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Figure 1: QCP Template

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1. INTRODUCTION

This Scope of Work provides the guideline for the supply of new gearboxes and geared motors and refurbishment of gearboxes and geared motors for the Power Station. The guideline provides a recommended scope of work and inspection checks that can be used during the refurbishment process.

This guideline can be provided to the supplier, but the responsibilities remain with the supplier to provide the final Scope of work (from the strip and access) to ensure that the gearbox is refurbished to standard.

2. SUPPORTING CLAUSES

2.1 SCOPE

The Scope of work is to supply new gearboxes, strip & assess (including report) and repair the of reduction gearboxes in the Bulk Handling Material Plants (i.e. Coal Stock Yard Plant, Terrace Coal Plant, Dust Handling Plant and Ash Disposal Plant), Milling Plant, Mill Feeders, Air Heaters and Water Treatment Plant at Tutuka Power Station.

2.1.1 Purpose

The purpose of this report is to give a guideline for the refurbishment and repairs of the reduction gearboxes and geared motors for Tutuka Power Station.

2.1.2 Applicability

This document shall apply to Tutuka Power Station.

2.2 NORMATIVE/INFORMATIVE REFERENCES

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

- [1] ISO 9001 Quality Management Systems.
- [2] Insert normative document references here.
- [3] ANSI/AGMA 2000 –A88, Gear Classification and Inspection Handbook – Tolerances and Measuring Methods for Unassembled Spur and Helical gears (Including metric equivalents).
- [4] ANSI/AGMA 2004-C08, Gear Materials and Heat Treatment Manual.
- [5] ANSI/AGMA 2005-B88, Design Manual for Bevel Gears.
- [6] ANSI/AGMA 2008-B90, Assembling Bevel Gears.
- [7] ANSI/AGMA 6000-A88, Specification for Measurement of linear Vibration on Gear units.
- [8] ANSI/AGMA 6101-E08, Design and Selection of Components for Enclosed gear Drives.
- [9] ANSI/AGMA 6010-E88, Standard for Spur, Helical, Herringbone, and Bevel Enclosed Drives.
- [10] ANSI/AGMA 6025-D98, Sound for Enclosed helical, Herringbone, and Spiral Bevel Drives.
- [11] ANSI/AGMA 9005-E02, Industrial gear lubrication.
- [12] ANSI/AGMA 6013-A06, Standard for Industrial Enclosed Gear drives.
- [13] ANSI/AGMA 6113-A06, Standard for Industrial Enclosed Gear Drives (Metric Edition)
- [14] AGMA 912-A04, Mechanisms of Gear Tooth Failure.

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- [15] AGMA 923-BO5, Metallurgical Specifications for Steel Gearing.
- [16] AGMA 925-A03, Effect of Lubrication on Gear Surface Distress.
- [17] AGMA ISO 14179-1, GEAR REDUCERS - THERMAL CAPACITY BASED ON ISO/TR 14179-1
- [18] AGMA 2001-D04, Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth.
- [19] AGMA 2004-C08, Gear Materials, Heat Treatment and Processing Manual.
- [20] AGMA 2101-D04, Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth (Metric Edition).
- [21] AGMA 6001-E08, Design and Selection of Components for Enclosed Gear Drives.
- [22] ISO 17485:2006, Bevel Gears – ISO System of Accuracy.
- [23] BS 436: Part \3: 1986, Spur and helical gears, Method for calculation of contact and root bending stress limitations for metallic involute gears.
- [24] BS 436: Part 4: 1996 (ISO 1328-1:1995), Cylindrical gears-ISO system of accuracy, Definitions and allowable values of deviations relevant to corresponding flanks of gear teeth.
- [25] BS 436: Part 5: 1997, (ISO 1328-2:1997), Cylindrical gears – ISO system of accuracy, Definitions and allowable values of deviations relevant to radial composite deviations and runout information.
- [26] DIN 3961, Tolerances for Cylindrical Gear teeth.
- [27] SABS ISO 9001:2008, Quality systems * Model for quality assurance in design, development, production, installation and servicing.
- [28] GGL 36-53 Rev 0, Eskom guideline for in–service monitoring of lubricating oils and hydraulic fluids.
- [29] GSP 36 818 Rev 0, Eskom minimum specification for extreme pressure gear oils List all of the references that were used in writing this document by title and reference number. This applies to documents internal or external to Eskom. Also quote the revision number where applicable.
- [30] PC/STWI/GL 32-631: Rev.1, Eskom approval of personnel performance quality related special processes on Eskom plant.
- [31] ST 32-632: Rev. 0, Requirement for Non-Destructive Testing (NDT) on Eskom plant.
- [32] 240-89217674: Refurbishment, repairs and supply of new geared motors and motors. Scope of work “as ad when” required basis.

2.2.2 Informative

None

2.3 DEFINITIONS

Definition	Description
“As new”, re-manufactured, rebuild or fully overhauled gearboxes:	Gearboxes and Geared Motors subjected to a complete overhaul and fitted with a complete set of new internal components meeting all the original design criteria and subject to the same quality assurance requirements as a new gearbox or geared motors

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Definition	Description
Refurbished gearboxes	Gearboxes and geared motors where work is carried out on the gearbox and motor to restore the gearbox and motor as close as possible to original performance requirements. Such work includes replacement of selected working components and/or work on/or repair to selected items.
Replacement gearboxes:	Gearboxes and motors in which specific items which have failed or considered to have failed or reached the end of their design life have been replaced.
Components or items	Refers to casings, gears, shafts, keys, bearings, lubrication systems, dowel pins, nuts, bolts, covers, dip sticks, breathers, seals, and any other item required to complete the gearbox assembly
Supplier or manufacturer	The company responsible for carrying out the repair, refurbishment or overhaul of a gearbox.
Original Equipment Manufacturer (OEM)	The company responsible for the design and manufacture of the original gearbox, including all its components.

2.3.1 Disclosure Classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

Confidential: the classification given to information that may be used by malicious/opposing/hostile elements to **harm** the objectives and functions of Eskom Holdings Limited.

2.4 ABBREVIATIONS

Abbreviation	Description
BHM	Bulk Handling Material
CSY	Coal Stock Yard
DHP	Dust Handling Plant
LH	Left Hand
MPI	Material Positive Identification
MTH	Mine transfer house
NDT	Non-Destructive Testing
OEM	Original Equipment Manufacturer
PS	Power Station
QC	Quality Checks
RH	Right Hand
SOW	Scope of Work

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Abbreviation	Description
VCI	Vapour Corrosion Inhibitors
VPI	Vapour Phase Inhibitors

2.5 ROLES AND RESPONSIBILITIES

System Engineer: Compile guideline for Supply and refurbishment Scope of work.

2.6 PROCESS FOR MONITORING

None.

2.7 RELATED/SUPPORTING DOCUMENTS

None.

3. SCOPE OF WORK

3.1 APPLICABLE PLANT

This SOW applies to gearboxes of the various plant area in the station as listed below following:

- **Coal Stock Yard:** Conveyor plant, Stacker Reclaim and Yellow plant.
- **Ash Disposal Plant:** Conveyor plant, Stacker and Stacker boom.
- **Dust Handling Plant:** Common and Unitized plants.
- **Terrace Coal Handling Plant:** Common and Unitized plants.
- **Air heaters:** Unitized plants.
- **Mill feeders:** Unitized plants.

Manufacture/Supplier to provide the services of the supply of new power transmission gear units, relevant maintenance spares, quality refurbishment and provide technical support when required as follows at Tutuka Power Station:

Location	Component Description	Qty	Estimated refurbishment for 5 years	Estimated New gearboxes for 5 years	Stock Nr
ASH Disposal Plant					
North and South overland	David Brown, H- series Type: B3-450 Ratio: 20.9:1 69rpm 240.5kW LH and RH gearboxes	4	9	4	176906
Short Coarse Ash	David Brown, Radicon Worm - CS8 Ration: 20:1 1480/74 rpm 7,5kW	6	6	4	176936

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Long coarse Ash	David Brown, Radicon Worm- CS10 Ratio: 20:1 Speed: 1480/74 rpm 11kW	6	6	4	176930
Long Coarse Ash Moveable Head Gearbox Conditioner conveyor moveable head gearbox	CU700 Ratio: 25:1 Speed: 1440rpm 7,5kW	12	7	3	571107
Spreader Boom	Flender KZA 200	1	3	1	176836
Spreader cable reel gearbox (for both power & control cable)	Reduction Gearbox Ratio: 30:1 Speed: 1500 rpm Power: 1.5 kW	1	3	1	771835
Link/Stacker Boom	Flender KZA 225, S/No: 479311014/4/1, Ratio: 22,14:1 Speed: 1480rpm Power 45kW	2	4	1	176837
Extendable/Shiftable conveyor	Flender Redurex Type: KZA 400 Hollow shaft Ratio: 26.3:1 Speed:1500rpm 323kW LH(4) and RH(2) gearboxes	7	6	4	176838
Extendable Tension Winch Gearbox	Dymot geared electric winch	2	4	2	573122
Stacker crawler drive	David Brown Worm gear Speed: 980rpm kW: 45 LH and RH gearboxes	2	2		527641
Ash stacker/Spreader slew gearbox	Lohmann/Stolterfoht Gearbox; reduction; Ratio: 1868,5917:1, Type: GPW130. Drg no: 0/3838/5044/0 Ratio: 1400:1	3	3	1	177782

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Transverse conveyor	David Brown, H Series B3-280 Ratio: 18,9:1 Speed: 86rpm 90KW LH and RH boxes	2	5	2	611224
Transverse movable head gearbox Cross moveable head gearbox	Motor Geared Ratio: 60:1 Output speed: 16,16 rpm 10,58kW	4	3	2	229737
Cross conveyor	David Brown, H Series Type:B3-250 Ration:18.9:1 Speed:78rpm 65,6kW LH and RH gearboxes	2	5	2	176900
Shuttles main drive gearbox	BF70-05 A/D16 LA4 Speed: 46rpm Ratio: 28.8:1 15kW	2	4	2	250345
Shuttles travel gearbox	Type: AG43-12/OK84-2005A Speed:1420 rpm Ratio: 186.842:1 0.55kW	2	4	2	698599
Stacker Cable reel gearbox (for both power & control cable)	CEFILAC Reduction Gearbox Ratio: 30:1 Speed: 1500 rpm Power: 1.5 Kw	1	3	1	771837
Tripper car travel drives gearbox	Motor Geared Speed: 1420 rpm 1.1kW	16	8	3	140733
Spreader gearbox	KZA 200 GB HOLLOW SHAFT	1	0	3	29146
In loading Mobile Feeder Gearbox (Short Conveyor)	Helical Bevel Gearmotor Ratio: 28.2:1 Speed: 1800 rpm Power: 5.5 kW	1	3	1	772018
In loading Mobile Feeder Gearbox (Long Conveyor)	Gearbox C/W Variator Ratio: 30:1 Speed: 1500 rpm Power: 5.5 kW	1	3	1	771849

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Coal Stock Yard					
16	David Brown, BEW Type: BDA320 Ratio: 14:1 Speed:1485 rpm 110kW	2	4	1	251093
11,12,15,18	David Brown, BEW Type: BDA440 Ratio: 18:1 Speed:79,81rpm 350kW	12	5	2	623522
17	David Brown, BEW Type:BTA500 Ratio: 22,4:1 Speed:1480 rpm 350kW Bi-directional	8	5	3	599300
13,14,22	David Brown, BEW Type: BDA380 Ratio: 18:1 Speed:1985 rpm 160kW	5	3	0	623523
20,21	David Brown, BEW 65M - Worm shaft Ratio: 40:1	2	2	1	772019
23	Hansen RDE43 ANR Ratio: 100:15:1	6	4	2	772020
STACKER SLEW GRBX SR 1&3	Thyssenkrupp Bevel Helical Ratio:727,45:1 Speed:1500 3,28kW AAKCV125/PBN450/S 1983. Serial no: 8841551238	4	1	0	582993
Coal Stacker Reclaim travel drives	David Brown Type:B35-80 Ratio: 31,1:1 Speed:1450rpm 10kW	12	3	0	251092
Stacker/Reclaimer bucket wheel G/B	Thyssenkrupp Bevel helical planetary shaft mounted gearbox Ratio: 218:1 Speed: 1480rpm 96kW	2	6	1	582995

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Stacker/Reclaimer Elevator conveyor	David Brown, Radicon B2-SF200 Speed:1460rpm	2	6	0	553274
Stacker/Reclaimer boom gearbox	Hansen Gearbox: 36 AN, Reduction	2	3	0	25935
Buffalo feeders reduction gearbox - Left	GEARBOX: REDUCTION; 88:2; 1500 RPM; 132 KW	3	2	1	772131
Buffalo feeders reduction gearbox - Right	GEARBOX: REDUCTION; 88:2; 1500 RPM; 132 KW	3	2	1	772130
Buffalo feeders Planetary gearbox	Bonfiglio, Gear Unit Assembly HDO120/317 Planetary	4	4	1	725112
Terrance coal Plant					
Over Silo 6A/B	David Brown, H Series B3-500. Ratio: 28,4:1 Speed: 51 rpm 429kW LH and RH gearboxes	2	2	1	176902
Over Silo 4A/B&2A/B Transverse conveyor	David Brown, H Series B3-280 Ratio: 17,2:1 Speed: 86rpm 90kW LH and RH gearboxes	6	3	1	176901
Over Silo 5A/B,3A/B&1A/B ASH-Cross conveyor	David Brown, H Series B3-250 Ratio: 18,9:1 Speed: 78 rpm 65,6kW RH and LH gearboxes	8	4	1	176900
Unit Incline 1 to 6	David Brown, H Series H2-355 RH Ratio: 20,9:1 Speed: 45rpm 128,3kW LH and RH gearboxes	6	4	2	176899
Cross Conveyor	David Brown, Radicon CU / DU 10 Ratio- 20:1 RH gearbox	6	6	2	176938

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Bunker Feed East & West	David Brown, Radicon CU / DU 14 Ratio 15:1 IP Speed: 1480 45kW RH gearbox	12	12	4	176937
Bunker distribution A,C,D&F ASH - Overland tension winch gearbox	David Brown, Radicon CU /DU600 Ratio: 20:1 RH gearbox	26	24	4	25747
Coal Shuttle conveyor	David Brown, Radicon 6SMB RH Ratio: 100:15 Speed: 1485 rpm 40kW	6	3	1	225493
Incline magnet Cov 1-6 GRBX 18-1/2/3 Magnet Magnet 16A /16B	KA77B/A; Ration: 12:36; Speed: 113 rpm;	11	8	2	251094
Dust Handling Plant					
Conditioner conveyor	David Brown, Radicon CU800 Ratio: 40:1 Speed:1450 rpm 17.3kW	6	6	3	176939
Ash conditioner	BEW Gear BTB320/171 Ratio: 40:1 Speed 1440rpm 75kW	6	5	2	177265
Bucket elevator	Siemens Geared Motor Output speed: 16,54 rpm Ratio: 90:1	6	5	2	501128
Bucket elevator	Siemens Geared Motor Ratio: 90:1 Speed: 720/1460rpm 16/32kW	12	7	3	501129
Ash conditioning sump	Agitator; Speed: 77 rpm Ratio: 4:1 2.2kW	2	3	1	253696

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Air heater					
Air heater drive	G&C Gearbox, Ratio: 12.17, Speed: 1460 rpm 25kW	12	16	2	25499
Clarifier bridge drive	Nord Gears Gearbox, Bridge drive, 0.37kW Speed: 1375 rpm	6	6	1	26656
Milling Plant					
Mill feeder gearbox NDE	Weco Speed reducer; 20:1; 356/17.73 rpm, 2LT33, 0,61/08855 rev 1; 3,67kW	18	9	4	177096
Mil feeder gearbox DE	Weco Speed reducer; 20:1; 356 rpm, 2LT33, 0,61/08855 rev 1; 3,67kW	18	9	4	177097

4. GUIDELINES

4.1 CHECKS TO BE COMPLETED BY ESKOM BEFORE SENDING THE GEARBOX FOR REPAIRS

The following check sheet should be completed prior to booking back the gearbox to stores:

Checks before gearbox is sent for refurbishment (Completed by Eskom)	
Pre-requisites for Eskom	Comments
Date of failure	
Conveyor belt installed	
Is there an old Name plate installed. Capture the details	
Serial number	
Running hours	
Attached latest vibration report/ Provide reason for failure	
Is the High-speed coupling on shaft	
Is the Low-speed coupling on shaft	
Breather and Breather pipe installed	
Were there oil leaks on gearbox	

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LH/RH gearbox. Facing the gearbox from the input shaft	
Drain the gearbox oil prior to booking back to stores.	
Visually inspect the gearbox and provide assessment report (include pictures)	

4.2 STRIP AND ASSESS

A strip and asses QCP must be compiled and sent to Eskom for approval by Engineering and maintenance to ensure that the required intervention points (hold- and witness) clear during the stripping process.

4.3 RECOMMENDED CHECKS WHEN THE SUPPLIER RECEIVES THE GEARBOX

- a. The supplier/manufacture will clean and record the nameplate details and/or shaft end stampings upon receiving the unit. He/she will check the delivery documents and the client/Eskom's initial work requirements.
- b. The supplier/manufacturer will remove the top of the case and record the layout of the gearing.
- c. The supplier/manufacturer also will record the following:
 - The running contact pattern, for gearboxes with horizontal shafts.
 - The backlash for each reduction stage, for gearboxes with horizontal shafts.
 - The shaft end floats, for gearboxes with horizontal shafts.
 - Any visual signs of damage, wear, or profile change including pictures.
- d. The supplier/manufacturer will remove the shafts, bearings, and gears from the case.

4.4 RECOMMENDED CHECKS TO BE PERFORMED BY THE MANUFACTURER ON THE BEARINGS:

Bearings should be removed, care should be taken not to damage them while removing them. For refurbished and re-manufactured gearboxes, it is good practice to replace all bearings. In the case of repaired gearboxes, if a bearing has completed less than 50% of it's L₁₀ design running hours and the bearings are in good condition, as inspected and verified as suitable by the original bearing manufacturers' technical department, or a suitably qualified person, they may be re-installed for further service depending the approval of the system engineer. The recommendation to re-use the bearings should be formally communicated through a report to the system engineer, who will review and approve/disapprove the recommendation. If bearings, which have completed a significant portion of their L₁₀ design life are re-used, the manufacturer may waive any guarantees on the repairs. Generally, the use of the old bearings is not recommended.

- a. Visually inspect the rolling elements and raceways for signs of wear and damage.
- b. Check the outer races for signs of movement in the bearing bores of the case and for signs of fretting and corrosion.
- c. Check the wear patterns of the bearing races for indications of misalignment.

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4.5 RECOMMENDED INSPECTION TO BE PERFORMED BY THE SERVICE-PROVIDER ON THE SHAFTS:

- a. MPI the shaft with attention to keyways, fillet radii and changes in section of the shaft.
- b. Check all bearing seats for signs of wear.
- c. Measure the bearing seats to check fits and tolerances and compare with the selected or specified bearing.
- d. Check oil seal tracks for signs of damage or wear.

4.6 THE FOLLOWING CHECKS WILL BE PERFORMED BY THE SERVICE-PROVIDER ON THE CASING:

- a. Inspect case joints for the presence of paper or other gasket materials.
- b. Check condition of all machined joint faces for damage.
- c. Check alignment of joint faces with gearbox feet and mounting faces.
- d. MPI all bearing bores and case feet.
- e. Dye penetrant test entire case after cleaning if required.
- f. Visually inspect all bores for signs of wear.
- g. For fabricated boxes, MPI all welds.
- h. Re-assemble case (with gasket if required) and tighten all bolts to the manufacturers specified torque.
- i. Measure all bearing bore diameters (vertically and across the joint).
- j. Measure centre distances of each bore and compare with drawing requirements.

4.7 THE FOLLOWING CHECKS WILL BE PERFORMED BY THE SERVICE-PROVIDER ON THE OTHER ITEMS:

- a. Record the details of all fastenings (nuts and bolts), dowels, washers, locking screws, seals and gaskets.
- b. Visually inspect all covers, oil catchers, loose bearing housings etc.

5. REPLACE/REFURBISH SCOPE OF WORK

The information gathered during the strip and access will determine the scope of work to repair, refurbish or re-manufacture of the gearbox.

A repair, refurbish or re-manufacture QCP should be compiled and sent to Eskom for approval by Engineering and maintenance to ensure that the required hold- and witness points are clear.

5.1 FOR THE SUPPLY OF A NEW GEARBOX, THE FOLLOWING ITEMS WILL BE INCLUDED IN THE SCOPE OF WORK AND SUPPLY:

- a. Replacement of all gears.
- b. The replacement of all rolling element bearings.
- c. The replacement of all nuts and bolts.
- d. If used, the re-lining of all journal bearings and thrust plates.
- e. Re-boring the bearing sleeves after skimming the joint faces.
- f. Machining, Re-lining and boring of bearing sleeves if required.
- g. Replacement of all keys and re-cutting of all keyways if required.

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- h. Gearbox casing internals to be coated with a zinc-based primer and suitable epoxy coating. The supplier must submit details of the proposed coating and method along with material data sheets to Eskom's corrosion specialists for approval.
- i. New nameplate fitted indicating the date of manufacture, order number, power rating, gear ratio, lubricant specification and other relevant technical details shall be fitted to the casing exterior. All original nameplates shall not be removed.

5.2 FOR A REFURBISHED GEARBOX, THE FOLLOWING ITEMS WILL BE INCLUDED IN THE SCOPE OF WORK AND SUPPLY:

- a. Replacement of all damaged gears. Old gears mating with new gears will have to be re-ground to restore the gear profile.
- b. If a gear/shaft assembly has been dismantled, the regrinding of the gear to ensure concentricity.
- c. The replacement of all rolling element bearings for gearboxes in which bearings have exceeded 50% of their L₁₀ design life. These items should ideally be replaced during a refurbishment as their cost is far less than the risk of a premature gear failure as a result of a bearing failure.
- d. The replacement of all damaged nuts and bolts.
- e. Re-boring the bearing sleeves after skimming the joint faces.
- f. Machining, re-lining and boring of bearing sleeves if required.
- g. Replacement of keys (should be taped to the shafts) and re-cutting of keyways if required.
- h. Replacement of breathers and breather pipes.
- i. Verification of dipstick lengths and replacement if missing or incorrect.
- j. Replacement of missing fans and fan covers installed on gearboxes
- k. Gearbox casing internals to be coated with a zinc-based primer and suitable epoxy coating. The supplier must submit details of the proposed coating and preparation method along with material data sheets to Eskom's corrosion specialists for approval.
- l. New nameplate fitted indicating the date of manufacture, order number, power rating, gear ratio, lubricant specification and other relevant technical details shall be fitted to the casing exterior. All original nameplates shall not be removed.

5.2.1 Geared Motor Refurbishment

The Supplier is to refurbish all the geared motors and motors parts as per the original specifications and manufacturing drawings as per the Supplier's design. The following can be used as a guideline:

5.2.1.1 Dismantling/ Stripping

- Dismantling shall not commence until proper arrangements have been made with interested and affected parties to witness the dismantling of Geared motors collected for a warrantee claim, and for acceptable records to be kept for findings.
- After the inspection, the Geared motors shall be dismantled to the extent needed, to either fully identify or repair the problem, or to carry out the specified overhaul.
- During disassembly all major Geared motors components shall be marked with the Geared motor serial number or Contractor job number to prevent mismatching of part as the running hours for each will be monitored.
- Bolts and other small parts shall be placed in a bin and the bin marked with a relevant job number. Parts from other jobs shall not be kept in the same bin.

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- If dowels or fitted bolts are used to ensure accurate fits, the location of these pieces shall be identified on the Incoming Inspection and Test Data Report.
- Measure and record seal clearances (if applicable) of the bearings, housings and brackets. Inspect seal condition to determine if damage has occurred.
- The following information shall be recorded about the Bearings:

The location, make, type, size, clearances and orientation of bearings. Method of lubrication, insulation (if any), and any other particular features of the motor bearing configuration. All degradation and abnormalities.

5.2.1.2 Cleaning

- Geared motor housing shall be thoroughly cleaned and shot blasted in the case of castings and shall be subjected to salt and oil tests prior to being coated.

5.2.1.3 Post-Cleaning Assessment

- Carry out a full assessment as per the *Employer's* "geared-motor assessment report". A detailed report for each gearbox/ geared motor shall be provided at all times, on request, to the *Employer*. The assessment report shall form part of the delivered gearbox/geared motor data pack.

5.2.1.4 Cause of Failure Report

- If failed components are identified during the incoming inspection, the *Contractor* shall perform assessment and verify the cause and report this in the Incoming Inspection report.
- Digital photographs should be taken of all damaged gearbox components and be included in the cause of failure report.
- Failure causes shall be discussed with the *Employer* before repair work proceeds, unless this is waved in the task order.

5.2.1.5 Repair Scope Recommendation and Approval

- The recommended repair scope of work, with itemized task pricing, and cause of failure report shall be submitted to the *Employer* for review and approval.
- The *Contractor* is to advise the *Employer* when it becomes no longer viable or acceptable to repair or overhaul the Geared motor.
- Repair activities shall not commence prior to the *Employer's* written approval, unless this is waved in the task order. Repair activities shall not commence prior to the *Employer's* written approval if the cost of repair exceeds 70% of the new gearbox/geared motor.

5.2.1.6 General Component Repairs

- The *Contractor* shall replace all damaged or corroded hardware including nuts, bolts, washers, etc.
- Replacement hardware shall be of similar or better grade to that being replaced.
- Gearbox/geared motor feet should be checked and polished or machined when necessary.
- Replace all nameplates when gearbox/geared motor data becomes illegible. In the event that a nameplate is missing, the Job number is to be used as the new Serial number.
- The repairs should be done in accordance with Eskom standard GGSS0405/0406
- All gearboxes/geared motors shall be in accordance with the latest AGMA standards.

5.2.1.7 Bearing Repairs:

- All rolling elements (Ball, roller bearing etc.) bearings and seals removed shall be replaced and not be reused. Only SKF, NSK, NTN and FAG type of bearings is to be used.

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5.2.1.8 Testing:

- All geared motors are to be subjected to a 24-hour no-load shop/factory test run. During the test, vibration levels, temperature rise, noise levels, etc. shall be recorded at hourly intervals and submitted to the engineer for acceptance before equipment is delivered to site.
- The *employer* shall be notified in advance (at least 3 days) to witness any tests.
- Special tests are performed when specified by the *Employer*.

5.2.1.9 Painting:

- All corrosion, oil, grease, and old paint shall be removed prior to painting. Surface preparation shall be in accordance with the paint manufacture's specification.
- At least one primer coat and two finish coats shall be applied.
- For internal painting, oil resistant, ivory colored paint shall be used.
- Housing shall be thoroughly cleaned and shot blasted in the case of castings and shall be subjected to a salt, oil and leak test prior to being painted/coated on the inside.

5.2.1.10 LV Motor SOW

Ref#	PHASE I SOW TASKS	TASK PROCEDURE/SPECIFICATION
1	Collect motor from Site	240-89217674
2	Conduct incoming visual inspections	240-89217674
3	Conduct incoming routine test (if motor in working condition to check for failure)	240-89217674
4	Disassemble motor complete	240-89217674
5	Pre-cleaning assessment	240-89217674
6	Clean motor components	240-89217674
7	Dry-out motor components	240-89217674
8	Post-cleaning assessment	240-89217674
9	Conduct electrical tests	240-89217674
10	Deliver assessment and failure report	240-89217674
11	Deliver recommended repair SOW	240-89217674
12	Deliver scrapped motor back to Site	240-89217674
		240-89217674
Ref#	PHASE II SOW TASKS (GENERAL OVERHAUL)	TASK PROCEDURE/SPECIFICATION
13	Replace DE Bearing	240-89217674
14	Replace NDE Bearing	240-89217674
15	Replace DE Bearing Seals	240-89217674
16	Replace NDE Bearing Seals	240-89217674
17	Re-sleeve DE bearing housing	240-89217674
18	Re-sleeve NDE bearing housing	240-89217674
19	Polish DE & NDE shaft journals and seal landings	240-89217674
20	Micro welding rotor shaft journal and polish (DE) - 25%	240-89217674
21	Micro welding rotor shaft journal and polish (DE) - 50%	240-89217674

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22	Micro welding rotor shaft journal and polish (DE) - 75%	240-89217674
23	Micro welding rotor shaft journal and polish (DE) - 100%	240-89217674
24	Micro welding rotor shaft journal and polish (NDE) - 25%	240-89217674
25	Micro welding rotor shaft journal and polish (NDE) - 50%	240-89217674
26	Micro welding rotor shaft journal and polish (NDE) - 75%	240-89217674
27	Micro welding rotor shaft journal and polish (NDE) - 100%	240-89217674
28	Micro weld and machine keyway	240-89217674
29	Micro weld and machine cooling fan keyway	240-89217674
30	Micro weld and machine seal landings	240-89217674
31	Overhaul terminal box	240-89217674
32	Overhaul space heater	240-89217674
33	Overhaul DE bearing assembly	240-89217674
34	Overhaul NDE bearing assembly	
35	Replace DE Bearing RTD/Thermocouple	240-89217674
36	Replace NDE Bearing RTD/Thermocouple	240-89217674
37	Endeavour to repair stator hot spots	240-89217674
38	Spray stator with insulating varnish	240-89217674
39	Repair brush holder and spring - Price per holder	240-89217674
40	Clean and polish commutator	240-89217674
41	Repair pole shoes	240-89217674
42	Repair armature core	240-89217674
43	Spray rotor with insulating varnish	240-89217674
44	Balance rotor with cooling fan	240-89217674
45	Reassemble motor complete	240-89217674
46	Conduct routine tests	240-89217674
47	Paint motor (G29 emerald, grey)	
48	Deliver motor back to Site	
Ref#	PHASE II SOW TASKS (MAJOR REPAIRS)	TASK PROCEDURE/SPECIFICATION
49	Replace rotor	240-89217674
50	Replace rotor shaft	240-89217674
51	Replace motor cooling fan	240-89217674
52	Replace fan cowl	240-89217674
53	Replace DE end-shield	240-89217674
54	Replace NDE end-shield	240-89217674
55	Replace terminal box	240-89217674
56	Replace terminal block and leads	240-89217674

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57	Replace terminal box cover	240-89217674
58	Replace space heater	240-89217674
59	Light machining of stator core insulation	240-89217674
60	Replace stator core	240-89217674
61	Replace stator winding	240-89217674
62	Replace brush holder and spring	240-89217674
63	Replace brush	240-89217674
64	Replace commutator	240-89217674
65	Re-bar rotor	240-89217674
66	Replace rotor end rings	240-89217674
67	Replace rotor core complete	240-89217674
68	Replace armature winding	240-89217674
69	Replace permanent magnet	240-89217674
70	Replace pole shoe	240-89217674
71	Conduct motor type test (Motor Full Load test)	240-89217674
72	Provide documentation	240-89217674

5.2.1.11 Motor Repairs/Rewinding

Motor repairs or rewinding should include the following:

Ref#	PHASE I SOW TASKS	TASK PROCEDURE/SPECIFICATION
1	Collect motor from Site	240-89217674
2	Conduct incoming visual inspections	240-89217674
3	Conduct incoming routine test (if motor in working condition to check for failure)	240-89217674
4	Disassemble motor complete	240-89217674
5	Pre-cleaning assessment	240-89217674
6	Clean motor components	240-89217674
7	Dry-out motor components	240-89217674
8	Post-cleaning assessment	240-89217674
9	Conduct electrical tests	240-89217674
10	Deliver assessment and failure report	240-89217674
11	Deliver recommended repair SOW	240-89217674
12	Deliver scrapped motor back to Site	240-89217674
		240-89217674
Ref#	PHASE II SOW TASKS (GENERAL OVERHAUL)	240-89217674
13	Replace DE Bearing	240-89217674
14	Replace NDE Bearing	240-89217674

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15	Replace DE Bearing Seals	240-89217674
16	Replace NDE Bearing Seals	240-89217674
17	Re-sleeve DE bearing housing	240-89217674
18	Re-sleeve NDE bearing housing	240-89217674
19	Polish DE & NDE shaft journals and seal landings	240-89217674
20	Micro welding rotor shaft journal and polish (DE) - 25%	240-89217674
21	Micro welding rotor shaft journal and polish (DE) - 50%	240-89217674
22	Micro welding rotor shaft journal and polish (DE) - 75%	240-89217674
23	Micro welding rotor shaft journal and polish (DE) - 100%	240-89217674
24	Micro welding rotor shaft journal and polish (NDE) - 25%	240-89217674
25	Micro welding rotor shaft journal and polish (NDE) - 50%	240-89217674
26	Micro welding rotor shaft journal and polish (NDE) - 75%	240-89217674
27	Micro welding rotor shaft journal and polish (NDE) - 100%	240-89217674
28	Micro weld and machine keyway	240-89217674
29	Supply and install the new pinions and keeper bolts	240-89217674
30	Supply and install the new back stops on the bucket elevator motors.	240-89217674
31	Micro weld and machine cooling fan keyway	240-89217674
32	Micro weld and machine seal landings	240-89217674
33	Overhaul terminal box	240-89217674
34	Overhaul space heater	240-89217674
35	Overhaul DE bearing assembly	240-89217674
36	Overhaul NDE bearing assembly	
37	Replace DE Bearing RTD/Thermocouple	240-89217674
38	Replace NDE Bearing RTD/Thermocouple	240-89217674
39	Endeavour to repair stator hot spots	240-89217674

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40	Spray stator with insulating vanish	240-89217674
41	Repair brush holder and spring - Price per holder	240-89217674
42	Clean and polish commutator	240-89217674
43	Repair pole shoes	240-89217674
44	Repair armature core	240-89217674
45	Spray rotor with insulting vanish	240-89217674
46	Balance rotor with cooling fan	240-89217674
47	Reassemble motor complete	240-89217674
48	Conduct routine tests	240-89217674
49	Paint motor (G29 emerald grey)	240-89217674
50	Deliver motor back to Site	240-89217674
		240-89217674
Ref#	PHASE II SOW TASKS (MAJOR REPAIRS)	240-89217674
51	Replace rotor	240-89217674
52	Replace rotor shaft	240-89217674
53	Replace motor cooling fan	240-89217674
54	Replace fan cowl	240-89217674
55	Replace DE end-shield	240-89217674
56	Replace NDE end-shield	240-89217674
57	Replace terminal box	240-89217674
58	Replace terminal block and leads	240-89217674
59	Replace terminal box cover	240-89217674
60	Replace space heater	240-89217674
61	Light machining of stator core insulation	240-89217674
62	Replace stator core	240-89217674
63	Replace stator winding	240-89217674
64	Replace brush holder and spring	240-89217674
65	Replace brush	240-89217674
66	Replace commutator	240-89217674
67	Re-bar rotor	240-89217674
68	Replace rotor end rings	240-89217674
69	Replace rotor core complete	240-89217674
70	Replace armature winding	240-89217674
71	Replace permanent magnet	240-89217674

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72	Replace pole shoe	240-89217674
73	Conduct motor type test (Motor Full Load test)	240-89217674
74	Provide documentation	240-89217674

5.3 REPAIRED GEARBOXES:

For a gearbox requiring repairs, the items requiring repair or replacement will depend on the nature of the failure and the extent of the resultant damage.

6. QUALITY ASSURANCE TESTS, INSPECTIONS AND DOCUMENTATION

The following documentation, inspections and tests are required when re-manufacturing, refurbishing or repairing a gearbox.

7. GEARBOX HISTORY AND DESIGN

If no drawing/s exists for the gearbox and its components, the supplier shall include the cost of the drawings separately in his quotation. The relevant drawing numbers must be reflected on the quality control plans.

8. PRODUCTION SCHEDULE AND QUALITY CONTROL PLANS (QCP'S):

The supplier shall submit to Eskom detailed quality control plans for the remanufacture, refurbishment or repair of the gearbox. QCP's should include QCP's for the manufacture or repair of individual components. The supplier should also provide a time-based production schedule to Eskom prior to starting work.

		TUTUKA POWER STATION QUALITY CONTROL PLAN										UNIQUE IDENTIFIER		MNT QIP F 194					
												DOCUMENT TYPE		TUTUKA FM					
												REVISION		2					
												DOCUMENT NUMBER							
												EFFECTIVE DATE		JUNE 2023					
				NEXT REVIEW DATE		JUNE 2026													
Item/Material/Plant:												Task Description / SOW							
Section:												Unit		QCP No.					
Contractor Name:												KKS No.							
Legend:	IP - Intervention Point	I - Inspection	S - Surveillance	R - Review	W - Witness	H - Hold	Date:												
Act No	Description of Activity	Specification/ Procedure/ Acceptance Standard	Artisan/Technician			Contractor QC/Supervisor			Eskom Representative			Eskom Engineer			Eskom QC/AIA				
			IP	Sign	Date	IP	Sign	Date	IP	Sign	Date	IP	Sign	Date	IP	Sign	Date		
				PREPARED BY			ACCEPTED BY												
				Artisan/Technician			Contractor QC/Supervisor			Eskom Representative			Eskom Engineer			Eskom QC/AIA			
		Name:																	
		Signature:																	
		Date:																	
1	Obtain PTW		H			R			R			R			R				
2	Risk Assessment		H			R			R			R			R				
3																			
4																			
				PREPARED BY			APPROVED BY												
				Artisan/Technician			Contractor QC/Supervisor			Eskom Representative			Eskom Engineer			Eskom QC/AIA			
		Name:																	
		Signature:																	
		Date:																	

Figure 1: QCP Template

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8.1 CHECKS AND DOCUMENTATION REQUIRED ON THE CASING:

- a. MPI report on bearing bores and mounting feet.
- b. Dye Penetrant Report on Casing.

8.2 CHECKS ON GEARS

- a. Material certificates for all new gears.
- b. Heat treatment certificates of castings and forgings.
- c. Mechanical test report (tensile strength).
- d. Microstructure report
- e. Lead, pitch and profile measurements for new and re-ground gears.
- f. Dimensional inspection versus drawing.
- g. Hardness checks on finished gears and forgings.
- h. MPI certificates for all gears.
- i. Heat treatment certificates for all new finished gears.
- j. Stamp identification on gears.
- k. Check and record contact pattern, backlash and shaft end float.

8.3 CHECKS AND DOCUMENTATION REQUIRED FOR SHAFTS:

- a. Material certificates for new shafts and keys.
- b. Stamp identification on shaft ends.
- c. Check for looseness of gears on shafts.

8.4 INFORMATION REQUIRED ON BEARINGS:

Bearing numbers, bearing clearance and brand name for all replaced bearings.

9. NAMEPLATE REQUIREMENTS:

An additional - new nameplate fitted indicating the date of manufacture, order number, power rating, gear ratio, lubricant specification and other relevant technical details shall be fitted to the casing exterior. All original nameplates shall not be removed.

10. NO LOAD TESTING:

Vibration levels and temperatures shall be checked under “no-load” conditions and the results recorded for Eskom. Note that the Siemens bucket elevator Geared Motors need to be test run in a vertical position. The motor currents and vibrations need to be measured during test running.

11. SURFACE AND CORROSION PROTECTION

The supplier shall submit details of corrosion protection measures to protect the gears and casing from deterioration during storage. If a gearbox is to be stored dry for a long period, the use of vapour phase inhibitors (VPI's) or vapour corrosion inhibitors (VCI's) is recommended.

12. TRANSPORTATION

Gearboxes and geared motors should be transported in such a manner as to prevent damage to the bearings or other gearbox/motor components and to prevent the ingress of dirt or moisture during transportation. The gearboxes and geared motors should be prevented from turning during transportation.

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