Big Ideas

- Functional intents are based on set points given in *SCC Facility Data Manual*. When data does not match functional intent, consultation with building manager is needed to determine whether functional intent values are correct.

- Air handlers maintain space air temperatures with minimal fluctuations.

- For AH42, 52, 62, 72, 82 & 92, space air temperatures are consistently lower than functional intent:
  - verify 74±2°F set point for AH42-82
  - verify 75±2°F set point for AH92
  - determine whether cooling coil is functioning as intended

- Unexpected positive correlations exist between space air temperatures and OAT.
Legends Used on Graphs

Functional Status Legend

- Needs immediate attention; little consistency with functional intent; major issue(s)
- System working but a few issues to be addressed; some consistency with functional intent; moderate issue(s)
- System is performing as intended; much consistency with functional intent; no/very minor issue(s)

Annotations Used in Graphs

- **Functional Intent**: Green line(s) indicate functional intent.
- **Inconsistent**: Red highlights anomalies or patterns inconsistent with functional intent.
- **Consistent**: Black highlights patterns consistent with functional intent.
# Systems Summary

<table>
<thead>
<tr>
<th>System</th>
<th>Functional Status</th>
<th>Area Served</th>
<th>Major Problem(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AH01</td>
<td></td>
<td>Basement</td>
<td>Space air temperatures 2-4°F below <em>Manual</em> set point</td>
</tr>
<tr>
<td>AH02</td>
<td></td>
<td>Basement</td>
<td>Space air temperatures 2-4°F below <em>Manual</em> set point</td>
</tr>
<tr>
<td>AH42</td>
<td></td>
<td>4th floor day room &amp; multi-purpose room</td>
<td>Space air temperatures 4°F below <em>Manual</em> set point</td>
</tr>
<tr>
<td>AH52</td>
<td></td>
<td>5th floor day room &amp; multi-purpose room</td>
<td>Space air temperatures 2-4°F below <em>Manual</em> set point</td>
</tr>
<tr>
<td>AH62</td>
<td></td>
<td>6th floor day room &amp; multi-purpose room</td>
<td>Space air temperatures 3-5°F below <em>Manual</em> set point</td>
</tr>
<tr>
<td>AH72</td>
<td></td>
<td>7th floor day room &amp; multi-purpose room</td>
<td>High fluctuation in space air temperature. Damper valve closes.</td>
</tr>
<tr>
<td>AH82</td>
<td></td>
<td>8th floor day room &amp; multi-purpose room</td>
<td>Space air temperatures 2°F below <em>Manual</em> set point. Heating/cooling coil valve position always 50%.</td>
</tr>
<tr>
<td>AH92</td>
<td></td>
<td>9th floor day room &amp; multi-purpose room</td>
<td>Space air temperatures 2-3°F below <em>Manual</em> set point. Mixed air and supply air positively correlate with OAT for colder temperatures.</td>
</tr>
<tr>
<td>Small Chilled Water Loop</td>
<td></td>
<td>Ground floor server room</td>
<td>Supply water temperature 3-5°F below <em>Manual</em> set point.</td>
</tr>
</tbody>
</table>
## Summary of the AH42 System

<table>
<thead>
<tr>
<th><strong>Functional Status</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functional Intent</strong></td>
<td>Day room and multi-purpose rooms are maintained at 74±2°F.</td>
</tr>
<tr>
<td><strong>Patterns Consistent w/ Functional Intent</strong></td>
<td>Day room and multi-purpose room temperatures stay fairly constant.</td>
</tr>
</tbody>
</table>
| **Patterns Inconsistent w/ Functional Intent** | 1. Day room ranges from 69-73°F and averages 72°F. Multi-purpose room ranges from 65-78°F and averages 71°F.  
2. Supply air temperature is too cold and range is too large. |
| **Testable Hypothesis** | 1. Multi-purpose room space temperature is set 4 degrees below manual set point.  
2. Cooling coil valve position causes supply air temperature to be too cold. |
| **Conclusions/Recommendations** | Space temperature does not align with *Manual* set point. Supply temperature and cooling coil position work together as expected. Cooling coil is open too much in cold weather. Determine whether cooling coil is malfunctioning. Determine whether actual set point is correct or if manual gives correct set point. Rewrite manual set point if incorrect. |

Basbagill, Russell-Smith, Wise
Day Room Space Air Temp. vs. OAT

- Space temperature stays fairly constant
- Day room temperature slightly below deadband

Multi-Purpose Room Space Air Temp. vs. OAT

- Multi-purpose room temperature positively correlates with OAT
Both space air temperatures suddenly decrease by 2° in late September; change in set point?
Multi-Purpose Room Supply Air Temp., Cooling Coil Valve Position vs. OAT

Constant value agrees with Building EQ pattern…but no data in warm weather

- Cooling coil valve position open during cold weather
- Cooling coil and supply air temperature work together as expected

Cooling coil valve position positively correlates with OAT

AH01-AH01-OutsideAirTemperature-(B)-[Deg F]
(Timeframe: 1/1/2009 12:00:00 AM to 12/31/2009 11:59:00 PM)

AH42-AH42-SupplyAirTemperature-(245)-[Deg F]
AH42-CoolingCoilValvePosition-(47)-[%]

(11/21/2009 from 7:15 PM to 8:15 PM)
# Summary of the AH52 System

<table>
<thead>
<tr>
<th>Functional Status</th>
<th>Day room and multi-purpose rooms are at 74±2°F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Intent</td>
<td>Day room and multi-purpose rooms are at 74±2°F.</td>
</tr>
<tr>
<td>Patterns Consistent w/ Functional Intent</td>
<td>Both space temperature dead bands are within ±2°F.</td>
</tr>
<tr>
<td>Patterns Inconsistent w/ Functional Intent</td>
<td>Day room 3°F below functional intent. Multi-purpose room 5°F below functional intent.</td>
</tr>
</tbody>
</table>
| Testable Hypothesis | 1. Space temperatures are set 3 and 5°F below manual set point.  
2. Cooling coil providing too much cooling. |
| Conclusions/Recommendations | Cooling coil and damper not open, so inconclusive why spaces are below functional intent. Determine whether cooling coil is ever fully open. Determine actual set points for both spaces and rewrite manual if different than manual set point. |
Day Room Space Air Temp. vs. OAT

Day room air temperature consistently lower than functional intent. Slight positive correlation with OAT.

Multi-Purpose Room Space Air Temp. vs. OAT

Multi-purpose room temperature does not cross functional intent deadband

Basbagill, Russell-Smith, Wise
Day Room Heating/Cooling Coil
Combined Valve Position vs. OAT

Valve position never fully open, so no cooling to multi-purpose room?

Cooling coil either closed (heating only) or open only 50% (no heating or cooling) in warmer weather

Day room is being heated and cooled
AH52

Outside Air Damper Position vs. OAT

Damper never closed/open?
AH62

POD A/B/C Day Room

POD A/B/C Multi Purpose

Air Temperature (84)

Valve Position (87)

On/Off Status (272)

Mixed Air Temperature (85)

Economizer

Supply Fan

Combined Valve Position (83)

Cooling Coil

Heating Coil

Outside Air

Damper Position (273)

Return Fan

Return Fan On/Off Status (262)

Basbagill, Russell-Smith, Wise
## Functional Status

- **Day room and multi-purpose rooms are set at 74±2°F. Rooms should receive 100% air replacement.**

## Functional Intent

- **Patterns Consistent w/ Functional Intent**
  1. Day room and multi-purpose room temperatures stay fairly constant.
  2. Mixed air temperature positively correlates with OAT.

- **Patterns Inconsistent w/ Functional Intent**
  1. Day room and multi-purpose rooms average 73°F ±5°F.
  2. Damper valve periodically closes.

## Testable Hypothesis

Spaces have a high range of temperatures because occupancy levels change dramatically.

## Conclusions/Recommendations

Investigate occupancy levels of the day room and multi-purpose room.
Outside Air Damper Position vs. OAT

100% is fully closed and 0% is fully open. Damper is closed periodically. Fans run continuously so damper should always be open for 100% air replacement.
AH62

Outside Air Damper Position vs. Time

Periodic closing of damper valve; air should be 100% replaced

Damper valve periodically closes for about 1½ hours

Basbagill, Russell-Smith, Wise
AH72

Air Temperature (104)

POD A/B/C

Day Room

POD A/B/C

Multi Purpose

Valve Position (107)

On/Off Status (284)

Mixed Air Temperature (105)

Economizer

Supply Fan

Combined Valve Position (103)

Heating Coil, Cooling Coil

Cooling Coil

Return Fan

Outside Air

Damper Position (285)

Return Fan On/Off Status (286)

Basbagill, Russell-Smith, Wise
# Summary of the AH72 System

## Functional Status

## Functional Intent

Day room and multi-purpose rooms maintained at 74±2°F. Damper position should be 100% open for 100% air replacement.

## Patterns Consistent w/ Functional Intent

Day room and multi-purpose room temperatures stay fairly constant. Mixed air temperature positively correlates with OAT.

## Patterns Inconsistent w/ Functional Intent

Day room and multi-purpose room temperatures are low with the average for each at ~72°F.

## Testable Hypothesis

Set point listed in manual is not the same as set point for which system was actually configured.

## Conclusions/Recommendations

Check set points for consistency across manual and physical system.
AH72

Multi-Purpose Room Space Air Temp. vs. OAT

Set point temperature appears to be 72 °F. Space temperature has slight positive correlation with OAT.

Slight dip could indicate over cooling.

 AH01-AH01-OutsideAirTemperature-(8)-[Deg F]
(Timeframe: 1/1/2005 12:00:00 AM to 12/30/2010 11:59:00 PM)
AH72

Day Room & Multi-Purpose Room Space Air Temp. vs. Time

Drop in average temperature; was there a change in set point?

(from 12/18/2009 12:00:00 AM to 4/7/2010 11:59:00 PM)
Summary of the AH82 System

<table>
<thead>
<tr>
<th>Functional Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Intent</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patterns Consistent w/ Functional Intent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day room and multi-purpose room temperatures stay fairly constant. Mixed air temperature positively correlates with OAT.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patterns Inconsistent w/ Functional Intent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Temperature for each room is maintained at a temperature lower than expected. Day room averages 71°F and multi-purpose room averages 72°F.</td>
</tr>
<tr>
<td>2. Heating/cooling coil valve position data shows that no heating/cooling is occurring.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Testable Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Temperature set point listed in manual is not the same as set point for which system was actually configured.</td>
</tr>
<tr>
<td>2. Heating/cooling coil sensor is not measuring actual position.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conclusions/Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check set points for consistency across manual and physical system. Physically verify if heating/cooling coils are functioning.</td>
</tr>
</tbody>
</table>
AH82

Day Room & Multi-Purpose Room Space Air Temp. and Mixed Air Temp. vs. OAT

Both space air temperatures lower than assumed functional intent over a wide temperature range

Mixed air temperature positively correlates with OAT

Basbagill, Russell-Smith, Wise
Day Room & Multi-Purpose Room Space Air Temp. and OAT vs. Time

Day room space air temperature negatively correlates with OAT

Multi-purpose room space air temperature remains relatively constant

Basbagill, Russell-Smith, Wise
AH82
Day Room Space Air Temp. & Heat/Cool Coil Combined Valve Position vs. Time

AH82 is neither heating nor cooling all year regardless of winter/summer seasons.
AH92
Summary of the AH92 System

Functional Status

Functional Intent
1. Penthouse mechanical room supply temperature is maintained at 75±2°F.
2. Mixed air temperature is maintained at 65±2°F.

Patterns Consistent w/ Functional Intent
Mechanical room is 75°F when OAT is 65°F and above.

Patterns Inconsistent w/ Functional Intent
1. For OAT 35-65°F, mechanical room space temperature positively correlates with OAT, increasing until the room reaches 70°F.
2. Mixed air temperature positively correlates with OAT.
3. Outside air damper position remains fully open when OAT is below 56°F.

Testable Hypothesis
1. Mixed air temperature set point listed in manual is incorrect.
2. Outside air damper position does not close when OAT is very cold (i.e., below 56°F).

Conclusions/Recommendations
Mixed air temperature positively correlates with OAT. Verify set point for mixed air temperature. Space air temperature is below functional intent when OAT is below 60°F. Check if valve is physically closing at colder OAT temperatures.

Basbagill, Russell-Smith, Wise
There is a small positive correlation with space temperature and OAT. Is this during cold months?

Space air temperature almost consistently matches functional intent when OAT exceeds 70°F.

Unexplained jump in supply temperature.
Penthouse Mechanical Room Space Air Temp. vs. Time

Was this a really hot day?

During winter months, space temperature is frequently lower than functional intent.

Space air temperature oscillates daily with OAT, until OAT is very hot.

Yes! This spike corresponds to very high OAT
There is a positive correlation, as OAT increases the damper position closes.

The damper is fully open when it is hot. This will make AH92 have to cool more.

The damper is fully open when it is really cold. This will cause the air to be too cold and the AH only has a cooling coil.
Actions to Take

_objects
Consult building manager to determine if Manual set points are correct.

_objects
Check whether coil valve position is operating according to functional intent.

_objects
Verify whether damper valves are closed when Manual says they should be open.

_objects
Determine whether high range of space air temperatures is due to high occupancy levels. If so, see whether occupants are uncomfortable; if so, find ways to reduce range for these occupancy loads.
Questions?