



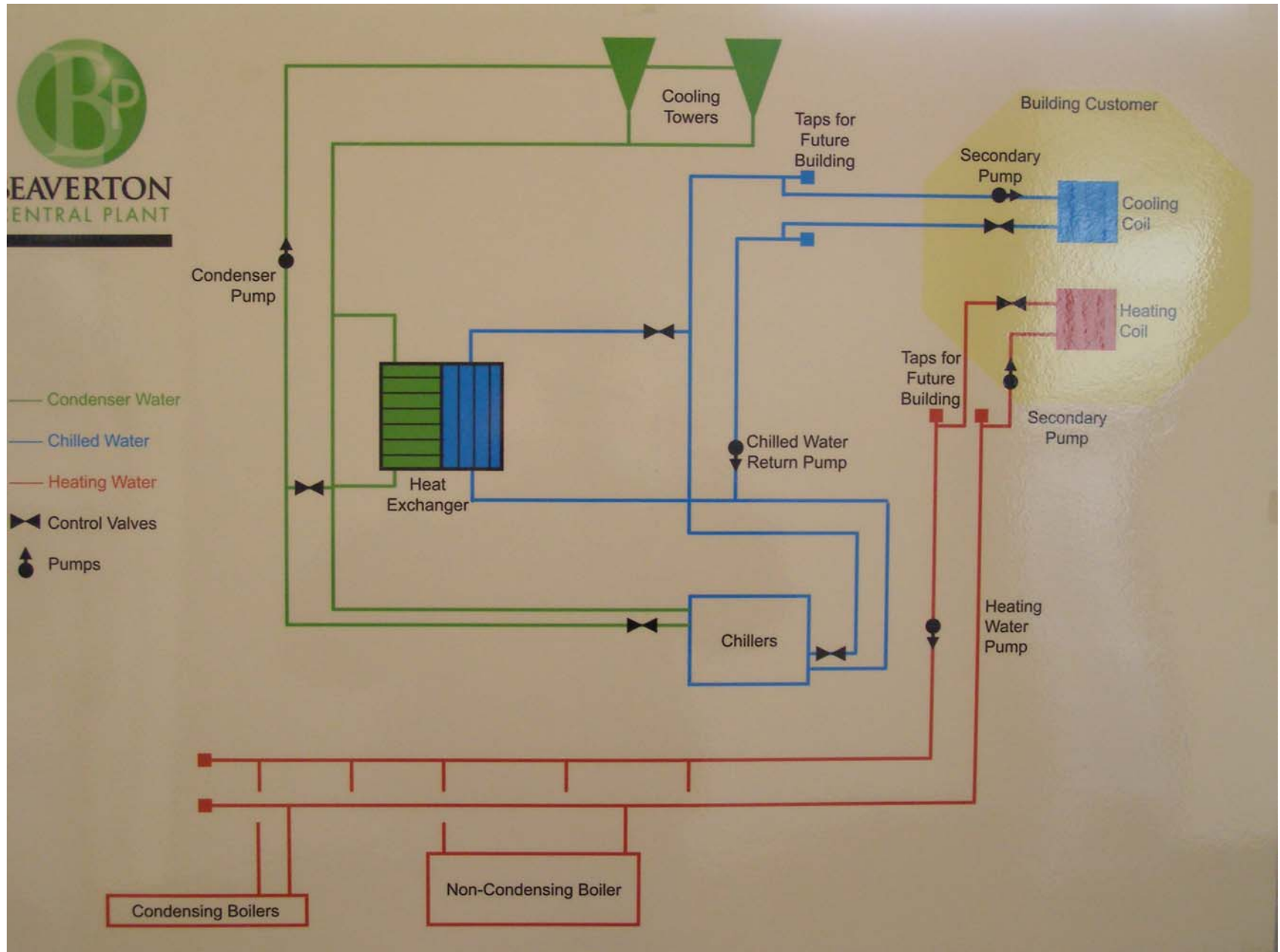
## **Solutions to Maximize Boiler and Central Plant Operations:** The Beaverton Round Case Study

Presenter:

Michael Hatten, SOLARC Architecture and Engineering

APEM Fall Forum, September 30, 2011

# Beaverton Round Plant

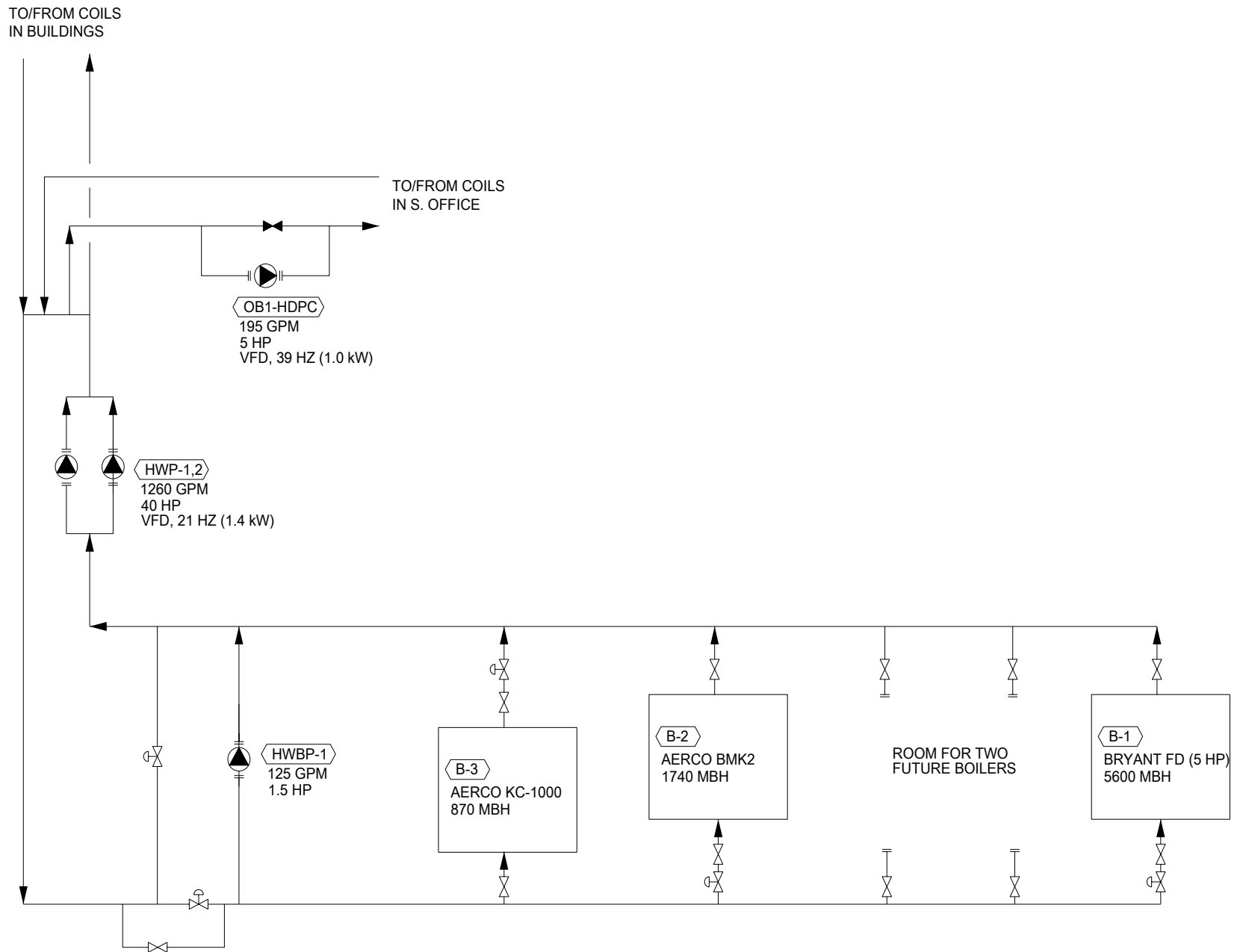


## Beaverton Plant Performance Assessment Process

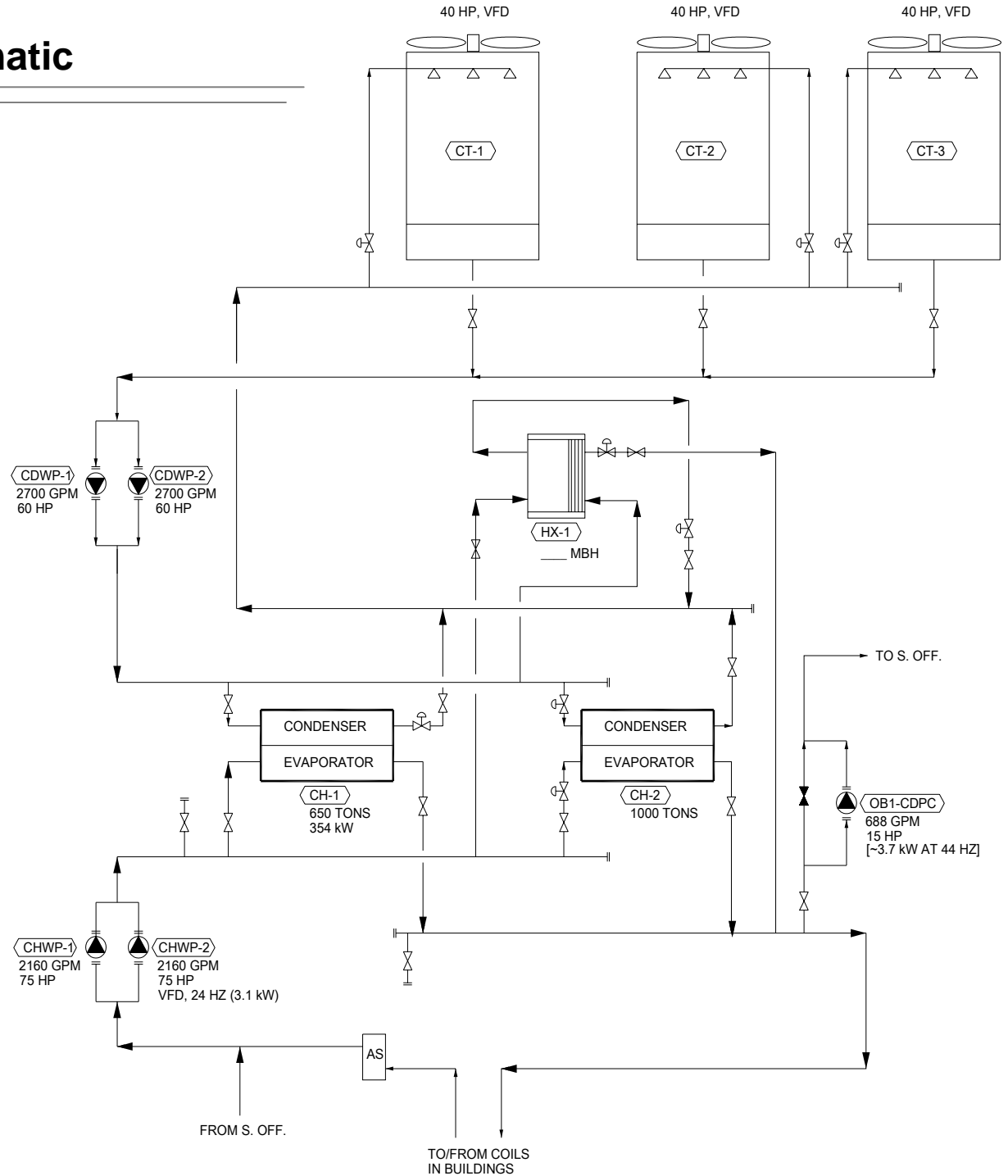
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- **Section 1 – Executive Summary** – presents a general overview of the plant that is intended to establish a context for comparison with similar facilities, identify the nature of potential improvements that could be considered, and identify any investment planning recommendations related to plant infrastructure.
- **Section 2 – Plant Energy Efficiency** – discusses in some detail the energy efficiency of the plant both at peak capacity as well as at part load performance. The calculated performance parameters are compared to typical heating and cooling plant statistics.
- **Section 3 – Building Loads and Energy Use** – discusses the building level systems that impose heating and cooling loads on the central plant. Information is presented that provides a summary of opportunities for load reduction, especially related to heating loads. Desired building system features associated with future development are identified.
- **Section 4 – Plant and Building Maintenance Issues** – reviews the overall heating and cooling energy used by the plant, and reviews opportunities (identified in other sections) to modify plant operations so that energy use will be reduced. Building-level modifications are also discussed. Considerations for future changes to the rate schedules are also presented.

# Heating Plant Schematic

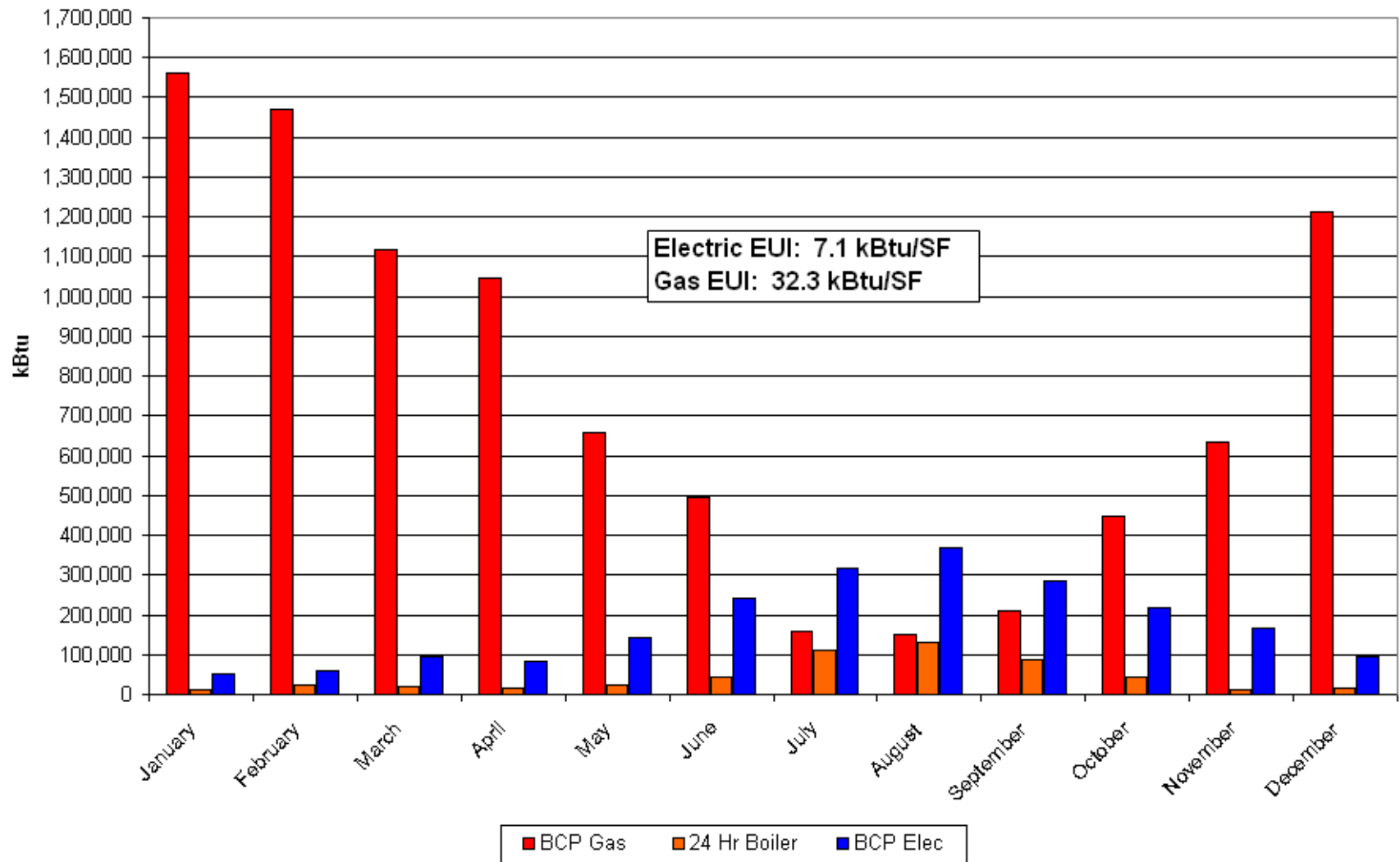


# Cooling Plant Schematic



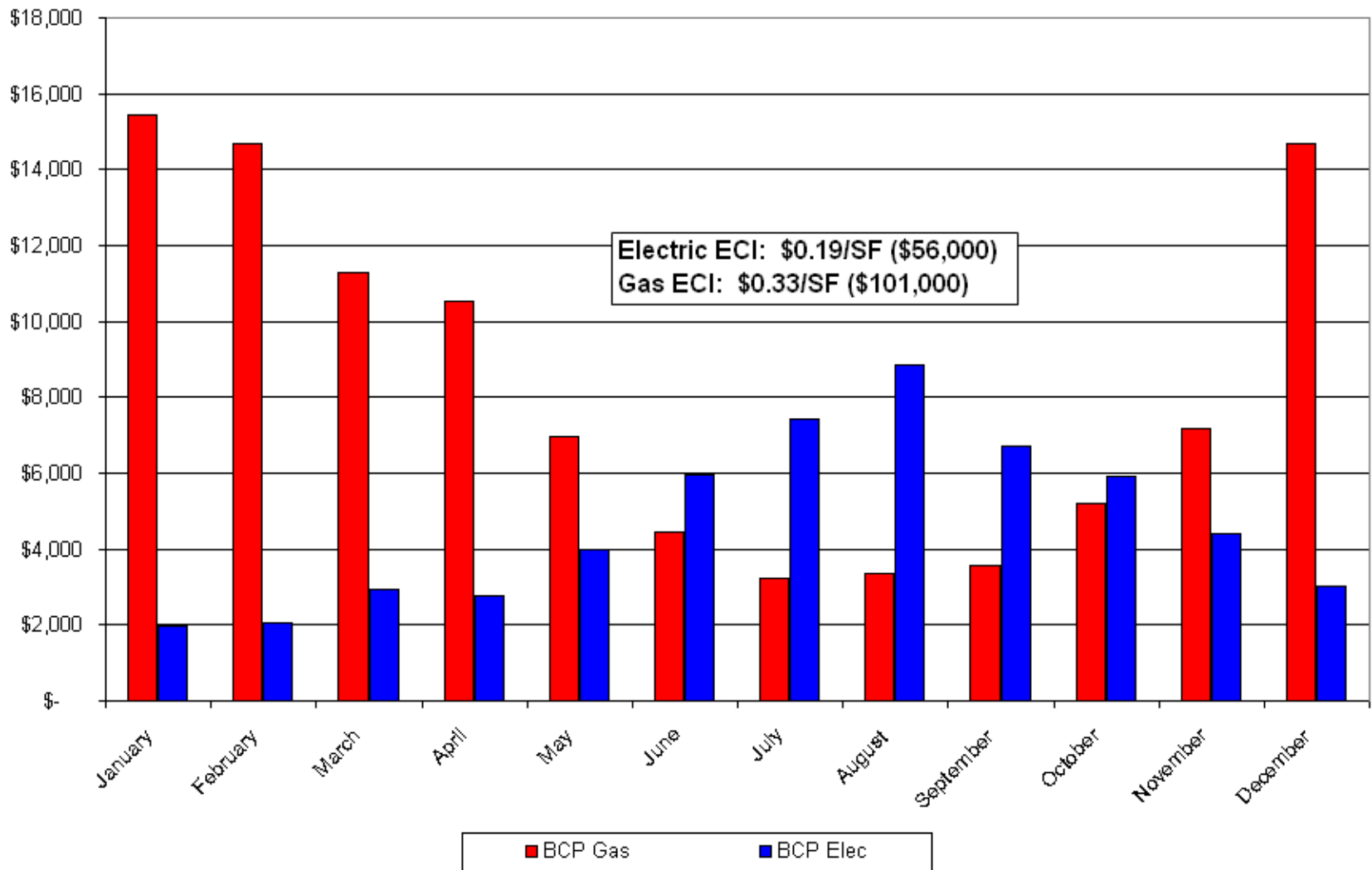
# Annual Plant Energy Use

2008 Plant Energy Use - Gas & Electric



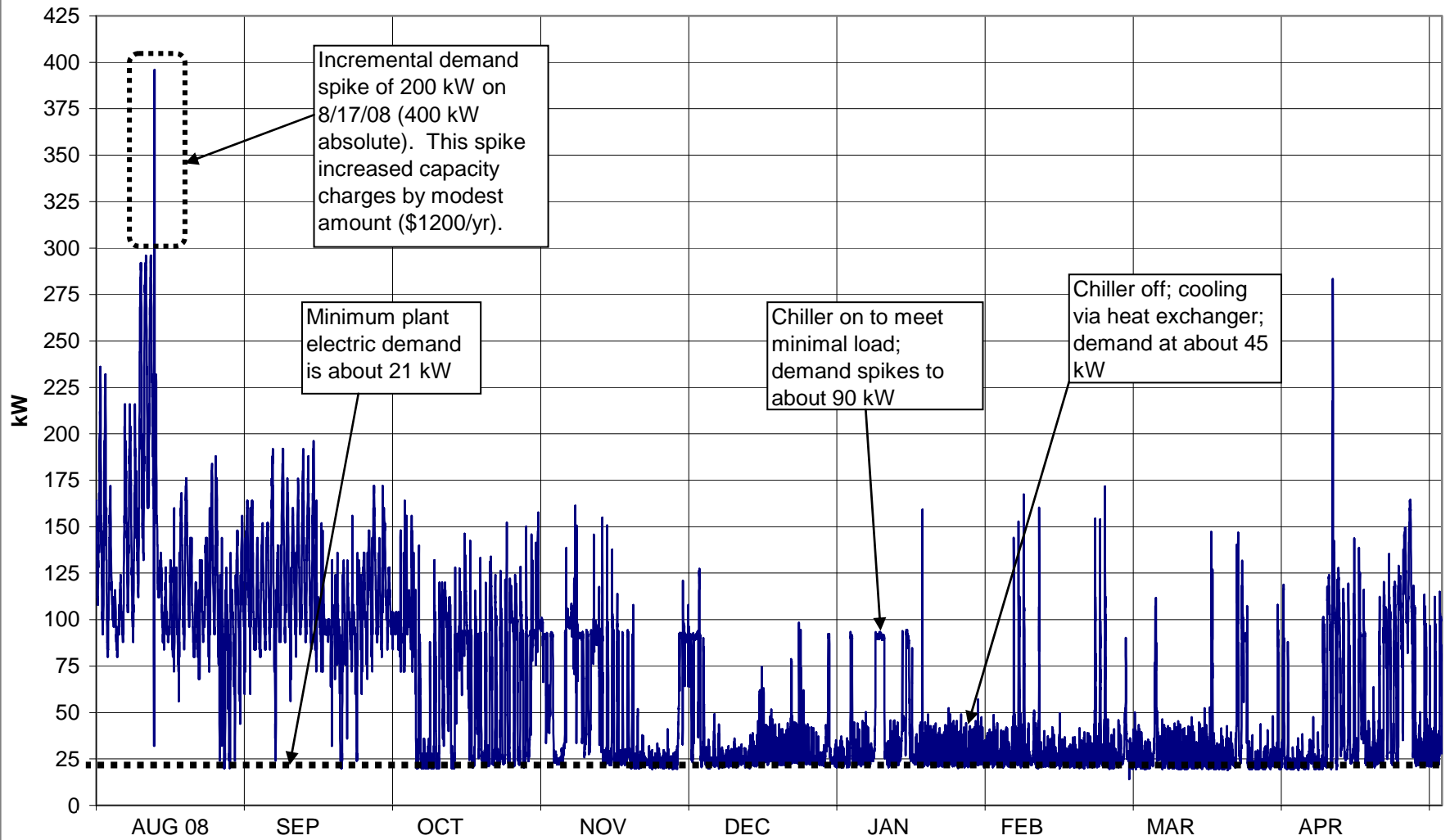
# Annual Plant Energy Cost

2008 Plant Energy Cost - Gas & Electric



# Plant Electric Use Profile: 15 minute intervals

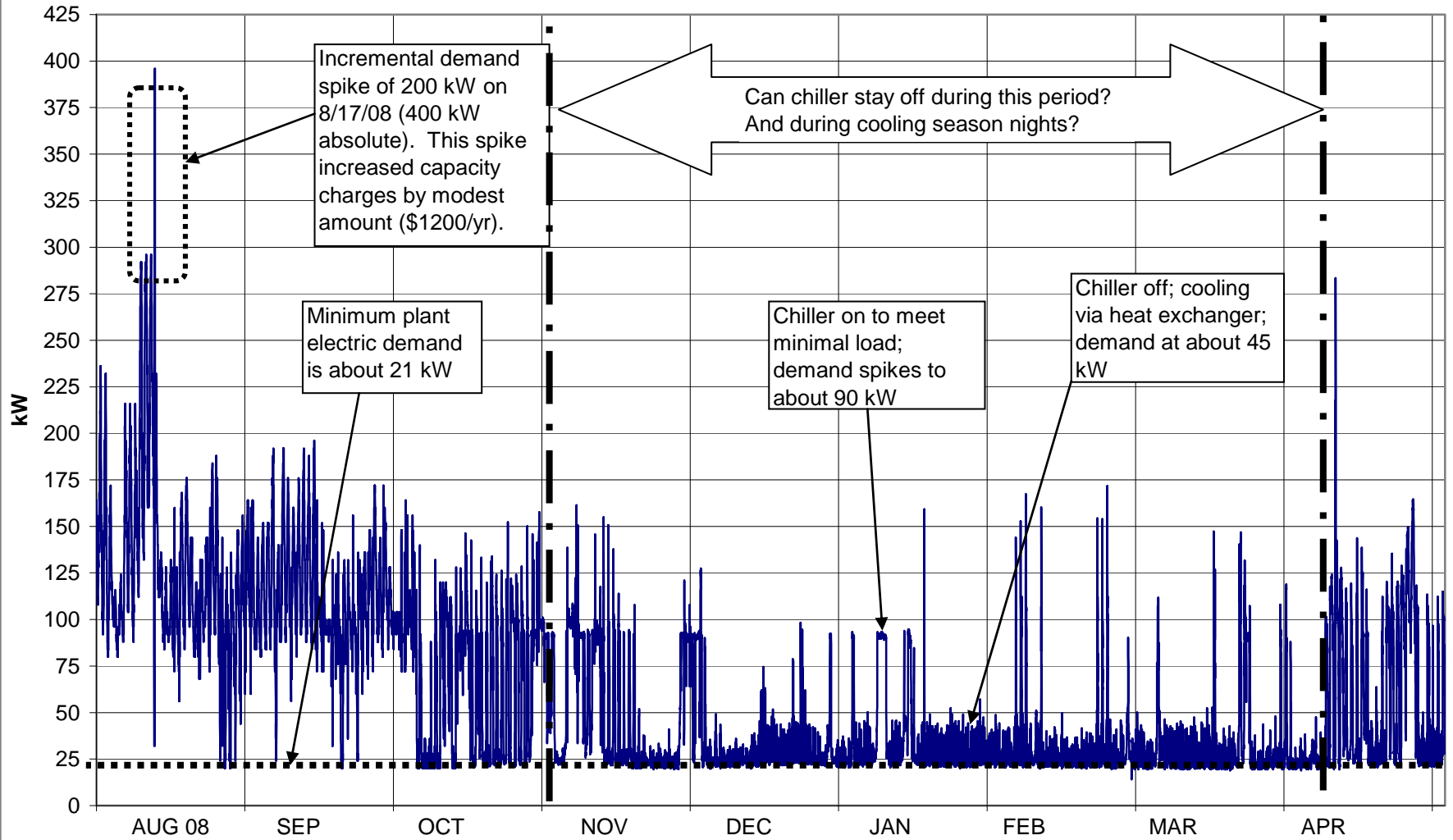
Plant Electric Demand  
Aug 2008 to Apr 2009





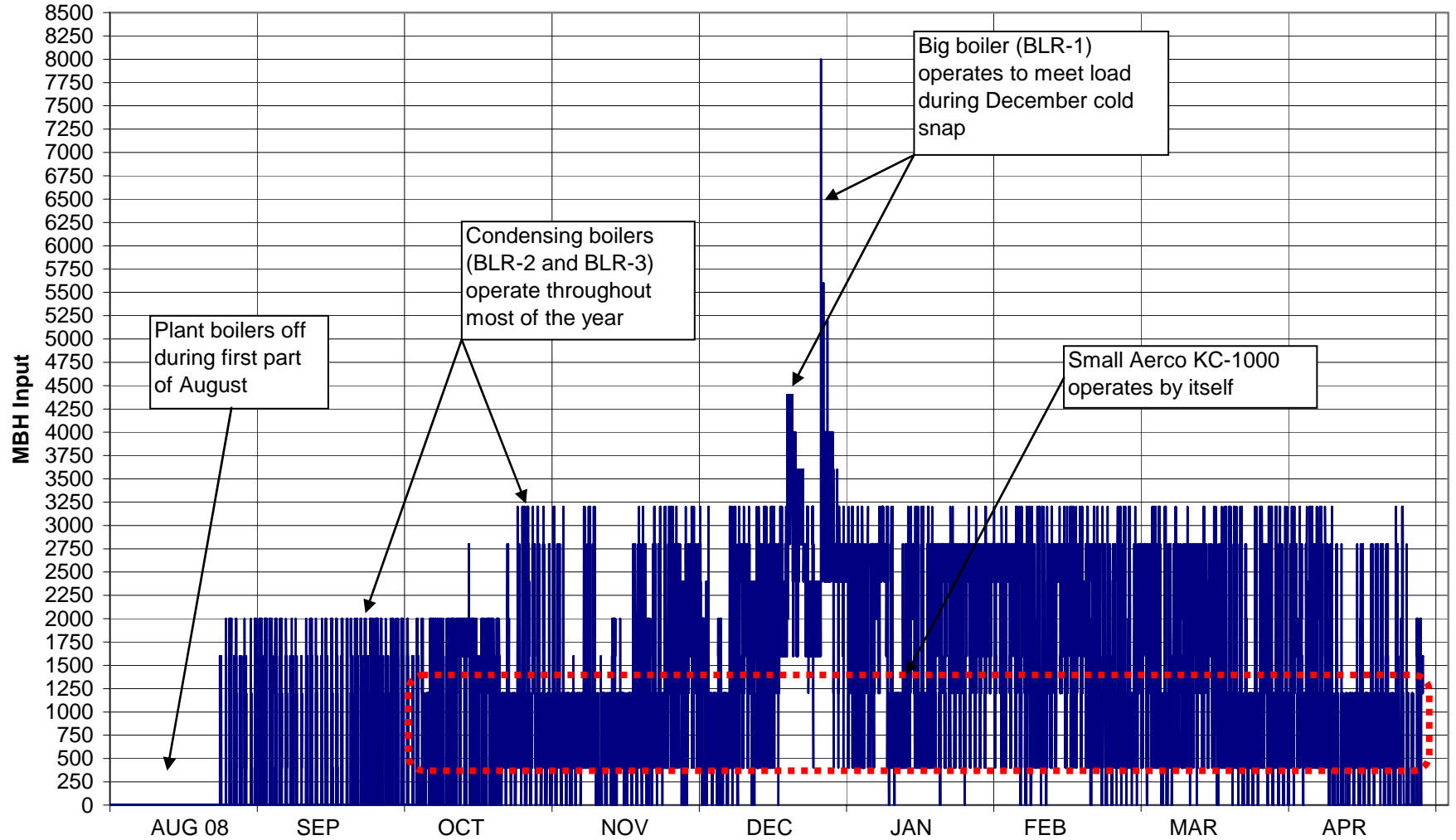
# Plant Electric Use Profile: Big Picture Implications

Plant Electric Demand  
Aug 2008 to Apr 2009



# Plant Gas Use Profile: 15 minute intervals

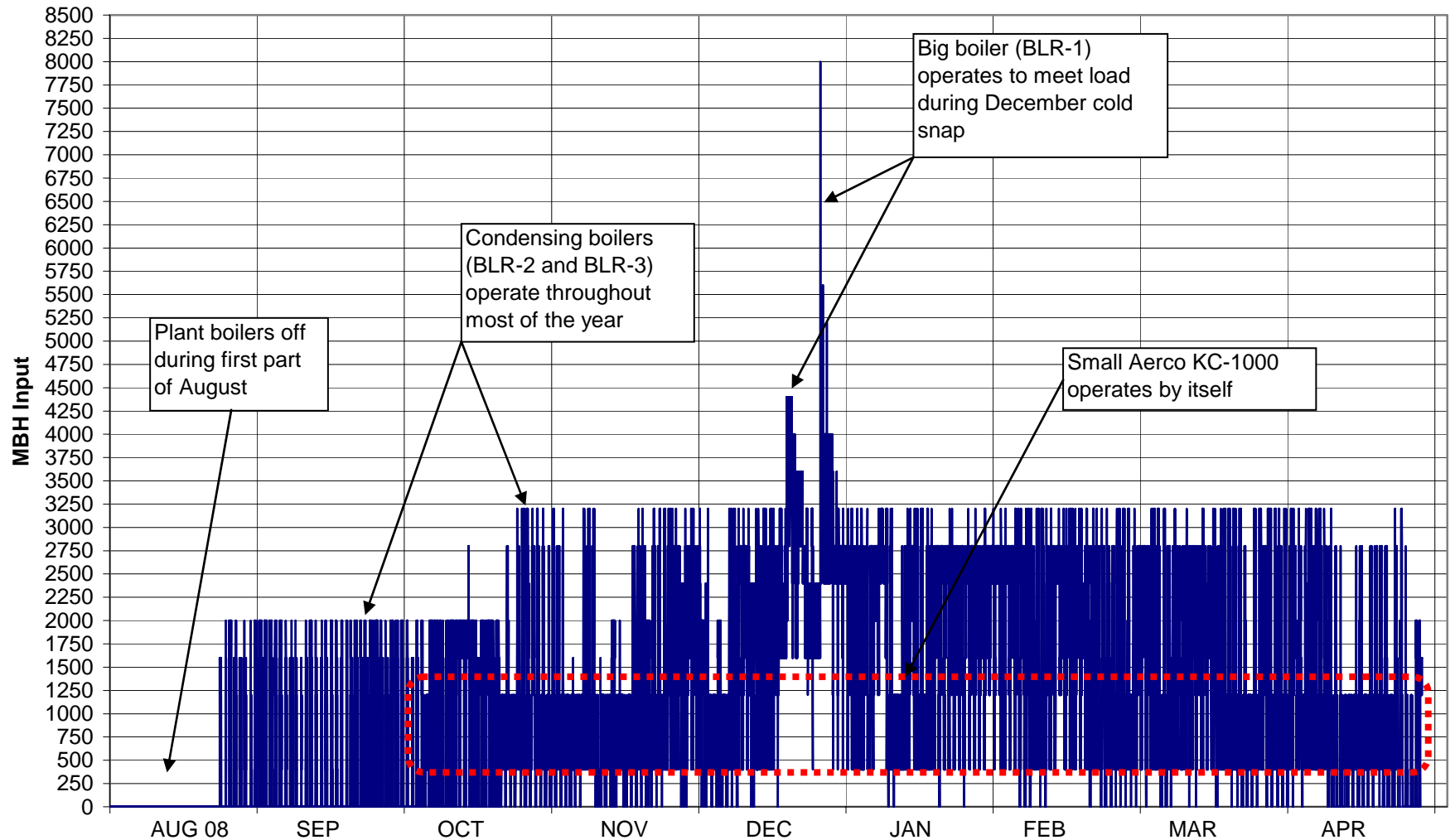
Plant Heat Demand  
Aug 2008 to Apr 2009



# Plant Gas Use Profile: Big Picture Implications

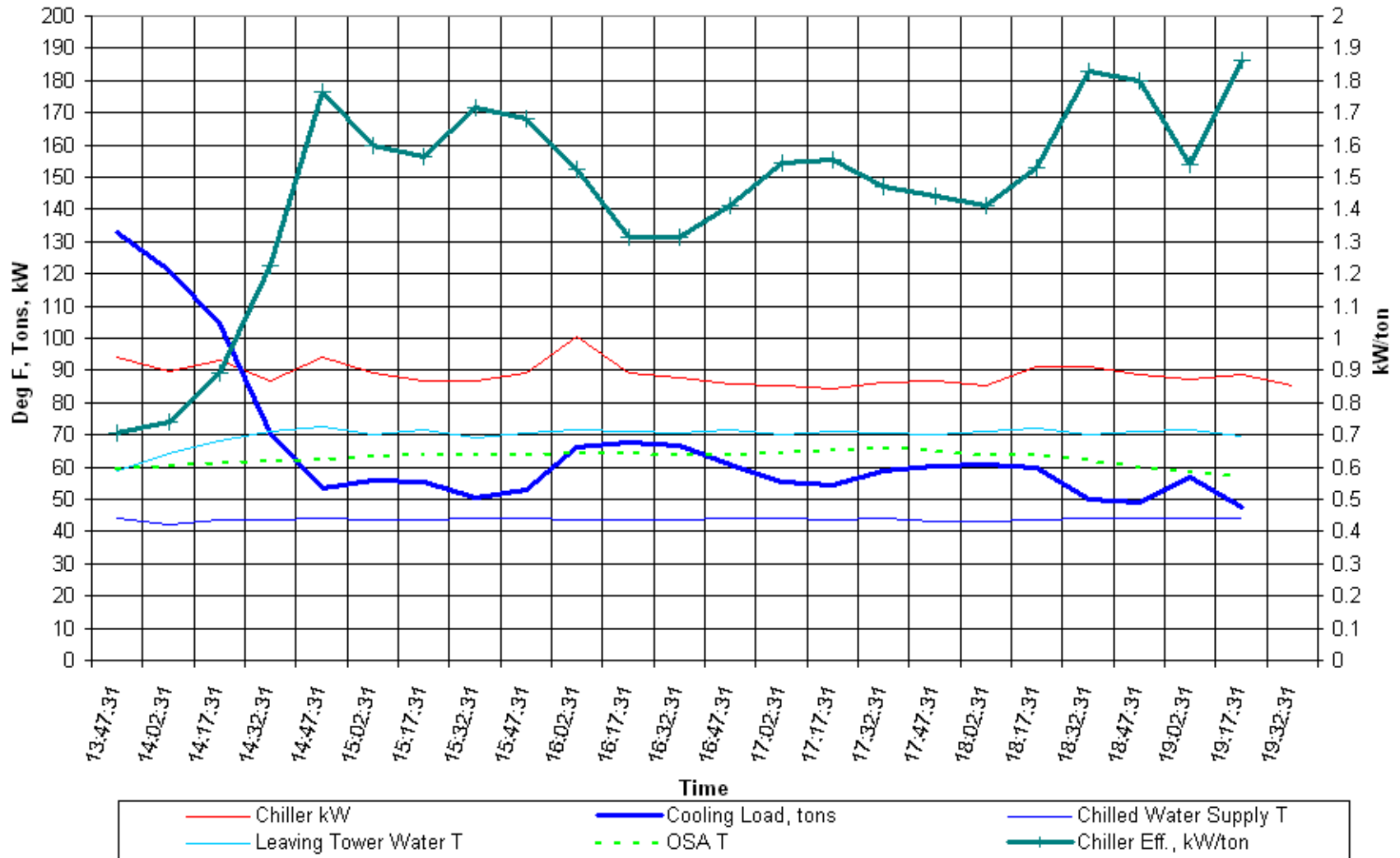
What is contributing to more or less *constant* heating load?

Plant Heat Demand  
Aug 2008 to Apr 2009



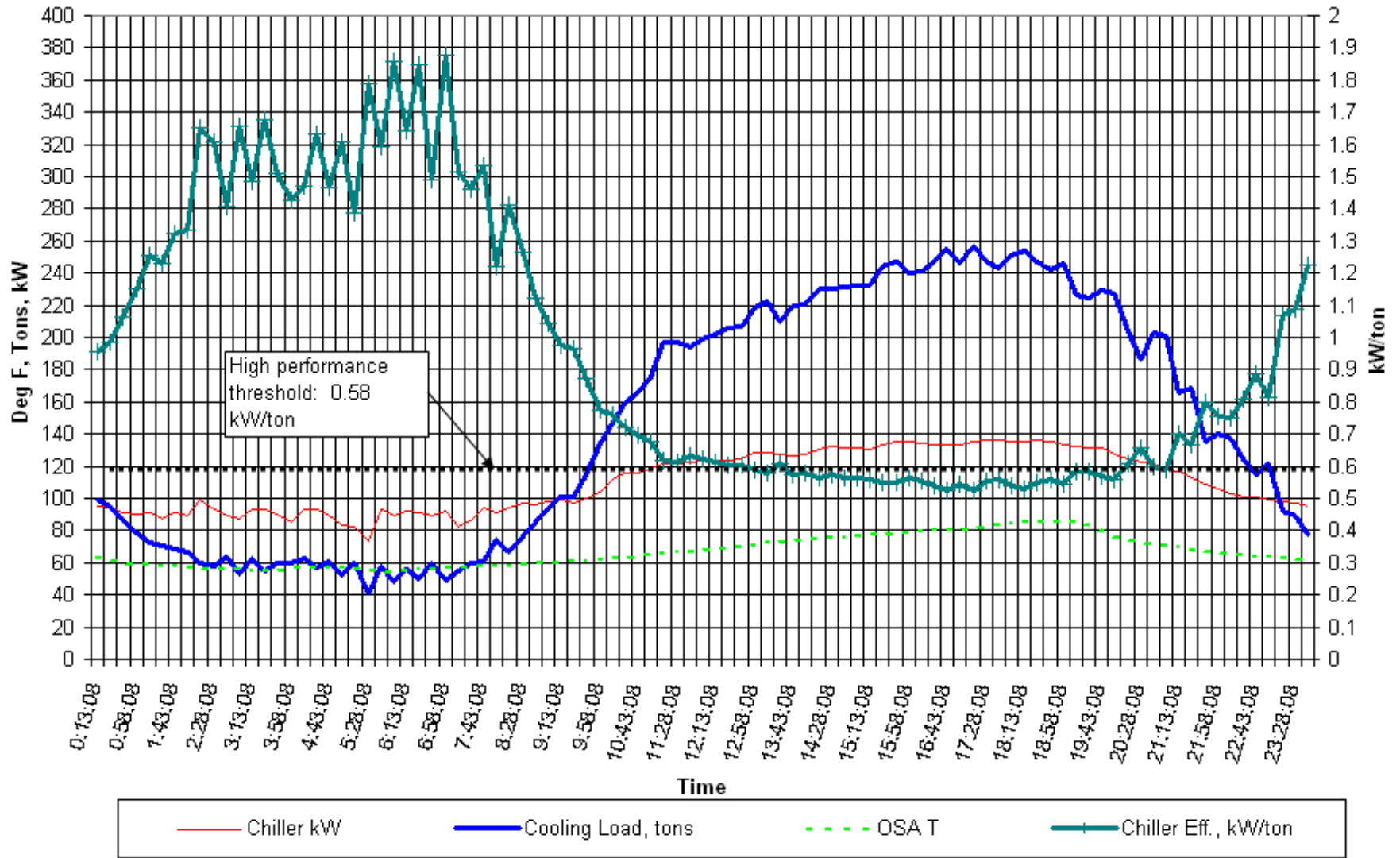
# Cooling Plant Load Trending

Chiller Plant Performance Low Load Condition (April 4, 2009)



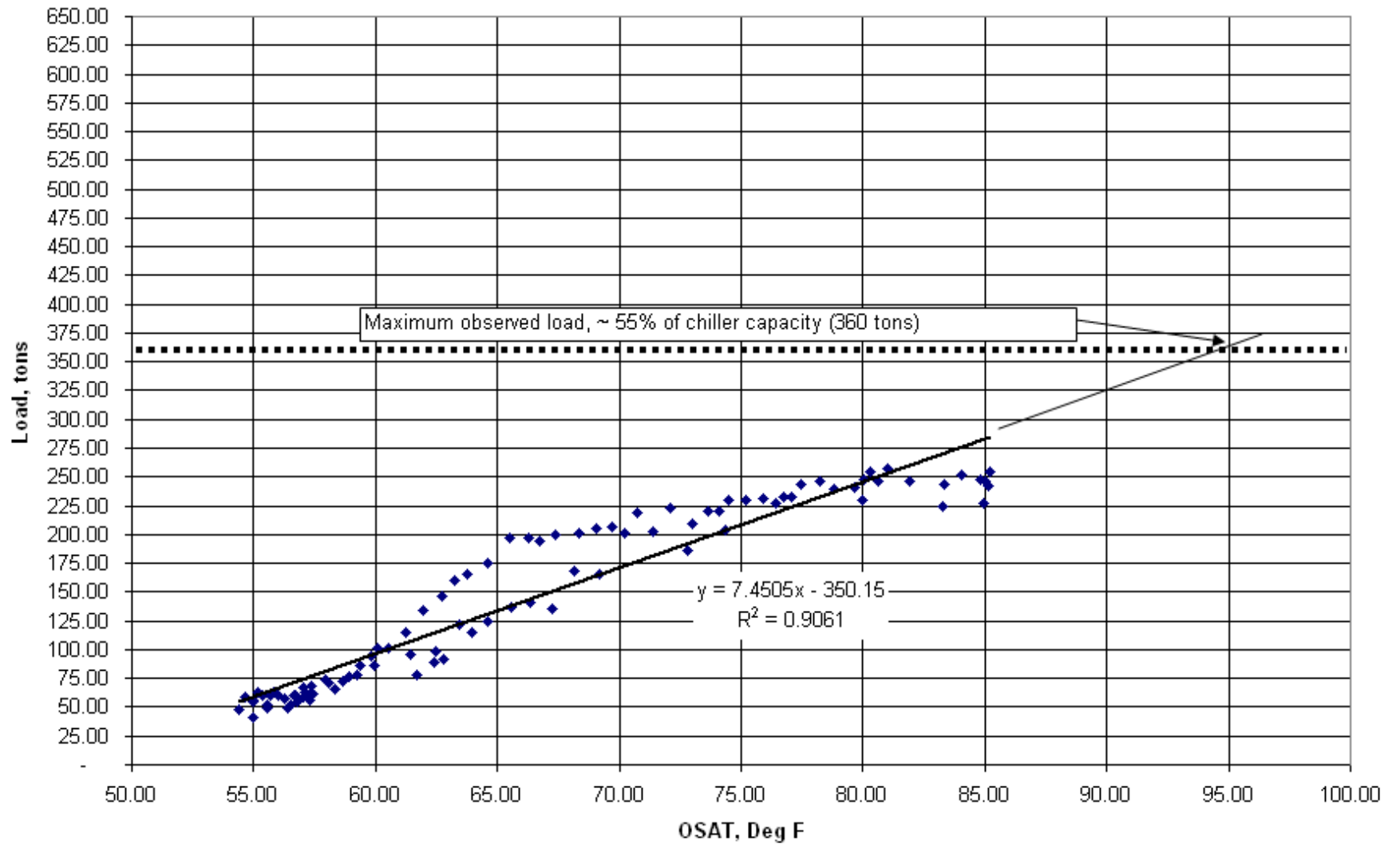
# Cooling Plant Load Trending

Chiller Plant Performance Moderate Load Condition (April 21, 2009)



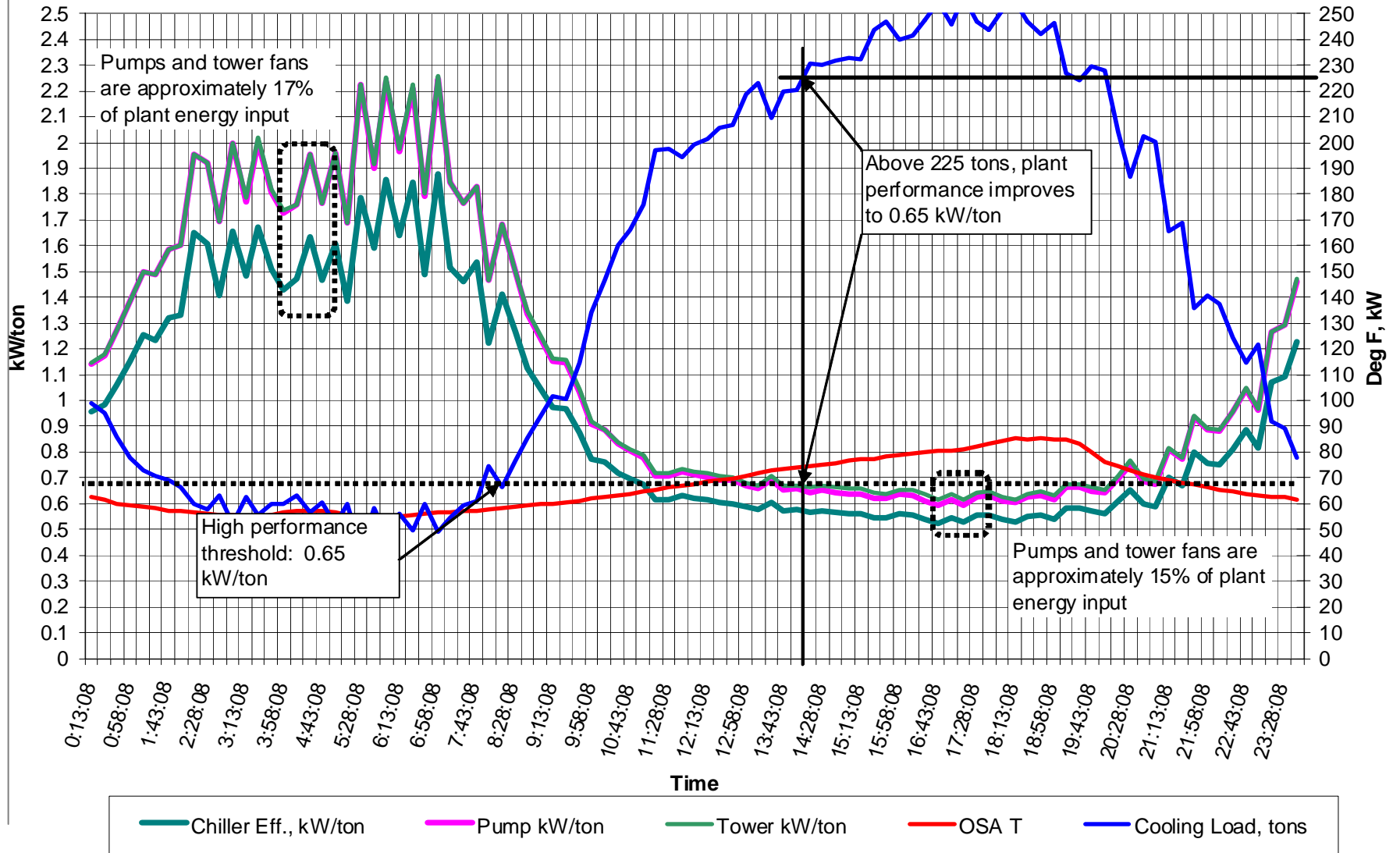
# Cooling Plant Load Modeling

Cooling Load = F(OSAT)



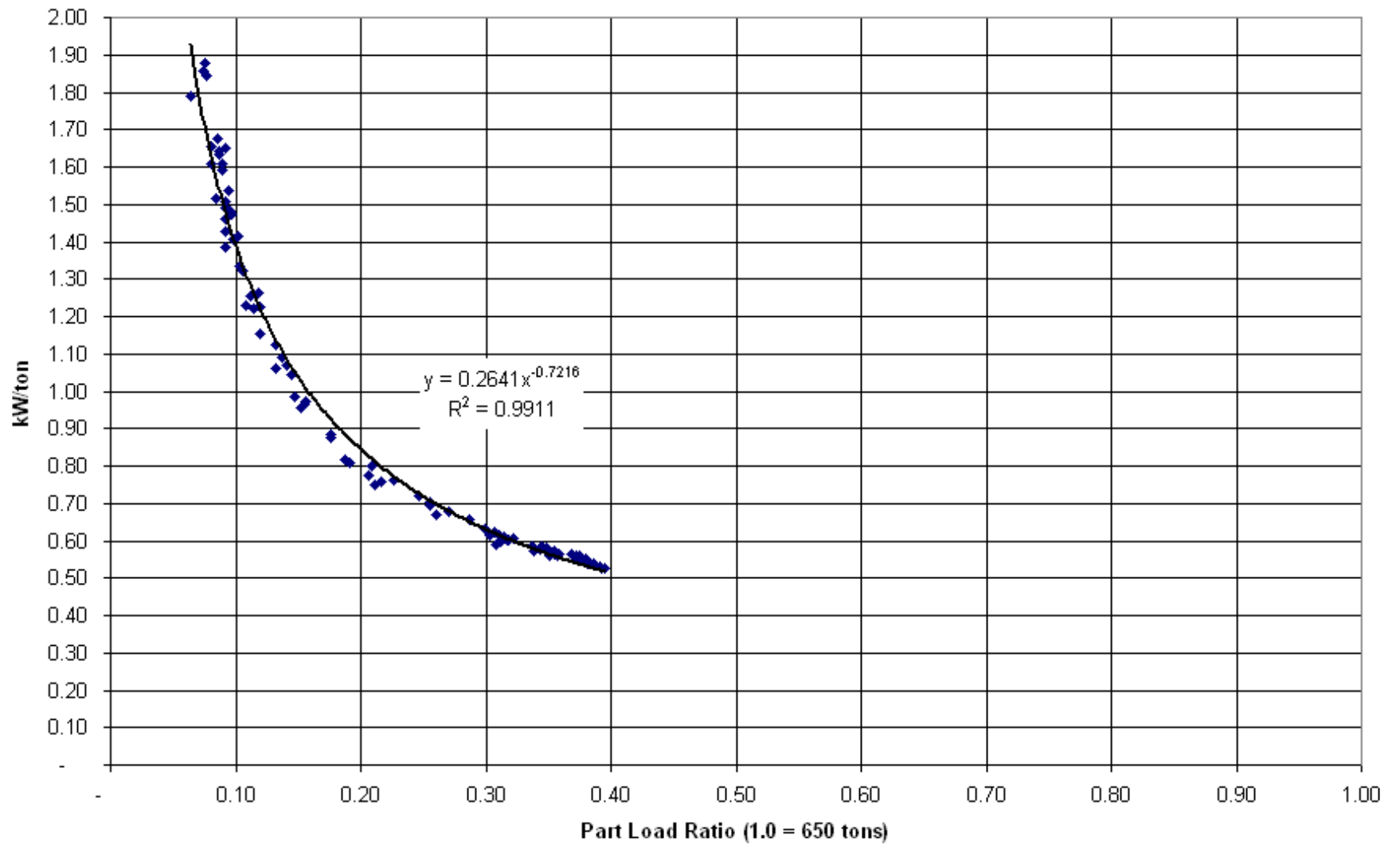
# Cooling Plant Load and Performance Trending

## Chiller Plant Performance Moderate Load Condition (April 21, 2009)



# Cooling Plant Performance Modeling

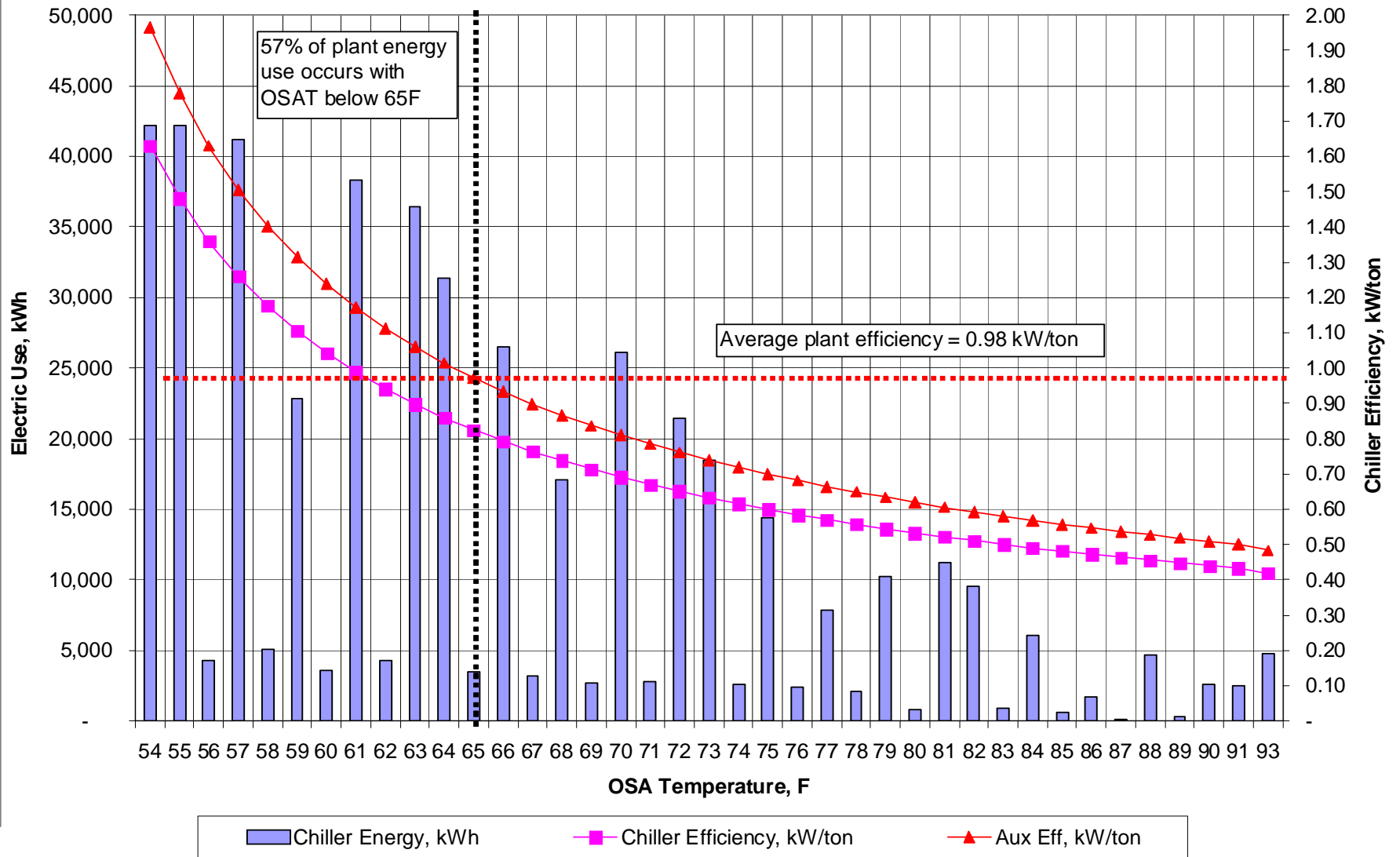
Chiller Efficiency = F (Part Load Ratio)





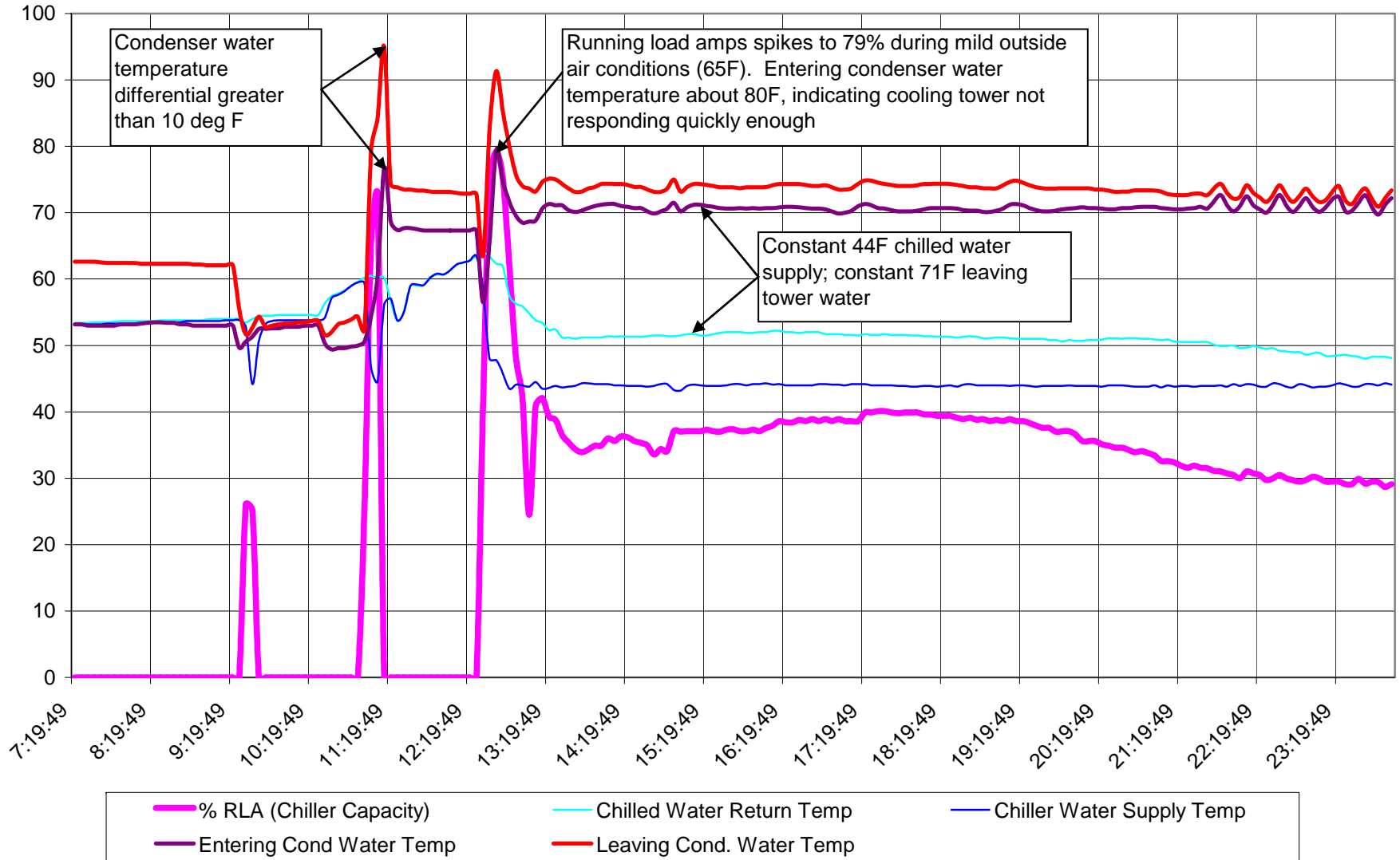
# Cooling Plant Load and Performance Modeling

Performance Model of Chiller Plant in Mechanical Cooling Mode  
Current Load Regime (312,270 GSF)



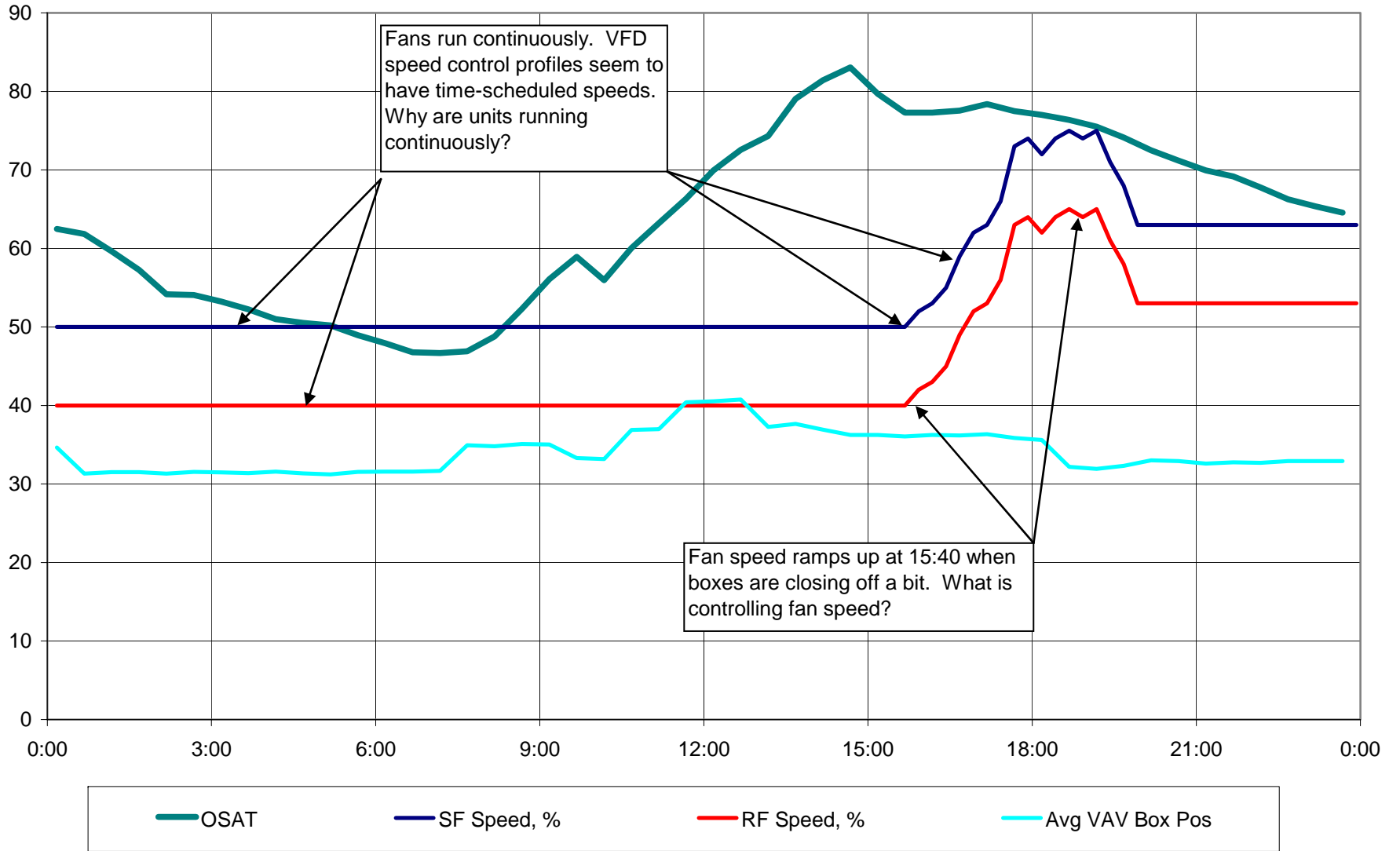
# Cooling Plant Operations: Plant Equipment Staging

## April 6 2009 Chiller Trend Demand Spike Event in April



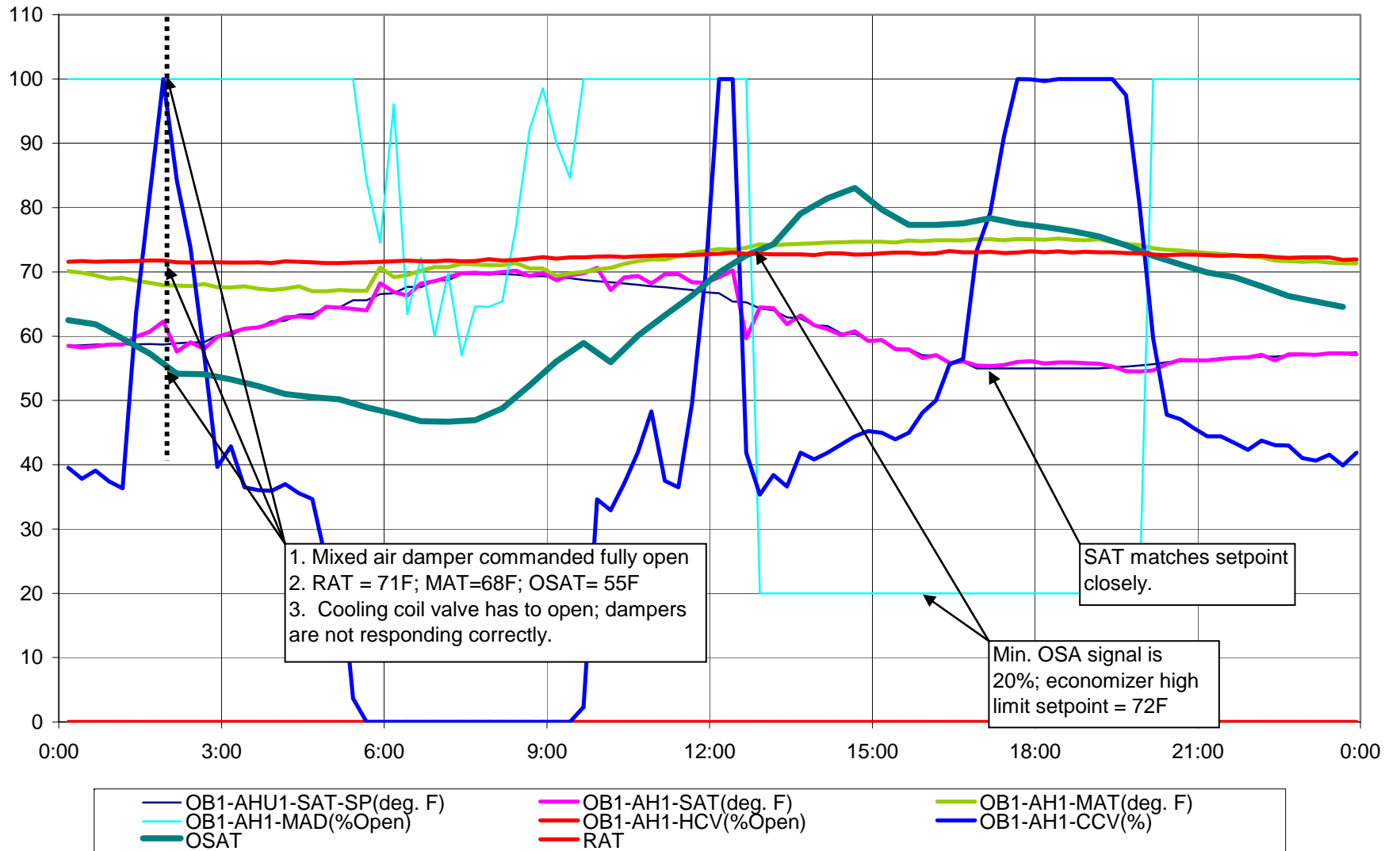
# Plant Operations: Understanding Loads

## South Office AHU-1 (6-April-09)



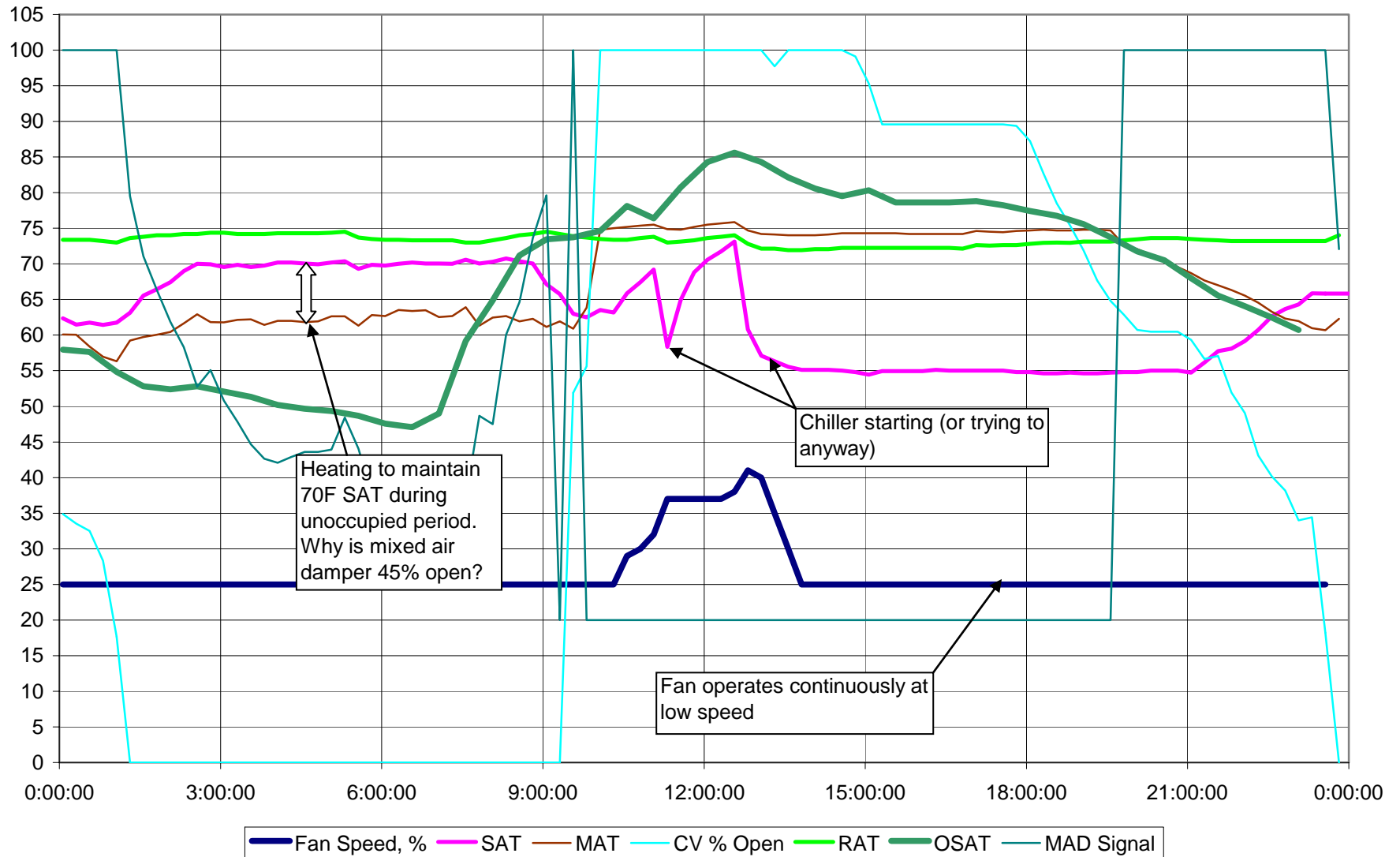
# Plant Operations: Understanding Loads

## South Office AHU-1 (6-April-09)



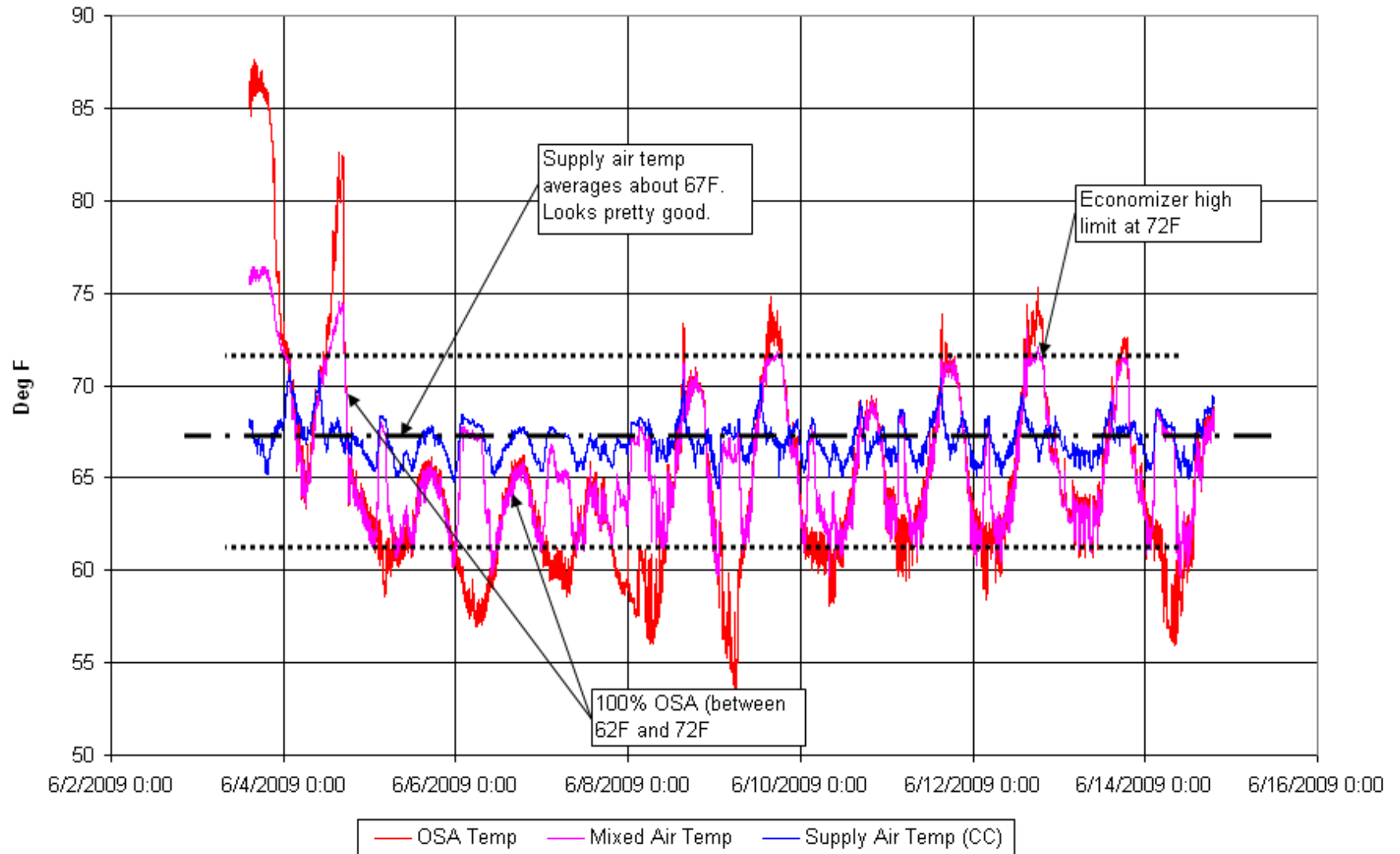
# Plant Operations: Understanding Loads

## Health Club Building AH-1 (4/6/09)



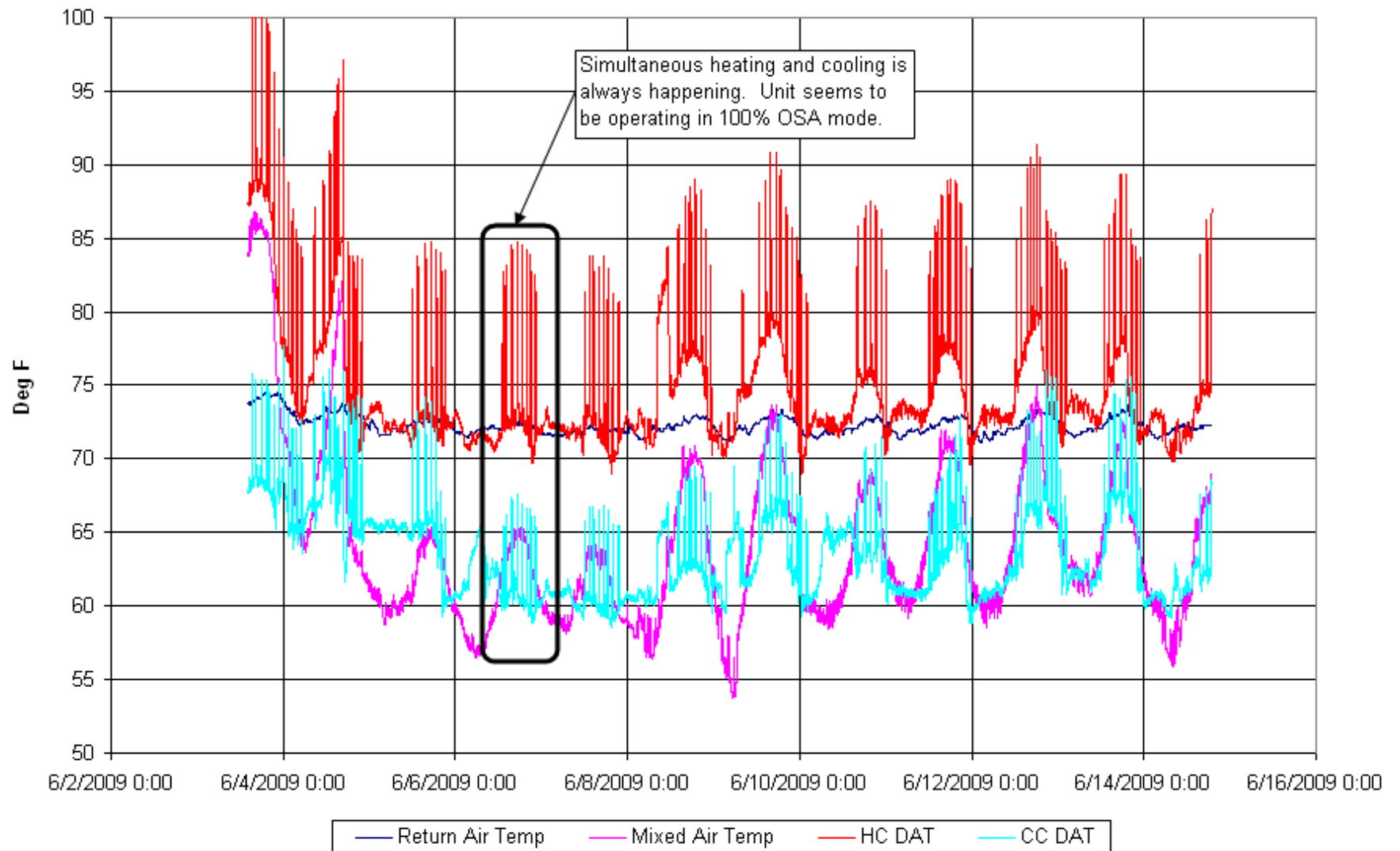
# Plant Operations: Understanding Loads

## Health Club Building (AHU-4 (Lockers))



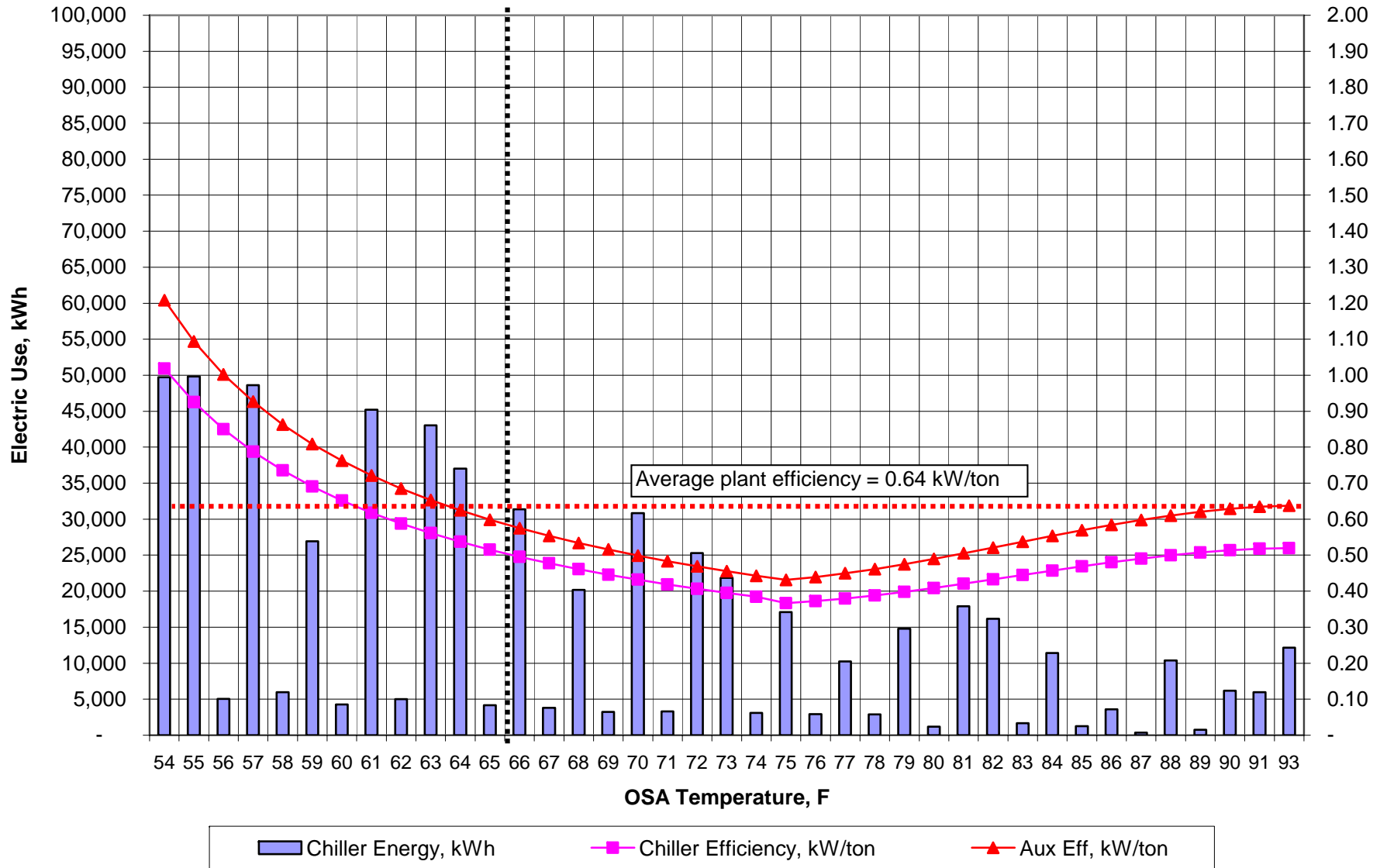
# Plant Operations: Understanding Loads

## Health Club AHU-2 (Pool)



# Cooling Plant Load and Performance Modeling

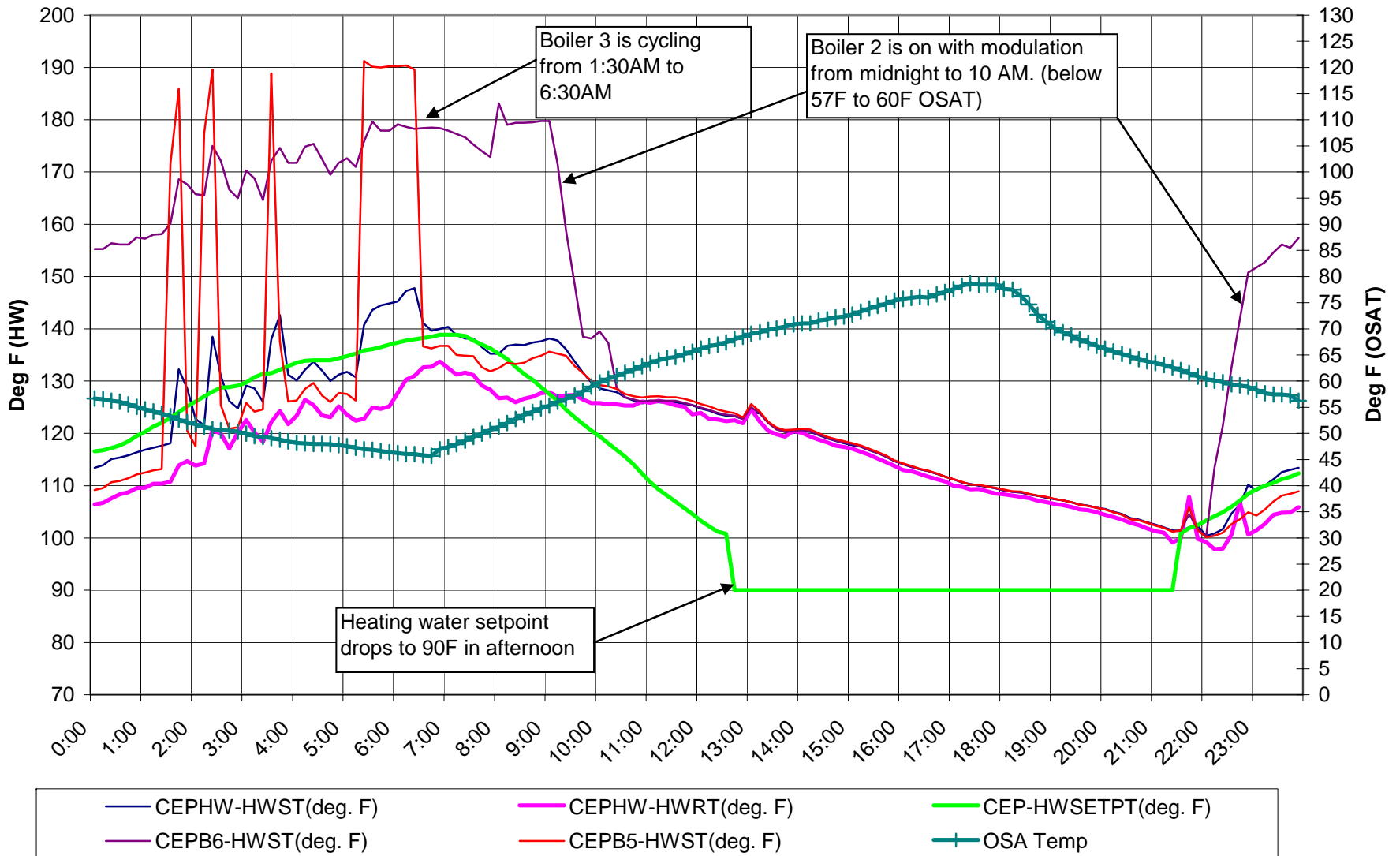
Performance Model of Chiller Plant in Mechanical Cooling Mode  
 Future Full Load Regime with Peak at 658 Tons (600,000 GSF)





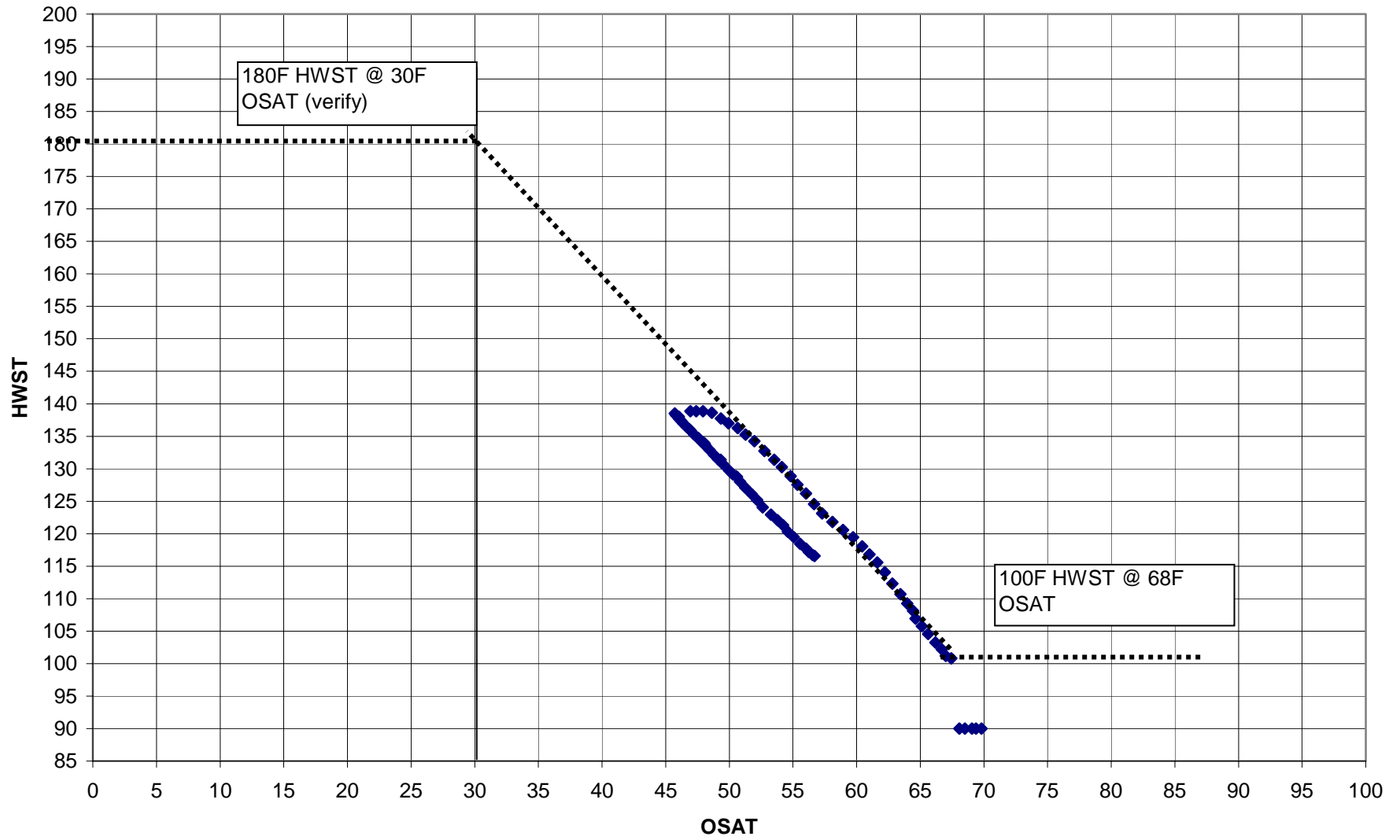
# Heating Plant Trending

## Heating Plant Operation 6-April-09



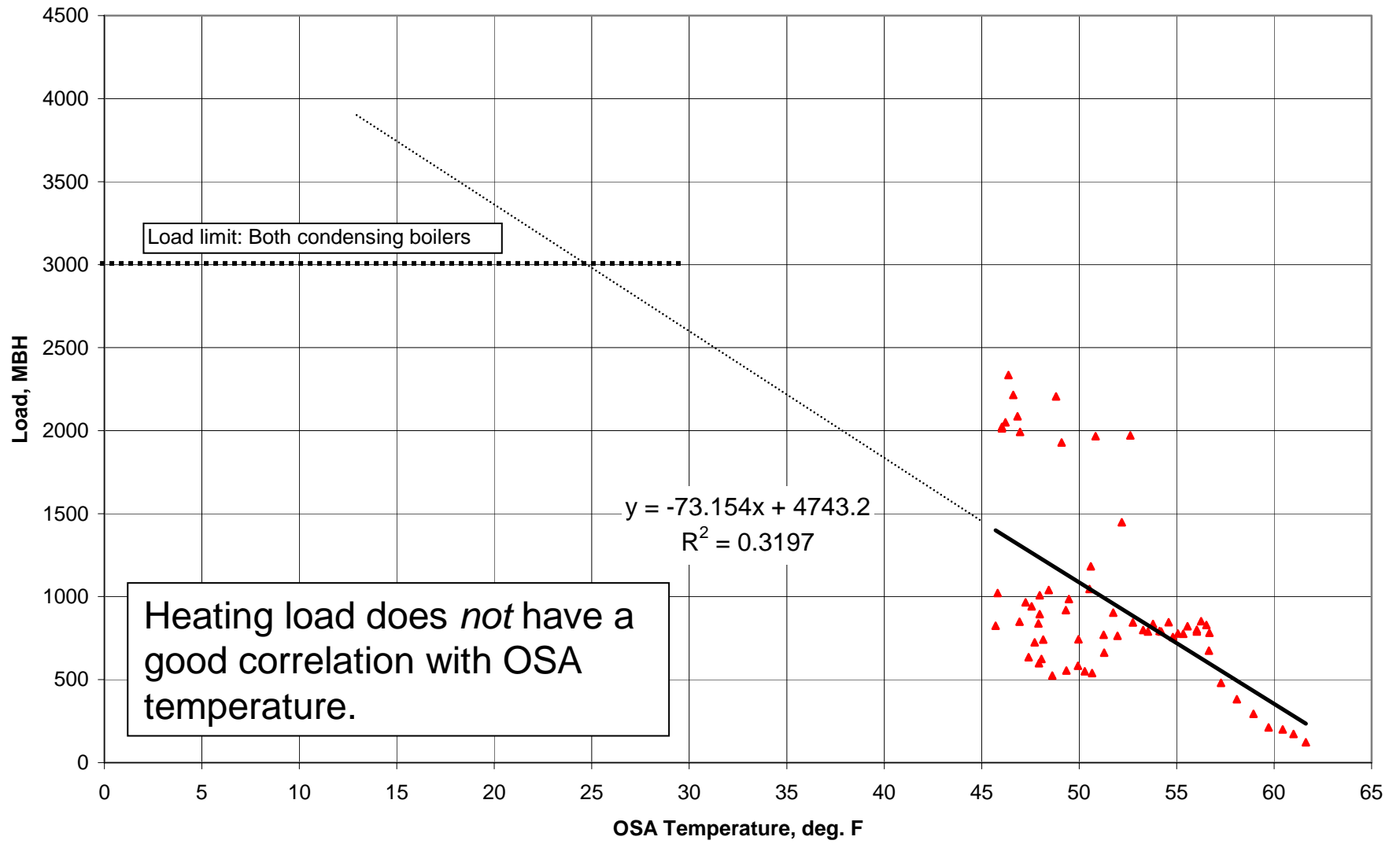
# Heating Plant Operations: Temperature Reset

## Heating Water Reset Schedule



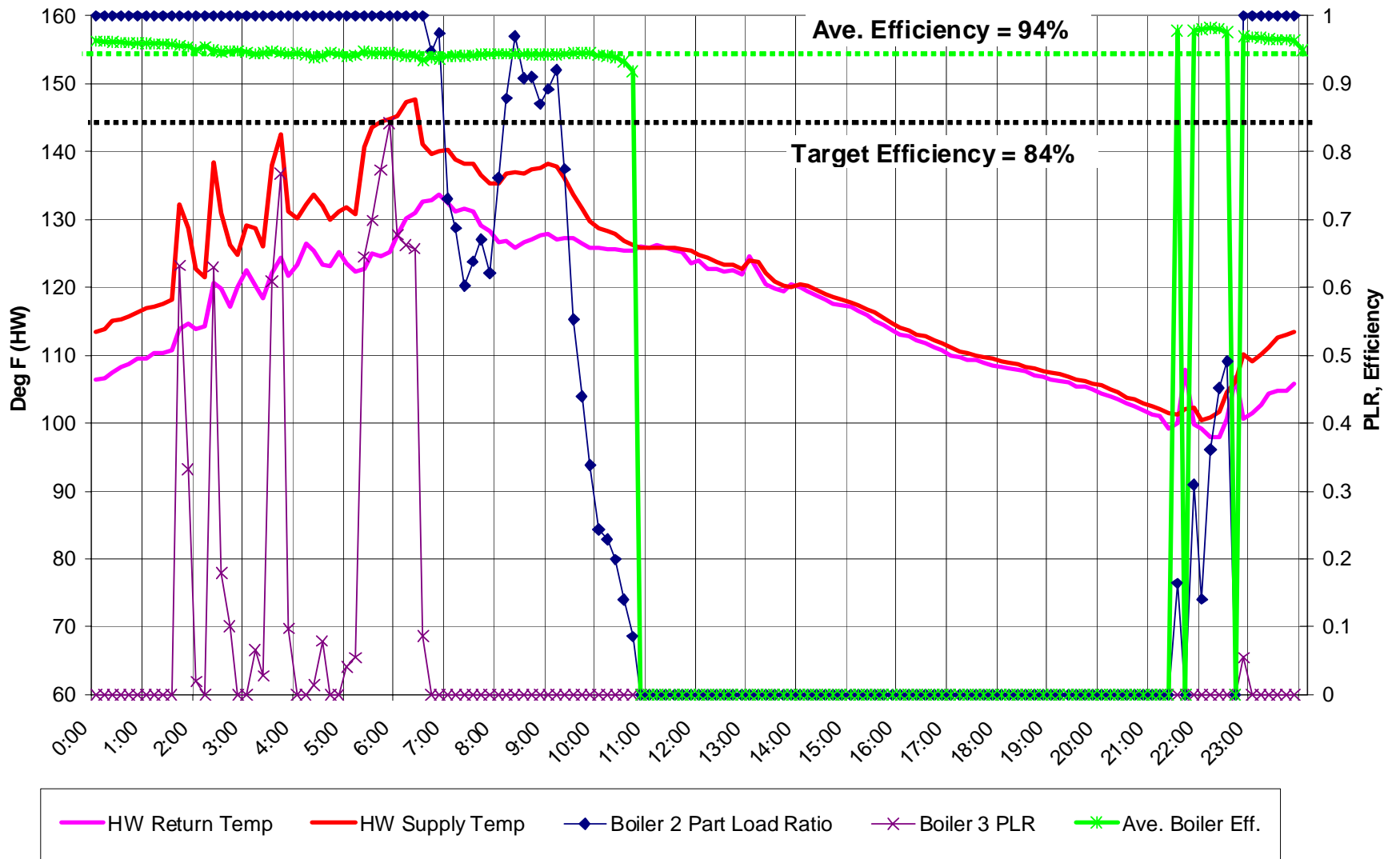
# Heating Plant Load Trending

Plant heating load as a function of OSA temperature



# Heating Plant Energy Performance Trending

Heating Plant Operation  
6-April-09



## Beaverton Plant Performance Assessment Results

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- **Section 1 – Executive Summary**
  - “state-of-the-art” chiller plant
  - “leadership level” boiler plant
- **Section 2 – Plant Energy Efficiency**
  - “waterside economizer” improvements
  - overall efficiency of chilled water plant will improve with load growth
  - heating water set-point coordination to reduce boiler short-cycling
- **Section 3 – Building Loads and Energy Use**
  - improved unoccupied period control, improved mixed air controls, and supply air temperature controls
  - restore automatic pump speed control
- **Section 4 – Plant and Building Maintenance/Operations Issues**
  - rate structure to encourage reduced electricity and gas consumption at the plant level
  - simpler temperature controls for occupants