Life Cycle Cost Of Selecting Chiller Equipment:

Manufacturer’s Viewpoint

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Equipment

- Using Different Kinds Of Equipment Or Different Performance Equipment Can Improve Cost

- Difficult Part Is To Evaluate Life Cycle Analysis
Air Cooled Vs. Water Cooled

- Water Cooled Will Be More Energy Efficient
- It Usually Costs Less To Operate
  - Maintenance And Water Costs
- For Optimization Go Water Cooled
Water Cooled - Optimizing Selections

- Enter Design Data Into The Program
  - Start The Process
    - Choose The Chiller After A Large Vertical Drop
    - Look At The Number Of Selections And Prioritize
  - Analyze Options

![Diagram showing cost analysis with 'Not Good' and 'Good Selection' annotations.]
Review Components

Selecting The Chiller Look At:

- Vessel Length Changes
- Vessel Diameter Changes
- Vessel Tube Count
- Compressor / Gear Selection-If Appropriate
- Motor Size
- Number Of Passes
Conditions Of Service:

- Use Lower Entering Condenser Water Temp
- Use Higher Leaving Chilled Water Temp
- 1/2 Degree Anywhere Makes a BIG Difference!!
- MINIMIZE LIFT
## Range Vs. Supply Water Temperature

- Declining Supply Water Temperature (44 To 38F)
- Increase Chilled Water Range From 10 To 24F
- Annual Energy Analysis

<table>
<thead>
<tr>
<th>Run</th>
<th>C.W. Range (°F)</th>
<th>C.W. S.T. (°F)</th>
<th>Chiller ($/yr)</th>
<th>Pumps ($/yr)</th>
<th>Tower Fan ($/yr)</th>
<th>S.A. Fan ($/yr)</th>
<th>Total ($/yr)</th>
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99% Of All Operating Hours Are At Part Load
Part Load Analysis (IPLV)

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<tr>
<th>% Load</th>
<th>Old % Hrs</th>
<th>New % Hrs</th>
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<tr>
<td>25</td>
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Systems Solution
Optimizing Selections- Glycol!

- High Glycol = Low Heat Transfer:
  - Propylene Glycol Has Really Bad Heat Transfer Properties – Increases Head On Compressor
  - Utilize Less % Of Glycol - Even 0.5% Can Make A Difference
  - ASHRAE Fundamentals: Physical Properties Of Secondary Coolants

- Don’t Limit Input Values
  - Run Selections Multiple Ways
Vessels

- **High Pressure Drops?**
  - Look At 1 Pass Vessels
  - Look At Reducing Evaporator Or Condenser Length
  - Tube Thickness Can Increase Pressure Drop

- **Conversely - High Temperature Difference?**
  - Look At (3) Pass
  - Look At Series Flow With 1, 2, Or 3 Pass
Optimizing Selections- F.L. Vs. IPLV

- Low NPLV Or IPLV: Look At Multiple Compressor Or VFD
  - Sort By NPLV/IPLV
  - Lowest NPLV Is Not Normally The Lowest Full Load kW/Ton
  - Slight Decrease In Full Load KW/TR Can Dramatically Increase Cost And Actually Increase NPLV/IPLV!
Various 500 Ton Chillers

Notes:  
WSC = Single Compressor Centrifugal Chiller  
WDC = Dual Compressor Centrifugal Chiller  
VFD = Variable Frequency Drive
Multiple Chillers On A Job?
- High Temperature Difference Across The Evaporator?
  - Look At Series / Counterflow Arrangements
  - 1 Multiple Compressor Instead Of 2 Singles
Cooling Tower Considerations

- Oversize Tower To Lower Condenser Water Supply Temperature
- Chiller Stays Same Price, Efficiency Improves 11%
- Tower Capital And Operating Cost Up Slightly
- 3% Annual Savings

<table>
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<tr>
<th>Run</th>
<th>Cond. W.S.T. (°F)</th>
<th>Chiller kW/Ton</th>
<th>Chiller Pumps ($/yr)</th>
<th>Tower Fan ($/yr)</th>
<th>S.A. Fan ($/yr)</th>
<th>Total ($/yr)</th>
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Annual WB In Major US Cities

Strong Candidates For VFD Chillers

Los Angeles, Washington DC, Atlanta, Chicago, Miami
Optimizing Starter Selections

- Try Different Starters
  - Solid State Starters Have Different Size Breaks Than Wye Delta Starters
  - Solid State Starters Are Now Cheaper In Most Cases - Try Both Ways Depending Upon Size Breaks
  - Try Unit Mounted And Free Standing - Size Breaks Can Make Different Selections Appear
  - Check VFD Sizing – Expensive At Very Bottom Of Amp Rating
Variable Flow Vs. Constant Flow

Notice Pump Work
Half Chiller Work!

Pump Work Cut
In Half

- Variable Primary Flow
- 2 Chiller Primary/Secondary Flow
- 2 Chiller Parallel Flow
Wrap-up

- Many Ways To Solve An Application
- Selection Is Only As Good As The Data Given
- Optimize Your Selections