

# Facility Dynamics

## *ENGINEERING*

### **Central Plants**

### Controlling Different Technologies

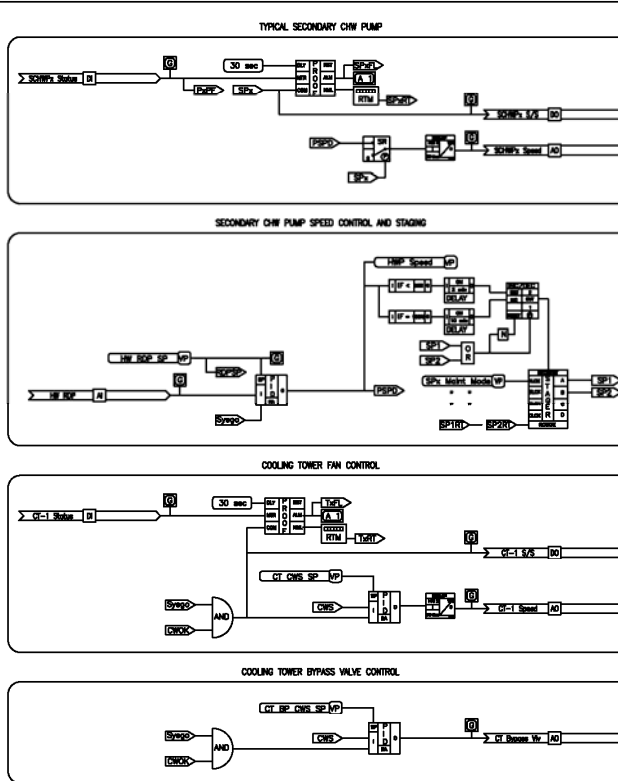
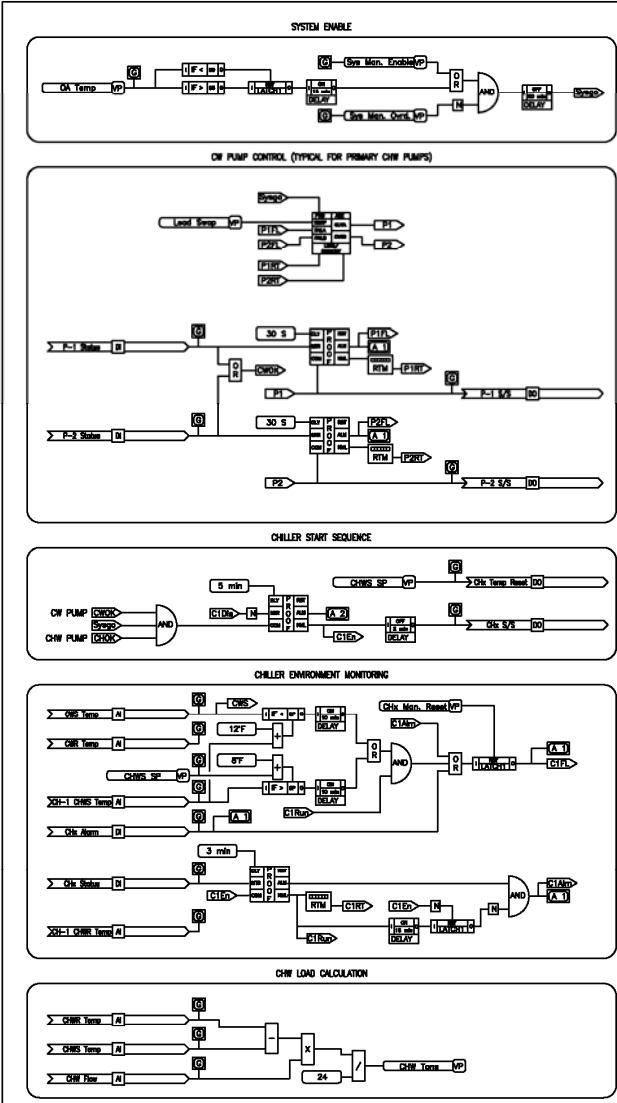
**Presented By:**

David Sellers; Facility Dynamics Engineering

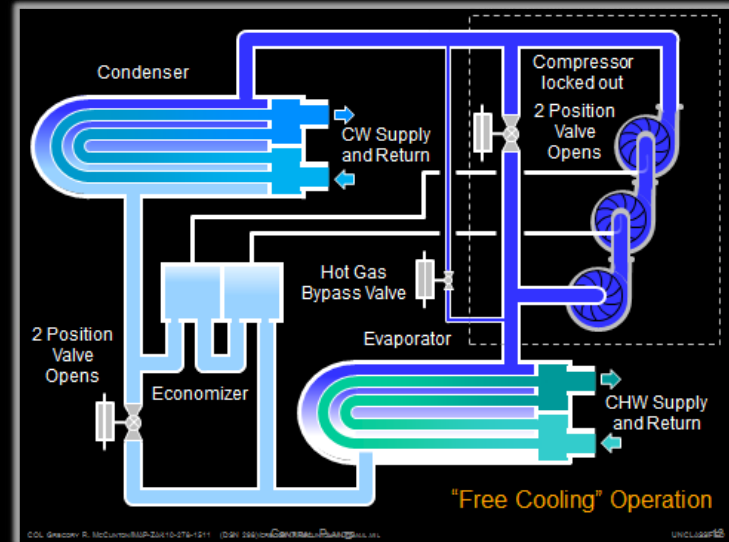
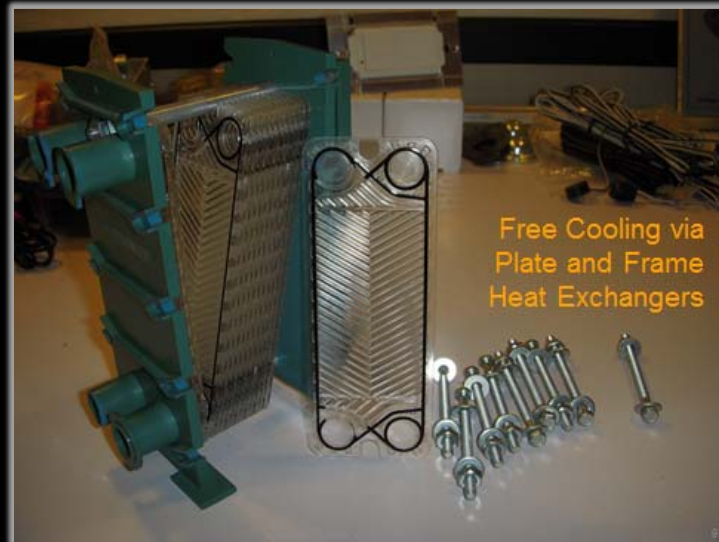
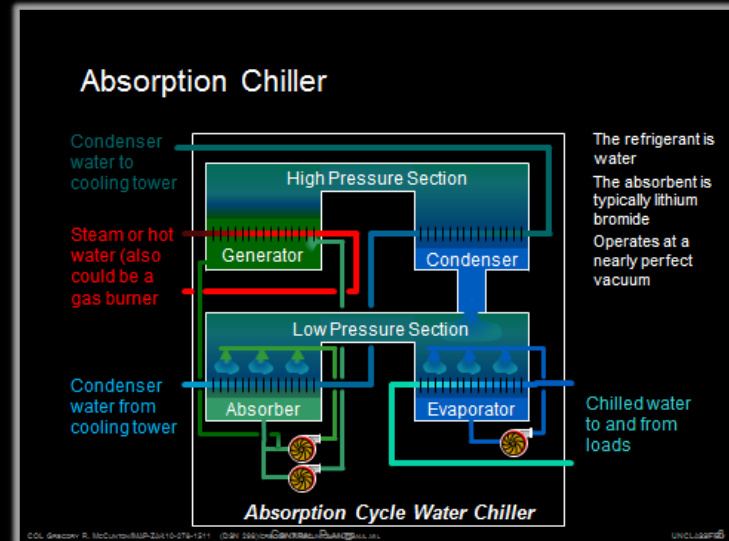
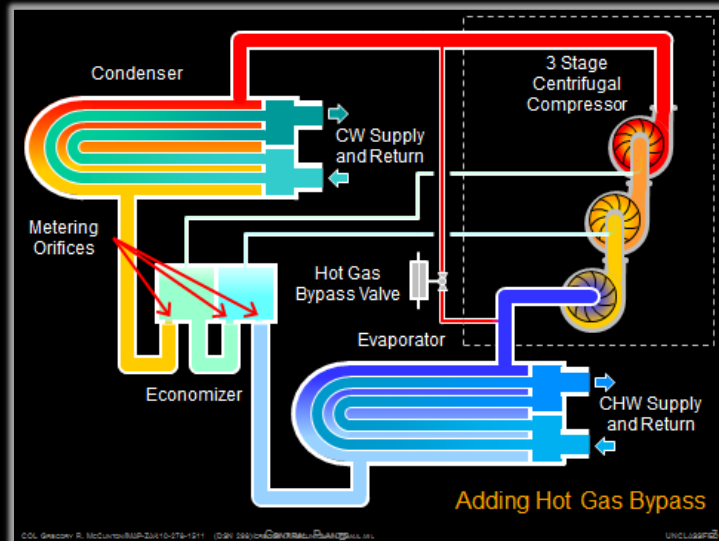
Senior Engineer

NAVFAC, San Diego

**Sample Central Plant Logic**  
Included on your CD in Tab 19

[illegible]

# Common Sources of Cooling



# Who Knows the Load on This Facility?

## The Building Does

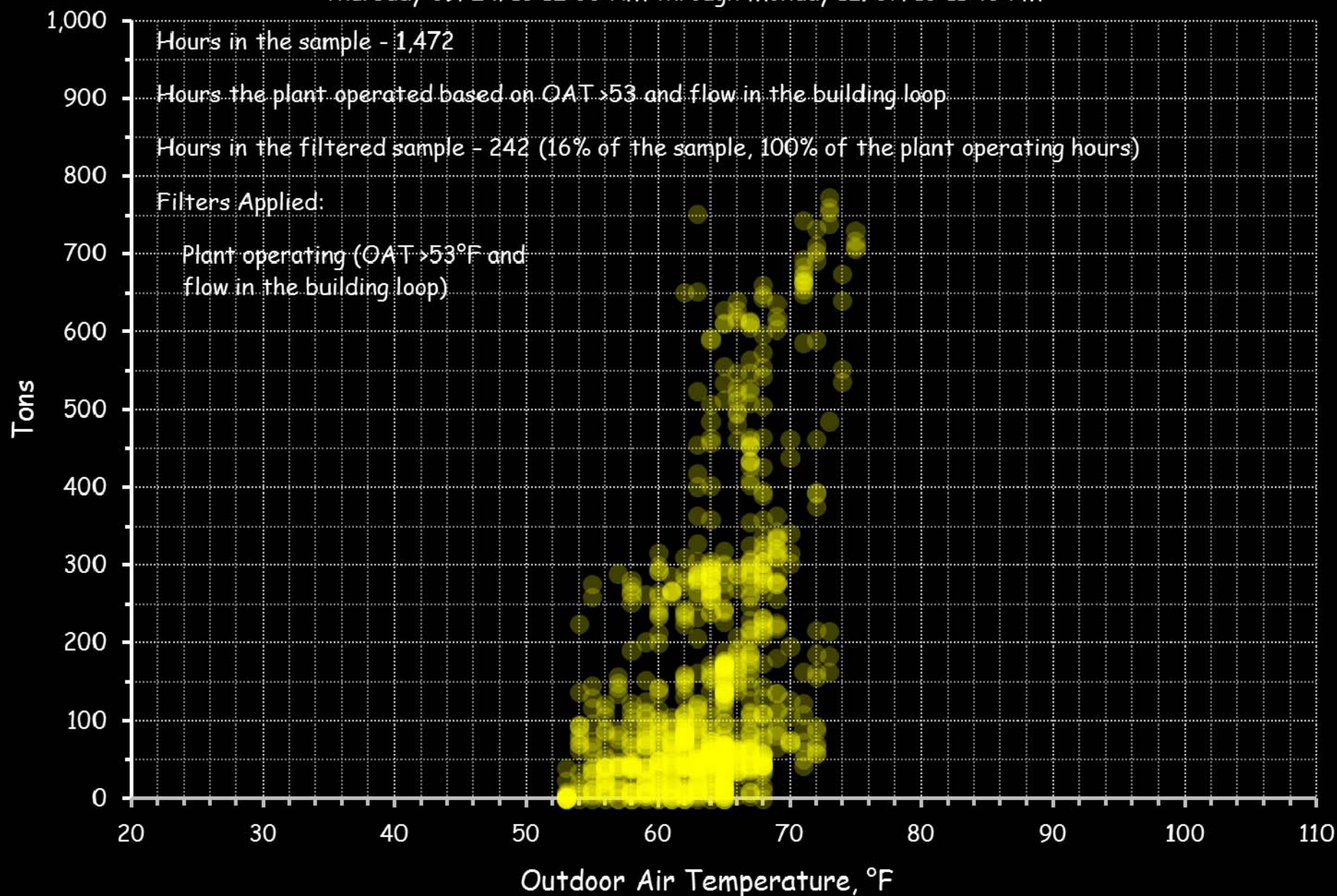
- Class A office space
- Well run, well maintained
- Aging chiller plant
  - 30+ years old
  - No longer parts for the chiller controller boards
  - Significant improvements in compressor kW per ton capabilities since the time of the original plant design





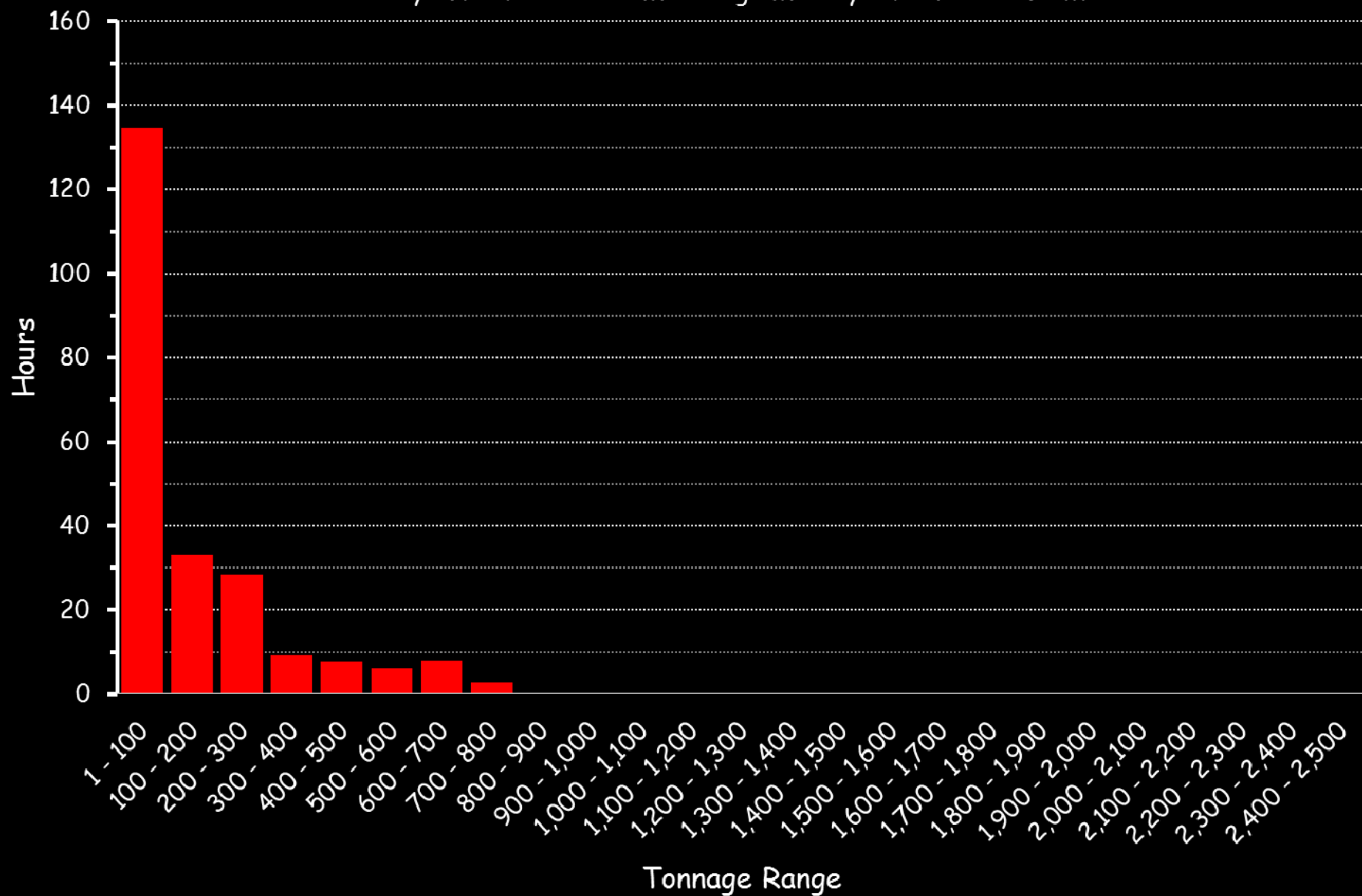
# Seattle Muni Central Plant Tons vs. Outdoor Temperature

Thursday 09/24/15 12:00 AM through Monday 12/07/15 11:45 PM



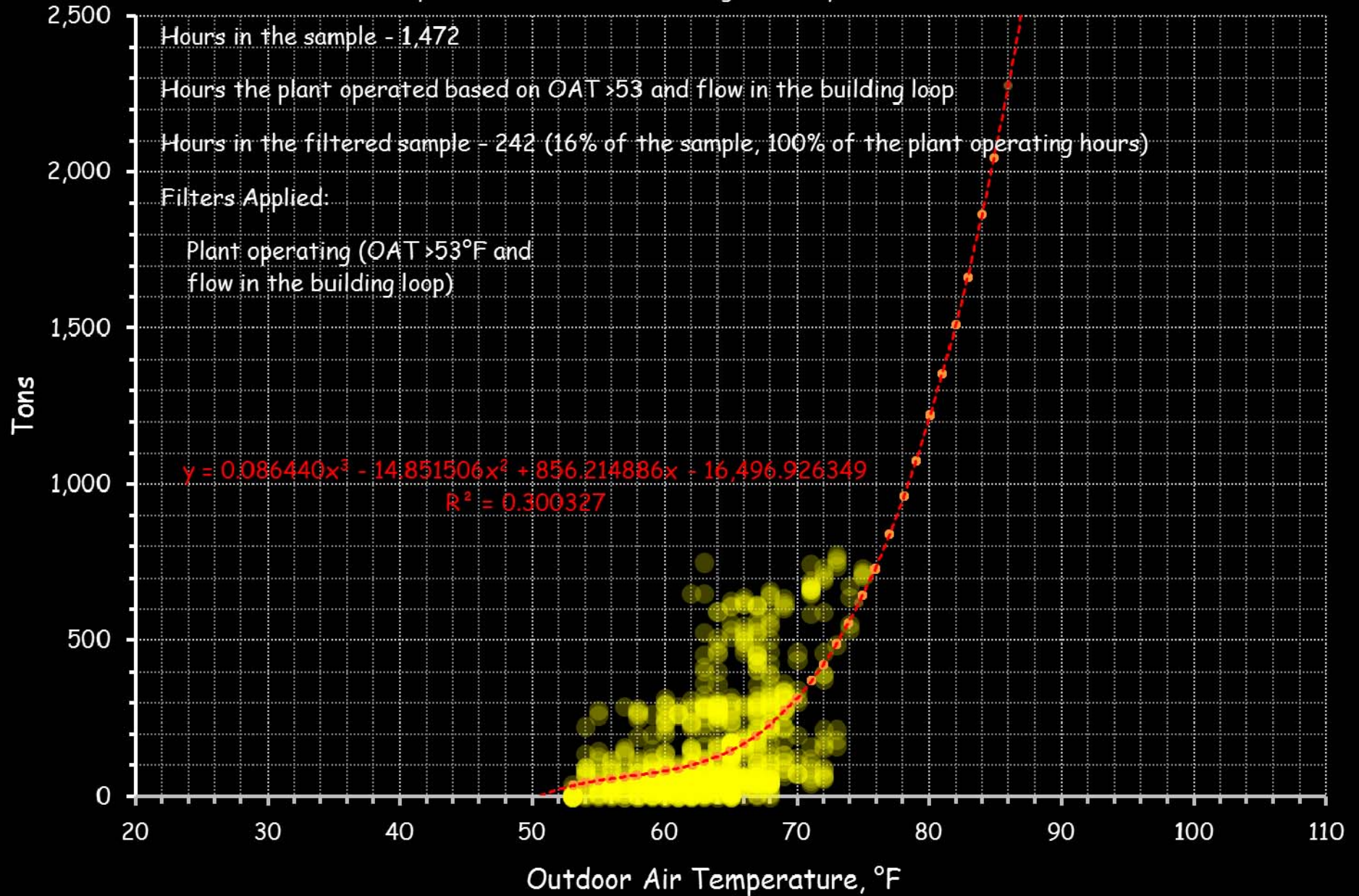
## Hours at a Given Tonnage Range

Thursday 09/24/15 12:00 AM thorough Monday 12/07/15 11:59 PM



# Seattle Muni Central Plant Tons vs. Outdoor Temperature

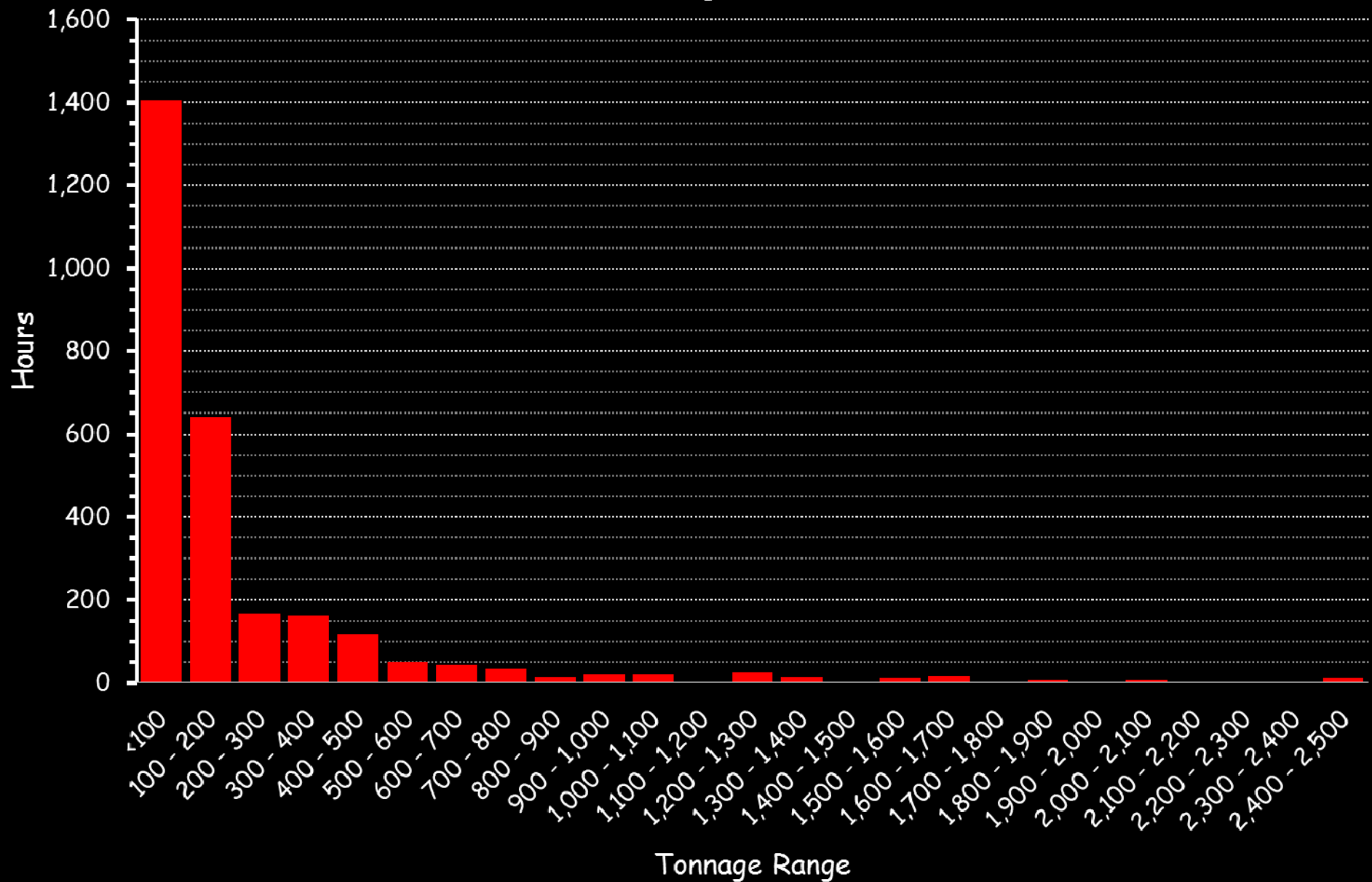
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# Hours at a Given Tonnage Range

Average Year



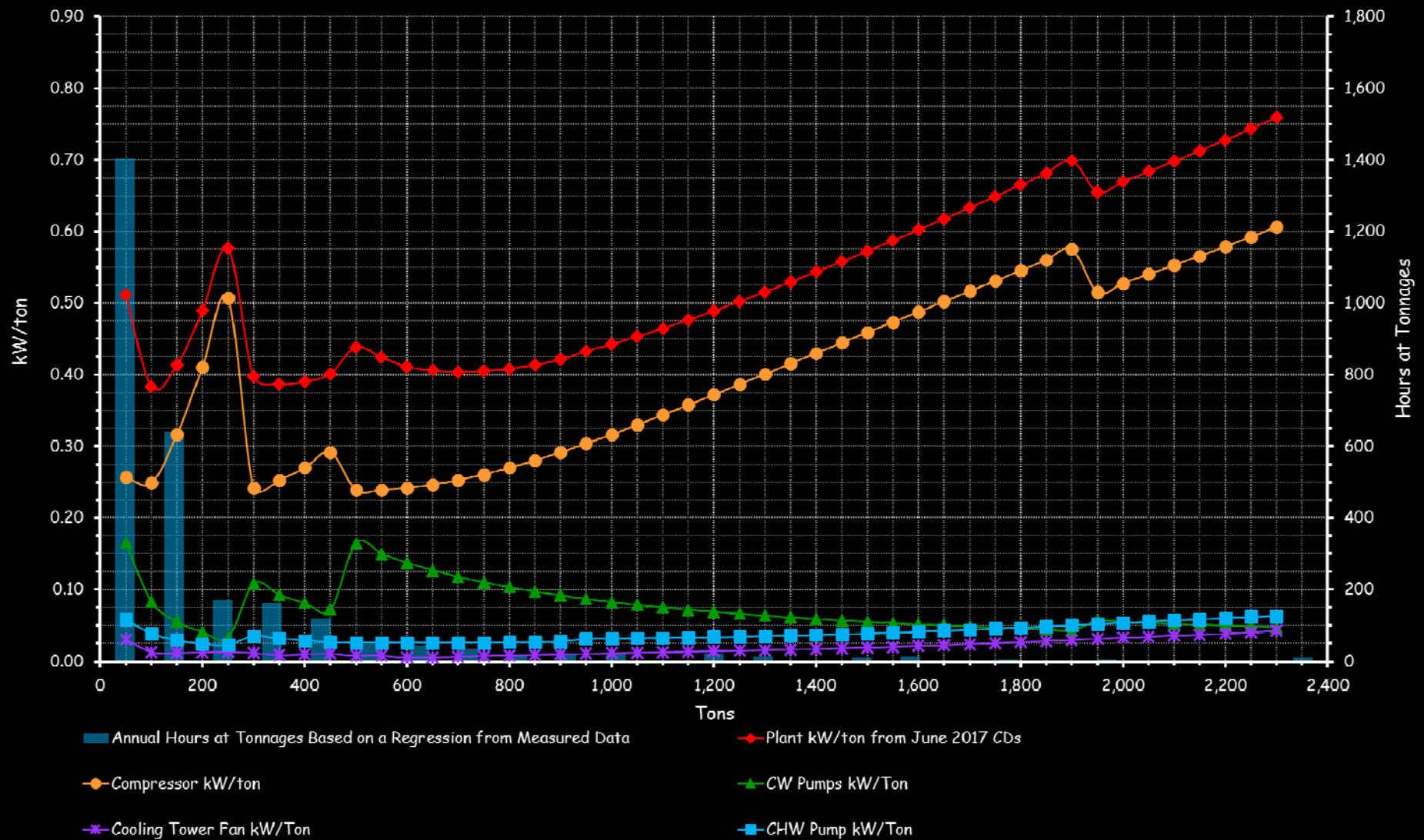


# There's More to Chiller Efficiency than the Compressor

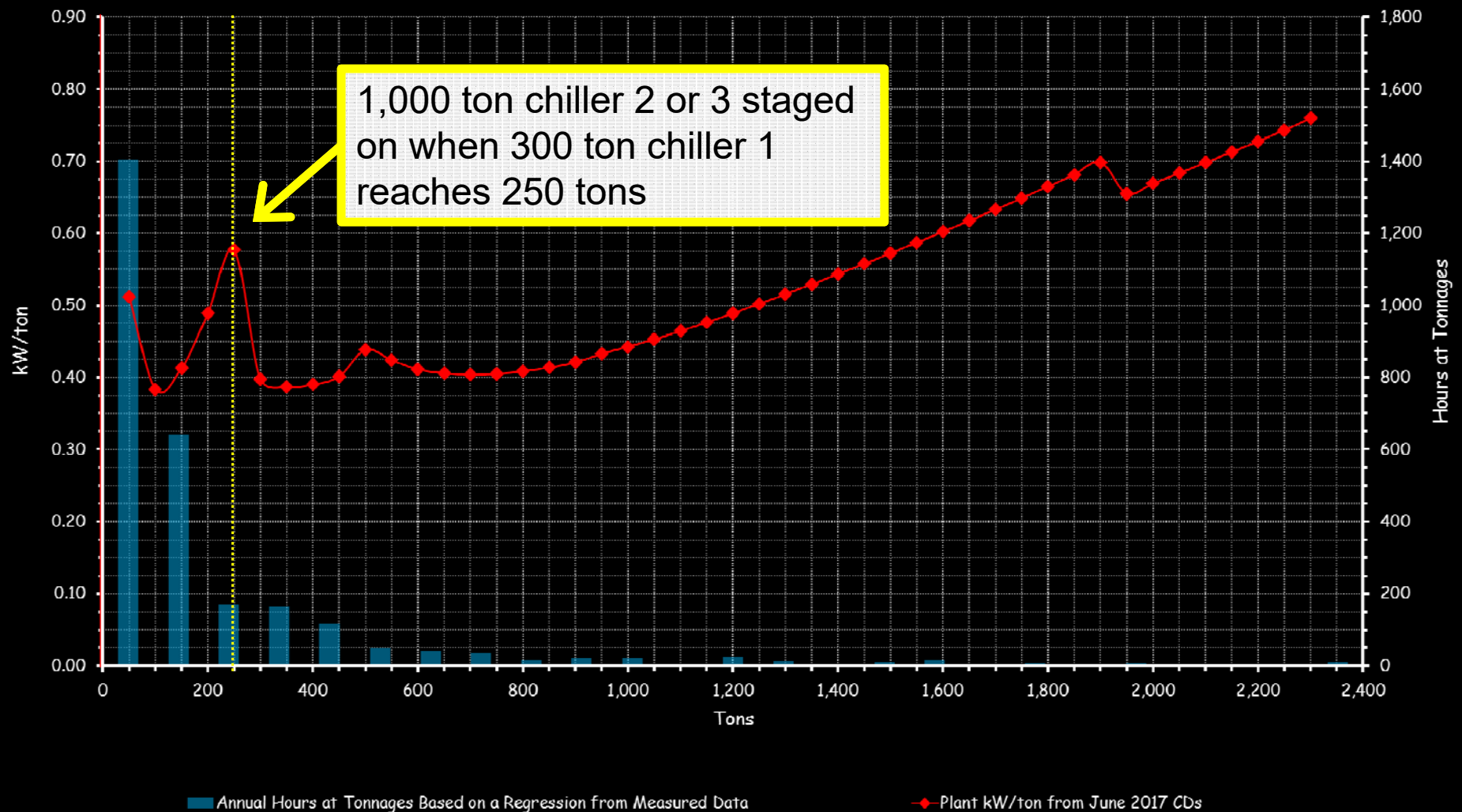
## Replacement Plant Characteristics

- Variable flow primary/secondary plant to be upgraded to variable flow primary only
- Variable flow primary only plant details:
  - 1 – 300 ton chiller
  - 2 – 1,000 ton chillers
  - Chilled water pumps headered together so any pump can serve any chiller
  - Dedicated condenser water pumps for each chiller
  - Condenser pumps are variable flow
  - Four cell cooling tower headered together so an cell can serve any chiller

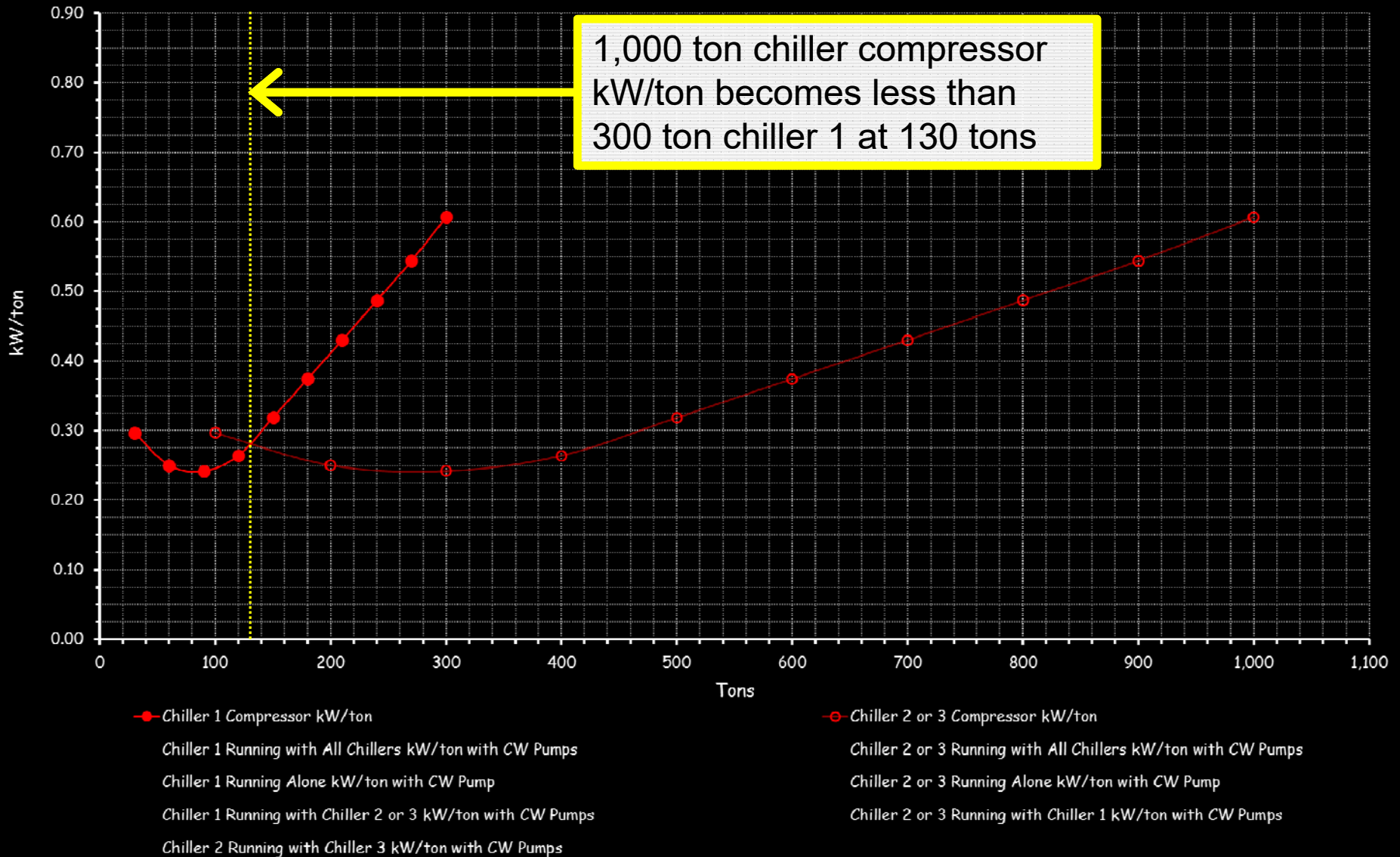
# There's More to Chiller Efficiency than the Compressor



# There's More to Plant Efficiency than Switching Chillers when One is Fully Loaded

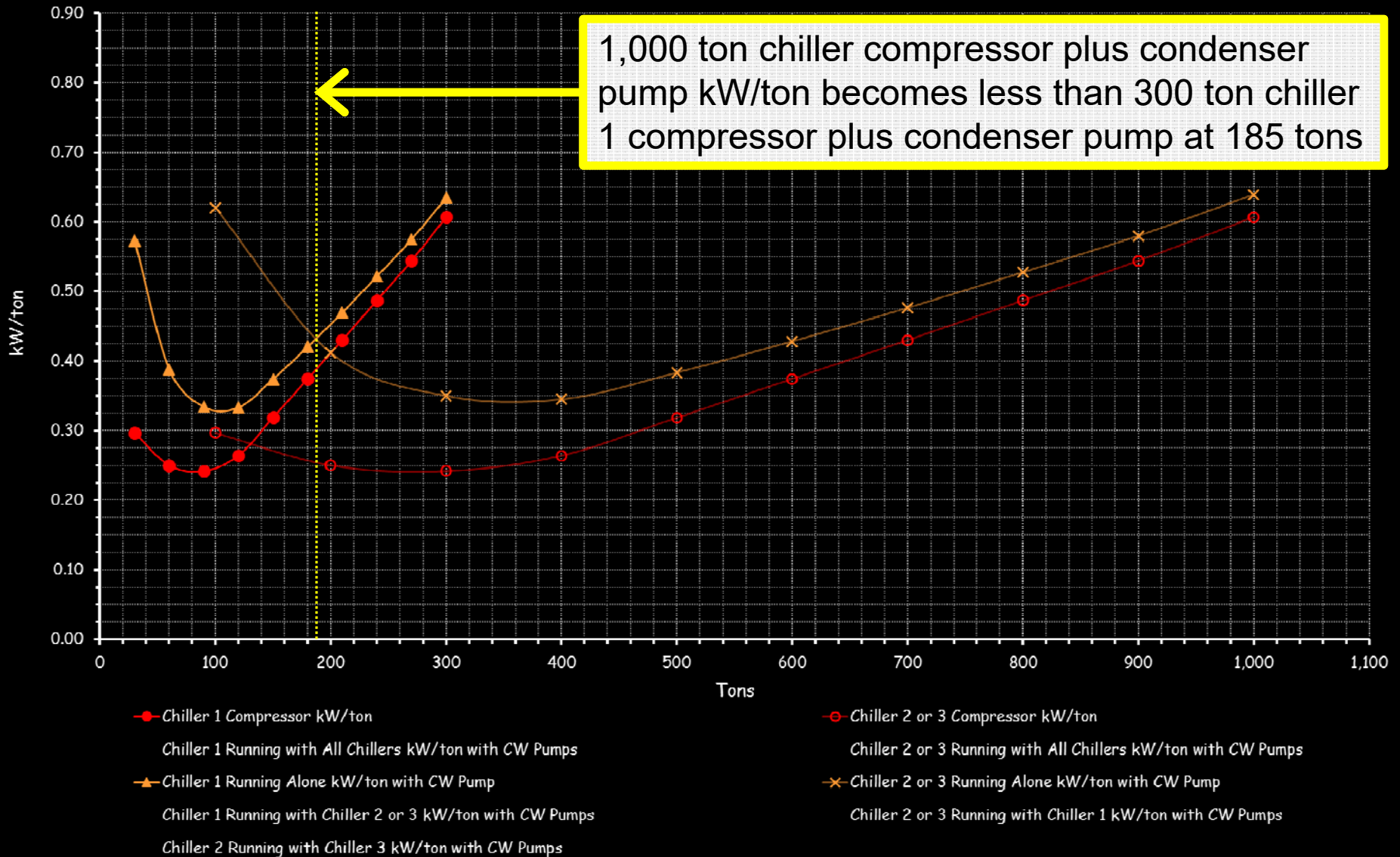


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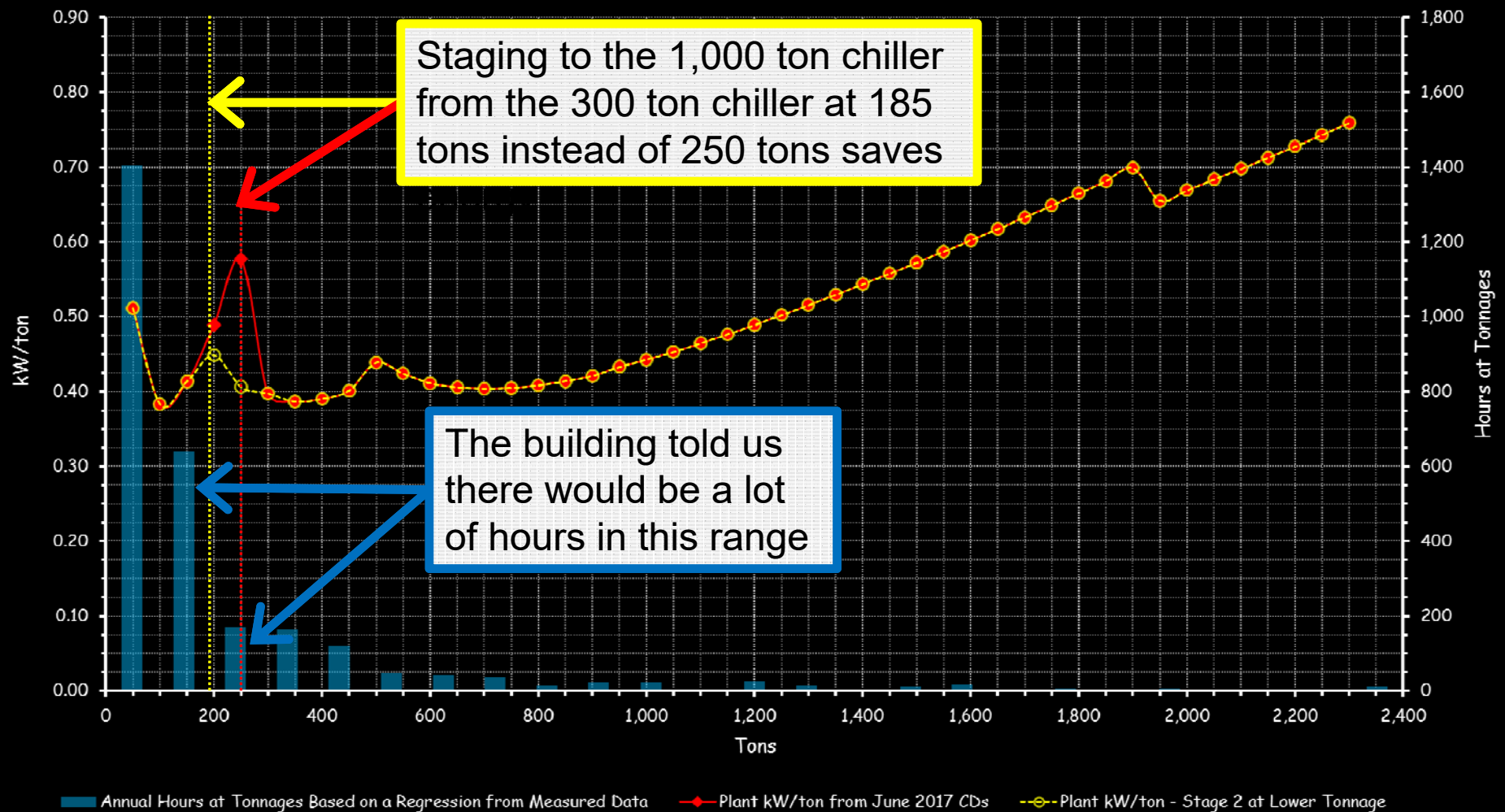




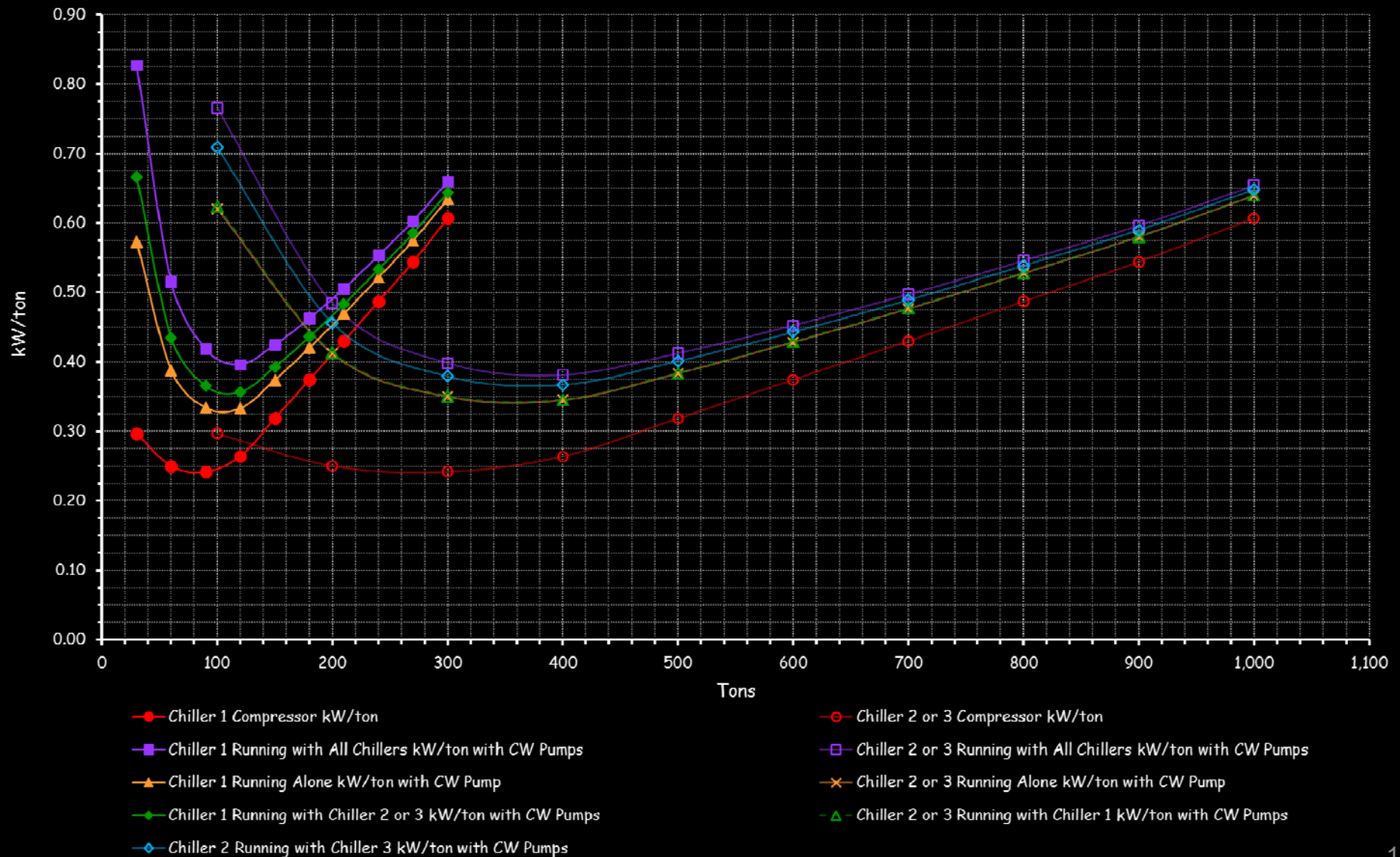
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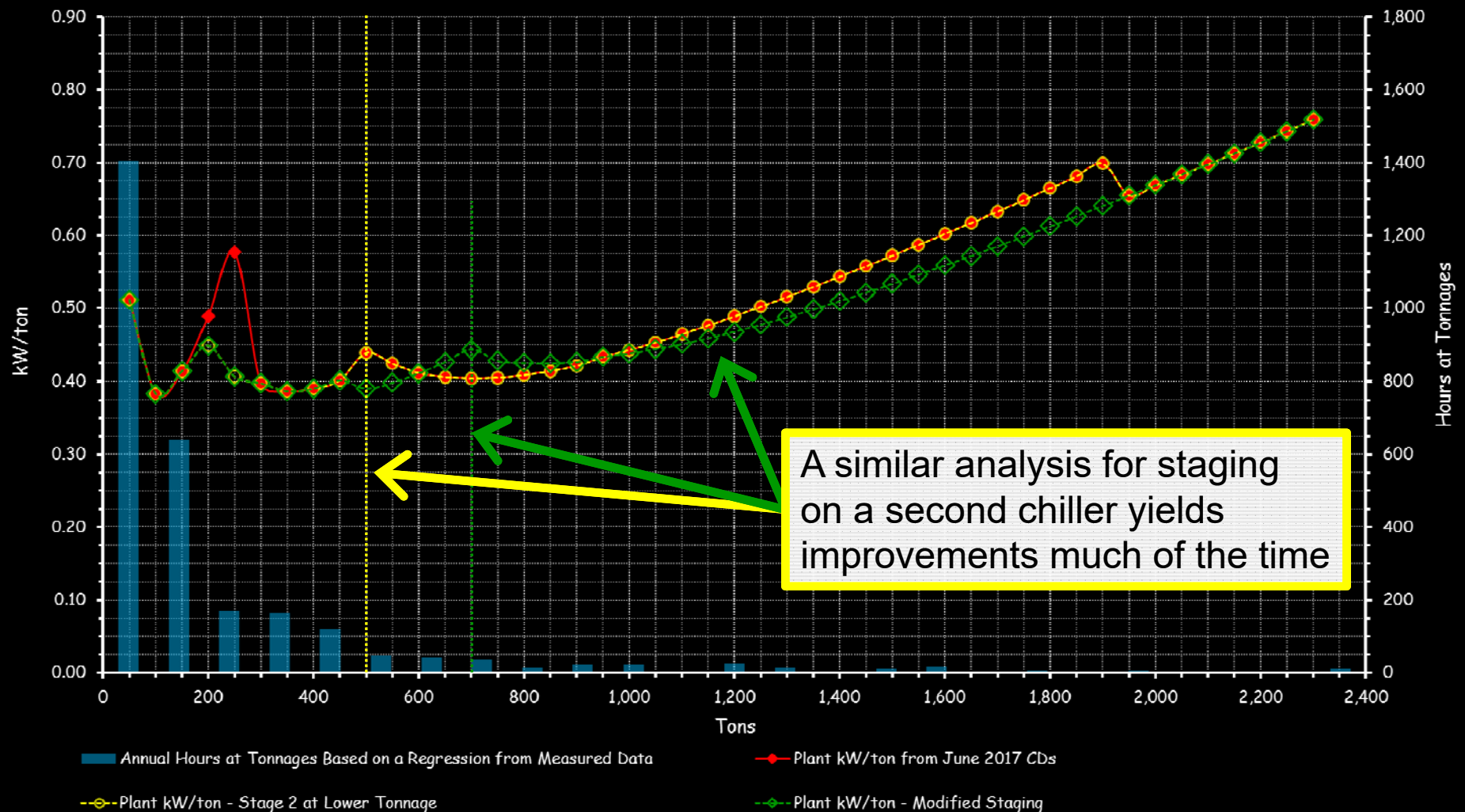
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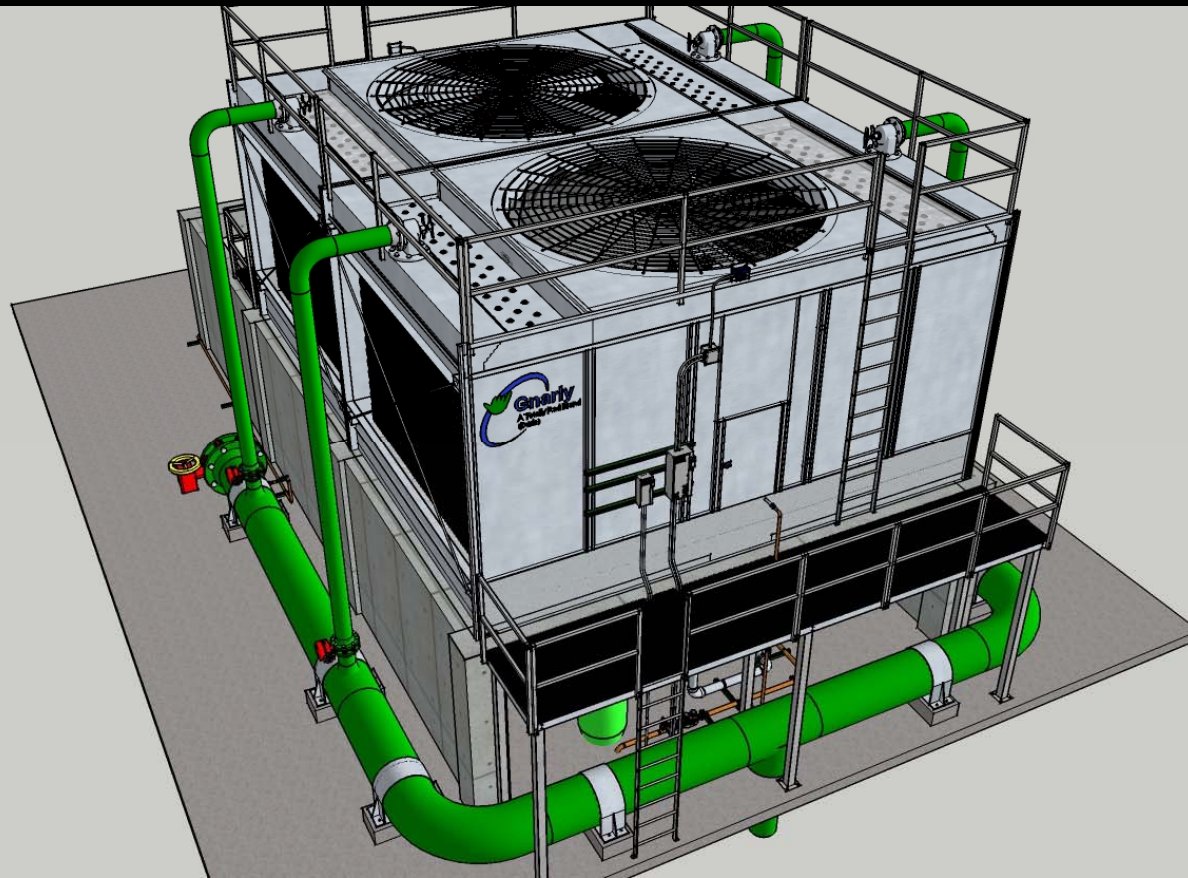


# There's More to Plant Efficiency than Switching Chillers when One is Fully Loaded





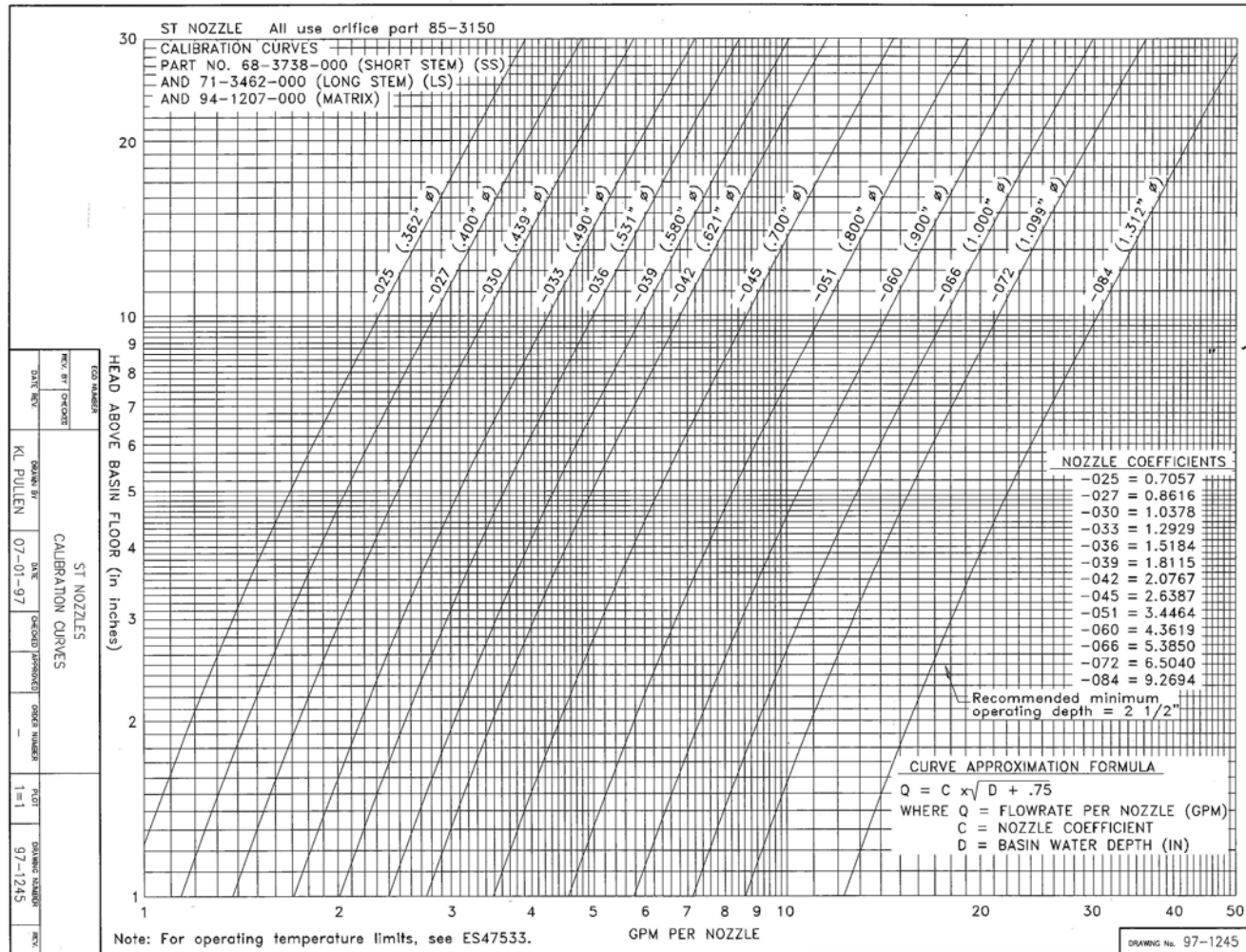
# Taking a Close Look at a Cooling Tower



# Typical Nozzles

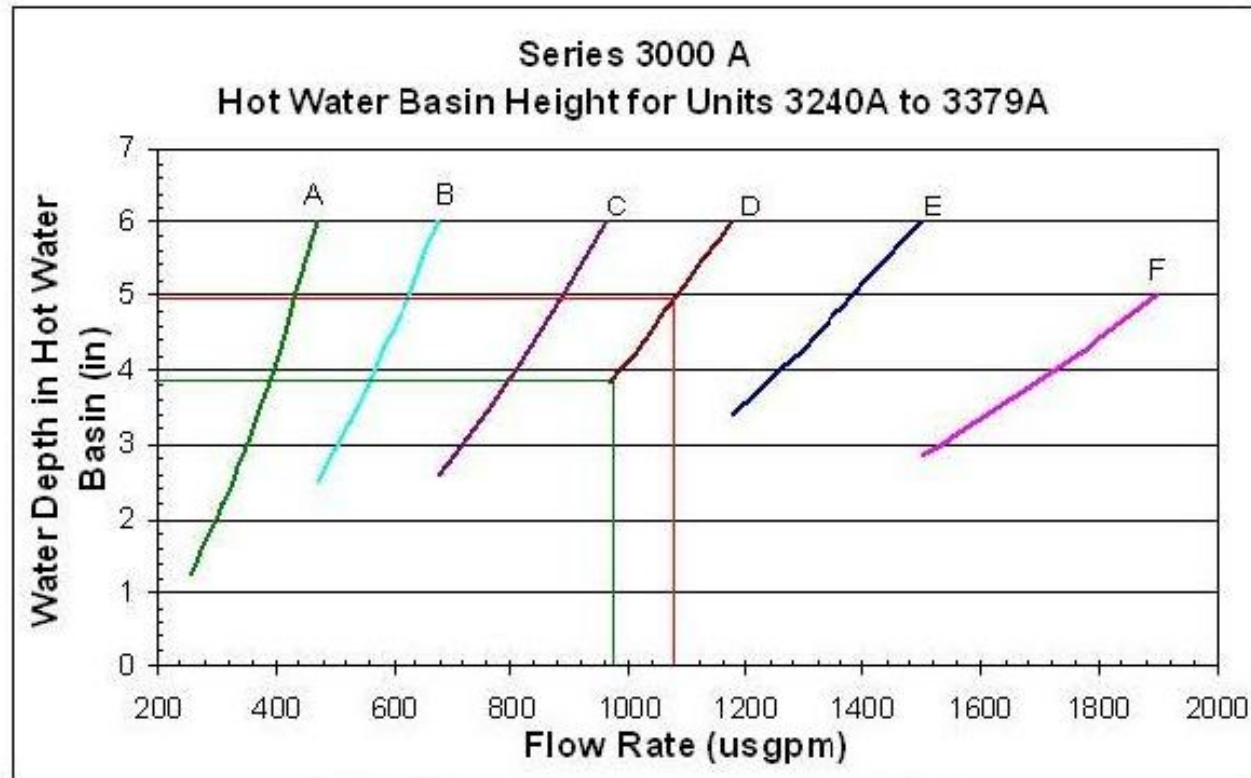


# Nozzle Curves





# Nozzle Curves



Curve A is for flows between 253 gpm & 470 gpm  
Curve B is for flows between 471 gpm & 678 gpm  
Curve C is for flows between 679 gpm & 965 gpm  
Curve D is for flows between 966 gpm & 1175 gpm  
Curve E is for flows between 1176 gpm & 1499 gpm  
Curve F is for flows between 1500 gpm & 1900 gpm

**Flow** rate curves for Series 3000, Units 3240-3379. RLD #1065.



# Typical Wiers

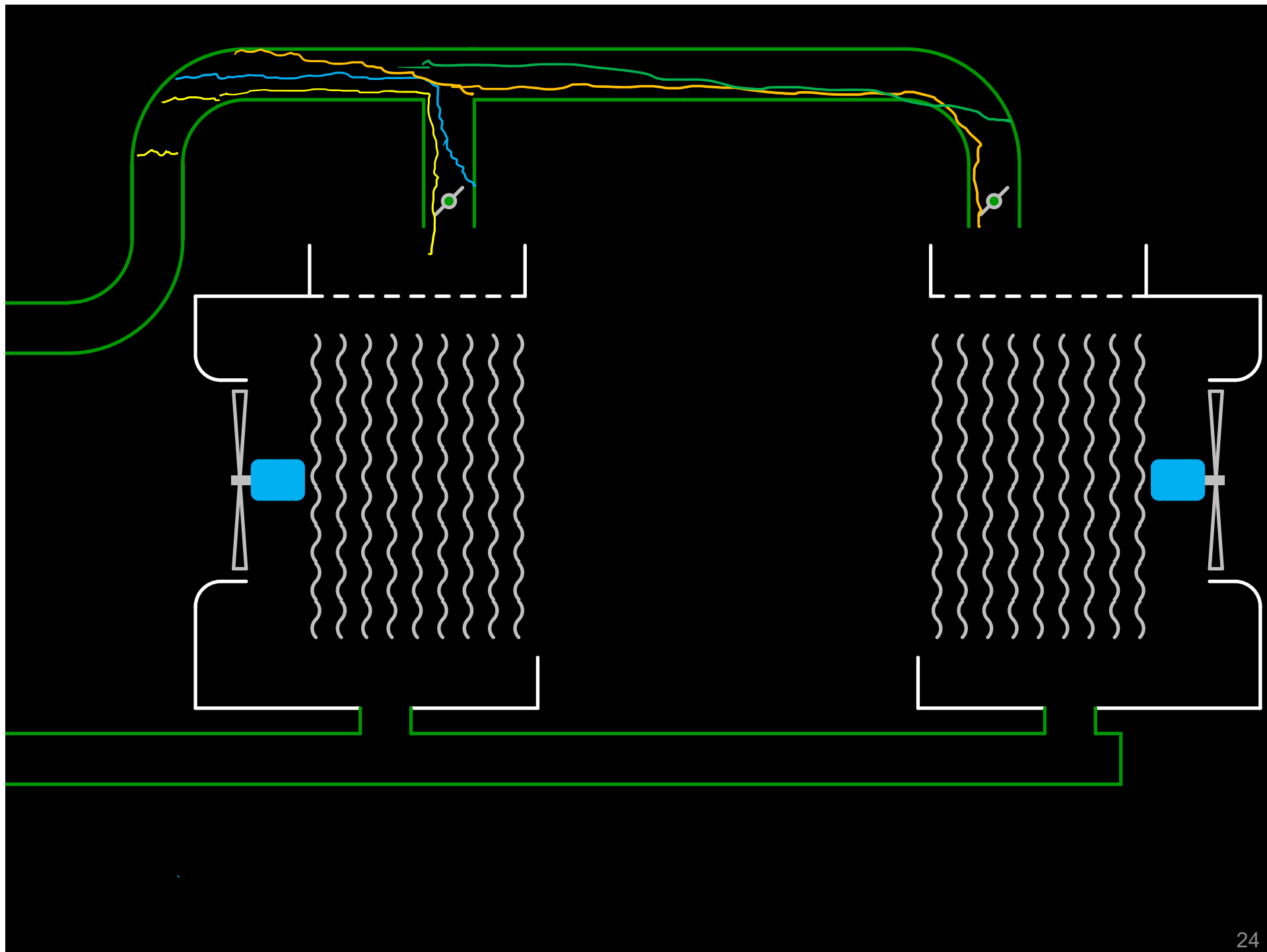




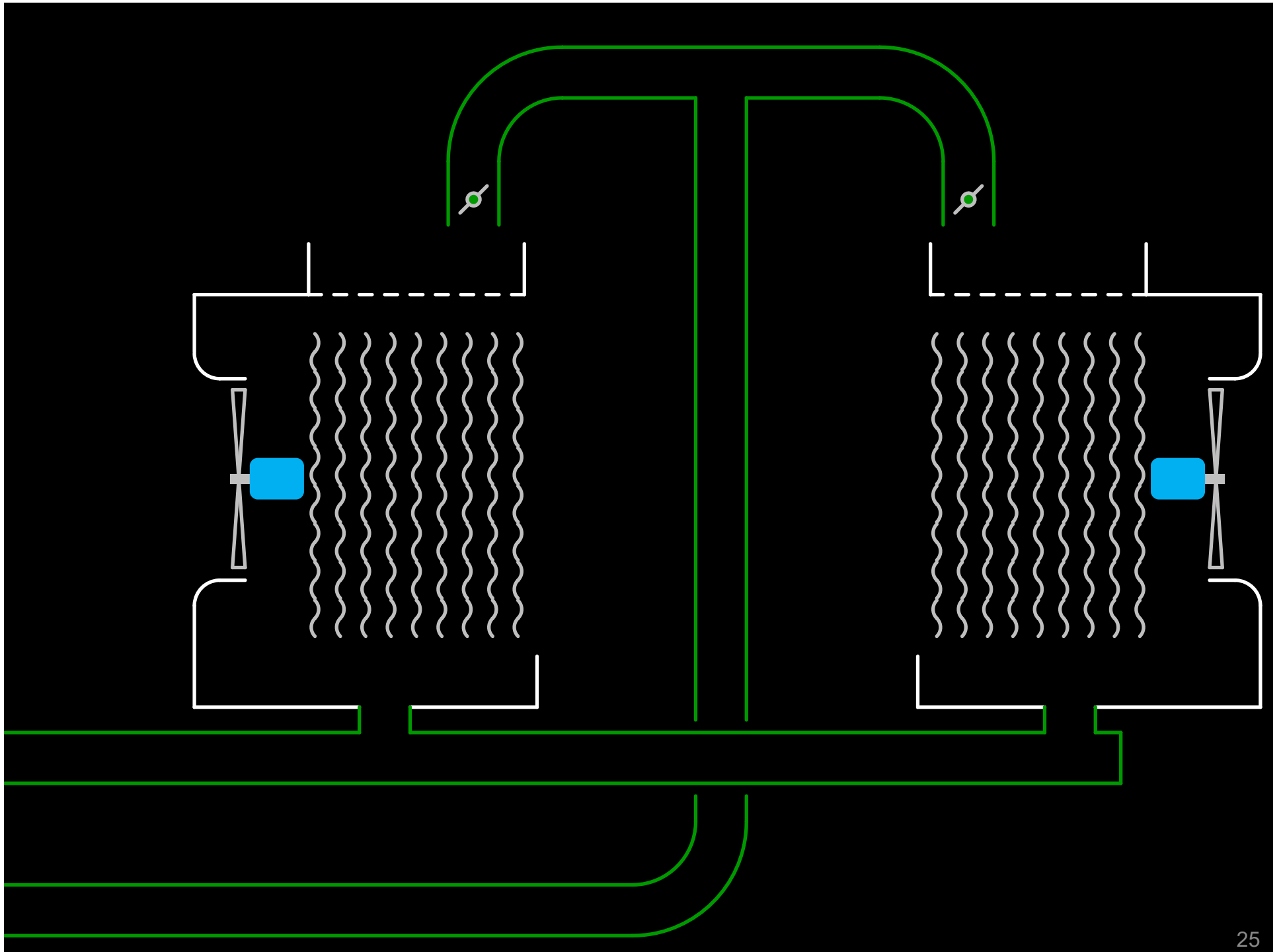
# A Wier Dam Problem

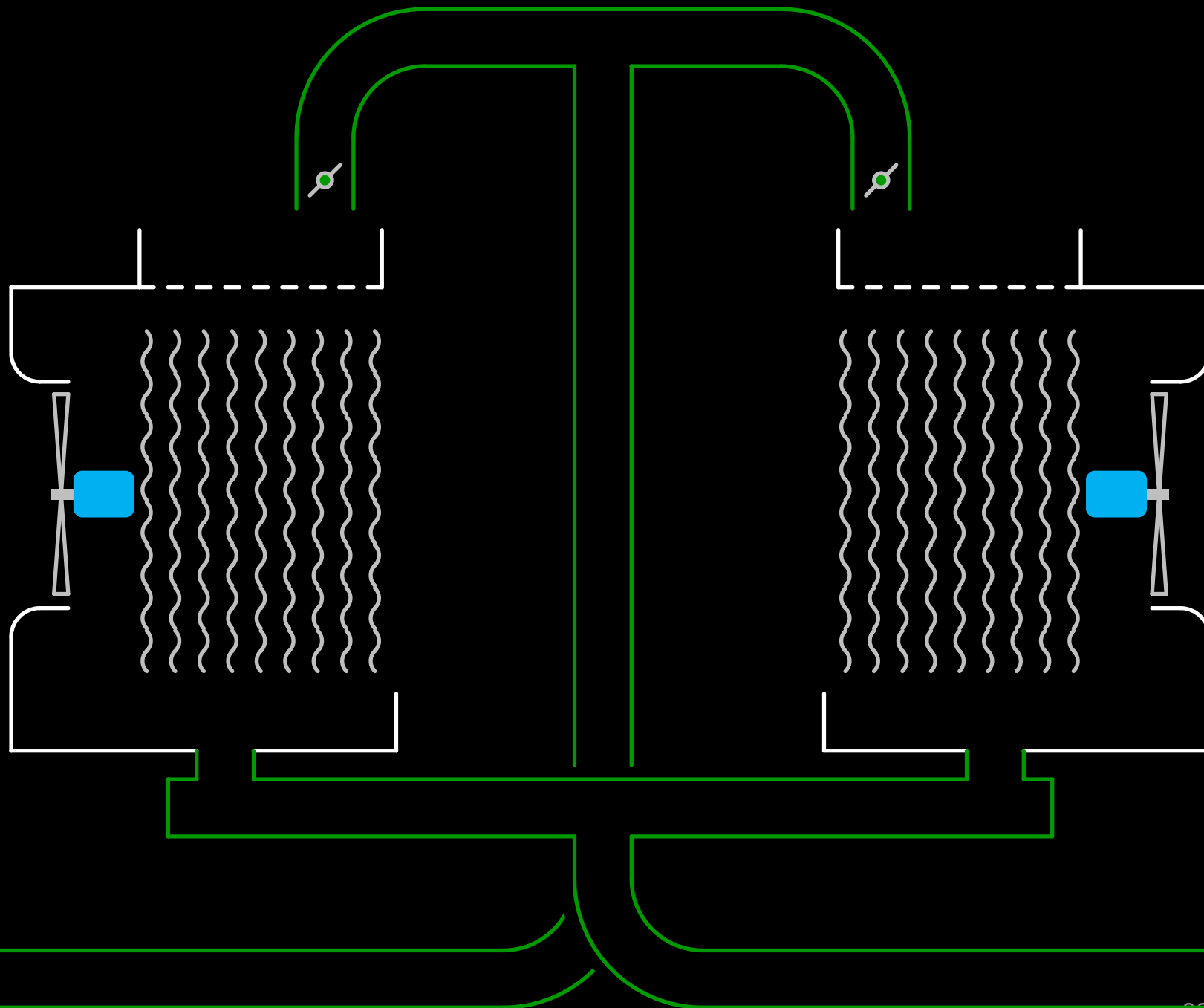


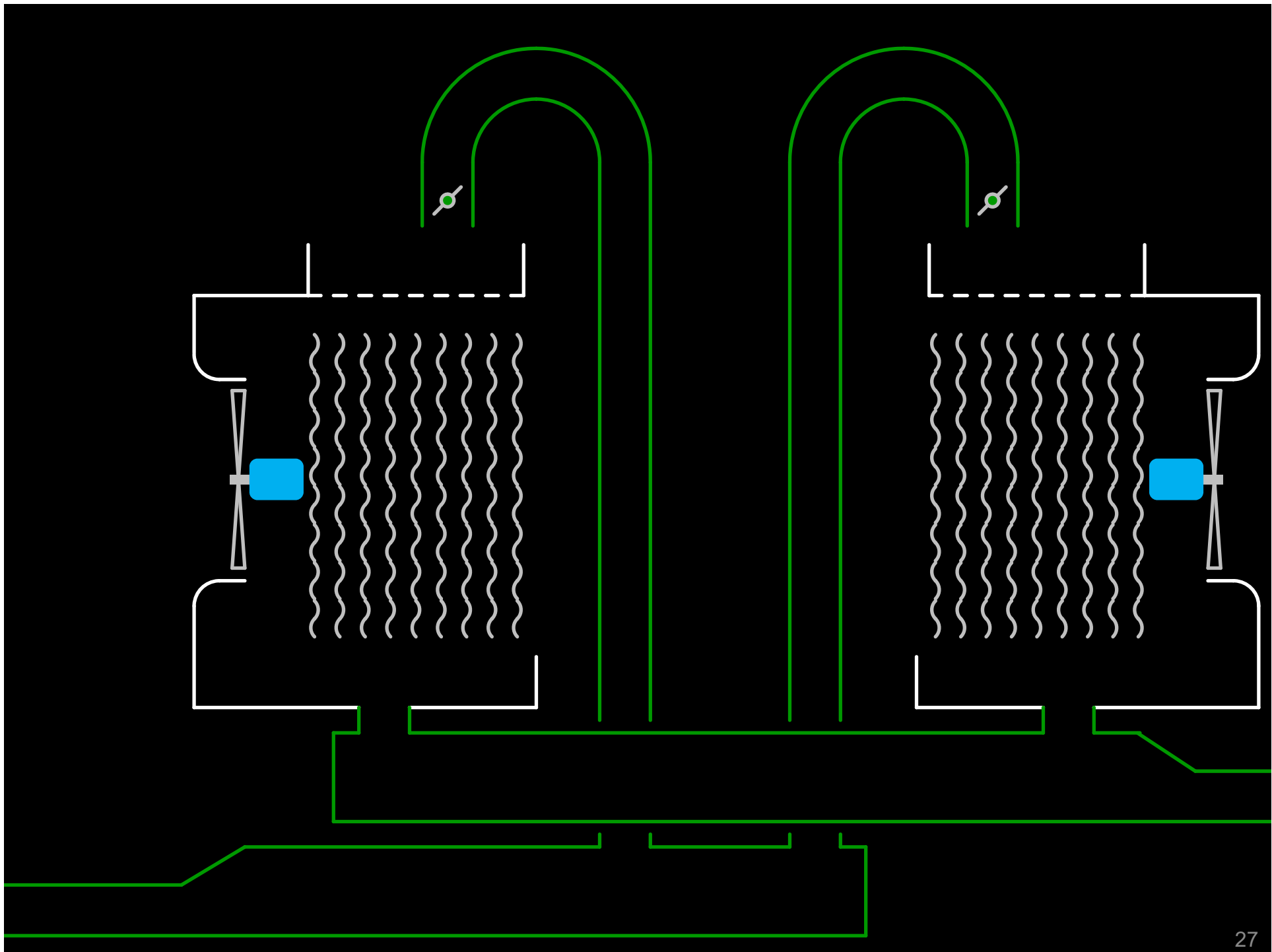
# A Wier Dam Problem











# Different Cooling Sources = Different Operating Requirements

## Vapor Compression Chiller

Cold condenser water = *Good*

Many moving parts;  
frequent or rapid cycling  
= *Compressor failure*

Improper start/stop  
/sequencing = *Energy  
and demand penalty*

Set point fine tuning =  
*Performance and  
efficiency optimization*

## Absorption Cycle Chiller

Cold condenser water =  
*Bad*

Fewer moving parts;  
frequent or rapid cycling  
= *Not gonna happen*

Improper start/stop  
/sequencing = *Angry  
boiler plant operators*

Set point fine tuning = *Just  
fooling your self (you're  
lucky its running)*

## Free Cooling Cycle

Cold condenser water =  
*Relative thing*

Some moving parts;  
frequent or rapid cycling  
= *Motor overheating*

Improper start/stop  
/sequencing = *Cooling  
tower failure*

Set point fine tuning =  
*Performance and  
efficiency optimization*

Monitoring operating data = *Ongoing performance optimization*