AIR-COOLED CONDENSER INTRODUCTION
1. System Configuration
2. Process Diagram
3. General Arrangement (3-D)
4. ACC Module Features
5. Finned Tube Type
6. Two Stage Condensing Process
7. Noise and Axial Fan
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1. ACC System Configuration

From Steam Turbine

- Steam Duct and Manifold
  - Fin cleaning system
  - Hotwell & Drain pump
  - Rupture disc
  - Safety relief valve
  - Bypass station
  - Flash Box
  - Expansion joint

Finned tube Bundle Modules

- Air Moving Unit (Fan, Gearbox, Motor)
  - Ambient Air

Air Extraction System

- to Atmosphere

Condensate Receiver Tank

- Make-up water
  - Deaerator

Condensate Forwarding pump

Feedwater to Boiler/HRSG
2. ACC Process Diagram
3. ACC General Arrangement (3-D)
3. ACC General Arrangement (3-D)
4. ACC Module Features

- A-Frame and Forced Draft Configuration
- Two Stage Condensing Bundles
  
  Primary – Main condensing, concurrent flow between steam and condensate
  Secondary - Non-condensable gas venting and condensing, Countercurrent flow

- Inclined gravity flow design
- Multi and Single Row Design
- Durable aluminum fin tube
- Each cell divided by Intermediate wall
5. Type of Finned tube

- Circular Finned tube (Aluminum Fin)
  - Conventional proven design
  - Good corrosion resistance
  - High power consumption
  - Some Dead zone
  - Weak flooding & freezing
  - Low investment cost

- Oval Finned tube (Galvanized steel Fin)

- Flat Finned tube (Aluminium fin)
  - Latest developed design
  - Easy HP water Fin Cleaning
  - Low power consumption
  - No Dead zone
  - Low flooding & freezing
  - High investment cost
6. Two-Stage Condensing Process

**Primary Condensing Bundle**
- **Flow**: Parallel (Concurrent)
- **Steam**: 75-90% flow
- **Air**: To Reflux bundle
- **Others**: -

**Secondary Reflux Bundle**
- **Flow**: Opposite (Countercurrent)
- **Steam**: 10-25% flow
- **Air**: To Vacuum System
- **Others**: Minimize Sub-cooling
### Axial Fan Type and Feature

<table>
<thead>
<tr>
<th>Fan type</th>
<th>Feature</th>
<th>Noise level (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Classic Straight aerofoil</td>
<td>75-85</td>
</tr>
<tr>
<td>Low / Very Low Noise</td>
<td>Straight aerofoil w/wide Tip</td>
<td>70-75</td>
</tr>
<tr>
<td>Ultra Low Noise</td>
<td>Special Shaped aerofoil</td>
<td>60-70</td>
</tr>
</tbody>
</table>
8. Vendor Technical Evaluation Criteria

- Electric Power Consumption
- Near/Far Field Noise Level
- Fan Deck Height
  (Perimeter Entrance Velocity around 3.5-4.0m/sec)
- Plot Area (Bay Arrangement)
- Capital & Equipment Cost
1) Steam Duct and Manifold

- **Major Components**
  - Main steam duct, distribution, riser and manifold
  - Hotwell and drain pump
  - Flash box
  - Multi-hole perforated IP/LP bypass station
  - Expansion Joints (Dog bone or hinged bellows)

- **Safety Device**
  - Rupture disc for pressure protection
  - Safety valves for pressure protection
  - Vacuum breaker valve for vacuum destruction

- **Design consideration for erosion and expansion**
  - Steam flow guide for elbow section
  - Low exhaust steam velocity
  - Flexibility study for thermal growth
2) Air Moving System (Fan Driving Unit)

- **Axial Fan w/Hub**
  - Manual adjustable type
  - Fan blade tip clearance adjustable
  - FRP or Al material for fan blade
  - Balancing test at fan supplier’s shop
  - FRP or steel bell shape Fan Ring (Smooth air flow)
  - Fan guard for foreign matter protection

  **Advantages of FRP Fan**
  - Superior damping
  - Corrosion resistance
  - Easy & little maintenance

- **Speed Reduction Gearbox**
  - Helical or spiral bevel type
  - Internal lubrication forced type
  - Service factor 2.0
  - Flexible coupling connection
  - Oil level glass, level switch and oil pressure switch
  - Back stop
9. ACC Components and Accessories (3/7)

- Electric driver (Motor)
  - Single, two or variable speed type
  - Energy saving motor
  - Freezing problem – use two or variable motor

- Accessories
  - Vibration Switch
  - Motor Bearing temperature element
  - Lube oil pressure & Level indicator

- Noise guarantee
  - Near field : 85db(A) at 1 meter from ACC perimeter
  - Far field : In compliance with client’s request
3) Air Evacuation System (Vacuum System)

- Air removal for start-up (Hogging) and normal operation (Holding)
  - Vacuum pump type
  - Steam jet ejector type
  - Silencer
- If steam is not available for start-up, Vacuum pump shall be applied.

Hogging evacuation time to 0.34 Bara : < 30 minutes
Holding capacity : Based on HEI standards

4) Condensate Receiver Tank

- Type : Horizontal Cylindrical
- Capacity : 5 minutes Holding time (NWL to LLWL)
- Installed at elevated structure for adequate pump NPSH
5) Make-up Deaerator (Vacuum Type)

- Oxygen Contents $\leq$ 7-20 ppb
- Deaeration by stripping and heating with exhaust steam
- Large surface contact by Packing (Pall ring)
- Installed at top of condensate receiver tank
- Vacuum system connected for good deaeration
- Shell made by stainless steel material
5) Make-up Deaerator on Condensate Tank
6) Finned Tube Cleaning System

- Performance improvement
  Steam turbine back pressure: >15-20% decrease
  Fan air volume flow: >10-15% increase

- Semi-automatic operation
- Movement
  Vertical – by motor w/tooth belt
  Horizontal – by hand manual
- High pressure cleaning- Max 80 Bar
- Cleaning rig and Drive Unit
- Spray nozzle beam Unit
- Control panel
Thank you!

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