Fouling, Energy Saving, & ROI Tools (Return On Investment)

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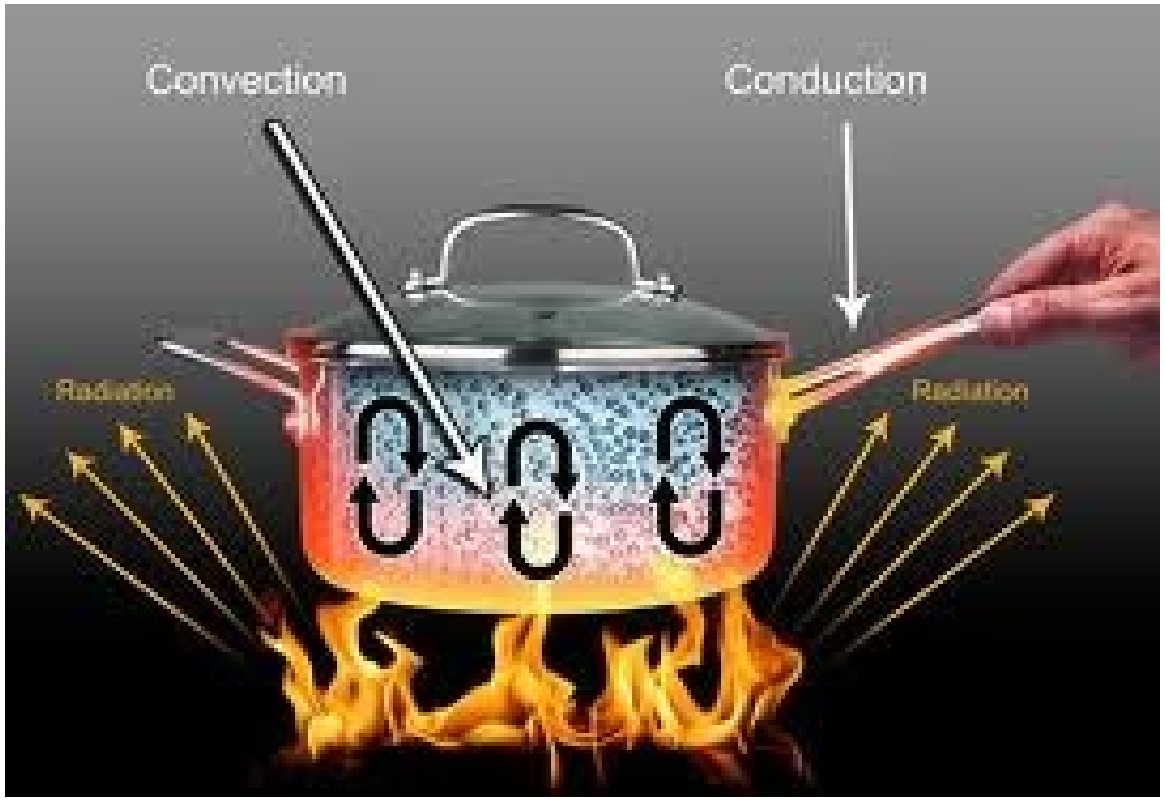
Agenda

1. What is Heat Transfer?
2. Fouling
3. Different types of HT equipment
4. Energy Savings
5. Return on Investment Calculations

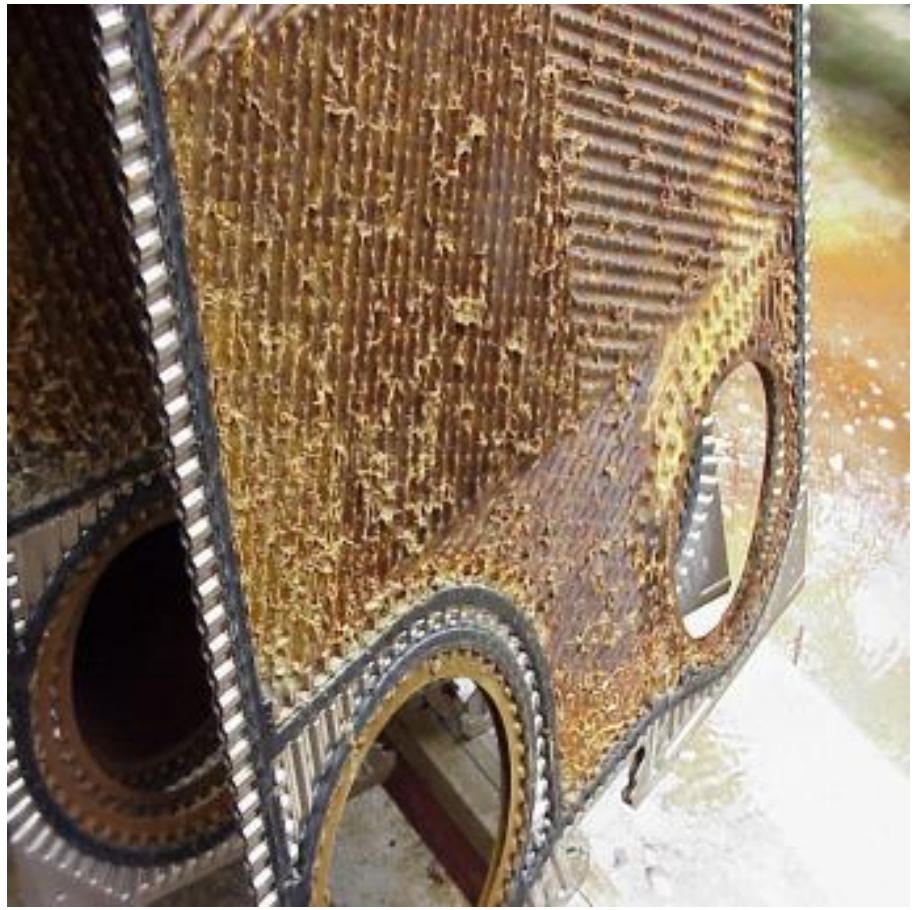
What is Heat Transfer

Heat transfer -is moving energy (heat, btu, Kw,etc.) from one fluid to another fluid or gas through some type of medium (usually metal)



Fouling

- Fouling occurs when any type of particles both organic or inorganic plug or plate out on heat transfer surfaces creating a resistance to transfer energy
- There are two types of fouling
  - Macro-fouling
  - Micro-fouling

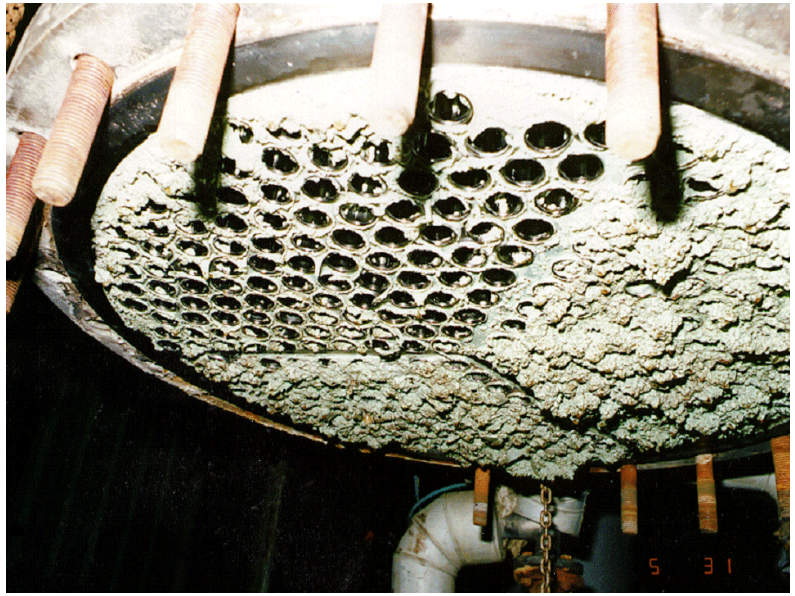


Fouling – Macro vs Micro Fouling

- Macro-fouling
  - Sand
  - Silt
  - Scale
  - Rust
  - Mineral deposits
    Example- Calcium Carbonate
- Micro-fouling
  - Biological growth
  - Algae
  - Bacteria
  - Mussels
    - Micro-fouling is controlled by water treatment

Fouling

- Many contaminants mix together to form larger deposits
  - Example- $CaCO_3$ mixed with sand makes concrete
- It is these large particles that create problems

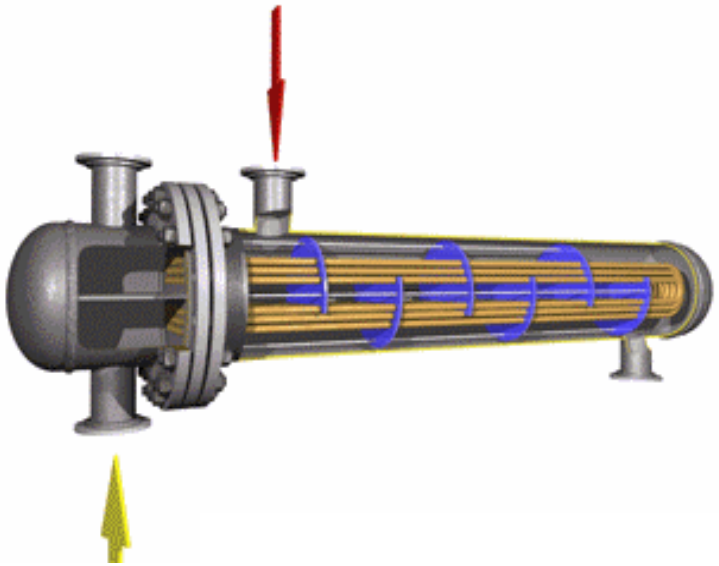


Fouling

- Are dissolved solids and particles under 40 micron a problem
- Typically no, as they do not precipitate out of solution until they reach 120F, or if the ph is out of balance
- The Bigger the Particle….The Bigger the Problem

Heat Exchangers

Plate Heat Exchanger



Shell and Tube Heat Exchangers

Plate Heat Exchangers

- Very effective way to transfer heat
- Compact in size
- High sheer stress on plates
  -This helps to reduce fouling
- U-Values range from 500-1000

Alfa Laval Plate Heat Exchanger Video

Plate Heat Exchangers

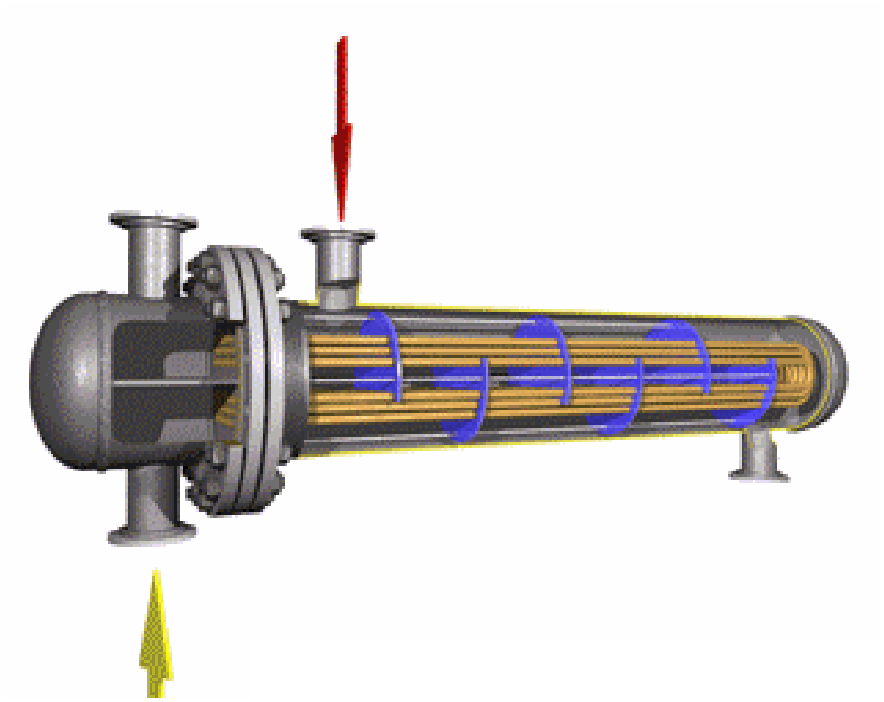
- Turbulence helps prevent particles from settling or plating out. Particle build up creates “Resistance/Fouling” inside equipment
- HVAC plates are usually designed with a 2mm pressing depth
- PHE are designed to pass particles up to half of the plate pressing depth
  - Example- A 2mm plate can pass a particle 1mm (or 1000 microns)
  - Note: Lakos Separators remove particles down to 40 microns

Plate Heat Exchangers

- Every PHE is designed with a certain flow rate
- Reducing flow just a few gpm can dramatically reduce the PHE performance
  - -This is why strainers and cartridge filters are not recommended for use with a PHE
  - -Separators do not have a barrier and therefore do not build up differential pressure and reduce flow to the PHE.

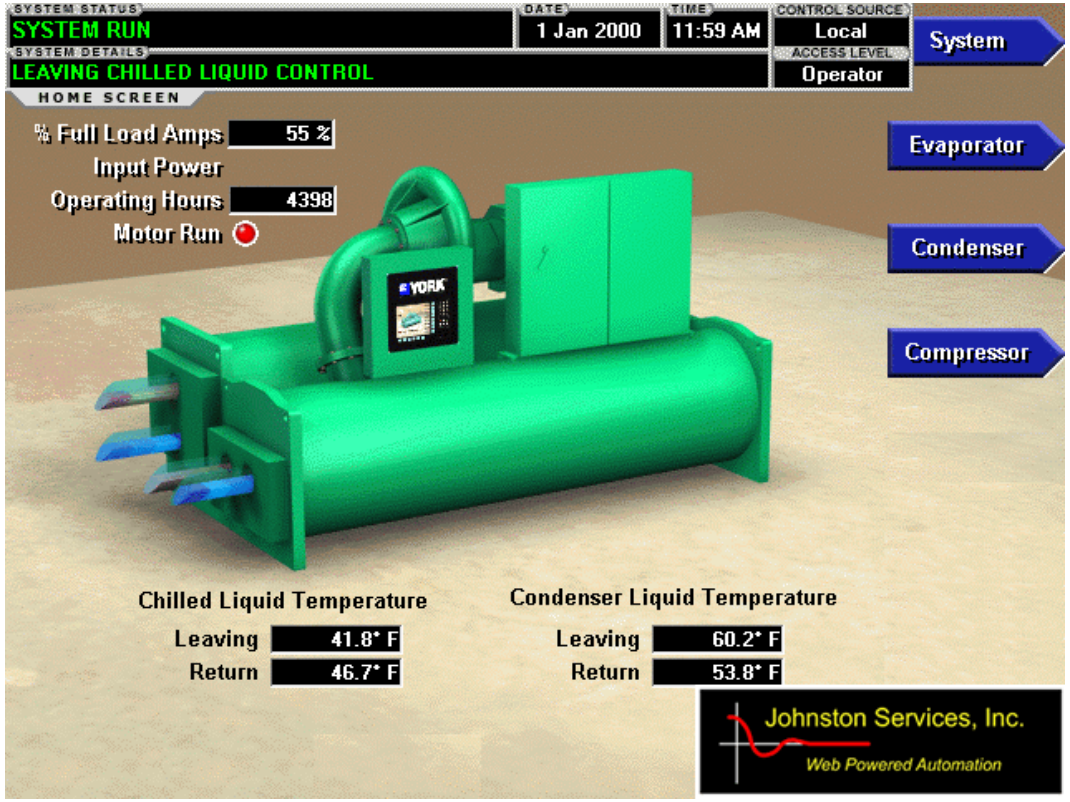
Shell and Tube Heat Exchanger

- Prone to fouling especially during low flow or downturn
- Particles tend to settle with laminar flow



Chillers

- Chillers are the largest energy consumer in HVAC applications
  - Up to 40%
- Most companies do not protect their chillers from fouling
- As fouling occurs, the chiller must work harder to maintain the designed heat transfer rate



Chillers

- The #1 goal is to protect your chiller from fouling.
- If you are cleaning tubes every year you are not utilizing proper filtration.
- 90% of customers have to clean chiller tubes each year.

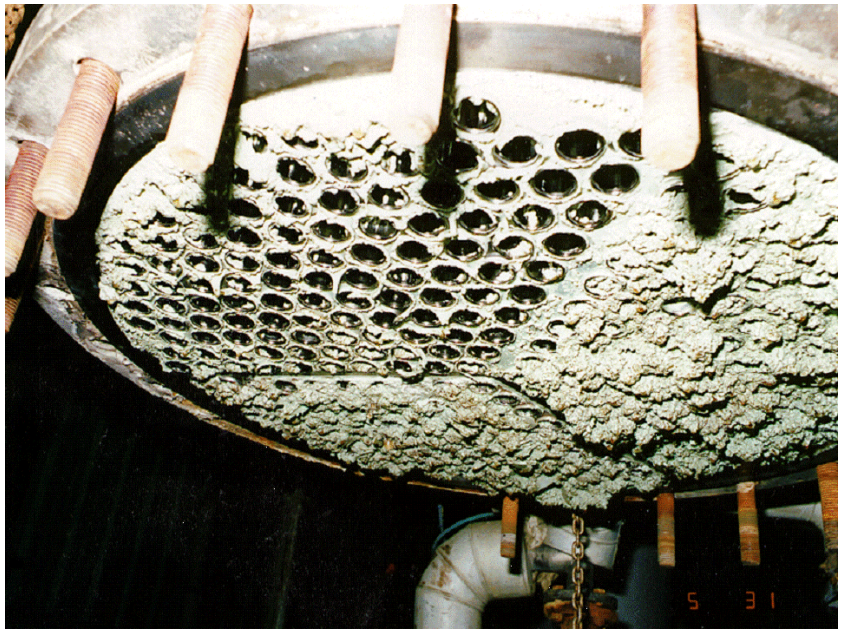
Chillers – Fouling Factors

Condenser Fouling Factors			
Fouling Factor (FF)	Approx. Scale Thickness In Inches	% of Power Increase Required	
Clean	.000	0	
.0001	.001	1.1	
.0005	.006	5.5	
.001	.012	11.0	Typical Fouling
.002	.024	22.0	
.003	.036	33.0	
.004	.048	44.0	

- In Evaporative Cooling loops we should consider the Particulate Fouling Factor (PFF) and “Scale” build up due to the constant ingression of solids

Particulate Fouling

- Calcium Carbonate (CaCO3) is produced when the cooling tower water evaporates. The mineral CaC03 can't evaporate so it precipitates out as a fine powder.
- The second you turn on the cooling tower you start to produce CaC03.
- CaC03 + Sand/silica + water = concrete scale
- This is why many customers punch chiller tubes every year



Chiller - Cleaning

- Punching or Cleaning tubes is very maintenance intensive
- Refinery Heat Exchanger Tubes Cleaning link to Refinery Tube video
- With proper filtration customers could extend this maintenance to an average of 4-5 years

Energy Savings – Cost to Operate a Chiller

- Example- 1000 ton chiller paying $.07 Kw/hr
- Operating 52 weeks/year, 24 hrs/day
- 65% Design efficiency Kw/tn at 70% load
- Annual energy cost $306,066
- Add a Particulate Fouling Factor of .001 and energy increases 11% or $33,667/ year

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- Now use a typical particulate fouling factor of .002
- Annual energy cost is $339,455
- Energy increases 22% or $74,680/year

Green Building?

Are you really operating a *GREEN SYSTEM*?

- Would you run your AC with the windows open?
- Would you run your heat with the doors open?

Filtration is not an option it is a must!

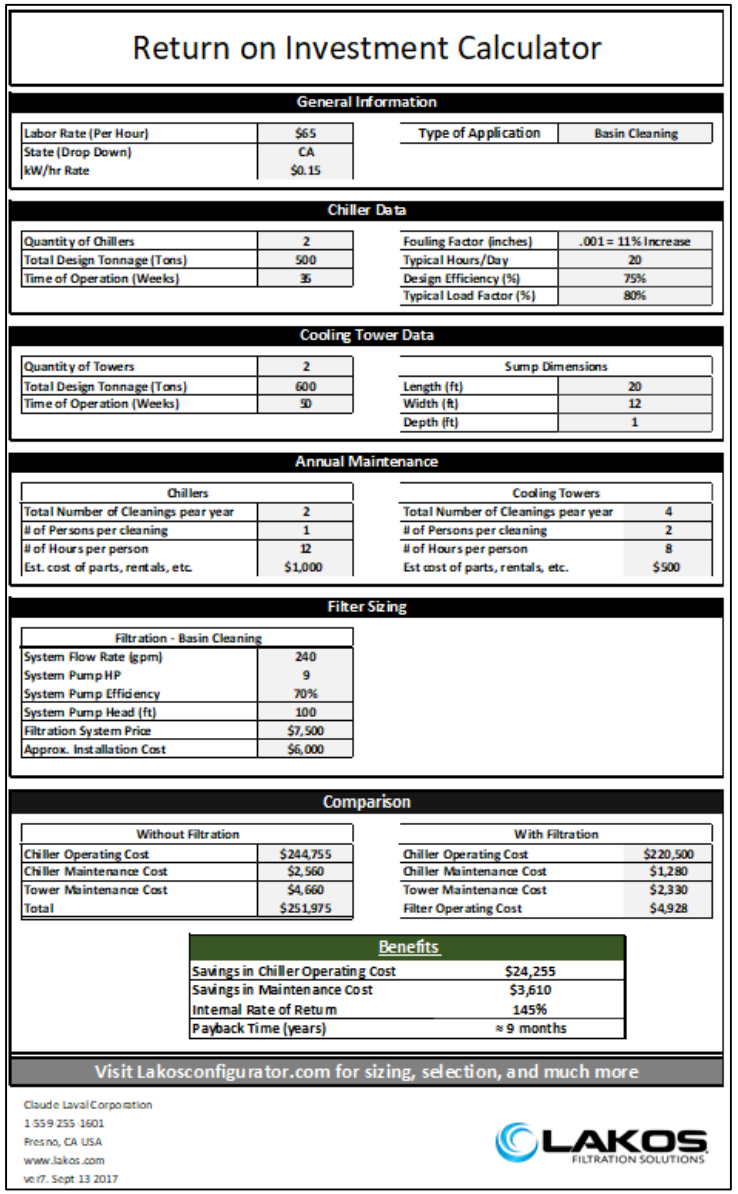
Where else in the HVAC system can you have an impact on energy savings?

- 11% to 33% energy savings every year just from basin sweeping

Return on Investment

- Most paybacks are less than a year
- While there are savings in chemicals, maintenance, and water…..these savings are peanuts compared to the potential ENERGY savings to be realized from not fouling HVAC equipment!!!

Return on Investment



Return on Investment Calculator

General Information

Labor Rate (Per Hour)	$65
State (Drop Down)	CA
kW/hr Rate	$0.15

Type of Application	Basin Cleaning

Chiller Data

Quantity of Chillers	2
Total Design Tonnage (Tons)	500
Time of Operation (Weeks)	35

Fouling Factor (inches)	.001 = 11% Increase
Typical Hours/Day	20
Design Efficiency (%)	75%
Typical Load Factor (%)	80%

Cooling Tower Data

Quantity of Towers	2
Total Design Tonnage (Tons)	600
Time of Operation (Weeks)	50

Sump Dimensions	
Length (ft)	20
Width (ft)	12
Depth (ft)	1

Annual Maintenance

Chillers	
Total Number of Cleanings pear year	2
# of Persons per cleaning	1
# of Hours per person	12
Est. cost of parts, rentals, etc.	$1,000

Cooling Towers	
Total Number of Cleanings pear year	4
# of Persons per cleaning	2
# of Hours per person	8
Est cost of parts, rentals, etc.	$500

Filter Sizing

Filtration - Basin Cleaning	
System Flow Rate (gpm)	240
System Pump HP	9
System Pump Efficiency	70%
System Pump Head (ft)	100
Filtration System Price	$7,500
Approx. Installation Cost	$6,000

Comparison

Without Filtration	
Chiller Operating Cost	$244,755
Chiller Maintenance Cost	$2,560
Tower Maintenance Cost	$4,660
Total	$251,975

With Filtration	
Chiller Operating Cost	$220,500
Chiller Maintenance Cost	$1,280
Tower Maintenance Cost	$2,330
Filter Operating Cost	$4,928

Benefits	
Savings in Chiller Operating Cost	$24,255
Savings in Maintenance Cost	$3,610
Internal Rate of Return	145%
Payback Time (years)	≈ 9 months

Visit Lakosconfigurator.com for sizing, selection, and much more

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LAKOS FILTRATION SOLUTIONS

[Link to ROI Spreadsheet]

Questions?

Three Things to Remember

- Chillers consume 40% of all energy used in an HVAC system
- Fouling factor of .001 equals .012in of scale and increases energy consumption 11%
- Micro fouling is controlled through chemical treatment.

THANK YOU