Chiller Systems for Combustion Inlet Air Cooling

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Chiller Systems

Outline

• Drivers for Chiller Systems
• TIAC Chiller System Overview
• Predominant Chiller System Types
• Project Design Parameters
• System Design Considerations
• Summary
Chiller Systems

Drivers

• Additional Output
• Dispatch Priority
• Predictable and Consistent Output
• Altitude Compensation
• Matching Output of Competitors GT
• Waste Heat Utilization
Chiller Systems

TIAC Chiller System Overview
Chiller Systems

Predominant Types

- Electric Centrifugal Chillers
- Screw Compressor Refrigeration Systems
- Absorption Chillers
# Chiller Systems

**Electric Centrifugal Chillers with Cooling Towers**

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• High Efficiency</td>
<td>• Requires Makeup Water</td>
</tr>
<tr>
<td>• Low Cost</td>
<td>• Open Loop Heat Rejection</td>
</tr>
<tr>
<td>• Small Footprint</td>
<td>• Water Discharge</td>
</tr>
<tr>
<td>• Operational Flexibility</td>
<td></td>
</tr>
</tbody>
</table>

**Limitations**

- Requires Makeup Water
- Open Loop Heat Rejection
- Water Discharge

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**Turbine Inlet Cooling Association**

turbineinletcooling.org
Chiller Systems
Electric Centrifugal Chillers with Cooling Towers
## Chiller Systems

### Electric Centrifugal Chillers with Radiators

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• No Water Required</td>
<td>• Lower Efficiency than with Cooling Towers</td>
</tr>
<tr>
<td>• Relatively Fast Startup</td>
<td>• Larger Footprint</td>
</tr>
<tr>
<td>• Low Cost Air-Cooled System</td>
<td>• Higher Sound Levels</td>
</tr>
<tr>
<td></td>
<td>• Higher Cost than with Cooling Towers</td>
</tr>
</tbody>
</table>
Chiller Systems
Electric Centrifugal Chillers with Radiators
Chiller Systems
Screw Compressor Refrigeration System with Air-Cooled Condenser

Benefits
• No Water Required
• Relatively Fast Startup
• Can be Modular

Limitations
• Lower Efficiency
• Larger Footprint
• Higher Sound Levels
• Higher Cost
Chiller Systems
Screw Compressor Refrigeration System with Air-Cooled Condenser
## Chiller Systems

### Absorption Chiller with Cooling Towers

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Fueled by Heat or Natural Gas</td>
<td>• Supply Water Temps</td>
</tr>
<tr>
<td></td>
<td>• Makeup Water Req</td>
</tr>
<tr>
<td></td>
<td>• Higher Cost</td>
</tr>
<tr>
<td></td>
<td>• Lacks Flexibility</td>
</tr>
<tr>
<td></td>
<td>• Must use Heat when Available</td>
</tr>
</tbody>
</table>
Chiller Systems
Absorption Chiller with Cooling Towers
Chiller Systems

Project Design Parameters - Sizing

• Ambient Design Conditions
• Elevation (Inlet Pressure)
• Mass Flow (Inlet Temperature)

• Parasitic Losses
  • Pipe Heat Leak
  • Pump Heat Load
  • Chiller Plant Cooling
  • Auxiliary Loads
Chiller Systems

Project Design Parameters - IAT

- Maximum Output
- Optimal Capital
- Optimum Heat Rate
- Minimum Augmentation
  - Satisfy Capacity Contract
  - Satisfy Competitive Specification
  - Site Utility Limitation
Chiller Systems

Project Design Parameters - Site

• Equipment
• Space
• Chiller Plant Energy Source
• Heat Rejection
• Permitting
Chiller Systems

System Design Considerations

Heat Transfer for Inlet Air
• Face Velocity (400 to 500 fpm)
• Pressure Drop
• Size Limitations
• Supply Temperature (Direct vs TES)
• Freeze Protection
• Macro-Environments
Chiller Systems

System Design Considerations

Chiller
• Type
• Refrigerant
• Configuration
• Tube Material
• Manufacturer
Chiller Systems

System Design Considerations

Pump
  • Redundancy
  • Configuration
  • Motors
Chiller Systems

System Design Considerations

Heat Rejection

• Cooling Towers
  • Materials
  • Sound

• Natural

• Radiators

• Condensers (wet surface or air-cooled)
Chiller Systems

System Design Considerations

Electrical

• Feeds
• Standards (NEMA, IEC, etc.)
• Gear (Arc Flash Resistant)
• Motors
• Controls
Chiller Systems

Summary

• Output Independent of Ambient Conditions
• Water Consumption and Discharge
• Design Parameter Determination is Key