Test Cases

Black-Box Tests

sys: control system
sim: environment simulator

Definition

set outside illuminance:	set outside illuminance modulated by a rectangle function, amplitude of rectangle function: +/-1 lux frequency of rectangle function: 1 Hz
set amplitude of modulation x :	set amplitude of rectangle function to x lux

TestCase: 1 U7

Start condition:

select Room (Office or CompLab or PRoom or MRoom)

Observe:

ambient light level (sys)

Sequence:

1. set ambient light level by using the user panel,
   expected result: Ceiling lights (and in the case of Room=office additionally task lights) produce illuminance according choosen ambient light level
2. set different ambient light level by using the user panel,
   expected result: Ceiling lights (and in the case of Room=office additionally task lights) produce illuminance according new ambient light level
3. repeat 1 to 2 for different Rooms

TestCase: 2 U8

Start condition:

select Room (Office or CompLab or PRoom or MRoom)

Observe:

default light scene (sys)

Sequence:

1. let the Facility Manager set a default light scene by using his panel,
   expected result: entered default scene
2. let him set a different default light scene, **expected result: new default scene**

3. repeat 1 to 2 for different Rooms

TestCase: 3 U6

Start condition:

select Room (Office or CompLab or PRoom or MRoom)

Observe:

light scenes(sys)

Sequence:

1. set light scene by using the panel, **expected result: entered scene**
2. set new different scene by using the panel, **expected result: new scene**
3. change parameter of existing scene by using the panel, **expected result: new scene**
4. repeat 1 to 3 for different Rooms

TestCase: 4 U9

Start conditions:

select Room (Office or CompLab or PRoom or MRoom)

Observe:

default ambient light level (sys)

Sequence:

1. let the Facility Manager set a default ambient light level by using his panel, **expected result: default ambient light level**
2. Let him set a different default ambient light level, **expected result: new default ambient light level**
3. repeat 1 to 2 for different Rooms

TestCase: 5 U1, U2, FM1 for Rooms

Start conditions:

select Room (Office or CompLab or PRoom or MRoom),
selected Room is empty, this means RoomOcc = false

Observe:

ambient light in Room (iAmb) (sim), ceiling lights (sim), task light (sim), RoomOcc(sys)

Sequence:

1. Set minimum ambient light value (iAmbMin)
2. set outside illuminance = 2 lux /* no light*/
3. select a new light scene /*controller should calculate the resulting inside illuminance (in_ill) from the outside illuminance*/
4. let a user enter an empty Room, **expected result: RoomOcc should change to true**,

if [(in_ill > iAmbMin + 10%) and (light scene does not require more light)]
-> **artificial lights (ceiling lights) = off (else on)**

5. increment outside illuminance in steps of 1000 lux until outside illuminance > 9 000 lux, return to 3.
6. in turn, return to 3 until all light scenes have been tested

TestCase: 6 U3, U4

Start conditions:

select Room (Office or CompLab or PRoom or MRoom),
selected Room is occupied by one user, set outside illuminance=2 lux

Observe:

lightscene (sys), ceiling lights(sim), task lights(sim)

Sequence:

1. select a new lightscene (iLightscene)
2. let the user leave the room
3. set Delay time (iDelaytime) = 9/10 * RoomDelay
4. let a user reenter the Room /* it is assumed: RoomDelay<ReoccRoomDelay*/
   expected result: the lightscene respectively the status of ceiling lights (and in the case of Room=Office the status of the task light) does not change and is still the same
5. Set Delay time (iDelaytime) = 11/10 * RoomDelay
6. let a user reenter the Room /* it is assumed: RoomDelay<ReoccRoomDelay*/
   expected result: the lightscene respectively the status of ceiling lights (and in the case of Room=Office the status of the task light) is reestablished
7. Set Delay time (iDelaytime) = 9/10 * ReoccRoomDelay
8. let a user reenter the Room /* it is assumed: RoomDelay<ReoccRoomDelay*/
   expected result: the lightscene respectively the status of ceiling lights (and in the case of Room=Office the status of the task light) is reestablished
9. Set Delay time (iDelaytime) = 11/10 * ReoccRoomDelay
10. let a user reenter the Room /* it is assumed: RoomDelay<ReoccRoomDelay*/
    expected result: the default lightscene respectively the corresponding status of ceiling lights (and in the case of Room=Office the status of the task light) is set
11. return to 1 until all light scenes are tested.
12. repeat 1 to 11 for different Rooms

TestCase: 7 U5

Start conditions:

select Room (Office or CompLab or PRoom or MRoom), selected Room is occupied.

Observe:

ceiling lights (sim)

Sequence:

1. set the Dim value of the ceilinglights to 50% and the outdoorilluminance to 2 lux, and the RoomOcc to true.

2. let the user push the pushbutton until the ceiling lights are off.
3. let the user push the pushbutton
   expected result: ->The ceiling lights are switched to “on” with full power
4. let the user push the pushbutton
   expected result: ->The ceiling lights are driven with half power
5. let the user push the pushbutton
   expected result: ->The ceiling lights are switched to “off”
6. Set the outdoorilluminance to 9 900 lux
7. let the user push the pushbutton
   expected result: ->The ceiling lights are switched to “on” with full power
8. let the user push the pushbutton
   expected result: ->The ceiling lights are dimmed, according to iAmb respectively Outdoor illuminance and chosen light scene.
9. let the user push the pushbutton
   expected result: ->The ceiling lights are switched to “off”
10. repeat 1 to 4 for different Rooms

TestCase: 8 U10

Start conditions:

select Room (Office or CompLab or PRoom or MRoom)

Observe:

ReoccRoomDelay (sys)

Sequence:

1. set ReoccRoomDelay (via the FM control panel) **expected result: ReoccRoomDelay**
2. set different ReoccRoomDelay (via the FM control panel)
   expected result: new ReoccRoomDelay
3. repeat 1 to 2 for different Rooms

TestCase: 9 U11 (SunDet), FM7, FM8

Start condition:

select Room (Office or CompLab or PRoom or MRoom)

Observe:

OccMal (sys)
Malfunction(sys) /*malfunction of ols, send to floor*/
SunDetMal(sys) /*malfunction of ols, send to user*/

Sequence:

1. select one of three sensors on one side of the building.
2. set the value of illuminance of this sensor to 2 lux, set the two other ones to 9 000 lux.
   wait 1 hour and 1 second **expected result: -> Malfunction= true and FM gets the signal**
3. repeat 1 to 2 for the three ols of the selected side of the building
4. repeat 1 to 3 for the other side of the building
5. if Malfunction= false set error flag “ inconsistency check of ols results fails“

1. set the daytime 6.00 pm on June 21st. and set the outdoor illuminance to 2 lux
   expected result: -> Malfunction= true and FM gets the signal
2. set the daytime 6.00 pm on December 21st. and set the outdoor illuminance to 9 999 lux
   expected result: -> Malfunction= true and FM gets the signal
3. set the daytime 6.00 am on June 21st. and set the outdoor illuminance to 2 lux
   expected result: -> Malfunction= true and FM gets the signal
4. set the daytime 6.00 am on December 21st. and set the outdoor illuminance to 9 999 lux
   expected result: -> Malfunction= true and FM gets the signal
5. repeat 1 to 4 for all six ols
6. if Malfunction= false set error flag "inconsistency check between daytime and outdoor illuminance fails"

1. select one of the six ols
2. set the illuminance value to 5000 lux
3. set amplitude of modulation 0
4. set time 1 second before full hour (sample time)
5. wait 2 seconds **expected result: -> Malfunction= true and FM gets the signal**
6. if Malfunction= false set error flag "absolut constant result check fails"
7. repeat 1 to 5 for all six ols

1. select one of the six ols
2. set the illuminance value to 1 lux
3. set noise 1
4. wait 1.1 sec **expected result: -> Malfunction= true and FM gets the signal**
5. set the illuminance value to 10 000 lux
6. set amplitude of modulation 1
7. wait 1.1 sec **expected result: -> Malfunction= true and FM gets the signal**
8. repeat 1 to 7 for all six ols
9. if Malfunction= false set error flag "value out of range check fails"

1. set Malfunction= false **expected result: -> SunDetMal=false**
2. set Malfunction= true **expected result: -> SunDetMal=true and user of this Room is informed**
3. repeat 1 to 2 for all six ols

TestCase: 10 U11 (MotDet), FM7, FM8

Start conditions:

select Room (Office or CompLab or PRoom or MRoom)

Observe:

OccMal(sys) /* variable of RoomOcc*/

Sequence:

1. set OccMal=true **expected result: OccMal=true and FM gets the signal**
2. repeat 1 for different Rooms

TestCase: 11   U12

Start conditions:

select Room (Office or CompLab or PRoom or MRoom) occupied by one user,
selected Room is occupied by a user,

Observe:

lightscene (sys)
ceiling lights (sim),
task light (sim)

Sequence:

1. set minimum ambient light value (iAmbMin)
2. set outside illuminance = 2 lux   /* no light*/
3. select a new light scene /*controller should calculate the resulting inside illuminance (in_ill) from the outside illuminance*/
4. **expected result:**
   if [(in_ill < iAmbMin - 10%) and (light scene does require more light)]
   -> **ceiling lights = on (else off), dimvalue respectively task lights choosen according to ambient light level.**
5. increment outside illuminance in steps of 1000 lux until outside illuminance > 9 000 lux, return to 3.
6. in turn, return to 3 until all light scenes have been tested
7. repeat 3 to 6 for different Rooms

TestCase: 12   U14, U16

Start conditions:

select Room (Office or CompLab or PRoom or MRoom), CeilingLight=off
only in the case of Room=Office : TaskLight=off

Observe:

Light(sim) /*dims the ceiling light*/
ToggleLight(sim) /*switches the ceiling light on/off by user panel*/

only in the case of Room=Office : TaskLight(sys) /*shows the status of task light (on/off) */
ToggleTaskLight(sim) /*switches the task light on/off by user panel*/

Sequence:

1. Let the user switch the ceilinglight switch on the control panel to on
   expected result: Light=on
2. for value=0 to 100% do
3. Let the user switch the ceilinglight switch on the control panel to ambient and set a certain Light (value) by use of the control panel
   expected result: Light=value
4. Let the user switch the ceilinglight switch on the control panel to off
   expected result: Light=off

5. only in the case of Room=Office do 6,7
6. Let the user switch the tasklight switch on the control panel to on
   expected result: TaskLight=on
7. Let the user switch the tasklight switch on the control panel to off
   expected result: TaskLight=off
8. repeat 1-8 for all different Rooms

TestCase: 13 U17, U18, FM1 for hallways

Start conditions:

select Hallway, selected Hallway is empty, outside illuminance is 2 lux /*no light*/.

Observe:

HwOcc(sys)	
Illuminance(sys)	/* room illuminance near wall to hallway */,
hallway illuminance	/* hallway illuminance, computed by outdoor illuminance via room illuminance near wall to hallway and status of room ceiling lights*/
ceiling lights (sim)	/* ceiling lamps in hallway */

Sequence:

1. set minimum illuminance (iIluMin)
2. wait max delay time, outside illuminance = 2 lux /* system in basic state */
3. let a user enter an empty hallway **expected result: HwOcc=true**
   if [(hallway illuminance > illuMin + 10%)
   - > hallway ceiling lights = off else -> hallway ceiling lights = on
4. increment outside illuminance in steps of 100 lux until outside illuminance > 9 900 lux, return to 3.
5. repeat 1-4 for all Hallways

TestCase: 14 U19

Start conditions:

select Hallway, selected Hallway is occupied by a user

Observe:

hallway ceiling lights (sim)

Sequence:

1. set Hallway ceiling light to off and set outdoor illuminance though, that hallway illuminance does not require additional artifical light.
2. Let the user push the pushbutton, **expected result: Light=on**
3. Let the user push the pushbutton, **expected result: Light=off**
4. set Hallway ceiling light to on and set outdoor illuminance though, that hallway illuminance does require additional artifical light.
5. Let the user push the pushbutton, **expected result: Light=off**
6. repeat 1-5 for all Hallways

TestCase: 15 FM2

Start conditions:

select Hallway, selected Hallway is occupied by one user,
outside illuminance is 2 lux /*no light*/ , delay time T2' =0.01xT2 [in seconds]

Observe:

HwOcc(sys), ceiling lights (sim) /* ceiling lamps in hallway */

Sequence:

1. set the hallway ceiling lights to on
2. let the user leave the hallway
3. wait a certain delay time T2'=0.9 T2
   expected result: hallway ceiling lights=on
4. wait a additional delay time T2'=0.2 T2
   expected result: hallway ceiling lights=off
5. repeat 1-4 for all Hallways

TestCase: 16 FM3

Start conditions:

select Room (Office or CompLab or PRoom or MRoom),
selected Room is occupied by one user,
outside illuminance is 2 lux /*no light*/
select a suited default light scene, so that task light and ceiling light can light.
delay time T3'=0.01xT3 [in seconds]

Observe:

RoomOcc(sys), ceiling lights (sim) /* ceiling lights in Room */
in the case of office: task light (sim) /* task light on desk */

Sequence:

1. set the room ceiling lights to on
2. in the case of office set the task light to on
3. let the user leave the room /*RoomOcc=false*/
4. wait a delay time T3'=0.9 T3 after the change of RoomOcc to false
   expected result: Room ceiling light=on, in the case of office: **task light=on**
5. wait a additional delay time T3'=0.2 T3
   expected result: Room ceiling light=off in the case of office: **task light=off**
6. repeat 1-5 for all Rooms

TestCase: 17 FM4

Start conditions:

Select Hallway

Observe:
HwOccDelay (sys) (=T2)

Sequence:
1. set HwOccDelay (=T2) by FM control panel, **expected result: HwOccDelay(=T2)**
2. set different HwOccDelay (=T2) by FM control panel, **expected result: new HwOccDelay (=T2)**
3. repeat 1 to 2 for all different Hallways

TestCase: 18 FM5

Start conditions:
select Room (Office or CompLab or PRoom or MRoom)

Observe:
RoomDelay (=T3) (sys)

Sequence:
1. set RoomDelay (=T3) **expected result: RoomDelay (=T3)**
2. set different RoomDelay (=T3) **expected result: new RoomDelay (=T3)**
3. repeat 1 to 2 for all different Rooms

TestCase: 19 FM6

Start conditions:
select Room (Office or CompLab or PRoom or MRoom) or Hallway, CeilingLight=on,
in the case of Hallway: HwOcc=false else RoomOcc=false
only in the case of Room=Office : TaskLight=on

Observe:
ToggleLight(sim) /*switches the ceiling light on/off by facility manager panel*/
only in the case of Room=Office : TaskLight(sys) /*shows the status of task light (on/off) */
ToggleTaskLight(sim) /*switches the task light on/off by facility manager panel*/

Sequence:
1. set Light=off by FM control panel, **expected result: Light=off**
2. set Light=on by FM control panel, **expected result: Light=on**
3. only in the case of Room=Office do 4, 5
4. set TaskLight=off by FM control panel, **expected result: TaskLight=off**
5. set TaskLight=on by FM control panel, **expected result: TaskLight=on**
6. in the case of Hallway set HwOcc=true else RoomOcc=true
   CeilingLight=on, in the case of Hallway: HwOcc=true
   only in the case of Room=Office : TaskLight=on, RoomOcc=true
7. set Light=off by FM control panel, **expected result: Light=on**
8. only in the case of Room=Office do set TaskLight=off by FM control panel,
   expected result: TaskLight=on
9. repeat 1-8 for all different Rooms and Hallways

TestCase: 20 FM9

Start conditions:
Set all CeilingLights, Tasklights =off,

Observe:
HwEnergyConsumpt(sys), RoomEnergyConsumpt(sys)

Sequence:
1. set time 1 second before sample time
2. select a Room or Hallway , set RoomOcc respectively HwOcc to true, set ceiling lights to on
3. repeat 2 for all Rooms or Hallways
4. wait 2 minutes.
5. select a Room or Hallway , set RoomOcc respectively HwOcc to true, set ceiling lights to off
6. repeat 5 for all Rooms or Hallways
7. wait 2 minutes.
8. repeat 1 -7 two times
   Expected Result: The current respectively the past energy consumption should oscillate with a frequency of 0.25min^{-1}.

TestCase: 21 FM10, FM11

Observe:
OccMal (sys), Malfunction(sys) /*malfunction of ols, send to floor*/

Sequence:
1. set time 1 second before sample time
2. select one of the ols (outdoor light sensors), set Malfunction= true
3. wait 2 seconds
4. set Malfunction= false
5. repeat 1 to 4 for all six ols
6. set time 1 second before sample time
7. select one of the imd (inner motion detection), set Malfunction= true
8. wait 2 seconds
9. set Malfunction= false
10. repeat 6 to 9 for all imds
11. set time 1 second before sample time
12. select a certain Malfunction which cannot be detected
13. set Malfunction=true by hand
14. wait 2 seconds
15. repeat 11 to 14 for all possible malfunctions which cannot be detected
   Expected result: On request of the facility manager the occured malfunction of all sensors should be reported

TestCase: 22 (NF1,) NF2, NF3

Observe:

Sun (sys)
Light (sys) /* Dimvalue of Ceiling Lights: Light dimValue:[0-5%]*/
in the case of room=office Tasklight (sys) /* shows the status of the TaskLight*/
Malfunction(sys) /*malfunction of ols, send to floor*/

Sequence:

1. select one room together with its significant ols and its adjacent hallway section.
2. set the HwOcc=true
3. set the value of illuminance (=Sun) of this sensor(s) to 2 lux
   /*Sun(ill:Lux) is send from SunDet to Office */
4. save the actual dim value of the ceiling lights, in the case of room=office additionally the status of the task light.
5. set Malfunction=error /*error=code of the ols*/
6. wait 1 seconds
7. set the value of illuminance (=Sun) of this sensor to 9 999 lux
   Expected result: The light scene should be though that all lights are on (Dimvalue 100%), respectively: The hallway ceiling light should be on.
   /* This statement should be investigated thorougly because an inconsistency in the original Requirements description between NF1 and NF2 was detected, and remarked in the addendum*/
8. repeat 1-7 for all rooms

TestCase: 23 NF4, NF5

Observe:

HwOcc(sys)
MotDetMal(sys) /*malfunction of imds in room or hallway*/

Sequence:

1. select a room or hallway
2. in the case of hallway: select one of three imds
3. set HwOcc=false
4. set MotDetMal(error) /*error = imds malfunction */
5. wait 1 second, **expected result: HwOcc should change to true**
6. repeat 1-5 for all imds
7. repeat 1-6 for all hallway sections
8. in the case of room set RoomOcc=false
9. set MotDetMal(error) /*error = imds malfunction */
10. wait 1 second, **expected result: RoomOcc should change to true**
11. repeat 8-10 for all Rooms

TestCase: 24 NF9

Observe:

Light (sim)	/* 0-100% reasonable*/
LightScene	/* 1-4 reasonable*/
DefaultAmbientLightScene	/* 1-4 reasonable*/
DefaultAmbientLightLevel	/* 2 - 9 999 lux reasonable*/
RoomReoccDelay	/*1-3600s reasonable*/
RoomDelay	/*1-3600s reasonable*/
HwPbDelay	/*1-3600s reasonable*/
HwOccDelay	/*1-3600s reasonable*/
HwDelay	/*1-3600s reasonable*/
HwEnergyDiffTime	/*1- 86 400 s reasonable*/
EnergyDiffTime	/*1- 86 400 s reasonable*/

Sequence:

1. select a room
2. Set Light = 100% , **Expected result: No System Warning**
   Set Light = 110% , **Expected result: System Warning about unresonable input**
3. Set LightScene=0 **Expected result: System Warning about unresonable input**
   Set LightScene=1, **Expected result:No System Warning**
   Set LightScene=4, **Expected result: No System Warning**
   Set LightScene=5, **Expected result: System Warning about unresonable input**
4. Set AmbientLightScene=0, **Expected result: System Warning about unresonable input**
   Set AmbientLightScene=1, **Expected result: No System Warning**
   Set AmbientLightScene=4, **Expected result: No System Warning**
   Set AmbientLightScene=5, **Expected result: System Warning about unresonable input**
5. Set AmbientLightLevel=0 lx, **Exp. res.: System Warning about unresonable input**
   Set AmbientLightLevel=1 lx, **Exp. res.: No System Warning**
   Set AmbientLightLevel=9 999 lx, **Exp. res.: No System Warning**
   Set AmbientLightLevel=10 000 lx, **Exp. res.: System Warning about unresonable input**
6. Set RoomReoccDelay=0s, **Exp. res.: System Warning about unresonable input**
   Set RoomReoccDelay=1s, **Exp. res.: No System Warning**
   Set RoomReoccDelay=3599s, **Exp. res.: No System Warning**
   Set RoomReoccDelay=3600s, **Exp. res.: System Warning about unresonable input**
7. Set RoomDelay=0s, **Exp. res.: System Warning about unresonable input**
   Set RoomDelay=1s, **Exp. res.: No System Warning**
   Set RoomDelay=3599s, **Exp. res.: No System Warning**
   Set RoomDelay=3600s, **Exp. res.: System Warning about unresonable input**
8. Set EnergyDiffTime=0s, **Exp. res.: System Warning about unresonable input**
   Set EnergyDiffTime=1s, **Exp. res.: No System Warning**
   Set EnergyDiffTime=86399s, **Exp. res.: No System Warning**
   Set EnergyDiffTime=86400s, **Exp. res.: System Warning about unresonable input**
9. repeat 1-8 for all rooms

10. select a hallway
11. Set HwPbDelay=0s, **Exp. res.: System Warning about unresonable input**
    Set HwPbDelay=1s, **Exp. res.: No System Warning**
    Set HwPbDelay=3599s, **Exp. res.: No System Warning**

Set HwPbDelay=3600s, **Exp. res.: System Warning about unresonable input**

12. Set HwOccDelay=0s, **Exp. res.: System Warning about unresonable input**
    Set HwOccDelay=1s, **Exp. res.: No System Warning**
    Set HwOccDelay=3599s, **Exp. res.: No System Warning**
    Set HwOccDelay=3600s, **Exp. res.: System Warning about unresonable input**
13. Set HwDelay=0s, **Exp. res.: System Warning about unresonable input**
    Set HwDelay=1s, **Exp. res.: No System Warning**
    Set HwDelay=3599s, **Exp. res.: No System Warning**
    Set HwDelay=3600s, **Exp. res.: System Warning about unresonable input**
14. Set HwEnergyDiffTime=0s, **Exp. res.: System Warning about unresonable input**
    Set HwEnergyDiffTime=1s, **Exp. res.: No System Warning**
    Set HwEnergyDiffTime=86399s, **Exp. res.: No System Warning**
    Set HwEnergyDiffTime=86400s, **Exp. res.: System Warning about unresonable input**
15. repeat 10-14 for all hallways