IDEA Annual Meeting
Seattle, WA

LAX Replacement Central Utility Plant
Chilled Water & Hot Water ΔT Improvements

June 10, 2014

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Burns & McDonnell
SINCE 1898

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AECOM

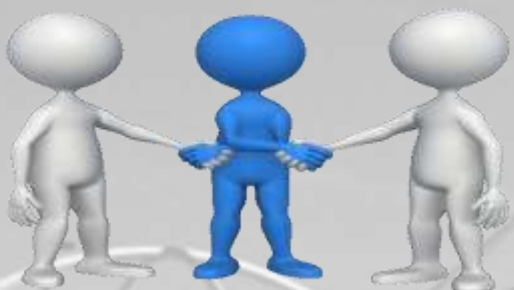
Los Angeles World Airports
AIRPORTS DEVELOPMENT GROUP

Los Angeles World Airports | Administration West Building
7301 World Way West , 9th Floor | Los Angeles, CA 90045

Agenda

- Project Description (George)
  - Overview of the Team
  - LAX Trivia
  - Project Challenges & Constraints
  - Project Overall Scope
- Terminal Pump Room Upgrades Project (Steve)
  - General Approach
  - 2011 Trended Data (pre-upgrade)
  - Current Trends with Upgrades
  - Results

Overview of the Team



Los Angeles World Airport (LAWA)

Airports Development Group (ADG)

- AECOM (Program Manager)
- Capital Engineering (CxA)
- Syska Hennessy Group (Prep of Bridging documents)
- Burns & McDonnell (CA phase support)

LAWA Facilities, Operations & Maintenance Groups (FMD)

Clark McCarthy a Joint Venture

- ARUP (EOR)
- Gruen (Architecture)
- Murray (Mechanical Contractor)
- Johnson Controls (FMCS/BAS)
- Sasco (Electrical Contractor)
- Rasic (Underground Piping)

QANTAS

SINGAPORE AIRLINES

SOUTHWEST AIRLINES

spirit airlines

AIR FRANCE

АЭРОФЛОТ

CATHAY PACIFIC

AIR PACIFIC
FIJI'S INTERNATIONAL AIRLINE

Alaska Airlines

American Eagle

Continental Airlines

Lufthansa

Lacsa
The Airline of Costa Rica

Alitalia

AA
American Airlines

NEW ZEAL

jetBlue

Thai

AEROMEXICO

Delta

UNITED

JAL

AIR CANADA

BRITISH AIRWAYS

Virgin america

Virgin australia

FRONTIER
AIRLINES

swissair

U.S. JUSTICE DEPARTMENT
DRUG ENFORCEMENT ADMINISTRATION

UNITED STATES CUSTOMS AND BORDER PROTECTION
U.S. DEPARTMENT OF HOMELAND SECURITY

TRANSPORTATION SECURITY ADMINISTRATION
U.S. DEPARTMENT OF TRANSPORTATION

DEPARTMENT OF JUSTICE
FEDERAL BUREAU OF INVESTIGATION

USO

LOS ANGELES AIRPORT
POLICE

SUSHI BOY

McDonald's

Hudson News

STARBUCKS COFFEE

Grand CAFE
WOLFGANG PUCK

PINK'S

PANDA EXPRESS
GOURMET CHINESE FOOD

LA BREA BAKERY

GLADSTONE'S
Long Beach

Häagen-Dazs

KARL STRAUSS
BREWING COMPANY

Jody Maroni's
SAUSAGE KINGDOM

Carl's Jr.

chili's too

BURGER KING

CALIFORNIA PIZZA KITCHEN

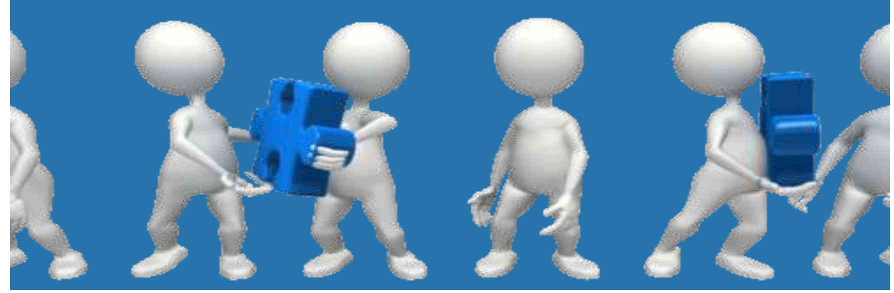
LAX Trivia

- 6th busiest worldwide
- 55 million passengers
- 4 million square feet
- 3500 acres
- 80 passenger airlines/ 20 cargo carriers
- Provides 60,000 jobs
- Round the clock operation

INTERNATIONAL DISTRICT ENERGY ASSOCIATION

Project Challenges

- Maintain Airport Operations during Project (24/7/365)
- Site Constraints
  - Postage stamp sized site
  - FAA Tower Proximity & site lines
  - Space and utility interconnection
    - Vanishing Network Station CHP
    - Vanishing TES Incentive
- Meeting Essential Facilities Seismic Criteria



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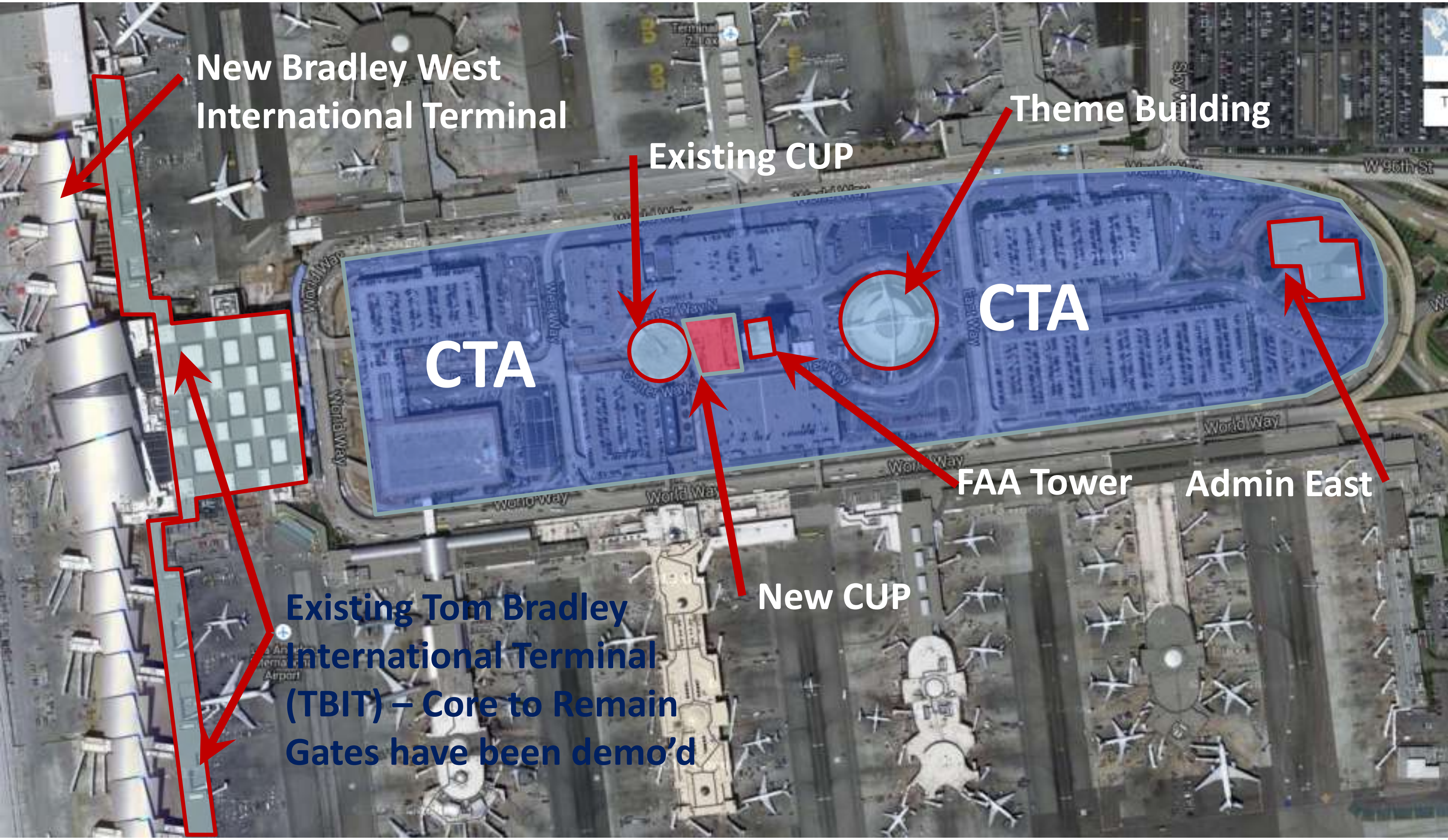
CUP Site Constraints



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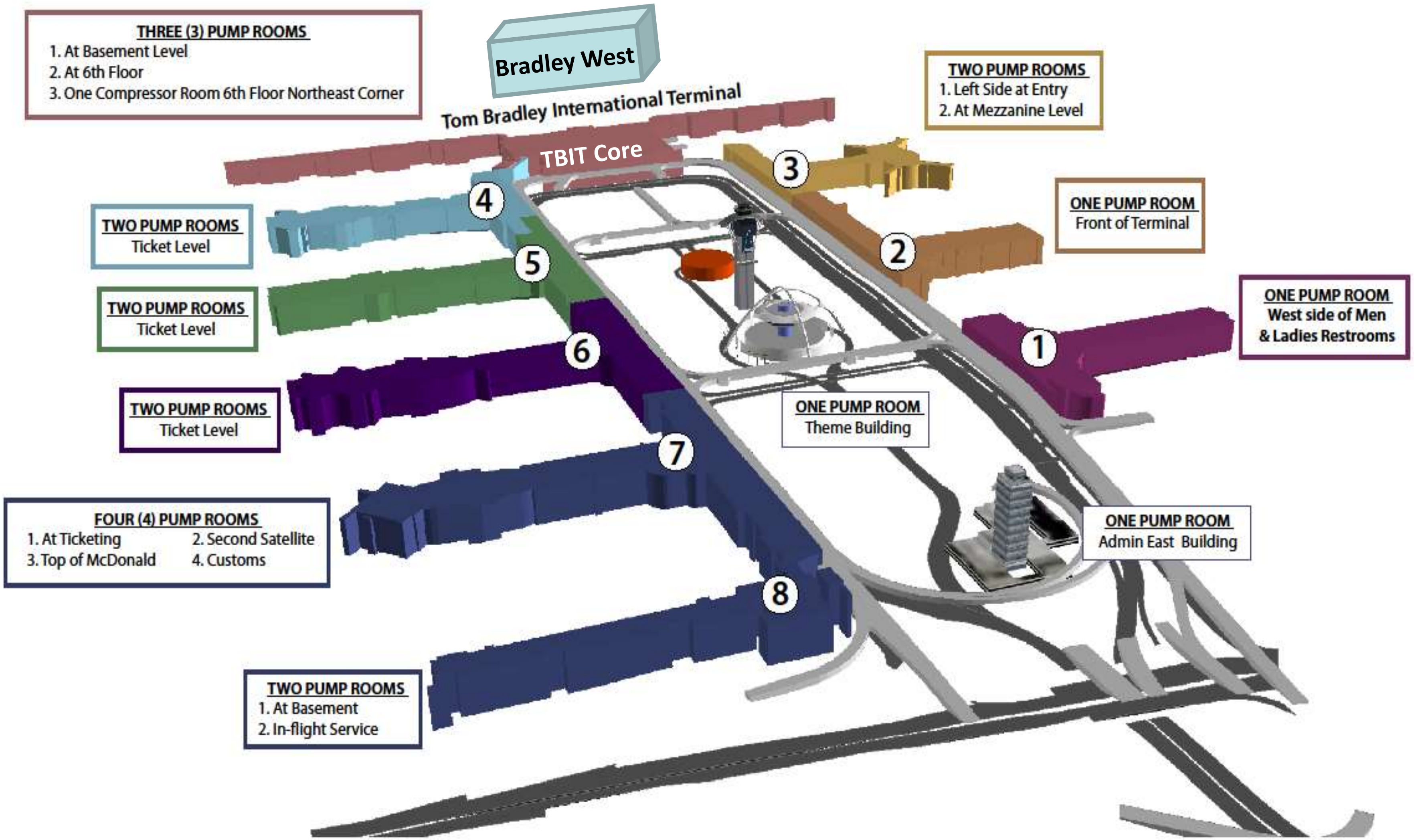
CUP Replacement Scope

- **Existing CUP**
  - Chilled Water -10,000 tons
    - Hybrid Plant (Steam & Elec)
    - No TES
    - Constant Volume Pumping
  - Hot Water – 46,000 MBH
    - Constant Volume Pumping
  - Power Generation 8.4 MW
  - Operating Temperatures:
    - CHW = 42°F to 54°F
    - MTHW = 280°F to 230°F
  - Constructed in 1961; renovated 1983 (CHP)

- **Replacement CUP**
  - Chilled Water ~20,000 Tons
    - Hybrid Plant (Steam & Elec)
    - TES – 1,550,000 gallons
    - Variable Volume Pumping
  - Hot Water - 71,000 MBH
    - Variable Volume Pumping
  - Power Generation - 8.8 MW
  - Operating Temperatures:
    - CHW = 40°F to 56°F
    - LTHW = 220°F to 170°F
  - Other Effort
    - Upgraded each Terminal Pump Room

Original Terminal Pump Room Layouts



Pump Room Upgrade Objectives

- Improve the overall reliability of terminal pump rooms distribution system
- Improve the quality & efficiency of mechanical and electrical systems
- Decrease maintenance and operating costs
- Provide uniform equipment & controls to each terminal
  - Single pump room per terminal
  - Standard design and layout

Terminal Upgrade Scope

- Existing Terminals
  - Direct Connected Chilled Water (multiple versions)
    - Orifice Plate Meters
    - Constant Volume Pumping
    - 3-way control valves at coils
  - Medium Temp Hot Water
    - Orifice Plate Meters
    - Shell & Tube HX for HHW
    - Constant Volume Pumping
    - 3-way control valves at coils
  - Operating Temperatures:
    - CHW = 42°F to 54°F
    - MTHW = 280°F to 230°F

- New Terminal Upgrades
  - Direct Connection (standardized)
    - ±0.25% Accurate Mag Meters
    - Replace pumps & add VFDs
    - Added V-1 rotary valve at CHWR
    - Replace most coil valves with 2-way PICV
  - Low Temp Hot Water
    - ±0.25% Accurate Mag Meters
    - New Brazed HX for HHW & DHW
    - Replace pumps & add VFDs
    - 2-way Pressure Independent CV
  - Operating Temperatures:
    - CHW = 40°F to 56°F
    - LTHW = 220°F to 170°F

2011 Trended Chilled Water ΔT

Total Load	Diversity	Terminal 1			Terminal 2			Terminal 3			Termi[nal 4]
7,660	0.85	Peak Load		1,032	Peak Load		1,124	Peak Load		512	Peak Load
2011	Air Temp (°F)	CHWS (°F)	CHWR (°F)	Monthly Avg ΔT	CHWS (°F)	CHWR (°F)	Monthly Avg ΔT	CHWS (°F)	CHWR (°F)	Monthly Avg ΔT	CHWS (°F)
January	62.2	43.7	50.4	6.6	43.0	46.2	3.3	43.0	48.0	5.0	43.0
February	58.5	43.4	49.7	6.3	43.0	46.0	3.0	43.0	48.5	5.5	42.8
March	60.3	43.4	49.8	6.4	43.0	46.2	3.1	43.1	48.6	5.5	42.7
April	64.1	43.6	50.7	7.2	43.3	47.0	3.7	43.3	49.3	5.9	43.0
May	65.7	43.8	50.8	7.0	43.3	46.8	3.5	43.5	49.7	6.2	42.9
June	67.6	43.2	51.0	7.8	42.9	47.3	4.3	43.0	49.6	6.7	42.8
July	72.2	42.4	51.9	9.5	42.7	48.2	5.5	42.8	50.1	7.4	42.6
August	71.7	42.0	51.4	9.4	42.1	47.7	5.5	42.2	49.3	7.1	42.2
September	70.9	42.3	51.2	8.8	42.2	47.6	5.4	42.3	48.7	6.4	42.5
October	68.4	42.7	51.4	8.7	42.0	46.8	4.8	42.0	48.0	6.0	42.8
November	63.3	43.0	[illegible]	[illegible]	[illegible]	46.0	3.5	42.5	48.4	5.9	42.8
December	58.3	43.2	[illegible]	7.5	42.8	[illegible]	3.0	42.9	48.1	5.2	43.1
Annual Avg.	65.3	[illegible]	50.9	7.8	42.7	[illegible]	4.1	42.8	48.9	6.1	42.8

Total System Annual Avera[illegible]

	[Term]inal 6	TBIT			Admin East			Theme		
	861	Peak Load		2,121	Peak Load		248	Peak Load		162
2011	Monthly Avg ΔT	CHWS (°F)	CHWR (°F)	Monthly Avg ΔT	CHWS (°F)	CHWR (°F)	Monthly Avg ΔT	CHWS (°F)	CHWR (°F)	Monthly Avg ΔT
January	1.8	43.8	51.5	7.6	43.8	51.5	7.6	43.4	45.3	1.9
February	1.5	43.3	50.4	7.1	43.3	50.4	7.1	43.0	44.7	1.6
March	1.4	43.4	50.5	7.1	43.4	50.5	7.1	42.9	44.8	1.9
April	1.5	43.4	50.7	7.3	43.4	50.7	7.3	42.9	45.9	3.0
May	1.5	43.2	50.4	7.2	43.2	50.4	7.2	42.8	46.2	3.4
June	1.7	42.9	50.6	7.7	42.9	50.6	7.7	42.5	47.6	5.1
July	2.3	42.9	52.4	9.5	42.9	52.4	9.5	42.4	49.2	6.9
August	2.3	42.8	52.0	9.3	42.8	52.0	9.3	42.0	48.7	6.7
September	2.0	43.1	52.4	9.3	43.1	52.4	9.3	42.2	49.1	6.9
October	1.7	43.2	52.0	8.8	43.2	52.0	8.8	42.5	47.8	5.3
November	1.2	43.2	50.7	7.5	43.2	50.7	7.5	42.5	46.1	3.7
December	1.9	43.6	49.8	6.2	43.6	49.8	6.2	42.5	45.5	3.0
Annual Avg.	1.7	43.2	51.1	7.9	43.2	51.1	7.9	42.6	46.7	4.1

Terminal 5

Peak Load		808
CHWS (°F)	CHWR (°F)	Monthly Avg ΔT
43.0	48.5	5.6
43.1	48.3	5.2
43.2	49.0	5.8
43.4	49.6	6.2
43.4	49.6	6.2
42.9	50.2	7.3
42.6	51.1	8.6
41.9	50.8	8.8
42.0	50.4	8.4
41.6	49.1	7.5
42.4	48.6	6.2
42.8	48.3	5.5
42.7	**49.5**	**6.8**

Terminal 6

Peak Load		861
CHWS (°F)	CHWR (°F)	Monthly Avg ΔT
44.2	46.0	1.8
44.0	45.6	1.5
43.9	45.3	1.4
44.2	45.8	1.5
44.4	45.9	1.5
43.9	45.6	1.7
43.5	45.8	2.3
43.2	45.4	2.3
43.5	45.5	2.0
43.7	45.4	1.7
43.7	44.9	1.2
42.9	44.8	1.9
43.8	**45.5**	**1.7**

5.91

Original Design ΔT = 12.0°F

2011 Actual ΔT = 5.9°F

2011 Trended Heating Hot Water ΔT

Monthly Summary of Terminal Heating Hot Water Delta T

Total Load		Terminal 1			Terminal 2			Terminal 3			Terminal 4			Terminal 5		
28,881		Peak Load		2,384	Peak Load		1,540	Peak Load		2,100	Peak Load		4,025	Peak Load		2,290
2011	Air Temp (°F)	HWS (°F)	HWR (°F)	Monthly Avg ΔT	HWS (°F)	HWR (°F)	Monthly Avg ΔT	HWS (°F)	HWR (°F)	Monthly Avg ΔT	HWS (°F)	HWR (°F)	Monthly Avg ΔT	HWS (°F)	HWR (°F)	Monthly Avg ΔT
January	62.2	268.2	243.5	24.7	268.2	263.3	4.8	268.2	243.6	24.5	268.2	243.3	24.8	268.2	241.4	26.8
February	58.5	267.9	242.5	25.4	267.9	262.6	5.3	267.8	237.0	30.8	267.8	243.2	24.7	267.8	240.6	27.2
March	60.3	268.5	242.4	26.1	268.5	263.8	4.6	268.5	244.2	24.2	268.5	241.8	26.7	268.5	241.1	27.4
April	64.1	265.2	240.0	25.2	265.2	260.9	4.3	265.2	243.2	22.0	265.2	239.1	26.1	265.2	237.8	27.4
May	65.7	263.8	238.8	24.9	263.8	253.4	10.3	263.8	242.3	21.5	263.8	238.2	25.5	263.8	238.0	25.8
June	67.6	266.9	241.0	25.9	266.9	263.2	3.7	266.9	240.3	26.6	266.9	242.1	24.8	266.9	244.0	22.9
July	72.2	263.0	237.9	25.1	263.0	259.3	3.7	263.0	242.3	20.7	263.0	240.6	22.4	263.0	241.4	21.6
August	71.7	262.5	237.6	24.9	262.5	259.0	3.5	262.5	239.0	23.5	262.5	239.5	23.0	262.5	237.6	24.9
September	70.9	265.5	240.8	24.7	265.5	261.9	3.6	265.5	246.2	19.3	265.5	241.7	23.8	265.5	[illegible]	[illegible]
October	68.4	264.7	[illegible]	[illegible]	[illegible]	260.6	4.1	264.7	240.7	24.0	264.7	239.5	25.2	264.7	[illegible]	25.2
November	63.3	263.0	[illegible]	25.6	263.0	258.6	4.4	263.0	240.2	22.9	263.0	236.8	26.2	[illegible]	238.1	24.9
December	58.3	[illegible]	236.9	25.4	262.4	248.6	13.8	262.4	232.7	29.7	262.4	234.0	28.4	[illegible]	[illegible]	[illegible]
Annual Avg.	**65.3**	**[illegible]**	[illegible]	[illegible]	[illegible]	**259.6**	**5.5**	**265.1**	**241.0**	**24.1**	**265.1**	**240.0**	**25.1**	**[illegible]**	[illegible]	[illegible]

2011	Terminal 6			Terminal 7			Terminal 8			TBIT			Admin East		
	Peak Load		4,286	Peak Load		2,669	Peak Load		1,676	Peak Load		6,445	Peak Load		1,464
	HWS (°F)	HWR (°F)	Monthly Avg ΔT	HWS (°F)	HWR (°F)	Monthly Avg ΔT	HWS (°F)	HWR (°F)	Monthly Avg ΔT	HWS (°F)	HWR (°F)	Monthly Avg ΔT	HWS (°F)	HWR (°F)	Monthly Avg ΔT
January	268.2	238.0	30.2	268.2	241.8	26.4	268.2	248.6	19.6	268.2	227.5	40.7	268.2	232.4	35.8
February	267.9	235.2	32.7	267.9	240.8	27.0	267.9	246.4	21.5	267.8	220.6	47.3	267.9	242.3	25.5
March	268.5	240.1	28.3	268.5	242.4	26.1	268.5	247.7	20.8	268.4	227.5	40.9	268.5	242.9	25.6
April	265.2	243.9	21.3	265.2	241.0	24.1	265.2	245.8	19.4	265.2	231.2	34.0	265.2	242.8	22.4
May	263.8	243.2	20.6	263.8	240.0	23.7	263.8	246.3	17.5	263.8	231.0	32.8	263.8	240.5	23.2
June	266.9	245.9	21.0	266.9	243.2	23.7	266.9	250.1	16.8	266.9	234.8	32.1	266.9	228.9	38.0
July	263.0	241.5	21.4	263.0	240.4	22.6	263.0	247.7	15.3	263.0	237.6	25.4	263.0	203.5	59.5
August	262.5	243.9	18.6	262.5	240.9	21.6	262.5	247.2	15.3	262.5	231.6	31.0	262.5	241.2	21.3
September	265.5	246.2	19.3	265.5	243.6	21.9	265.5	249.7	15.8	265.5	238.3	27.2	265.5	244.9	20.6
October	[illegible]	239.5	25.2	264.7	240.5	24.2	264.7	245.7	19.0	264.7	234.4	30.3	264.7	237.0	27.7
November	264.7	235.1	29.6	264.7	236.3	28.4	264.7	241.4	23.3	264.7	263.0	1.7	264.7	228.1	36.6
December	[illegible]	233.8	28.6	262.4	230.6	31.8	262.4	239.5	22.9	262.4	220.8	41.6	262.4	238.8	23.5
Annual Avg.	**[illegible]**	**240.5**	**24.7**	**265.3**	**240.1**	**25.1**	**265.3**	**246.3**	**18.9**	**265.3**	**233.2**	**32.1**	**265.3**	**235.3**	**30.0**

Total System Annual Average ΔT

25.4

25.3

Original Design ΔT = 50.0°F

2011 Actual ΔT = 25.4°F

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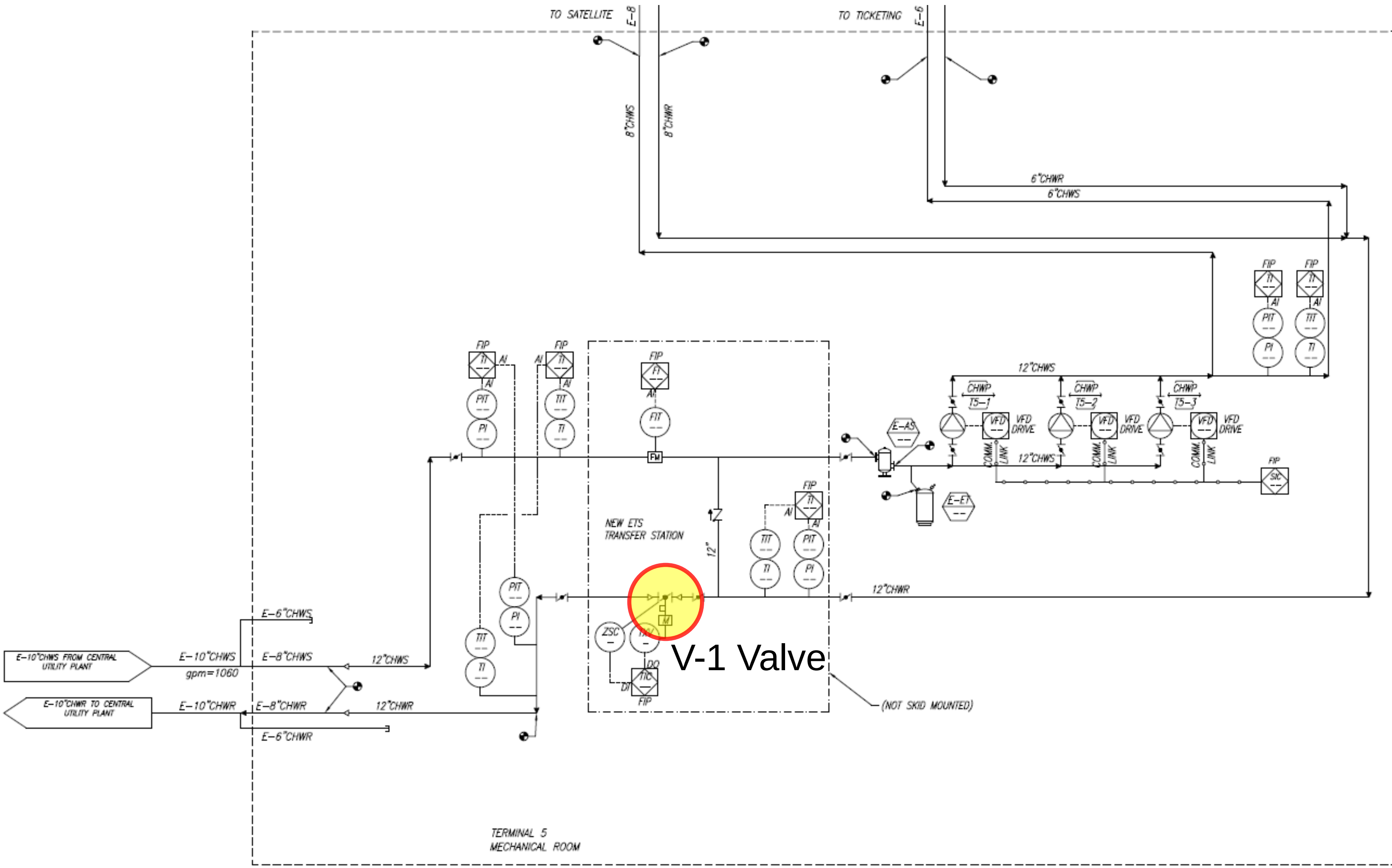
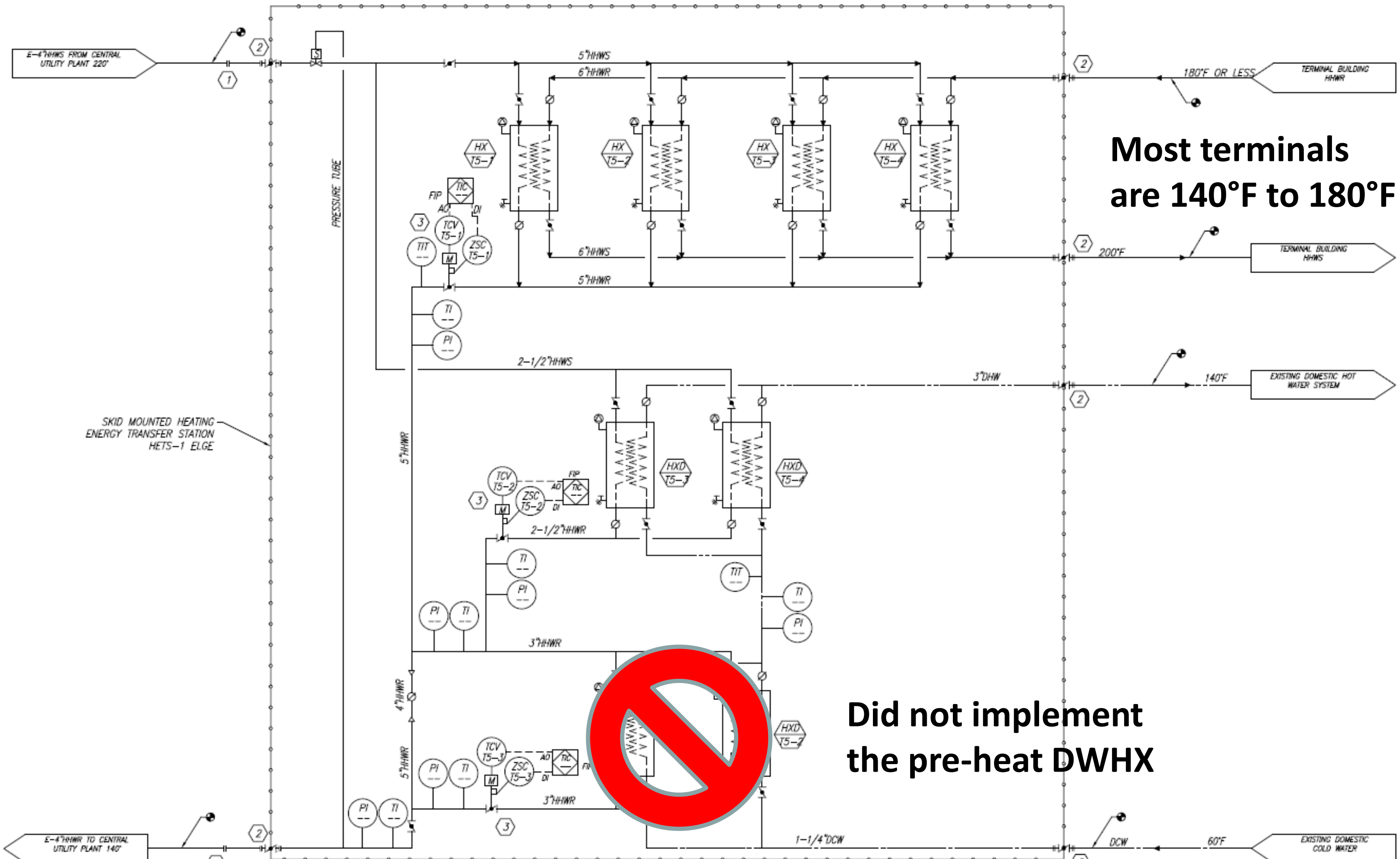
Typical New Cooling ETS Diagram



INTERNATIONAL DISTRICT ENERGY ASSOCIATION

Typical New Heating ETS Diagram



Most terminals are 140°F to 180°F

Did not implement the pre-heat DWHX

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Current Results

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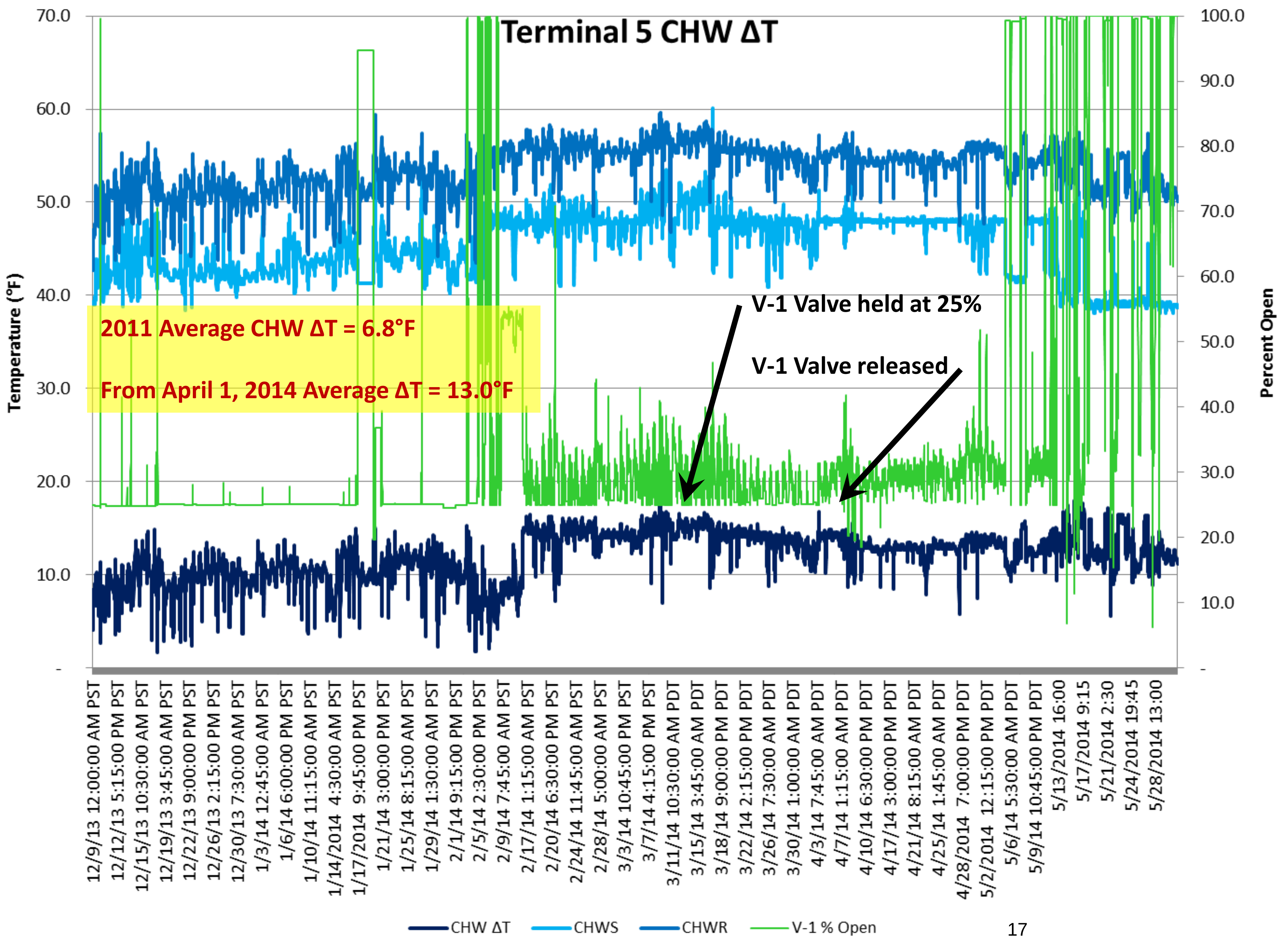
Terminal 5 CHW ΔT
2011 Average CHW ΔT = 6.8°F
From April 1, 2014 Average ΔT = 13.0°F
V-1 Valve held at 25%
V-1 Valve released
Temperature (°F)
Percent Open
70.0
60.0
50.0
40.0
30.0
20.0
10.0
-
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
-
12/9/13 12:00:00 AM PST
12/12/13 5:15:00 PM PST
12/15/13 10:30:00 AM PST
12/19/13 3:45:00 AM PST
12/22/13 9:00:00 PM PST
12/26/13 2:15:00 PM PST
12/30/13 7:30:00 AM PST
1/3/14 12:45:00 AM PST
1/6/14 6:00:00 PM PST
1/10/14 11:15:00 AM PST
1/14/2014 4:30:00 AM PST
1/17/2014 9:45:00 PM PST
1/21/14 3:00:00 PM PST
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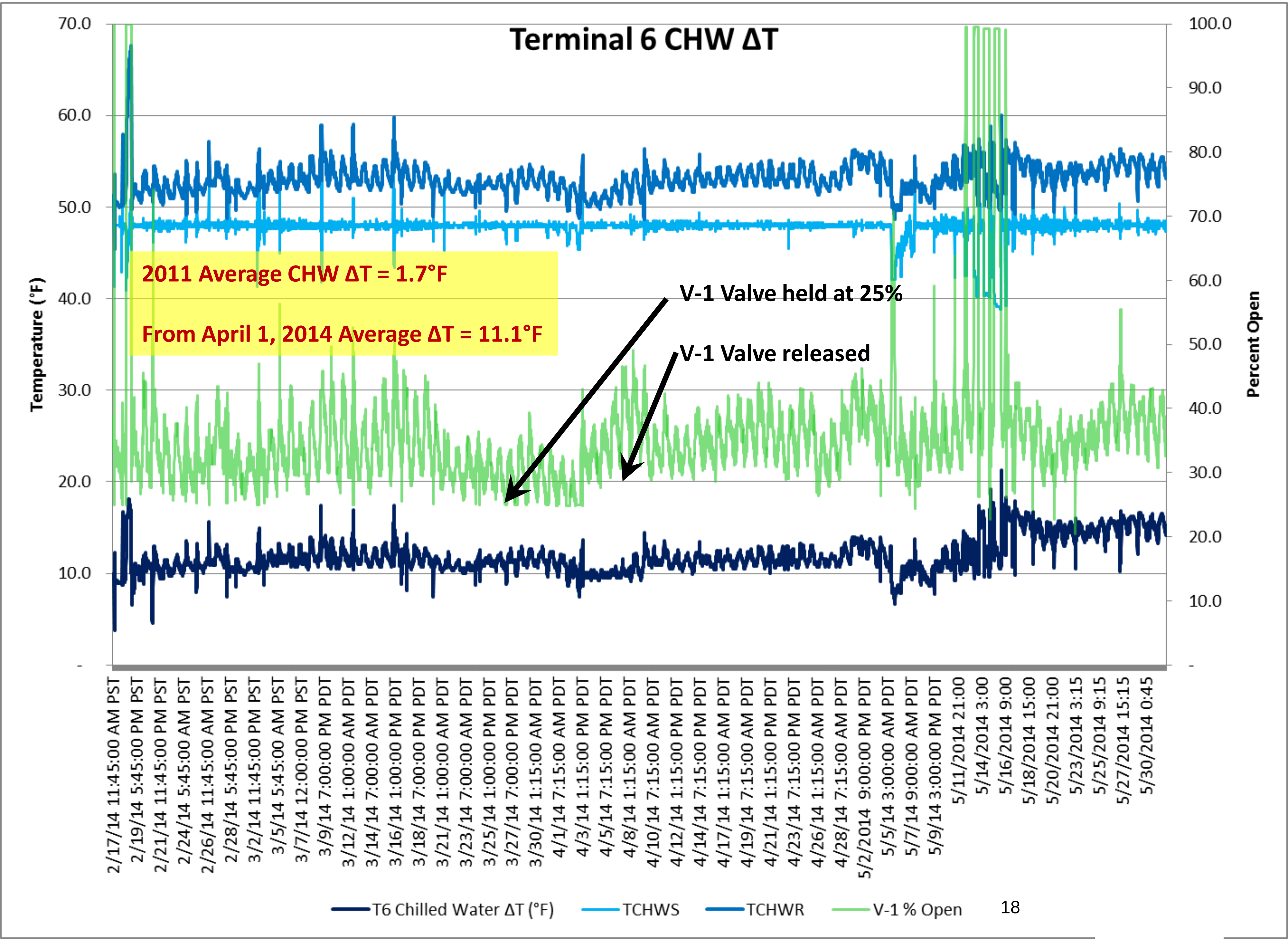
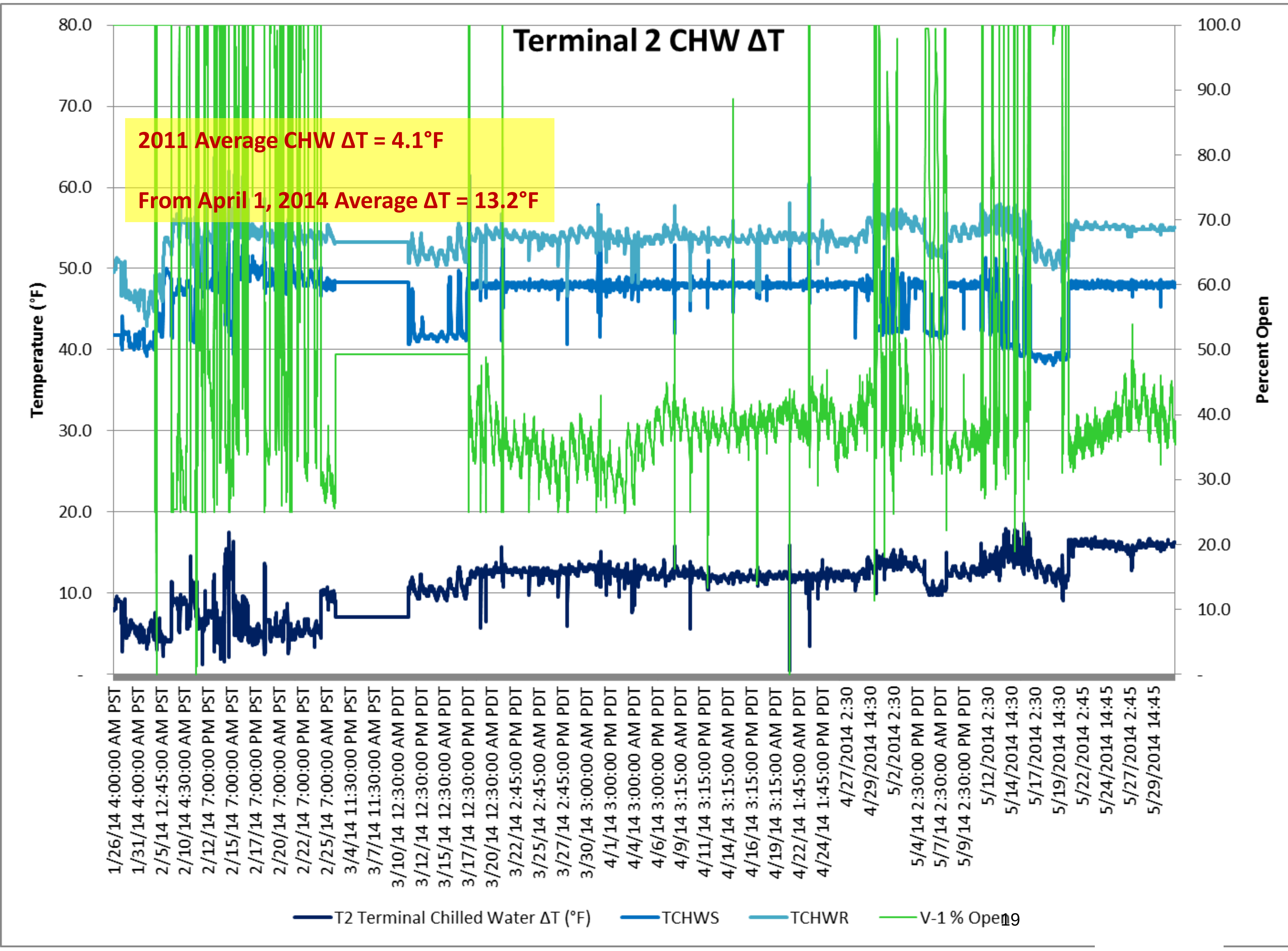
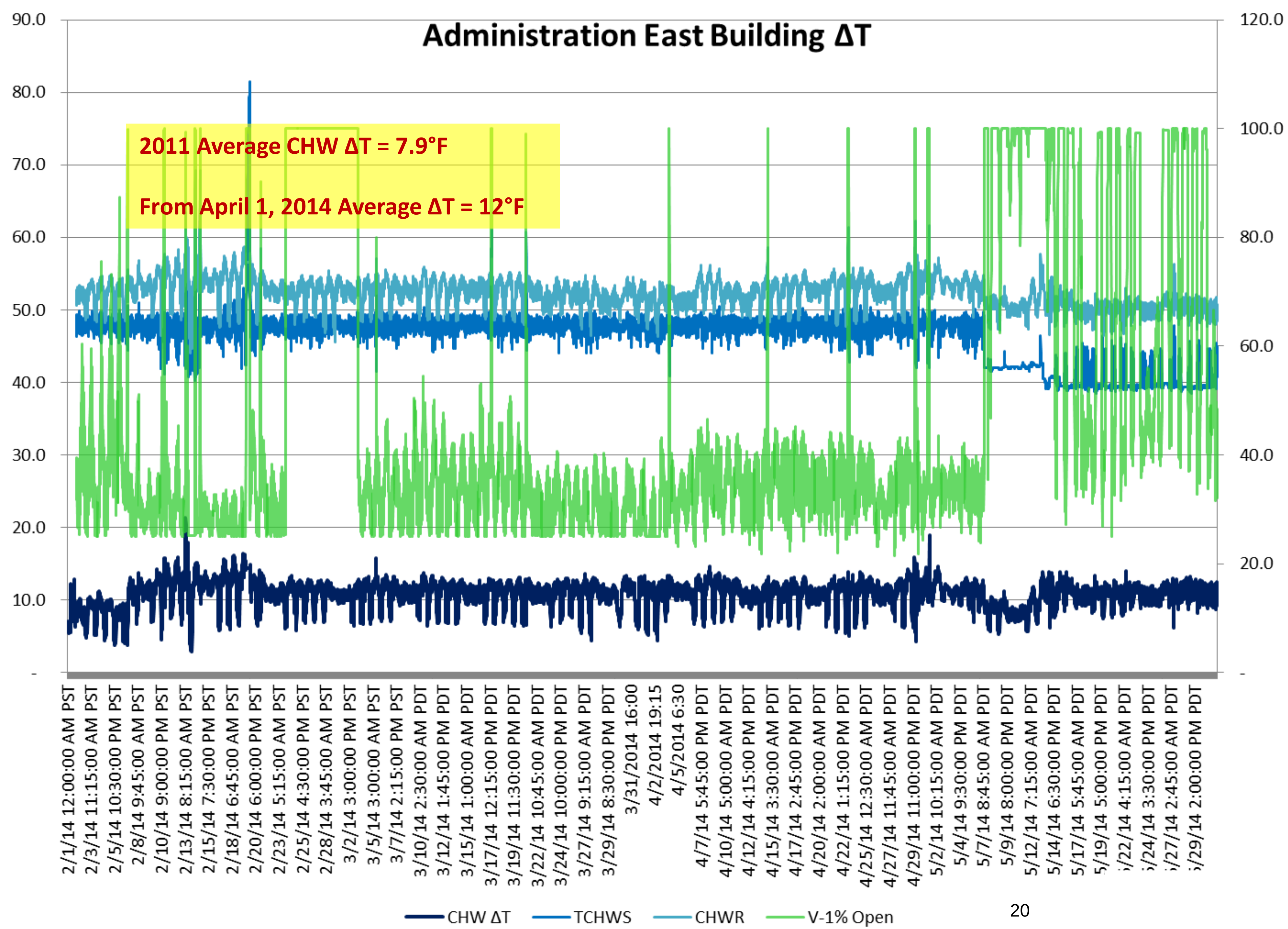
2/17/14 1:15:00 AM PST
2/20/14 6:30:00 PM PST
2/24/14 11:45:00 AM PST
2/28/14 5:00:00 AM PST
3/3/14 10:45:00 PM PST
3/7/14 4:15:00 PM PST
3/11/14 10:30:00 AM PDT
3/15/14 3:45:00 AM PDT
3/18/14 9:00:00 PM PDT
3/22/14 2:15:00 PM PDT
3/26/14 7:30:00 AM PDT
3/30/14 1:00:00 AM PDT
4/3/14 7:45:00 AM PDT
4/7/14 1:15:00 AM PDT
4/10/14 6:30:00 PM PDT
4/17/14 3:00:00 PM PDT
4/21/14 8:15:00 AM PDT
4/25/14 1:45:00 AM PDT
4/28/2014 7:00:00 PM PDT
5/2/2014 12:15:00 PM PDT
5/6/14 5:30:00 AM PDT
5/9/14 10:45:00 PM PDT
5/13/2014 16:00
5/17/2014 9:15
5/21/2014 2:30
5/24/2014 19:45
5/28/2014 13:00
CHW ΔT
CHWS
CHWR
V-1 % Open


Terminal 6 CHW ΔT
2011 Average CHW ΔT = 1.7°F
From April 1, 2014 Average ΔT = 11.1°F
V-1 Valve held at 25%
V-1 Valve released
Temperature (°F)
Percent Open
T6 Chilled Water ΔT (°F)
TCHWS
TCHWR
V-1 % Open



Terminal 2 CHW ΔT
2011 Average CHW ΔT = 4.1°F
From April 1, 2014 Average ΔT = 13.2°F
Temperature (°F)
Percent Open
T2 Terminal Chilled Water ΔT (°F)
TCHWS
TCHWR
V-1 % Open



Administration East Building ΔT
2011 Average CHW ΔT = 7.9°F
From April 1, 2014 Average ΔT = 12°F
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
-
120.0
100.0
80.0
60.0
40.0
20.0
-
2/1/14 12:00:00 AM PST
2/3/14 11:15:00 AM PST
2/5/14 10:30:00 PM PST
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2/25/14 4:30:00 PM PST
2/28/14 3:45:00 AM PST
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3/15/14 1:00:00 AM PDT
3/17/14 12:15:00 PM PDT
3/19/14 11:30:00 PM PDT
3/22/14 10:45:00 AM PDT
3/24/14 10:00:00 PM PDT
3/27/14 9:15:00 AM PDT
3/29/14 8:30:00 PM PDT
3/31/2014 16:00
4/2/2014 19:15
4/5/2014 6:30
4/7/14 5:45:00 PM PDT
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4/25/14 12:30:00 AM PDT
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5/2/14 10:15:00 AM PDT
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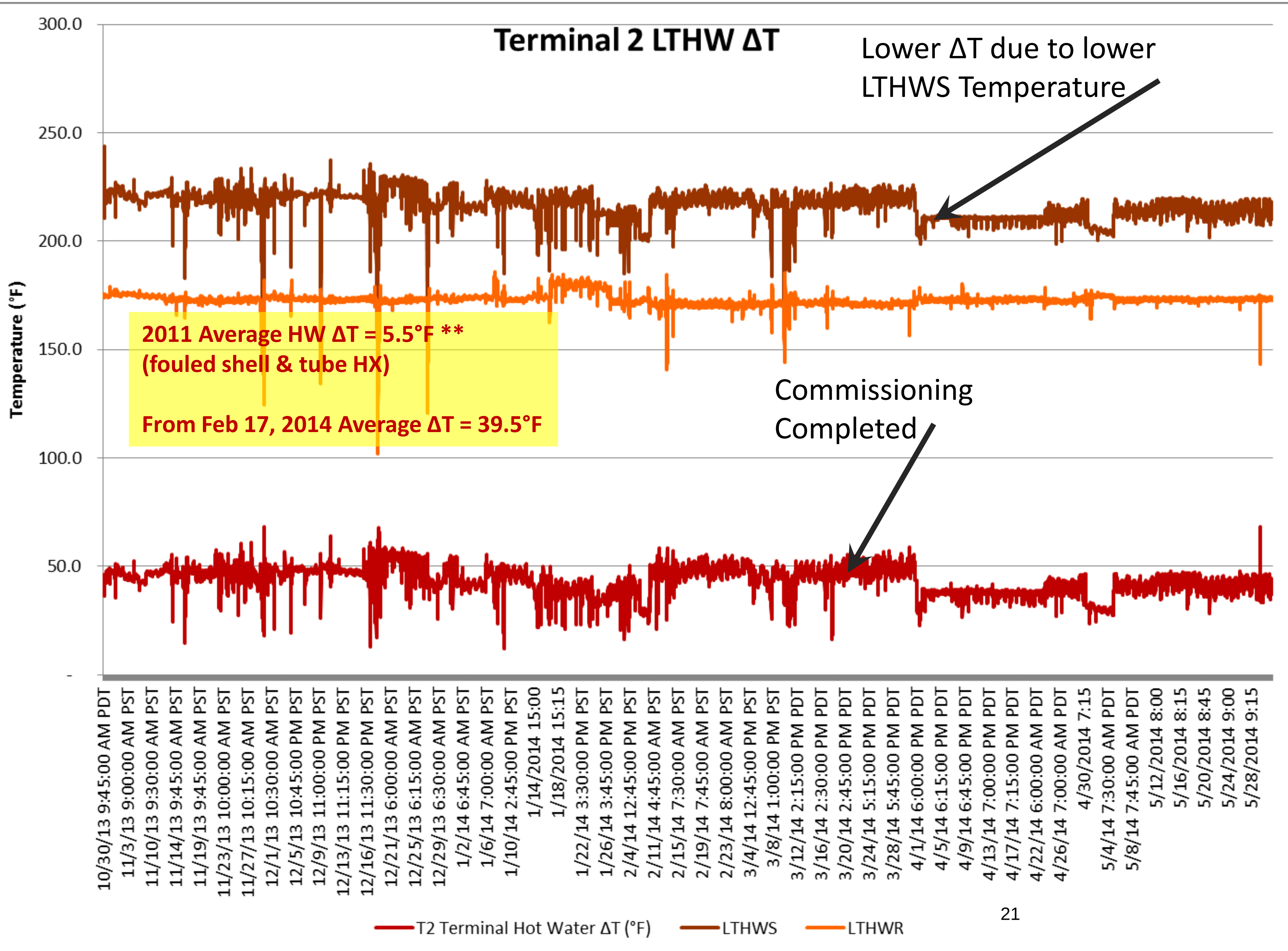
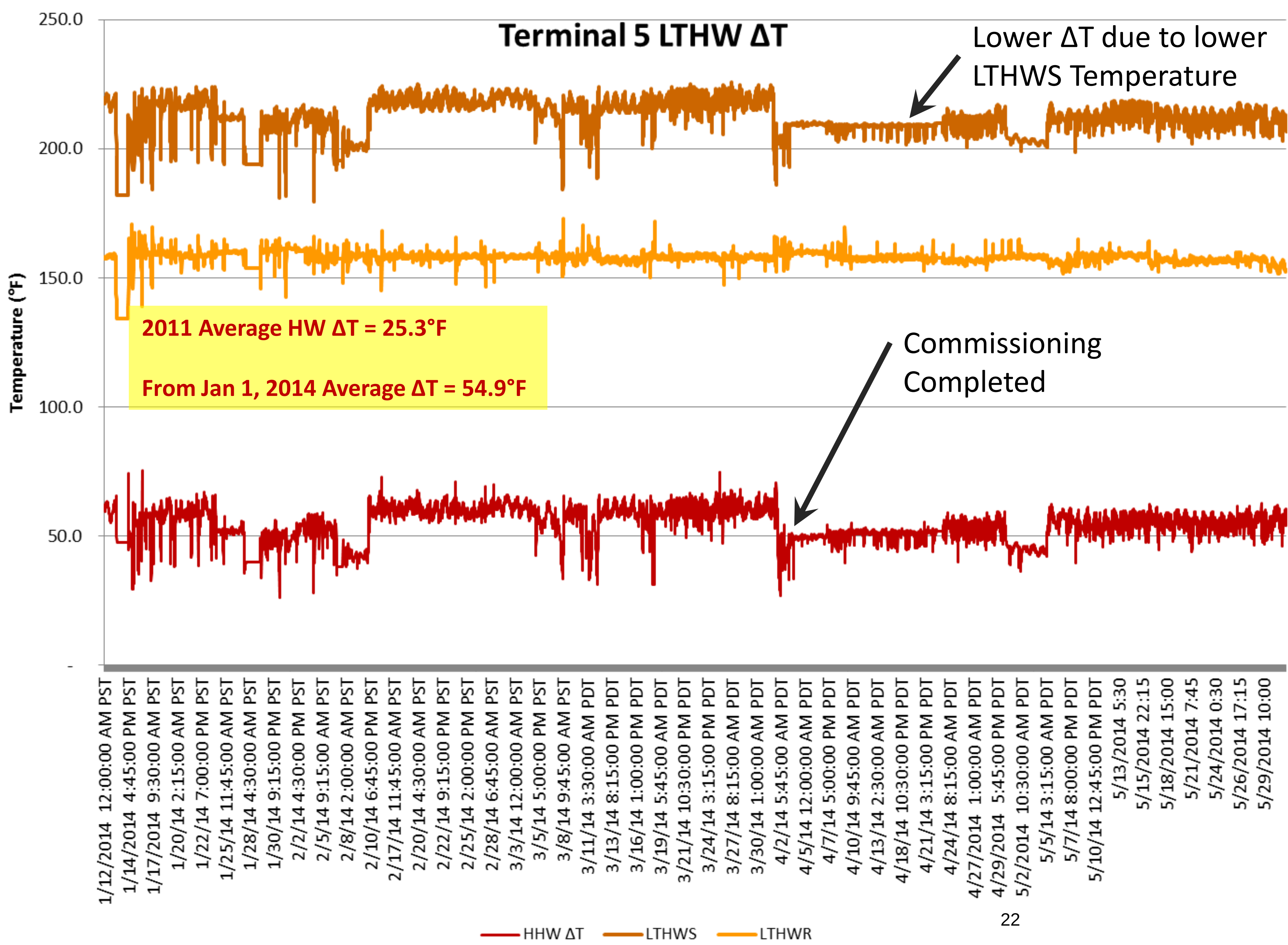
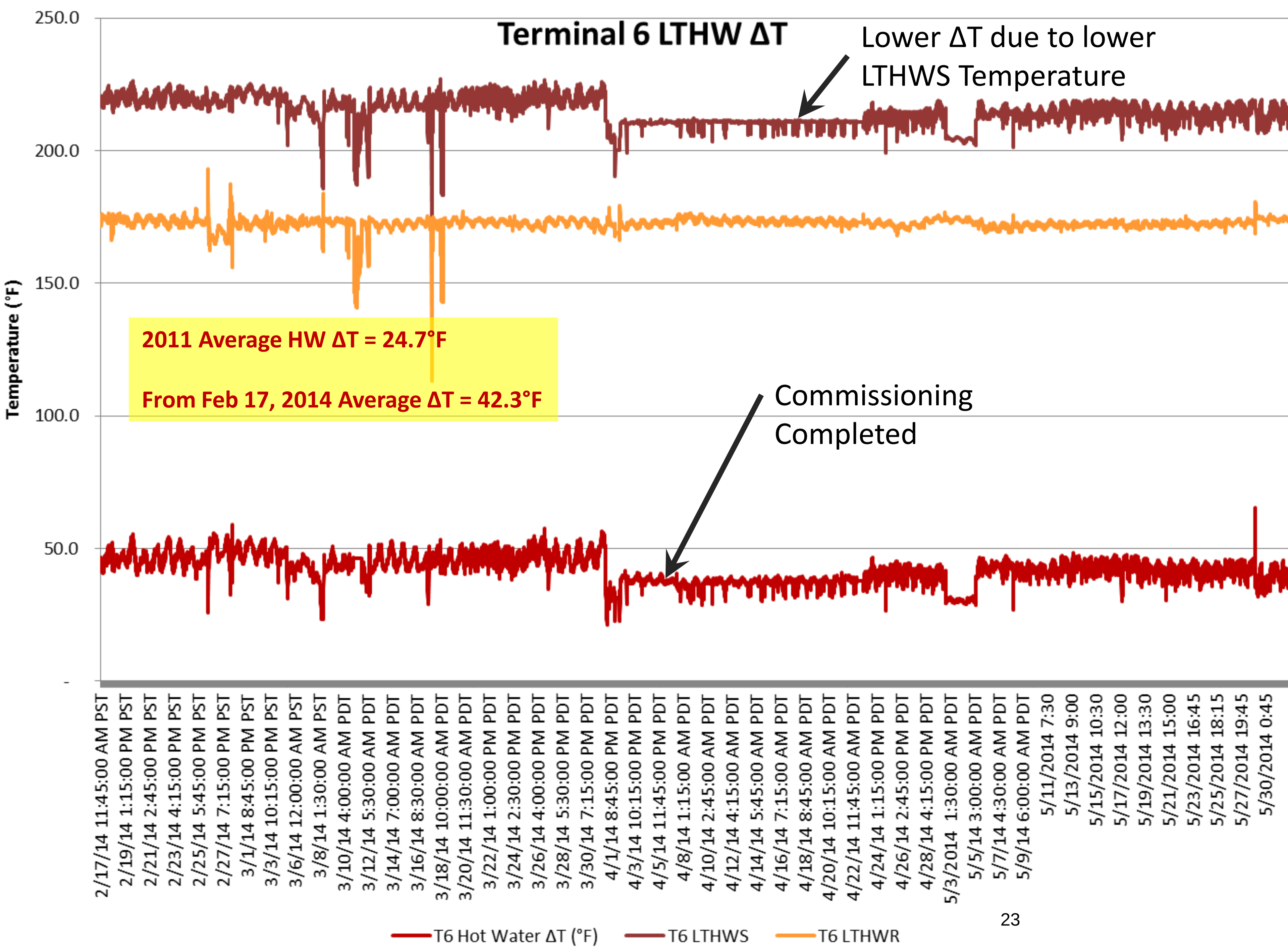
5/7/14 8:45:00 AM PDT
5/9/14 8:00:00 PM PDT
5/12/14 7:15:00 AM PDT
5/14/14 6:30:00 PM PDT
5/17/14 5:45:00 AM PDT
5/19/14 5:00:00 PM PDT
CHW ΔT
TCHWS
CHWR
V-1% Open


Terminal 2 LTHW ΔT
Lower ΔT due to lower
LTHWS Temperature
Commissioning
Completed
2011 Average HW ΔT = 5.5°F **
(fouled shell & tube HX)
From Feb 17, 2014 Average ΔT = 39.5°F
Temperature (°F)
300.0
250.0
200.0
150.0
100.0
50.0
-
10/30/13 9:45:00 AM PDT
11/3/13 9:00:00 AM PST
11/10/13 9:30:00 AM PST
11/14/13 9:45:00 AM PST
11/19/13 9:45:00 AM PST
11/23/13 10:00:00 AM PST
11/27/13 10:15:00 AM PST
12/1/13 10:30:00 AM PST
12/5/13 10:45:00 PM PST
12/9/13 11:00:00 PM PST
12/13/13 11:15:00 PM PST
12/16/13 11:30:00 PM PST
12/21/13 6:00:00 AM PST
12/25/13 6:15:00 AM PST
12/29/13 6:30:00 AM PST
1/2/14 6:45:00 AM PST
1/6/14 7:00:00 AM PST
1/10/14 2:45:00 PM PST
1/14/2014 15:00
1/18/2014 15:15
1/22/14 3:30:00 PM PST
1/26/14 3:45:00 PM PST
2/4/14 12:45:00 PM PST
2/11/14 4:45:00 AM PST
2/15/14 7:30:00 AM PST
2/19/14 7:45:00 AM PST
2/23/14 8:00:00 AM PST
3/4/14 12:45:00 PM PST
3/8/14 1:00:00 PM PST
3/12/14 2:15:00 PM PDT
3/16/14 2:30:00 PM PDT
3/20/14 2:45:00 PM PDT
3/24/14 5:15:00 PM PDT
3/28/14 5:45:00 PM PDT
4/1/14 6:00:00 PM PDT
4/5/14 6:15:00 PM PDT
4/9/14 6:45:00 PM PDT
4/13/14 7:00:00 PM PDT
4/17/14 7:15:00 PM PDT
4/22/14 6:00:00 AM PDT
4/26/14 7:00:00 AM PDT
4/30/2014 7:15
5/4/14 7:30:00 AM PDT
5/8/14 7:45:00 AM PDT
5/12/2014 8:00
5/16/2014 8:15
5/20/2014 8:45
5/24/2014 9:00
5/28/2014 9:15
T2 Terminal Hot Water ΔT (°F)
LTHWS
LTHWR



Terminal 5 LTHW ΔT
Lower ΔT due to lower LTHWS Temperature
2011 Average HW ΔT = 25.3°F
From Jan 1, 2014 Average ΔT = 54.9°F
Commissioning Completed
Temperature (°F)
250.0
200.0
150.0
100.0
50.0
-
1/12/2014 12:00:00 AM PST
1/14/2014 4:45:00 PM PST
1/17/2014 9:30:00 AM PST
1/20/14 2:15:00 AM PST
1/22/14 7:00:00 PM PST
1/25/14 11:45:00 AM PST
1/28/14 4:30:00 AM PST
1/30/14 9:15:00 PM PST
2/2/14 4:30:00 PM PST
2/5/14 9:15:00 AM PST
2/8/14 2:00:00 AM PST
2/10/14 6:45:00 PM PST
2/17/14 11:45:00 AM PST
2/20/14 4:30:00 AM PST
2/22/14 9:15:00 PM PST
2/25/14 2:00:00 PM PST
2/28/14 6:45:00 AM PST
3/3/14 12:00:00 AM PST
3/5/14 5:00:00 PM PST
3/8/14 9:45:00 AM PST
3/11/14 3:30:00 AM PDT
3/13/14 8:15:00 PM PDT
3/16/14 1:00:00 PM PDT
3/19/14 5:45:00 AM PDT
3/21/14 10:30:00 PM PDT
3/24/14 3:15:00 PM PDT
3/27/14 8:15:00 AM PDT
3/30/14 1:00:00 AM PDT
4/2/14 5:45:00 AM PDT
4/5/14 12:00:00 AM PDT
4/7/14 5:00:00 PM PDT
4/10/14 9:45:00 AM PDT
4/13/14 2:30:00 AM PDT
4/18/14 10:30:00 PM PDT
4/21/14 3:15:00 PM PDT
4/24/14 8:15:00 AM PDT
4/27/2014 1:00:00 AM PDT
4/29/2014 5:45:00 PM PDT
5/2/2014 10:30:00 AM PDT
5/5/14 3:15:00 AM PDT
5/7/14 8:00:00 PM PDT
5/10/14 12:45:00 PM PDT
5/13/2014 5:30
5/15/2014 22:15
5/18/2014 15:00
5/21/2014 7:45
5/24/2014 0:30
5/26/2014 17:15
5/29/2014 10:00
HHW ΔT
LTHWS
LTHWR



Terminal 6 LTHW ΔT
Lower ΔT due to lower LTHWS Temperature
2011 Average HW ΔT = 24.7°F
From Feb 17, 2014 Average ΔT = 42.3°F
Commissioning Completed
Temperature (°F)
250.0
200.0
150.0
100.0
50.0
-
2/17/14 11:45:00 AM PST
2/19/14 1:15:00 PM PST
2/21/14 2:45:00 PM PST
2/23/14 4:15:00 PM PST
2/25/14 5:45:00 PM PST
2/27/14 7:15:00 PM PST
3/1/14 8:45:00 PM PST
3/3/14 10:15:00 PM PST
3/6/14 12:00:00 AM PST
3/8/14 1:30:00 AM PST
3/10/14 4:00:00 AM PDT
3/12/14 5:30:00 AM PDT
3/14/14 7:00:00 AM PDT
3/16/14 8:30:00 AM PDT
3/18/14 10:00:00 AM PDT
3/20/14 11:30:00 AM PDT
3/22/14 1:00:00 PM PDT
3/24/14 2:30:00 PM PDT
3/26/14 4:00:00 PM PDT
3/28/14 5:30:00 PM PDT
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4/1/14 8:45:00 PM PDT
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4/16/14 7:15:00 AM PDT
4/18/14 8:45:00 AM PDT
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4/22/14 11:45:00 AM PDT
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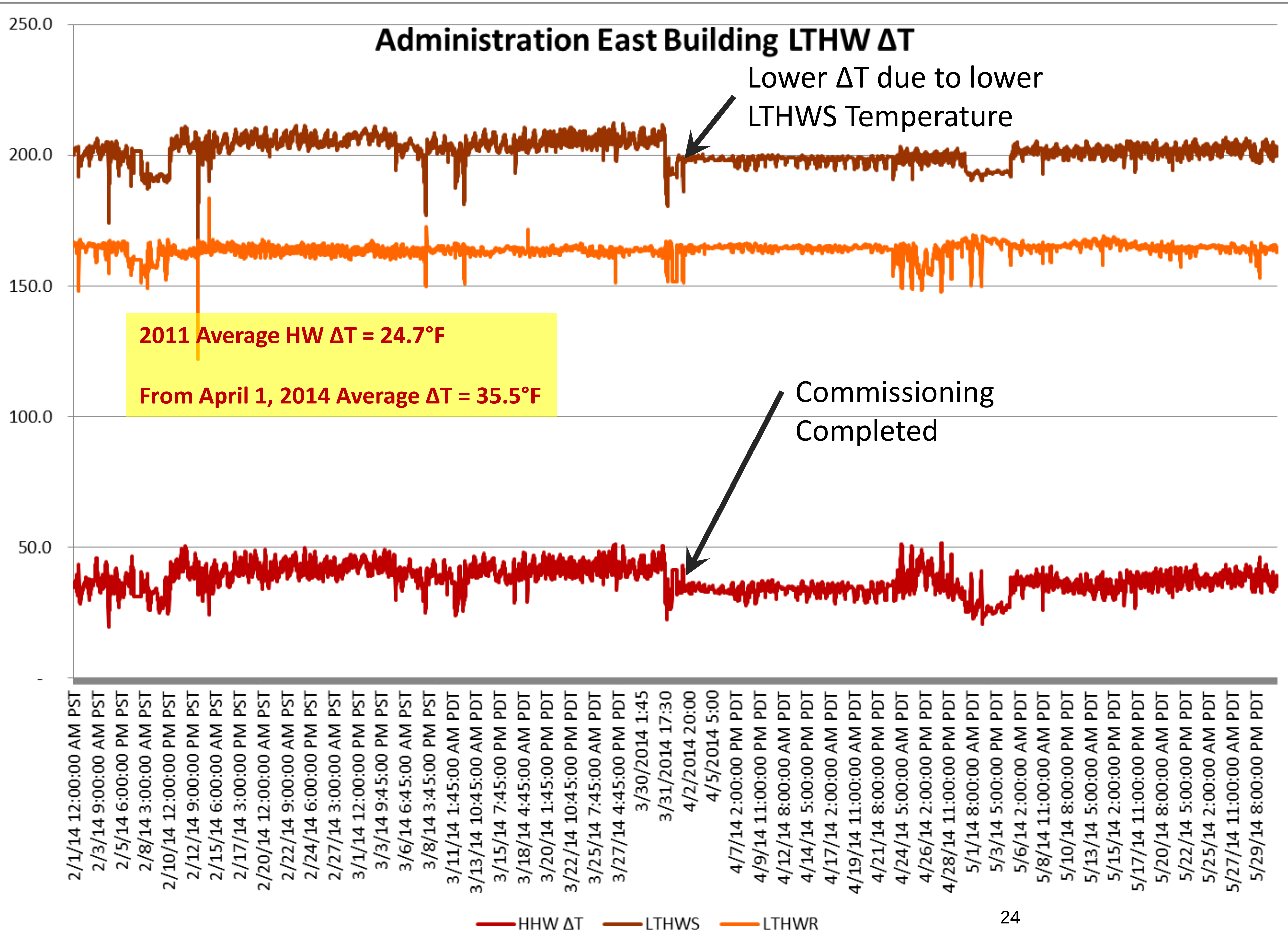
4/26/14 2:45:00 PM PDT
4/28/14 4:15:00 PM PDT
5/3/2014 1:30:00 AM PDT
5/5/14 3:00:00 AM PDT
5/7/14 4:30:00 AM PDT
5/9/14 6:00:00 AM PDT
5/11/2014 7:30
5/13/2014 9:00
5/15/2014 10:30
5/17/2014 12:00
5/19/2014 13:30
5/21/2014 15:00
5/23/2014 16:45
5/25/2014 18:15
5/27/2014 19:45
5/30/2014 0:45
T6 Hot Water ΔT (°F)
T6 LTHWS
T6 LTHWR


Administration East Building LTHW ΔT
Lower ΔT due to lower LTHWS Temperature
Commissioning Completed
2011 Average HW ΔT = 24.7°F
From April 1, 2014 Average ΔT = 35.5°F
250.0
200.0
150.0
100.0
50.0
-
2/1/14 12:00:00 AM PST
2/3/14 9:00:00 AM PST
2/5/14 6:00:00 PM PST
2/8/14 3:00:00 AM PST
2/10/14 12:00:00 PM PST
2/12/14 9:00:00 PM PST
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3/1/14 12:00:00 PM PST
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3/8/14 3:45:00 PM PST
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3/22/14 10:45:00 PM PDT
3/25/14 7:45:00 AM PDT
3/27/14 4:45:00 PM PDT
3/30/2014 1:45
3/31/2014 17:30
4/2/2014 20:00
4/5/2014 5:00
4/7/14 2:00:00 PM PDT
4/9/14 11:00:00 PM PDT
4/12/14 8:00:00 AM PDT
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5/29/14 8:00:00 PM PDT
HHW ΔT
LTHWS
LTHWR

Were the Upgrades Successful?

- Almost doubled the ΔT, halving the flow required to serve the same heating and cooling load.
- Have to address the issue with higher terminal CHWS at 48°F and leaving air temperature of cooling coils
- Not all terminals are like Terminal 5.
  - Need to assess reasons and correct
  - Replace remainder of 3-way valves & ΔT Pirates
- T1 & T3 have not undergone full ETS implementation due to imminent remodeling projects
- New Bradley West not interconnected to CUP yet

Questions?

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