"Condenser Water Heat Recovery"

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What Is Sustainability?

“sustainable development meets the needs of today without compromising the ability of future generations to meet their own needs”

World Commission on Environment and Development 1987
ASHRAE Position

“supports building sustainability as a means to provide **safe, healthy, comfortable indoor environment** while simultaneously limiting the impact on the Earth’s natural resources”
Greater Efficiency Today, Blue Skies Tomorrow
Why Sustainable Design?

• Buildings In The US Consume 39% Of Our Total Energy
• 70% Of Our Electricity Annually
• 5 Billion Gallons Potable Water Per Day For Toilets
• Typical Construction Generates 2.5 lbs. Of Solid Waste Per Square Foot
• High Performance Building Practices Can Reduce These Negative Environmental Impacts
What Is LEED?

- 6 Sections of LEED
  - Sustainable Sites
  - Water Efficiency
  - Energy & Atmosphere
  - Materials & Resources
  - Indoor Environmental Quality
  - Innovation & Design Process
Commercial State Energy Code Status
As of October 2008

Source:
Building Codes Assistance Project
www.bcap-energy.org

Legend:
- Effective code meets or exceeds ASHRAE 90.1-2007 or equivalent
- Meets 2006 IECC / ASHRAE 90.1-2004 or equivalent
- Meets 2003 IECC / ASHRAE 90.1-2001 or equivalent
- Meets 2001 IECC / ASHRAE 90.1-1999 or equivalent (meets EPCA)
- Precedes ASHRAE 90.1-1999 or no statewide code
- Significant adoptions in jurisdictions
- Lighter color indicates code has been adopted but not yet effective
Single Chiller Design

- 800 Tons Load
- 3 Way Valves
- 2400 GPM at 95°F
- Cooling Tower 40 kW
- 85°F Supply to Chiller
- 44°F Chilled Water Supply
- 800 Ton Chiller 0.55 kW/ton
Range Vs. Supply Water Temperature

- **Change To 14F Range**
  - Smaller Pumps, Pipes etc.
- **Maintain Supply Water Temperature**
- **LMTD Increases**
  - Improves Chiller Performance
- **Hurts Chilled Water Coil Performance**
  - Deeper Coils Required
  - Increased Fan Static Pressure
Why Consider Heat Recovery?

• **Green Is Good**
  Conservation of Natural Resources

• **Lower Annual Energy Usage**
  – Reduce Operating Cost

• **Provide a Good Life Cycle Analysis**
Green

- ANSI/ASHRAE/IESNA Standard 90.1
  - LEED requires you comply with 90.1 and exceed it for more points.
  - LEED requires some water conservation and reducing evaporation from towers qualifies.
  - Heat Recovery chiller in the condenser stream reduces water evaporation.
Heat Recovery Requirements

Simultaneous Heating And Cooling

- The Potential Heat Recovery At Any Point In Time Is The Lesser Of The Heat Source Or The Heat Load
Must have a heat source

Cooling & heating loads are coincident
Single Condenser HR Design
Split Condenser HR Design

- Cooling Tower
- Boiler Loop
- Split Condenser Heat Recovery Chiller
- Chilled Water Pump
- Heat Recovery Pump
- 3 Way Bypass Valve
Looks like a normal chiller!

They are!!!
Heat Pump Chiller Design
Tertiary Loop Design

• Allows Different Flowrates And Temperature Ranges In HR Loop From Boiler Loop
• Can Reclaim Max. Energy
• Isolates Loops
• Pump Only Operates When Required
  – Std 90.1 Requires Pump Pressure Drop Exceeds 20 ft
Heat Recovery Design

• Generally Design Boiler Load Greater Than Design Chiller THR (Total Heat of Rejection)
  – Actual Design Heat Recovery Rate Requires Annual Energy Analysis
  – Almost Never Boiler Or THR Design Capacity
  – Load Will Be Met By Combination Of HR And Boiler

• THR = 1.25 x Chiller Capacity

• Only One Chiller Need Be HR Type In Multiple Chiller Plant
  – Must Be First On, Last Off
Heat Recovery Control

“During Heat Recovery Mode, Maintain Boiler Return Water Temperature At 95°F”
- Boiler Supply Water Temperature Will “Float” Depending On Actual Heating Load In Building
- 25% Boiler Load = 100°F SWT (5°F Temperature Range)

Not

“During Heat Recovery Mode, Maintain Boiler Supply Water Temperature At 105°F”
- 25% Boiler Load = 100°F RWT
- Entering Condenser WT will be 5°F Higher Than Above
- Boiler Will Still Be Required
- Same Amount Of Energy Will Be Recovered
- Chiller will Work A Lot (10%) Harder
Results
Geothermal Heating

- Reheat
- Domestic Heat
- Domestic Hot H2O
- Process Heat

120°F - 160°F

65°F - 55°F

GROUND LOOP
Heat Pump Benefits

- Recovers Waste Heat
- Heats Water Economically
- Saves Water
- Saves Chemical Treatment
- Reduces Blowdown & Sewer Charges
- Improves Chiller Efficiency
Analysis is a MUST
Questions?