

## HVAC Controls Upgrade FPT: Scheduling, Override & Night Setback; End-to End (2-26-15)

PROJECT NAME: \_\_\_\_\_ DATE: \_\_\_\_\_

### **REQUIRED SEQUENCES CONTROLS/FEATURES:**

Indicate that the specific feature is installed and record the date it was verified to work correctly. Indicate NA if not required by grant.

Installed?	Date Tested	General Description
<b>End- to-End</b>		
Y / NA		1. Each point on the DDC GUI represents the correct equipment and state (end-to- end verification)
Y / NA		2. OA sensor(s) are calibrated and located in shady area representative of OA equipment intake temperature
<b>Schedules and Override</b>		
Y / NA		3. Schedules for all air handlers (supply and exhaust) match occupied hours by zone
Y / NA		4. Zone boxes are grouped by Tenant (or _____) for Scheduling and for override functions
Y / NA		5. Overrides for each box/zone are programmed with a time limit (maximum 2 hours)
Y / NA		6. Easy way to change box grouping to match changing tenants/zones – does not require reprogramming by controls contractor
Y / NA		7. 7-day scheduling and holiday schedules are set up for the first year
Y / NA		8. GUI: Schedule name is on VAV box schedule and on AHU graphic; name changes when schedule changes
<b>Night Setback – Unoccupied Mode</b>		
Y / NA		9. Night/Unoccupied zone temperatures: cooling 80F or higher; heating 58F or lower. Actual ____/____
Y / NA		10. Outside air damper is closed in unoccupied mode unless cooling is needed
Y / NA		11. Night Heating – VAV system: VAV fan boxes only come on. AHU stays off for those zones where VAV box can be used to heat. Zones in constant need of heating are not keeping system on continuously.
Y / NA		12. Night Cooling: AHU uses outside air with no mechanical cooling. A minimum number of boxes come on to prevent over pressurization of ducts. Boxes in constant need of cooling are not keeping system on continuously.
Y / NA		13. Override for each zone is programmed with time limit (maximum 2 hours). Actual Time Limit _____
Notes (if required by grant and marked NA explain, if installed differently than required explain, etc.):		

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### END-to-END VERIFICATION & SEQUENCE VERIFICATION

1. Start with all equipment in the occupied mode.
2. Indicate the schedule name and which zone and VAV boxes the schedule serves.
3. For each major piece of equipment complete this entire set of tests prior to moving onto the next piece of equipment. Use multiple pages as needed to cover all equipment.
  - a. Fill in at column head Equipment ID#s controlled by the schedule. (Example: AHU-1)
  - b. For each test indicate **P** if passed test and **F** if failed. If the test failed and the condition cannot be corrected, provide notes at the bottom of the tests to indicate what the issue was. If filling out by hand it is okay to cross out F and put in P if system failed initially, was corrected and then passed.

SCHEDULE NAME: \_\_\_\_\_ For Zone/Area: \_\_\_\_\_

List Boxes & Other equipment on schedule: \_\_\_\_\_

Hours of Occupancy: \_\_\_\_\_ Type of Occupants: \_\_\_\_\_

EQUIP ID:	EQUIP ID:	EQUIP ID:	EQUIP ID:	<b>Test Procedure &amp; Results (perform tests in order)</b> Each piece of equipment circle if passed (P) or failed (F) or NA. If failed provide details in notes then cross out F and circle P when corrected.
P / F / NA	P / F / NA	P / F / NA	P / F / NA	1. <b>OA Temperature:</b> Only do once per OA sensor. Measure OA temp right next to sensor and at the same time observe value on DDC GUI. Verify the values are within 2 degrees. For each piece of equipment verify that the OAT indicated on the equipment screen matches the values on all equipment screens tested for OA calibration.
P / F / NA	P / F / NA	P / F / NA	P / F / NA	2. <b>Occupied:</b> Verify that the schedule shows occupied on scheduling screen, unit graphics and graphic for all VAV boxes and equipment (i.e. EFs) tied to that schedule.
P / F / NA	P / F / NA	P / F / NA	P / F / NA	3. <b>Supply Fan (SF):</b> DDC equipment graphic shows running and fan is actually running
P / F / NA	P / F / NA	P / F / NA	P / F / NA	4. <b>Exhaust Fan (EF):</b> DDC equipment graphic shows running and fan is actually running
P / F / NA	P / F / NA	P / F / NA	P / F / NA	5. <b>Return Fan (RF):</b> DDC equipment graphic shows running and fan is actually running
P / F / NA	P / F / NA	P / F / NA	P / F / NA	6. <b>Outside Air (OA) damper:</b> Override damper fully open and fully closed. DDC equipment graphic reflects actual damper position and the damper fully opens and closes.
P / F / NA	P / F / NA	P / F / NA	P / F / NA	7. <b>Return Air (RA) damper:</b> Override damper fully open and fully closed. DDC equipment graphic reflects actual damper position and the damper fully opens and closes.
P / F / NA	P / F / NA	P / F / NA	P / F / NA	8. <b>Exhaust Air (EA) damper:</b> Override damper fully open and fully closed. Verify DDC equipment graphic reflects actual damper position and the damper fully opens and closes.
P / F / NA	P / F / NA	P / F / NA	P / F / NA	9. <b>Supply Air (SA) &amp; Mixed Air (MA) Temperature:</b> With OA damper fully open and unit heating and cooling off, verify the SA temp reading on DDC GUI is within 2 degrees of MA temperature

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EQUIP ID:	EQUIP ID:	EQUIP ID:	EQUIP ID:	<b>Test Procedure &amp; Results (perform tests in order)</b> Each piece of equipment circle if passed (P) or failed (F) or NA. If failed provide details in notes then cross out F and circle P when corrected.
				and OA temperature.
P / F / NA	P / F / NA	P / F / NA	P / F / NA	10. <b>Return Air (RA) Temperature:</b> Verify RA temp is within 5 degrees of (average) room temp
P / F / NA	P / F / NA	P / F / NA	P / F / NA	11. <b>Unoccupied:</b> Change the schedule using the scheduling screen and verify unit graphics and graphics of all VAV boxes and equipment (i.e. EFs) tied to schedule show the equipment in the unoccupied mode.
P / F / NA	P / F / NA	P / F / NA	P / F / NA	12. <b>Supply Fan (SF):</b> DDC equipment graphic shows off and fan is actually off.
P / F / NA	P / F / NA	P / F / NA	P / F / NA	13. <b>Exhaust Fan (EF):</b> DDC equipment graphic shows off and fan is actually off.
P / F / NA	P / F / NA	P / F / NA	P / F / NA	14. <b>Return Fan (RF):</b> DDC equipment graphic shows off and fan is actually off.
P / F / NA	P / F / NA	P / F / NA	P / F / NA	15. <b>Outside Air (OA) damper:</b> damper shows closed on equipment graphic
P / F / NA Boxes tested:	P / F / NA Boxes tested:	P / F / NA Boxes tested:	P / F / NA Boxes tested:	16. <b>Room Temperature Setback:</b> Verify cooling temp setpoint increases to 80F or higher and heating temp setpoint decreases to 58F or lower. Note boxes tested (at least 3 per AHU). Note setpoints: Day/Night Heating setpoints: _____ Day/Night Cooling setpoints: _____
P / F / NA Boxes tested:	P / F / NA Boxes tested:	P / F / NA Boxes tested:	P / F / NA Boxes tested:	17. <b>Night heating/Zone Override – VAV fan powered box:</b> Verify override time is 2 hrs or less. Set override time limit to a short time. Override the room temp setpoint above room temp. Push override button for box/zone and verify that the box/zone comes on but AHU does not come on. Note VAV boxes tested (at least 3 per AHU). Wait for the override period to end and verify that the box/zone returns back to unoccupied mode with the fan off and the OA damper closed. Release setpoint override. Return override time to original override time limit: _____ hours. Note VAV Boxes tested (at least 3 per AHU).
P / F / NA	P / F / NA	P / F / NA	P / F / NA	18. <b>Night heating /Zone Override – non-VAV/single zone or non-fan powered box:</b> Verify override time is 2 hrs or less. Set override time limit to a short time. Override room temp setpoint above room temp. Push override button for box/zone and verify AHU comes on. Wait for the override period to end and verify that the box/zone returns to the unoccupied mode with fan off and the OA damper closed. Release setpoint override. Return override time to original override time limit: _____ hours. Override room temp setpoint above room temp and verify that the AHU comes on and the outside air damper remains closed. Release setpoint override.
P / F / NA Boxes tested:	P / F / NA Boxes tested:	P / F / NA Boxes tested:	P / F / NA Boxes tested:	19. <b>Night cooling – VAV boxes:</b> Override room temp setpoint below room temp and verify that the AHU comes on in economy cooling mode with mechanical cooling locked out and, VAV box comes on to cool. Verify not all VAV boxes come on, only the number needed to prevent over pressurization come on. Note VAV boxes tested (at least 3 per AHU)

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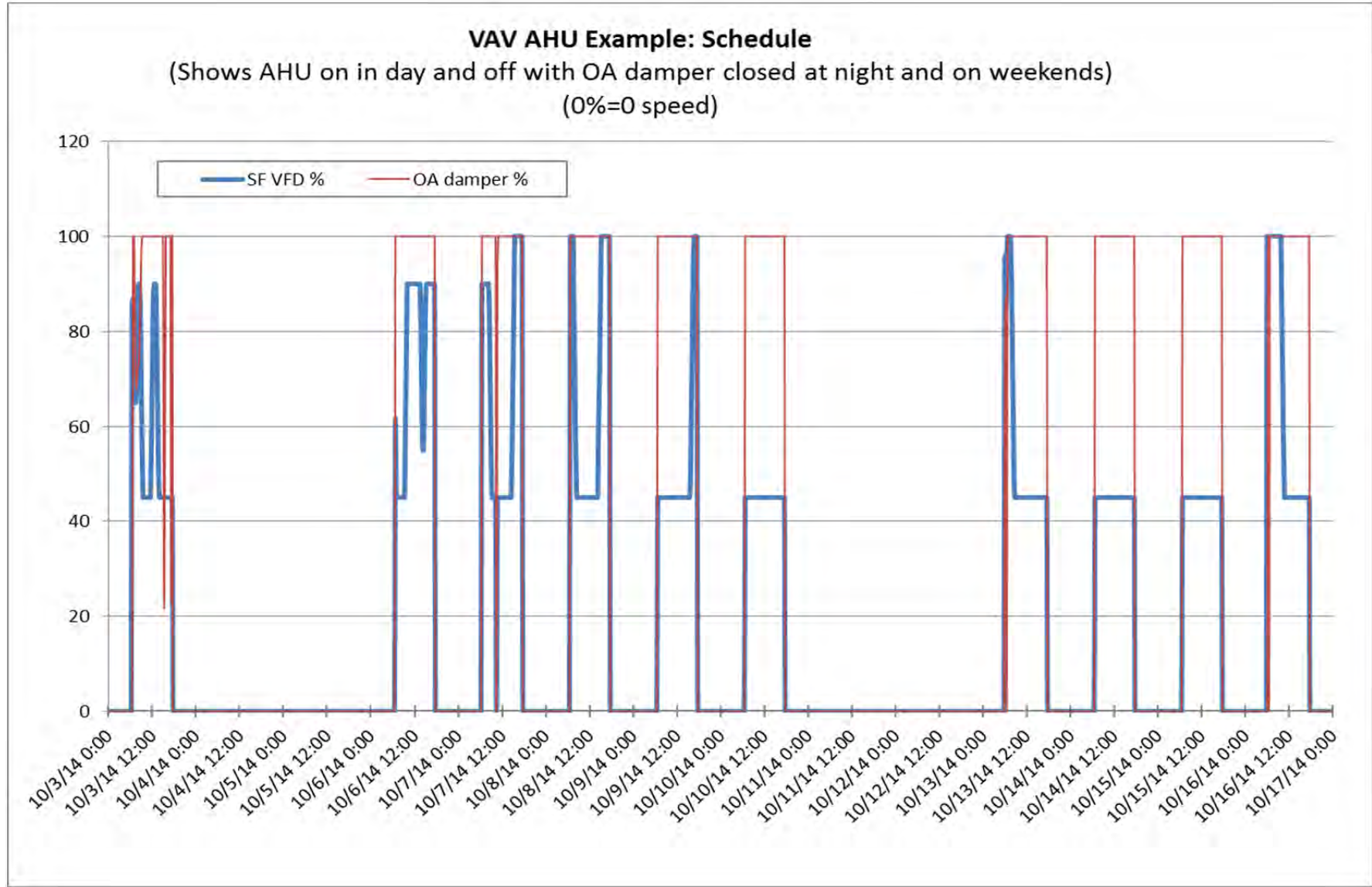
EQUIP ID:	EQUIP ID:	EQUIP ID:	EQUIP ID:	<b>Test Procedure &amp; Results (perform tests in order)</b> Each piece of equipment circle if passed (P) or failed (F) or NA. If failed provide details in notes then cross out F and circle P when corrected.
Other on:	Other on:	Other on:	Other on:	Note other boxes on for over-pressurization protection. Release setpoint override.
P / F / NA	P / F / NA	P / F / NA	P / F / NA	20. <b>Night cooling – non-VAV/single zone:</b> Override room temp setpoint below room temp and verify that the AHU comes on in economy cooling mode (OA damper opens above minimum) with mechanical cooling locked out. Release setpoint override.
P / F / NA Boxes tested:	P / F / NA Boxes tested:	P / F / NA Boxes tested:	P / F / NA Boxes tested:	21. <b>VAV boxes assigned to a different schedule:</b> Move a VAV box to a different schedule for a unit in the occupied mode. Verify that the box now comes on and is shown to have the new schedule on the VAV box graphics (summary & individual). Note boxes tested (at least one per AHU). Move box back to the original schedule and verify that it turns off and is now associated with the original schedule.
22. <b>Release overrides:</b> Change the schedule back to original. Return systems to normal operation. If all tests are passed, start integrated tests (trends).				
P / F / NA	P / F / NA	P / F / NA	P / F / NA	23. <b>Integrated tests (trends and GUI screenshots):</b> As a final verification of sequences, trend the following points for 2 weeks in 15 minute intervals and produce the trend graphs shown on next pages (Excel or dated DDC screenshots if points and values can be clearly seen) and provide the dated DDC screen shots listed. Provide a list explaining point names: a. <b>Each AHU:</b> AHU/SF/RF/EF statuses, SF/RF/EF fan %, OA damper % and mode b. <b>Each AHU and each type of box:</b> Screenshot of equipment graphic c. <b>At least 3 boxes per AHU:</b> status (fan if available), CFM, room temp & setpoints, and mode d. <b>Each AHU:</b> Screenshot of scheduler
<b>Notes</b> (failures that can not be resolved; test procedures if done differently than listed):          				
<b>Testing Agent Name and Company:</b> _____				
I certify the systems have passed the tests and are working per the design intent: _____ (signature & date)				

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TREND GRAPHICS NEEDED (provide back-up trends are well):

AHU Scheduling Example:

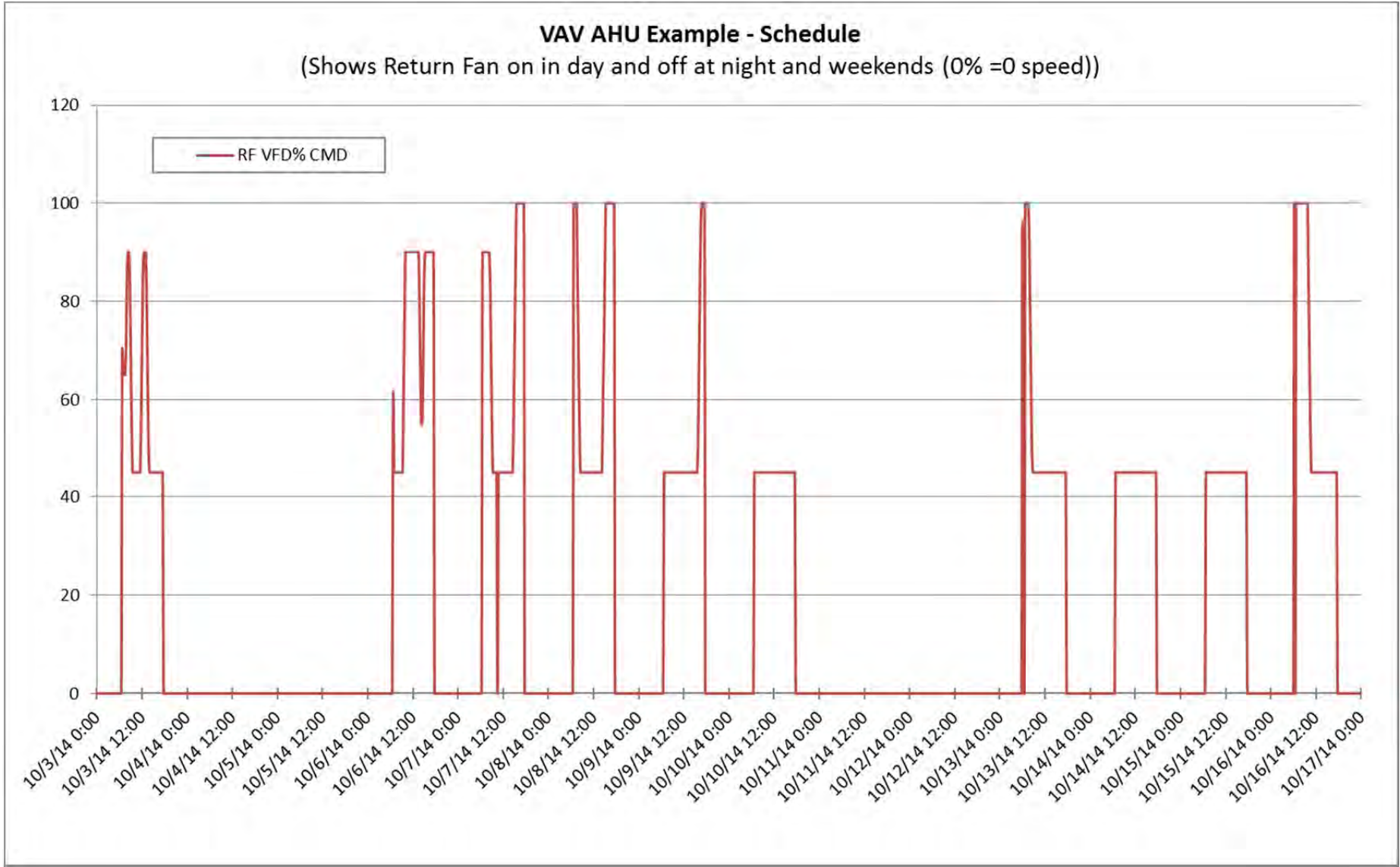




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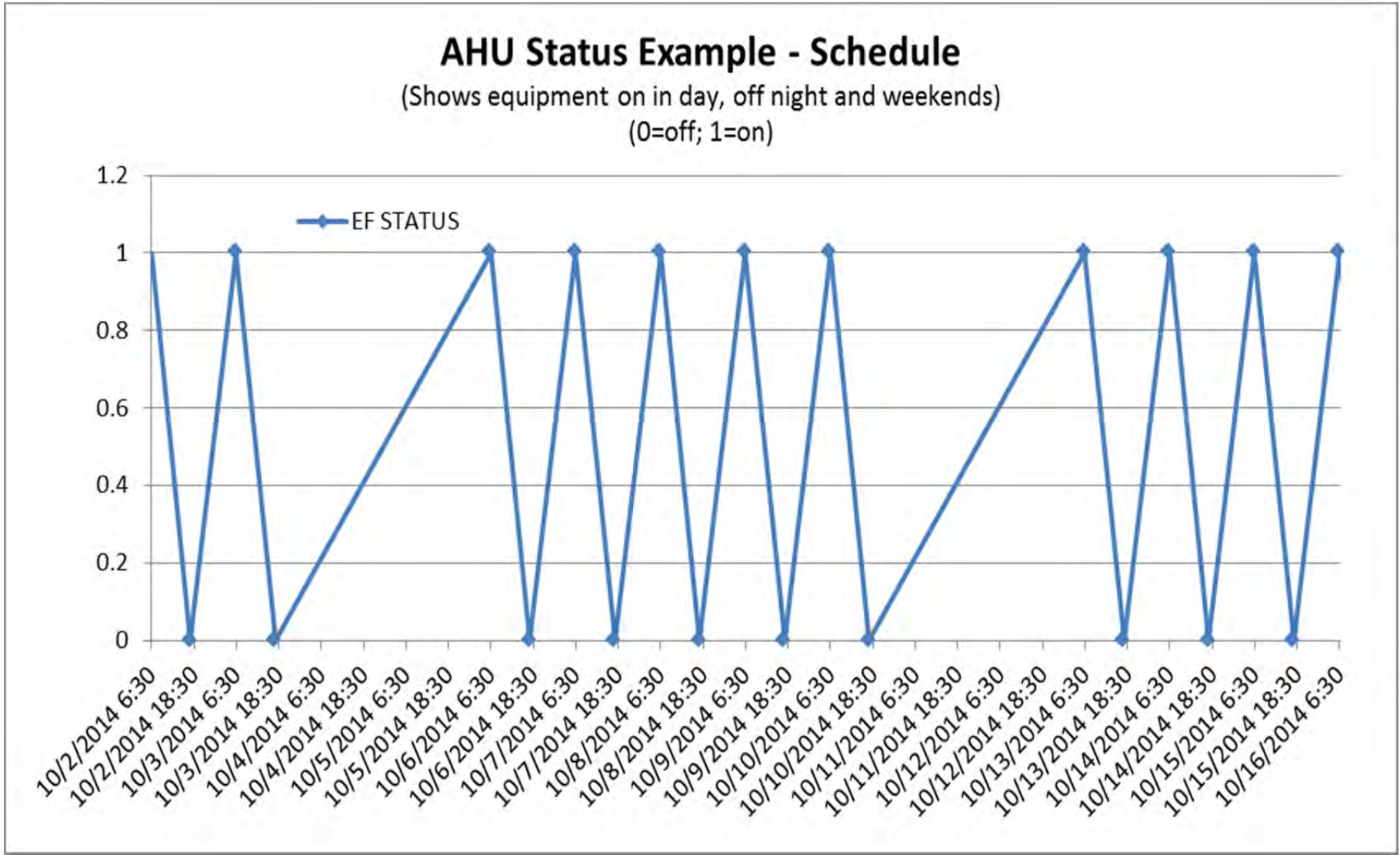
## AHU Scheduling Example (cont.):



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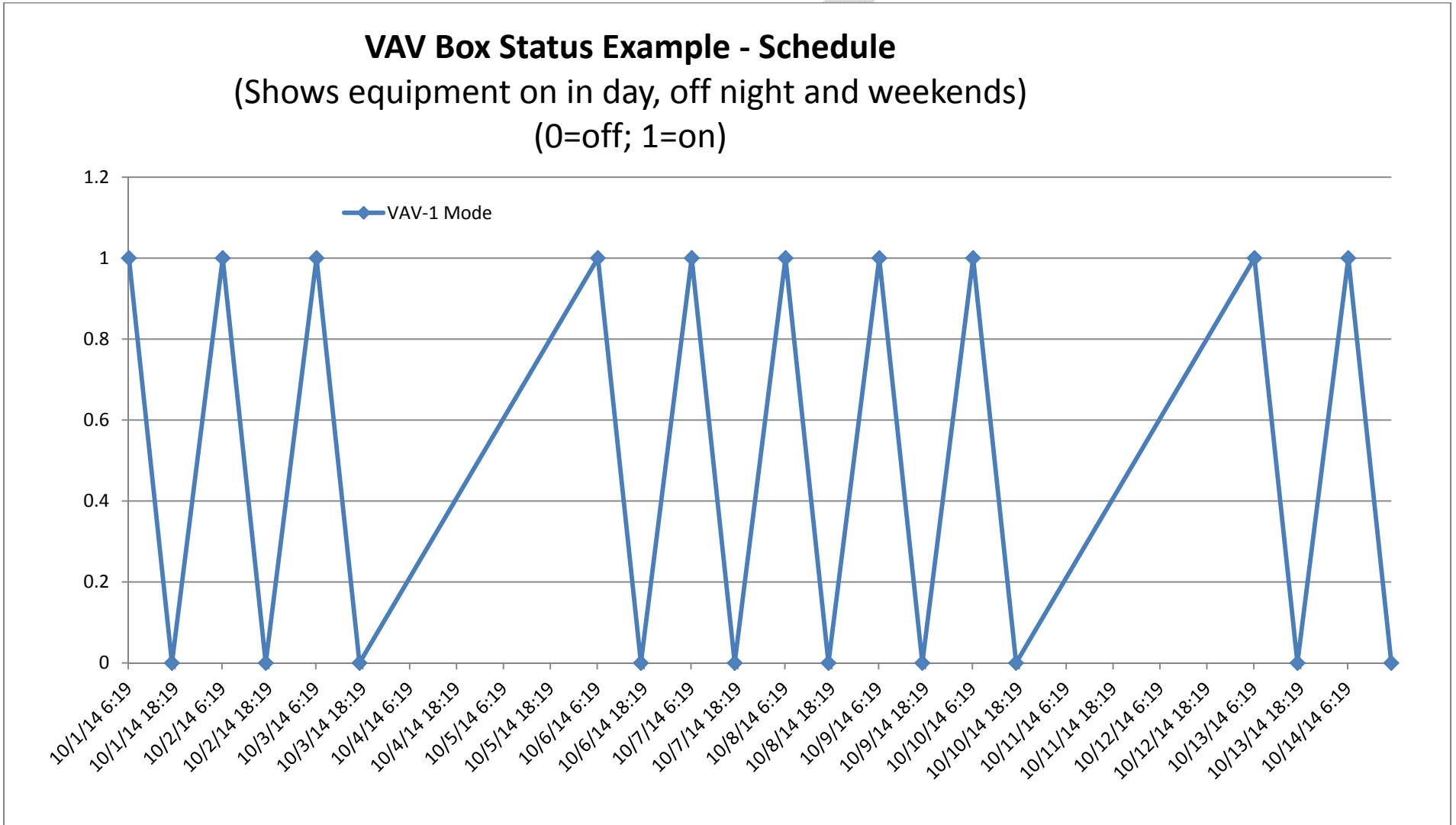
AHU Scheduling Example (cont.) – status if no fan speed; do not combine status or voltage/amp (or low number) data with analog (or large number) data



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ZONE Scheduling Example – status if no fan speed; do not combine status or voltage/amp (or low number) data with analog (or large number) data





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ZONE Scheduling example: this could be broken up into two charts to better show setpoints and space temperature

