SYSTEM DESCRIPTION MBH10 COOLING AND SEALING AIR SYSTEM	Respons. dept / Date GPMA 04-02-04	Reg. MDB 101
	Prepared A.Samuelsson	Yamama Cement

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Purpose of the system

The purpose of the cooling and sealing air system is to supply the turbine with necessary amount of air for cooling of hot parts and sealing air to protect from oil and exhaust gas leakage.

That is:

Sealing air:

The sealing air has two duties:

- The first is to prevent lube oil leakage.
- The second is to prevent hot gas leakage to enter the turbine discs.

The ten stage compressor has slots for bleed-off air after the second and fifth stage. The air flows through the slots into two cavities, the low pressure (LP) and the high pressure (HP) bleed cavities located between the inner stator blade carrier ring and the outer casing.

Sealing air to bearing no 1 is supplied internally from the LP bleed air cavity. The major part of the air, flows via the bearing housing to the lube oil reservoir, because this is kept at a sub-atmospheric pressure maintained by the oil mist fan. The minor part flows via the labyrinth sealings into the compressor flow path.

Sealing to bearing no 3 is taken from the lower part of the LP bleed air cavity and is led to the bearing via an external pipe. One part of the air, flows from the bearing to the outlet casing, the other part flows with the return oil flow to the oil reservoir.

Sealing air to bearing no 2 is taken from the compressor discharge. The air is hot and has to be cooled down in the external seal air cooler before entering the bearing. Air flows from the bearing is extracted to the lube oil reservoir, then led to the atmosphere via an oil mist separator. The transport is maintained by the oil mist fan.

Sealing air is also supplied to the power turbine from the HP bleed cavity.

Cooling air:
The two stages of the compressor turbine are cooled by air from the compressor. Both the guide vanes and the blades are hollow to allow the cooling air to flow inside, which makes the cooling more effective.

Cooling air to the power turbine is mainly taken from the HP bleed cavity. Cooling and sealing air is fed via an external pipe to a ring manifold. From there, individual flexible hoses supply the third stage guide vanes with cooling for disc cooling purposes.

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General description of the system

Refer to P&ID 2046 020.

A part of the air flow through the compressor is tapped for the purpose of sealing the bearings and cooling of hot parts.

Main components

- Seal air cooler
  MBH10AC005
  The seal air cooler cools the sealing air to bearing no 2. The cooler is an air cooled tube heat exchanger type. Cooling air flows through the shell and sealing air flows through the tubes. The cooler is equipped with draining- and ventilation connections. In case of condensation at the shell side, the cooler is continuously drained through a small pipe and an orifice. Only one of the seal air coolers is in operation at a time.

- Orifice
  MBH10BP205
  The purpose of the orifice is to restrict the air flow in the drain from the seal air cooler.

- Orifice
  MBH10BP005
  The purpose of the orifice is to restrict the sealing air flow to bearing no 2.

- Temperature transmitter
  MBH10CT005
  Seal air temperature downstream the cooler is continuously measured.
  The seal air temperature depends on the seal air flow, which depends of the gas turbine load. The cooling air flow through the cooler is constant since the fans on the cooler operate at constant speed.
  The temperature transmitter monitors the seal air temperature versus the design temperature.

  High gas temperature (H1) gives an alarm.
  High seal air temperature (H2) initiates unloading turbine trip

- Orifice
  MBH10BP010
  The purpose of the orifice is to restrict the cooling air flow to the power turbine.

- Orifice
  MBH10BP015
  The purpose of the orifice is to restrict the sealing air flow to bearing no 3.

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Function

Operation of the system is fully automatic.

Start up

When starting the gas turbine, the cooling and sealing air system automatically starts.

Continuous operation

During normal running the bearings and the turbine are supplied with cooling and sealing air from the compressor.

Turbine stop

During shut down, the system is operating as long as the gas generator is running.

Stand still

After shut down the system is not in operation.

Disturbances

Gas turbine trip

The system is operating as long as the gas generator is running.

Generator breaker trip

The system is operating as long as the gas generator is running.

Loss of power supply

The cooler fans stop at power supply failure, that result in lost of cooling capacity.

System faults

- Seal air cooler
Malfunction of cooler may result in high seal air temperature. High temperature (H2) gives a trip.
Malfunction of tubes will result in sealing air pressure drop.

- Pipes
External pipe leakage may cause increased temperature level in the gas turbine room.

- Flow obstructions in channels or inside piping will decrease the sealing and cooling efficiency.

Actions for the operators to take during alarms&trips are included in the plant operation documentation.

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Technical specification

Design criteria and standards

Ambient air.

Dimensioning data

Sealing air flow: 900 kg/h

Engineering data

Design pressure: 16 Bar(g)

Design temperature downstream cooler: -15 to +130 °C
Design temperature upstream cooler: -15 to +400 °C

Emergency power supply

N/A.

Installation

The system is installed near the gas turbine. The cooling and sealing channels are partly integrated with the gas turbine mechanical design.
The seal air cooler is installed outside the gas turbine package.

Materials

Seal air cooler pipes, sealing air pipes between LP bleed cavity and bearing no 3 and sealing air pipe between HP bleed cavity and power turbine are made of stainless steel.
By pass channels are made of carbon steel.

The seal air cooler is made of stainless steel except the supporting frame, which is made of galvanised steel.

Component data

See the aggregate and instrument lists

Testing and service

Testing during normal operation

No function test is possible during normal operation.

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Accessibility during normal operation

No objects in the system are available for maintenance during normal operation.

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