (9,12)  (1.0)
238                                     (13)  (0.53)
239                                     (14,17)  (1.0)
240                                     (18)  (0.32)
241                                     (19,22)  (0.11)
242                                     (23)  (0.05)
243                                     (24)  (0.0)  ..
244
245  EQ-2             =DAY-SCHEDULE     (1,6)  (0.3)
246                                     (7,8)  (0.4)
247                                     (9,12)  (0.5)
248                                     (13,17)  (0.35)
249                                     (18,24)  (0.3)  ..
250
251  EQ-3             =DAY-SCHEDULE     (1,24)  (0.2)   ..
252  EQ-4             =DAY-SCHEDULE     (1,24)  (0.0)   ..
253  EQ-5             =DAY-SCHEDULE     (1,24)  (1.0)   ..
254
255
256  EQ-WEEK          =WEEK-SCHEDULE    (WD) EQ-1 (SAT) EQ-3 (SUN) EQ-3 (HOL) EQ-3 ..
257  EQ-WEEK2         =WEEK-SCHEDULE    (WD) EQ-3 (SAT) EQ-3 (SUN) EQ-3 (HOL) EQ-3 ..
258  EQ-WEEK3         =WEEK-SCHEDULE    (WD) EQ-5 (SAT) EQ-5 (SUN) EQ-5 (HOL) EQ-5 ..
259
260
261  EQUIP-1          =SCHEDULE         THRU DEC 31 EQ-WEEK  ..
262  EQUIP-2          =SCHEDULE         THRU DEC 31 EQ-WEEK2  ..
263  EQUIP-3          =SCHEDULE         THRU DEC 31 EQ-WEEK3  ..
264
265
266  $ INFILTRATION SCHEDULE
267  IF-1             =DAY-SCHEDULE     (1,6)  (1.0)
268                                     (7,19)  (0.25)
269                                     (20,24)  (1.0)  ..
270
271  IF-2             =DAY-SCHEDULE     (1,7)  (1.0)
272                                     (8,18)  (0.25)
273                                     (19,24)  (1.0)  ..
274
275  IF-3             =DAY-SCHEDULE     (1,24)  (0.0)   ..
276  IF-4             =DAY-SCHEDULE     (1,24)  (1.0)   ..
277  IF-5             =DAY-SCHEDULE     (1,24)  (0.25)  ..
278
279  IF-6             =DAY-SCHEDULE     (1,6)  (1.0)
280                                     (7,23)  (0.25)
281                                     (24)  (1.0)  ..
282
283  IF-WEEK          =WEEK-SCHEDULE    (WD) IF-1 (SAT) IF-2 (SUN) IF-4 (HOL) IF-4 ..
284  IF-WEEK2         =WEEK-SCHEDULE    (WD) IF-4 (SAT) IF-4 (SUN) IF-4 (HOL) IF-4 ..
285  IF-WEEK3         =WEEK-SCHEDULE    (WD) IF-5 (SAT) IF-5 (SUN) IF-5 (HOL) IF-5 ..
286
287  INFIL-SCH        =SCHEDULE         THRU DEC 31 IF-WEEK  ..
288  INFIL-SCH2       =SCHEDULE         THRU DEC 31 IF-WEEK2  ..
```

```
289   INFIL-SCH3     =SCHEDULE            THRU DEC 31 IF-WEEK3  ..
290
291
292
293   $======================= SPACE DEFAULTS & DESCRIPTION =======================
294
295
296   $ SET DEFAULT VALUE
297
298                   SET-DEFAULT FOR SPACE  FLOOR-WEIGHT = 0 ..
299                   SET-DEFAULT FOR WINDOW  HEIGHT=5.0
300                               GLASS-TYPE=WIN_GLS3  Y=1 ..
301               SET-DEFAULT FOR EXTERIOR-WALL  CONSTRUCTION=NONRES_EXT_WALL ..
302
303
304   $ GENERAL SPACE DEFINITION
305
306   OFFICE           =SPACE-CONDITIONS  PEOPLE-SCHEDULE      =OCCUPY-1
307                                       NUMBER-OF-PEOPLE     =31
308                                       PEOPLE-HEAT-GAIN     =450
309                                       LIGHTING-SCHEDULE    =LIGHTS-1
310                                       LIGHTING-W/SQFT      = 0.79
311                                       EQUIP-SCHEDULE       = EQUIP-1
312                                       EQUIPMENT-W/SQFT     = 0.63
313                                       INF-METHOD           = AIR-CHANGE
314                                       AIR-CHANGES/HR       = 0.0
315                                       INF-SCHEDULE         =INFIL-SCH2  ..
316
317
318                     $ SPECIFIC SPACE DETAILS
319
320   $ ATTIC
321   ATTIC-SC    = SPACE-CONDITIONS
322               ZONE-TYPE   = UNCONDITIONED
323               FLOOR-WEIGHT  = 0 ..
324
325   ATTIC    = SPACE    S-C = ATTIC-SC  AREA = 6113.686  VOLUME = 24533.31
326               X = 0  Y = 0  Z = 0  AZ = 0 ..
327   N-ROOF = POLYGON
328           (92.81,62.53) (-1.97,62.53) (30.28,32.03) (60.56,32.03)..
329   S-ROOF = POLYGON
330           (-1.97,-1.97) (92.81,-1.97) (60.56,32.03) (30.28,32.03) ..
331   E-GABLE = POLYGON
332           (0,0) (64.5,0) (32.25,34)  ..
333   W-GABLE = POLYGON
334           (-1.97,62.53,10) (-1.97,-1.97,10) (30.28,30.28,20.77)  ..
335
336
337
338   $ ROOF RAISED
339   N-ROOF-EXT = ROOF              CONSTRUCTION = ATTIC-ROOF
340                                  POLYGON = S-ROOF
341                                  TILT =18.5, AZ = 0,
342                                  X= 90.84 Y = 60.56 Z = 10.0  ..
343
344   S-ROOF-EXT = ROOF              CONSTRUCTION = ATTIC-ROOF
345                                  POLYGON = S-ROOF
346                                  TILT =18.5, AZ = 180, Z = 10.0  ..
347
348   E-GABLE-EXT = ROOF             CONSTRUCTION = ATTIC-ROOF
349                                  POLYGON = E-GABLE
350                                  TILT =18.2, AZ = 90
351                                  X = 92.81 Y = -1.97 Z = 10.0 ..
352
353   W-GABLE-EXT = ROOF             CONSTRUCTION = ATTIC-ROOF
354                                  POLYGON = E-GABLE
355                                  TILT =18.2, AZ = 270
356                                  X = -1.97 Y = 62.53 Z = 10.0 ..
357
358
359   N-ROOF-SOFFIT = BUILDING-SHADE  HEIGHT = 1.97  WIDTH = 94.78
360                                  X=-1.97  Y=60.6  Z=10
361                                  TRANSMITTANCE = 0.0
```

```
362                                     AZIMUTH = 180   TILT = 180  ..
363     S-ROOF-SOFFIT = BUILDING-SHADE   HEIGHT = 1.97  WIDTH =
        94.78
364                              X=-1.97  Y=0   Z=10
365                              TRANSMITTANCE = 0.0
366                              AZIMUTH = 180 TILT = 180  ..
367     E-ROOF-SOFFIT = BUILDING-SHADE   HEIGHT = 1.97  WIDTH =
        60.56
368                              X=90.85  Y=0   Z=10
369                              TRANSMITTANCE = 0.0
370                              AZIMUTH = 90   TILT = 180  ..
371     W-ROOF-SOFFIT = BUILDING-SHADE   HEIGHT = 1.97  WIDTH =
        60.56
372                              X=0   Y=0   Z=10
373                              TRANSMITTANCE = 0.0
374                              AZIMUTH = 90   TILT = 180  ..
375
376
377
378     SPACE1-1      =SPACE                SPACE-CONDITIONS = OFFICE
379                                         AREA = 1221.28925  VOLUME = 12221.4264
380                                         NUMBER-OF-PEOPLE = 7    ..
381        FRONT-1    =EXTERIOR-WALL        HEIGHT = 10   WIDTH = 90.8
382                                         X=0   Y=0   Z=0 AZIMUTH = 180    ..
383
384         WF-1     =WINDOW               WIDTH = 6   X = 4.56   Y = 2.95  ..
385         WF-2     =WINDOW               WIDTH = 6   X = 19.72  Y = 2.95  ..
386         WF-3     =WINDOW               WIDTH = 6   X = 34.84  Y = 2.95  ..
387         WF-4     =WINDOW               WIDTH = 6   X = 50.00  Y = 2.95  ..
388         WF-5     =WINDOW               WIDTH = 6   X = 65.12  Y = 2.95  ..
389         WF-6     =WINDOW               WIDTH = 6   X = 80.28  Y = 2.95  ..
390         DF-1     =WINDOW               WIDTH = 6   HEIGHT = 7
391                                        X = 42.42  Y = 0
392                                        GLASS-TYPE=WIN_GLS3  ..
393
394        C1-1      =INTERIOR-WALL        AREA = 1221.28925  NEXT-TO ATTIC
395                                        CONSTRUCTION = CEIL_MAT2   ..
396
397        F1-1      =UNDERGROUND-FLOOR    AREA = 1221.28925  CONSTRUCTION = EXT_SLAB ..
398
399        SB12      =INTERIOR-WALL        AREA=231.931  NEXT-TO SPACE2-1
400                                        CONSTRUCTION = INT_WALL    ..
401
402        SB14      =INTERIOR-WALL        LIKE SB12   NEXT-TO SPACE4-1   ..
403        SB15      =INTERIOR-WALL        AREA 580    NEXT-TO  SPACE5-1
404                                        CONSTRUCTION = INT_WALL    ..
405
406     SPACE2-1      =SPACE                SPACE-CONDITIONS = OFFICE
407                                         AREA = 724.4845  VOLUME = 7249.7832
408                                         NUMBER-OF-PEOPLE = 4   ..
409
410        RIGHT-1    =EXTERIOR-WALL        HEIGHT = 10   WIDTH = 60.5
411                                         X=90.8  Y=0   Z=0  AZIMUTH = 90  ..
412
413         WR-1     =WINDOW               WIDTH = 6   X = 4.56   Y = 2.95  ..
414         WR-2     =WINDOW               WIDTH = 6   X = 19.72  Y = 2.95  ..
415         WR-3     =WINDOW               WIDTH = 6   X = 34.84  Y = 2.95  ..
416         WR-4     =WINDOW               WIDTH = 6   X = 50.00  Y = 2.95  ..
417
418        C2-1      =INTERIOR-WALL        AREA = 724.4845  NEXT-TO ATTIC
419                                        CONSTRUCTION = CEIL_MAT2   ..
420
421        F2-1      =UNDERGROUND-FLOOR    AREA = 724.4845  CONSTRUCTION = EXT_SLAB ..
422
423        SB23      =INTERIOR-WALL        AREA = 231.931  NEXT-TO SPACE3-1
424                                        CONSTRUCTION = INT_WALL    ..
425
426        SB25      =INTERIOR-WALL        AREA = 277  NEXT-TO SPACE5-1
427                                        CONSTRUCTION = INT_WALL    ..
428
429     SPACE3-1      =SPACE                SPACE-CONDITIONS = OFFICE
430                                         AREA  = 1221.28925  VOLUME = 12221.4264
431                                         NUMBER-OF-PEOPLE = 7   ..
```

```
432
433      BACK-1       =EXTERIOR-WALL         HEIGHT = 10   WIDTH = 90.8
434                                          X=90.8  Y=60.5  Z=0  AZIMUTH = 0   ..
435
436        WB-1       =WINDOW                WIDTH = 6   X = 4.56   Y = 2.95 ..
437        WB-2       =WINDOW                WIDTH = 6   X = 19.72  Y = 2.95 ..
438        WB-3       =WINDOW                WIDTH = 6   X = 34.84  Y = 2.95 ..
439        WB-4       =WINDOW                WIDTH = 6   X = 50.00  Y = 2.95 ..
440        WB-5       =WINDOW                WIDTH = 6   X = 65.12  Y = 2.95 ..
441        WB-6       =WINDOW                WIDTH = 6   X = 80.28  Y = 2.95 ..
442        DB-1       =DOOR                  WIDTH = 3   HEIGHT = 7
443                                          X = 28.08  Y = 0
444                                          CONSTRUCTION = DOOR2   ..
445        DB-2       =DOOR                  WIDTH = 3   HEIGHT = 7
446                                          X = 41.92  Y = 0
447                                          CONSTRUCTION = DOOR2    ..
448
449      C3-1         =INTERIOR-WALL         AREA = 1221.28925  NEXT-TO ATTIC
450                                          CONSTRUCTION = CEIL_MAT2   ..
451
452      F3-1         =UNDERGROUND-FLOOR     AREA = 1221.28925
453                                          CONSTRUCTION = EXT_SLAB   ..
454
455      SB34         =INTERIOR-WALL         AREA = 231.931  NEXT-TO SPACE4-1
456                                          CONSTRUCTION = INT_WALL   ..
457
458      SB35         =INTERIOR-WALL         AREA = 580  NEXT-TO SPACE5-1
459                                          CONSTRUCTION = INT_WALL   ..
460
461  SPACE4-1         =SPACE                 SPACE-CONDITIONS = OFFICE
462                                          AREA = 724.4845  VOLUME = 7249.7832
463                                          NUMBER-OF-PEOPLE = 4   ..
464
465      LEFT-1       =EXTERIOR-WALL         HEIGHT = 10   WIDTH = 60.5
466                                          X=0   Y=60.5  Z=0   AZIMUTH = 270  ..
467
468        WL-1       =WINDOW                WIDTH = 6   X = 4.56   Y = 2.95  ..
469        WL-2       =WINDOW                WIDTH = 6   X = 19.72  Y = 2.95  ..
470        WL-3       =WINDOW                WIDTH = 6   X = 34.84  Y = 2.95  ..
471        WL-4       =WINDOW                WIDTH = 6   X = 50.00  Y = 2.95  ..
472
473      C4-1         =INTERIOR-WALL         AREA = 724.4845  NEXT-TO ATTIC
474                                          CONSTRUCTION = CEIL_MAT2   ..
475
476      F4-1         =UNDERGROUND-FLOOR     AREA = 724.4845
477                                          CONSTRUCTION = EXT_SLAB   ..
478
479      SB45         =INTERIOR-WALL         AREA = 277  NEXT-TO SPACE5-1
480                                          CONSTRUCTION = INT_WALL   ..
481
482  SPACE5-1         =SPACE                 SPACE-CONDITIONS = OFFICE
483                                          AREA = 1611.0899  VOLUME = 16122.1672
484                                          NUMBER-OF-PEOPLE = 9   ..
485
486      C5-1         =INTERIOR-WALL         AREA = 1611.0899  NEXT-TO ATTIC
487                                          CONSTRUCTION = CEIL_MAT2   ..
488
489      F5-1         =UNDERGROUND-FLOOR     AREA = 1611.0899
490                                          CONSTRUCTION = EXT_SLAB ..
491
492
493  END  ..
494  COMPUTE  LOADS   ..
495
496
497
498  $============================= SYSTEM DESCRIPTION ============================
499
500  INPUT SYSTEMS    ..
501
502               SYSTEMS-REPORT  SUMMARY=(ALL-SUMMARY)
503                               REPORT-FREQUENCY = HOURLY
504                               HOURLY-DATA-SAVE = FORMATTED    ..
```

```
505
506
507    $ SYSTEMS SCHEDULES
508
509    FAN-1           =DAY-SCHEDULE        (1,6)(0)(7,19)(1)(20,24)(0)  ..
510    FAN-2           =DAY-SCHEDULE        (1,24) (0)    ..
511    FAN-3           =DAY-SCHEDULE        (1,24) (1)    ..
512    FAN-4           =DAY-SCHEDULE        (1,6)(0)(7,23)(1)(24)(0)   ..
513    FAN-5           =DAY-SCHEDULE        (1,8)(0)(9,17)(1)(18,24)(0)   ..
514
515    FAN-WEEK        =WEEK-SCHEDULE        (WD) FAN-1 (WEH) FAN-2  ..
516    FAN-WEEK2       =WEEK-SCHEDULE        (WD) FAN-2 (WEH) FAN-2  ..
517    FAN-WEEK3       =WEEK-SCHEDULE        (WD) FAN-3 (WEH) FAN-3  ..
518
519
520    FAN-SCHED       =SCHEDULE            THRU DEC 31  FAN-WEEK  ..
521    FAN-SCHED2      =SCHEDULE            THRU DEC 31  FAN-WEEK2 ..
522    FAN-SCHED3      =SCHEDULE            THRU DEC 31  FAN-WEEK3 ..
523
524
525    $ THERMOSTAT SET-POINTS FOR HEATING AND COOLING
526    $ SET TEMPERATURES CONVERTED TO IP UNITS FROM SI UNITS
527
528    HEAT-1          =DAY-SCHEDULE        (1,6) (60.01) (7) (69.98)
529                                         (8,19) (69.98)  (20,24) (60.01)  ..
530    HEAT-2          =DAY-SCHEDULE        (1,5) (60.01)  (6) (64.04)  (7) (68.0)
531                                         (8,17) (69.98)  (18,24) (60.01)  ..
532    HEAT-3          =DAY-SCHEDULE        (1,24) (60.01)   ..
533    HEAT-4          =DAY-SCHEDULE        (1,24) (69.98)   ..
534
535
536    HEAT-WEEK   =WEEK-SCHEDULE    (MON,FRI)  HEAT-1   (SAT) HEAT-3  (SUN) HEAT-3
537                                  (HOL) HEAT-3 ..
538    HEAT-WEEK2  =WEEK-SCHEDULE    (MON,FRI)  HEAT-3   (SAT) HEAT-3  (SUN) HEAT-3
539                                  (HOL) HEAT-3 ..
540    HEAT-WEEK3  =WEEK-SCHEDULE    (MON,FRI)  HEAT-4   (SAT) HEAT-4  (SUN) HEAT-4
541                                  (HOL) HEAT-4 ..
542
543
544    HEAT-SCHED  =SCHEDULE         THRU DEC 31   HEAT-WEEK    ..
545    HEAT-SCHED2 =SCHEDULE         THRU DEC 31   HEAT-WEEK2   ..
546    HEAT-SCHED3 =SCHEDULE         THRU DEC 31   HEAT-WEEK3   ..
547
548
549    COOLOFF     =SCHEDULE         THRU DEC 31 (ALL) (1,24) (1)   ..
550    HEATOFF     =SCHEDULE         THRU DEC 31 (ALL) (1,24) (1)   ..
551
552
553    COOL-1      =DAY-SCHEDULE     (1,6) (84.99)  (7) (75.00)
554                                  (8,18) (75.00)  (19,24) (84.99)  ..
555    COOL-2      =DAY-SCHEDULE     (1,5) (84.99)  (6) (78.08)  (7) (77.0)
556                                  (8,17) (75.00)  (18,24) (84.99)  ..
557    COOL-3      =DAY-SCHEDULE     (1,24) (84.99)   ..
558    COOL-4      =DAY-SCHEDULE     (1,24) (75.00)   ..
559
560
561    COOL-WEEK   =WEEK-SCHEDULE    (MON,FRI)  COOL-1   (SAT) COOL-3  (SUN) COOL-3
562                                  (HOL) COOL-3 ..
563    COOL-WEEK2  =WEEK-SCHEDULE    (MON,FRI)  COOL-3   (SAT) COOL-3  (SUN)
       COOL-3
564                                  (HOL) COOL-3 ..
565    COOL-WEEK3  =WEEK-SCHEDULE    (MON,FRI)  COOL-4   (SAT) COOL-4  (SUN)
       COOL-4
566                                  (HOL) COOL-4 ..
567
568
569    COOL-SCHED  =SCHEDULE         THRU DEC 31   COOL-WEEK    ..
570    COOL-SCHED2 =SCHEDULE         THRU DEC 31   COOL-WEEK2
       ..
571    COOL-SCHED3 =SCHEDULE         THRU DEC 31   COOL-WEEK3   ..
572
573
574    HVAC-HEAT   =SCHEDULE          THRU DEC 31 (ALL) (1,24) (1)      ..
```

```
575   HVAC-COOL    =SCHEDULE         THRU DEC 31 (ALL) (1,24) (1)      ..
576
577   24HR-OFF     =SCHEDULE         THRU DEC 31 (ALL) (1,24) (0)      ..
578
579   DHW-SCHED    =SCHEDULE         THRU DEC 31 (ALL) (1,24) (1)      ..
580   DHWINLETSCH-1 =SCHEDULE        THRU DEC 31 (ALL) (1,24) (140)    ..
581
582   INT-1        =DAY-SCHEDULE     (1,7) (0)   (8) (0.35)  (9) (0.69)   (10)
      (0.43)
583                                 (11) (0.37)  (12) (0.43)   (13) (0.58)   (14) (0.48)
584                                 (15,16) (0.37)   (17) (0.46)   (18) (0.62)
585                                 (19) (0.12)  (20,21) (0.04)   (22,24) (0)
                                    ..
586   INT-2        =DAY-SCHEDULE     (1,7) (0)   (8) (0.16)  (9) (0.14)  (10) (0.21)
587                                 (11) (0.18)   (12) (0.25)   (13) (0.21)   (14) (0.13)
588                                 (15) (0.08)  (16) (0.04)  (17) (0.05)
589                                 (18) (0.06)  (19,24) (0)    ..
590   INT-3        =DAY-SCHEDULE     (1,24) (0)   ..
591   INT-WEEK     =WEEK-SCHEDULE    (MON,FRI) INT-3   (SAT) INT-3   (SUN) INT-3
592                                 (HOL) INT-3 ..
593   INT-SHED     = SCHEDULE         THRU DEC 31   INT-WEEK    ..
594
595
596
597   $ SYSTEM DESCRIPTION
598
599   ZAIR         =ZONE-AIR     OA-CFM/PER= 17
600                              EXHAUST-CFM = 0
601                              EXHAUST-EFF = 0.75
602                              EXHAUST-STATIC = 0   ..
603
604
605   CONTROL   = ZONE-CONTROL     DESIGN-HEAT-T = 70
606                               DESIGN-COOL-T = 75
607                               HEAT-TEMP-SCH = HEAT-SCHED
608                               COOL-TEMP-SCH = COOL-SCHED
609                               THERMOSTAT-TYPE =
                                  PROPORTIONAL
610                               THROTTLING-RANGE = 0.1
                                  ..
611
612
613   SPACE1-1     =ZONE        ZONE-AIR=ZAIR
614                             SIZING-OPTION=ADJUST-LOADS
615                             ZONE-CONTROL=CONTROL   ..
616
617   SPACE2-1     =ZONE        LIKE SPACE1-1    ..
618   SPACE3-1     =ZONE        LIKE SPACE1-1    ..
619   SPACE4-1     =ZONE        LIKE SPACE1-1    ..
620   SPACE5-1     =ZONE        LIKE SPACE1-1    ..
621
622   ATTIC        =ZONE        ZONE-TYPE=UNCONDITIONED
      ..
623
624
625   S-CONT       =SYSTEM-CONTROL  COOLING-SCHEDULE=
      COOLOFF
626                                HEATING-SCHEDULE=
                                   HEATOFF
627                                COOL-CONTROL = CONSTANT
628                                PREHEAT-T = 44.6
629
                                   MAX-SUPPLY-T=104
630                                MIN-SUPPLY-T=55
                                   ..
631
632   S-AIR        =SYSTEM-AIR    MAX-OA-FRACTION =
      1.0
633                               OA-CONTROL = TEMP ..
634
635   S-FAN        =SYSTEM-FANS   FAN-SCHEDULE=FAN-SCHED5
```

```
636                                         FAN-CONTROL=
                                            INLET
637                                         MOTOR-PLACEMENT =
                                            IN-AIRFLOW
638                                         FAN-PLACEMENT =
                                            DRAW-THROUGH
639
                                            SUPPLY-EFF=0.55575

640                                         MAX-FAN-RATIO = 1.1
641                                         MIN-FAN-RATIO =
                                            0.3
642
                                            NIGHT-CYCLE-CTRL=STAY-OFF

643                                         SUPPLY-DELTA-T =
                                            2.117
644                                         SUPPLY-KW = 0.000685
                                            ..
645
646
647    $ COIL CURVE-FIT
648    HPACCoolCapFT =
       CURVE-FIT
649                      TYPE = BI-QUADRATIC
650                      COEFFICIENTS = (0.766956,0.0107756,-0.0000414703,0.00134961,
651                      -0.000261144,0.000457488) ..
652    HPACCoolCapFFF =
       CURVE-FIT
653                       TYPE = QUADRATIC
654                       COEFFICIENTS = (0.8,0.2,0) ..
655    HPACCOOLEIRFT =
       CURVE-FIT
656                      TYPE = BI-QUADRATIC
657                      COEFFICIENTS = (0.297145,0.0430933,-0.000748766,0.00597727,
658                      0.000482112,-0.000956448) ..
659    HPACCOOLPLFFPLR =
       CURVE-FIT
660                       TYPE = QUADRATIC
661                       COEFFICIENTS = (0.85,0.15,0) ..
662
663
664    S-EQUIP  =SYSTEM-EQUIPMENT   COOL-CAP-FT = SDL-C3
665                                 COOLING-EIR  = 0.242745131
666                                 COOL-EIR-FT =
                                     SDL-C13
667                                 COOL-EIR-FPLR = SDL-C18
668                                 COOL-SH-FT =SDL-C23
669                                 COIL-BF-FT = HPACCoolCapFT
670                                 COIL-BF-FCFM = HPACCoolCapFFF
671                                 COIL-BF-FPLR = HPACCOOLPLFFPLR
672
                                     COIL-BF=0.19

673                                 COOL-FT-MIN=
                                     70
674                                 HEAT-CAP-FT =
                                     SDL-C55
675                                 HEATING-EIR  =
                                     0.29751543
676                                 HEAT-EIR-FT =
                                     SDL-C60
677                                 HEAT-EIR-FPLR =
                                     SDL-C65
678                                 DEFROST-FRAC-FT =
                                     HPACCOOLEIRFT
679                                 OUTSIDE-FAN-T = 45
680                                 OUTSIDE-FAN-MODE =
                                     INTERMITTENT
681                                 COMPRESSOR-TYPE =
                                     SINGLE-SPEED
682                                 RATED-CCAP-FCFM = SDL-C78
683                                 RATED-SH-FCFM=
```

```
                                   SDL-C85
684                                RATED-CEIR-FCFM= SDL-C93
685                                RATED-HCAP-FCFM=
                                   SDL-C100
686                                CRANKCASE-HEAT= 0.05
687                                CRANKCASE-MAX-T= 39.92
                                   ..
688
689
690    SYST-1        =SYSTEM        SYSTEM-TYPE=
       PVAVS
691                                SYSTEM-CONTROL= S-CONT
692                                SYSTEM-FANS= S-FAN
693                                SYSTEM-TERMINAL= S-TERM
694                                SYSTEM-EQUIPMENT=
                                   S-EQUIP
695                                HEAT-SOURCE=
                                   HEAT-PUMP

696                                PREHEAT-SOURCE=
                                   HEAT-PUMP
697                                RETURN-AIR-PATH= DIRECT
698                                SIZING-OPTION =
                                   NON-COINCIDENT
699
                                   ZONE-NAMES=(SPACE5-1,SPACE1-1,SPACE2-1

700                                      SPACE3-1,SPACE4-1,ATTIC)
                                            ..
701
702
703    HP-1      = PLANT-ASSIGNMENT  SYSTEM-NAMES = (SYST-1)
704                                HP-LOOP-HEATING = FROM-SYSTEMS
705                                HP-LOOP-COOLING = FROM-SYSTEMS
706                                DHW-SIZE        = 40
707                                DHW-GAL/MIN     =
                                   0.0486
708                                DHW-SCH         = DHW-SCHED
709                                DHW-INLET-T-SCH = DHWINLETSCH-1
710                                DHW-SUPPLY-T    =
                                   131
711                                DHW-TYPE        = ELECTRIC
712                                DHW-EIR         = 1
713                                DHW-EIR-FT      = DHWHPEIRFT
714                                DHW-HEAT-RATE-FT = DHWHPCAPFT
715                                DHW-EIR-FPLR    = DHWGEIRFPLR
716                                DHW-PUMP-ELEC   = 0
717                                MAX-FLUID-T     = 140
718                                MIN-FLUID-T     = 50
719                                FLUID-VOLUME    = 15
                                   ..
720
721
722    $========================= HOURLY-REPORT FOR SYSTEM
       ==============================
723
724    $ HOURLY-REPORT FOR SYSTEM PART
725    HRSCH-2        = SCHEDULE
726                     THRU DEC 31 (ALL)(1,24)(1) ..
727
728    S1_ZT          = REPORT-BLOCK
729                     VARIABLE-TYPE=SPACE1-1
730                     VARIABLE-LIST=(6,14)
                         ..

731
732    S2_ZT          = REPORT-BLOCK
733                     VARIABLE-TYPE=SPACE2-1
734                     VARIABLE-LIST=(6,14)
                         ..
735
736    S3_ZT          = REPORT-BLOCK
737                     VARIABLE-TYPE=SPACE3-1
```

```
738                         VARIABLE-LIST=(6,14) ..
739
740    S4_ZT           = REPORT-BLOCK
741                      VARIABLE-TYPE=SPACE4-1
742                      VARIABLE-LIST=(6,14) ..
743
744    S5_ZT           = REPORT-BLOCK
745                      VARIABLE-TYPE=SPACE5-1
746                      VARIABLE-LIST=(6,14)
                          ..

747
748    SYS1            = REPORT-BLOCK
749                      VARIABLE-TYPE=SYST-1
750                      VARIABLE-LIST=(1,2) ..
751
752    PPRT1           = HOURLY-REPORT
753                      REPORT-SCHEDULE = HRSCH-2
754                      REPORT-BLOCK = (S1_ZT,S2_ZT,S3_ZT,S4_ZT,S5_ZT,SYS1)  ..
755
756    $=============================================================================
757
758
759
760    END    ..
761    COMPUTE SYSTEMS   ..
762
763
764    INPUT PLANT    ..
765
766                    PLANT-REPORT  SUMMARY=(ALL-SUMMARY)
767                    REPORT-FREQUENCY = HOURLY
768                    HOURLY-DATA-SAVE = FORMATTED   ..
769
770    $======================== HOURLY-REPORT FOR PLANT
       ==============================
771
772    HRSCH-3         = SCHEDULE
773                      THRU DEC 31 (ALL)(1,24)(1) ..
774
775    PLT             = REPORT-BLOCK
776                      VARIABLE-TYPE=PLANT
777                      VARIABLE-LIST=(3) ..
778
779    ENDU            = REPORT-BLOCK
780                      VARIABLE-TYPE=END-USE
781                      VARIABLE-LIST=(1,3,5,6,9)
                          ..

782
783    PPRT1           = HOURLY-REPORT
784                      REPORT-SCHEDULE = HRSCH-3
785                      REPORT-BLOCK = (PLT,ENDU)   ..
786
787    $=============================================================================
788
789
790    END  ..
791    COMPUTE PLANT    ..
792
793
794
795    STOP ..
796
```

2.3   Chicago, IL: Thermal Zoning Models

2.3.1   Reference Model 1: Single-Zone Model in Chicago, IL (PSZ System)

In this section the DOE-2 input file for "Case 1: Five-Zone Model in Chicago, IL" is described.

```
 1    $============================ SIMULATION ZONING ============================
 2
 3    INPUT LOADS   ..
 4
 5    TITLE          LINE-1 *SAMP1E PROVIDED BY PROF.JEFF HABERL*
 6                   LINE-2 *CHICAGO, TX, CLIMATE ZONE 4A*
 7                   LINE-3 *ASHRAE 90.1-2016 REQUIREMENTS SATISFIED*
 8                   LINE-4 *STUDY FOR BUILDING OCCUPANCY PROFILE ANALYSIS*   ..
 9
10                   RUN-PERIOD       JAN 1 2019 THRU DEC 31 2019    ..
11
12                   ABORT            ERRORS  ..
13                   DIAGNOSTIC       WARNINGS  ..
14                   LOADS-REPORT     SUMMARY = (ALL-SUMMARY)
15                                    REPORT-FREQUENCY = HOURLY
16                                    HOURLY-DATA-SAVE = FORMATTED
17                                    VERIFICATION = (ALL-VERIFICATION) ..
18
19                   BUILDING-LOCATION  LATITUDE=41.98
20                                    LONGITUDE=87.92
21                                    GROUND-T = (67.838, 67.604, 67.604, 67.838,
22                                    68.18,72.05,73.184, 73.526, 73.634, 69.944,
23                                    68.954, 68.342)
24                                    DAYLIGHT-SAVINGS = NO
25                                    ALTITUDE=659.45
26                                    TIME-ZONE=6
27                                    AZIMUTH=0.0    ..
28
29    $  BUILDING DESCRIPTION
30
31    $============================ BUILDING CONSTRUCTION ============================
32
33
34    $  CONSTRUCTION AND GLASS-TYPES
35
36    $  MATERIAL PROPERTY (IP UNITS)
37    $  ALL VALUES CONVERTED FROM SI UNITS IN PNNL SMALL OFFICE MODEL FOR 90.1-2016
38    $  ROOF AND CEILING PROPERTY
39    ROOF_BUIL       = MAT         THICKNESS = 0.03116798
40                                  CONDUCTIVITY = 0.092446272
41                                  DENSITY = 69.9193264
42                                  SPECIFIC-HEAT = 0.348715014  ..
43
44    ROOF_INS_2      = MAT         RESISTANCE = 45.98476874  ..
45
46    ROOF_SUR_1      = MAT         THICKNESS = 0.002624672
47                                  CONDUCTIVITY = 26.16229498
48                                  DENSITY = 488.4364373
49                                  SPECIFIC-HEAT = 0.11942295  ..
50
51    ROOF_ASPHT      = MAT         THICKNESS = 0.010498688
52                                  CONDUCTIVITY = 0.023111568
53                                  DENSITY = 69.9193264
54                                  SPECIFIC-HEAT = 0.300945834  ..
55
56    ROOF_WOOD       = MAT         THICKNESS = 0.052165356
57                                  CONDUCTIVITY = 0.069334704
58                                  DENSITY = 33.96081568
59                                  SPECIFIC-HEAT = 0.289003539  ..
60
61
62    $  SLAB PROPERTY
63    SLAB_CONC200    = MAT         THICKNESS = 0.666666688
64                                  CONDUCTIVITY = 1.334693052
65                                  DENSITY = 144.9577463
66                                  SPECIFIC-HEAT = 0.198719789  ..
67
68    SLAB_CONC100    = MAT         THICKNESS = 0.333333344
69                                  CONDUCTIVITY = 1.334693052
70                                  DENSITY = 144.9577463
71                                  SPECIFIC-HEAT = 0.198719789  ..
72
73    SLAB_CARP       = MAT         RESISTANCE = 1.22923033  ..
```

```
74
75
76   $  WALL PROPERTY
77   WALL_STU        = MAT                 THICKNESS = 0.083333336
78                                         CONDUCTIVITY = 0.416008224
79                                         DENSITY = 115.8663123
80                                         SPECIFIC-HEAT = 0.200630556  ..
81
82   WALL_GYP1       = MAT                 THICKNESS = 0.052165356
83                                         CONDUCTIVITY = 0.092446272
84                                         DENSITY = 49.942376
85                                         SPECIFIC-HEAT = 0.260342031  ..
86
87   WALL_GYP2       = MAT                 THICKNESS = 0.041666668
88                                         CONDUCTIVITY = 0.092446272
89                                         DENSITY = 49.942376
90                                         SPECIFIC-HEAT = 0.260342031  ..
91
92   WALL_INS_2      = MAT                 RESISTANCE = 17.42897129 ..
93
94
95   $  WINDOW PROPERTY
96   WIN_GLS3        = GLASS-TYPE          GLASS-CONDUCTANCE = 0.3954
97                                         VIS-TRANS = 0.452
98                                         SHADING-COEF =
                                           0.41954023
99                                         PANES = 2                  ..
100
101  DOOR1           = GLASS-TYPE          GLASS-CONDUCTANCE = 0.370
102                                        SHADING-COEF = 0.7  ..
103
104  AIR-LAYER       = CONSTRUCTION        U = 1.11 ..
105
106
107
108  $  MATERIAL LAYERS
109  ATTIC-R1  =LAYERS =MAT=(AR02,PW04)  ..
110
111  ATTIC-R2  =LAYERS =MAT=(PW04)   ..
112
113  ROOF_1    =LAYERS =MAT=(ROOF_INS_2,GP02)   ..
114  EX_SLAB_1 =LAYERS =MAT=(SLAB_CONC200,CP02)   ..
115  EX_WALL_1 =LAYERS =MAT=(SC01,GP02,WALL_INS_2,GP02)   ..
116  IN_WALL_1 =LAYERS =MAT=(GP01,GP01)   ..
117  IN_SLAB_1 =LAYERS =MAT=(SLAB_CONC100,CP02)   ..
118  CEIL_MAT1 =LAYERS =MAT=(AC02,GP01)   ..
119
120
121  $  MATERIAL CONSTRUCTION
122  EXT_SLAB                    =CONSTRUCTION        LAYERS = EX_SLAB_1
123                                                  ABSORPTANCE = 0.7     ..
124  NONRES_EXT_WALL             =CONSTRUCTION        LAYERS = EX_WALL_1
125                                                  ABSORPTANCE = 0.7     ..
126  INT_WALL                    =CONSTRUCTION        LAYERS = IN_WALL_1
127                                                  ABSORPTANCE = 0.7     ..
128  CEIL_MAT2                   =CONSTRUCTION        LAYERS = ROOF_1
129                                                  ABSORPTANCE = 0.7     ..
130  ATTIC-ROOF                  =CONSTRUCTION        LAYERS = ATTIC-R1
131                                                  ABSORPTANCE = 0.7     ..
132  ATTIC-SOFFIT                =CONSTRUCTION        LAYERS = ATTIC-R2
133                                                  ABSORPTANCE = 0.7     ..
134  DOOR2                       =CONSTRUCTION        U = 1.426492621
135                                                  ABSORPTANCE = 0.7  ..
136
137  $ OCCUPANCY SCHEDULE
138  OC-1            =DAY-SCHEDULE         (1,6) (0.0)
139                                       (7) (0.11)
140                                       (8) (0.21)
141                                       (9,12) (1.0)
142                                       (13) (0.53)
143                                       (14,17) (1.0)
144                                       (18) (0.32)
145                                       (19,22) (0.11)
```

```
146                                  (23) (0.05)
147                                  (24) (0.0)  ..
148
149    OC-2            =DAY-SCHEDULE  (1,6) (0.0)
150                                  (7,8) (0.1)
151                                  (9,12) (0.3)
152                                  (13,17) (0.1)
153                                  (18,19) (0.05)
154                                  (20,24) (0.0)  ..
155
156    OC-3            =DAY-SCHEDULE  (1,6) (0.0)
157                                  (7,18) (0.05)
158                                  (19,24) (0.0)  ..
159
160    OC-4            =DAY-SCHEDULE  (1,24) (0.0)  ..
161    OC-5            =DAY-SCHEDULE  (1,24) (1.0)  ..
162
163
164    OC-WEEK         =WEEK-SCHEDULE (WD) OC-1 (SAT) OC-4 (SUN) OC-4 (HOL) OC-4 ..
165    OC-WEEK2        =WEEK-SCHEDULE (WD) OC-4 (SAT) OC-4 (SUN) OC-4 (HOL) OC-4 ..
166    OC-WEEK3        =WEEK-SCHEDULE (WD) OC-5 (SAT) OC-5 (SUN) OC-5 (HOL) OC-5 ..
167
168    OCCUPY-1        =SCHEDULE      THRU DEC 31 OC-WEEK   ..
169    OCCUPY-2        =SCHEDULE      THRU DEC 31 OC-WEEK2  ..
170    OCCUPY-3        =SCHEDULE      THRU DEC 31 OC-WEEK3  ..
171
172
173    $ LIGHTING SCHEDULE
174
175    LT-1            =DAY-SCHEDULE  (1,5) (0.18)
176                                  (6,7) (0.23)
177                                  (8) (0.42)
178                                  (9,12) (0.9)
179                                  (13) (0.8)
180                                  (14,17) (0.9)
181                                  (18) (0.61)
182                                  (19,20) (0.42)
183                                  (21,22) (0.32)
184                                  (23) (0.23)
185                                  (24) (0.18)  ..
186
187    LT-0            =DAY-SCHEDULE  (1,6) (0.0)
188                                  (7) (0.11)
189                                  (8) (0.21)
190                                  (9,12) (1.0)
191                                  (13) (0.53)
192                                  (14,17) (1.0)
193                                  (18) (0.32)
194                                  (19,22) (0.11)
195                                  (23) (0.05)
196                                  (24) (0.0)  ..
197
198    LT-2            =DAY-SCHEDULE  (1,6) (0.05)
199                                  (7,8) (0.1)
200                                  (9,12) (0.3)
201                                  (13,17) (0.15)
202                                  (18,24) (0.05) ..
203
204    LT-3            =DAY-SCHEDULE  (1,24) (0.18)  ..
205    LT-4            =DAY-SCHEDULE  (1,24) (0.0)  ..
206    LT-5            =DAY-SCHEDULE  (1,24) (1.0)  ..
207
208
209    LT-WEEK         =WEEK-SCHEDULE (WD) LT-1 (SAT) LT-3 (SUN) LT-3 (HOL) LT-3 ..
210    LT-WEEK2        =WEEK-SCHEDULE (WD) LT-3 (SAT) LT-3 (SUN) LT-3 (HOL) LT-3 ..
211    LT-WEEK3        =WEEK-SCHEDULE (WD) LT-5 (SAT) LT-5 (SUN) LT-5 (HOL) LT-5 ..
212
213    LIGHTS-1        =SCHEDULE      THRU DEC 31 LT-WEEK   ..
214    LIGHTS-2        =SCHEDULE      THRU DEC 31 LT-WEEK2  ..
215    LIGHTS-3        =SCHEDULE      THRU DEC 31 LT-WEEK3  ..
216
217
218    $ OFFICE EQUIPMENT SCHEDULE
```

```
219   EQ-1             =DAY-SCHEDULE        (1,5) (0.5)
220                                         (6,12) (1.0)
221                                         (13) (0.94)
222                                         (14,17) (1.0)
223                                         (18) (0.5)
224                                         (19,24) (0.2)  ..
225
226   EQ-0             =DAY-SCHEDULE        (1,6) (0.0)
227                                         (7) (0.11)
228                                         (8) (0.21)
229                                         (9,12) (1.0)
230                                         (13) (0.53)
231                                         (14,17) (1.0)
232                                         (18) (0.32)
233                                         (19,22) (0.11)
234                                         (23) (0.05)
235                                         (24) (0.0)  ..
236
237   EQ-2             =DAY-SCHEDULE        (1,6) (0.3)
238                                         (7,8) (0.4)
239                                         (9,12) (0.5)
240                                         (13,17) (0.35)
241                                         (18,24) (0.3)  ..
242
243   EQ-3             =DAY-SCHEDULE        (1,24) (0.2)    ..
244   EQ-4             =DAY-SCHEDULE        (1,24) (0.0)    ..
245   EQ-5             =DAY-SCHEDULE        (1,24) (1.0)    ..
246
247
248   EQ-WEEK          =WEEK-SCHEDULE       (WD) EQ-1 (SAT) EQ-3 (SUN) EQ-3 (HOL) EQ-3 ..
249   EQ-WEEK2         =WEEK-SCHEDULE       (WD) EQ-3 (SAT) EQ-3 (SUN) EQ-3 (HOL) EQ-3 ..
250   EQ-WEEK3         =WEEK-SCHEDULE       (WD) EQ-5 (SAT) EQ-5 (SUN) EQ-5 (HOL) EQ-5 ..
251
252
253   EQUIP-1          =SCHEDULE            THRU DEC 31 EQ-WEEK   ..
254   EQUIP-2          =SCHEDULE            THRU DEC 31 EQ-WEEK2  ..
255   EQUIP-3          =SCHEDULE            THRU DEC 31 EQ-WEEK3  ..
256
257
258   $ INFILTRATION SCHEDULE
259   IF-1             =DAY-SCHEDULE        (1,6) (1.0)
260                                         (7,19) (0.25)
261                                         (20,24) (1.0)  ..
262
263   IF-2             =DAY-SCHEDULE        (1,7) (1.0)
264                                         (8,18) (0.25)
265                                         (19,24) (1.0)  ..
266
267   IF-3             =DAY-SCHEDULE        (1,24) (0.0)  ..
268   IF-4             =DAY-SCHEDULE        (1,24) (1.0)  ..
269   IF-5             =DAY-SCHEDULE        (1,24) (0.25)  ..
270
271
272   IF-WEEK          =WEEK-SCHEDULE       (WD) IF-1 (SAT) IF-2 (SUN) IF-4 (HOL) IF-4 ..
273   IF-WEEK2         =WEEK-SCHEDULE       (WD) IF-4 (SAT) IF-4 (SUN) IF-4 (HOL) IF-4 ..
274   IF-WEEK3         =WEEK-SCHEDULE       (WD) IF-5 (SAT) IF-5 (SUN) IF-5 (HOL) IF-5 ..
275
276   INFIL-SCH        =SCHEDULE            THRU DEC 31 IF-WEEK   ..
277   INFIL-SCH2       =SCHEDULE            THRU DEC 31 IF-WEEK2  ..
278   INFIL-SCH3       =SCHEDULE            THRU DEC 31 IF-WEEK3  ..
279
280
281   $======================= SPACE DEFAULTS & DESCRIPTION ==========================
282
283
284   $ SET DEFAULT VALUE
285
286                    SET-DEFAULT FOR SPACE   FLOOR-WEIGHT = 0 ..
287                    SET-DEFAULT FOR WINDOW  HEIGHT=5.0
288                                            GLASS-TYPE=WIN_GLS3  Y=1 ..
289                    SET-DEFAULT FOR EXTERIOR-WALL  CONSTRUCTION=NONRES_EXT_WALL ..
290
291
```

```
292   $ GENERAL SPACE DEFINITION
293
294   OFFICE          =SPACE-CONDITIONS    PEOPLE-SCHEDULE      =OCCUPY-1
295                                        NUMBER-OF-PEOPLE     =31
296                                        PEOPLE-HEAT-GAIN     =450
297                                        LIGHTING-SCHEDULE    =LIGHTS-1
298                                        LIGHTING-W/SQFT      = 0.79
299                                        EQUIP-SCHEDULE       = EQUIP-1
300                                        EQUIPMENT-W/SQFT     = 0.63
301                                        INF-METHOD           = AIR-CHANGE
302                                        AIR-CHANGES/HR       = 0.0
303                                        INF-SCHEDULE         =INFIL-SCH   ..
304
305
306                       $ SPECIFIC SPACE DETAILS
307
308   $ ATTIC
309   ATTIC-SC    = SPACE-CONDITIONS
310               ZONE-TYPE   = UNCONDITIONED
311               FLOOR-WEIGHT  = 0 ..             $ CUSTOM WEITING FACTOR
312
313   ATTIC    = SPACE    S-C = ATTIC-SC  AREA = 6113.686  VOLUME = 24533.31
314             X = 0  Y = 0  Z = 0  AZ = 0 ..
315   N-ROOF = POLYGON
316           (92.81,62.53) (-1.97,62.53) (30.28,32.03) (60.56,32.03)..
317   S-ROOF = POLYGON
318           (-1.97,-1.97) (92.81,-1.97) (60.56,32.03) (30.28,32.03) ..
319   E-GABLE = POLYGON
320           (0,0) (64.5,0) (32.25,34)  ..
321   W-GABLE = POLYGON
322           (-1.97,62.53,10) (-1.97,-1.97,10) (30.28,30.28,20.77)  ..
323
324
325
326   $ ROOF RAISED
327   N-ROOF-EXT = ROOF              CONSTRUCTION = ATTIC-ROOF
328                                  POLYGON = S-ROOF
329                                  TILT =18.5, AZ = 0,
330                                  X= 90.84 Y = 60.56 Z = 10.0  ..
331
332   S-ROOF-EXT = ROOF              CONSTRUCTION = ATTIC-ROOF
333                                  POLYGON = S-ROOF
334                                  TILT =18.5, AZ = 180, Z = 10.0  ..
335
336   E-GABLE-EXT = ROOF             CONSTRUCTION = ATTIC-ROOF
337                                  POLYGON = E-GABLE
338                                  TILT =18.2, AZ = 90
339                                  X = 92.81 Y = -1.97 Z = 10.0 ..
340
341   W-GABLE-EXT = ROOF             CONSTRUCTION = ATTIC-ROOF
342                                  POLYGON = E-GABLE
343                                  TILT =18.2, AZ = 270
344                                  X = -1.97 Y = 62.53 Z = 10.0 ..
345
346
347   N-ROOF-SOFFIT = BUILDING-SHADE  HEIGHT = 1.97  WIDTH = 94.78
348                                  X=-1.97  Y=60.6  Z=10
349                                  TRANSMITTANCE = 0.0
350                                  AZIMUTH = 180  TILT = 180  ..
351   S-ROOF-SOFFIT = BUILDING-SHADE  HEIGHT = 1.97  WIDTH =
      94.78
352                                  X=-1.97  Y=0  Z=10
353                                  TRANSMITTANCE = 0.0
354                                  AZIMUTH = 180 TILT = 180  ..
355   E-ROOF-SOFFIT = BUILDING-SHADE  HEIGHT = 1.97  WIDTH =
      60.56
356                                  X=90.85  Y=0  Z=10
357                                  TRANSMITTANCE = 0.0
358                                  AZIMUTH = 90  TILT = 180  ..
359   W-ROOF-SOFFIT = BUILDING-SHADE  HEIGHT = 1.97  WIDTH =
      60.56
360                                  X=0  Y=0  Z=10
361                                  TRANSMITTANCE = 0.0
```

```
362                         AZIMUTH = 90   TILT = 180  ..
363
364
365
366    SPACE1-1        =SPACE              SPACE-CONDITIONS = OFFICE
367                                        AREA = 1221.28925  VOLUME = 12221.4264
368                                        NUMBER-OF-PEOPLE = 7   ..
369       FRONT-1      =EXTERIOR-WALL      HEIGHT = 10   WIDTH = 90.8
370                                        X=0   Y=0   Z=0  AZIMUTH = 180   ..
371
372         WF-1      =WINDOW             WIDTH = 6  X = 4.56  Y = 2.95  ..
373         WF-2      =WINDOW             WIDTH = 6  X = 19.72  Y = 2.95  ..
374         WF-3      =WINDOW             WIDTH = 6  X = 34.84  Y = 2.95  ..
375         WF-4      =WINDOW             WIDTH = 6  X = 50.00  Y = 2.95  ..
376         WF-5      =WINDOW             WIDTH = 6  X = 65.12  Y = 2.95  ..
377         WF-6      =WINDOW             WIDTH = 6  X = 80.28  Y = 2.95  ..
378         DF-1      =WINDOW             WIDTH = 6  HEIGHT = 7
379                                        X = 42.42  Y = 0
380                                        GLASS-TYPE=WIN_GLS3  ..
381
382       C1-1         =INTERIOR-WALL      AREA = 1221.28925  NEXT-TO ATTIC
383                                        CONSTRUCTION = CEIL_MAT2   ..
384
385       F1-1         =UNDERGROUND-FLOOR  AREA = 1221.28925
386                                        CONSTRUCTION = EXT_SLAB ..
387
388       SB12         =INTERIOR-WALL      AREA=231.931  NEXT-TO SPACE2-1
389                                        CONSTRUCTION = INT_WALL    ..
390
391       SB14         =INTERIOR-WALL      LIKE SB12  NEXT-TO SPACE4-1   ..
392       SB15         =INTERIOR-WALL      AREA 580    NEXT-TO  SPACE5-1
393                                        CONSTRUCTION = INT_WALL    ..
394
395    SPACE2-1        =SPACE              SPACE-CONDITIONS = OFFICE
396                                        AREA = 724.4845  VOLUME = 7249.7832
397                                        NUMBER-OF-PEOPLE = 4   ..
398
399       RIGHT-1      =EXTERIOR-WALL      HEIGHT = 10  WIDTH = 60.5
400                                        X=90.8  Y=0   Z=0  AZIMUTH = 90  ..
401
402         WR-1      =WINDOW             WIDTH = 6  X = 4.56  Y = 2.95  ..
403         WR-2      =WINDOW             WIDTH = 6  X = 19.72  Y = 2.95  ..
404         WR-3      =WINDOW             WIDTH = 6  X = 34.84  Y = 2.95  ..
405         WR-4      =WINDOW             WIDTH = 6  X = 50.00  Y = 2.95  ..
406
407       C2-1         =INTERIOR-WALL      AREA = 724.4845  NEXT-TO ATTIC
408                                        CONSTRUCTION = CEIL_MAT2   ..
409
410       F2-1         =UNDERGROUND-FLOOR  AREA = 724.4845
411                                        CONSTRUCTION = EXT_SLAB ..
412
413       SB23         =INTERIOR-WALL      AREA = 231.931  NEXT-TO SPACE3-1
414                                        CONSTRUCTION = INT_WALL    ..
415
416       SB25         =INTERIOR-WALL      AREA = 277  NEXT-TO SPACE5-1
417                                        CONSTRUCTION = INT_WALL    ..
418
419    SPACE3-1        =SPACE              SPACE-CONDITIONS = OFFICE
420                                        AREA  = 1221.28925  VOLUME = 12221.4264
421                                        NUMBER-OF-PEOPLE = 7   ..
422
423       BACK-1       =EXTERIOR-WALL      HEIGHT = 10  WIDTH = 90.8
424                                        X=90.8  Y=60.5  Z=0  AZIMUTH = 0   ..
425
426         WB-1      =WINDOW             WIDTH = 6  X = 4.56  Y = 2.95 ..
427         WB-2      =WINDOW             WIDTH = 6  X = 19.72  Y = 2.95 ..
428         WB-3      =WINDOW             WIDTH = 6  X = 34.84  Y = 2.95 ..
429         WB-4      =WINDOW             WIDTH = 6  X = 50.00  Y = 2.95 ..
430         WB-5      =WINDOW             WIDTH = 6  X = 65.12  Y = 2.95 ..
431         WB-6      =WINDOW             WIDTH = 6  X = 80.28  Y = 2.95 ..
432         DB-1      =DOOR               WIDTH = 3  HEIGHT = 7
433                                        X = 28.08  Y = 0
434                                        CONSTRUCTION = DOOR2    ..
```

```
435       DB-2     =DOOR                WIDTH = 3   HEIGHT = 7
436                                     X = 41.92   Y = 0
437                                     CONSTRUCTION = DOOR2   ..
438
439       C3-1     =INTERIOR-WALL       AREA = 1221.28925   NEXT-TO ATTIC
440                                     CONSTRUCTION = CEIL_MAT2   ..
441
442       F3-1     =UNDERGROUND-FLOOR   AREA = 1221.28925
443                                     CONSTRUCTION = EXT_SLAB   ..
444
445       SB34     =INTERIOR-WALL       AREA = 231.931   NEXT-TO SPACE4-1
446                                     CONSTRUCTION = INT_WALL   ..
447
448       SB35     =INTERIOR-WALL       AREA = 580   NEXT-TO SPACE5-1
449                                     CONSTRUCTION = INT_WALL   ..
450
451   SPACE4-1     =SPACE               SPACE-CONDITIONS = OFFICE
452                                     AREA = 724.4845   VOLUME = 7249.7832
453                                     NUMBER-OF-PEOPLE = 4   ..
454
455       LEFT-1   =EXTERIOR-WALL       HEIGHT = 10   WIDTH = 60.5
456                                     X=0   Y=60.5   Z=0   AZIMUTH = 270  ..
457
458       WL-1     =WINDOW              WIDTH = 6   X = 4.56    Y = 2.95   ..
459       WL-2     =WINDOW              WIDTH = 6   X = 19.72   Y = 2.95   ..
460       WL-3     =WINDOW              WIDTH = 6   X = 34.84   Y = 2.95   ..
461       WL-4     =WINDOW              WIDTH = 6   X = 50.00   Y = 2.95   ..
462
463       C4-1     =INTERIOR-WALL       AREA = 724.4845   NEXT-TO ATTIC
464                                     CONSTRUCTION = CEIL_MAT2   ..
465
466       F4-1     =UNDERGROUND-FLOOR   AREA = 724.4845
467                                     CONSTRUCTION = EXT_SLAB   ..
468
469       SB45     =INTERIOR-WALL       AREA = 277   NEXT-TO SPACE5-1
470                                     CONSTRUCTION = INT_WALL   ..
471
472   SPACE5-1     =SPACE               SPACE-CONDITIONS = OFFICE
473                                     AREA = 1611.0899   VOLUME = 16122.1672
474                                     NUMBER-OF-PEOPLE = 9   ..
475
476       C5-1     =INTERIOR-WALL       AREA = 1611.0899   NEXT-TO ATTIC
477                                     CONSTRUCTION = CEIL_MAT2   ..
478
479       F5-1     =UNDERGROUND-FLOOR   AREA = 1611.0899
480                                     CONSTRUCTION = EXT_SLAB .
481
482   END  ..
483   COMPUTE  LOADS   ..
484
485
486
487   $============================= SYSTEM DESCRIPTION =================================
488
489   INPUT SYSTEMS   ..
490
491               SYSTEMS-REPORT  SUMMARY=(ALL-SUMMARY)
492                               REPORT-FREQUENCY = HOURLY
493                               HOURLY-DATA-SAVE = FORMATTED   ..
494
495
496   $ SYSTEMS SCHEDULES
497
498   FAN-1       =DAY-SCHEDULE     (1,6)(0)(7,19)(1)(20,24)(0)  ..
499   FAN-2       =DAY-SCHEDULE     (1,24)(0)    ..
500   FAN-3       =DAY-SCHEDULE     (1,24)(1)    ..
501   FAN-4       =DAY-SCHEDULE     (1,6)(0)(7,23)(1)(24)(0)  ..
502   FAN-5       =DAY-SCHEDULE     (1,8)(0)(9,17)(1)(18,24)(0)  ..
503
504   FAN-WEEK    =WEEK-SCHEDULE    (WD) FAN-1 (WEH) FAN-2  ..
505   FAN-WEEK2   =WEEK-SCHEDULE    (WD) FAN-2 (WEH) FAN-2  ..
506   FAN-WEEK3   =WEEK-SCHEDULE    (WD) FAN-3 (WEH) FAN-3  ..
507
```

```
508   FAN-SCHED      =SCHEDULE           THRU DEC 31  FAN-WEEK
      ..
509   FAN-SCHED2     =SCHEDULE           THRU DEC 31  FAN-WEEK2  ..
510   FAN-SCHED3     =SCHEDULE           THRU DEC 31  FAN-WEEK3
      ..
511
512
513   $ THERMOSTAT SET-POINTS FOR HEATING AND COOLING
514   $ SET TEMPERATURES CONVERTED TO IP UNITS FROM SI UNITS
515
516   HEAT-1         =DAY-SCHEDULE       (1,6) (60.01)  (7) (69.98)
517                                      (8,19) (69.98)  (20,24) (60.01)
      ..
518   HEAT-2         =DAY-SCHEDULE       (1,5) (60.01)  (6) (64.04)  (7) (68.0)
519                                      (8,17) (69.98)  (18,24) (60.01)  ..
520   HEAT-3         =DAY-SCHEDULE       (1,24) (60.01)    ..
521   HEAT-4         =DAY-SCHEDULE       (1,24) (69.98)    ..
522
523   HEAT-WEEK      =WEEK-SCHEDULE      (MON,FRI) HEAT-1   (SAT) HEAT-3  (SUN) HEAT-3
524                                      (HOL) HEAT-3 ..
525   HEAT-WEEK2     =WEEK-SCHEDULE      (MON,FRI)  HEAT-3   (SAT) HEAT-3  (SUN)
      HEAT-3
526                                      (HOL) HEAT-3 ..
527   HEAT-WEEK3     =WEEK-SCHEDULE      (MON,FRI)  HEAT-4   (SAT) HEAT-4  (SUN)
      HEAT-4
528                                      (HOL) HEAT-4 ..
529
530   HEAT-SCHED     =SCHEDULE           THRU DEC 31   HEAT-WEEK
      ..
531   HEAT-SCHED2    =SCHEDULE           THRU DEC 31   HEAT-WEEK2
      ..
532   HEAT-SCHED3    =SCHEDULE           THRU DEC 31   HEAT-WEEK3
      ..
533
534
535   COOLOFF        =SCHEDULE           THRU DEC 31 (ALL) (1,24) (1)
      ..
536   HEATOFF        =SCHEDULE           THRU DEC 31 (ALL) (1,24) (1)
      ..
537
538
539   COOL-1         =DAY-SCHEDULE       (1,6) (84.99)   (7)
      (75.00)
540                                      (8,18) (75.00)  (19,24) (84.99)
      ..
541   COOL-2         =DAY-SCHEDULE       (1,5) (84.99)   (6) (78.08)   (7) (77.0)
542                                      (8,17) (75.00)  (18,24) (84.99)  ..
543   COOL-3         =DAY-SCHEDULE       (1,24) (84.99)    ..
544   COOL-4         =DAY-SCHEDULE       (1,24) (75.00)    ..
545
546   COOL-WEEK      =WEEK-SCHEDULE      (MON,FRI)  COOL-1   (SAT) COOL-3  (SUN) COOL-3
547                                      (HOL) COOL-3 ..
548   COOL-WEEK2     =WEEK-SCHEDULE      (MON,FRI)  COOL-3   (SAT) COOL-3  (SUN)
      COOL-3
549                                      (HOL) COOL-3 ..
550   COOL-WEEK3     =WEEK-SCHEDULE      (MON,FRI)  COOL-4   (SAT) COOL-4  (SUN)
      COOL-4
551                                      (HOL) COOL-4 ..
552
553   COOL-SCHED     =SCHEDULE           THRU DEC 31   COOL-WEEK
      ..
554   COOL-SCHED2    =SCHEDULE           THRU DEC 31   COOL-WEEK2
      ..
555   COOL-SCHED3    =SCHEDULE           THRU DEC 31   COOL-WEEK3
      ..
556
557
558   HVAC-HEAT      =SCHEDULE           THRU DEC 31 (ALL) (1,24) (1)       ..
559   HVAC-COOL      =SCHEDULE           THRU DEC 31 (ALL) (1,24) (1)
      ..
560
561   24HR-OFF       =SCHEDULE           THRU DEC 31 (ALL) (1,24) (0)
      ..
```

```
562
563    DHW-SCHED   =SCHEDULE        THRU DEC 31 (ALL) (1,24) (1)
       ..
564    DHWINLETSCH-1 =SCHEDULE      THRU DEC 31 (ALL) (1,24) (140)
       ..
565
566    INT-1       =DAY-SCHEDULE    (1,7) (0)  (8) (0.35)  (9) (0.69)  (10)
       (0.43)
567                                 (11) (0.37)  (12) (0.43)  (13) (0.58)  (14) (0.48)
568                                 (15,16) (0.37)  (17) (0.46)  (18) (0.62)
569                                 (19) (0.12)  (20,21) (0.04)  (22,24) (0)
                                    ..
570    INT-2       =DAY-SCHEDULE    (1,7) (0)  (8) (0.16)  (9) (0.14)  (10) (0.21)
571                                 (11) (0.18)  (12) (0.25)  (13) (0.21)  (14) (0.13)
572                                 (15) (0.08)  (16) (0.04)  (17) (0.05)
573                                 (18) (0.06)  (19,24) (0)    ..
574    INT-3       =DAY-SCHEDULE    (1,24) (0)   ..
575    INT-WEEK    =WEEK-SCHEDULE   (MON,FRI) INT-3  (SAT) INT-3  (SUN) INT-3
576                                 (HOL) INT-3 ..
577    INT-SHED    = SCHEDULE        THRU DEC 31   INT-WEEK
       ..
578
579
580
581    $ SYSTEM DESCRIPTION
582
583    ZAIR        =ZONE-AIR       OA-CFM/PER=
       17
584                                EXHAUST-CFM =
                                   0
585                                EXHAUST-EFF =
                                   0.75
586                                EXHAUST-STATIC = 0   ..
587
588
589    CONTROL    = ZONE-CONTROL    DESIGN-HEAT-T =
       70
590                                 DESIGN-COOL-T =
                                    75
591                                 HEAT-TEMP-SCH = HEAT-SCHED
592                                 COOL-TEMP-SCH = COOL-SCHED
593                                 THERMOSTAT-TYPE =
                                    PROPORTIONAL
594                                 THROTTLING-RANGE = 0.1
                                    ..
595
596
597    SPACE1-1    =ZONE           ZONE-AIR=ZAIR
598                                SIZING-OPTION=ADJUST-LOADS
599                                ZONE-CONTROL=CONTROL   ..
600
601    SPACE2-1    =ZONE           LIKE SPACE1-1    ..
602    SPACE3-1    =ZONE           LIKE SPACE1-1    ..
603    SPACE4-1    =ZONE           LIKE SPACE1-1    ..
604    SPACE5-1    =ZONE           LIKE SPACE1-1    ..
605
606    ATTIC       =ZONE           ZONE-TYPE=UNCONDITIONED
       ..
607
608
609    S-AIR       =SYSTEM-AIR     MAX-OA-FRACTION =
       1.0
610                                OA-CONTROL = TEMP
                                    ..
611
612

613    S-CONT     =SYSTEM-CONTROL  COOLING-SCHEDULE=
       COOLOFF
614                                HEATING-SCHEDULE=
                                   HEATOFF
615                                PREHEAT-T =
                                   44.6
```

```
616
                                  MAX-SUPPLY-T=104

617                               MIN-SUPPLY-T=55
                                  ..
618
619    S-FAN        =SYSTEM-FANS    FAN-SCHEDULE=FAN-SCHED
620
                                  FAN-CONTROL=CONSTANT-VOLUME

621                               MOTOR-PLACEMENT =
                                  IN-AIRFLOW
622                               FAN-PLACEMENT =
                                  BLOW-THROUGH
623
                                  SUPPLY-EFF=0.55575

624                               MAX-FAN-RATIO =
                                  1.1
625                               MIN-FAN-RATIO =
                                  0.3
626
                                  NIGHT-CYCLE-CTRL=STAY-OFF

627                               SUPPLY-DELTA-T =
                                  1.815
628                               SUPPLY-KW = 0.000531
                                  ..
629
630
631    $ COIL CURVE-FIT
632    HPACCoolCapFT = CURVE-FIT
633                    TYPE = BI-QUADRATIC
634                    COEFFICIENTS = (0.766956,0.0107756,-0.0000414703,0.00134961,
635                    -0.000261144,0.000457488) ..
636    HPACCoolCapFFF = CURVE-FIT
637                     TYPE = QUADRATIC
638                     COEFFICIENTS = (0.8,0.2,0) ..
639    HPACCOOLEIRFT =
       CURVE-FIT
640                    TYPE = BI-QUADRATIC
641                    COEFFICIENTS = (0.297145,0.0430933,-0.000748766,0.00597727,
642                    0.000482112,-0.000956448) ..
643    HPACCOOLPLFFPLR =
       CURVE-FIT
644                     TYPE = QUADRATIC
645                     COEFFICIENTS = (0.85,0.15,0) ..
646
647
648    S-EQUIP  =SYSTEM-EQUIPMENT    COOL-CAP-FT = SDL-C3
649                                  COOLING-EIR  =
                                     0.242745131
650                                  COOL-EIR-FT = SDL-C13
651                                  COOL-EIR-FPLR =
                                     SDL-C18
652                                  COOL-SH-FT
                                     =SDL-C23
653                                  COIL-BF-FT = HPACCoolCapFT
654                                  COIL-BF-FCFM = HPACCoolCapFFF
655                                  COIL-BF-FPLR =
                                     HPACCOOLPLFFPLR
656
                                     COIL-BF=0.19

657                                  COOL-FT-MIN=
                                     70
658                                  HEAT-CAP-FT = SDL-C55
659                                  HEATING-EIR  = 0.29751543
660                                  HEAT-EIR-FT = SDL-C60
661                                  HEAT-EIR-FPLR = SDL-C65
662                                  DEFROST-FRAC-FT = HPACCOOLEIRFT
663                                  OUTSIDE-FAN-T = 45
664                                  OUTSIDE-FAN-MODE = INTERMITTENT
```

```
665                              COMPRESSOR-TYPE =
                                 SINGLE-SPEED
666                              RATED-CCAP-FCFM = SDL-C78
667                              RATED-SH-FCFM= SDL-C85
668                              RATED-CEIR-FCFM= SDL-C93
669                              RATED-HCAP-FCFM= SDL-C100
670                              CRANKCASE-HEAT= 0.05
671                              CRANKCASE-MAX-T= 39.92
                                 ..
672
673
674
675
676    S-TERM      =SYSTEM-TERMINAL REHEAT-DELTA-T=
       50
677                              MIN-CFM-RATIO= 1.0    ..
678
679    SYST-1      =SYSTEM        SYSTEM-TYPE=
       PSZ
680                              SYSTEM-CONTROL= S-CONT
681                              SYSTEM-FANS= S-FAN
682                              SYSTEM-TERMINAL= S-TERM
683                              SYSTEM-EQUIPMENT=
                                 S-EQUIP
684                              HEAT-SOURCE=
                                 HEAT-PUMP
685                              PREHEAT-SOURCE=
                                 HEAT-PUMP
686                              ECONO-LIMIT-T=
                                 82.4
687                              ECONO-LOW-LIMIT=
                                 32
688                              RETURN-AIR-PATH= DIRECT
689                              SIZING-OPTION =
                                 NON-COINCIDENT
690                              ZONE-NAMES=(SPACE5-1,SPACE1-1,SPACE2-1
691                                  SPACE3-1,SPACE4-1,ATTIC)
                                      ..
692
693
694    HP-1    = PLANT-ASSIGNMENT  SYSTEM-NAMES = (SYST-1)
695                              HP-LOOP-HEATING = FROM-SYSTEMS
696                              HP-LOOP-COOLING = FROM-SYSTEMS
697                              DHW-SIZE        = 40
698                              DHW-GAL/MIN     =
                                 0.0486
699                              DHW-SCH         = DHW-SCHED
700                              DHW-INLET-T-SCH = DHWINLETSCH-1
701                              DHW-SUPPLY-T    =
                                 131
702                              DHW-TYPE        = ELECTRIC
703                              DHW-EIR         = 1
704                              DHW-EIR-FT      = DHWHPEIRFT
705                              DHW-HEAT-RATE-FT = DHWHPCAPFT
706                              DHW-EIR-FPLR    = DHWGEIRFPLR
707                              DHW-PUMP-ELEC   = 0
708                              MAX-FLUID-T     = 140
709                              MIN-FLUID-T     = 50
710                              FLUID-VOLUME    = 15
                                 ..
711
712
713    $========================== HOURLY-REPORT FOR SYSTEM
       ==============================
714
715    $ HOURLY-REPORT FOR SYSTEM PART
716    HRSCH-2        = SCHEDULE
717               THRU DEC 31 (ALL)(1,24)(1) ..
```

```
718
719   S1_ZT              = REPORT-BLOCK
720                        VARIABLE-TYPE=SPACE1-1
721                        VARIABLE-LIST=(6,14)
                           ..

722
723   S2_ZT              = REPORT-BLOCK
724                        VARIABLE-TYPE=SPACE2-1
725                        VARIABLE-LIST=(6,14)
                           ..
726
727   S3_ZT              = REPORT-BLOCK
728                        VARIABLE-TYPE=SPACE3-1
729                        VARIABLE-LIST=(6,14) ..
730
731   S4_ZT              = REPORT-BLOCK
732                        VARIABLE-TYPE=SPACE4-1
733                        VARIABLE-LIST=(6,14) ..
734
735   S5_ZT              = REPORT-BLOCK
736                        VARIABLE-TYPE=SPACE5-1
737                        VARIABLE-LIST=(6,14)
                           ..

738
739   SYS1               = REPORT-BLOCK
740                        VARIABLE-TYPE=SYST-1
741                        VARIABLE-LIST=(1,2) ..
742
743   PPRT1              = HOURLY-REPORT
744                        REPORT-SCHEDULE = HRSCH-2
745                        REPORT-BLOCK = (S1_ZT,S2_ZT,S3_ZT,S4_ZT,S5_ZT,SYS1)  ..
746
747   $=============================================================================
748
749
750
751   END    ..
752   COMPUTE SYSTEMS   ..
753
754
755   INPUT PLANT   ..
756
757                  PLANT-REPORT  SUMMARY=(ALL-SUMMARY)
758                  REPORT-FREQUENCY = HOURLY
759                  HOURLY-DATA-SAVE = FORMATTED  ..
760
761   $========================== HOURLY-REPORT FOR PLANT
      ==============================
762
763   HRSCH-3            = SCHEDULE
764                        THRU DEC 31 (ALL)(1,24)(1) ..
765
766
767   ENDU               = REPORT-BLOCK
768                        VARIABLE-TYPE=END-USE
769                        VARIABLE-LIST=(1,3,5,6,9)
                           ..

770
771   PPRT1              = HOURLY-REPORT
772                        REPORT-SCHEDULE = HRSCH-3
773                        REPORT-BLOCK = (ENDU)  ..
774
775   $=============================================================================
776
777
778   END   ..
779   COMPUTE PLANT   ..
780
781
782


783   STOP ..
784
```

2.3.2 Reference Model 2: Five-Zone Model in Chicago, IL (PVAV System)

In this section the DOE-2 input file for "Case 2: Five-Zone Model in Chicago, IL" is described.

```
1    $============================ SIMULATION ZONING ============================
2
3    INPUT LOADS   ..
4
5    TITLE            LINE-1 *SAMP1E PROVIDED BY PROF.JEFF HABERL*
6                     LINE-2 *CHICAGO, TX, CLIMATE ZONE 5A*
7                     LINE-3 *ASHRAE 90.1-2016 REQUIREMENTS SATISFIED*
8                     LINE-4 *STUDY FOR BUILDING OCCUPANCY PROFILE ANALYSIS*  ..
9
10                    RUN-PERIOD        JAN 1 2019 THRU DEC 31 2019    ..
11
12                    ABORT             ERRORS ..
13                    DIAGNOSTIC        WARNINGS  ..
14                    LOADS-REPORT      SUMMARY = (ALL-SUMMARY)
15                                      REPORT-FREQUENCY = HOURLY
16                                      HOURLY-DATA-SAVE = FORMATTED
17                                      VERIFICATION = (ALL-VERIFICATION) ..
18
19                    BUILDING-LOCATION LATITUDE=41.98
20                                      LONGITUDE=87.92
21                                      GROUND-T = (67.838, 67.604, 67.604, 67.838,
22                                      68.18,72.05,73.184, 73.526, 73.634, 69.944,
23                                      68.954, 68.342)
24                                      DAYLIGHT-SAVINGS = NO
25                                      ALTITUDE=659.45
26                                      TIME-ZONE=6
27                                      AZIMUTH=0.0   ..
28
29
30
31   $   BUILDING DESCRIPTION
32
33   $============================ BUILDING CONSTRUCTION ============================
34
35
36   $   CONSTRUCTION AND GLASS-TYPES
37
38   $   MATERIAL PROPERTY (IP UNITS)
39   $   ALL VALUES CONVERTED FROM SI UNITS IN PNNL SMALL OFFICE MODEL FOR 90.1-2016
40   $   ROOF AND CEILING PROPERTY
41   ROOF_BUIL       = MAT              THICKNESS = 0.03116798
42                                      CONDUCTIVITY = 0.092446272
43                                      DENSITY = 69.9193264
44                                      SPECIFIC-HEAT = 0.348715014  ..
45
46   ROOF_INS_2      = MAT              RESISTANCE = 45.98476874  ..
47
48   ROOF_SUR_1      = MAT              THICKNESS = 0.002624672
49                                      CONDUCTIVITY = 26.16229498
50                                      DENSITY = 488.4364373
51                                      SPECIFIC-HEAT = 0.11942295  ..
52
53   ROOF_ASPHT      = MAT              THICKNESS = 0.010498688
54                                      CONDUCTIVITY = 0.023111568
55                                      DENSITY = 69.9193264
56                                      SPECIFIC-HEAT = 0.300945834  ..
57
58   ROOF_WOOD       = MAT              THICKNESS = 0.052165356
59                                      CONDUCTIVITY = 0.069334704
60                                      DENSITY = 33.96081568
61                                      SPECIFIC-HEAT = 0.289003539  ..
62
63
64   $   SLAB PROPERTY
65   SLAB_CONC200    = MAT              THICKNESS = 0.666666688
66                                      CONDUCTIVITY = 1.334693052
67                                      DENSITY = 144.9577463
68                                      SPECIFIC-HEAT = 0.198719789  ..
69
70   SLAB_CONC100    = MAT              THICKNESS = 0.333333344
71                                      CONDUCTIVITY = 1.334693052
72                                      DENSITY = 144.9577463
73                                      SPECIFIC-HEAT = 0.198719789  ..
```

```
 74
 75    SLAB_CARP       = MAT              RESISTANCE = 1.22923033  ..
 76
 77
 78    $  WALL PROPERTY
 79    WALL_STU        = MAT              THICKNESS = 0.083333336
 80                                       CONDUCTIVITY = 0.416008224
 81                                       DENSITY = 115.8663123
 82                                       SPECIFIC-HEAT = 0.200630556  ..
 83
 84    WALL_GYP1       = MAT              THICKNESS = 0.052165356
 85                                       CONDUCTIVITY = 0.092446272
 86                                       DENSITY = 49.942376
 87                                       SPECIFIC-HEAT = 0.260342031  ..
 88
 89    WALL_GYP2       = MAT              THICKNESS = 0.041666668
 90                                       CONDUCTIVITY = 0.092446272
 91                                       DENSITY = 49.942376
 92                                       SPECIFIC-HEAT = 0.260342031  ..
 93
 94    WALL_INS_2      = MAT              RESISTANCE = 17.42897129 ..
 95
 96
 97    $  WINDOW PROPERTY
 98    WIN_GLS3        = GLASS-TYPE       GLASS-CONDUCTANCE = 0.3954
 99                                       VIS-TRANS = 0.452
100                                       SHADING-COEF =
                                          0.41954023
101                                       PANES = 2                  ..
102
103    DOOR1           = GLASS-TYPE       GLASS-CONDUCTANCE = 0.370
104                                       SHADING-COEF = 0.7  ..
105
106    AIR-LAYER       = CONSTRUCTION     U = 1.11 ..
107
108
109    $  MATERIAL LAYERS
110    ATTIC-R1  =LAYERS =MAT=(AR02,PW04)  ..
111    ATTIC-R2  =LAYERS =MAT=(PW04)   ..
112    ROOF_1    =LAYERS =MAT=(ROOF_INS_2,GP02)   ..
113    EX_SLAB_1 =LAYERS =MAT=(SLAB_CONC200,CP02)   ..
114    EX_WALL_1 =LAYERS =MAT=(SC01,GP02,WALL_INS_2,GP02)   ..
115    IN_WALL_1 =LAYERS =MAT=(GP01,GP01)   ..
116    IN_SLAB_1 =LAYERS =MAT=(SLAB_CONC100,CP02)   ..
117    CEIL_MAT1 =LAYERS =MAT=(AC02,GP01)   ..
118
119
120    $  MATERIAL CONSTRUCTION
121    EXT_SLAB              =CONSTRUCTION     LAYERS = EX_SLAB_1
122                                           ABSORPTANCE = 0.7      ..
123    NONRES_EXT_WALL       =CONSTRUCTION     LAYERS = EX_WALL_1
124                                           ABSORPTANCE = 0.7      ..
125    INT_WALL              =CONSTRUCTION     LAYERS = IN_WALL_1
126                                           ABSORPTANCE = 0.7      ..
127    CEIL_MAT2             =CONSTRUCTION     LAYERS = ROOF_1
128                                           ABSORPTANCE = 0.7      ..
129    ATTIC-ROOF            =CONSTRUCTION     LAYERS = ATTIC-R1
130                                           ABSORPTANCE = 0.7      ..
131    ATTIC-SOFFIT          =CONSTRUCTION     LAYERS = ATTIC-R2
132                                           ABSORPTANCE = 0.7      ..
133    DOOR2                 =CONSTRUCTION     U = 1.426492621
134                                           ABSORPTANCE = 0.7  ..
135
136    $ OCCUPANCY SCHEDULE
137    OC-1            =DAY-SCHEDULE      (1,6) (0.0)
138                                       (7) (0.11)
139                                       (8) (0.21)
140                                       (9,12) (1.0)
141                                       (13) (0.53)
142                                       (14,17) (1.0)
143                                       (18) (0.32)
144                                       (19,22) (0.11)
145                                       (23) (0.05)
```

```
146                                       (24) (0.0)  ..
147
148   OC-2            =DAY-SCHEDULE       (1,6) (0.0)
149                                       (7,8) (0.1)
150                                       (9,12) (0.3)
151                                       (13,17) (0.1)
152                                       (18,19) (0.05)
153                                       (20,24) (0.0)  ..
154
155   OC-3            =DAY-SCHEDULE       (1,6) (0.0)
156                                       (7,18) (0.05)
157                                       (19,24) (0.0)  ..
158
159   OC-4            =DAY-SCHEDULE       (1,24) (0.0)  ..
160   OC-5            =DAY-SCHEDULE       (1,24) (1.0)  ..
161
162
163   OC-WEEK         =WEEK-SCHEDULE      (WD) OC-1 (SAT) OC-4 (SUN) OC-4 (HOL) OC-4 ..
164   OC-WEEK2        =WEEK-SCHEDULE      (WD) OC-4 (SAT) OC-4 (SUN) OC-4 (HOL) OC-4 ..
165   OC-WEEK3        =WEEK-SCHEDULE      (WD) OC-5 (SAT) OC-5 (SUN) OC-5 (HOL) OC-5 ..
166
167   OCCUPY-1        =SCHEDULE           THRU DEC 31 OC-WEEK   ..
168   OCCUPY-2        =SCHEDULE           THRU DEC 31 OC-WEEK2  ..
169   OCCUPY-3        =SCHEDULE           THRU DEC 31 OC-WEEK3  ..
170
171
172
173   $ LIGHTING SCHEDULE
174
175   LT-1            =DAY-SCHEDULE       (1,5) (0.18)
176                                       (6,7) (0.23)
177                                       (8) (0.42)
178                                       (9,12) (0.9)
179                                       (13) (0.8)
180                                       (14,17) (0.9)
181                                       (18) (0.61)
182                                       (19,20) (0.42)
183                                       (21,22) (0.32)
184                                       (23) (0.23)
185                                       (24) (0.18)  ..
186
187   LT-0            =DAY-SCHEDULE       (1,6) (0.0)
188                                       (7) (0.11)
189                                       (8) (0.21)
190                                       (9,12) (1.0)
191                                       (13) (0.53)
192                                       (14,17) (1.0)
193                                       (18) (0.32)
194                                       (19,22) (0.11)
195                                       (23) (0.05)
196                                       (24) (0.0)  ..
197
198   LT-2            =DAY-SCHEDULE       (1,6) (0.05)
199                                       (7,8) (0.1)
200                                       (9,12) (0.3)
201                                       (13,17) (0.15)
202                                       (18,24) (0.05) ..
203
204   LT-3            =DAY-SCHEDULE       (1,24) (0.18)  ..
205   LT-4            =DAY-SCHEDULE       (1,24) (0.0)  ..
206   LT-5            =DAY-SCHEDULE       (1,24) (1.0)  ..
207
208
209   LT-WEEK         =WEEK-SCHEDULE      (WD) LT-1 (SAT) LT-3 (SUN) LT-3 (HOL) LT-3 ..
210   LT-WEEK2        =WEEK-SCHEDULE      (WD) LT-3 (SAT) LT-3 (SUN) LT-3 (HOL) LT-3 ..
211   LT-WEEK3        =WEEK-SCHEDULE      (WD) LT-5 (SAT) LT-5 (SUN) LT-5 (HOL) LT-5 ..
212
213
214   LIGHTS-1        =SCHEDULE           THRU DEC 31 LT-WEEK   ..
215   LIGHTS-2        =SCHEDULE           THRU DEC 31 LT-WEEK2  ..
216   LIGHTS-3        =SCHEDULE           THRU DEC 31 LT-WEEK3
                      ..
217
```

```
218
219    $ OFFICE EQUIPMENT SCHEDULE
220    EQ-1              =DAY-SCHEDULE        (1,5)  (0.5)
221                                          (6,12) (1.0)
222                                          (13)  (0.94)
223                                          (14,17) (1.0)
224                                          (18)  (0.5)
225                                          (19,24) (0.2)  ..
226
227    EQ-0              =DAY-SCHEDULE        (1,6)  (0.0)
228                                          (7)  (0.11)
229                                          (8)  (0.21)
230                                          (9,12) (1.0)
231                                          (13)  (0.53)
232                                          (14,17) (1.0)
233                                          (18)  (0.32)
234                                          (19,22) (0.11)
235                                          (23)  (0.05)
236                                          (24)  (0.0)  ..
237
238    EQ-2              =DAY-SCHEDULE        (1,6)  (0.3)
239                                          (7,8)  (0.4)
240                                          (9,12) (0.5)
241                                          (13,17) (0.35)
242                                          (18,24) (0.3)  ..
243
244    EQ-3              =DAY-SCHEDULE        (1,24) (0.2)   ..
245    EQ-4              =DAY-SCHEDULE        (1,24) (0.0)   ..
246    EQ-5              =DAY-SCHEDULE        (1,24) (1.0)   ..
247
248
249    EQ-WEEK           =WEEK-SCHEDULE       (WD) EQ-1 (SAT) EQ-3 (SUN) EQ-3 (HOL) EQ-3 ..
250    EQ-WEEK2          =WEEK-SCHEDULE       (WD) EQ-3 (SAT) EQ-3 (SUN) EQ-3 (HOL) EQ-3 ..
251    EQ-WEEK3          =WEEK-SCHEDULE       (WD) EQ-5 (SAT) EQ-5 (SUN) EQ-5 (HOL) EQ-5 ..
252
253    EQUIP-1           =SCHEDULE            THRU DEC 31 EQ-WEEK   ..
254    EQUIP-2           =SCHEDULE            THRU DEC 31 EQ-WEEK2  ..
255    EQUIP-3           =SCHEDULE            THRU DEC 31 EQ-WEEK3  ..
256
257
258    $ INFILTRATION SCHEDULE
259    IF-1              =DAY-SCHEDULE        (1,6)  (1.0)
260                                          (7,19) (0.25)
261                                          (20,24) (1.0)  ..
262
263    IF-2              =DAY-SCHEDULE        (1,7)  (1.0)
264                                          (8,18) (0.25)
265                                          (19,24) (1.0)  ..
266
267    IF-3              =DAY-SCHEDULE        (1,24) (0.0)  ..
268    IF-4              =DAY-SCHEDULE        (1,24) (1.0)  ..
269    IF-5              =DAY-SCHEDULE        (1,24) (0.25)  ..
270
271
272    IF-WEEK           =WEEK-SCHEDULE       (WD) IF-1 (SAT) IF-2 (SUN) IF-4 (HOL) IF-4 ..
273    IF-WEEK2          =WEEK-SCHEDULE       (WD) IF-4 (SAT) IF-4 (SUN) IF-4 (HOL) IF-4 ..
274    IF-WEEK3          =WEEK-SCHEDULE       (WD) IF-5 (SAT) IF-5 (SUN) IF-5 (HOL) IF-5 ..
275
276    INFIL-SCH         =SCHEDULE            THRU DEC 31 IF-WEEK   ..
277    INFIL-SCH2        =SCHEDULE            THRU DEC 31 IF-WEEK2  ..
278    INFIL-SCH3        =SCHEDULE            THRU DEC 31 IF-WEEK3  ..
279
280
281
282    $======================= SPACE DEFAULTS & DESCRIPTION ==========================
283
284
285    $ SET DEFAULT VALUE
286
287                     SET-DEFAULT FOR SPACE  FLOOR-WEIGHT = 0 ..
288                     SET-DEFAULT FOR WINDOW  HEIGHT=5.0
289                                             GLASS-TYPE=WIN_GLS3  Y=1 ..
290                     SET-DEFAULT FOR EXTERIOR-WALL  CONSTRUCTION=NONRES_EXT_WALL ..
```

```
291
292
293    $ GENERAL SPACE DEFINITION
294
295    OFFICE            =SPACE-CONDITIONS    PEOPLE-SCHEDULE        =OCCUPY-1
296                                          NUMBER-OF-PEOPLE       =31
297                                          PEOPLE-HEAT-GAIN       =450
298                                          LIGHTING-SCHEDULE      =LIGHTS-1
299                                          LIGHTING-W/SQFT        = 0.79
300                                          EQUIP-SCHEDULE         = EQUIP-1
301                                          EQUIPMENT-W/SQFT       = 0.63
302                                          INF-METHOD             = AIR-CHANGE
303                                          AIR-CHANGES/HR         = 0.0
304                                          INF-SCHEDULE           =INFIL-SCH  ..
305
306
307                          $ SPECIFIC SPACE DETAILS
308
309    $ ATTIC
310    ATTIC-SC   = SPACE-CONDITIONS
311                ZONE-TYPE   = UNCONDITIONED
312                FLOOR-WEIGHT = 0 ..                    $ CUSTOM WEITING FACTOR
313
314    ATTIC     = SPACE    S-C = ATTIC-SC  AREA = 6113.686  VOLUME = 24533.31
315            X = 0  Y = 0  Z = 0  AZ = 0 ..
316    N-ROOF = POLYGON
317          (92.81,62.53) (-1.97,62.53) (30.28,32.03) (60.56,32.03)..
318    S-ROOF = POLYGON
319          (-1.97,-1.97) (92.81,-1.97) (60.56,32.03) (30.28,32.03) ..
320    E-GABLE = POLYGON
321          (0,0) (64.5,0) (32.25,34)  ..
322    W-GABLE = POLYGON
323          (-1.97,62.53,10) (-1.97,-1.97,10) (30.28,30.28,20.77)  ..
324
325
326
327    $ ROOF RAISED
328    N-ROOF-EXT = ROOF             CONSTRUCTION = ATTIC-ROOF
329                                  POLYGON = S-ROOF
330                                  TILT =18.5, AZ = 0,
331                                  X= 90.84 Y = 60.56 Z = 10.0  ..
332
333    S-ROOF-EXT = ROOF             CONSTRUCTION = ATTIC-ROOF
334                                  POLYGON = S-ROOF
335                                  TILT =18.5, AZ = 180, Z = 10.0  ..
336
337    E-GABLE-EXT = ROOF            CONSTRUCTION = ATTIC-ROOF
338                                  POLYGON = E-GABLE
339                                  TILT =18.2, AZ = 90
340                                  X = 92.81 Y = -1.97 Z = 10.0 ..
341
342    W-GABLE-EXT = ROOF            CONSTRUCTION = ATTIC-ROOF
343                                  POLYGON = E-GABLE
344                                  TILT =18.2, AZ = 270
345                                  X = -1.97 Y = 62.53 Z = 10.0 ..
346
347
348    N-ROOF-SOFFIT = BUILDING-SHADE  HEIGHT = 1.97  WIDTH = 94.78
349                                  X=-1.97  Y=60.6  Z=10
350                                  TRANSMITTANCE = 0.0
351                                  AZIMUTH = 180  TILT = 180  ..
352    S-ROOF-SOFFIT = BUILDING-SHADE  HEIGHT = 1.97  WIDTH =
       94.78
353                                  X=-1.97  Y=0  Z=10
354                                  TRANSMITTANCE = 0.0
355                                  AZIMUTH = 180 TILT = 180  ..
356    E-ROOF-SOFFIT = BUILDING-SHADE  HEIGHT = 1.97  WIDTH =
       60.56
357                                  X=90.85  Y=0  Z=10
358                                  TRANSMITTANCE = 0.0
359                                  AZIMUTH = 90  TILT = 180  ..
360    W-ROOF-SOFFIT = BUILDING-SHADE  HEIGHT = 1.97  WIDTH =
       60.56
```

```
361                                 X=0   Y=0   Z=10
362                                 TRANSMITTANCE = 0.0
363                                 AZIMUTH = 90   TILT = 180  ..
364
365
366
367    SPACE1-1      =SPACE          SPACE-CONDITIONS = OFFICE
368                                 AREA = 1221.28925  VOLUME = 12221.4264
369                                 NUMBER-OF-PEOPLE = 7   ..
370       FRONT-1    =EXTERIOR-WALL  HEIGHT = 10   WIDTH = 90.8
371                                 X=0   Y=0   Z=0  AZIMUTH = 180   ..
372
373         WF-1     =WINDOW         WIDTH = 6   X = 4.56   Y = 2.95   ..
374         WF-2     =WINDOW         WIDTH = 6   X = 19.72  Y = 2.95   ..
375         WF-3     =WINDOW         WIDTH = 6   X = 34.84  Y = 2.95   ..
376         WF-4     =WINDOW         WIDTH = 6   X = 50.00  Y = 2.95   ..
377         WF-5     =WINDOW         WIDTH = 6   X = 65.12  Y = 2.95   ..
378         WF-6     =WINDOW         WIDTH = 6   X = 80.28  Y = 2.95   ..
379         DF-1     =WINDOW         WIDTH = 6   HEIGHT = 7
380                                 X = 42.42  Y = 0
381                                 GLASS-TYPE=WIN_GLS3  ..
382
383       C1-1       =INTERIOR-WALL  AREA = 1221.28925  NEXT-TO ATTIC
384                                 CONSTRUCTION = CEIL_MAT2   ..
385
386       F1-1       =UNDERGROUND-FLOOR  AREA = 1221.28925
387                                 CONSTRUCTION = EXT_SLAB ..
388
389       SB12       =INTERIOR-WALL  AREA=231.931  NEXT-TO SPACE2-1
390                                 CONSTRUCTION = INT_WALL    ..
391
392       SB14       =INTERIOR-WALL  LIKE SB12  NEXT-TO SPACE4-1   ..
393       SB15       =INTERIOR-WALL  AREA 580    NEXT-TO  SPACE5-1
394                                 CONSTRUCTION = INT_WALL    ..
395
396    SPACE2-1      =SPACE          SPACE-CONDITIONS = OFFICE
397                                 AREA = 724.4845  VOLUME = 7249.7832
398                                 NUMBER-OF-PEOPLE = 4   ..
399
400       RIGHT-1    =EXTERIOR-WALL  HEIGHT = 10  WIDTH = 60.5
401                                 X=90.8  Y=0    Z=0  AZIMUTH = 90  ..
402
403         WR-1     =WINDOW         WIDTH = 6   X = 4.56   Y = 2.95   ..
404         WR-2     =WINDOW         WIDTH = 6   X = 19.72  Y = 2.95   ..
405         WR-3     =WINDOW         WIDTH = 6   X = 34.84  Y = 2.95   ..
406         WR-4     =WINDOW         WIDTH = 6   X = 50.00  Y = 2.95   ..
407
408       C2-1       =INTERIOR-WALL  AREA = 724.4845  NEXT-TO ATTIC
409                                 CONSTRUCTION = CEIL_MAT2   ..
410
411       F2-1       =UNDERGROUND-FLOOR  AREA = 724.4845
412                                 CONSTRUCTION = EXT_SLAB ..
413
414       SB23       =INTERIOR-WALL  AREA = 231.931  NEXT-TO SPACE3-1
415                                 CONSTRUCTION = INT_WALL    ..
416
417       SB25       =INTERIOR-WALL  AREA = 277  NEXT-TO SPACE5-1
418                                 CONSTRUCTION = INT_WALL    ..
419
420    SPACE3-1      =SPACE          SPACE-CONDITIONS = OFFICE
421                                 AREA  = 1221.28925  VOLUME = 12221.4264
422                                 NUMBER-OF-PEOPLE = 7   ..
423
424       BACK-1     =EXTERIOR-WALL  HEIGHT = 10  WIDTH = 90.8
425                                 X=90.8  Y=60.5  Z=0  AZIMUTH = 0   ..
426
427         WB-1     =WINDOW         WIDTH = 6   X = 4.56   Y = 2.95 ..
428         WB-2     =WINDOW         WIDTH = 6   X = 19.72  Y = 2.95 ..
429         WB-3     =WINDOW         WIDTH = 6   X = 34.84  Y = 2.95 ..
430         WB-4     =WINDOW         WIDTH = 6   X = 50.00  Y = 2.95 ..
431         WB-5     =WINDOW         WIDTH = 6   X = 65.12  Y = 2.95 ..
432         WB-6     =WINDOW         WIDTH = 6   X = 80.28  Y = 2.95 ..
433         DB-1     =DOOR           WIDTH = 3   HEIGHT = 7
```

```
434                                        X = 28.08  Y = 0
435                                        CONSTRUCTION = DOOR2   ..
436        DB-2      =DOOR                  WIDTH = 3  HEIGHT = 7
437                                        X = 41.92  Y = 0
438                                        CONSTRUCTION = DOOR2   ..
439
440     C3-1      =INTERIOR-WALL         AREA = 1221.28925  NEXT-TO ATTIC
441                                        CONSTRUCTION = CEIL_MAT2   ..
442
443     F3-1      =UNDERGROUND-FLOOR     AREA = 1221.28925
444                                        CONSTRUCTION = EXT_SLAB   ..
445
446     SB34      =INTERIOR-WALL         AREA = 231.931  NEXT-TO SPACE4-1
447                                        CONSTRUCTION = INT_WALL   ..
448
449     SB35      =INTERIOR-WALL         AREA = 580  NEXT-TO SPACE5-1
450                                        CONSTRUCTION = INT_WALL   ..
451
452  SPACE4-1     =SPACE                 SPACE-CONDITIONS = OFFICE
453                                        AREA = 724.4845  VOLUME = 7249.7832
454                                        NUMBER-OF-PEOPLE = 4   ..
455
456     LEFT-1    =EXTERIOR-WALL         HEIGHT = 10  WIDTH = 60.5
457                                        X=0   Y=60.5  Z=0   AZIMUTH = 270  ..
458
459        WL-1   =WINDOW               WIDTH = 6  X = 4.56  Y = 2.95   ..
460        WL-2   =WINDOW               WIDTH = 6  X = 19.72  Y = 2.95  ..
461        WL-3   =WINDOW               WIDTH = 6  X = 34.84  Y = 2.95  ..
462        WL-4   =WINDOW               WIDTH = 6  X = 50.00  Y = 2.95  ..
463
464     C4-1      =INTERIOR-WALL         AREA = 724.4845  NEXT-TO ATTIC
465                                        CONSTRUCTION = CEIL_MAT2   ..
466
467     F4-1      =UNDERGROUND-FLOOR     AREA = 724.4845
468                                        CONSTRUCTION = EXT_SLAB   ..
469
470     SB45      =INTERIOR-WALL         AREA = 277  NEXT-TO SPACE5-1
471                                        CONSTRUCTION = INT_WALL   ..
472
473  SPACE5-1     =SPACE                 SPACE-CONDITIONS = OFFICE
474                                        AREA = 1611.0899  VOLUME = 16122.1672
475                                        NUMBER-OF-PEOPLE = 9   ..
476
477     C5-1      =INTERIOR-WALL         AREA = 1611.0899  NEXT-TO ATTIC
478                                        CONSTRUCTION = CEIL_MAT2   ..
479
480     F5-1      =UNDERGROUND-FLOOR     AREA = 1611.0899
481                                        CONSTRUCTION = EXT_SLAB ..
482
483  END  ..
484  COMPUTE   LOADS   ..
485
486
487
488  $============================ SYSTEM DESCRIPTION ==============================
489
490  INPUT SYSTEMS   ..
491
492                SYSTEMS-REPORT  SUMMARY=(ALL-SUMMARY)
493                REPORT-FREQUENCY = HOURLY
494                HOURLY-DATA-SAVE = FORMATTED   ..
495
496
497  $ SYSTEMS SCHEDULES
498
499  FAN-1         =DAY-SCHEDULE         (1,6)(0)(7,19)(1)(20,24)(0)   ..
500  FAN-2         =DAY-SCHEDULE         (1,24) (0)    ..
501  FAN-3         =DAY-SCHEDULE         (1,24) (1)    ..
502  FAN-4         =DAY-SCHEDULE         (1,6)(0)(7,23)(1)(24)(0)   ..
503  FAN-5         =DAY-SCHEDULE         (1,8)(0)(9,17)(1)(18,24)(0)   ..
504
505  FAN-WEEK      =WEEK-SCHEDULE        (WD) FAN-1 (WEH) FAN-2  ..
506  FAN-WEEK2     =WEEK-SCHEDULE        (WD) FAN-2 (WEH) FAN-2  ..
```

```
507   FAN-WEEK3      =WEEK-SCHEDULE      (WD) FAN-3 (WEH) FAN-3  ..
508
509   FAN-SCHED      =SCHEDULE           THRU DEC 31  FAN-WEEK   ..
510   FAN-SCHED2     =SCHEDULE           THRU DEC 31  FAN-WEEK2  ..
511   FAN-SCHED3     =SCHEDULE           THRU DEC 31  FAN-WEEK3  ..
512
513
514   $ THERMOSTAT SET-POINTS FOR HEATING AND COOLING
515   $ SET TEMPERATURES CONVERTED TO IP UNITS FROM SI UNITS
516
517   HEAT-1         =DAY-SCHEDULE       (1,6) (60.01) (7) (69.98)
518                                      (8,19) (69.98)  (20,24) (60.01)  ..
519   HEAT-2         =DAY-SCHEDULE       (1,5) (60.01)  (6) (64.04)  (7) (68.0)
520                                      (8,17) (69.98)  (18,24) (60.01)  ..
521   HEAT-3         =DAY-SCHEDULE       (1,24) (60.01)   ..
522   HEAT-4         =DAY-SCHEDULE       (1,24) (69.98)   ..
523
524   HEAT-WEEK      =WEEK-SCHEDULE      (MON,FRI)  HEAT-1   (SAT) HEAT-3  (SUN) HEAT-3
525                                      (HOL) HEAT-3 ..
526   HEAT-WEEK2     =WEEK-SCHEDULE      (MON,FRI)  HEAT-3   (SAT) HEAT-3  (SUN)
      HEAT-3
527                                      (HOL) HEAT-3 ..
528   HEAT-WEEK3     =WEEK-SCHEDULE      (MON,FRI)  HEAT-4   (SAT) HEAT-4  (SUN)
      HEAT-4
529                                      (HOL) HEAT-4 ..
530
531   HEAT-SCHED  =SCHEDULE             THRU DEC 31   HEAT-WEEK    ..
532   HEAT-SCHED2 =SCHEDULE             THRU DEC 31   HEAT-WEEK2   ..
533   HEAT-SCHED3 =SCHEDULE             THRU DEC 31   HEAT-WEEK3   ..
534
535
536   COOLOFF     =SCHEDULE             THRU DEC 31 (ALL) (1,24) (1)  ..
537   HEATOFF     =SCHEDULE             THRU DEC 31 (ALL) (1,24) (1)  ..
538
539
540   COOL-1      =DAY-SCHEDULE         (1,6) (84.99)   (7)
      (75.00)
541                                      (8,18) (75.00)  (19,24) (84.99)  ..
542   COOL-2      =DAY-SCHEDULE         (1,5) (84.99)   (6) (78.08)   (7) (77.0)
543                                      (8,17) (75.00)  (18,24) (84.99)  ..
544   COOL-3      =DAY-SCHEDULE         (1,24) (84.99)   ..
545   COOL-4      =DAY-SCHEDULE         (1,24) (75.00)   ..
546
547   COOL-WEEK   =WEEK-SCHEDULE        (MON,FRI)  COOL-1   (SAT) COOL-3  (SUN) COOL-3
548                                      (HOL) COOL-3 ..
549   COOL-WEEK2  =WEEK-SCHEDULE        (MON,FRI)  COOL-3   (SAT) COOL-3  (SUN)
      COOL-3
550                                      (HOL) COOL-3 ..
551   COOL-WEEK3  =WEEK-SCHEDULE        (MON,FRI)  COOL-4   (SAT) COOL-4  (SUN)
      COOL-4
552                                      (HOL) COOL-4 ..
553
554
555   COOL-SCHED  =SCHEDULE             THRU DEC 31   COOL-WEEK
      ..
556   COOL-SCHED2 =SCHEDULE             THRU DEC 31   COOL-WEEK2
      ..
557   COOL-SCHED3 =SCHEDULE             THRU DEC 31   COOL-WEEK3
      ..
558
559
560   HVAC-HEAT   =SCHEDULE             THRU DEC 31 (ALL) (1,24) (1)      ..
561   HVAC-COOL   =SCHEDULE             THRU DEC 31 (ALL) (1,24) (1)
      ..
562
563   24HR-OFF    =SCHEDULE             THRU DEC 31 (ALL) (1,24) (0)
      ..
564
565   DHW-SCHED   =SCHEDULE             THRU DEC 31 (ALL) (1,24) (1)
      ..
566   DHWINLETSCH-1 =SCHEDULE           THRU DEC 31 (ALL) (1,24) (140)
      ..
567
```

```
568   INT-1        =DAY-SCHEDULE   (1,7) (0)   (8) (0.35)   (9) (0.69)   (10)
      (0.43)
569                              (11) (0.37)   (12) (0.43)   (13) (0.58)   (14) (0.48)
570                              (15,16) (0.37)   (17) (0.46)   (18) (0.62)
571                              (19) (0.12)   (20,21) (0.04)   (22,24) (0)
                                 ..
572   INT-2        =DAY-SCHEDULE   (1,7) (0)   (8) (0.16)   (9) (0.14)   (10) (0.21)
573                              (11) (0.18)   (12) (0.25)   (13) (0.21)   (14) (0.13)
574                              (15) (0.08)   (16) (0.04)   (17) (0.05)
575                              (18) (0.06)   (19,24) (0)     ..
576   INT-3        =DAY-SCHEDULE   (1,24) (0)     ..
577   INT-WEEK     =WEEK-SCHEDULE  (MON,FRI)  INT-3   (SAT) INT-3   (SUN) INT-3
578                              (HOL) INT-3 ..
579   INT-SHED     = SCHEDULE      THRU DEC 31   INT-WEEK
      ..
580
581
582
583   $ SYSTEM DESCRIPTION
584
585   ZAIR         =ZONE-AIR       OA-CFM/PER= 17
586                              EXHAUST-CFM =
                                 0
587                              EXHAUST-EFF =
                                 0.75
588                              EXHAUST-STATIC = 0
                                 ..
589
590
591   CONTROL    = ZONE-CONTROL     DESIGN-HEAT-T = 70
592                                DESIGN-COOL-T = 75
593                                HEAT-TEMP-SCH = HEAT-SCHED
594                                COOL-TEMP-SCH = COOL-SCHED
595                                THERMOSTAT-TYPE = PROPORTIONAL
596                                THROTTLING-RANGE = 0.1
                                   ..
597
598   SPACE1-1     =ZONE           ZONE-AIR=ZAIR
599
                                 SIZING-OPTION=ADJUST-LOADS

600                              ZONE-CONTROL=CONTROL   ..
601
602   SPACE2-1     =ZONE          LIKE SPACE1-1   ..
603   SPACE3-1     =ZONE          LIKE SPACE1-1   ..
604   SPACE4-1     =ZONE          LIKE SPACE1-1   ..
605   SPACE5-1     =ZONE          LIKE SPACE1-1   ..
606
607   ATTIC        =ZONE          ZONE-TYPE=UNCONDITIONED
      ..
608
609
610
611   S-CONT       =SYSTEM-CONTROL  COOLING-SCHEDULE=
      COOLOFF
612                                HEATING-SCHEDULE=
                                   HEATOFF
613                                COOL-CONTROL =
                                   CONSTANT
614                                PREHEAT-T =
                                   44.6
615                                MAX-SUPPLY-T=104

616                                MIN-SUPPLY-T=55
                                   ..
617
618
619   S-AIR        =SYSTEM-AIR      MAX-OA-FRACTION =
      1.0
620                                OA-CONTROL = TEMP
```

```
621
622
623    S-FAN         =SYSTEM-FANS      FAN-SCHEDULE=FAN-SCHED
624                                    FAN-CONTROL=
                                       INLET
625                                    MOTOR-PLACEMENT =
                                       IN-AIRFLOW
626                                    FAN-PLACEMENT = DRAW-THROUGH
627                                    SUPPLY-EFF=0.55575
628                                    MAX-FAN-RATIO = 1.1
629                                    MIN-FAN-RATIO = 0.3
630                                    NIGHT-CYCLE-CTRL=STAY-OFF
631                                    SUPPLY-DELTA-T = 2.117
632                                    SUPPLY-KW = 0.000685   ..
633
634
635    $ COIL CURVE-FIT
636    HPACCoolCapFT = CURVE-FIT
637                   TYPE = BI-QUADRATIC
638                   COEFFICIENTS = (0.766956,0.0107756,-0.0000414703,0.00134961,
639                   -0.000261144,0.000457488) ..
640    HPACCoolCapFFF = CURVE-FIT
641                    TYPE = QUADRATIC
642                    COEFFICIENTS = (0.8,0.2,0) ..
643    HPACCOOLEIRFT = CURVE-FIT
644                   TYPE = BI-QUADRATIC
645                   COEFFICIENTS = (0.297145,0.0430933,-0.000748766,0.00597727,
646                   0.000482112,-0.000956448) ..
647    HPACCOOLPLFFPLR = CURVE-FIT
648                     TYPE = QUADRATIC
649                     COEFFICIENTS = (0.85,0.15,0) ..
650
651
652    S-EQUIP  =SYSTEM-EQUIPMENT    COOL-CAP-FT = SDL-C3
653                                  COOLING-EIR  = 0.242745131
654                                  COOL-EIR-FT = SDL-C13
655                                  COOL-EIR-FPLR = SDL-C18
656                                  COOL-SH-FT =SDL-C23
657                                  COIL-BF-FT = HPACCoolCapFT
658                                  COIL-BF-FCFM = HPACCoolCapFFF
659                                  COIL-BF-FPLR = HPACCOOLPLFFPLR
660                                  COIL-BF=0.19
661                                  COOL-FT-MIN= 70
662                                  HEAT-CAP-FT = SDL-C55
663                                  HEATING-EIR  = 0.29751543
664                                  HEAT-EIR-FT = SDL-C60
665                                  HEAT-EIR-FPLR = SDL-C65
666                                  DEFROST-FRAC-FT = HPACCOOLEIRFT
667                                  OUTSIDE-FAN-T = 45
668                                  OUTSIDE-FAN-MODE = INTERMITTENT
669                                  COMPRESSOR-TYPE = SINGLE-SPEED
670                                  RATED-CCAP-FCFM = SDL-C78
671                                  RATED-SH-FCFM= SDL-C85
672                                  RATED-CEIR-FCFM= SDL-C93
673                                  RATED-HCAP-FCFM= SDL-C100
674                                  CRANKCASE-HEAT= 0.05
675                                  CRANKCASE-MAX-T= 39.92  ..
676
677
678    S-TERM        =SYSTEM-TERMINAL REHEAT-DELTA-T= 50
       ..
679
680    SYST-1        =SYSTEM           SYSTEM-TYPE= PVAVS
681                                    SYSTEM-FANS= S-FAN
682                                    SYSTEM-TERMINAL= S-TERM
683                                    SYSTEM-EQUIPMENT= S-EQUIP
684                                    HEAT-SOURCE=
                                       HEAT-PUMP

685                                    PREHEAT-SOURCE= HEAT-PUMP
686                                    RETURN-AIR-PATH= DIRECT
687                                    SIZING-OPTION =
```

```
                                    NON-COINCIDENT
688
                             ZONE-NAMES=(SPACE5-1,SPACE1-1,SPACE2-1
689                                      SPACE3-1,SPACE4-1,ATTIC)
                                            ..
690
691
692  HP-1       = PLANT-ASSIGNMENT  SYSTEM-NAMES = (SYST-1)
693                             HP-LOOP-HEATING = FROM-SYSTEMS
694                             HP-LOOP-COOLING = FROM-SYSTEMS
695                             DHW-SIZE        = 40
696                             DHW-GAL/MIN     =
                                0.0486
697                             DHW-SCH         = DHW-SCHED
698                             DHW-INLET-T-SCH = DHWINLETSCH-1
699                             DHW-SUPPLY-T    =
                                131
700                             DHW-TYPE        = ELECTRIC
701                             DHW-EIR         = 1
702                             DHW-EIR-FT      = DHWHPEIRFT
703                             DHW-HEAT-RATE-FT = DHWHPCAPFT
704                             DHW-EIR-FPLR    = DHWGEIRFPLR
705                             DHW-PUMP-ELEC   = 0
706                             MAX-FLUID-T     = 140
707                             MIN-FLUID-T     = 50
708                             FLUID-VOLUME    = 15            ..
709
710
711
712  $=========================== HOURLY-REPORT FOR SYSTEM
     ===============================
713
714  $ HOURLY-REPORT FOR SYSTEM PART
715  HRSCH-2        = SCHEDULE
716                   THRU DEC 31 (ALL)(1,24)(1) ..
717
718  S1_ZT          = REPORT-BLOCK
719                   VARIABLE-TYPE=SPACE1-1
720                   VARIABLE-LIST=(6,14)
                      ..

721
722  S2_ZT          = REPORT-BLOCK
723                   VARIABLE-TYPE=SPACE2-1
724                   VARIABLE-LIST=(6,14)
                      ..
725
726  S3_ZT          = REPORT-BLOCK
727                   VARIABLE-TYPE=SPACE3-1
728                   VARIABLE-LIST=(6,14) ..
729
730  S4_ZT          = REPORT-BLOCK
731                   VARIABLE-TYPE=SPACE4-1
732                   VARIABLE-LIST=(6,14) ..
733
734  S5_ZT          = REPORT-BLOCK
735                   VARIABLE-TYPE=SPACE5-1
736                   VARIABLE-LIST=(6,14)
                      ..

737
738  SYS1           = REPORT-BLOCK
739                   VARIABLE-TYPE=SYST-1
740                   VARIABLE-LIST=(1,2) ..
741
742  PPRT1          = HOURLY-REPORT
743                   REPORT-SCHEDULE = HRSCH-2
744                   REPORT-BLOCK = (S1_ZT,S2_ZT,S3_ZT,S4_ZT,S5_ZT,SYS1)  ..
745
746  $================================================================================
747
748
```

```
749
750    END    ..
751    COMPUTE SYSTEMS    ..
752
753
754    INPUT PLANT    ..
755
756                 PLANT-REPORT  SUMMARY=(ALL-SUMMARY)
757                 REPORT-FREQUENCY = HOURLY
758                 HOURLY-DATA-SAVE = FORMATTED   ..
759
760    $========================= HOURLY-REPORT FOR PLANT
       ==============================
761
762    HRSCH-3          = SCHEDULE
763                      THRU DEC 31 (ALL)(1,24)(1) ..
764
765    PLT             = REPORT-BLOCK
766                      VARIABLE-TYPE=PLANT
767                      VARIABLE-LIST=(3) ..
768
769    ENDU            = REPORT-BLOCK
770                      VARIABLE-TYPE=END-USE
771                      VARIABLE-LIST=(1,3,5,6,9)
                          ..

772
773    PPRT1           = HOURLY-REPORT
774                      REPORT-SCHEDULE = HRSCH-3
775                      REPORT-BLOCK = (PLT,ENDU)   ..
776
777    $==============================================================================
778
779
780    END   ..
781    COMPUTE PLANT    ..
782
783
784
785    STOP ..
786
```

3   REFERENCE

[1] Kim, C. 2020. A study of occupancy-based smart building controls in commercial buildings. Ph.D. Dissertation, Texas A&M University.
[2] ASHRAE. (2017). Standard 90.1-2016 User's Manual. Atlanta, GA, American Society of Heating, Refrigerating, and Air-conditioning Engineers.
[3] PNNL and U.S.DOE. (2014). Commercial Prototype Building Models. U.S. Department of Energy (DOE). Retrieved from https://www.energycodes.gov/development/commercial/prototype_models.

Appendix A: Simulation Information

Appendix A describes the detailed information to support DOE-2.1e models modified based on the U.S.DOE commercial prototype buildings for Standard 90.-2016. The tables in Appendix A provide further information for the boundary conditions (i.e., walls, roof, ground, etc.) and internal heat gains.

Table A-1 Summary of Small Office Model Construction

#	Type	Houston (2A)		Chicago (5A)	
		U-Value (Btu/hr-ft^2-F)	SHGC	U-Value (Btu/hr-ft^2-F)	SHGC
1	Roof	0.526 0.0257	-	0.526 0.0202	-
2	Ceiling	0.027 (0.027)	-	0.021 (0.021)	-
3	External wall	0.087 (0.089)	-	0.050 (0.051)	-
4	Interior wall	0.442	-	0.442	-
5	Ground floor*	0.415 (F-0.730)	-	0.415 (F-0.520)	-
6	Window**	0.52 (0.54)	0.249 (0.25)	0.367 (0.38)	0.365 (0.38)
7	Glass door**	0.52 (0.54)	0.249 (0.25)	0.367 (0.38)	0.365 (0.38)
8	Opaque door	0.370 (0.037)	-	0.370	-

* Note: The numbers in brackets are code-compliance for Standard 90.1-2016. U-value and SHGC were extracted from DOE-2.1e LV-C and LV-D reports. U-values included air films.

* Ground floor is slab-on-grade (unheated) both for Houston and Chicago models, which used 8" concrete slab with carpet pad. As of August 2020, DOE updated the prototype models using F-factor for underground calculations. Before then, U-value used for underground calculations. The construction of F-factor insulation can be found in Standard 90.1-2016, Table A6.3.1.

** Hypothetical window with weighted U-factor and SHGC used based on the PNNL prototype models. The weighting process is described in Thornton et al. (2011).

Table A-2 Houston (2A): Small Office Model Material Layers

#	Type	Material Layers (Outside to Inside)
1	Attic roof	Asphalt shingles, 5/8" plywood
2	Ceiling insulation	Insulation (R-35.4), 15/8" gypsum board
3	External slab 8" with carpet	7 7/8" normal-weight concrete floor, carpet pad
4	Exterior wall	1" stucco, 5/8" gypsum board, insulation (R-9), 5/8" gypsum board
5	Interior wall	½" gypsum board, ½" gypsum board
6	Exterior roof soffit	5/8" plywood
7	Window	Glass 1576, air 2 1/16", Glass 102 (U-value 0.58, SHGC 0.25)
8	Glass door	U-value 0.58, SHGC 0.25
9	Swinging door	Opaque door panel

Table A-3 Chicago (5A): Small Office Model Material Layers

#	Type	Material Layers (Outside to Inside)
1	Attic roof	Asphalt shingles, 5/8" plywood
2	Ceiling insulation	Insulation (R-45.98), 5/8" gypsum board
3	External slab 8" with carpet	7 7/8" normal-weight concrete floor, carpet pad
4	Exterior wall	1" stucco, 5/8" gypsum board, insulation (R-17.43), 5/8" gypsum board
5	Interior wall	½" gypsum board, ½" gypsum board
6	Exterior roof soffit	5/8" plywood
7	Window	Glass 8652, air ½", Glass 102 (U-value 0.41, SHGC 0.38)
8	Glass door	U-value 0.41, SHGC 0.38
9	Swinging door	Opaque door panel

Table A-4 Average Monthly Ground Temperature in DOE-2.1e and EnergyPlus

Month	Houston (CZ 2A, °F)	Chicago (CZ 5A,°F)	Reference
January	69.314	67.838	PNNL and U.S.DOE (2014)
February	69.224	67.604	
March	69.368	67.604	
April	69.512	37.838	
May	69.692	68.180	
June	73.634	72.050	
July	74.300	73.184	
August	74.444	73.526	
September	74.480	73.634	
October	70.448	69.944	
November	69.818	68.954	
December	69.458	68.342	

Table A-5 Internal Heat Gain Inputs in DOE-2.1e and EnergyPlus Simulation Tests

Heat sources	DOE-2.1e	EnergyPlus	Reference
Occupancy	- 450W/person - 200ft^2/person	- 450W/person - 200ft^2/person	ASHRAE (2017)
Electrical equipment	0.63 W/ft^2	0.63 W/ft^2	ASHRAE (2017)
Internal lighting	0.79 W/ft^2	0.79 W/ft^2	ASHRAE (2017)
Task lighting	Not modeled	Not modeled	N/A