SYSTEM DESCRIPTION MBK GEAR SYSTEM	Respons. dept. GRPD	Date 05-02-08	Reg. M DB 101
	Prepared O.Landmark		YAMAMA CEMENT

Table of Contents

Approved 2005-02-08 Åsa Johansson	Latest revision	Archive	HG 9100
Checked 2005-02-08 Stefan Grenestam		No. 8004 9786	

SYSTEM DESCRIPTION MBK GEAR SYSTEM	Respons. dept. GRPD	Date 05-02-08	Reg. M DB 101
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Purpose of the system

The function of the system is to reduce the speed of the turbine to a speed compatible with the electric generator.

That is:
- To permit the generator and the turbine to have different, and optimised shaft speeds.
- To transmit power from the turbine to the generator.

General description of the system

Refer to P&ID 2046 022.

The gearbox is a parallel shaft gear of double helical design connected to the power turbine via a flexible coupling of membrane type, that admits difference in lateral movements between the PT and the gear. The gear is connected to the generator with an internal quill shaft.

Casing

The gear casing is a welded design and with a horizontal split. Inspection openings allow easy inspection of the gear mesh.
Provision for mounting of RTD's, vibration probes and key phazors are standard.

Gearing and shafts

The pinion and the wheel are always manufactured from high alloy, special quality steel and case hardened. The tooth flanks are precision ground with lead and profile correction to compensate for torsional and thermal deflections and to provide low vibration and noise levels. Angular and parallel misalignment is compensated by means of flexible shafts. Between the turbine and the gearbox there is an external flexible coupling and between the gearbox and the generator an internal quill shaft is used. The quill shaft forging (incl. solid flange) is made from high quality tempered steel.

Lubrication

The bearings and the gear receive lubricating oil from the turbine lube oil system through a central connection in the gear casing. The lube oil amount for each bearing and gear mesh is optimised in order to obtain the highest efficiency.
The lube oil returns to the reservoir through the oil drain openings on the short sides of the gear casing.

Bearings and seals

The gear is equipped with hydrodynamic journal bearings, of sleeve type, which are horizontally split and white metal lined. There is no thrust bearing in the gear, thus the axial position is controlled by the thrust bearing in the gas turbine.
To prevent oil leakage out of the gear casing, the shaft penetrations through the casing are provided with non-contact shaft seals of labyrinth type.

Instrumentation

Approved 2005-02-08 Åsa Johansson	Latest revision	Archive	HG 9100
Checked 2005-02-08 Stefan Grenestam		No. 8004 9786	

- Temperature transmitter

MBK10CT005
The PT100 sensor measures the bearing metal temperature in the pinion bearing at the turbine end.
High metal temperature (H1) gives an alarm and if the second alarm level (H2) is reached shut down is required. Inspection when stopped.

- Temperature transmitter

MBK10CT010
The PT100 sensor measures the bearing metal temperature in the pinion bearing at the free end.
High metal temperature (H1) gives an alarm and if the second alarm level (H2) is reached shut down is required. Inspection when stopped.

- Temperature transmitter

MBK10CT025
The PT100 sensor measures the bearing metal temperature in the wheel bearing at the free end.
High metal temperature (H1) gives an alarm and if the second alarm level (H2) is reached shut down is required. Inspection when stopped.

- Temperature transmitter

MBK10CT030
The PT100 sensor measures the bearing metal temperature in the wheel bearing at the generator end.
High metal temperature (H1) gives an alarm and if the second alarm level (H2) is reached shut down is required. Inspection when stopped.

- Vibration transducer

MBK10CY005
The accelerometer sensor measures vibration on the gear box casing.
High vibration (H1) gives an alarm and high vibration (H2) gives unloading trip.
High vibration (H3) gives turbine trip.

SYSTEM DESCRIPTION MBK GEAR SYSTEM	Respons. dept. GRPD	Date 05-02-08	Reg. M DB 101
	Prepared O.Landmark		YAMAMA CEMENT

Function

Start up

The gear speed/load is determined by the turbine during start up.

Continuous operation

The gear load is determined by the gas turbine during continuous operation. The gear is designed for all normal operating modes, including starting up, normal running and shut down.

Turbine stop

The gear coasts down with the power turbine and generator.

Stand still

The gear, power turbine and generator are at stand still, also during the gas turbine cooling down period.

Disturbances

Gas turbine trip

After a gas turbine trip the gear coasts down with the power turbine and generator. The lube oil supply to the gear is ensured by the gas turbine lube oil system.

Generator trip

After a generator trip the gear coasts down with the power turbine and the generator.

Loss of power supply

Loss of power supply does not directly affect the system. The lube oil supply to the gear is ensured by the gas turbine lube oil system.

System faults

If there are any damages on the gearbox or couplings the gas turbine unit may not be started or has to be shut down.

- Gearing and couplings
Wear or damage to the gearing or couplings gives high vibration on the gear box.

- Bearings
Wear or damage to the bearings gives high vibration or/and high bearing metal temperature. Gear vibration and bearing metal temperature are monitored and alarms are given if any of them exceeds the

Approved 2005-02-08 Åsa Johansson	Latest revision	Archive	HG 9100
Checked 2005-02-08 Stefan Grenestam		No. 8004 9786	

setting values for alarm. In this case the load should be reduced. If the bearing metal temperature continuous to rise the turbine should be shut down manually. The turbine trips if the vibration level increases.

Other faults

Fault in connecting systems:

- Lube oil system

Fault in the lube oil system which results in incorrect incoming lube oil temperature and/or pressure to the gear box. These parameters are monitored in the lube oil system and the turbine is tripped at too low pressure respective at too high temperature. In case of reduced or interrupted oil flow the gear is not available for operation.

Technical specification

Design criteria and standards

The reduction gear is designed for maximum load during continuous operating and for 5 times nominal torque during short circuit. The design is according to AGMA 421.06 with SF 1,3.
If API 613 with SF=1.3 is required, the power is limited to 26MW.

Direction of high speed shaft rotation	Clockwise, facing gear from generator
High speed shaft, nominal speed	7734 rpm

Dimensioning data

Low speed shaft, nominal speed.	1500 rpm
Power output, maximum	29 MW

Engineering data

Lubrication	
inlet pressure nominal	1.5 bar
max	2.0 bar
alarm	1.2 bar
shutdown	0.8 bar

Emergency power supply

The gearbox needs no auxiliary power.

Installation

The gearbox is installed on a the same skid as the gas turbine. All rotating parts have protecting covers (coupling guards). The alignment is controlled by adjustment screws under the feet of the casing.

Materials

The materials are selected in accordance with the suppliers standard.

Component data

Gear mesh type	Double helical design
Journal bearing type	Cylindrical and offset halves
Net weight	13 330 kg

Testing and service

Testing during normal operation

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Accessibility during normal operation

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SYSTEM DESCRIPTION MBK GEAR SYSTEM	Respons. dept. GRPD	Date 05-02-08	Reg. M DB 101
	Prepared O.Landmark		YAMAMA CEMENT

Index of Components

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Approved 2005-02-08 Åsa Johansson	Latest revision	Archive	HG 9100
Checked 2005-02-08 Stefan Grenestam		No. 8004 9786	