APPENDIX B3. PERFORMANCE & CONDITION MONITORING AND PROTECTION SYSTEM REQUIREMENTS

B3.1. Scope

This Appendix contains minimum design requirements which should be considered for equipment performance (by ICSS) and machine monitoring system (MMS). These requirements are applicable in conjunction with the requirements which have been specified in applicable ADNOC Business Unit specification(s).

All rotating equipment designed under current COMPANY Standard shall be supplied with safeguarding shutdown functions to preclude serious failures resulting in potential hazards to personnel or the environment.

The instrument functions for alarms, shutdowns and condition monitoring are specified within Table B3.1. The requirements for voting system logic are specified within Table B3.2. These shall take precedence over the requirements specified within API Standard 613 5th Edition “Special Purpose Gear Units”

B3.2. Normative References

References used throughout this appendix are listed within AGS-SP-05-007 Section B and AGES-SP-05-006. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

B3.3. Alarm / Shutdown Requirements for Special Purpose Gear Units

Table B3.1 Instrument Functions for Machine Monitoring and Protections System

Machine Type	Machine Parameter	[PSR]	[Recommended]
Gear Unit	(2 minimum or 3 off where space permits) High axial displacement, axial position probes	–	Alarm (H) Trip (HH) (Note 7)
	(8 off – 2 each on each radial bearing) High radial vibration, XY position probes	–	Alarm (H) Trip (HH)
	(8 off – 2 each on each radial bearing) Radial bearing temperature	–	Alarm (H) (Note 8)
	(3 or 4 off on each side) Thrust bearing (Both active and inactive side) temperature	–	Alarm (H) (Note 8)
	(2 off) Casing accelerometers (X-Y probes on Pinion coupling end and X-Y probes on gear coupling end)	–	Alarm (H)
	High metal content in oil return line (if specified with oil debris chip detector monitor)	–	Alarm
	High operating temperature (if specified with thermography image monitor)	–	Alarm
	(2 off) Key Phaser for both high and low speed shafts	–	-

Table B3.2 Voting System Logic Description

Machine Type	Radial Vibration Philosophy	Axial Displacement Philosophy	Bearing Temperature Philosophy	Key Phasor
Gear Unit	**Radial Bearing** Provide two X, Y arrangement, 90 degrees apart, proximity probes for each radial bearing. All four probes voting is 2oo4 logic comprising of all four probes (Drive End and Non Drive End side). Apart from 2oo4, probe 'Not OK' shall be considered as vote to trip when probe is not functional. Logic shall include any one of four probes reading HH limit and other probes reaching H limit.	**Thrust Bearing** Three (or two) Axial position transducers shall be provided at each thrust bearing. When 3 probes are fitted, trip shall be based on 2oo3. Where 2 probes are fitted, HH trip shall be based on 2oo2. Logic shall consider probe 'Not OK' as a vote to trip.	**Radial Bearing** 2 Duplex RTDs to be fitted per bearing within the expected load zone. For "load between pads" bearings the leading and trailing pads shall be fitted with RTDs. RTD's shall be installed and wired to Junction box mounted at skid edge in accordance with API 670 and (Note 5). **Thrust Bearing** Thrust bearings shall have four duplex RTD's on each side (active & non-active side). Minimum 3 on each side shall be provided when 4 RTDs cannot be fitted due to space limitations. Bearing metal temperature sensors shall not be in adjacent pads for both active and inactive sides. They shall be located in highest load part of each pad. RTD's installed and wired to Junction box mounted at skid edge in accordance with API 670 and (Note 5).	Key phasors for both high and low speed shafts shall be installed.

Notes:

1. All machine trips shall be provided with a pre-alarm prior to a shutdown to allow operations sufficient time (to be finalized by COMPANY/SUPPLIER) to take action to prevent a trip.

Shutdown function design shall incorporate the recommendations of the original equipment manufacturer (OEM).

Not OK shall trigger a high priority operation alarm and should be considered as vote to trip when probe is not functional. Logic shall include any one of four probes reading HH limit and other probes reaching H limit.

MMS Design requirements for train driver (such as gas turbine, steam turbine, HV electrical motors) and driven equipment (such as compressor, pump) have been addressed in respective ADNOC Specifications.

Platinum (100 Ohm, three-wire) duplex RTD's (socket type) shall be used for bearing metal temperature detection. Transmitters are required (mounted in JBs) for all the RTDs for further connections to machine monitoring system.

For instrumentation requirements, refer to AGES-SP-04-007. The machine monitoring system (MMS) will interface with integrated control and safety system (ICSS) for performance and protection control. The MMS shall be BN3500 monitor with BN System 1 servers, or equivalent COMPANY approved system.

Thrust bearings shall be provided with a load measurement feature, either load cells or calculated by machine monitoring system (MMS), based on axial probe displacement.

Alarm recommended unless SUPPLIER mandates a bearing temperature trip. Where temperature trip is insisted by gear unit SUPPLIER with technical justification, for building trip logic, each probe expected temperature shall be configured (not average of all probes or maximum of values) since temperature measured by each probe may be different, due to its mounting location/position.

Instrumentation for epicyclic gear units shall be based on Tables B3.1 & B3.2, for input and output shaft bearing, and an additional accelerometer shall be mounted on top of gear unit casing.

APPENDIX B4. SUPPLEMENTARY REQUIREMENTS FOR VARIABLE SPEED GEAR UNITS

B4.1. Introduction

This appendix details the minimum supplementary technical requirements for variable speed gear units for applications across ADNOC Business Units. Unless otherwise stated in this appendix, the supplied equipment shall comply fully with the requirements of AGES-SP-05-007 Section B.

B4.2. Purpose

Define minimum technical requirements for variable speed gear units, considering their propriety design and manufacturing processes may differ from the requirements of AGES-SP-05-007 Section B.

B4.3. Design Basis

The use of variable speed gear units is subject to COMPANY approval, and only designs that have been successfully verified by the COMPANY, may be acceptable.

The gear unit SUPPLIER shall provide a deviation list, stating any non-confinity with AGES-SP-05-007 Section B specification, for the COMPANY review and approval.

B4.4. Supplementary Technical Requirements

B4.4.1 Variable speed gear units may use synthetic lube oil, with higher than load stage 5, FZG load stage rating, if oil is acceptable to other machinery within the drive train.

Make and specification (grade) of recommended oil shall be supplied in proposal and confirmed with the COMPANY before order.

B4.4.2 Service factors (SF) for gear unit shall be confirmed by SUPPLIER, based on the maximum torque required by the train at trip speed and during transient conditions (start up etc.).

B4.4.3 Condition monitoring system requirements shall be based AGES-SP-05-007 Appendix B3, for bearing vibration and temperature monitoring.

B4.4.4 AGES-SP-05-007 Section B site maintenance requirements, for example unit access requirements, JB positioning, etc. shall be considered mandatory.

B4.4.5 Mechanical run test to include demonstration of variable speed operational control, with operation between and including at, minimum and maximum continuous speed. Else the test shall follow similar steps as indicated for parallel shaft gear unit, in AGES-SP-05-007 Figure B1.1 Mechanical Run Test.

B4.4.6 The maximum allowable residual unbalance shall not exceed the following ISO 21940 quality grades:

a. High speed shaft assembly: grade G 1.0

b. Other assemblies: grade G2.5

B4.4.7 Special tools and capital spares shall be supplied similar to AGES-SP-05-007 Section B requirements.

Storage/packing requirements shall comply with AGES-SP-05-007 Section B

B4.4.8 SAT shall follow similar procedure, as indicated for parallel shaft gear unit, in AGES-SP-05-007 Appendix B1.