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COMBINATION BOILER RESET CONTROLLER FIELD EVALUATION

Comparing supply water temperature setpoint reset strategies

Project Background
MFR Combo-Boiler Savings Opportunities

- Equipment (0.5-1 MMBtu/hr serving 40)
  - Combustion Efficiency ~20% ……..(major capital spending)
  - Circulating Pump motor VFD~1 HP ……(limited savings)
  - Controls ……(biggest bang for the bucks)
  - Flue damper … ……..(sensitive and unit-dependent)
  - Heat recovery
- System
  - Piping configuration ……(Where HW Return is connected to the tank can make a big difference)
  - Piping insulation ……..(limited savings)
  - Tank insulation ……..(limited savings)
- O&M
  - Owner's attitude
  - Leak repair
  - Tune-up ……(not credited by CPUC)

Project History –
Phase 1

Technology Assessment Phase 2009-2010

- SoCal Gas, EAC
  - February 2010 Report
- 4 Pilot Units were tested in 2009-2010 Shoulder and Summer Months

TEST LOCATIONS

- Sycamore Springs in Alta Loma
  - 240 Unit Apartment Complex
  - 20% savings in Shoulder months
  - 27% savings in Summer months
- Club Laguna in Laguna Beach
  - 421 Unit Apartment Complex
  - 26% savings in Shoulder months
  - 39% savings in Summer months

Project History – Phase 2

Scaled Field Placement Phase 2010-2011

- M&V Testing under "Real World" Conditions
- Nov. 2010 to Oct. 2011
- 8 Apartment Complexes
- 29 Boiler Units
- 3 counties (in SCG territory)

TEST LOCATIONS

1) Huntington Creek in Huntington Beach
2) Highland Meadows in Moreno Valley
3) Redlands Lawn & Tennis in Redlands
4) Sycamore Springs in Alta Loma
5) Woodland Village in Costa Mesa
6) Parkwood Village in Anaheim
7) The Crest in Pomona
8) Mountain View Apts. in San Dimas

Scaled Field Placement
Phase 2

RESULTS

#	Site Name (City)	Avg. Baseline Therms per unit-day	Avg. Optimized Therms per unit-day	% Saved	Avg. Monthly Therms Saved per Apartment*	Avg. Annual Therms Saved per Apartment	Climate Zone
1	Anaheim	1.23	0.84	32.0%	11.9	144.4	8
2	Costa Mesa	0.90	0.77	15.2%	4.1	50.0	6
3	Huntington Beach	1.17	1.00	14.6%	5.1	62.1	6
4	Moreno Valley	0.81	0.65	19.4%	4.7	57.0	10
5	Pomona	0.63	0.49	22.6%	4.3	52.3	9
6	Alta Loma	0.97	0.71	26.5%	7.7	93.7	10
7	Redlands	0.67	0.64	4.5%	0.9	10.9	10
8	San Dimas	1.12	0.79	29.0%	9.7	118.1	9
AVERAGE		**0.84**	**0.68**	**19.1%**	**4.8**	**58.8**	

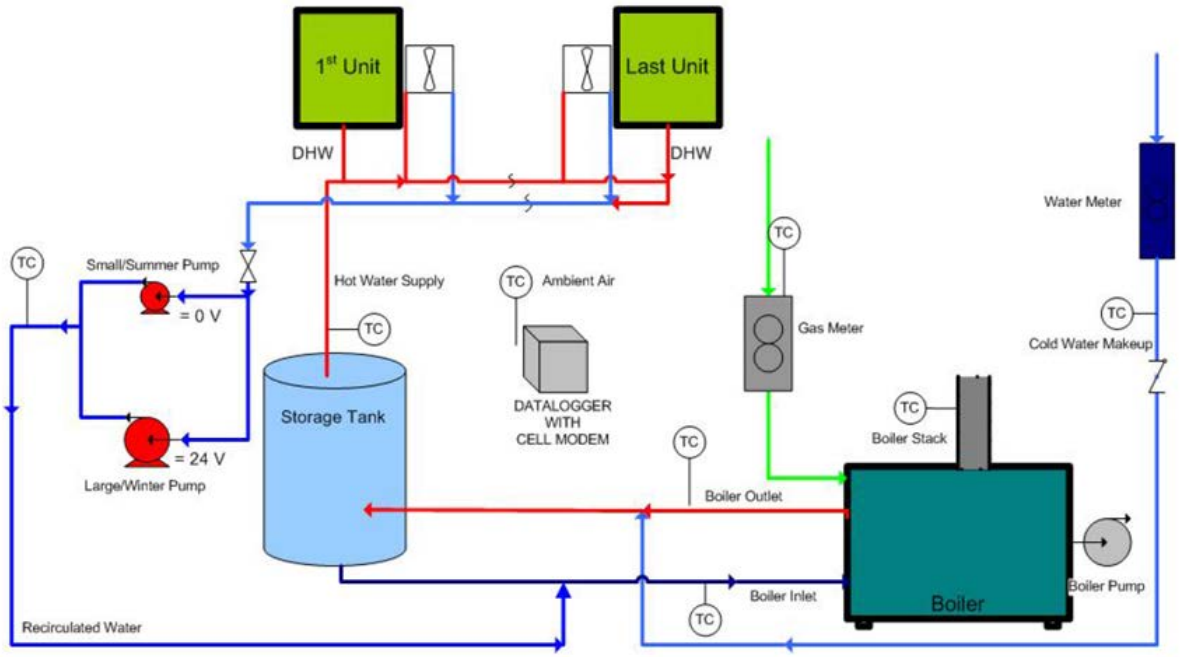
* 30 days per month (for consistency)

Phase 3 – Comparison of 4 Similar Competing Products

- Multi-family condo complex in Laguna Beach, CA

Test Site Overview

» Central boilers serving DHW & HHW



Test Site Boilers

- All test site boilers have the same capacity

ID	Boiler Model	Boiler Rated Size [kBtu/hr]	Number of Serviced Condo Units
Baseline	Raypak H3-0502B	500	24
Controller 1	Raypak WH3-0502A	500	24
Controller 2	Raypak W3-0502A	500	24
Controller 3	Raypak W3-0502A	500	24
Controller 4	Raypak W3-0502A	500	23
Controller 5	Raypak WH3-0502A	500	24

Test Site Boilers

- Each heating plant includes a boiler, storage tank, and pumps

The Controllers & their Configuration

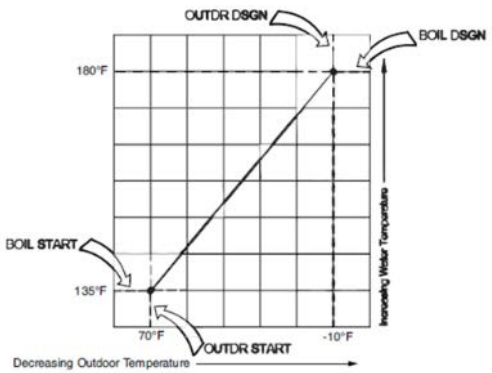
- Goal is to compare 5 setpoint reset controllers

Item	Baseline	Controller 1	Controller 2	Controller 3	Controller 4	Controller 5
Highest Allowed Tank Setpoint	130 °F	130 °F	130 °F	130 °F	130 °F	130 °F
Lowest Allowed Tank Setpoint	-	120 °F	120 °F	120 °F	120 °F	120 °F
Corresponding High OSA Temp.	-	75 °F	75 °F	-[1]	-[1]	-
Corresponding Low OSA Temp.	-	55 °F	55 °F	-[1]	-[1]	55 °F
Algorithm	Fixed	Linear	2nd Order	-[1]	-[1]	Step

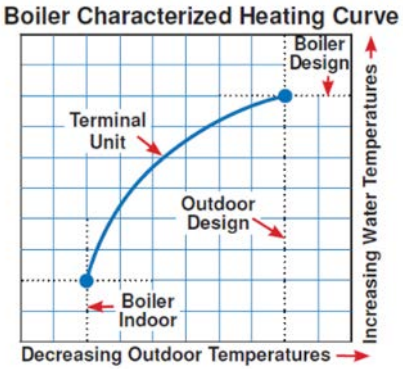
1. Return water temperature based

Some graphs from vendor literature

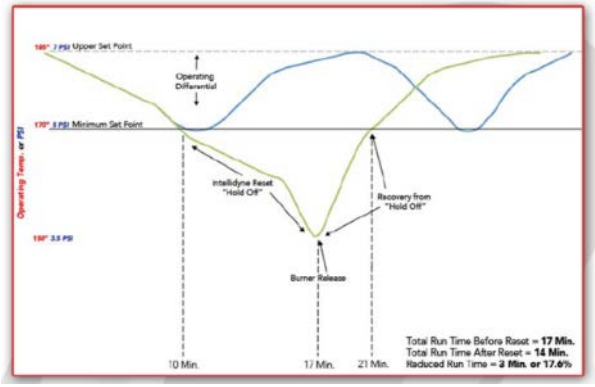
Controller 1
(Linear)



Controller 2
(2nd Order Poly.)



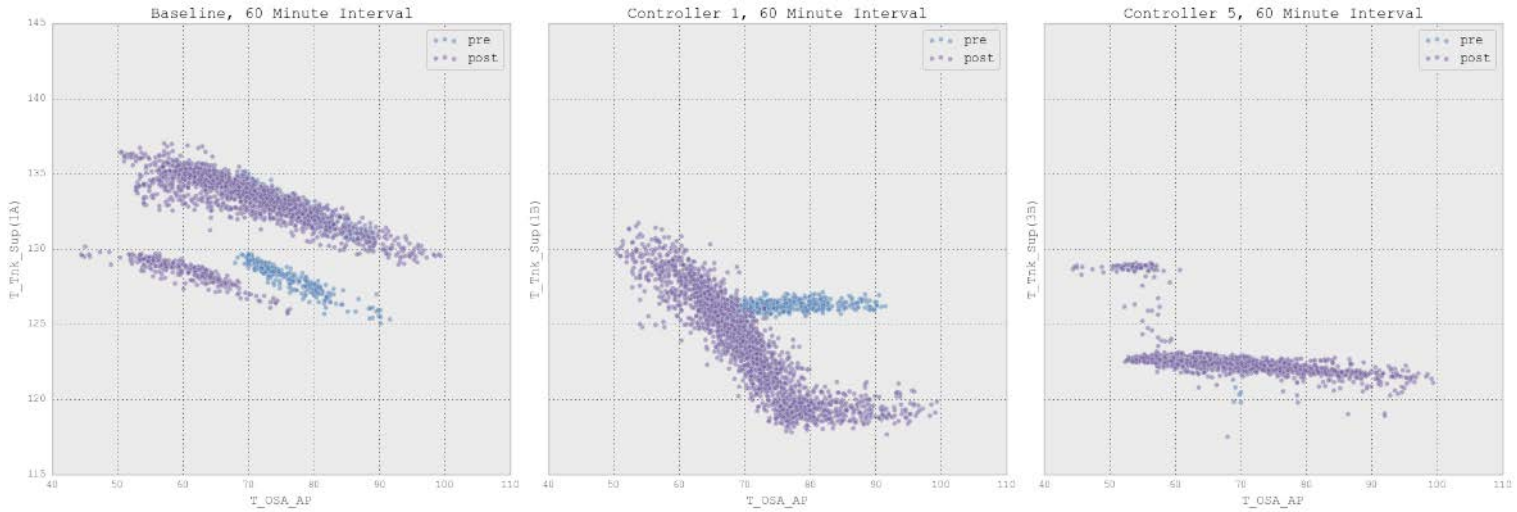
Controller 3
(Return water based)



Note: Some controllers are missing from this slide for the sake of brevity.

Some Preliminary Scatter Plots

- Baseline boiler has two anomalies:
  - Unauthorized modification of the setpoint
  - Tankstat is not properly measuring water temperature
- Controller 1 works properly (albeit pre period setpoint was too low)
- Controller 5 works properly (albeit delta between setpoints too low)



Note: Some controllers are missing because analysis is underway.

Baseline Boiler existing tankstat

- It’s not functioning properly and we’re fixing it.
- Nevertheless, what an interesting failure mode.

Preliminary Findings

- Temperature reset controllers function properly but require attentive configuration and monitoring
- Conventional tankstats can have failure modes that are difficult to detect if they are not installed correctly or not calibrated
- Choosing upper and lower allowed temperature setpoints that will maximize savings but minimize occupant complaints is critical

Next Steps

1. Continue to troubleshoot potential issues
2. Collect Additional Data
3. Calculate & compare natural gas savings
4. Deliver report with final results and conclusions