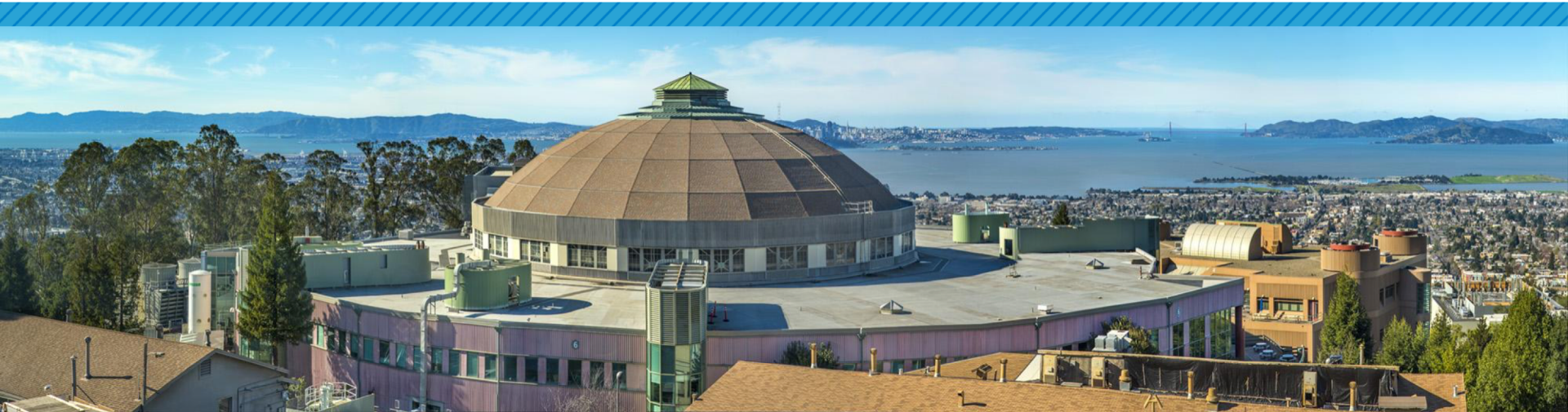


Data Analytics

to support the ongoing commissioning process



 **SUSTAINABLE BERKELEY LAB**

sbl.lbl.gov

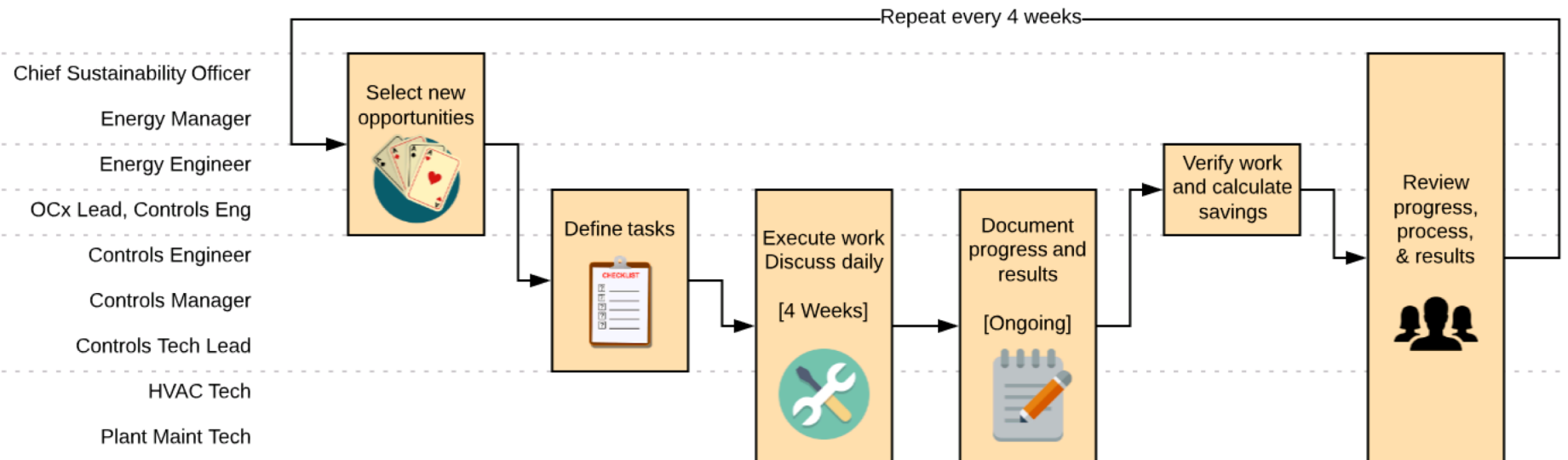


October 22, 2019

Chris Weyandt, PE, CEM | Control Systems Engineer

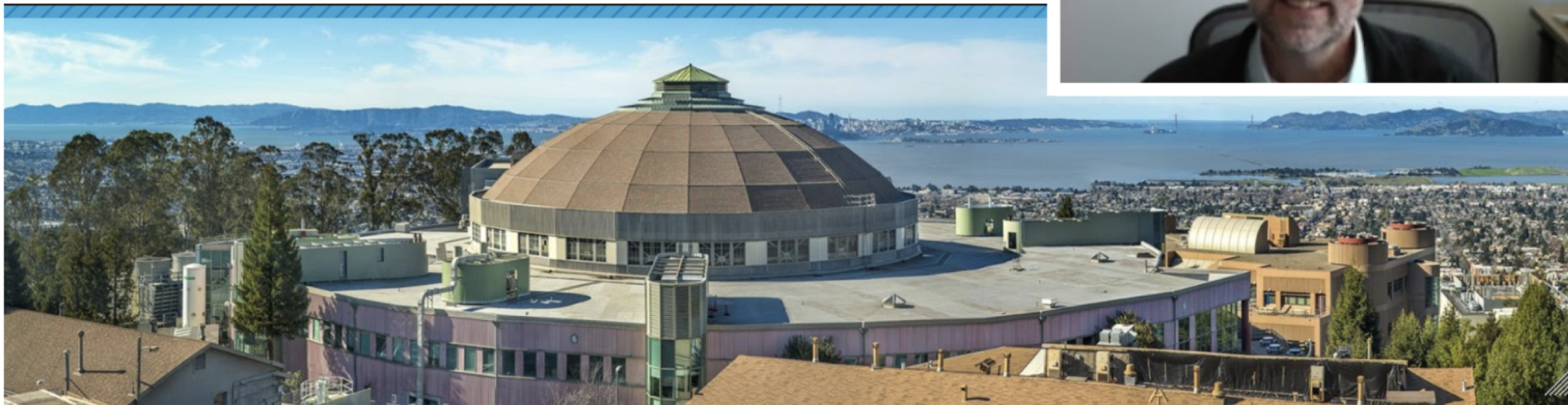
Key Elements of OCx

1. Cross-functional, dedicated team
2. Repeated cycle to select opportunities, complete and verify savings
3. Daily team check-ins
4. Regular feedback for continual improvement
5. Tools and a process to maintain savings





 **SUSTAINABLE BERKELEY LAB**
ONGOING COMMISSIONING



Annualized maintained savings

Total Annual Energy Savings (kWh/year)

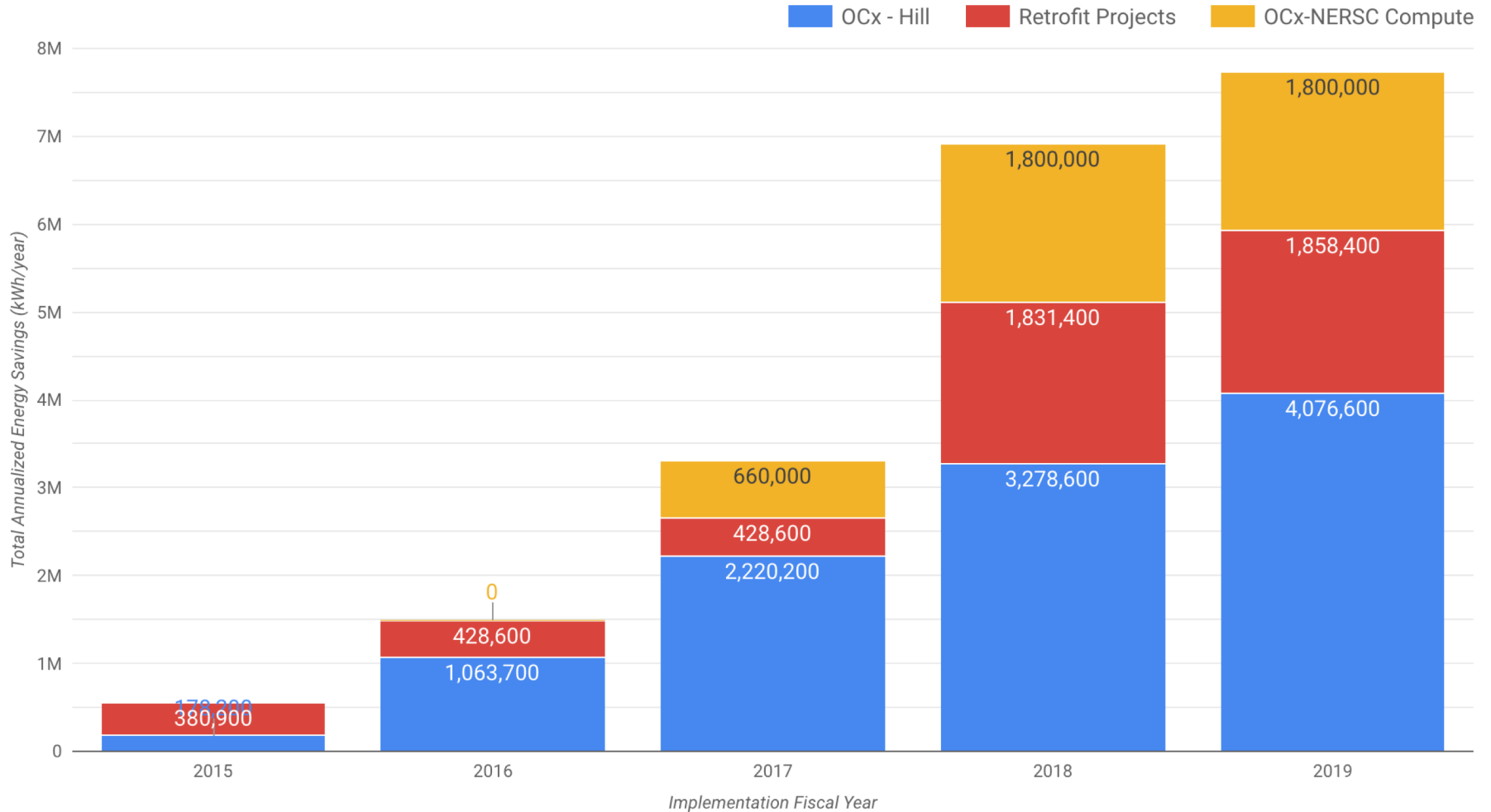
7.7M

Annual Water Savings (gallons/year)

19.6M

Annual Cost Savings (\$/year)

466.2K



HVAC system deficiency resolution



HVAC controls tuning and calibration



Laboratory Airflow Management



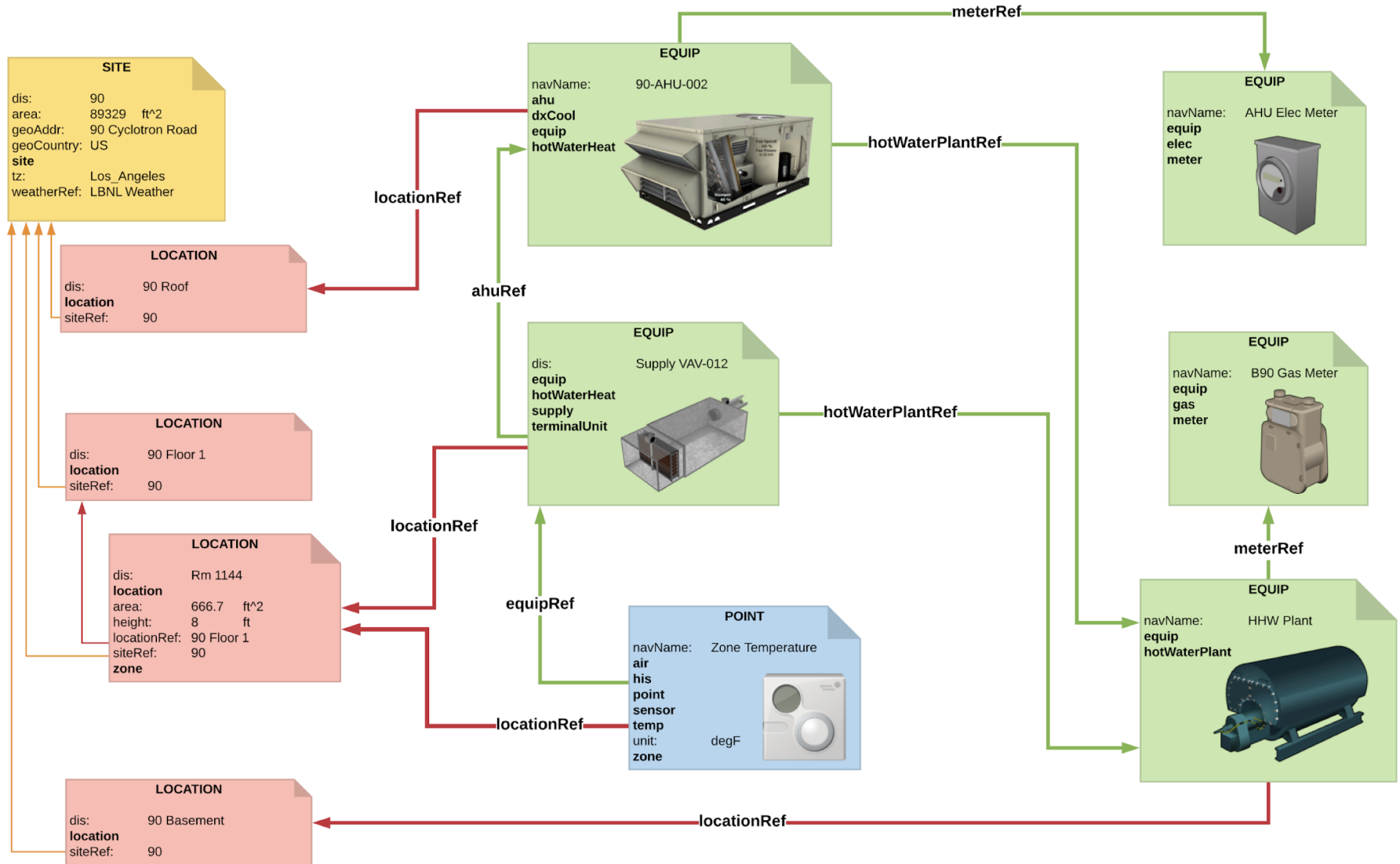
Building Automation @ Berkeley Lab



Legacy control systems integration



Software modeling of building systems



Consistent metadata tags applied across all sources

Equip (Meter) Tag	Equip Tags Opt	Point Name	Haystack Point Tags	Other Tags	Other Tags Explanation	Kind	Default Assumed Range / Unit
meter, elec		Power	power, sensor			Number	kW
meter, elec		Energy	energy, sensor	delta	Use 'delta' to distinguish f	Number	kWh
meter, elec		Accumulator, Energy	energy, sensor	accumulator		Number	kWh
meter, elec		Power Factor	pf, sensor			Number	
meter, gas		Power	power, sensor			Number	Btu/h
meter, gas		Energy	energy, sensor	delta	Use 'delta' to distinguish f	Number	Btu
meter, gas		Accumulator, Raw	sensor	accumulator, raw		Number	_pulses
meter, gas		Accumulator, Energy	energy, sensor	accumulator		Number	Btu
meter, gas		Accumulator, Volume	volume, sensor	accumulator		Number	ft ³
meter, gas		Volume Rate	volume, sensor	rate		Number	cfh
meter, chilled, water		Power	power, sensor			Number	Btu/h
meter, chilled, water		Energy	energy, sensor	delta		Number	Btu
meter, chilled, water		Flow	flow, sensor			Number	gal/min
meter, chilled, water		Supply Temperature	temp, sensor	supply		Number	°F
meter, chilled, water		Return Temperature	return, temp, sensor			Number	°F
meter, hot, water		Power	power, sensor			Number	Btu/h
meter, hot, water		Energy	energy, sensor	delta		Number	Btu
meter, hot, water		Flow	flow, sensor			Number	gal/min
meter, hot, water		Supply Temperature	temp, sensor	supply		Number	°F
meter, hot, water		Return Temperature	return, temp, sensor			Number	°F
meter, water	[blowdown / makeup]	Flow	flow, sensor			Number	gal/min
meter, water	[blowdown / makeup]	Volume	volume, sensor	delta		Number	gal
meter, water	[blowdown / makeup]	Accumulator, Raw	sensor	accumulator, raw		Number	_pulses
meter, water	[blowdown / makeup]	Accumulator, Volume	volume, sensor	accumulator		Number	gal

+ ☰
Equip Structure ▾
Equip Tags ▾
AHU Points ▾
CHW Points ▾
Meter Points ▾
Zone Points ▾
VFD Points ▾
exportSkySpark ▾
Questions ▾
Goals ▾
removed ▾

Link to LBNL/kW Tagging Standard DRAFT: <http://bit.ly/2TOc0Zk>

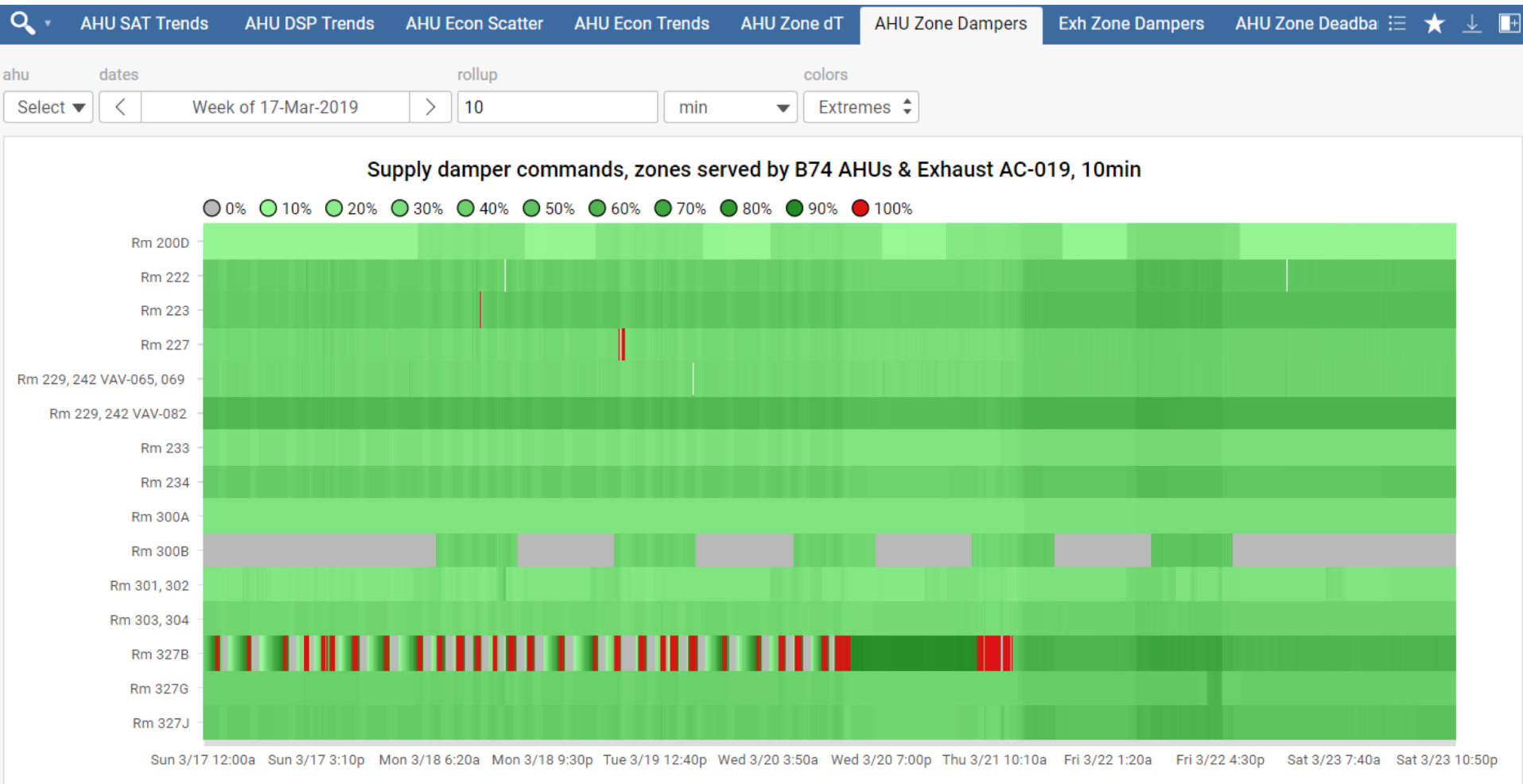
Standardized views across all data sources



Air handler duct static pressure cycling

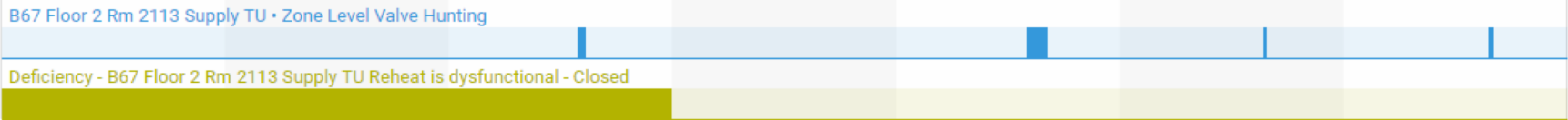


Duct static pressure cycling, pinpoint the culprit

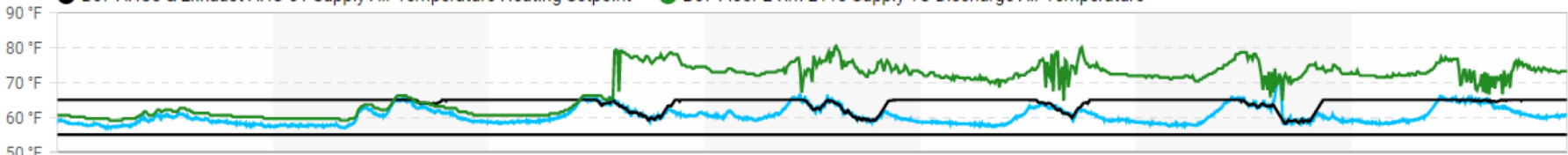


Zone trend templates with Sparks and Deficiencies

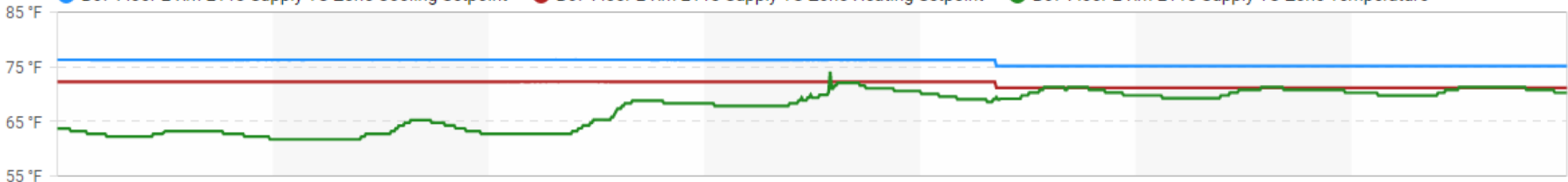
B67 Floor 2 Rm 2113 Trends



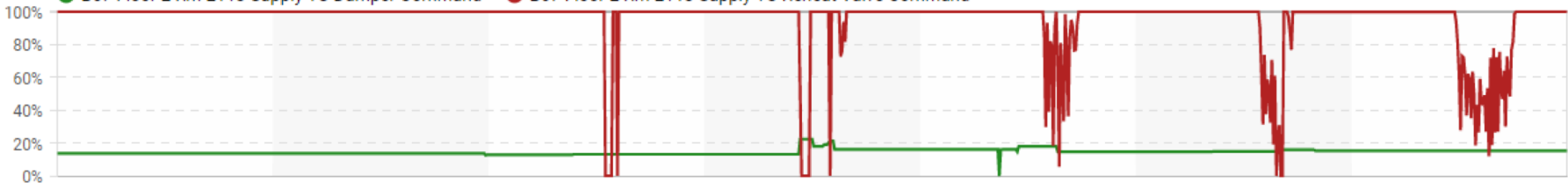
● B67 AHUs & Exhaust AHU-01 Supply Air Temperature ● B67 AHUs & Exhaust AHU-01 Supply Air Temperature Cooling Setpoint
● B67 AHUs & Exhaust AHU-01 Supply Air Temperature Heating Setpoint ● B67 Floor 2 Rm 2113 Supply TU Discharge Air Temperature



● B67 Floor 2 Rm 2113 Supply TU Zone Cooling Setpoint ● B67 Floor 2 Rm 2113 Supply TU Zone Heating Setpoint ● B67 Floor 2 Rm 2113 Supply TU Zone Temperature



● B67 Floor 2 Rm 2113 Supply TU Damper Command ● B67 Floor 2 Rm 2113 Supply TU Reheat Valve Command



Integrated deficiency management



Deficiencies List

Deficiency Details

Planning

Site deficiencyGroup status sprints assignedTo filter

id	state	sprintRef	size	assignedTo	energyValue	operationalValue	startDate	endDate	hasResponses	deficiencyGroupRef
① B33 Floor 2 Rm 236 (VAV-060) Glass wash and boilers are ...	To Do	23	0	Deirdre Carter	High	Low	1-Jan-2016			
① B67 AHUs & Exhaust AHU-02 DSP setpoint is hunting	In Progress	22	2	Chris Weyandt	None	High	4-Feb-2019		✓	
① B67 AHUs & Exhaust AHU-03 Supply Fan 2 AHU AFMS calibrat...	In Progress	23	0	Ricky Brambila			3-Oct-2019	4-Oct-2019	✓	
① B67 Floor 2 Rm 2113 Supply TU RHV tuning needed	In Progress	23		Ricky Brambila	None	Low	30-May-2019		✓	Reheat valve tuning
① B67 Floor 2 Rm 2210 Scheduling capabilities are not used...	To Do	18	1	Gonzalo Padilla	Low	None	1-Jan-2000			Zone scheduling is needed
① B67 Floor 3 Rm 3103, 3105 (RR) Supply TU RHV tuning need...	To Do	23		Ricky Brambila	None	Low				Reheat valve tuning
① B67 Floor 3 Rm 3108 West Supply TU RHV tuning needed	In Progress	23	0	Ricky Brambila	None	Low	2-Aug-2019		✓	Reheat valve tuning
① B67 Floor 3 Rm 3209 Supply TU RHV tuning needed	In Progress	23		Ricky Brambila	None	Low	30-May-2019		✓	Reheat valve tuning
① B67 Floor 3 Rm 3229 Scheduling capabilities are not used...	To Do	18	1	Gonzalo Padilla	Low	None	1-Jan-2000			Zone scheduling is needed
① B67 Floor 4 Rm 4108 Supply TU RHV tuning needed	In Progress	23	0	Ricky Brambila	None	Low	14-Jun-2019		✓	Reheat valve tuning
① B67 Floor 4 Rm 4111 Scheduling capabilities are not used...	To Do	18	1	Gonzalo Padilla	Low	None	1-Jan-2000			Zone scheduling is needed
① B67 Floor 4 Rm 4203 Measured supply airflow is higher th...	To Do	23	1	Ricky Brambila	Low	Low			✓	Zone airflow balancing
① B67 Floor 4 Rm 4203 TSI airflow controls are hunting	To Do	23	1	Ricky Brambila	Low	Medium				Zone damper tuning
① B67 Floor 4 Rm 4203A Airflows need testing and balancing...	To Do	23	0.5	Ricky Brambila	Low	Low	18-Sep-2019			Zone airflow balancing
① B67 Floor 4 Rm 4203A Exh VAV-4E-016 Damper is often comm...	To Do	23	1	Ricky Brambila	Low	Low				Zone damper leakby
① B67 Floor 4 Rm 4203B Supply airflow setpoints are differ...	To Do	23	0.5	Ricky Brambila	Low	Low				Zone airflow balancing
① B67 Floor 4 Rm 4210 Exhaust damper is overridden to 100% ...	To Do	23	0.5	Ricky Brambila	Low	Low			✓	Zone airflow balancing
① B67 Floor 4 Rm 4210 Heating setpoint is 70°F despite air...	To Do	23	0.5	Ricky Brambila	Medium	None				
① B67 Floor 5 Rm 5111 Scheduling capabilities are not used...	To Do	18	1	Gonzalo Padilla	Low	None	1-Jan-2000			Zone scheduling is needed
① B67 Floor 5 Rm 5201 RHV tuning needed for two terminal u...	To Do	23		Ricky Brambila	None	Low				Reheat valve tuning
① B67 Floor 5 Rm 5204A Supply TU Damper is often commanded...	To Do	23	1	Ricky Brambila	Low	Low				Zone damper leakby
① B67 Floor 5 Rm 5208 Back Supply TU Damper is commanded 0...	To Do	23	1	Ricky Brambila	Low	Low				Zone damper leakby
① B67 Floor 5 Rm 5210A Supply TU Damper is commanded 0% op...	To Do	23	1	Ricky Brambila	Low	Low	15-Mar-2019			Zone damper leakby
① B67 Floor 5 Rm 5210C Supply TU Damper is commanded 0% op...	To Do	23	2	Ricky Brambila	Medium	Low	15-Mar-2019			Zone damper leakby
① B67 Floor 5 Rm 5216 Supply TU Damper is commanded 0% ope...	In Progress	23	2	Ricky Brambila	Medium	Low	15-Mar-2019		✓	Zone damper leakby
① B67 Floor 5 Rm 5219 Supply TU Damper is commanded 0% ope...	To Do	23	2	Ricky Brambila	Medium	Low	15-Mar-2019			Zone damper leakby
① B67 Floor 5 Rm 5235 Supply TU Damper is commanded 0% ope...	To Do	23	1	Ricky Brambila	Low	Low	15-Mar-2019			Zone damper leakby
① B67 Floor 5 Rm 5236C Supply TU Damper is commanded 0% op...	To Do	23	1	Ricky Brambila	Low	Low	15-Mar-2019			Zone damper leakby
① B67 Floor 6 Rm 6114 Supply TU RHV tuning needed	To Do	23		Ricky Brambila	None	Low	12-Aug-2019			Reheat valve tuning
① BACnet 75.70 Implement pulse counters in gas meter ALC p...	In Progress			Erik First						Meter pulse counter needed
① BACnet 79.00 Implement pulse counters in gas meter ALC p...	In Progress			Erik First						Meter pulse counter needed
① Utility 30 Water Meter is not connected to ALC or integ...	In Progress			Erik First	None	Medium	11-Sep-2019			

Integrated deficiency management



Deficiencies List

Deficiency Details

Planning



Select ▼

Add Note

B67 Floor 2 Rm 2113 Supply TU Reheat is dysfunctional

Current status: **Closed**

Deficiency ended on **2019-05-28**.

Description:

The room temperature is lower than the heating setpoint. The reheat valve is commanded fully open, but the discharge air temperature is about 1°F warmer than the air from the air handler, which means the reheat coil provides no reheat.

Data as far back as early December 2018 (earliest data we have) shows the same issue.

Recommendation:

- Test reheat valve and actuator. Repair or replace as needed.

Links:

[Link 1](#)

[Link 2](#)

Location:

- [67](#)
- B67 Floor 2
- B67 Floor 2 Rm 2113
- B67 Floor 2 Rm 2113 Supply TU

Originally created by Raphael Vitti

Notes

On 2019-05-30 (Thu) at 10:39, Ricky Brambila wrote:

Replaced HHWV actuator. Also increased minimum airflow setpoint from 215 to 250 cfm.

On 2019-05-30 (Thu) at 10:47, Ricky Brambila wrote:

3-way valve, return balancing valve fully open.

On 2019-06-05 (Wed) at 23:24, Raphael Vitti wrote:

Checked trends, confirmed the reheat valve issue was resolved on 2019-05-28.

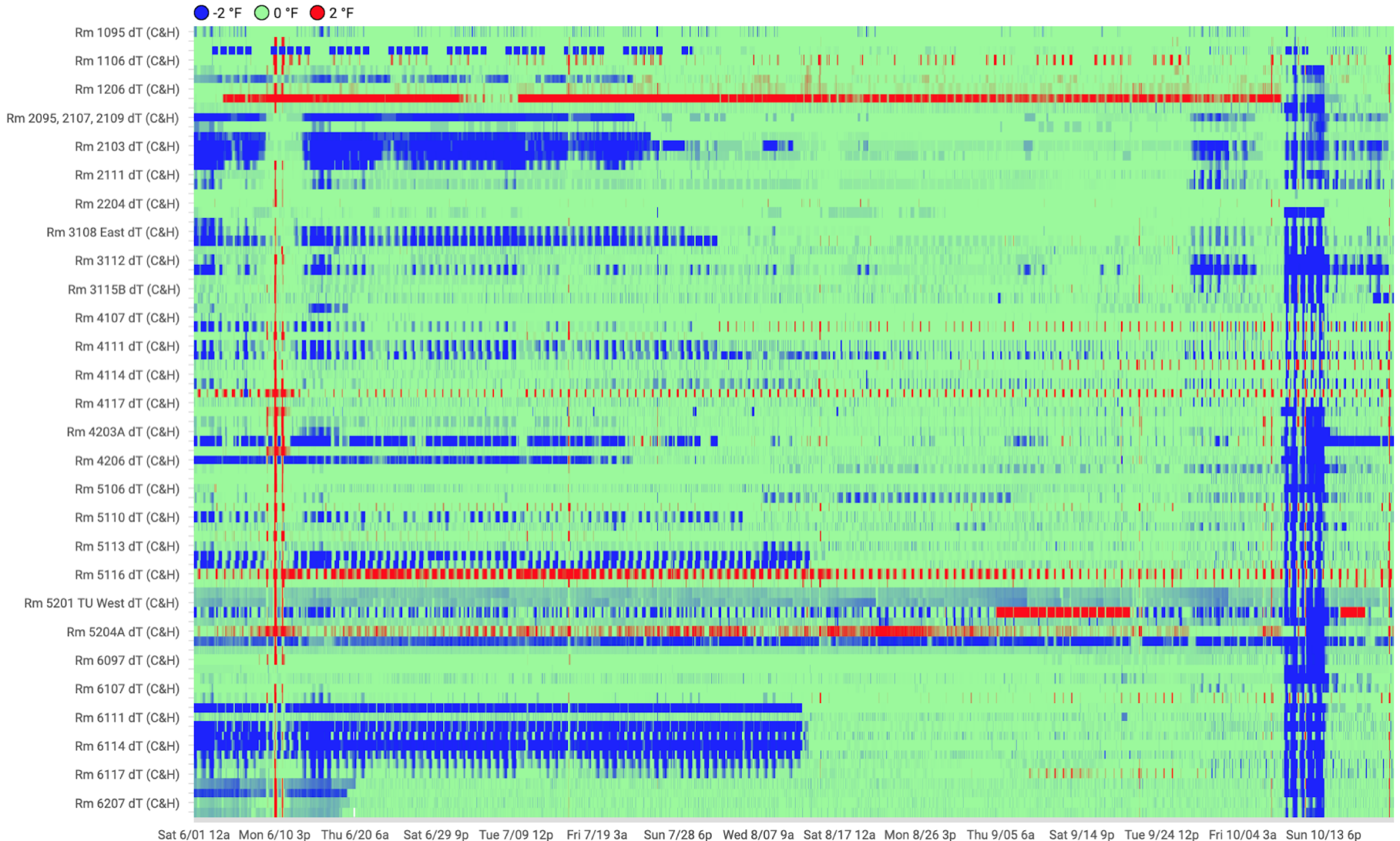
On 2019-09-09 (Mon) at 11:09, Raphael Vitti wrote:

ZAT setpoint now maintained and RHV doesn't max out in mild weather. Observed reheat valve command cycling (30-min cycles of 40% magnitude).

Ricky confirmed that the bypass of the three-way valve is 100% open. Most of the three-way valves the team has looked at so far have had 100% open bypass legs. According to Ricky, we should look into reducing the bypass flows because there is a large number of three-way valves on each floor.

System summary visualizations

Deviation from deadband, zones served by B67 AHUs & Exhaust AHU-01



System level summary of zone operation

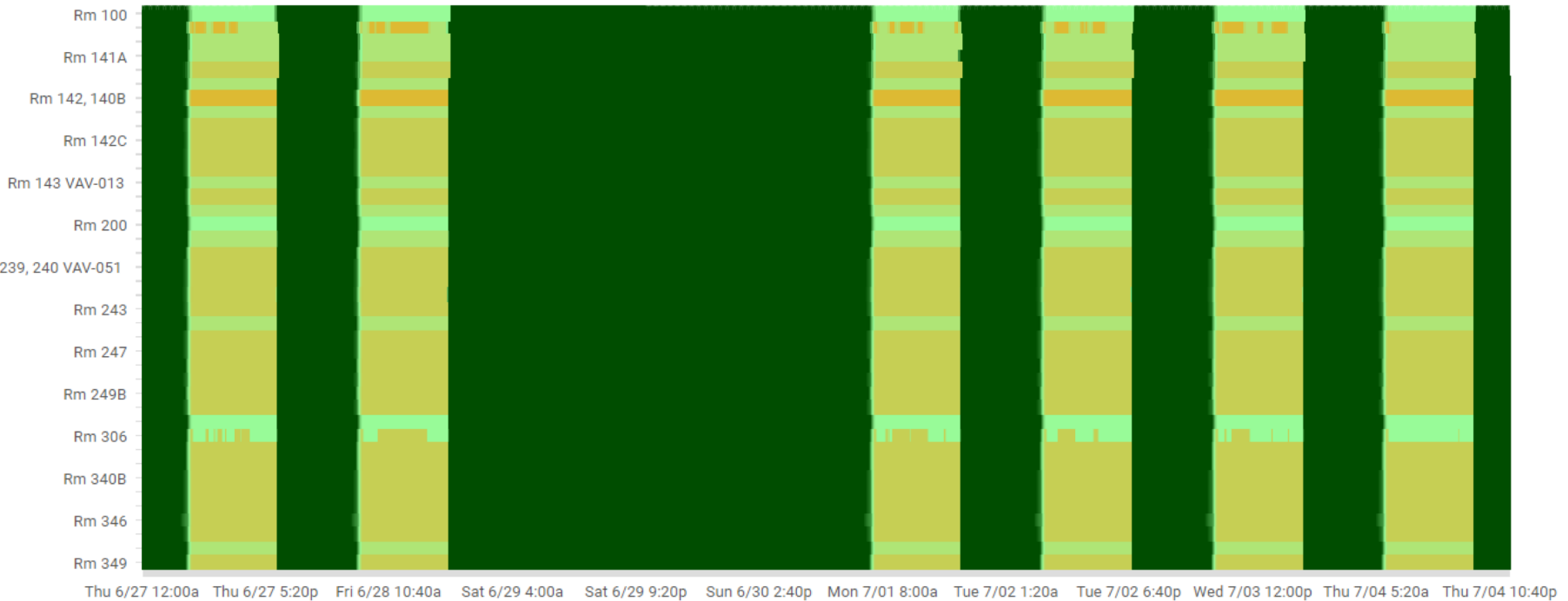


Zone temperature deadbands, schedules

ahu: Select | dates: < 27-Jun-2019..4-Jul-2019 > | maxDeadband: 12 | °F | rollup: 10 | min

Width of temperature deadbands, zones served by B33 Roof AHU-3

0 °F 3 °F 6 °F 9 °F 12 °F



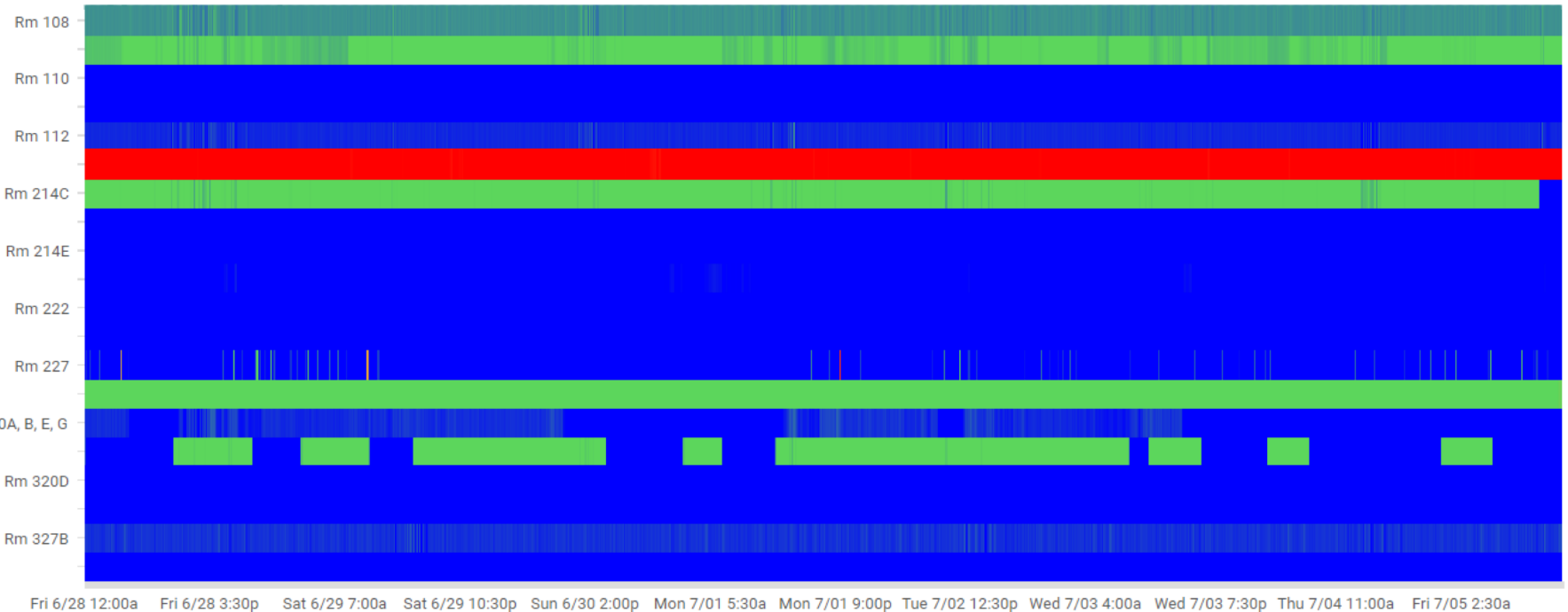
Laboratory spaces, air change rates vs. target

Site ▼ Face Velocities **Air Change Rates** Zone Pressures Zone Pressures - 2 Sash Heights by Occ Sash Heights Sash Heat Map Sash Scores Fume I ☰ ★ ↓ +

Site span rollupMinutes side mode overrideMinACR focus Schedule showAllErrors
Select ◀ 28-Jun-2019..5-Jul-2019 ▶ 10 Supply ▾ Relative to zone minimum ▾ 6_ach ▾ All ▾ Select ▾ False ▾

B74 relative air change rates, heat map, Fri 2019-06-28 to Fri 2019-07-05

● 90% ● 95% ● 100% ● 105% ● 110% ● 115% ● 120% ● 125% ● 130%

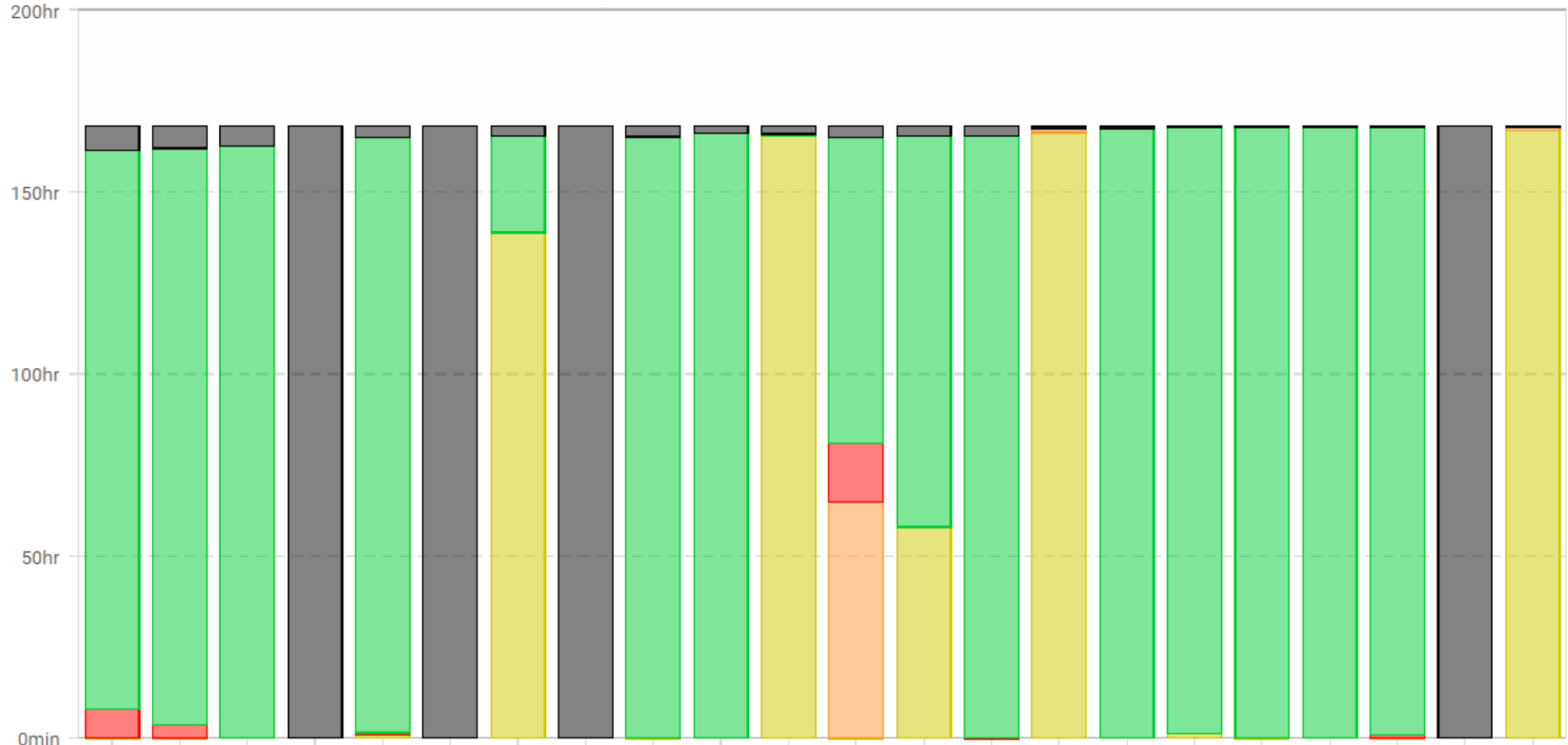


Laboratory spaces, fume hood sash positions

Site dates focus Schedule
Select < Week of 2-Jun-2019 > All Select

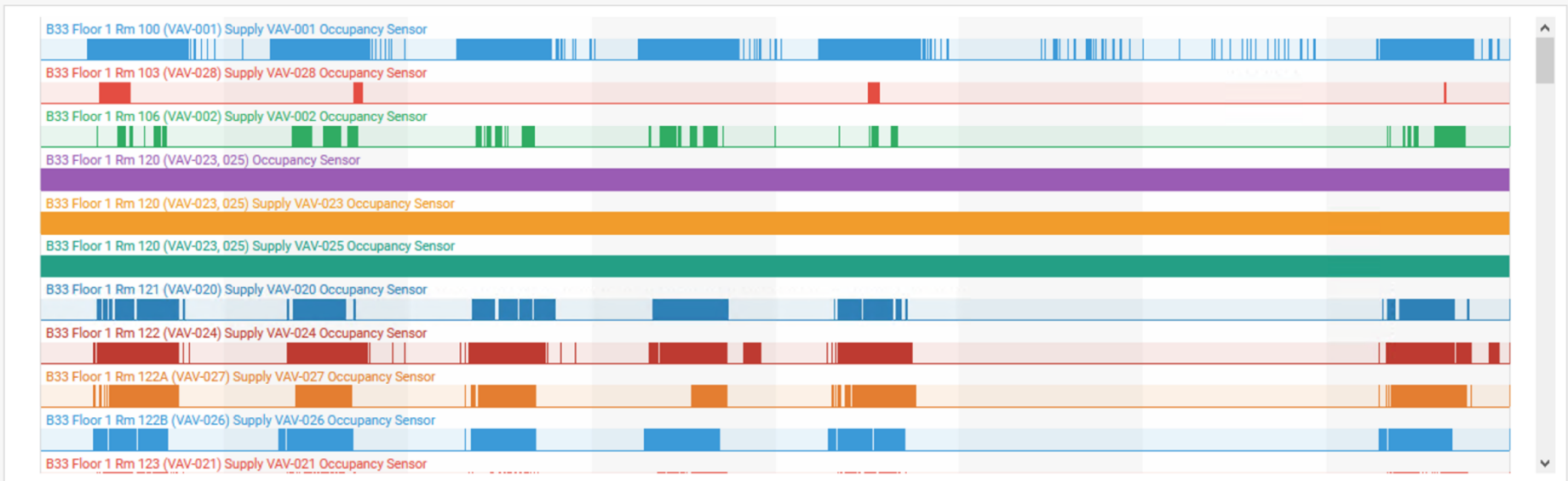
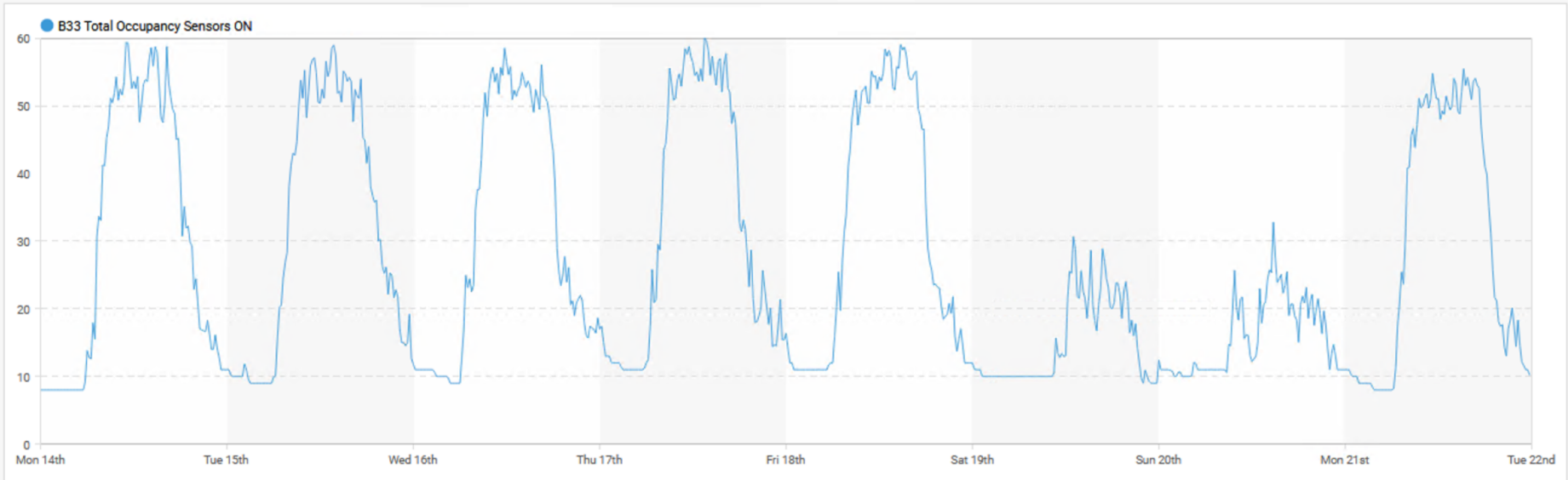
B74 sash heights, time in each category, Sun 2019-06-02 to Sat 2019-06-08

04 to 08 in 08 to 12 in 12+ in Closed Data issue



Rm 108 Fume Hood, VAV-015 Rm 214A, 214B Fume Hood, VAV-062 Rm 227 Fume Hood, VAV-138 Rm 320A, B, E, G Fume Hood, VAV-105 Rm 327B Fume Hood, VAV-129

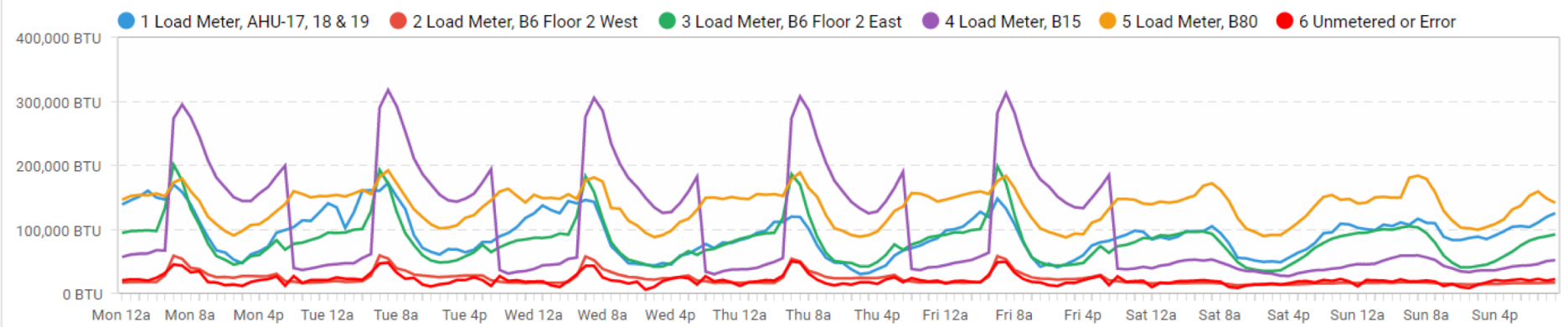
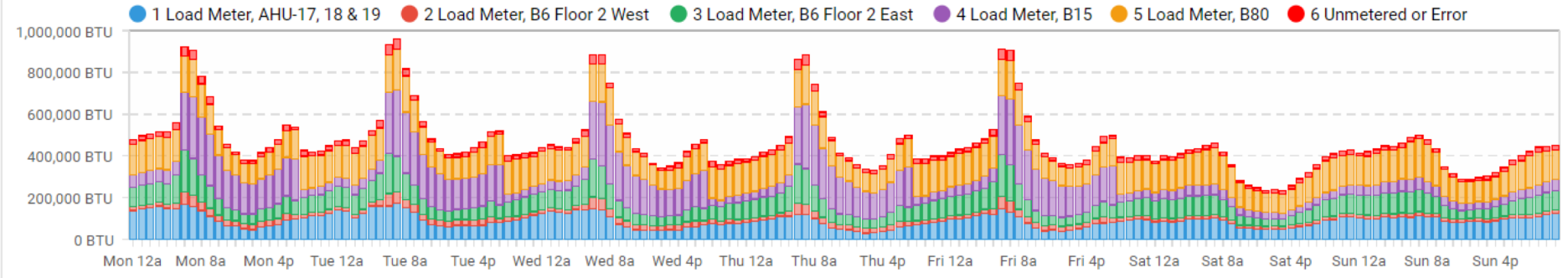
Zone trend templates with Sparks and Deficiencies



Submetering data, load meters

Select < 2-Jul-2018..30-Jun-2019 > Weekly Avg

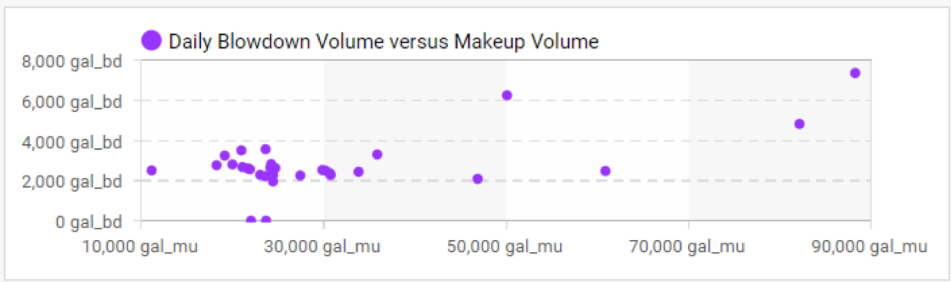
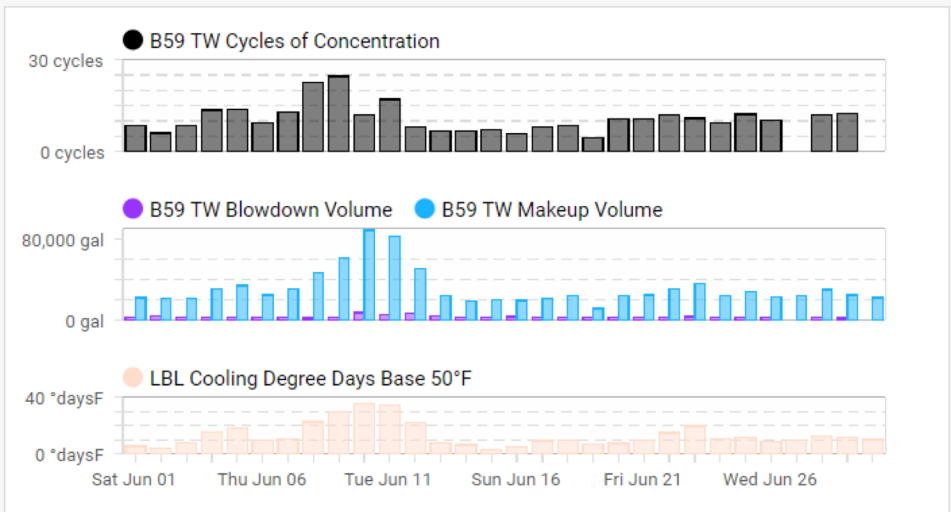
B6 HHW Plant Load Meter Submeter Energy Breakdown



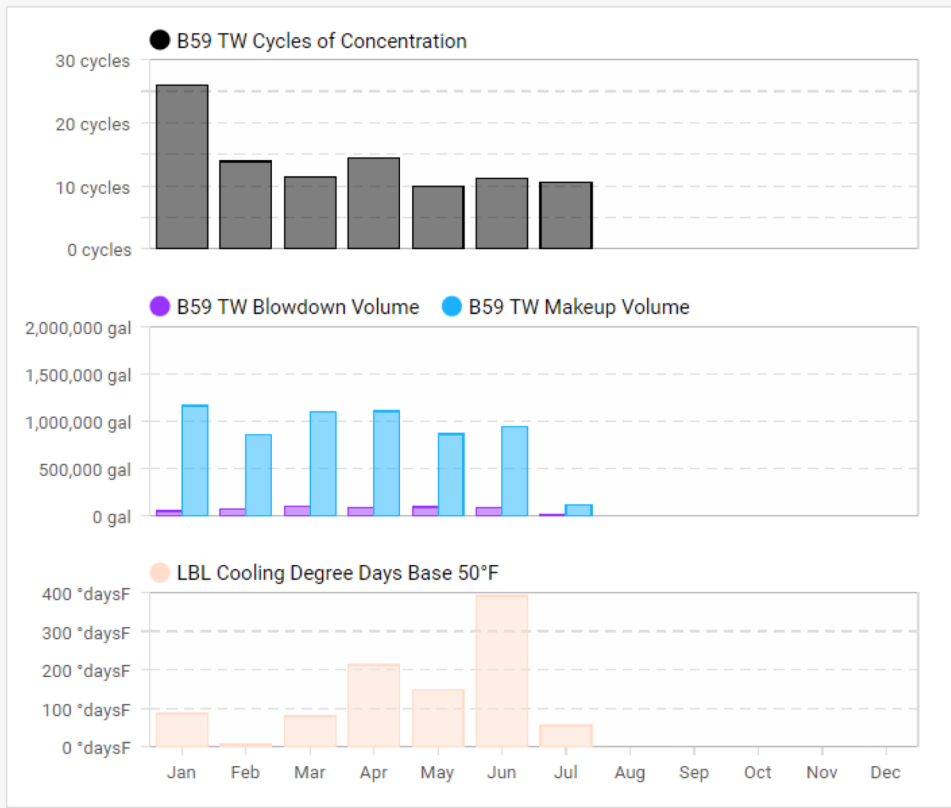
Cooling tower water, cycles of concentration

Select ▾

< Jun-2019 >



< 2019 >



Conclusion, feedback, contacts



Chris Weyandt
cweyandt@lbl.gov



Learn more | sbl.lbl.gov
Contact | sbl@lbl.gov