



Memorandum

To: Brian Smith and David Fay
From: John Snell
Re: Measures to submit for final approval by National Grid
Date: November 11, 2016

National Grid has notified us that it would like to complete their site inspections of our completed work at Harvard's Bromfield HS, Hildreth ES, and Public Library. We believe that Harvard is pretty close if not already at a point where it would be OK to schedule a final inspection. Here's a summary of where we believe things stand in the three buildings:

Bromfield HS

We submitted five measures that were pre-approved at Bromfield HS for National Grid's custom incentive program:

1. Reduce occupied setpoints
2. Update optimal start sequence
3. Update sequence for active VFD modulation (HV-1,-2,-4,-5)
4. Fix HW valves (HV-4,-6)
5. Update sequences to lower the unoccupied temperature in the building

Our engineer, Kaj Huld, kept a log from his two sessions with BCM. Appendix A of his log documents changes that BCM made to 4 of the 5 measures (1, 2, 4, and 5), and for each of those, it appears that BCM has made some initial progress but additional work is needed. For measure 3 to be implemented, some repair work must first occur.

Kaj's 11/1/16 site visit notes (Appendix B) also indicate additional savings opportunities, which we hope BCM will be able to continue to work on. Some of these measures will require price quotes from BCM to complete the work.

We recommend submitting items 1, 2, 4, and 5 to National Grid for final review. National Grid may not approve the total amount of savings that we had submitted.

Hildreth ES

We submitted two measures that were pre-approved at Hildreth ES for National Grid's custom incentive program:

1. Schedule HV-6
2. Update sequences to lower unoccupied temperature

Our Fall 2016 Snapshot Report for Hildreth documents that measure 1 has been implemented and HV-6 has been turned down. Regarding measure 2, can Harvard confirm whether or not the control sequences for Hildreth have been updated to lower the school space temperature when the building is unoccupied?

We recommend submitting measure 1 to National Grid for final review. We recommend submitting measure 2 if the sequences have been updated.

Public Library

We submitted three measures that were pre-approved at the Public Library for National Grid's custom incentive program:

1. Turn off second HW pump & review DP setpoint
2. Add optimal start sequence and tighten scheduling
3. Adjust unoccupied heating setpoints to 55F

Our Fall 2016 Snapshot Report for the library confirms that measure 1 has been implemented and the two pumps do not run simultaneously. Can Harvard confirm whether or not Library staff has implemented measures 2 and/or 3?

We recommend submitting measure 1 to National Grid for final review. If measures 2 and 3 have been implemented, those can be submitted also.

Appendix A – BMS Engineering Log

Comment		Reference	Comments	Recommendation	1/27/16 Comment	11/1/16 Comments
No.	Date					
1	01/27/16	CO2 control	CO2 setpoints are not user accessible	Bring setpoint forward to graphic	Follow-up service from BCM	This applies to HV-1, -2 (gym) and 4, -5 (common areas). 4 and 5 complete. 1 and 2 are follow-ups
2	01/27/16	HV-1, -2	Space setpoint 74F	Change to 68F	Complete	
3	01/27/16	HV-1, -2, -4, -5	Economizer low limit is set at 65F	Change to 50F	Complete	
4	01/27/16	HV-1, -2, -4, -5	CO2 control opens OAD 50% upon exceeding setpoint.	Update CO2 control: use PID logic to increment damper if CO2 exceeds setpoint. Disable CO2 control and revert to min OAD position if CO2 readings <300, >2,000 PPM	Follow-up programming by BCM	Needs follow-up
5	01/27/16	HV-1, -2	Space temp 3-5F off between the two units in open gym	Consider averaging results from both sensors (including CO2) and setting up both H&V's to run in the same mode off a common command	Mark ok'd update - BCM to program	Complete
6	01/27/16	HV-1, -2	CO2 reading of 586 (HV-2) and 820 (HV-1). This is the same space	Recalibrate sensors	Follow-up service by BCM	Suggest adding CO2 averaging of both sensors so both H&V's operate in same mode. Follow-up w/ comment #4
7	01/27/16	HV-1, -2, -4, -5	Sequence calls for 70% fan speed unless HW valve is 100% open, then 100% speed. Single zone systems w/ VFD are usually controlled off space temp and CO2	Consider updating sequence to follow a fan reset speed off zone temp. Suggest a 50% speed min.	Follow-up service by BCM	Follow-up w/ #4
8	01/27/16	HV-1	OAD is calling for 50%, but it is not clear if the damper is opened as SAT is still fairly close to room temp	We manually opened damper to 100% w/ the HW valve locked out and were able to see a response.	None	
9	01/27/16	HV-4	CO2 reading high in "Zone 1"	Recalibrate. For now increased CO2 setpoint to 1,100 ppm so that OAD is not @ 50%	Follow-up service by BCM	Readings are ok today. Setpoint dropped back to 800 ppm
10	01/27/16	HV-4	Not sure why there are two CO2 zones in hallway, when H&V return conditions should suffice.	Consider using existing temp sensor and return CO2. Suggest putting a cage over active temp sensors in the hallways	Mark ok'd update - BCM to program	Follow-up to reconfigure for return CO2 control.
11	01/27/16	HV-4, -5, -6	Effective setpoint = setpoint +/- differential off TSTAT sliders	Reconfigure for direct setpoint, disable sliders & update graphic	Complete	
12	01/27/16	HV-4, -5, -6	From above, setpoint is 74, effective 71 to 73F	New setpoint is 70F	Complete	
13	01/27/16	HV-4	This unit has been off more often than not during the last week according to trends.	Determine who's turning unit off and reason	Follow-up w/ Mark	Optimal start issue found - see new comment below
14	01/27/16	HV-4	Both reheats showing considerable temp differential w/ valves off	Checked coils and there is definitely HW flow to the coils. Suggest checking & adjusting actuators. If necessary service valve(s)	Follow-up by BCM & plumber (if necessary)	HW continues to be supplied with no call. Preheat coil and both reheats. Actuators need to be checked
15	01/27/16	HV-6	Confirmed valve leaking by. Actuator was stroked and stem adjusted. Also noted small water leak that has saturated pipe insulation	Fix water leak and if necessary remove valve body for service / replacement	Follow-up by plumber	

Comment		Reference	Comments	Recommendation	1/27/16 Comment	11/1/16 Comments
No.	Date					
16	01/27/16	HV-6	This unit serves an unoccupied storage area & maint shop. OAD min is set at 0%	Consider changing sequence so unit cycles	Update programming by BCM	Completed today - setup to go to occupied mode when is 2F below occ/unocc space temp setpoint.
17	01/27/16	HV-6	Space temp near 80F	Changed setpoint to 68F	Complete	
18	01/27/16	HV-6	This unit (5 hp) came on at 3:45 a.m. on Opt Start.	Troubleshoot program. Needs to be an OA cutoff, below which system do not start for cooling (applies to all non-cooling units in the bldg)	Follow-up services by BCM	Optimal start has been removed via fan cycling change from above
19	01/27/16	HV-6	Unit not being scheduled?	Check trend	Follow-up services by BCM	Follow-up needed to build unoccupied sequence.
20	01/27/16	HV-7	Min. OAD is set at 0% This is a locker room and it needs some fresh air	Changed to 10%	Complete	
21	01/27/16	RTU-1, -2	Setpoint 72F	Changed to 70F		
22	01/27/16	RTU-2, -3	OAD is at 0% and HRU isn't working. No fresh air coming in	There should be at least 10% fresh air on systems w/o CO2 control	School to maintain min. 10% OA setting on all RTU's	
23	01/27/16	RTU-3	From data, it looks like OAD is open, even though is not being commanded open	Field confirm damper position / movement	Follow-up services by mechanic	Appears to be closed today
24	01/27/16	RTU-3 (applies to all the other RTU's as well)	SAT setpoint is 73.4F, but space is considerably over setpoint (70F). Would expect SAT setpoint to be lower and heat off when space temp is too high by about 2-3 F	Troubleshoot reset strategy. Recommend using zone temp to drive the valve / DX stages off PID loop. Let SAT be whatever it needs to be to achieve results	Follow-up service by BCM	There are two sensors and the system DAT is trying to meet the average of the two. We update the graphic to show both, plus calculated average temp.
25	01/27/16	RTU-4	SAT is 78F, but no heating coil in unit?	Field confirm no heating coil in RTU. If there is a coil, need to "discover" additional points and resolve why heat is on. Otherwise troubleshoot	Follow-up service by BCM	This unit has been replaced
26	01/27/16	RTU's	There isn't any accommodation for free-cooling	Update sequence to shutoff wheel or use auxiliary OA vent to free cool the AHU	Follow-up service	1) suggest commissioning on new units, (2) for operational existing units, these are integration to older LON cards - can't change sequence.
27	01/27/16	RTU-6	EF status appears to be faulty	Resolve	Lower priority	Today command is off, status is on. Unit operating in hand? Status faulty? Follow-up on this issue.
28	01/27/16	RTU-1, 6, 7	Controllers are obsolete and no access to sequence for modifications. Applies to FTRs and other small devices running off these controllers	Consider replacement w/ Sneider product as was done for other RTUs	BCM to provide pricing for update	Follow-up. RTU-7 is no longer working
29	01/27/16	HRU-14, -15	Controllers are obsolete and failed. Inorder to operate this equipment, staff have to manually turn on/off. At present equipment is off.	Consider replacement w/ Sneider product as was done for other RTUs	BCM to provide pricing for update	Follow-up

Comment		Reference	Comments	Recommendation	1/27/16 Comment	11/1/16 Comments
No.	Date					
30	01/27/16	FTR - Rm 393	Zone temp reading 83F	Troubleshooting revealed linked to old controller (removed). Correct link established to old room # 121	None	
31	01/27/16	FTRs	These devices are not linked to schedule	Add unoccupied setpoint and link to "A" schedule		The six pieces on "radiation" page needs sequence update
32	01/27/16	FTR associated w/ RTU-7	Same as above	Consider building an "outside" solution to change setpoint in unoccupied mode	Follow-up service	Looks like 8 pieces. Failed controller. Fix and then build new sequence, including unoccupied
33	01/27/16	Radiant heat panels	These are in new wing on 1st and 2nd Flr. Don't think these are following unoccupied mode.	Check logic and if necessary build an unoccupied setpoint sequence.	Follow-up service by BCM	Confirmed radiation valve remain closed in unocc mode. No further changes required.
34	01/27/16	Radiant heat panels	This side of the bldg is very hot. Solar load, or are there leaking valves?	Check a sample of valves on the units	Follow-up service by BCM	See below
35	01/27/16	UV Room 238	Unit is down. The controller is down	Troubleshoot controller - replace if necessary	Follow-up service	Still out of service. Needs follow-up. UV is off, coil flooded
36	01/27/16	UVs	Unoccupied setpoint not seen on graphic	Internal setpoint is 55F	None	
37	01/27/16	FTR in A001	The HW valve is opening, even though the room temp is satisfied. The controller for this unit is off RTU-6, which is an old unit without access.	Need to replace this controller	Discussion w/ Mark	Looks ok today - See above - needs new controller
38	01/27/16	Room 295	Space temp reading 0F. FCU is manually turned off	Fix space temp reading and place unit back in auto operations	Follow-up service	Follow-up
39	01/27/16	FCU Room 171	This is the unit in the industrial area that was observed to be on during Xmas break when the bldg was in unoccupied mode	Checked trend and unit looks like its scheduling now	Monitor	Checked trend and turning on 7:30. Looks ok
40	01/27/16	FTRs & VAVs	Various setpoints in use - typically 72F	Update all to 70F	Complete	
41	11/01/16	HV-5	This unit is down. VFD is tripped. From trend log, unit has been down for at least a month.	VFD was reset and unit restarted. Monitor unit. If it goes down again, suggest troubleshooting VFD / electrical.		
42	11/01/16	HV-4	Trend shows unit consistently starting at 5:30 am, although scheduled start is 8 am. Optimal start issue?	Troubleshooting required		
43	11/01/16	HW valves on FCU's and radiation panels	The valves have a high rate of failure.	BCM tested all and replaced roughly 25% of the valves. Suggest testing again next year.		

Appendix B – 11/1/16 Site visit notes

Most of our engineering log action items have not been addressed at this time. The following priority items remain, including justification for the investments needed for BCM to perform the work. See the comments log in Appendix A for further details.

Next Steps:

We recommend forwarding this memo to BCM for them to price those items that are of interest to the Town. Once the work is complete, Peregrine is available to revisit the school to verify that repairs and new strategies are properly installed, perform “tuning” as necessary, and review the system/trends for additional improvement opportunities.

1. Demand Control Ventilation Updates:

- HV-1 and -2: Add CO2 setpoint input cell to graphics.
- HV-1, and -2: Update sequence to look at average of the two CO2 sensors in the open gym so units operate in same mode of operation (they serve the same space).
- HV-4: Update sequence to look at return CO2 only. The two hallway CO2 sensors shall be reference only.
- HV-1, -2, -3, -4: Update programming so that outdoor air damper opens incrementally from 0% minimum (adj) via PID loop upon exceeding CO2 setpoint, limited by a mixed air temperature low limit of 50F (adj). Call for economizer cooling overrides demand control ventilation. If the CO2 sensor reading is out of range (less than 300 ppm or greater than 2,000 ppm): (1) send sensor failure alarm and (2) disable DCV, reset OAD to 15% minimum position (adj).

Justification: *The primary reason to make the suggested updates is to assure that the demand control ventilation strategy doesn't inadvertently cause excessive use of outside air. Under normal operating conditions, these updates will create no additional energy reduction. However, in the event of an anomaly that goes unseen, not implementing these updates would make it easy for a unit to run inefficiently for an extended time period, with a cost of hundreds if not a few thousand dollars in excess heating energy use.*

3. VFD Control:

- HV-1, -2, -3, -4: New fan speed sequence – increase/decrease fan speed incrementally via PID loop to meet space temperature and CO2 setpoints. Minimum fan speed is 30% (adj).

Justification: This update will significantly reduce fan energy when there is no heating/cooling/ventilation demand. Estimated savings are about 8,000 kWh/yr, or roughly \$1,100.

4. Scheduling:

- HV-4: Troubleshoot optimal start feature, which is prematurely starting the unit (this may have been completed by BCM on the afternoon of November 1).
- HV-6: Update sequence so unit has unoccupied mode of operation tied to appropriate schedule (this may have been completed by BCM on the afternoon of November 1).
- Six “Radiation” units on graphic: Update sequence so units have unoccupied mode of operation tied to appropriate schedule.
- FTR associated with RTU-7: Update sequence so units have unoccupied mode of operation tied to appropriate schedule (requires replacement of RTU-7 controller).

Justification: Estimated impact for above is about 2,000 kWh and 300 Therms per year, or roughly \$500.

4. Replace Controllers:

- RTU-1, -6, HRU-14, -15: Replace obsolete controllers.
- RTU-7: Replace failed and obsolete controller.
- UV in room 238: Replace failed controller

Justification: These are necessary replacements to restore functionality. New controllers allow for sequence updates, which are not possible now. There is unlikely to be an energy use reduction. However, restarting equipment that has been stopped due to lack of control can result in more energy consumption.

5. Miscellaneous:

- Room 295: Replace failed sensor

Justification: Necessary for proper operation of the unit ventilator in this classroom, which is currently manually turned off.