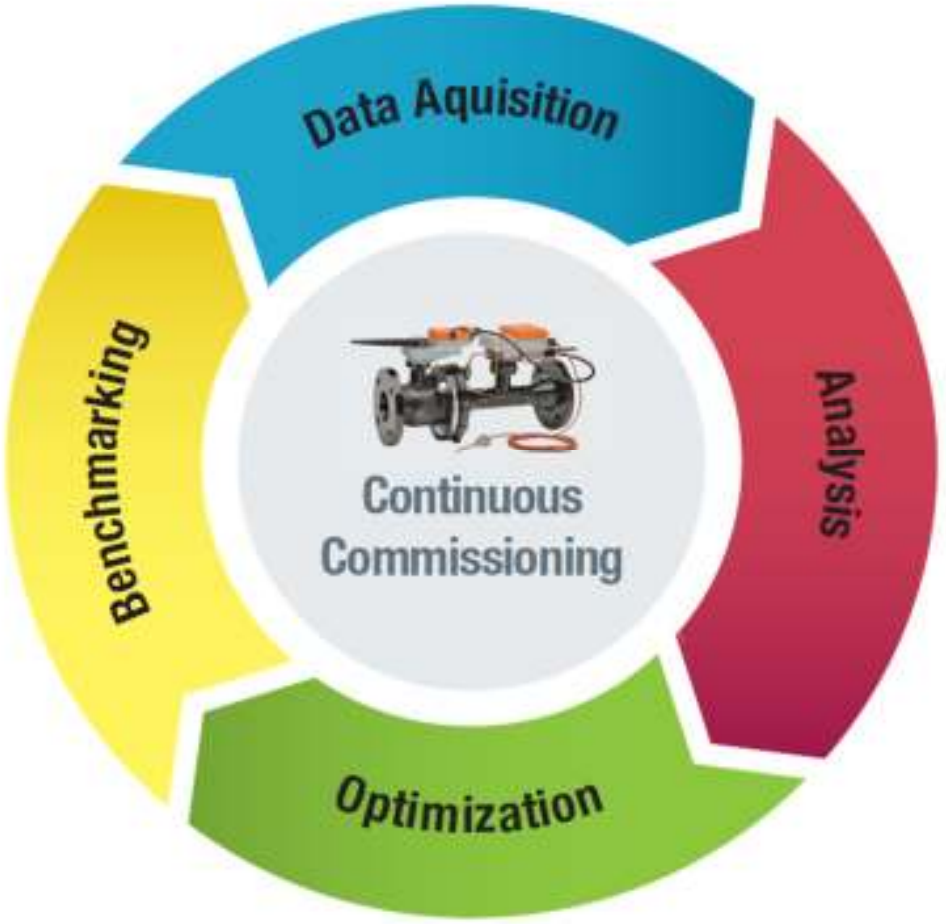
Improved Chilled Water Plant Performance with New Energy Valve (EV)

Outline

- Chilled Water ΔT Study
- AHU Coil Overview
- Cooling Overview
- Test Setup
- Data Analysis
- Findings
- Summary



The Energy Valve, (EV)

- The EV is an intelligent/smart valve that corrects Low Delta T Syndrome in Chilled Water systems.
- Low Delta T Syndrome occurs when the temperature difference between Supply and Return chilled water temperatures across an Air Handling Unit, (AHU), heat exchanger is lower than the Chiller's Design Chilled Water Delta T . This causes additional chillers to come on line even though the cooling load has not increased, thus wasting energy.

Hayden Library Case Study

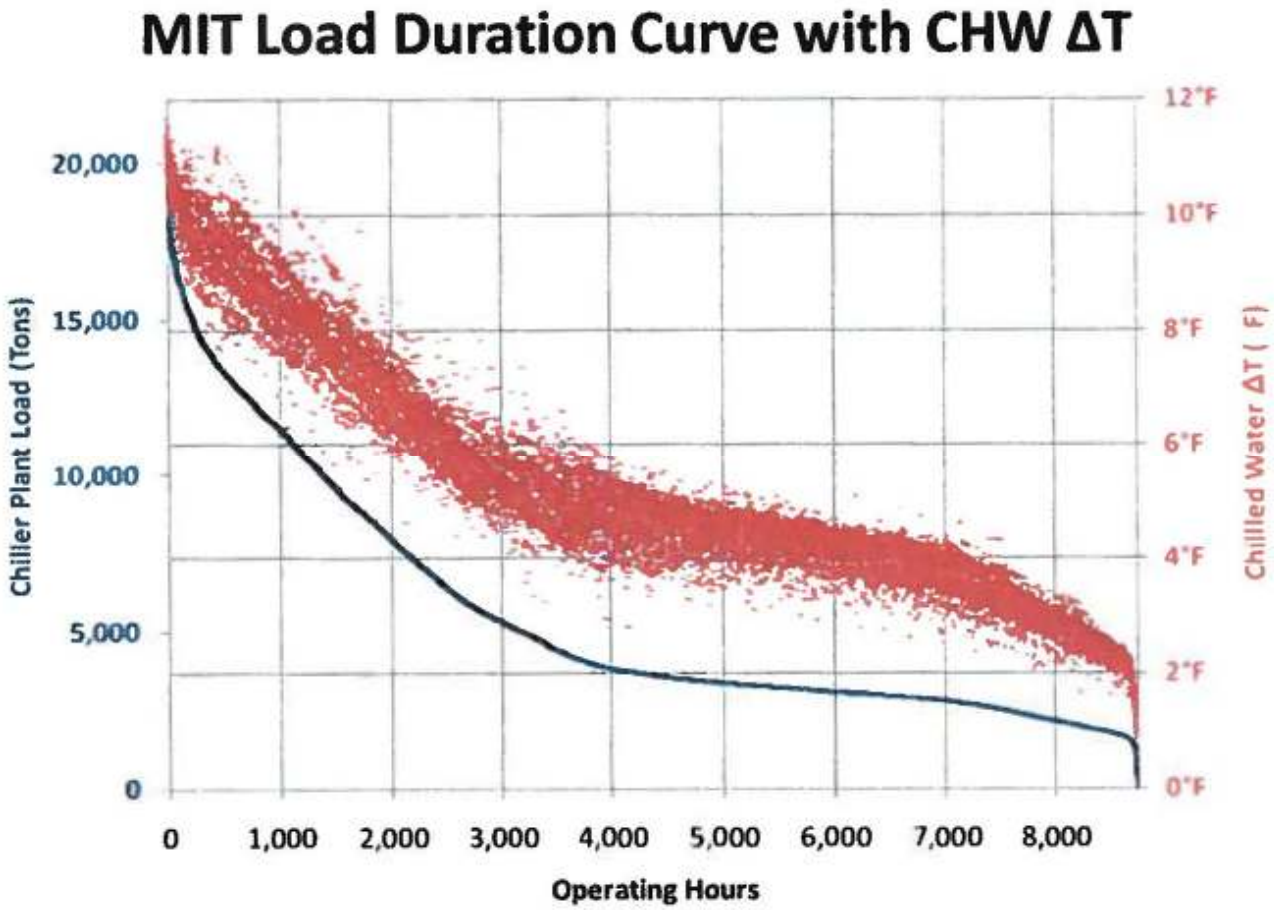
MIT Savings goal by eliminating causes of low Delta T (30,000 Ton Plant)

WM Group Engineers
Smart solutions that work.

Recommend implementing chilled water delta T improvement projects across the campus….

Component	Annual Energy Savings	Annual Cost Savings	
Chiller Steam	10,887 Mlbs	$181,000.00	
Chiller Electric	2,576,000 kWh	$412,000.00	
CHW Pump Electric	2,334,000 kWh	$373,000.00	25%
CW Pump Electric	2,417,000 kWh	$387,000.00	
CT Fan Electric	740,000 kWh	$118,000.00	
TOTAL SAVINGS		$1,471,000.00	100%

MIT Chilled Water System 2011
Peak Load 26,000 tons



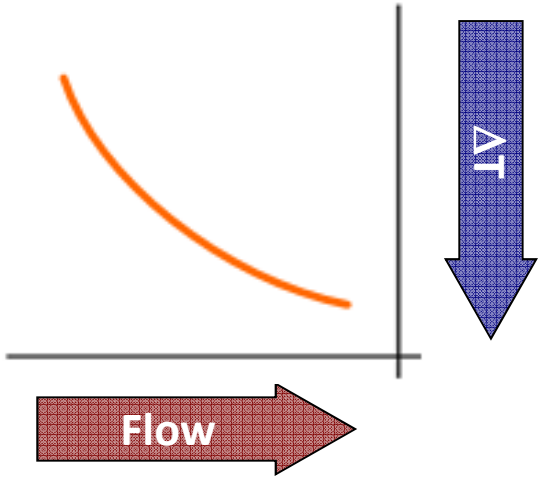
WM Group Engineers
Smart solutions that work.

* From 2008 Chilled Water Delta T Study

Cooling Energy

$$GPM = \frac{Tons \times 24}{\Delta T}$$

Flow & **ΔT** are inversely proportional; for a given load, as flow increases, **ΔT** drops



The Coil

Causes of Low ΔT

Overflowing the coil

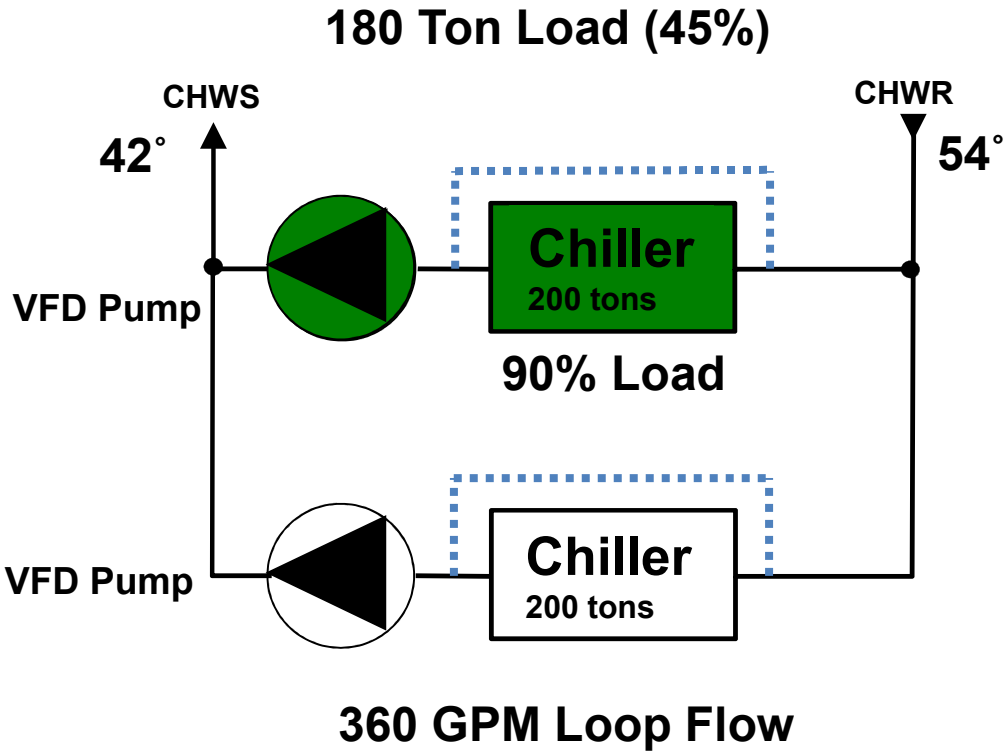
- Control valves oversized
- Improper balancing
- Non-dynamic balancing
- Dirty or fouled coils
- etc.

Typical Chilled Water System

System Data
Chiller #1 Load = 90%
Chiller #2 Load = 0%
Loop Flow = 360 GPM
Chiller ΔT = 12˚F

Increase flow by 15%

Design: 400 Ton CHW System @ 12˚ΔT



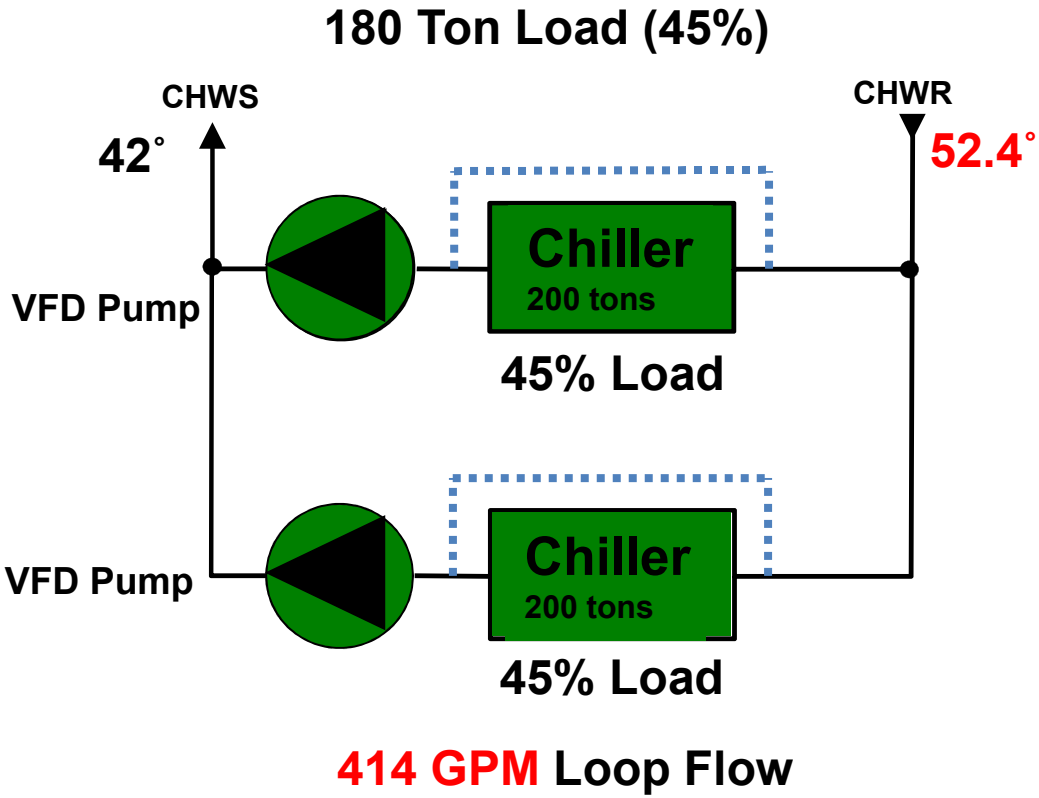
Typical Chilled Water System

System Data
Chiller #1 Load = 45%
Chiller #2 Load = 45%
Loop Flow = 414 GPM
Chiller ΔT = 10.4˚F

Increase flow by 15%

An additional pump and chiller were started to meet the flow demand, not cooling demand!

Design: 400 Ton CHW System @ 12˚ΔT



Cooling Energy

$$GPM = \frac{Tons \times 24}{\Delta T}$$

Flow & **ΔT** are inversely proportional; for a given load, as flow increases, **ΔT** drops

You have to run your central plant to supply the building's need for water, not it's need for cooling!

If flow is increased by 15%, Delta T is lowered by 13% !

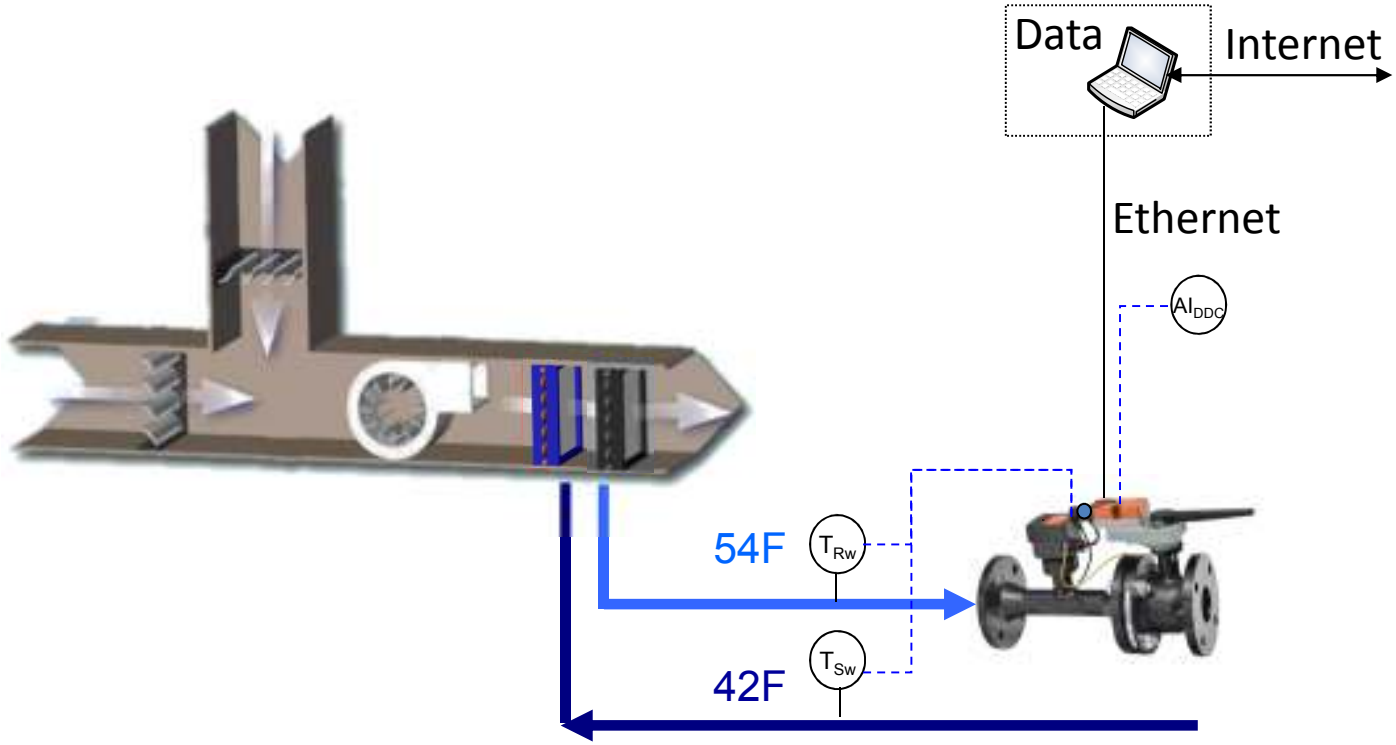
Charles Hayden Library

6 AHU units, 153,000 sq-ft

Case Study Issues

- Coil ΔT reported as 6 Degree F
- Over pumping
- Low DeltaT Syndrome at Chiller Plant

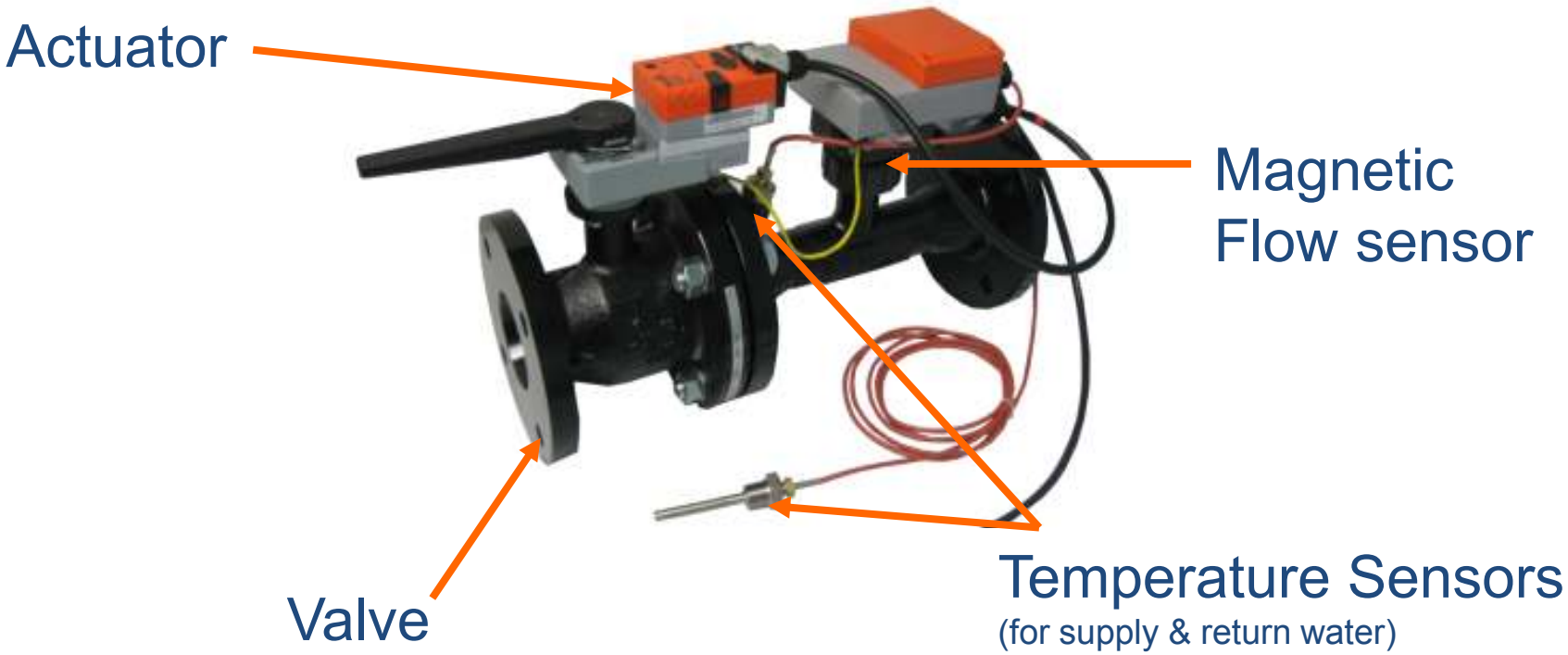
Case Study Setup



Chilled Water is designed to run through a coil at a designed temperature drop to supply air conditioned cooling air and to de-humidify. i.e. Water Delta T=12 degrees F.

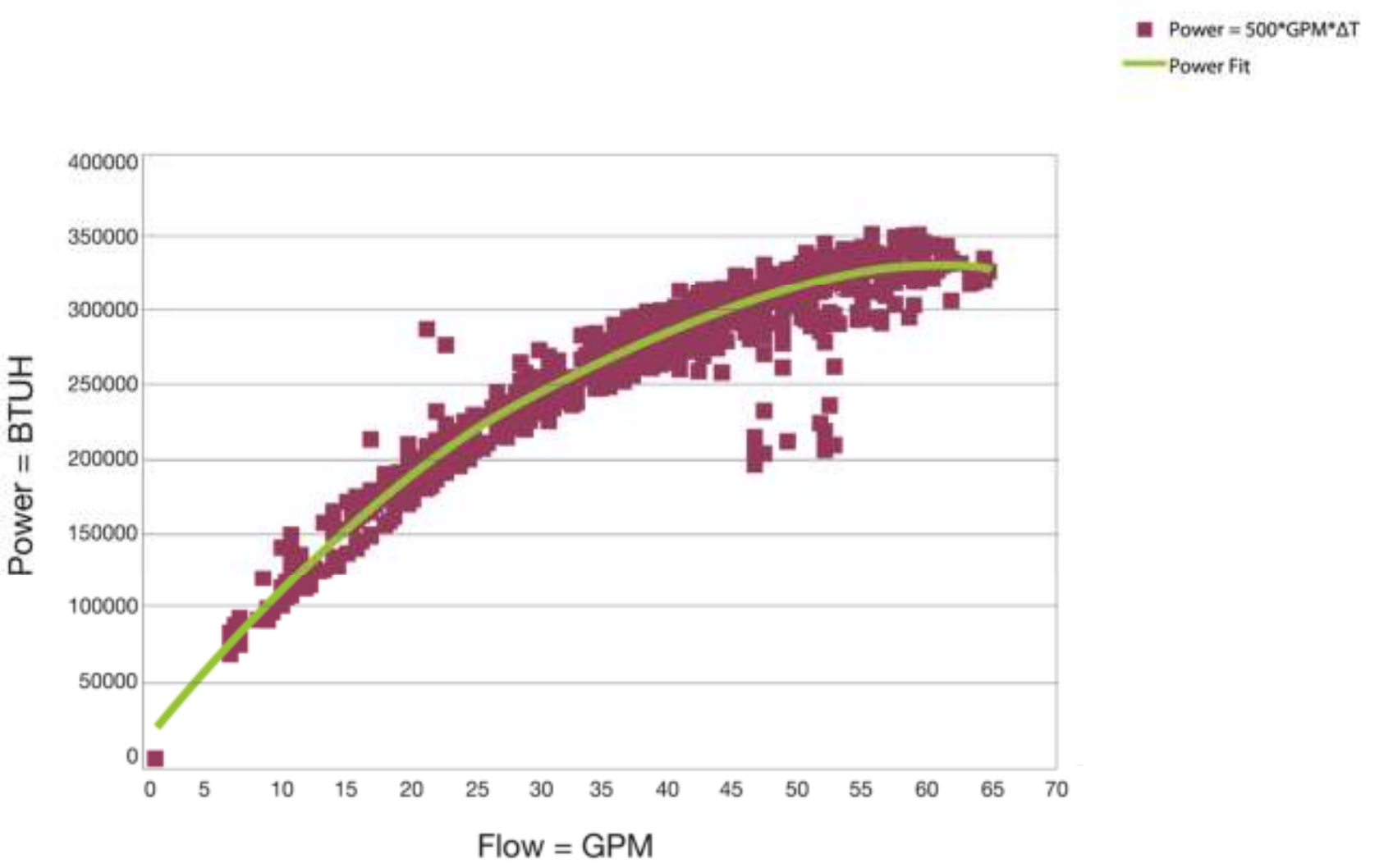
Belimo Energy Valve ™

The Energy Valve is a pressure independent control valve that optimizes, documents and proves water coil performance.



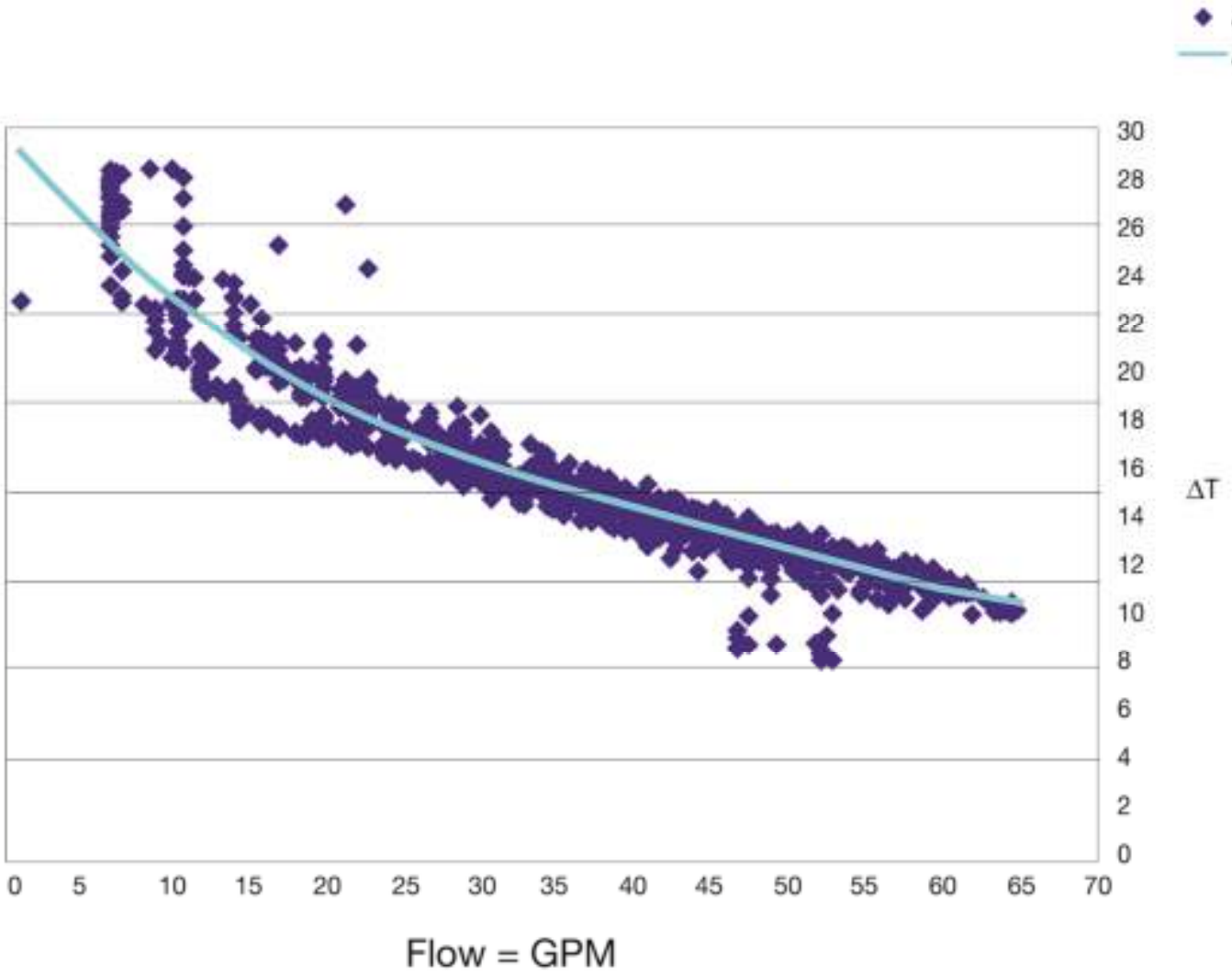
AHU-6 Cooling Power Curve:

July 4, 2011



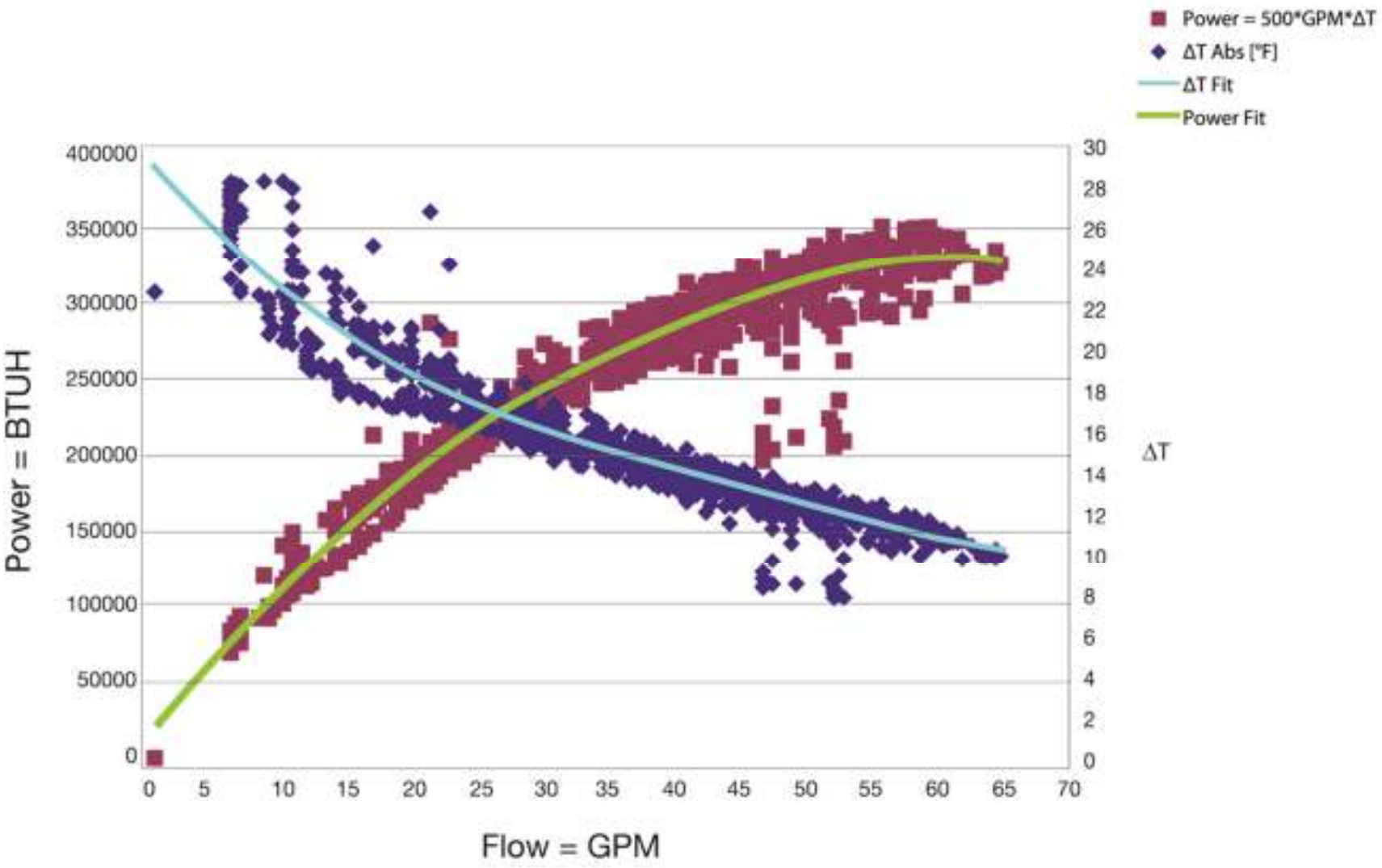
AHU-6 Chilled Water ΔT Curve:

July 4, 2011



AHU-6 Power & ΔT Curve:

July 4, 2011



Definitions

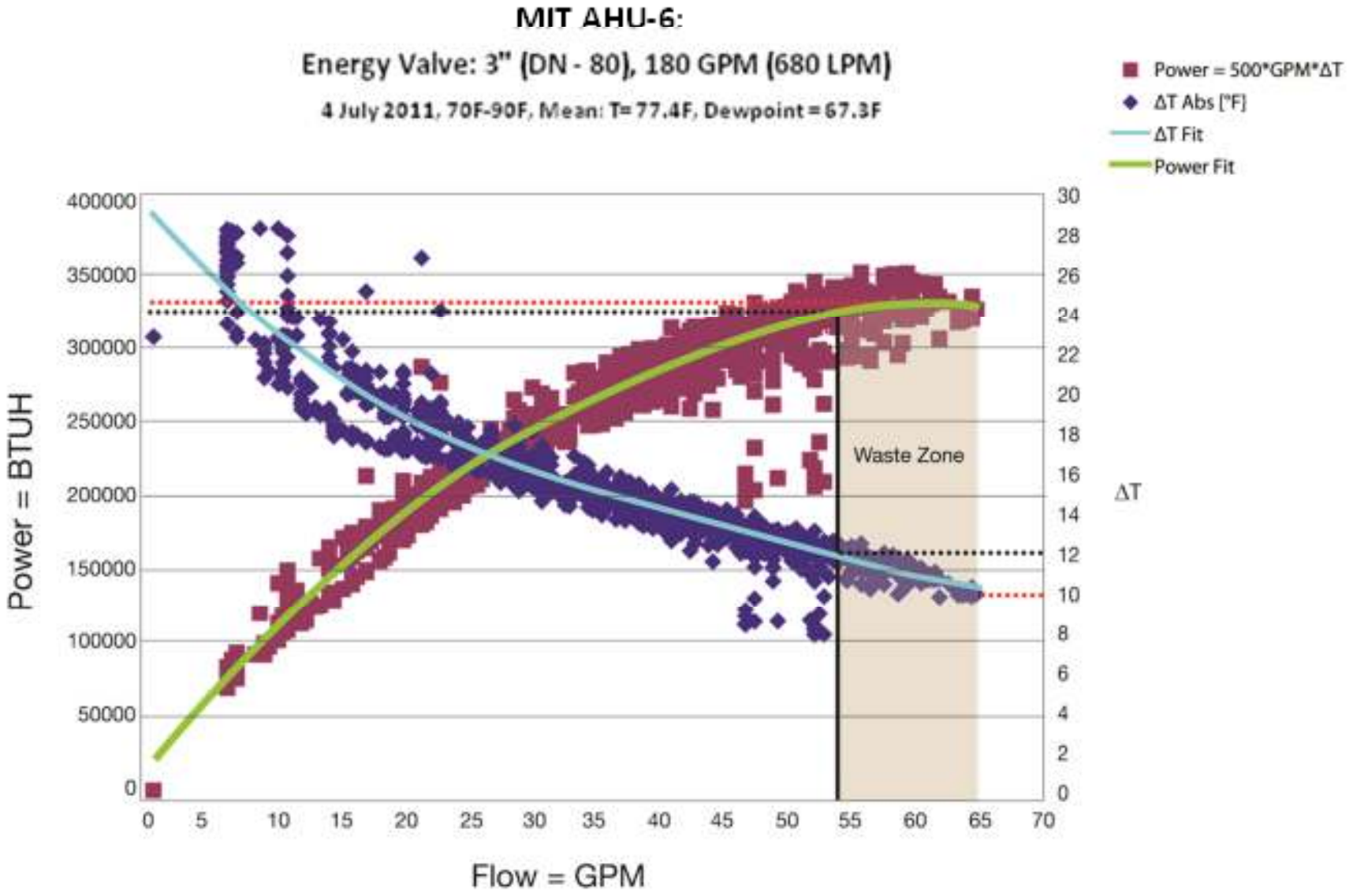
Power Saturation Point

Point beyond which coil cannot yield additional heat transfer regardless of increased flow.

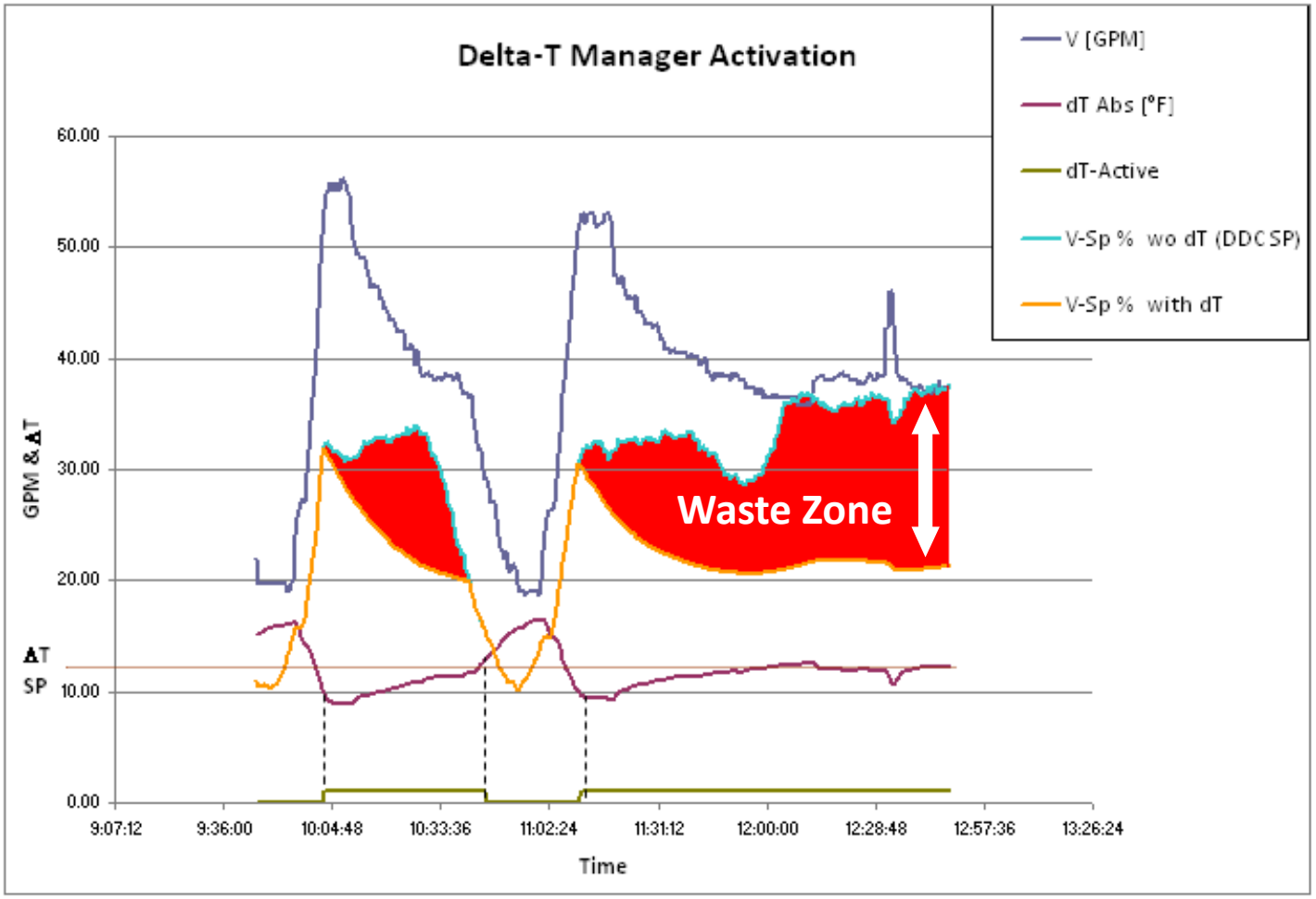
Waste Zone

Range beyond the “Power Saturation Point”.

Power Saturation & Waste Zone

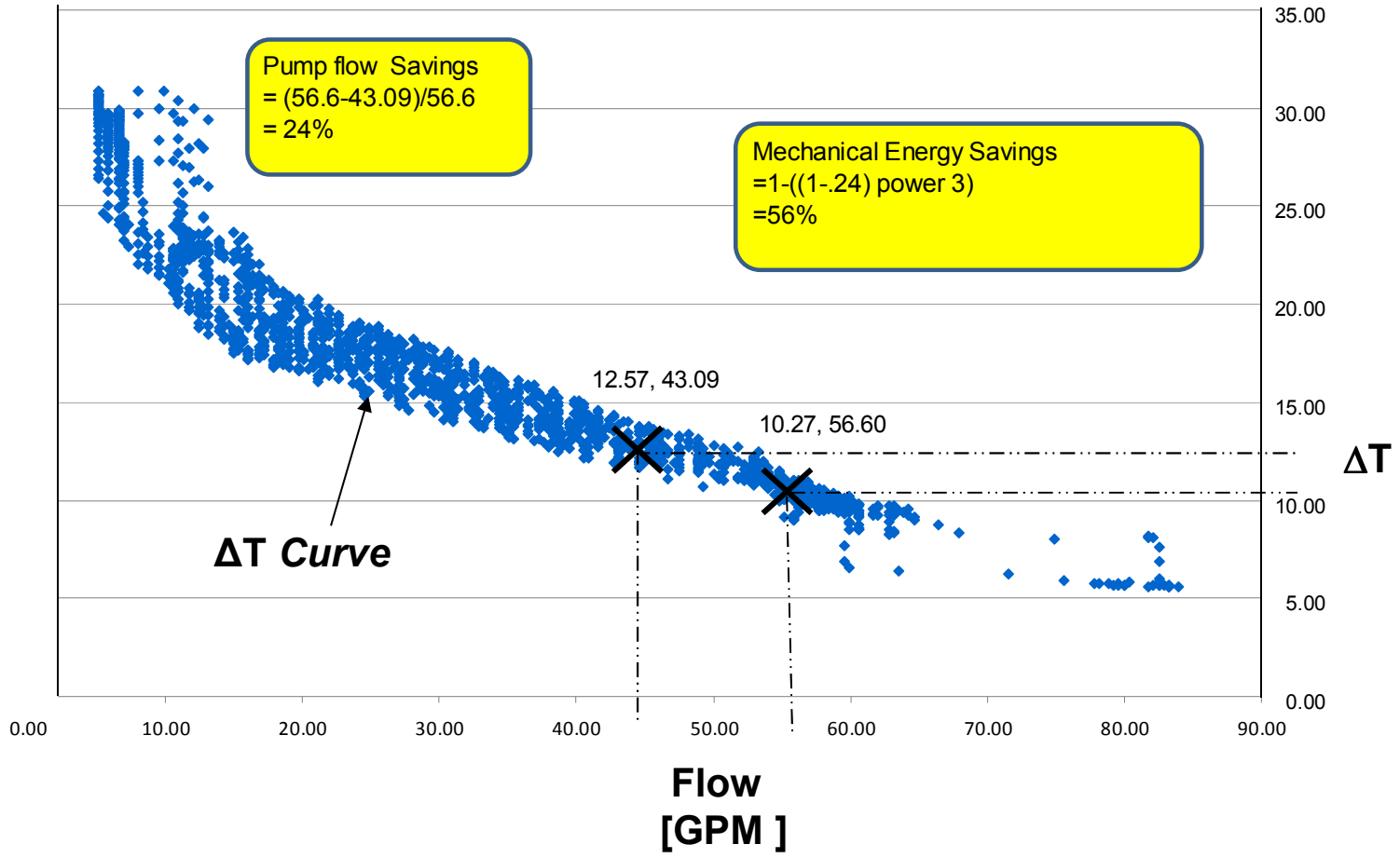


Energy Valve Delta-T Manager

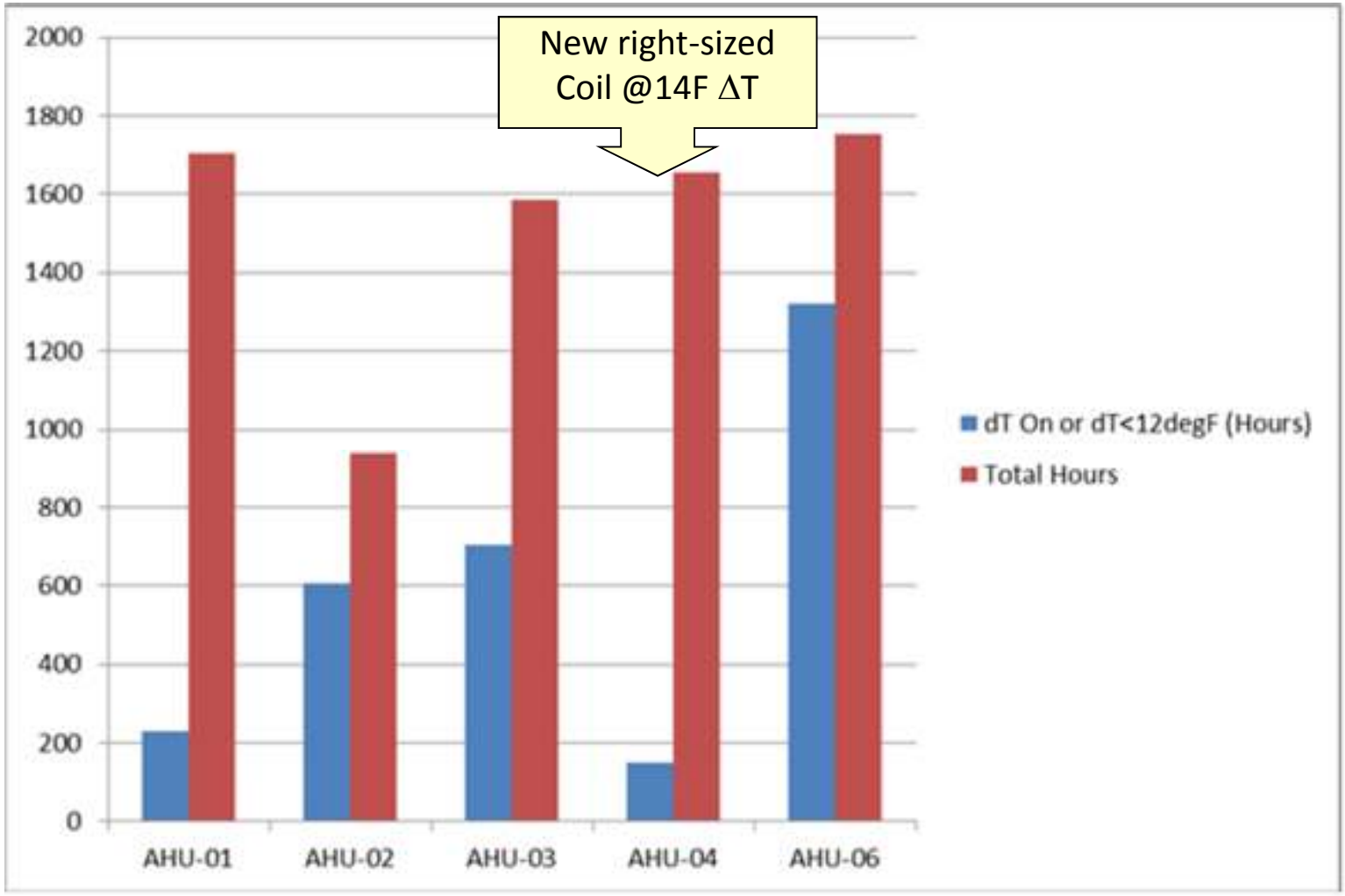


Pump Savings Example

24% flow savings = 56% energy savings



Hours Delta T Manager Active
(Summer 2011)



Hayden Whole Building Results

6 AHU units, 153,000 sq-ft

2011 vs. 2010 Flow

- 8/9-10/9 2010 6.15 F ΔT
- 8/9-10/9 2011 12.14 F ΔT

From whole building meters, Metering data PI archive
Tonsx24/GPM= Weighted Average Delta T

Hayden Library
Case Study Findings

1. The Delta-T limiting is especially effective on coils that display "power saturation"

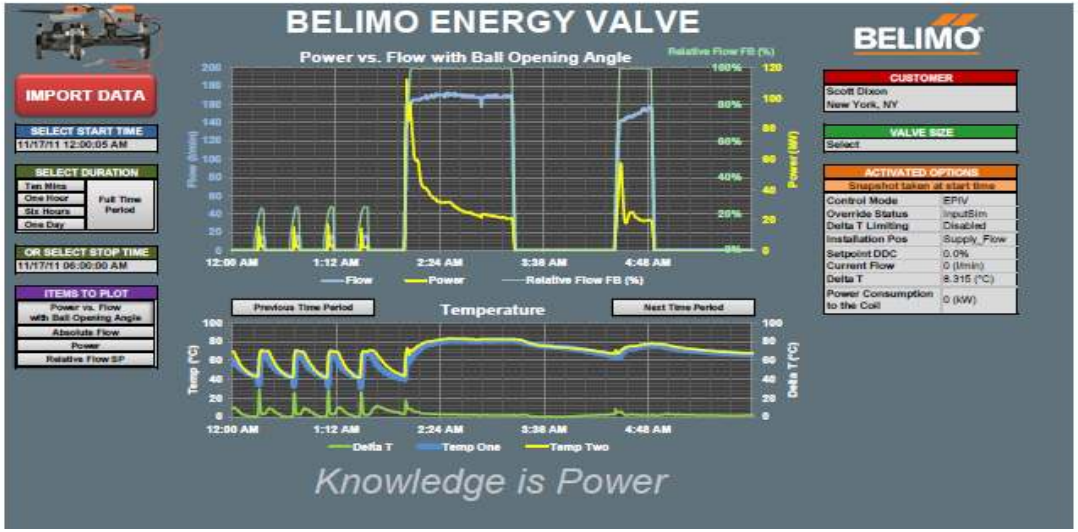
2. Overall reduction of chilled water flow

3. Significant energy savings are realized in mechanical pumping energy with Delta-T Manger
   - Estimated annual pump energy savings of $12,529
   - Total estimated annual overall savings of $50,116
   - Two year payback
   - NSTAR and National Grid are conducting EV evaluations to determine incentives

Belimo Energy Valve

Technical Summary

- Maximize coil performance
- Monitor savings at the coil level
- Documented commissioning of coil
- 13 month data archive



Thank You

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