



NEC3 Term Service Contract (TSC3)

Between **ESKOM HOLDINGS SOC Ltd**
(Reg No. 2002/015527/30)

and [Insert at award stage]
(Reg No. _____)

for **The maintenance and technical support of the mills
and mill auxiliaries from unit 1 to 6 at Duvha Power
Station**

Contents:	No of pages
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CONTRACT No. [Insert at award stage]

PART C1: AGREEMENTS & CONTRACT DATA

Contents:	No of pages
C1.1 Form of Offer and Acceptance	[•]
[to be inserted from Returnable Documents at award stage]	
C1.2a Contract Data provided by the <i>Employer</i>	[•]
C1.2b Contract Data provided by the <i>Contractor</i>	[•]
[to be inserted from Returnable Documents at award stage]	
C1.3 Proforma Guarantees	[•]

C1.1 Form of Offer & Acceptance

Offer

The Employer, identified in the Acceptance signature block, has solicited offers to enter into a contract for the procurement of:

The maintenance and technical support of the mills and mill auxiliaries from unit 1 to 6 at Duvha Power Station

The tenderer, identified in the Offer signature block, has examined the documents listed in the Tender Data and addenda thereto and by submitting this Offer has accepted the Conditions of Tender.

By the representative of the tenderer, deemed to be duly authorised, signing this part of this Form of Offer and Acceptance the tenderer offers to perform all of the obligations and liabilities of the *Contractor* under the contract including compliance with all its terms and conditions according to their true intent and meaning for an amount to be determined in accordance with the *conditions of contract* identified in the Contract Data.

Options A	The offered total of the Prices exclusive of VAT is	R [●]
	Sub total	R [●]
	Value Added Tax @ 15% is	R [●]
	The offered total of the amount due inclusive of VAT is ¹	R [●]
	(in words) [●]	

This Offer may be accepted by the Employer by signing the Acceptance part of this Form of Offer and Acceptance and returning one copy of this document including the Schedule of Deviations (if any) to the tenderer before the end of the period of validity stated in the Tender Data, or other period as agreed, whereupon the tenderer becomes the party named as the *Contractor* in the *conditions of contract* identified in the Contract Data.

Signature(s)

Name(s)

Capacity

**For the
tenderer:**

(Insert name and address of organisation)

Name &
signature of
witness

Date

Tenderer's CIDB registration number:

¹ This total is required by the *Employer* for budgeting purposes only. Actual amounts due will be assessed in terms of the *conditions of contract*.

Acceptance

By signing this part of this Form of Offer and Acceptance, the Employer identified below accepts the tenderer's Offer. In consideration thereof, the Employer shall pay the Contractor the amount due in accordance with the *conditions of contract* identified in the Contract Data. Acceptance of the tenderer's Offer shall form an agreement between the Employer and the tenderer upon the terms and conditions contained in this agreement and in the contract that is the subject of this agreement.

The terms of the contract, are contained in:

Part C1	Agreements and Contract Data, (which includes this Form of Offer and Acceptance)
Part C2	Pricing Data
Part C3	Scope of Work: Service Information

and drawings and documents (or parts thereof), which may be incorporated by reference into the above listed Parts.

Deviations from and amendments to the documents listed in the Tender Data and any addenda thereto listed in the Returnable Schedules as well as any changes to the terms of the Offer agreed by the tenderer and the Employer during this process of offer and acceptance, are contained in the Schedule of Deviations attached to and forming part of this Form of Offer and Acceptance. No amendments to or deviations from said documents are valid unless contained in this Schedule.

The tenderer shall within two weeks of receiving a completed copy of this agreement, including the Schedule of Deviations (if any), contact the Employer's agent (whose details are given in the Contract Data) to arrange the delivery of any securities, bonds, guarantees, proof of insurance and any other documentation to be provided in terms of the *conditions of contract* identified in the Contract Data at, or just after, the date this agreement comes into effect. Failure to fulfil any of these obligations in accordance with those terms shall constitute a repudiation of this agreement.

Notwithstanding anything contained herein, this agreement comes into effect on the date when the tenderer receives one fully completed and signed original copy of this document, including the Schedule of Deviations (if any).

Signature(s)

Name(s)

Capacity

**for the
Employer**

(Insert name and address of organisation)

Name &
signature of
witness

Date

Note: If a tenderer wishes to submit alternative tenders, use another copy of this Form of Offer and Acceptance.

Schedule of Deviations to be completed by the *Employer* prior to contract award

Note:

1. This part of the Offer & Acceptance would not be required if the contract has been developed by negotiation between the Parties and is not the result of a process of competitive tendering.
2. The extent of deviations from the tender documents issued by the Employer prior to the tender closing date is limited to those permitted in terms of the Conditions of Tender.
3. A tenderer's covering letter must not be included in the final contract document. Should any matter in such letter, which constitutes a deviation as aforesaid be the subject of agreement reached during the process of Offer and Acceptance, the outcome of such agreement shall be recorded here and the final draft of the contract documents shall be revised to incorporate the effect of it.

No.	Subject	Details
1	[•]	[•]
2	[•]	[•]
3	[•]	[•]
4	[•]	[•]
5	[•]	[•]
6	[•]	[•]
7	[•]	[•]

By the duly authorised representatives signing this Schedule of Deviations below, the Employer and the tenderer agree to and accept this Schedule of Deviations as the only deviations from and amendments to the documents listed in the Tender Data and any addenda thereto listed in the Tender Schedules, as well as any confirmation, clarification or changes to the terms of the Offer agreed by the tenderer and the Employer during this process of Offer and Acceptance.

It is expressly agreed that no other matter whether in writing, oral communication or implied during the period between the issue of the tender documents and the receipt by the tenderer of a completed signed copy of this Form shall have any meaning or effect in the contract between the parties arising from this Agreement.

For the tenderer:

For the Employer

Signature _____

Name _____

Capacity _____

On behalf of _____
(Insert name and address of organisation)

(Insert name and address of organisation)

Name & signature of witness _____

Date _____

C1.2 TSC3 Contract Data

Part one - Data provided by the *Employer*

[Instructions to the contract compiler: (delete these two notes in the final draft of a contract)]

1. Please read the relevant clauses in the conditions of contract before you enter data. The number of the clause which requires the data is shown in the left hand column for each statement however other clauses may also use the same data.
2. Some TSC3 options are always selected by Eskom Holdings SOC Ltd. The remaining TSC3 options are identified by shading in the left hand column. In the event that the option is not required select and delete the whole row. Where the following symbol is used "[•]" - data is required to be inserted relevant to the specific option selected.]

Completion of this data in full, according to the Options chosen, is essential to create a complete contract.

Clause	Statement	Data
1	General	
	The <i>conditions of contract</i> are the core clauses and the clauses for main Option:	
		A: Priced contract with price list
	dispute resolution Option	W1: Dispute resolution procedure
	and secondary Options	
		X1: Price adjustment for inflation
		X2 Changes in the law
		X17: Low service damages
		X18: Limitation of liability
		X19: Task Order
		Z: Additional conditions of contract
	of the NEC3 Term Service Contract April 2013 ² (TSC3)	
10.1	The <i>Employer</i> is (name):	Eskom Holdings SOC Ltd (reg no: 2002/015527/30), a state owned company incorporated in terms of the company laws of the Republic of South Africa
	Address	Registered office at Megawatt Park, Maxwell Drive, Sandton, Johannesburg
	Tel No.	[•]
	Fax No.	[•]
10.1	The <i>Service Manager</i> is (name):	Simphiwe Nkutha

² Available from Engineering Contract Strategies Tel 011 803 3008 Fax 086 539 1902 www.ecs.co.za

	Address	Duvha Power Station
	Tel	013 690 2605
	Fax	N/A
	e-mail	NkuthaS@eskom.co.za
11.2(2)	The Affected Property is	Duvha PS Milling Plant (Unit 1-6)
11.2(13)	The <i>service</i> is	Maintenance Services on the Milling Plant and associated plant on Duvha Units 1 to 6
11.2(14)	The following matters will be included in the Risk Register	As identified by the parties from time to time and recorded in the plant specific Risk Register
11.2(15)	The Service Information is in	Part 3: Scope of Work and all documents and drawings to which it makes reference.
12.2	The <i>law of the contract</i> is the law of	the Republic of South Africa
13.1	The <i>language of this contract</i> is	English
13.3	The <i>period for reply</i> is	1 week
2	The Contractor's main responsibilities	Data required by this section of the core clauses is also provided by the <i>Contractor</i> in Part 2 and terms in italics used in this section are identified elsewhere in this Contract Data
21.1	The <i>Contractor</i> submits a first plan for acceptance within	A plan for each activity in the activity schedule shall be submitted with the Tender Returnable.
3	Time	
30.1	The <i>starting date</i> is.	01 August 2022 OR as soon as possible thereafter
30.1	The <i>service period</i> is	60 Months
4	Testing and defects	The defect correction period is to be agreed on the first meeting when that defect is formally discussed.
5	Payment	
50.1	The <i>assessment interval</i> is	To specified on the task order.
51.1	The <i>currency of this contract</i> is the	South African Rand
51.2	The period within which payments are made is	30 days from transmittal of the Contract's invoice to the Employer APS department.
51.4	The <i>interest rate</i> is	(i) the publicly quoted prime rate of interest (calculated on a 365 day year) charged by from time to time by the Standard Bank of South Africa Limited (as certified, in the event of any dispute, by any manager of such bank, whose

appointment it shall not be necessary to prove)
for amounts due in Rands and

(ii) the LIBOR rate applicable at the time for amounts due in other currencies. LIBOR is the 6 month London Interbank Offered Rate quoted under the caption "Money Rates" in The Wall Street Journal for the applicable currency or if no rate is quoted for the currency in question then the rate for United States Dollars, and if no such rate appears in The Wall Street Journal then the rate as quoted by the Reuters Monitor Money Rates Service (or such service as may replace the Reuters Monitor Money Rates Service) on the due date for the payment in question, adjusted *mutatis mutandis* every 6 months thereafter (and as certified, in the event of any dispute, by any manager employed in the foreign exchange department of The Standard Bank of South Africa Limited, whose appointment it shall not be necessary to prove.

6	Compensation events	Compensation Events are to be approved by the <i>Employer</i> prior to the commencement of any work related to the Compensation Event.
7	Use of Equipment Plant and Materials	There is no reference to Contract Data in this section of the core clauses and terms in italics used in this section are identified elsewhere in this Contract Data
8	Risks and insurance	
80.1	These are additional Employer's risks	<p>1. Work Quality Not adhering to standards and procedures</p> <p>2. Unqualified or in-experienced people</p> <p>3. Internal strike due to salary payments</p>
9	Termination	There is no reference to Contract Data in this section of the core clauses and terms in italics used in this section are identified elsewhere in this Contract Data.
10	Data for main Option clause	
A	Priced contract with price list	
20.5	The <i>Contractor</i> prepares forecasts of the final total of the Prices for the whole of the <i>service</i> at intervals no longer than	1 month.
11	Data for Option W1	
W1.1	The <i>Adjudicator</i>	the person selected from the ICE-SA Division (or its successor body) of the South African Institution of Civil Engineering Panel of Adjudicators by the Party intending to refer a dispute to him. (see www.ice-sa.org.za). If the Parties do not agree on an Adjudicator the

		Adjudicator will be appointed by the Arbitration Foundation of Southern Africa (AFSA).		
	Address	[•]		
	Tel No.	[•]		
	Fax No.	[•]		
	e-mail	[•]		
W1.2(3)	The <i>Adjudicator nominating body</i> is:		the Chairman of ICE-SA a joint Division of the South African Institution of Civil Engineering and the Institution of Civil Engineers (London) (see www.ice-sa.org.za) or its successor body.	
W1.4(2)	The <i>tribunal</i> is:		arbitration	
W1.4(5)	The <i>arbitration procedure</i> is		the latest edition of Rules for the Conduct of Arbitrations published by The Association of Arbitrators (Southern Africa) or its successor body.	
	The place where arbitration is to be held is		[•] South Africa	
	The person or organisation who will choose an arbitrator		the Chairman for the time being or his nominee of the Association of Arbitrators (Southern Africa) or its successor body.	
	<ul style="list-style-type: none">- if the Parties cannot agree a choice or- if the arbitration procedure does not state who selects an arbitrator, is			
12	Data for secondary Option clauses			
X1	Price adjustment for inflation			
X1.1	The <i>base date</i> for indices is		One month prior to the enquiry closing date	
	The proportions used to calculate the Price Adjustment Factor are:		proportion	linked to index for
			0.80	C3 Actual Labour Costs, All Hourly paid employees
			0.10	L2(A) Road Freight Cost [•]
			0.10	non-adjustable
			1.00	
X2	Changes in the law		There is no reference to Contract Data in this Option and terms in italics are identified elsewhere in this Contract Data.	
X17	Low service damages:			
X17.1	The <i>service level table</i> is in			

	Description	Penalty
	Poor workmanship (loadloss)	Contractor to carry 2% - 10% of the month task order.
	Plant rework	R nil / Overtime
X18	Limitation of liability	
X18.1	The <i>Contractor's</i> liability to the <i>Employer</i> for indirect or consequential loss is limited to	R0.0 (zero Rand)
X18.2	For any one event, the <i>Contractor's</i> liability to the <i>Employer</i> for loss of or damage to the <i>Employer's</i> property is limited to	the amount of the deductibles relevant to the event
X18.3	The <i>Contractor's</i> liability for Defects due to his design of an item of Equipment is limited to	The greater of the total of the Prices at the Contract Date and the amounts excluded and unrecoverable from the <i>Employer's</i> insurance (other than the resulting physical damage to the <i>Employer's</i> property which is not excluded) plus the applicable deductibles
X18.4	The <i>Contractor's</i> total liability to the <i>Employer</i> , for all matters arising under or in connection with this contract, other than the excluded matters, is limited to	the total of the Prices other than for the additional excluded matters. The <i>Contractor's</i> total liability for the additional excluded matters is not limited. The additional excluded matters are amounts for which the <i>Contractor</i> is liable under this contract for Defects due to his design, plan and specification, Defects due to manufacture and fabrication outside the Affected Property, loss of or damage to property (other than the <i>Employer's</i> property, Plant and Materials), death of or injury to a person and infringement of an intellectual property right.
X18.5	The <i>end of liability date</i> is	12 months after the end of the <i>service period</i>.
X19	Task Order	
X19.5	The <i>Contractor</i> submits a Task Order programme to the <i>Service Manager</i> within	2 days of receiving the Task Order
Z	The <i>additional conditions of contract</i> are	
	Z1 to Z14 always apply.	

Z1 Cession delegation and assignment

- Z1.1 The *Contractor* does not cede, delegate or assign any of its rights or obligations to any person without the written consent of the *Employer*.
- Z1.2 Notwithstanding the above, the *Employer* may on written notice to the *Contractor* cede and delegate its rights and obligations under this contract to any of its subsidiaries or any of its present divisions or operations which may be converted into separate legal entities as a result of the restructuring of the Electricity Supply Industry.

Z2 Joint ventures

- Z2.1 If the *Contractor* constitutes a joint venture, consortium or other unincorporated grouping of two or more persons or organisations then these persons or organisations are deemed to be jointly and severally liable to the *Employer* for the performance of this contract.
- Z2.2 Unless already notified to the *Employer*, the persons or organisations notify the *Service Manager* within two weeks of the Contract Date of the key person who has the authority to bind the *Contractor* on their behalf.
- Z2.3 The *Contractor* does not alter the composition of the joint venture, consortium or other unincorporated grouping of two or more persons without the consent of the *Employer* having been given to the *Contractor* in writing.

Z3 Change of Broad Based Black Economic Empowerment (B-BBEE) status

- Z3.1 Where a change in the *Contractor's* legal status, ownership or any other change to his business composition or business dealings results in a change to the *Contractor's* B-BBEE status, the *Contractor* notifies the *Employer* within seven days of the change.
- Z3.2 The *Contractor* is required to submit an updated verification certificate and necessary supporting documentation confirming the change in his B-BBEE status to the *Service Manager* within thirty days of the notification or as otherwise instructed by the *Service Manager*.
- Z3.3 Where, as a result, the *Contractor's* B-BBEE status has decreased since the Contract Date the *Employer* may either re-negotiate this contract or alternatively, terminate the *Contractor's* obligation to Provide the Service.
- Z3.4 Failure by the *Contractor* to notify the *Employer* of a change in its B-BBEE status may constitute a reason for termination. If the *Employer* terminates in terms of this clause, the procedures on termination are P1, P2 and P4 as stated in clause 92, and the amount due is A1 and A3 as stated in clause 93.

Z4 Confidentiality

- Z4.1 The *Contractor* does not disclose or make any information arising from or in connection with this contract available to Others. This undertaking does not, however, apply to information which at the time of disclosure or thereafter, without default on the part of the *Contractor*, enters the public domain or to information which was already in the possession of the *Contractor* at the time of disclosure (evidenced by written records in existence at that time). Should the *Contractor* disclose information to Others in terms of clause 25.1, the *Contractor* ensures that the provisions of this clause are complied with by the recipient.
- Z4.2 If the *Contractor* is uncertain about whether any such information is confidential, it is to be regarded as such until notified otherwise by the *Service Manager*.
- Z4.3 In the event that the *Contractor* is, at any time, required by law to disclose any such information

which is required to be kept confidential, the *Contractor*, to the extent permitted by law prior to disclosure, notifies the *Employer* so that an appropriate protection order and/or any other action can be taken if possible, prior to any disclosure. In the event that such protective order is not, or cannot, be obtained, then the *Contractor* may disclose that portion of the information which it is required to be disclosed by law and uses reasonable efforts to obtain assurances that confidential treatment will be afforded to the information so disclosed.

Z4.4 The taking of images (whether photographs, video footage or otherwise) of the Affected Property or any portion thereof, in the course of Providing the Service and after the end of the *service period*, requires the prior written consent of the *Service Manager*. All rights in and to all such images vests exclusively in the *Employer*.

Z4.5 The *Contractor* ensures that all his subcontractors abide by the undertakings in this clause.

Z5 Waiver and estoppel: Add to core clause 12.3:

Z5.1 Any extension, concession, waiver or relaxation of any action stated in this contract by the Parties, the *Service Manager* or the *Adjudicator* does not constitute a waiver of rights, and does not give rise to an estoppel unless the Parties agree otherwise and confirm such agreement in writing.

Z6 Health, safety and the environment: Add to core clause 27.4

Z6.1 The *Contractor* undertakes to take all reasonable precautions to maintain the health and safety of persons in and about the execution of the *service*. Without limitation the *Contractor* accepts that the *Employer* may appoint him as the "Principal Contractor" (as defined and provided for under the Construction Regulations 2014 (promulgated under the Occupational Health & Safety Act 85 of 1993) ("the Construction Regulations") for the Affected Property; warrants that the total of the Prices as at the Contract Date includes a sufficient amount for proper compliance with the Construction Regulations, all applicable health & safety laws and regulations and the health and safety rules, guidelines and procedures provided for in this contract and generally for the proper maintenance of health & safety in and about the execution of the *service*; and undertakes, in and about the execution of the *service*, to comply with the Construction Regulations and with all applicable health & safety laws and regulations and rules, guidelines and procedures otherwise provided for under this contract and ensures that his Subcontractors, employees and others under the *Contractor's* direction and control, likewise observe and comply with the foregoing.

Z6.2 The *Contractor*, in and about the execution of the *service*, complies with all applicable environmental laws and regulations and rules, guidelines and procedures otherwise provided for under this contract and ensures that his Subcontractors, employees and others under the *Contractor's* direction and control, likewise observe and comply with the foregoing.

Z7 Provision of a Tax Invoice and interest. Add to core clause 51

Z7.1 Within one week of receiving a payment certificate from the *Service Manager* in terms of core clause 51.1, the *Contractor* provides the *Employer* with a tax invoice in accordance with the *Employer's* procedures stated in the Service Information, showing the amount due for payment equal to that stated in the payment certificate.

Z7.2 If the *Contractor* does not provide a tax invoice in the form and by the time required by this contract, the time by when the *Employer* is to make a payment is extended by a period equal in time to the delayed submission of the correct tax invoice. Interest due by the *Employer* in terms of core clause 51.2 is then calculated from the delayed date by when payment is to be made.

Z7.3 The *Contractor* (if registered in South Africa in terms of the companies Act) is required to

comply with the requirements of the Value Added Tax Act, no 89 of 1991 (as amended) and to include the *Employer's* VAT number 4740101508 on each invoice he submits for payment.

Z8 Notifying compensation events

Z8.1 Delete the last paragraph of core clause 61.3 and replace with:

If the *Contractor* does not notify a compensation event within eight weeks of becoming aware of the event, he is not entitled to a change in the Prices.

Z9 *Employer's* limitation of liability

Z9.1 The *Employer's* liability to the *Contractor* for the *Contractor's* indirect or consequential loss is limited to R0.00 (zero Rand)

Z9.2 The *Contractor's* entitlement under the indemnity in 82.1 is provided for in 60.1(12) and the *Employer's* liability under the indemnity is limited to compensation as provided for in core clause 63 and X19.11 if Option X19 Task Order applies to this contract.

Z10 Termination: Add to core clause 91.1, at the second main bullet point, fourth sub-bullet point, after the words "against it":

Z10.1 or had a business rescue order granted against it.

Z11 Ethics

For the purposes of this Z-clause, the following definitions apply:

Affected Party means, as the context requires, any party, irrespective of whether it is the *Contractor* or a third party, such party's employees, agents, or Subcontractors or Subcontractor's employees, or any one or more of all of these parties' relatives or friends,

Coercive Action means to harm or threaten to harm, directly or indirectly, an Affected Party or the property of an Affected Party, or to otherwise influence or attempt to influence an Affected Party to act unlawfully or illegally,

Collusive Action means where two or more parties co-operate to achieve an unlawful or illegal purpose, including to influence an Affected Party to act unlawfully or illegally,

Committing Party means, as the context requires, the *Contractor*, or any member thereof in the case of a joint venture, or its employees, agents, or Subcontractors or the Subcontractor's employees,

Corrupt Action means the offering, giving, taking, or soliciting, directly or indirectly, of a good or service to unlawfully or illegally influence the actions of an Affected Party,

Fraudulent Action means any unlawfully or illegally intentional act or omission that misleads, or attempts to mislead, an Affected Party, in order to obtain a financial or other benefit or to avoid an obligation or incurring an obligation,

Obstructive Action means a Committing Party unlawfully or illegally destroying, falsifying, altering or concealing information or making false statements to materially impede an investigation into allegations of Prohibited Action, and

Prohibited Action means any one or more of a Coercive Action, Collusive Action Corrupt Action, Fraudulent Action or Obstructive Action.

- Z11.1 A Committing Party may not take any Prohibited Action during the course of the procurement of this contract or in execution thereof.
- Z11.2 The *Employer* may terminate the *Contractor's* obligation to Provide the Services if a Committing Party has taken such Prohibited Action and the *Contractor* did not take timely and appropriate action to prevent or remedy the situation, without limiting any other rights or remedies the *Employer* has. It is not required that the Committing Party had to have been found guilty, in court or in any other similar process, of such Prohibited Action before the *Employer* can terminate the *Contractor's* obligation to Provide the Services for this reason.
- Z11.3 If the *Employer* terminates the *Contractor's* obligation to Provide the Services for this reason, the amounts due on termination are those intended in core clauses 92.1 and 92.2.
- Z11.4 A Committing Party co-operates fully with any investigation pursuant to alleged Prohibited Action. Where the *Employer* does not have a contractual bond with the Committing Party, the *Contractor* ensures that the Committing Party co-operates fully with an investigation.

Z12 Insurance

Z 12 .1 Replace core clause 83 with the following:

Insurance cover 83

- 83.1 When requested by a Party, the other Party provides certificates from his insurer or broker stating that the insurances required by this contract are in force.
- 83.2 The *Contractor* provides the insurances stated in the Insurance Table A from the *starting date* until the earlier of Completion and the date of the termination certificate.

INSURANCE TABLE A

Insurance against	Minimum amount of cover or minimum limit of indemnity
Loss of or damage caused by the <i>Contractor</i> to the <i>Employer's</i> property	The replacement cost where not covered by the <i>Employer's</i> insurance. The <i>Employer's</i> policy deductible as at Contract Date, where covered by the <i>Employer's</i> insurance.
Loss of or damage to Plant and Materials	The replacement cost where not covered by the <i>Employer's</i> insurance. The <i>Employer's</i> policy deductible as at Contract Date, where covered by the <i>Employer's</i> insurance.
Loss of or damage to Equipment	The replacement cost where not covered by the <i>Employer's</i> insurance. The <i>Employer's</i> policy deductible as at Contract Date, where covered by the <i>Employer's</i> insurance.
The <i>Contractor's</i> liability for loss of or damage to property (except the <i>Employer's</i> property, Plant and Materials and Equipment) and liability for bodily injury to or death of a	<u>Loss of or damage to property</u> The replacement cost <u>Bodily injury to or death of a person</u>

person (not an employee of the <i>Contractor</i>) arising from or in connection with the <i>Contractor's</i> Providing the Service	The amount required by the applicable law.
Liability for death of or bodily injury to employees of the <i>Contractor</i> arising out of and in the course of their employment in connection with this contract	The amount required by the applicable law

Z 12.2 Replace core clause 86 with the following:

**Insurance
by the
Employer** 86

86.1 The *Employer* provides the insurances stated in the Insurance Table B

INSURANCE TABLE B

Insurance against or name of policy	Minimum amount of cover or minimum limit of indemnity
Assets All Risk	Per the insurance policy document
Contract Works insurance	Per the insurance policy document
Environmental Liability	Per the insurance policy document
General and Public Liability	Per the insurance policy document
Transportation (Marine)	Per the insurance policy document
Motor Fleet and Mobile Plant	Per the insurance policy document
Terrorism	Per the insurance policy document
Cyber Liability	Per the insurance policy document
Nuclear Material Damage and Business Interruption	Per the insurance policy document
Nuclear Material Damage Terrorism	Per the insurance policy document

Z13 Nuclear Liability

Z13.1 The *Employer* is the operator of the Koeberg Nuclear Power Station (KNPS), a nuclear installation, as designated by the National Nuclear Regulator of the Republic of South Africa, and is the holder of a nuclear licence in respect of the KNPS.

Z13.2 The *Employer* is solely responsible for and indemnifies the *Contractor* or any other person against any and all liabilities which the *Contractor* or any person may incur arising out of or resulting from nuclear damage, as defined in Act 47 of 1999, save to the extent that any liabilities are incurred due to the unlawful intent of the *Contractor* or any other person or the presence of the *Contractor* or that person or any property of the *Contractor* or such person at or in the KNPS or on the KNPS

site, without the permission of the *Employer* or of a person acting on behalf of the *Employer*.

Z13.3 Subject to clause Z13.4 below, the *Employer* waives all rights of recourse, arising from the aforesaid, save to the extent that any claims arise or liability is incurred due or attributable to the unlawful intent of the *Contractor* or any other person, or the presence of the *Contractor* or that person or any property of the *Contractor* or such person at or in the KNPS or on the KNPS site, without the permission of the *Employer* or of a person acting on behalf of the *Employer*.

Z13.4 The *Employer* does not waive its rights provided for in section 30 (7) of Act 47 of 1999, or any replacement section dealing with the same subject matter.

Z13.5 The protection afforded by the provisions hereof shall be in effect until the KNPS is decommissioned.

Z14 Asbestos

For the purposes of this Z-clause, the following definitions apply:

AAIA	means approved asbestos inspection authority.
ACM	means asbestos containing materials.
AL	means action level, i.e. a level of 50% of the OEL, i.e. 0.1 regulated asbestos fibres per ml of air measured over a 4 hour period. The value at which proactive actions is required in order to control asbestos exposure to prevent exceeding the OEL.
Ambient Air	means breathable air in area of work with specific reference to breathing zone, which is defined to be a virtual area within a radius of approximately 30cm from the nose inlet.
Compliance Monitoring	means compliance sampling used to assess whether or not the personal exposure of workers to regulated asbestos fibres is in compliance with the Standard's requirements for safe processing, handling, storing, disposal and phase-out of asbestos and asbestos containing material, equipment and articles.
OEL	means occupational exposure limit.
Parallel Measurements	means measurements performed in parallel, yet separately, to existing measurements to verify validity of results.
Safe Levels	means airborne asbestos exposure levels conforming to the Standard's requirements for safe processing, handling, storing, disposal and phase-out of asbestos and asbestos containing material, equipment and articles.
Standard	means the <i>Employer's</i> Asbestos Standard 32-303: Requirements for Safe Processing, Handling, Storing, Disposal and Phase-out of Asbestos and Asbestos Containing Material, Equipment and Articles.
SANAS	means the South African National Accreditation System.
TWA	means the average exposure, within a given workplace, to airborne asbestos fibres, normalised to the baseline of a 4 hour continuous period, also applicable to short term exposures, i.e. 10-minute TWA.

Z14.1 The *Employer* ensures that the Ambient Air in the area where the *Contractor* will Provide the Services conforms to the acceptable prescribed South African standard for asbestos, as per the regulations published in GNR 155 of 10 February 2002, under the Occupational Health and Safety Act, 1993 (Act 85 of 1993) ("Asbestos Regulations"). The OEL for asbestos is 0.2 regulated asbestos fibres per millilitre of air as a 4-hour TWA, averaged over any continuous period of four hours, and the short term exposure limit of 0.6 regulated asbestos fibres per millilitre of air as a 10-

minute TWA, averaged over any 10 minutes, measured in accordance with HSG248 and monitored according to HSG173 and OESSM.

- Z14.2 Upon written request by the *Contractor*, the *Employer* certifies that these conditions prevail. All measurements and reporting are effected by an independent, competent, and certified occupational hygiene inspection body, i.e. a SANAS accredited and Department of Employment and Labour approved AAIA. The *Contractor* may perform Parallel Measurements and related control measures at the *Contractor's* expense. For the purposes of compliance the results generated from Parallel Measurements are evaluated only against South African statutory limits as detailed in clause Z14.1. Control measures conform to the requirements stipulated in the AAIA-approved asbestos work plan.
- Z14.3 The *Employer* manages asbestos and ACM according to the Standard.
- Z14.4 In the event that any asbestos is identified while Providing the Services, a risk assessment is conducted and if so required, with reference to possible exposure to an airborne concentration of above the AL for asbestos, immediate control measures are implemented and relevant air monitoring conducted in order to declare the area safe.
- Z14.5 The *Contractor's* personnel are entitled to stop working and leave the contaminated area forthwith until such time that the area of concern is declared safe by either Compliance Monitoring or an AAIA approved control measure intervention, for example, per the emergency asbestos work plan, if applicable.
- Z14.6 The *Contractor* continues to Provide the Services, without additional control measures presented, on presentation of Safe Levels. The contractually agreed dates to Provide the Services, including the Completion Date, are adjusted accordingly. The contractually agreed dates are extended by the notification periods required by regulations 3 and 21 of the Asbestos Regulations, 2001.
- Z14.7 Any removal and disposal of asbestos, asbestos containing materials and waste, is done by a registered asbestos contractor, instructed by the *Employer* at the *Employer's* expense, and conducted in line with South African legislation.

C1.2 Contract Data

Part two - Data provided by the *Contractor*

[Instructions to the contract compiler: (delete this notes before issue to tenderers with an enquiry)

Whenever a cell is shaded in the left hand column it denotes this data is optional and would be required in relation to the option selected. In the event that the option is not required select and delete the whole row.]

Notes to a tendering contractor:

1. Please read both the both the NEC3 Term Service Contract April 2013 and the relevant parts of its Guidance Notes (TSC3-GN)³ in order to understand the implications of this Data which the tenderer is required to complete.
2. The number of the clause which requires the data is shown in the left hand column for each statement however other clauses may also use the same data.
3. Where a form field like this [] appears, data is required to be inserted relevant to the option selected. Click on the form field **once** and type in the data. Otherwise complete by hand and in ink.

Completion of the data in full, according to Options chosen, is essential to create a complete contract.

Clause	Statement	Data
10.1	The <i>Contractor</i> is (Name): Address Tel No. Fax No.	
11.2(8)	The <i>direct fee percentage</i> is	%
	The <i>subcontracted fee percentage</i> is	%
11.2(14)	The following matters will be included in the Risk Register	
11.2(15)	The Service Information for the <i>Contractor's</i> plan is in:	
21.1	The plan identified in the Contract Data is contained in:	
24.1	The key people are: 1 Name: Job: Responsibilities: Qualifications: Experience: 2 Name: Job	

³ Available from Engineering Contract Strategies Tel 011 803 3008 Fax 086 5391902 or www.ecs.co.za

Responsibilities:

Qualifications:

Experience:

CV's (and further key person's data including
CVs) are in _____.

A	Priced contract with price list
11.2(12)	The <i>price list</i> is in
11.2(19)	The tendered total of the Prices is R
C	Target contract with price list
11.2(12)	The <i>price list</i> is in
11.2(20)	The tendered total of the Prices is R
E	Cost reimbursable contract
11.2(12)	The <i>price list</i> is in

PART 2: PRICING DATA
TSC3 Option A

Document reference	Title	No of pages
C2.1	Pricing assumptions: Option A	2
C2.2	The <i>price list</i>	[•]

C2.1 Pricing assumptions: Option A

How work is priced and assessed for payment

Clause 11 in NEC3 Term Service Contract (TSC3) core clauses and Option A states:

Identified and defined terms	11	
	11.2	(12) The Price List is the <i>price list</i> unless later changed in accordance with this contract.
		(17) The Price for Services Provided to Date is the total of <ul style="list-style-type: none">the Price for each lump sum item in the Price List which the <i>Contractor</i> has completed andwhere a quantity is stated for an item in the Price List, an amount calculated by multiplying the quantity which the <i>Contractor</i> has completed by the rate.
		(19) The Prices are the amounts stated in the Price column of the Price List. Where a quantity is stated for an item in the Price List, the Price is calculated by multiplying the quantity by the rate.

This confirms that Option A is a priced contract where the Prices are derived from a list of items of service which can be priced as lump sums or as expected quantities of service multiplied by a rate or a mix of both.

Function of the Price List

Clause 54.1 in Option A states: "Information in the Price List is not Service Information". This confirms that instructions to do work or how it is to be done are not included in the Price List but in the Service Information. This is further confirmed by Clause 20.1 which states, "The *Contractor* Provides the Service in accordance with the Service Information". Hence the *Contractor* does **not** Provide the Service in accordance with the Price List. The Price List is only a pricing document.

Link to the *Contractor's* plan

Clause 21.4 states "The *Contractor* provides information which shows how each item description on the Price List relates to the operations on each plan which he submits for acceptance". Hence when compiling the *price list*, the tendering contractor needs to develop his first clause 21.2 plan in such a way that operations shown on it can be priced in the *price list* and result in a satisfactory cash flow in terms of clause 11.2(17).

Preparing the *price list*

Before preparing the *price list*, both the *Employer* and tendering contractors should read the TSC3 Guidance Notes pages 14 and 15. In an Option A contract, either Party may have entered items into the *price list* either as a process of offer and acceptance (tendering) or by negotiation depending on the nature of the service to be provided. Alternatively the *Employer*, in his Instructions to Tenderers or in a Tender Schedule, may have listed some items that he requires the *Contractor* to include in the *price list* to be prepared and priced by him.

It is assumed that in preparing or finalising the *price list* the *Contractor*:

- Has taken account of the guidance given in the TSC3 Guidance Notes relevant to Option A;
- Understands the function of the Price List and how work is priced and paid for;
- Is aware of the need to link operations shown in his plan to items shown in the Price List;
- Has listed and priced items in the *price list* which are inclusive of everything necessary and incidental to Providing the Service in accordance with the Service Information, as it was at the time of tender, as well as correct any Defects not caused by an *Employer's* risk;
- Has priced work he decides not to show as a separate item within the Prices or rates of other listed items in order to fulfil the obligation to complete the *service* for the tendered total of the Prices.
- Understands there is no adjustment to items priced as lump sums if the amount, or quantity, of work within that item later turns out to be different to that which the *Contractor* estimated at time of tender. The only basis for a change to the (lump sum) Prices is as a result of a compensation event.

Format of the *price list*

(From the example given in an Appendix within the TSC3 Guidance Notes)

Entries in the first four columns in the *price list* in section C2.2 are made either by the *Employer* or the tendering contractor.

If the *Contractor* is to be paid an amount for the item which is not adjusted if the quantity of work in the item changes, the tendering contractor enters the amount in the Price column only, the Unit, Expected Quantity and Rate columns being left blank.

If the *Contractor* is to be paid an amount for an item of work which is the rate for the work multiplied by the quantity completed, the tendering contractor enters the rate which is then multiplied by the Expected Quantity to produce the Price, which is also entered.

If the *Contractor* is to be paid a Price for an item proportional to the length of time for which a service is provided, a unit of time is stated in the Unit column and the expected length of time (as a quantity of the stated units of time) is stated in the Expected Quantity column.

C2.2 the *price list*

Item no.	Description	Unit	Qty.	Rate (per hour)	Hours/ month	Price/Month
A. RESOURCES (MANPOWER)						
1	Site Manager Normal time	Hrs.	1	R	173	R
2	Site Manager Normal Overtime Including Saturday	Hrs		R		
3	Site Manager Sunday and P/H Overtime	Hrs.		R		
4	Supervisor Normal time	Hrs.	5	R	173	R
5	Supervisor Normal Overtime Including Saturday	Hrs		R		
6	Supervisor Sunday and P/H Overtime	Hrs.		R		
7	Mechanical Fitter Normal time	Hrs	10	R	173	R
8	Mechanical Fitter Normal Overtime Including Saturday	Hrs.		R		
9	Mechanical Fitters Sunday and P/H Overtime	Hrs.		R		
10	Welder Normal time	Hrs	10	R	173	R
11	Welder Normal Overtime Including Saturday	Hrs.		R		
12	Welder Sunday and P/H Overtime	Hrs.		R		
13	Boiler Maker Normal time	Hrs	10	R	173	
14	Boiler Maker Normal Overtime Including Saturday	Hrs.		R		
15	Boiler Maker Sunday and P/H Overtime	Hrs.		R		
16	Rigger Normal Time	Hrs	3	R	173	
17	Rigger Normal Over Time Including Saturday	Hrs.		R		
18	Rigger Sunday and P/H Overtime	Hrs.		R		
19	Assistant Normal Time	Hrs	30	R	173	
20	Assistant Normal Overtime Including Saturday	Hrs.		R		
21	Assistant Sunday and P/H Overtime	Hrs.		R		
22	Tackler Normal Time	Hrs	10	R	173	
23	Tackler Normal Overtime Including Saturday	Hrs.		R		
24	Tackler Sunday and P/H Overtime	Hrs.		R		
25	Safety Officer Normal Time	Hrs	2	R	173	R
26	Safety Officer Normal Overtime Including Saturday	Hrs.		R		
27	Safety Officer Sunday and P/H Overtime	Hrs.		R		
28	Quality Inspector Normal Time	Hrs	2	R	173	R

29	Quality Inspector Normal Overtime Including Saturday	Hrs		R		
30	Quality Inspector Sunday and P\H Overtime	Hrs		R		
31	Planner Normal Time	Hrs	1	R	173	R
32	Planner Normal Overtime Including Saturday	Hrs.		R		
33	Planner Officer Sunday and P/H Overtime	Hrs.		R		
Subtotal A: MANPOWER PER MONTH						R
Subtotal A: MANPOWER FOR 60 MONTHS (5 YEARS)						R
B. PRELIMINARY AND GENERALS						
34	Site Establishment (Provide Breakdown)	Sum	1	R	1	R
35	Site de- establishment (Provide Breakdown)	Sum	1	R	1	R
36	Tools and Equipment (Refer to a List of Resources)	Sum	1	R	1	R
Subtotal B: PRELIMINARY AND GENERALS FOR 5YEARS						R
C. FIXED TERM ITEMS						
37	22-Seater transport x4 (Home-work-home)	Monthly	4	R	60	R
38	Bakkie x 1 (Single Cap)	Monthly	1	R	60	R
Subtotal C: FIXED TERM ITEMS FOR 60 MONTHS (5 YEARS)						R
D. TIME RELATED ITEMS						
39	Health and Safety Measures (Refer to a List of Resources)	Annually	1	R	5	R
Subtotal D: FIXED TERM ITEMS FOR 5 YEARS						R

The total of the Price for 60 Months (5 Years) Subtotals A+B+C+D excluding VAT

1. LIST OF RESOURCES

A. RESOURCES (MANPOWER)

NUMBERS	DESCRIPTION	UNIT	QUANTITY	HOURS/MONTH
	RESOURCES (MANPOWER)			
1	Direct Labour - Normal Hours			
2	Site Manager	Hour	1	173
3	Supervisor (Fitter by Trade)	Hour	5	173
	Assistants	Hour	30	173
5	Tacklers	Hour	10	173
6	Mechanical Fitter	Hour	10	173
7	Boiler Makers	Hour	10	173
8	Welders	Hour	10	173
9	Quality Inspector	Hour	2	173
10	Riggers	Hour	3	173
11	Safety Officer	Hour	2	173
	Planner	Hour	1	173
			84	

B. PRELIMINARY AND GENERALS

NUMBERS	DESCRIPTION	UNIT	QUANTITY
	PRELIMINARY AND GENERALS		
1	Site-establishment	Sum	1
2	Tools and Equipment (REFER TO LIST OF TOOLS AND EQUIPMENTS BELOW)	Sum	1
3	Site de-Establishment on Completion of contract	Sum	1

Tools And Equipment

Numbers	Description
1	Workshop work benches X 2
2	Chain block 3 ton X 4
3	Welding Rectifiers 380 volt X 4
4	Lead lights 220 volts X 6
5	Lead light extension cables 220 volts (30 meter each) X 8
6	Welding machines and hot boxes including oven for heating/ baking welding rods X 4
7	Hydraulic jacks and bearing puller X 2
8	All fitting tools to be supplied by the contractor. (Artisans supply their own tools)
9	All boiler making tools to be supplied by the contractor. (Artisans supply their own tools).
10	All welding tools to be supplied by the contractor. (Artisans supply their own tools).
11	Potable disc grinding machines X2
12	Portable electric drilling machines X1
13	Screw thread cutting taps and dies inclusive of die nut sets X2

14	Special measuring tools, clock gauges, vernier callipers, micrometers, torque wrenches, torque multipliers, socket spanners etc. to be supplied by the contractor.
15	Forklift (Dry-rate) X1

C. FIXED TERM ITEMS

NUMBERS	DESCRIPTION	UNIT	QUANTITY	MONTHLY
	FIXED TERM ITEMS			
1	22-Seater transport x4 (Home-work-home)	Month	4	60
2	Bakkie x 1 (Single Cap)	Month	1	60

D. TIME RELATED ITEMS

NUMBERS	DESCRIPTION	UNIT	QUANTITY
	TIME RELATED ITEMS		
1	Hard Hat	Yearly	5
2	Safety Goggles or Shield	Yearly	5
3	Gloves	Yearly	5
4	Safety Shoes	Yearly	5
5	Overalls	Yearly	5
6	Fall Arrest System	Yearly	5
7	First Aid	Sum	1

Document reference	Title	No of pages
C3.1	This cover page <i>Employer's Service Information</i>	1
C3.2	<i>Contractor's Service Information</i>	
	Total number of pages	

C3.1: EMPLOYER'S SERVICE INFORMATION

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Otherwise insert list of contents manually.

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C3.1: EMPLOYER'S SERVICE INFORMATION

1 Description of the service

1.1 Interpretation and Terminology

For the purpose of interpreting the Service Information the following terminology shall apply:

The term '*service*' like all italicised terms used in the NEC Term

Service Contract (June 2005), is identified in the Contract Data and is the title given to the overall scope of work in this contract. For this contract *service* is identified as "Maintenance Services on the Milling and Associated Plant on Duvha Units 1 to 6".

The term 'Affected Property' refers to Duvha Units 1 to 6 Milling and Associated Plant and is the area where the *Contractor's services* are required.

For this contract, secondary Option X19 of the NEC Term Service Contract (June 2005) has been selected which allows for work to be instructed by Task Order. A Task is defined as work within the *service* which the *Service Manager* may instruct the *Contractor* to carry out within a stated period of time. Tasks are identified from Maintenance Strategies, Notifications, etc.

1.2 Executive Overview

The work in this contract relates to the maintenance of the Employer's Milling Plant facilities by the *Contractor*, through the provision of skilled labour, engineering knowledge and management experience. All of the *service* shall be instructed by means of Task Orders issued by the Employer at any time during the term of the contract.

Technical, Quality and Workmanship requirements for the *service* shall be described in Quality Control Procedures (QCP's) provided by the *Contractor* for acceptance by the *Employer's* Engineering Section and the *Service Manager* before work is carried out.

Key Performance Indicators (KPI's) have been included in this Service Information to motivate best practice and innovation for improved *service* outputs by the *Contractor*.

1.3 Objectives

The objectives for this contract include:

- Maintaining and improving the efficient operation of Duvha Milling Plant;
- Ensuring that the *Contractor* provides consistent availability of cost effective milling plant maintenance *services* to the Employer;
- Reducing costs through continuous improvement and efficiencies;
- Ensuring the application of appropriate maintenance policies and updating of maintenance techniques;
- Developing performance standards which support the Employer's reliability and availability targets.
- Ensuring that there are sufficient skilled persons available on a twenty-four (24) hour basis to attend to any milling plant incidents that could result in deterioration of the Employer's technical performance and safety targets.

2 Management Strategy

2.1 Provision of Services

The *Contractor* shall provide *services* in the following categories:

2.1.1 Core Services

2.1.1.1 Planned Outage Maintenance Tasks

Planned Outage Maintenance tasks are derived from the *Affected Property* Manufacturer's Operating and Maintenance documentation. In addition, other known tasks that the Employer has identified as requiring *services* have been added. Appendix 11 details the tasks for which *services* are required. Appendices 4 to 9 provide additional detail on the activities required to perform these tasks.

2.1.1.2 Planned On-Load Routine Maintenance Tasks

Routine Maintenance Tasks are derived from the *Affected Property* Manufacturer's Operating and Maintenance documentation. Most of the items of work within the *service* required for planned on-load routine maintenance will not have been priced before the *starting date*. As a result, additional Prices shall be developed as an express requirement of this contract in such a manner that they can be included in the Price List once agreed by the *Contractor* and *Service Manager*.

2.1.1.3 Unplanned Maintenance Tasks

Unplanned Maintenance Tasks refer to plant failures that render or can potentially render the *Affected Property* un-serviceable or partially serviceable. These tasks will normally take preference and requires immediate action. The *Contractor* shall on instruction from the *Service Manager*, suspend all work on the Planned Maintenance Task Order, and allocate the team on site (or the Standby Team) to correct any failures on the *Affected Property*. This instruction can be verbal, with the necessary Task Order completed in retrospect.

2.1.2 Auxiliary Services

2.1.2.1 Cleaning of the Affected Property & Coal Hang-up Release

As part of providing the *services* for Planned Outage Maintenance, the *Contractor* shall provide a team of cleaning resources. The team shall be responsible for cleaning of the entire *Affected Property*, not only the area being worked on. In addition, this team will be available to release coal hang-ups and clean out coal feeders when required.

2.2 Planning, Resourcing, and Scheduling of Skills

The *Contractor* shall provide staffing levels for carrying out the *services* to ensure that the delivery of skills and quality required by the contract can be achieved.

2.2.1 For Core Services Tasks

The *Contractor* shall satisfy the following requirements:

2.2.1.1 Normal Work Week (Monday to Friday)

There shall be Five (5) teams working on a normal shift basis (eight hour shift) to ensure availability of the *services* on a twenty-four (24) hour basis during the work week (Monday to Friday).

2.2.1.2 Standby Hours

The *Contractor* shall provide a rolling four (4) week roster of persons on standby during week-ends, which includes coverage from the last team worked on Friday to the first team on the next Monday.

2.2.1.3 Staffing Levels

The composition of the teams will be informed by the skills requirement needed to provide the *services* for three (3) planned mill outages simultaneously within the durations stipulated in scope of work provided for service and overhaul.

2.2.1.4 Forecasted Activity Level

Based on the current Milling Plant Maintenance Philosophy, the Planned Outage Tasks require approximately 260 working days per year when utilising three (3) teams.

2.2.2 For Auxiliary Services Tasks

The *Contractor* shall satisfy the following requirements:

The *Contractor* shall provide four (5) teams working shifts as per an agreed shift roster that ensure availability on a twenty-four (24) hour basis, including weekends. The team shall consist of at least one person that has been authorised in terms of the Plant Safety Regulations and is capable of applying for and accepting a Permit to Work (PTW) if required for the *services* to be carried out.

2.3 Providing the Service by Task Order

2.3.1 Requirements for each Task Order

Secondary Option X19 is part of the conditions of contract and states the procedure for developing and managing a Task Order. Persons involved in the administration of this contract shall read Option X19 before preparing any Task Order. A Task Order format suitable for this contract is provided in Appendix 12. A Task Order is required for all work carried out under this contract.

2.3.2 Task Orders for Unplanned Maintenance Tasks

The *Service Manager* may at any time instruct the *Contractor* orally, followed up in writing, to carry out work which is of an emergency nature as defined in Section 2.1.3. Due to the urgent nature of this work, the *Contractor* shall action the *services* required immediately. The *Service Manager* shall issue a Task Order Request for this work before the end of the next business day.

2.4 Site Establishment

The Employer may at no cost to the *Contractor* provide facilities for use by the Mill Maintenance Team. During such time as the *Contractor's* employees are in possession or control of them, the *Contractor* shall be responsible and liable for them and for the use of them as though the facilities were the *Contractor's*. The *Contractor* shall use such facilities for work only in this contract, and shall not charge the Employer either directly or indirectly for their use.

2.5 Meetings and Planning

2.5.1.1 Mill Maintenance Meeting

The *Service Manager* shall arrange a daily Mill Maintenance Meeting at a time to suit attendance by both him/herself and the *Contractor*.

Minutes of the Mill Maintenance Meeting shall be kept by the *Service Manager*. The followings item should be discussed:

- Safety and housekeeping.
- Daily performance, incidents (INO) and system status.
- Review of priorities done on last 24 hours.
- Review of new priorities raised on last 24 hours.
- Progress report on planned maintenance activities.
- Problems concerning maintenance and repairs.
- Special requirements, tractor trailer and mobile crane and scaffolding.
- Quality inspections / take over inspection after maintenance.

2.5.1.2 Mill Maintenance Planning Meeting

The *Service Manager* shall arrange a weekly Mill Maintenance Planning Meeting at a time to suit attendance by him/herself, the Employer's Milling Plant Engineer and the *Contractor*.

Minutes of the Mill Maintenance Planning Meeting shall be kept by the *Service Manager*. The followings item should be discussed:

- Spares requirements
- Critical/rotatable spares availability
- Quality
- Evaluation of all short term plans
- Review all milling plant related load losses
- Review all milling plant related defects and problems
- Update and plan the mill *service* program (this include priority 3 & 4) to ensure that short and long term maintenance strategies and spares requirements are met.
- Plant availability and reliability
- Review of the previous weeks Key Performance Indicators

Minutes of the weekly planning meeting shall be kept by Eskom (Duvha Power Station).

2.5.1.3 Quality

Eskom requires an effective and proper implemented quality management system in accordance with ISO9001:2008. If the company in question does not have a quality management system in accordance to ISO9001:2008, proof is required in terms of how a quality management system is implemented managed and implemented, in other words how are quality control plans , non – conformance reports and other quality related issues handled and managed.

The contractor is required to provide artisan training for the dismantling and assembly of mill drive motor plain type bearings (white metal). Prove of such training to be submitted to Eskom.

The contractor is required to provide artisan training for the alignment of the mill drive motor to the mill drive gearbox. Prove of such training to be submitted to Eskom.

The contractor is required to provide artisan training for the alignment of the seal air fan train (bearing alignment, shaft alignment, motor alignment, levelling and more) . Prove of such training to be submitted to Eskom.

2.5.1.4 Safety

The contractor is responsible for compiling and submitting the required Safety File to the Risk and Assurance Department for approval before work can commence.

All personnel employed by the Contractor shall be subject to Eskom Life Saving Rules and Eskom Safety Regulations and Requirements.

3 Health & Safety, the Environment and Quality Assurance

The *Contractor* shall be accredited as ISO compliant for both Quality and Environmental Management and shall maintain this accreditation throughout the *service* period.

3.1 Provision of suitably skilled persons

The *Contractor* shall:

- Provide the *service* in accordance with the latest revision of the Employer's document, QM-58 Supplier contract requirement specification.
- Implement a skills quality management system designed to ensure the provision of adequately skilled, experienced and qualified persons, whether employed on a permanent or temporary basis, to carry out work in this contract.

The skills quality management system shall be designed to provide at any time at least the following particulars:

- Detailed skills, experience and qualification documentation for each staff member employed or to be employed for work in this contract.

The *Contractor* allows the *Service Manager* to inspect at any time within working hours the details and records within the skills quality management system

3.2 Specifications for Workmanship

The *Contractor's* business management systems shall include a Quality Plan designed to ensure quality assurance and control of the *services* carried out for this contract. The *Contractor* shall submit the Quality Plan to the *Service Manager* for his acceptance.

Any further quality assurance requirements and associated control documentation (the Process Quality Plan) specific to a Task Order shall be provided by the *Contractor* to the *Service Manager* for his acceptance before work commences on the Task Order.

The Process Quality Plan (PQP) for each Task Order shall demonstrate that the *Contractor* has or will make as a minimum provision for:

- Technical and quality input from the *Contractor* in sufficient detail specific to the Affected Property and Equipment used.
- Reference to all applicable procedures which procedures shall be available at the site of the work,
- Hold and witness points and provision for other appropriate sign off.

The PQP shall be completed and updated during the course of the work to demonstrate that all hold and witness points have been respected.

3.3 Authorisations

The *Contractor* shall ensure that adequate (minimum of three personnel) representatives are authorised as Responsible Persons in the milling plant area units 1 – 6 within the two months following contract award in terms of Eskom Plant Safety Regulations. All maintenance activities performed on Duvha Power Station shall be in accordance to Eskom Plant Safety Regulations.

The successful contractor is to ensure that within a time period of 6 months, after awarding of the contract, the Senior Supervisor, all Supervisors and all Artisans (fitters, boiler makers, and welders) to obtain RP (Responsible Persons Authorisation).

4 Tools and Equipment

All equipment inclusive of special tools, consumables and lifting equipment required by the *Contractor* to provide the *service* shall be provided by the *Contractor*. The *Contractor* is to provide a list of the equipment required together with a price list per item.

The Employer shall supply a tractor and trailer to transport mill grinding rings, grinding balls, spiders, mill drive gearboxes and mill drive motors as required. A 25 and 80 ton mobile crane will be provided to disassemble and assemble the pulverised fuel mills as required. The Employer shall also supply the forklift for workshop purposes, however the operation (Driver and Maintenance) of the forklift shall remain the responsibility of the Contractor.

Arrangement for the mentioned equipment must be made at least three (3) days prior to the required date. No extension of time and /or claim for standing time will be granted to the *Contractor* should the above mentioned equipment not be available. Table below illustrate the consumables required for execution of task activities

Tools and equipment to be in good working order. It is required that all electrical equipment, lifting equipment and any support trestles be listed on a Preventative Maintenance Schedule.

NUMBERS	DESCRIPTION
CONSUMABLE BREAKDOWN	
1	Workshop work benches.
2	Chain block 3 ton.
3	Welding Rectifiers 380 volt.
4	Lead lights 220 volts.
5	Lead light extension cables 220 volts (30 meter each)
6	Welding machines and hot boxes including oven for heating/ baking welding rods.
7	Hydraulic jacks and bearing puller
8	All fitting tools to be supplied by the contractor. (Artisans supply their own tools).
9	All boiler-making tools to be supplied by the contractor. (Artisans supply their own tools).
10	All welding tools to be supplied by the contractor. (Artisans supply their own tools).
11	Portable disc grinding machines.
12	Portable disc sanding machines.
13	Portable electric drilling machines.
14	Drill bits.
15	Screw thread cutting taps and dies inclusive of die nut sets.
16	Special measuring tools, clock gauges, vernier callipers, micrometers, torque wrenches, torque multipliers, socket spanners etc. to be supplied by the contractor.
17	Computers and a Planning / Scheduling Package.
18	Forklift (Dry-rate)

4.2 Resources

Resources required: Five (5) Teams each consisting of personnel as illustrated in Table .

Resources	Quantity	Qualifications
Site Manager	1	<p>National Diploma or N6. Trade Test Certificate or approved Red Seal Certificate (certified copies). Experience in welding, boiler making and fitting.</p> <p>Responsibilities:</p> <ul style="list-style-type: none"> Controlling daily work – plan activities. Supervising staff. Implementation of plant safety programmes. Verifying that information on defects, work orders and notifications are correct Ensuring that all machinery and equipment is correctly maintained. Maintaining staff authorisations on plant as per legislative requirements. Enforcing Permit to Work System. Managing section budget according to PFMA. Manage section Maintenance Priorities. Including all plant administrative work (timesheets, contract assessments, daily work progress updates plant problems, issue investigations, root cause analysis and resolutions. <p>At least 7-10 years proven milling plant maintenance experience.</p>
Supervisor	5	<p>N4 to N6. Trade Test Certificate or approved Red Seal Certificate (certified copies). Experience in welding, boiler making and fitting.</p> <p>At least 5 years proven milling plant maintenance experience.</p>
Quality Inspector	2	<p>National Diploma in Mechanical Engineering/N4 to N6.Experience in welding, boiler making and fitting. (certified copies).</p> <p>At least a qualification in Quality Management Systems ISO 9001</p> <p>At least 5 years proven milling plant maintenance experience. (certified copies).</p>
Safety Officer	2	<p>SAMTRAC 3-4 years' experience, or alternatively NEBOSH 2 years' experience. (certified copies).</p>
Mechanical Fitter	10	<p>Fitters employed by the Contractor shall be qualified and be able to submit proof of such qualification. Trade Test Certificate or</p>

		approved Red Seal Certificate (certified copies).
Boiler Makers	10	Boiler Makers employed by the Contractor shall be qualified and be able to submit proof of such qualification. Trade Test Certificate or approved Red Seal Certificate (certified copies).
Welders	10	At least Welder qualification 9606. Trade Test Certificate or approved Red Seal Certificate (certified copies).
Riggers	3	Riggers employed by the Contractor shall be qualified and be able to submit proof of such qualification. Trade Test Certificate or approved Red Seal Certificate. (certified copies).
Tacklers	10	Grade 10 Basic Rigging Skills qualification (certified copies).
Assistants	30	Grade 10 (certified copies).
Planner	1	N4 to N6. Trade Test Certificate or approved Red Seal Certificate (certified copies). Experience in maintenance , welding, boiler making and fitting.

5 Scaffolding

All scaffolding will be provided by Eskom (Duvha Power Station). Scaffolding requirements will be planned **for and discussed during each daily activity planning meeting**. Arrangement for scaffolding must be made at least one (1) days prior to the required date.

6 Spares

The procurement and the holding of spares shall be the responsibility of Eskom (Duvha Power Station) for the duration of the contract.

All spares procured by the Employer shall be quality controlled by Eskom (Duvha Power Station) and the *Contractor* before such spares are used.

The Contractor shall check and provide the necessary input for the compilation of scope of work that will be done by a specialist contractor.

All spares to be ordered as scheduled, the Contractor shall attend a joint planning session on a weekly basis with Eskom (Duvha Power Station).

7 Performance incentives

7.1 Performance measurement

The *Contractor's* performance shall be measured against the Key Performance Indicators (KPI's) in line with principles set in Appendix 10. The KPI's may be adjusted at the start of a new Financial Year of Duvha Power Station.

The *Service Manager* and the *Contractor* shall record and sign off the KPI's achieved at each power station every month.

Final Reviews of the compact will be done during April of each year for the preceding financial year by the *Service Manager* and the *Contractor*. The final results will be signed off by the *Service Manager* and *Contractor*.

At the end of each financial year the weighted composite average of the KPI results is calculated into a percentage over or under target. This percentage is applied to the annual turnover of the *Contractor* to give a bonus or penalty payable to or by the *Contractor*.

This is illustrated in table A below:

Floor	Kick-in	Target	Stretch	Ceiling
1	2	3	4	5
- 4%	- 1.5%	0%	1.5%	4.0%

Table A

7.2 Performance incentive

An amount (the performance incentive) is either paid to or paid by the *Contractor* before end of May each year based on the Key Performance Indicators (KPI's) calculations. In event that the *Contractor* is required to pay an amount to the Employer, the amount will be deducted from the Retention amount. The remaining amount will be paid back to the *Contractor*.

7.3 Typical KPI's

- UCLF (Milling Plant)
- Availability (Mills)

8 Boundaries for the provision of the services

8.1 Unit 1 – 4 (12.9E type Babcock Mills) – Mill A to F

8.1.1 Primary air & Tempering air System

From primary and tempering air dampers to mill including:

- All primary and tempering air damper manhole doors

- All primary and tempering air damper blades, bearings, arms, ball joints and linkages, motors and actuators
- All quick close and maintenance damper manhole doors
- All quick close and maintenance air damper blades, bearings, arms, ball joints and linkages motors and actuators
- All maintenance damper drive units
- All primary air ductings and inspection doors
- All primary air compensators
- All primary air ducting supports
- All PA ring line

8.1.2 Mill Internals & Externals

From mill PA inlet to mill PF outlet including:

- Mill body/casing
- Rings
- Yoke/Table
- Balls
- Segmented/rotating throat and ledge covers
- Complete classifier assembly
- Reject/plenum chamber
- Liners
- Springs

8.1.3 PF Piping & Ducts

All ducts from mill outlet turret to mill distribution box and pipe work from mill distribution outlet to burner's inlet. This includes the following:

- Mill outlet turret
- Mill discharge ducting
- All ducting compensators
- Distribution boxes including damper linkages, bearings, motor, actuator and covers
- All pipe work couplings
- All pipe work supports (Inspection and repairs)
- PF pipes
- All ducting supports (Inspection and repairs)

8.1.4 Raw Coal

This is from coal gate to raw coal pipe inlet to the mill including the following:

- Coal gate assembly (gate, gears, chain, wheel, motor and actuator)
- Feeder inlet chute
- Complete feeder assembly with all drive mechanism
- Feeder outlet chute/square to round
- Raw coal pipes (all sections)
- Raw coal pipe compensator

8.1.5 Gas Loading System

This is from gas loading cabinet to air bag system including:

- Complete cabinet assembly
- Pipes
- Valves
- Air bag assembly with dust & boot seal
- Extension stubs
- Gas bottle

8.1.6 Reject system

This is from sluice pump discharge line to the reject line inside the ash hopper including:

- Pipes
- Flanges
- Couplings
- Pump
- Valves
- Handle
- Complete reject box assembly
- Reject inner door
- Complete water seal system

8.1.7 Mill Drive System

This include the following

- Motor (bearing oil, DE & NDE bearing)
- Gearbox
- Complete gearbox lubes oil system (pipes, valves, pump, motor, coupling, cooling water and gearbox oil)

8.1.8 Seal air system

This includes the following:

- Pipes
- Compensators
- Valve
- Motor
- Actuator
- Link
- Rod
- Damper
- Bearings

8.2 Unit 5 – 6 (26 – 30D type Loesche mills) – Mill A to F

8.2.1 Primary Air & Tempering Air System

From primary and tempering air dampers to mill including:

- All primary and tempering air damper manhole doors

- All primary and tempering air damper blades, bearings, arms, ball joints and linkages, motors and actuators
- All quick close and maintenance damper manhole doors
- All quick close and maintenance air damper blades, bearings, arms, ball joints and linkages motors and actuators
- All maintenance damper drive units
- All primary air ductings and inspection doors
- All primary air compensators
- All primary air ducting supports
- All PA ring line

8.2.2 Mill Internals & Externals

From mill PA inlet to mill PF outlet including:

- Mill body/casing
- Rocker arm
- Yoke/Table
- Roller
- Throat
- Complete classifier assembly
- Reject/plenum chamber
- Liners
- Stand

8.2.3 PF Piping & Ducts

All ducts from mill outlet turret to mill distribution box and pipe work from mill distribution outlet to burner's inlet. This includes the following:

- Mill outlet turret
- Mill discharge ducting
- All ducting compensators
- Distribution boxes including damper linkages, bearings, motor, actuator and covers
- All pipe work couplings
- All pipe work supports PF pipes
- All ducting supports

8.2.4 Hydraulic System

From reservoir (outlet) to cylinder back to the reservoir (inlet) including:

- Pump
- Valves and solenoids
- Manifold block
- Oil cooler
- Breathers and filters
- Steel and flexible pipes
- Accumulators

- Cylinders
- Pressure relief valves
- Boot seals
-

8.2.5 Reject System

This is from sluice pump discharge line to the reject line inside the ash hopper including:

- Pipes
- Flanges
- Couplings
- Pump
- Valves
- Handle
- Complete reject box assembly
- Reject inner door
- Complete water seal system

8.2.6 Mill Drive System

This includes the following:

- Motor (bearing oil, DE & NDE bearing)
- Gearbox
- Complete gearbox lubes oil system (pipes, valves, pump, motor, coupling, cooling water and gearbox oil)

8.2.7 Seal Air System

From seal air fan to mill including:

- Pipes and compensator
- Runners
- Filters
- Coupling
- Bearings

8.2.8 Raw Coal System

This is from coal gate to raw coal pipe inlet to the mill including the following:

- Coal gate assembly (gate, gears, chain, wheel, motor and actuator)
- Feeder inlet chute
- Complete feeder assembly with all drive mechanism
- Feeder outlet chute/square to round
- Raw coal pipes (all sections)
- Raw coal pipe compensator

9 Exclusions

9.1 Electrical

All electrical refurbishment is carried out by the ***Employer.***

Including the Following:

- Connecting and disconnecting of cables
- Repairs to motors and heaters
- Repairs to lighting
- Tidying of cables

9.2 Control & Instrumentation

All Control and Instrumentation refurbishment is carried out by the ***Employer.***

Including repairs to all field devices but not limited to:

- Pressure switches
- Flow switches
- Level switches
- Level detectors
- Position feedback monitors
- Temperature transmitters
- Pressure transmitters

10 List of Appendices

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Appendix 2: BABCOCK & WILCOX MILLS – SPECIFICATIONS

Appendix 3: LOESCHE 26-30D MILLS – SPECIFICATIONS

Appendix 4: BABCOCK & WILCOX MILLS - RING CHANGE “C” SERVICE

Appendix 5: BABCOCK & WILCOX MILLS - BALL CHANGE (“A, B & C” SERVICES)

Appendix 6: BABCOCK & WILCOX MILLS – INSPECTION

Appendix 7: LOESCHE MILLS - HYDRAULIC CYLINDER REPLACEMENT

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Appendix 9: LOESCHE MILLS – INSPECTION

Appendix 10: LOESCHE MILLS – REFURBISHMENT

Appendix 11: LOESCHE MILLS – SEAL AIR FANS

Appendix 12: KEY PERFORMANCE INDICATORS

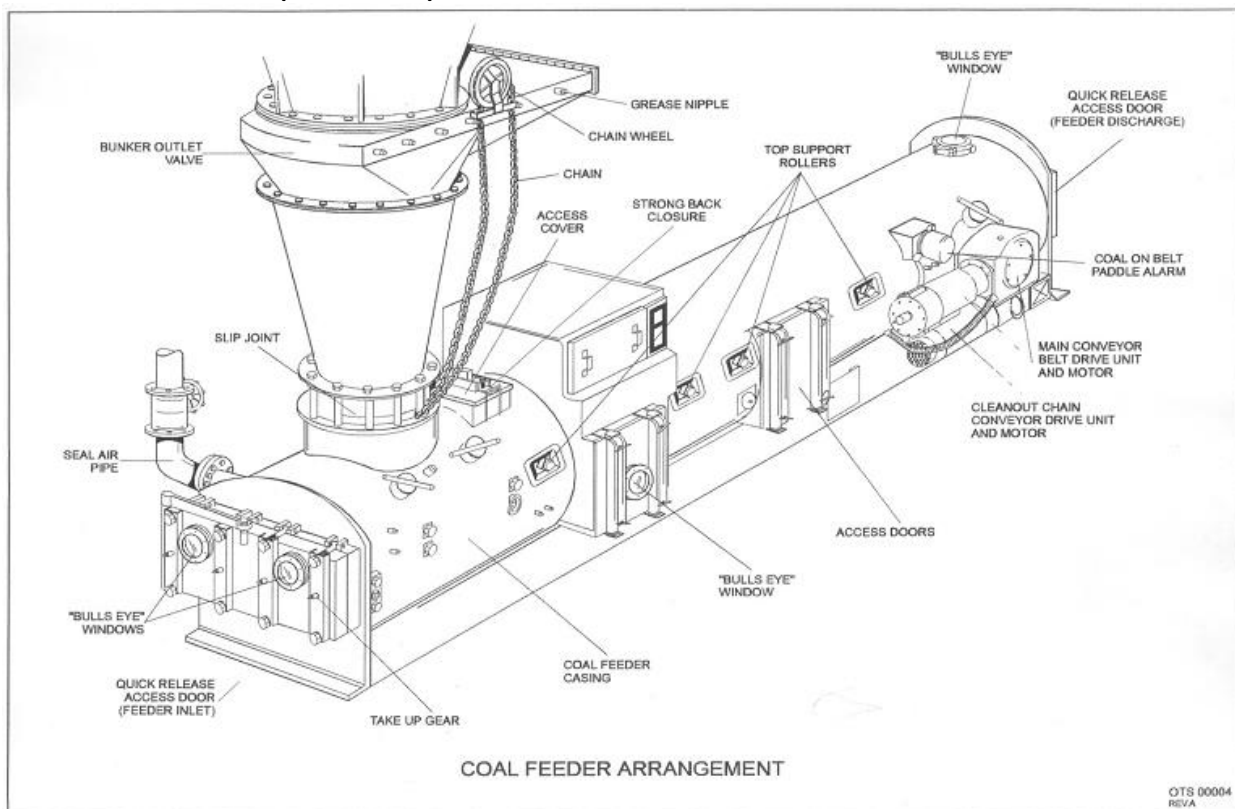
Appendix13: SERVICES REQUIRED

APPENDIX 01: MILLING PLANT COAL FEEDERS

The coal mill is served by a volumetric coal feeder located at the 16 m level directly above the relevant coal mill.

The purpose of the coal feeder is to deliver the correct amount of coal so that there is always the required fuel/air ratio leaving the mill. The correct air/fuel ratio is important as too much coal and too little air can result in damage to the equipment, due to blockages and ensuing fire hazards. Too little coal for the amount of primary air (PA) could cause the fuel /air ratio to enter the explosive range in the mill and pulverised fuel (PF) pipe work causing spontaneous combustion conditions.

Volumetric feeder (Units 1 to 6)



The coal feeder comprises a main belt conveyor and a clean out chain conveyor housed in a cylindrical steel tube, each conveyor having its own drive unit. Quick release access doors and covers are provided at either end of the feeder for inspection and maintenance purposes.

At the inlet end of the feeders is a seal air pipe which pressurises the feeder and stops the PF from blowing out of the coal mill, up to the feeder casing.

The main conveyor belt drive comprises a General Electric 3HP COL 186AY DC Motor capable of 1750 to 427 RPM and the reduction gear unit which is connected to the head pulley and is mounted on the right hand

side of the feeder. A similar drive unit for the clean out conveyor comprises an electric motor 0.198kW AC K56C running at 1425rpm and a double reduction gear unit is mounted below the main conveyor belt at the coal feeder outlet. The AC driven clean out conveyor motor also provides cooling air for the DC driven main conveyor belt motor.

Coal is gravity fed from the coal bunker through the bunker outlet gate and down to the feeder coal inlet chute onto the coal conveyor belt. The coal is entrained on the belt by side skirts.

The levelling bar ensures that a constant height of coal sits on the belt after the bar. The belt is supported at the coal inlet chute by a support pan and rollers fitted at intervals to support the weight of the coal on the belt. The take-up gear, fitted at the inlet end of the coal feeder works in conjunction with the tension roller in the centre section to maintain the required tension in the belt. The tension roller indicators are provided on both sides of the coal feeder.

To increase or reduce the volume of coal between 75700 kg/hr maximum and 30280 kg/hr minimum through the feeder, the motor speed is controlled via a VSD between 1500 and 600 rpm as PA flow demand dictates.

The mill feeder is fitted with the following feeder faults alarms:

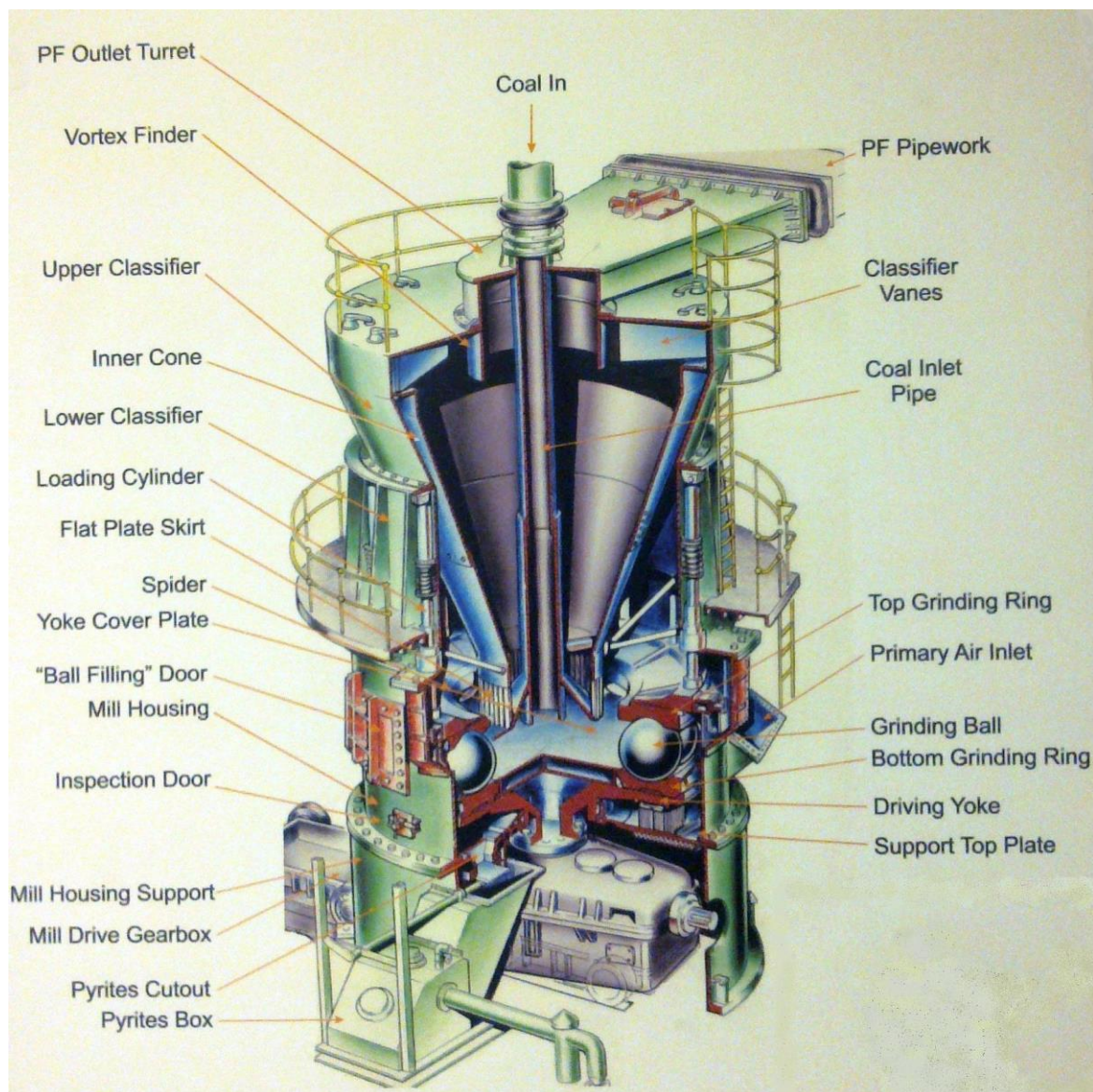
- No coal on belt
- Feeder blocked chute
- Motor phase fault
- Feeder motor temperature >139°C
- Feeder clean out conveyor off.

Two paddle arms are fitted to the coal feeder, one at the top of the outlet section to provide “no coal on belt” alarm and a second paddle located at the feeder outlet to provide “feeder blocked chute” alarm.

The clean out chain conveyor is located in the bottom of the feeder casing and is used to remove any accumulated particles of the coal which fall from the main belt conveyor.

APPENDIX 02: BABCOCK-WILCOX MILLS

The Babcock 12.9 E coal mill is described as a vertical spindle, low speed type "E" pressurised ball mill. The 12.9 denotes the centre to centre measurements of 129 inches of the bottom and the top grinding ring track. Within the Babcock direct fired pulverised fuel system there is a "Stock" coal feeder and an "E" type coal mill which is served with sealing air and primary air. Raw coal is delivered from the coal bunkers to the coal feeder which regulates the quantity of raw coal supplied to the coal mill. The flow of raw coal enters the coal mill via the coal inlet pipe from where it falls onto the yoke cover plate. Pulverised fuel is the product of the raw coal being ground in the coal mill and PF pipe work mounted on the top of the coal mill conveys the aerated PF to the boiler PF burners.



1. Babcock 12.9E type coal mill

The Babcock 12.9 E coal mill is described as a vertical spindle, low speed type "E" pressurised ball mill. The 12.9 denotes the centre to centre measurements of 129 inches of the bottom and the top grinding ring track. Within the Babcock direct fired pulverised fuel system there is a "Stock" coal feeder and an "E" type coal mill which is served with sealing air and primary air. Raw coal is delivered from the coal bunkers to the coal feeder which regulates the quantity of raw coal supplied to the coal mill. The flow of raw coal enters the coal mill via the coal inlet pipe from where it falls onto the yoke cover plate. Pulverised fuel is the product of the raw coal being ground in the coal mill and PF pipe work mounted on the top of the coal mill conveys the aerated PF to the boiler PF burners.

The mill crushes raw coal into a fine powder known as PF using grinding balls entrained and rotating between a top and bottom grinding ring. The coal is delivered from the coal feeder down the mill coal inlet pipe onto the yoke cover plate. The coal gravitates outward and falls into the track of the rotating bottom grinding ring where the ten grinding balls grind the coal to dust (PF). The drive for the bottom ring rotation is transmitted through the yoke which is mounted on the output flange of the triple reduction gearbox. During mill operation the top grinding ring is prevented from rotating by four vertical keys fitted to the spider and aligned with four keyways fitted to the mill housing. The keys prevent rotation but allow the grinding ring to rise and fall as the grinding balls pass over harder pieces of material in the grinding track. To maximise the grinding efficiency, ten loading cylinders push down on the spider which exerts downward force on the grinding balls.

2. Mill housing and internals

Each 12.9E coal mill can, for descriptive purposes, be divided into four levels; the first level is the mill housing support which is cylindrical in shape. Within the housing support is the mill drive gearbox and access to the gearbox is obtained through cut outs in the support housing. The mill housing support is mounted on its own steel foundation frame and the gearbox is mounted independently on its own foundation frame. Welded to the top of the mill housing support is the support top plate which has six wear plates bolted to it. One wear plate and the top plate have a cut out in them so that pyrite rejects fall through into the pyrites box.

The support top plate provides the base for the second level which is the mill housing; the mill housing is cylindrical in shape and is bolted to the support top plate. Mounted in the mill housing is the driving yoke, the bottom grinding ring, the grinding balls, the top grinding ring and the spider. Access to this area is through inspection doors and "ball filling" doors fitted to the mill housing. Two ducts welded to the mill housing supply the PA to the mill.

Level three is the PF classifier which comprises a lower cylindrical shell with a wide bottom flange which is bolted to the top of the mill housing. The bottom flange is also the mounting point for the ten loading cylinders of the pneumatic loading system (air bags).

Bolted to the top flange of the lower classifier is the upper classifier which is an inverted cone welded to a cylindrical top piece and within the top piece are the sixteen adjustable classifier vanes (level four). Mounted within the classifier outer casing is an inverted cone which is bolted to the upper classifier and braced from the lower classifier. At the bottom of the inverted cone is a flat plate skirt which acts as a return for coarse ground coal back to the grinding area.

The primary air enters the throat area via a plenum chamber of the mill by two primary air inlet ducts. The primary air passes through segmented/rotating throat area and drives the pulverised fuel from the grinding zone upwards into the classifier.

3. Pyrite rejects system

When the PF flows outward towards the mill housing, it is entrained by the PA and lifted upwards into the classifier. Heavy items such as pyrites, slates and tramp iron fall from the bottom ring and are moved around until they fall through the relief gate into the plenum chamber where they are swept into the reject hopper (in the event where the stationary segmented type throat are fitted). In the event of having the rotating nozzle type throat fitted all these "rejects" simply falls down through the vaned throat area into the plenum chamber area (hot gas pass) where removal is further the same as for the segmented type throat assembly.

The relief gate is fitted in the throat plate so that the gate swings open when a reject is carried around trapped in the annulus between the bottom grinding ring and the throat plate. When the rejected item strikes the reject gate, the gate swings open to allow the rejects to drop into the hot gas pass. After the object has dropped the reject gate swings back to assume its original position in line with the throat plate. The reject gate is swivelled back into position by the force exerted by the balance weight. When rejects are passed through the relief gate they fall into the hot gas pass. With each revolution of the yoke the two brushes ploughs sweep the rejects around the hot gas pass until the rejects fall into the pyrites box inlet and into the pyrites box.

The pyrites reject gate is a rack and pinion operated mechanism which is used to close off the inlet to the pyrites box. When the operators aide has to empty the pyrites box, he/she will first isolate the pyrites box from the hot gas pass by closing the pyrites reject gate. The operation is necessary to prevent the pyrites box continuous pressurisation by PA.

When the pyrites reject gate has been closed, only then can the external pyrites door be opened and the rejects withdrawn from the pyrites box (this only being necessary in the event of manual cleaning out of the pyrite box). To operate the pyrites reject gate the operator turns the pyrites reject gate shaft by a ratchet handle. The two pinions which are engaged with the two racks move the racks which are secured to the pyrites gate. The pyrites gate slides forward to cover the pyrites box inlet and two door braces under spring tension hold the pyrites gate firmly against the gate frame. After the operator has cleaned out the pyrites box, will turn the pyrites reject gate shaft in the opposite direction to open the pyrites reject gate.

Cooling water from the sluice pump system is supplied to the reject hopper for washing the inside of the inspection window and to the reject hopper water seal. Water at high pressure from the sluice pumps is supplied to the jet pulsion pumps. These pumps are installed underneath the reject chamber work on the same principle as the hydrovac nozzles, where a jet of water causes a partial vacuum. The rejects from the reject hopper are sucked into the pump and carried away by water. The steel screen in the bottom half of the hopper prevents large rejects entering and possibly choking the jet pulsion pump. The pump throughput is 90m³/hr. The mills run with the inner reject door open to allow the rejects to fall into the hopper. The reject hopper is subjected to the varying mill pressures. The water seal protects the rejects hopper from pressurising as it has a head of 1,58 metres. The vacuum valve also protects the reject hopper in case of the inner door closing or blockage occurs which would allow the jet pulsion pump to pull a vacuum in the reject chamber. There is an inspection window which enables operator inspection of the levels of rejects in the hoppers so as to empty the hoppers in time. The hopper checking should be done hourly. Under normal operation the mill reject hopper should take 4 to 8 hours to fill with pyrites.

4. Sealing air system

The seal air is tapped off from the tempering air duct before the tempering air regulating damper via an isolating damper. The seal air pressure is 13.5kPa and the temperature is $\pm 50^{\circ}\text{C}$. The seal air to the mill yoke stem to gearbox drive labyrinth seal is supplied through a seal air isolating damper. The seal air distribution is as follows;

- The mill yoke stem to gearbox drive shaft labyrinth gland seal is a seal air pressurised labyrinth gland surrounding the yoke stem. An air pressure differential is maintained between the PA and the seal air so that any leak of air will be seal air into the mill and not PA and PF out of the mill.
- The seal air to the feeder keeps the feeder under slight pressure and prevents PF from blowing out of the ball mill, up into the feeder casing. The seal air also helps in keeping the pulleys and bearings clean.
- Seal air is supplied to the relief gate shaft gland to prevent hot gas and PF entering the relief gate shaft seals which could impair the efficient operation of the relief gate.

5. Primary air supply

Hot air for coal drying and PF transportation is supplied from the FD fan via the main boiler air heater. The hot air passes to a common hot air to mill main duct, and hence by individual ducts to each mill PA inlet. The pressure of the hot air being increased as it passes through the PA fan, sufficiently to overcome the mill and piping resistance. To control the mill outlet temperature, in instances of low mill output or low moisture fuel conditions, tempering air is taken from a tapping at the PA fan discharge, before the main boiler air heater, to a common main duct, from which tempering air to each mill PA inlet duct is taken.

The primary air is supplied from the primary air duct at a temperature of 190-300°C depending on load and a pressure of 12.5 kPa. The air is mixed with cold air from the cold tempering air duct and is controlled by the mill outlet temperature which is set between 95 and 105°C.

A venturi flow measuring device measures the flow of air to the mill. The flow measurement is then used to control the air flow to the mill and forms the set point for the coal feeder and determines the ratio of air to fuel which also depends on the load and is between 2,75:1 and 1,6:1 respectively for full load.

The fuel air mixture passes through the outlet turret to the fuel distribution box via a fuel distribution box damper. The pressure differential across the mill, which is the difference in pressure of the primary air inlet to the mill and the pressure at the mill outlet, indicates the mill loading.

The following motorised dampers are important to the safety of, operation and maintenance of the mill:

- The primary air damper and tempering air damper provide the required mixture of hot and cold air at the mill inlet to satisfy the desired value of the mill outlet temperature.
- The maintenance damper and PF distribution box damper are used to isolate the mill for maintenance.
- The quick closing damper is used for the emergency operation in the event of loss of ignition in the furnace, the damper will close rapidly thus preventing any further transport of PF into a dead but very hot furnace so preventing a possible explosion.

6. Mill classifier

The classifier consists of an inverted cone shaped structure mounted above the grinding elements. The mixture of PA and PF moves upwards between the classifier casing and the inner cone. Due to the throat/louver ring vanes being at an angle, the PA/PF mixture has an angular momentum and therefore spiral upwards, flowing through an extended path on its way from the grinding elements to the classifier. Since the angular momentum tends to expand the flow of the mixture, a certain percentage of the coarser particles drops back onto the grinding table and thus reduces the load on the classifier.

Upon reaching the entrance of the classifier blade chamber, the flow of dust and air is deflected by the classifier vanes. Pivoted vanes are arranged equidistantly around the upper end of the cone. The angular setting of these vanes is adjustable in order to adjust the speed and direction of the coal/air mixture and thus the degree of fineness of the final product. Particle size is affected by the intensity of the cyclonic effect induced into the flow of the primary air and the PF (PA/PF) mixture flowing up into the classifier. Coarse particles of coal weigh heavier than the fine particles and these coarse particles are entrained radially through centrifugal force until they strike the inside of the inner cone.

The coarse particles flow down the inside of the inner cone until they come to rest against the return flat plate skirt. As the weight of the coarse particles increases against the return flat plate skirt, the plates of the flat skirt swing outwards allowing the coarse particles to flow down onto the grinding area. The coarse grains are ground finer and are again entrained in the PA/PF mixture flow to the classifiers. During operation, the design of the return flat plate skirt prevents the PA/PF mixture from bypassing the intended route of the PA/PF mixture through the classifier vanes by resting between the inner cone and a Chinese hat that is attached to the coal inlet pipe. Fine particles of the coal flow to the centre of the created vortex and flow upwards through the vortex finder into the PF outlet turret.

7. PF system

PF is graded in the classifier and if the PF is fine enough it passes through the vortex finder into the PF outlet turret. In appearance the turret resembles a top hat with a cylindrical section, and the PF pipe of a rectangular section is attached horizontally to the turret. The raw coal inlet pipe is attached to and passes through the top of the cylindrical section. From the rectangular section of the PF outlet duct, the PA/PF mixture passes to the distribution box from where it is separated into four PF pipes which are routed to the four pulverised fuel burners. A motorised damper is installed between the two stages of the distribution box, this damper serving to isolate the mill from the boiler during mill maintenance.

The PF Burner is required to achieve complete combustion of the coal for efficiency and economic reasons. To achieve this uniform distribution of fuel and air during the entire range of boiler loading is required. A distribution box or riffle is a device designed to divide a flow of material in one duct into a pre-determined number of separate flows of equal proportions. The separation is achieved by dividing the cross section of the duct at the riffle inlet into elemental slots. The length of each slot being the full width of the duct. The outlet flows from selected groupings of these slots are then combined and directed to one particular outlet path. Thus each outlet path is provided with a composite sample of the material entering the riffle. The Duvha riffles are composite two stage type in which the flow is first divided into two in the primary riffles, and then each half sub divided into two flows in the secondary riffles. The maximum permissible deviation from the design flow to each burner has been set by the boiler manufacturers at about 10%. Even if the primary air flow to the burners were perfectly divided, this tolerance on coal flow would allow significant differences in combustion conditions from burner to burner.

The PF pipes are of varying lengths and require an orifice in each pipe to ensure equal flow of PF/PA mixture to each burner. The velocity of the correct ratio of PF/PA mixture in the PF pipes should not be less than 18 m/s as flows below this velocity will cause the PF particles to fall out and block the PF pipes.

8. Mill drive system

8.1.1 Mill motor

The electrical motor is of the induction type, (MKT-WH), output power of 683 kW and input speed of 970 RPM built by Mitsubishi induction motors. The motor is of totally enclosed type with air to air heat exchanger cooling. The two bearings are of the self-lubricating type using carrier oil throwing rings to lubricate the bearings from an oil sump as an integral part of the motor bearing housing. The motor has a temperature rise limit of 80°C. Output drive from the motor to the gearbox is through a Wellman Bibby flexible coupling. The NDE and DE motor bearings are fitted with temperature indicators and an alarm is initiated when the temperature exceeds 75°C and trip initiated when temperatures reach 85°C.

8.1.2 Mill gearbox

The mill gearbox is a triple reduction gearbox, output speed of 26.7 RPM built by David Brown Gear Industries and is fitted under the mill on all units and supports the weight of the grinding table. The gearbox is driven by a type MKT-WH electric motor through a Wellman Bibby flexible coupling, horizontally mounted. The rotation of the shaft is clockwise when viewed from the motor side and the output shaft is also clockwise when view from the above

The lubrication for the gearbox is provided by an external unit which forces oil under pressure through spray nozzles to the various gears and bearings in the unit. There are sight glasses on the side of the gearbox housing to indicate the working oil level for the main body and thrust bearing. The system has an operational pressure of 110 kPa and an operating temperature of between 50-70°C. The gearbox casing acts as an oil sump and has a filter point and dip stick in the output shaft end of the casing.

At the output end of the gearbox casing are two dust proof oil breather vents and a grease nipple to feed the output shaft labyrinth seal. At the input shaft end is the oil seal cover and grease nipple fitted to the cover to provide lubrication to the bevel pinion and shaft.

8.1.3 Mill gearbox lube oil system

The oil is circulated by a David Brown 'Roloid' Gear Pump 4H directly connected to a three phase induction motor by a flexible gear coupling, drawing the oil from the sump to the gearbox. The filter is a dual basket 10 micron gauze filter and requires no bypass as the filter can be changed over whilst cleaning is carried out. The oil flows from the filter to the gearbox distribution system. The oil cooler is a cast iron cylinder containing aluminium brass tubes through which the cooling water flows. The oil enters at the top of the unit and is directed over the tubes by a series of baffles leaving the unit at the bottom. The cooling water is supplied from the boiler auxiliary coolant system entering at the top of the cooler, and then makes a double pass through the cooler before leaving at the branch at the top of the cooler. The cooling water flow is regulated by means of valves on the inlet and outlet pipes. A pressure gauge is mounted on the pipeline between the oil pump and the filter indicating the oil pressure before the filter. Under normal conditions the oil

pressure should not differ by more than 100 kPa if this pressure is compared with that at the cooler outlet.

The blockage across the filter is indicated by high differential pressure across the filter (Maximum = 150 kPa). The temperature of the oil leaving the oil cooler is monitored as high temperatures will cause overheating in the gearbox.

9. Babcock mill technical data

MILL	
Type	12,9E Coal Mill
Manufacturer	Babcock (Africa)
Overall Height	7.852 mm
GRINDING BALLS	
Number of Grinding Balls	10
Nominal Outside Diameter	985 mm
Minimum Ball Diameter	840 mm
"Fill In"Ball Diameter (ball 11)	920 mm
Weight of 985 mm Diameter (each)	2.350 T
GRINDING RINGS	
Number of Grinding Rings	2
Weight (each)	14 T
YOKE	
Outside Diameter	4240 mm
Height Overall	844.5 mm
Weight (estimated)	28 T
FLAT YOKE COVER PLATE	
Outside diameter	2500 mm
Height	286 mm

Weight (estimated)	1.25 T
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SPIDER	
Height	464 mm
Weight (estimated)	12,1 T
PNEUMATIC LOADING SYSTEM	
Manufacturer	Lockhyd Industrial Hydraulics (Pty) Ltd
Number of loading Cylinders	10
Airbag Operating Pressures:	
Ball size 985mm – 920mm	1600 kPa
Ball size 920mm – 880mm	1800 kPa
Ball size 880mm – 840mm	2000 kPa
Ball size	
MOTOR	
Mill Motor	Mitsubishi MKT-WH
Rated Power	683 kW
Motor Speed	970 RPM
Rated Voltage	3300 V
Rated Current	143 A
Insulation Class	F
Enclosure	Totally enclosed with air to air heat exchanger
Bearing Type	Sleeve with Oil Ring
Bearing Oil Spec.	BP Energol THB 46
Mill Motor Alarms:	Mill Motor NDE Bearing Temp >75°C ALARM
	Mill Motor NDE Bearing Temp >85°C Trip Motor
	Mill Motor DE Bearing Temp >75°C Alarm
	Mill Motor DE Bearing Temp >85°C Trip Motor

GEARBOX	
Type	Triple Reduction Bevel/Helical MK III
Gearbox Speed Output	26.7 RPM
Gearbox Suppliers	David Brown Gear Industries (Pty) Ltd
Power Transmitted	724 kW
Normal Running Oil pressure	108 kPa at Gearbox Entry
Low oil pressure motor trip	34 kPa at gearbox entry
Weight (empty)	35 T
MILL GEAR BOX LUBE OIL	
Pump	David Brown 'Roloid' Gear Pump 4H
Pump Speed	735 RPM
Pump Pressure	350 kPa
Pump Output	110 l/min
Oil Sump Temp	65-75 °C
Oil Sump Capacity	550 litres
Filter & Cooler Diff Pressure	Normal 100 kPa/ Maximum 150 kPa
Press Indicator Before Gearbox	110-140 kPa
Press Switch Before Gearbox	Alarm < 55 kPa/ Interlock > 80 kPa

Cooling water Flow	68.2 l/min at 40 °C
Gearbox Inlet Oil Temp	45-50 °C
Gearbox Outlet Oil Temp Ind Max	71 °C
Gearbox Outlet Oil Temp Ind Normal	50 °C
Oil Spec	BP Energol GR-XP 220
Oil Flow To Mill Gearbox	70 l/min minimum/110 l/min normal
Resistance Relief Valve	210 kPa
Filter Relief Valve	350 kPa
Regulator Relief Valve	140 kPa

VOLUMETRIC COAL FEEDER	
Manufacturer	Stock Equipment Company
Number	One per Coal Mill
Type	Volumetric Belt Feeder
Centre of Inlet to Centre of Outlet	3750 mm
Belt length, Pulley C/L to pulley C/L	3680 mm
Feeder Design Capacity	75,700 kg/hr Max and 30,280 kg/hr Min
Speed Control	Between 1500 and 600 RPM
Feeder Bar Profile	135 mm height
Mill Feeder Fault Alarms:	No Coal on Belt
	Feeder Blocked Chute
	Motor Phase Fault
	Feeder Motor Temperature > 130°C
	No Feeder Clean Out Conveyor

10. Mill operating philosophy.

Each boiler is equipped with 6 mills. It is a requirement to operate 5 mills for full unit load (600 MW). The remaining mill is either on standby or undergoing maintenance.

11. Criticality of milling plant.

The milling plant is responsible for the grinding and transportation of coal to the furnace to generate required MW. If the standby mill is not available and other mill fails due to a specific reason, the implication is that the remaining mills will not be possible to generate required MW and hence load losses will be experienced. For these reasons, the milling plant is considered to be a critical plant in the power station.

12. Mill maintenance philosophy

The current mill maintenance philosophy for the milling plant is one of condition based corrective maintenance. In other words items are replaced or repaired based on their condition. This type of maintenance regime relies on regular shutdown and inspection of the milling plant.

The life cycle (wear rate) of the grinding rings and grinding balls governs the maintenance philosophy. Basically each individual mill grinding element life cycle comprises of the following:

3 x set ball cycle

3 x 985mm ball cycles to a total of $\pm 10,500$ hours with ball changes at 3,500 hours intervals.

Complete mill refurbishment to enable operation (without component failures) to the filler ball intervention, minimum maintenance intervention time to increase 6 mill availability. Same for the 920 & 880mm ball size cycles.

New – 0 hours = Ring change is deemed to be a refurbishment activity, conduct complete overhaul and 10 x 985mm new balls.

Cycle 1 – 3,500 hours = Ball change, new 985mm down to 920mm.

Cycle 2 – 7,000 hours = Ball change, new 985mm down to 920mm.

Cycle 3 – 10,500 hours = Ball change, new 985mm down to 920mm.

Cycle 4 – 12,500 hours = Filler ball added, 920mm down to 880mm (11 x 920mm balls).

Cycle 5 – 14,000 hours = Ball change, 920mm down to 880mm.

Cycle 6 – 15,500 hours = Ball change, 920mm down to 880mm.

Cycle 7 – 17,000 hours = Ball change, 880mm down to 840mm (11 x 880mm balls).

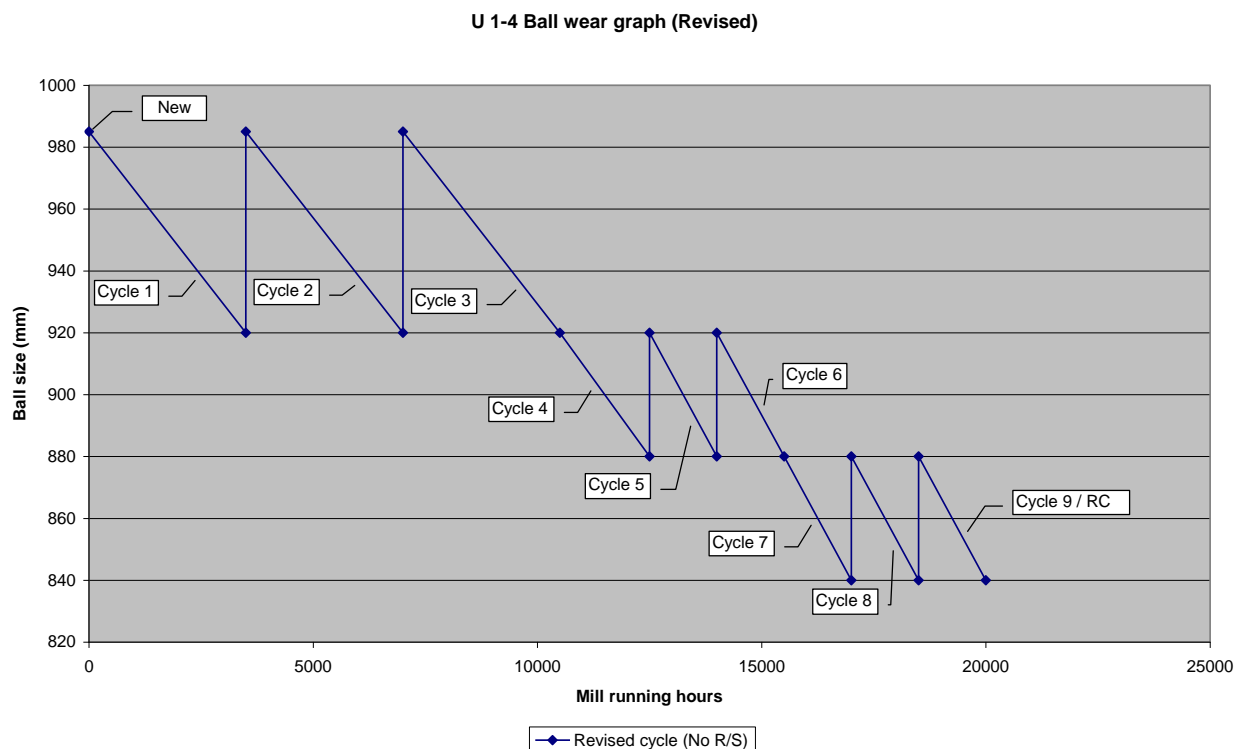
Cycle 8 – 18,500 hours = Ball change, 880mm down to 840mm.

Cycle 9 – 20,000 hours = Ball change, 880mm down to 840mm. Prepare for ring change.

NOTE: All cycles will require a short inspection to measure ball & ring depths to determine the exact time of the specific cycle intervention.

The life cycle of the grinding elements is 20 000 operating hours depending on the wear rate which is dictated by the quality of the coal, such as abrasiveness and hardgrove index.

The flow chart on the next page illustrates the maintenance activities from mill overhaul (grinding element replacement) to mill overhaul.



Appendix 3: LOESCHE 26-30D MILLS – SPECIFICATIONS

1. Primary air supply

Hot air for coal drying and PF transportation is supplied from the FD fan via the main boiler air heater. The hot air passes to a common hot air to mill main duct, and hence by individual ducts to each mill PA inlet. The pressure of the hot air being increased as it passes through the PA fan, sufficiently to overcome the mill and piping resistance. To control the mill outlet temperature, in instances of low mill output or low moisture fuel conditions, tempering air is taken from a tapping at the PA fan discharge, before the main boiler air heater, to a common main duct, from which tempering air to each mill PA inlet duct is taken.

The primary air is supplied from the primary air duct at a temperature of 190-300°C depending on load and a pressure of 12.5 kPa. The air is mixed with cold air from the cold tempering air duct and is controlled by the mill outlet temperature which is set between 95 and 105°C.

A venturi flow measuring device measures the flow of air to the mill. The flow measurement is then used to control the air flow to the mill and forms the set point for the coal feeder and determines the ratio of air to fuel which also depends on the load and is between 2,75:1 and 1,6:1 respectively for full load.

The fuel air mixture passes through the outlet turret to the fuel distribution box via a fuel distribution box damper. The pressure differential across the mill, which is the difference in pressure of the primary air inlet to the mill and the pressure at the mill outlet, indicates the mill loading.

The following motorised dampers are important to the safety of, operation and maintenance of the mill:

- The primary air damper and tempering air damper provide the required mixture of hot and cold air at the mill inlet to satisfy the desired value of the mill outlet temperature.
- The maintenance damper and PF distribution box damper are used to isolate the mill for maintenance.
- The quick closing damper is used for the emergency operation in the event of loss of ignition in the furnace, the damper will close rapidly thus preventing any further transport of PF into a dead but very hot furnace so preventing a possible explosion.

2. LM 26-30D coal mill

Each mill weighs approximately 200 tons complete and is capable of grinding 64 tons/hour. The starting of the mill is governed by a series of automatic interlocks which prevent damage to the mill components, and provides for safety of the mill operation. The size requirement of the raw coal fed to the mill, is determined by the mean diameter of the grinding tyre, which in the case of the LM26-30 D Mill is 5% of the mean tyre diameter or coal size of 85 mm maximum.

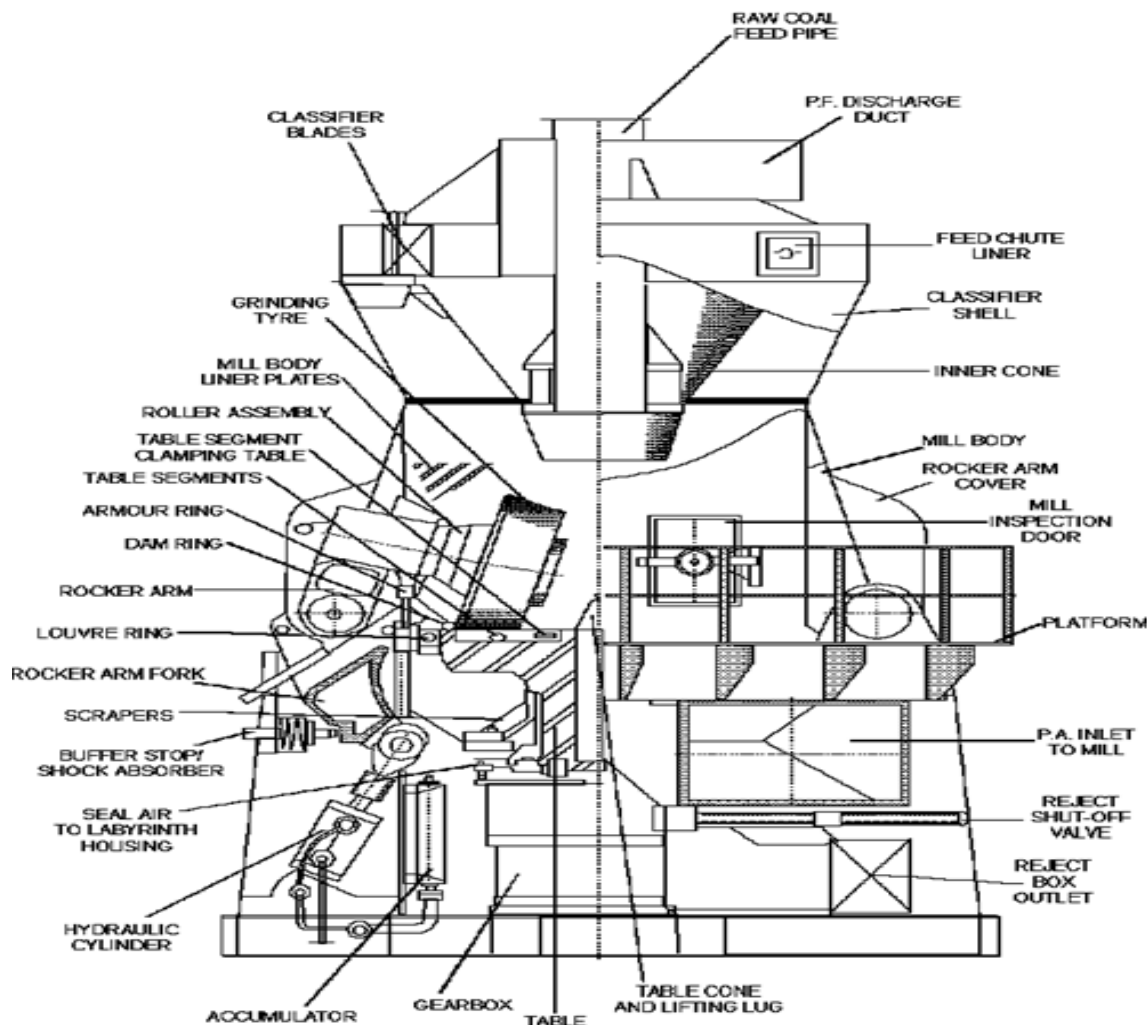


Figure 1 : Coal mill

3. Mill body, stand and foundation

The mill body is a conical housing of steel plate that is welded together. The function of the mill body is to enclose the grinding space and seal it off from the outside. In addition it serves to guide the dust/gas mixture between the table and the classifier.

The mill stand has two functions. It serves as a platform and support for the rocker arms and are load absorbing components, but it also serves to accommodate the ring canal which supplies primary air to the louver/throat ring which surrounds the grinding table. The mill stand consists of the foundation frame, the gearbox base plate, and the three stands, the three bridge pieces interconnecting the stands, then the ring canal and the gas canal, ending in two outlet chutes at the bottom to the reject discharge.

A cast steel bearing block with two bearing housings that locate the rocker arm shaft bearings, is welded to a metal box girder. This box shaped structure of the stand is re-enforced underneath the cast bearing block by means of a channel beam. This channel serves also as a support for the buffer stop of the rocker arm. The stands are also forming the enclosure within which the hydraulic cylinders are mounted.

The foundation frame is a steel joist construction mainly composed of broad flanged beams. The frame supports the pedestals as well as the mill gearbox via the gearbox base plate. The gearbox base plate is a machined metal plate. Its function is to support the mill gearbox as well as to connect it with the mill lower housing. The gearbox foot flange is firmly connected with the gearbox base plate via gearbox foot bolts. The mill housing support assembly is mounted on a concrete plinth which is supported on a series of springs and viscous dampers to reduce vibration. A sump is provided for access to visually inspect the damper assemblies. The mill sub foundation must be free of water accumulation at all times, as water and the sulphur in PF could create a corrosive mixture which would be detrimental to the springs and viscous dampers supporting the mill foundation.

4. Gas canal

The hot gas duct is situated inside the main structure of the stand and has a single entry flange for connection to the primary air ducting. The mild steel ducting distributes the primary air around the periphery of the mill through to the louver ring (mill throat). The duct gives a clear and large space to enable rejects to fall clear from the louver ring. Steel hinged scrapers connected to the grinding table sweep the duct on each rotation through to the reject chamber. The duct is steeply inclined to ensure the un-interrupted flow of unwanted material away from the gas passages.

The plenum chamber should be regarded as a continuation of the hot gas pipeline to the mill. It leads the (hot) gases to a ring-shaped channel port within the lower housing of the mill. The chamber is simultaneously equipped as a chute in its floor area via which foreign substances may be thrown out. On its lower surface the chute has a flange. Later on the slide gate for the pyrites chamber is screwed against this flange. A labyrinth seal for the table is installed below the plenum chamber.

5. Reject system

Non-combustible material e.g. tramp iron, pyrites and stones have a higher density than the pulverised coal and cannot be carried upwards by the air stream. They fall through the louver ring to plenum chamber. This non-combustible material is removed by two brush ploughs fastened to the underside of the grinding table and then discharged into the reject box through the reject gate.

Mill reject hoppers are attached to the mills to collect the rejected pyrites in the coal. A jet pulsion pump is fitted to the bottom outlet of the hopper to transport the rejects by hydraulic sluicing through piping into the boiler coarse ash hopper. These pumps installed underneath the reject chamber work on the same principle as the hydrovac nozzles, where a jet of water causes a partial vacuum to be formed. The rejects from the reject hopper are sucked into the pump and carried away by water. The through put of this pump is 90 m³/hr.

On the side of the hopper is the combined water seal and overflow. The water seal has a maximum head of 1.58 meters WG to prevent the water being blown out by the air pressure within the mill. A steel screen is placed horizontally across the inside lower part of the hopper to prevent occasional large rejects from choking the jet pulsion pump.

The reject hopper is provided with an air tight access door with an inspection window, an internal light fitting, a hopper level indicator and a vacuum release valve. Cooling water from the hopper cooling system is supplied to the reject hopper for washing the inside of the inspection window and to the reject hopper water seal. Water at high pressure from the sluice pumps is supplied to the jet pulsion pump.

Two reject gates are attached to the gas duct of the mill stand. The slide gates consist of a rigid steel housing with a labyrinth frame fitted on top. The slide operates in a gas tight casing and it is actuated by pneumatic cylinder. With the slide guided by round cogs it is virtually impossible for dust to accumulate and impede on its motion on travel. When in the close position the slide is lifted by wedge shaped blocks and it is forced against the labyrinth frame. The labyrinth reduces the gas pressure gradually from the mill so that any possible leakage of gas into the reject box is reduced to the minimum. The pneumatic cylinder is connected to the slide gate housing and the piston rod end is connected with a pipe. The pipe in turn ends as a hinged form which is connected to the slide gate housing. To eliminate transverse or shearing forces away from the seal, the push rod slides in two axial ball guides.

The mill runs with the inner reject door open to allow the rejects to fall into the hopper. Thus the reject hopper is subject to the varying pressures in the mill. The water seal protects the reject hopper from over pressurisation as it has a maximum head of 1,58 metres. The vacuum valve also protects the reject hopper in case of the inner reject door closing or a blockage occurs which would allow the jet pulsion pump to pull a vacuum in the reject chamber. The inspection window enables the operator to inspect the level of rejects in the hopper to timeously empty the hopper. The hopper should be checked hourly, it takes 6 to 8 hours to fill a hopper when the mill is operating at full load. It is important that the internal lamp which is of the totally enclosed 220 volt 15 Watt screw type (Pigmy) is always working.

6. Seal air fans

The seal air fans provide a supply of air to the roller arms and table labyrinth at a slightly higher pressure than the primary air in the mill. This prevents the ingress of pulverised fuel to the surrounding working area. The fans are positioned on the 16 m level in front of the coal feeders appropriate to each mill. They take their air supply from the area through a gauze filter in the air intake. There are two 790 mm diameter two stage fans per mill, driven by a double shafted electric motor positioned between them. The fan runners are single inlet backward bladed aerofoil types placed back to back on a common shaft to eliminate any large axial thrust. The first stage is ducted through the fan plinth to the inlet of the second stage. Duty one seal air fan provides seal air to the gearbox to the mill labyrinth seal at a pressure of 17.25 kPa and flow capacity of 3000 m³/hr. Duty two seal air fan provides seal air to the roller arm assemblies via a ring around the mill body at a

pressure of 15,0 kPa and flow capacity of 4000 m³ /hr. The motor is a 75 kW totally enclosed induction motor. Motor cooling is achieved by a fan mounted on the shaft at one end under a bell housing that forces air over the fluted casing of the motor. The motor and the fans are coupled by a flexible rubber coupling to take up any misalignment and to prevent vibration from either fan being transmitted to the other.

The seal air to mill feeder is tapped off from the tempering air duct before the tempering air regulating damper via an isolating damper. The seal air pressure is 13.5kPa and the temperature is $\pm 50^{\circ}\text{C}$. The seal air to the feeder keeps the feeder under slight pressure and prevents PF from blowing out of the ball mill, up into the feeder casing. The seal air also helps in keeping the pulleys and bearings clean.

7. Mill grinding elements (figure 3)

The grinding table is keyed and bolted to the output flange of the mill gearbox. The complete table assembly consists of the table casting, the grinding segments of wear resistant material, the clamping ring, dam ring liner, louver ring, armor ring and the reject scrapers. The grinding table rotates at 36 RPM. The louver and armor ring are fixed. The grinding table is fitted with eight grinding segments and is clamped down onto the table with a clamping ring.

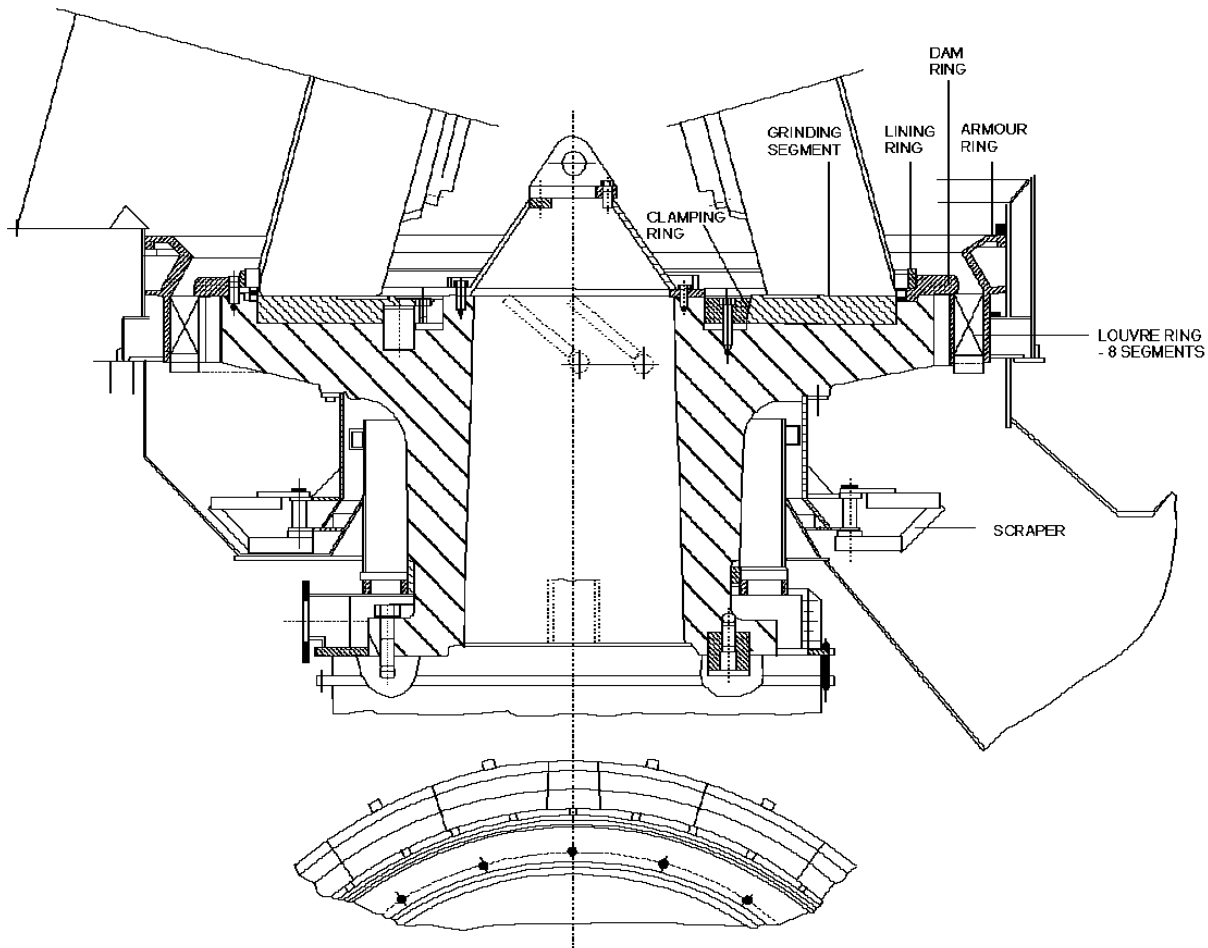


Figure 3 : Mill grinding elements

The table body has a horizontal surface, armoured with the grinding segments, which serves as the grinding path. The grinding forces generated by the rollers are passed through the table to the gearbox. Due to the mass of the table, and the chosen material of manufacture, a proportion of the dynamic forces created by the up and down movements of the rollers is absorbed by the table, (anvil effect). Thus only a portion of these forces is transmitted to the axial thrust bearing of the gearbox.

The dam ring is screwed onto the grinding table. The height of the dam ring determines the thickness of the layer of coal on the grinding table bed and is set at 115 mm. Since a high grinding bed results in increased energy consumption of the mill, without proportional increase of the grinding effect, the height of the dam ring should be kept as low as practically possible. However, a low dam ring retains less coal on the table, so that the larger quantity of coal flung off the table by centrifugal force imposes a larger load on the louver ring, this may result in rough running and rejecting.

Before a mill is commissioned, the height of the dam ring is calculated through experience suitable for its particular application. The various characteristics of the coal fed into the mill, such as the grind ability factor, particle size and moisture content may make it necessary to adjust the height of the dam ring, once the mill has been put into operation. After this initial adjustment the height of the dam ring will remain constant.

The segmented grinding track forms the lining of the mill and consists of wear resistant castings. Each segment has a smooth underside to guarantee at least 75% support on the table upper surface. The segments are positional located by dowel pins found in the mill table. The segments are clamped by the clamping pieces of the inner clamping ring and by weld-on clamping blocks on the outside. These outside clamping blocks are in turn welded to the inner ring of the throat assembly.

In the center on top of the table is a conical cover plate and a lifting lug. This protects the hollow shaft down the center of the table casting and also acts as a displacement cone for the coal directing it towards the grinding area under the rollers. Due to insufficient centrifugal force in the center of the mill, considerable amount of coal could build up without this cap.

Around the grinding table, fixed to the mill body is the louver ring. The louver ring is made up of eight segments. The purpose of the louver ring is to direct the primary air stream through the mill, and to allow non-combustible material to drop through for rejection. The velocity of the PA through the louver ring is of utmost importance. For every application the velocity is pre-set at a rate that theoretically allows a minimum amount of combustible material to drop through the louver ring against the stream of primary air flow.

The armor ring protects the mill body against abrasive accelerated wear through changes in the direction of primary air flow towards the center of the mill.

8. Roller assembly

The mill is equipped with three roller assemblies, each being fitted to its own rocker arm. Each roller consists basically of the roller hub, the sealing cover, the hub cover, the roller shaft, the roller bearings and the roller tire and the slip ring seal. The roller runs in a cylindrical roller bearing positioned in the rocker arm side of the roller hub and a self-aligning spherical roller bearing.

Each grinding roller/rocker arm is sealed off against atmosphere by a cover which forms part of the mill body. Clean sealing air with a pressure higher than the pressure inside the mill body is supplied into the rocker arm to the rear end of the roller. From there the velocity is accelerated in an aperture between ring and the opposing ring which is part of the rocker arm wear shield where penetration of dust is prevented.

Seal gas is supplied from the primary air duct prior to entering the mill body. The seal gas is fed into a seal gas chamber around the mill body at a pressure of 8.98 kPa and temperature of 220°C. The pressure in the seal gas chamber is 5.17 kPa and supplies hot air at the back of the roller to prevent PF build up.

The purpose and function of the hydraulic power pack next to every mill is to ensure that a constant, uniform, operating hydraulic pressure is generated in the hydraulic cylinders connected to each of three rocker arms. This in effect will result in a constant pressure on the three rollers onto the table to ensure consistent grinding of the product. It is very important to keep this force as constant and stable as possible to ensure effective grinding as well as keeping a constant and uniform force on the table circumference that will work through to the gearbox. The product throughput as well as the particle size will be affected if the set operating pressure cannot be kept constant and this will affect the efficiency in the boiler.

The set operating pressure is approximately 52 bar (5 200 kPa). The quality of the coal plays a major part in the mill throughput, particle size and efficiency of the boiler and the hydraulic operating pressure is one of many factors that can be adjusted on the Loesche mill to optimize that efficiency.

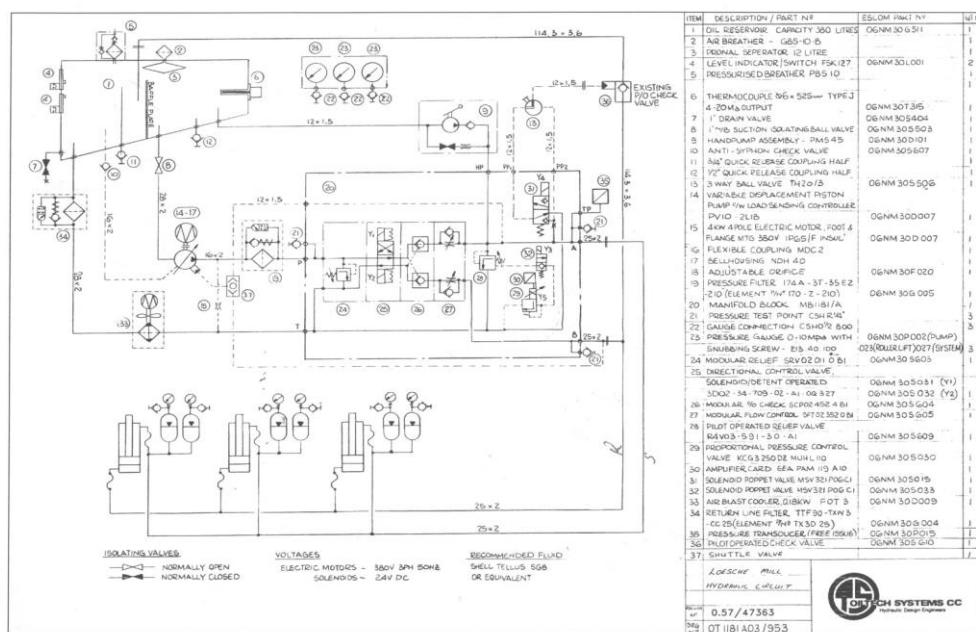


Figure 4 : Hydraulic circuit

The hydraulic cabinet and cylinders are connected with steel pipes and flexible hoses. The oil in steel pipes should move at very low resistance, only by the movement the rollers and the pistons. The cabinet is fitted with a 630L oil tank which is situated at the top of the cabinet. The oil tank has a cleaning and a discharge cock at the lowest point for the ease of maintenance. A high pressure pump which supplies the hydraulic cylinders and accumulators with the correct pressure has an overflow valve with a setting of 14 MPa. The accumulators have a safety valve with the relief pressure set at 20 MPa.

Each hydraulic cylinder is individually mounted in a stand and through flexible hoses and steel pipes; each cylinder in turn is connected to the hydraulic cabinet (power pack). The hydraulic cylinders are of the double action design. For normal mill operation, the operating pressure is acting on the piston rod side, whilst the non-piston rod side serves to lift the rollers. The hydraulic accumulators act as gas springs during mill operation when oil is displaced from the cylinders into the accumulators by means of the roller assembly movement. Vent valves are provided on the hydraulic cylinder and on the accumulator.

The lifting pressure enables lifting of the rollers from the grinding table when the oil pressure is reversed in the hydraulic cylinder. This procedure enables the mill to be started with a layer of coal on the grinding table but without pressure being exerted. The high pressure pump of the hydraulic system can be used for the swing-out mechanism which serves the purpose of raising the rocker arms and roller assemblies out of the mill body.

The hydraulic accumulator bottles consist of a steel housing with a connection socket and flange for the connection of the hydraulic line. In the connecting socket a spring-closing disc valve is mounted which remains in the open position during operation. The accumulator steel housing encloses a rubber balloon with a gas filling valve which is mounted on the opposite side of the oil at the upper bottle rim.

10. Hydraulic swing-out device

The hydraulic swinging-out device constitute an additional device provided for the purpose of facilitating the exchange or replacement of grinding rollers or worn-out roller tyres, respectively. This facility allows for swinging the roller out of the mill body and, at the same time, for supporting the roller when it has exceeded the point of neutral equilibrium. The grinding roller shaft will be in vertical position while the roller itself is in swung-out condition.

The swinging-out device will likewise facilitate removal of the grinding plate segments on the grinding table.

11. PF system

PF is graded in the classifier and if the PF is fine enough it passes through the vortex finder into the PF outlet turret. In appearance the turret resembles a top hat with a cylindrical section, and the PF pipe of a rectangular section is attached horizontally to the turret. The raw coal inlet pipe is attached to and passes through the top of the cylindrical section. From the rectangular section of the PF outlet duct, the PA/PF mixture passes to the distribution box from where it is separated into four PF pipes which are routed to the four pulverised fuel burners. A motorised damper is installed between the two stages of the distribution box, this damper serving to isolate the mill from the boiler during mill maintenance.

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The PF pipes are of varying lengths and require an orifice in each pipe to ensure equal flow of PF/PA mixture to each burner. The velocity of the correct ratio of PF/PA mixture in the PF pipes should not be less than 18 m/s as flows below this velocity will cause the PF particles to fall out and block the PF pipes.

12. Mill motor

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13. Mill gearbox

The mill gearbox is fitted under the mill on all units and supports the weight of the grinding table. The gearboxes are driven from an electric motor horizontally mounted. The input speed is 980 RPM and output speed is 36 RPM.

The lubrication for the gearbox is provided by external unit which forces oil under pressure through spray nozzles to the various bearings in the unit. There are two oil sight glasses on the side of the gearbox housing to indicate the working oil level for the main body and thrust bearing. To prevent the ingress of PF and dust from atmosphere into the thrust bearings, grease filled labyrinth seal is used.

The seal is an integral part of the gearbox casing and is located underneath the gearbox flange. The oil sight glasses are marked with two indicators for the running is green and standing oil level is red. It should be noted that the oil level

14. Lubrication system

The oil is circulated by a gear type oil pump directly connected to a small three phase induction motor via a flexible coupling, taking suction from the gearbox sump. The oil pump has an internal relief valve set to approximately 600 KPa. The pump normally discharges at 250 KPa with a discharge flow of 4.8 l/s.

The motor and pump are vertically mounted for cooling of the motor to be achieved by the flowing of air over the fluted motor casing. The oil then passes through a dual basket gauze filter which is fitted with bypass protection in case of filter blockage. This prevents the gauze filters from collapsing if they become blocked. The oil filter bypasses operates at a pressure of 200 KPa. The oil filters are also fitted with a differential pressure switch set to operate an alarm at > 150 KPa to indicate that filters require cleaning or changing.

The oil then passes to the oil cooler where it is cooled before returning to the gearbox. The cooler takes its cooling water from the secondary cooling system to maintain effective cooling of circulating oil. The oil flow is monitored by flow meter which has a low flow contact.

15. Seal air system

The seal air is tapped off from the tempering air duct before the tempering air regulating damper via an isolating damper. The seal air distributes air to the feeder to keep the feeder under slight pressure and prevents PF from blowing out of the mill, up into the feeder casing. The seal air also helps in keeping the pulleys and bearings clean.

Appendix 3: LOESCHE 26-30D MILLS – SPECIFICATIONS

16.Loesche mill technical data

MILL	
Manufacturer	Loesche SA
Dam Ring Height	115 mm
Gap Between Roller and table	5 mm
N ₂ Bottle Loading Pressure	3,5 MPa
Hydraulic Operating Pressure	5,2 to 5,4 MPa
MILL PERFORMANCE DATA AT 100% LOAD	
Mill Capacity	62,2 T/hr
Coal Feeder	85%
PA to Mill	83%
PA to Mill	74 000 nm ³ /hr
Mill Differential Pressure	6,4 kPa
Mill Motor	120 Amps
Pressure of Seal Gas in Main Duct	8,96 kPa
Seal Gas Pressure in Seal Gas Chamber	5,17 kPa
Seal Gas Temperature before the Mill	220°C
PA Temperature Mill Inlet	220°C
PA /PF Temperature Mill outlet	96°C
Tempering Air	60°C
A/H Outlet Primary Air Temperature	297°C
PA Pressure Mill Inlet	10,06 kPa
PA Pressure Mill Outlet	2,45 kPa
Gap At Buffer Stop	35 mm
MILL DRIVE MOTOR	
Power Output	683 kW
Motor speed	980 RPM
Voltage (three phase)	3300 V
Motor FLC	143 A
Starting Current	840 A

MILL GEARBOX	
Type	LGK 200 (KMS 850)
Gearbox Suppliers	Flender Bocholt
Input Power	750 kW
Input Speed	980 RPM
Output Speed	36 RPM
Oil Viscosity	VG 220
GEARBOX LUBE OIL OPERATING PARAMETERS	
Gearbox Oil Temperature	32,5 °C
Gearbox Oil Pressure	100 Kpa
Gearbox Oil Flow	89%
Gearbox Thrust Bearing Temperature	44°C
Gearbox Lube Oil Pump Motor	19 Amps
Gearbox Lube Oil System Cooling Water Flow	4700 l/hr
Alarms and Trips:	
Gearbox Lube Oil Pressure Low Alarm	< 80 kPa
Gearbox Lube Oil Pressure Low Trip	< 50 kPa
Gearbox Lube Oil Temperature High	> 60 °C
Gearbox Lube Oil Filter Differential Pressure High Alarm	>150 kPa
SEAL AIR FAN	
Manufacturer	Airtec Davidson
Type	790 diam 2 Stage Blower – PSC-05
Runner Type	Backward Bladed

Performance Data	Units	Duty 1	Duty 2
Capacity	m ³ /hr	3000	4000
Pressure	kPa	17,25	15
Density	kg/m ³	0.957	0,957
Speed	RPM	2950	2950
Absorbed Power	kW	32.4	32.5
Motor Power	kW	75	75
Design Temperature	°C	30	30
Altitude	m	1524	1524
Motor Details: (Motor Dual Extension Shafts)		Make	Siemens
	kW	Power	75
	RPM	Speed	2950
		Frame	280S
		Voltage	380/3/50

16. Mill operating philosophy.

Each boiler is equipped with 6 mills. It is a requirement to operate 5 mills for full unit load (600 MW). The remaining mill is either on standby or undergoing maintenance.

17. Criticality of milling plant.

The milling plant is responsible for the grinding and transportation of coal to the furnace to generate required MW. If the standby mill is not available and other mill fails due to a specific reason, the implication is that the remaining mills will not be possible to generate required load and hence load losses will be experienced. For these reasons, the milling plant is considered to be a critical plant in the power station.

18. Current mill maintenance philosophy

The current mill maintenance philosophy for the milling plant is one of condition based corrective maintenance. In other words items are replaced or repaired based on their condition. This type of maintenance regime relies on regular shutdown and inspection of the milling plant.

The life cycle (wear rate) of the grinding table segments and grinding tyres governs the maintenance philosophy. Basically each individual mill grinding element life cycle comprises of the following:

1 x set of grinding table segments & tyres for a cycle duration of 6 500 hours

Conduct 3,000 hours internal inspection intervals

- For the LM 26-30D mills

New – 0 hours = Grinding element change is deemed to be a refurbishment activity, conduct Complete overhaul (1 set of tyres consist of 3 tyres and 1 set of segments consist of 8 segments)

Cycle 1 – 3 000 hours = Inspection & basic repairs

Cycle 2 – 6 000 hours = Inspection (determine condition/used based condition) for next refurbishment

Cycle 3 – 6 500 hours = Post inspection & prepare for grinding element change/complete refurbishment

NOTE: All cycles will require a short inspection to measure the tyre & table segments depths to determine the exact time of the specific cycle intervention.

The life cycle of the grinding elements is 6 500 operating hours depending on the wear rate which is dictated by the quality of the coal, such as abrasiveness and hard grove index. The graph below illustrates the maintenance activities from mill overhaul (grinding element replacement) to mill overhaul (next grinding elements replacement).

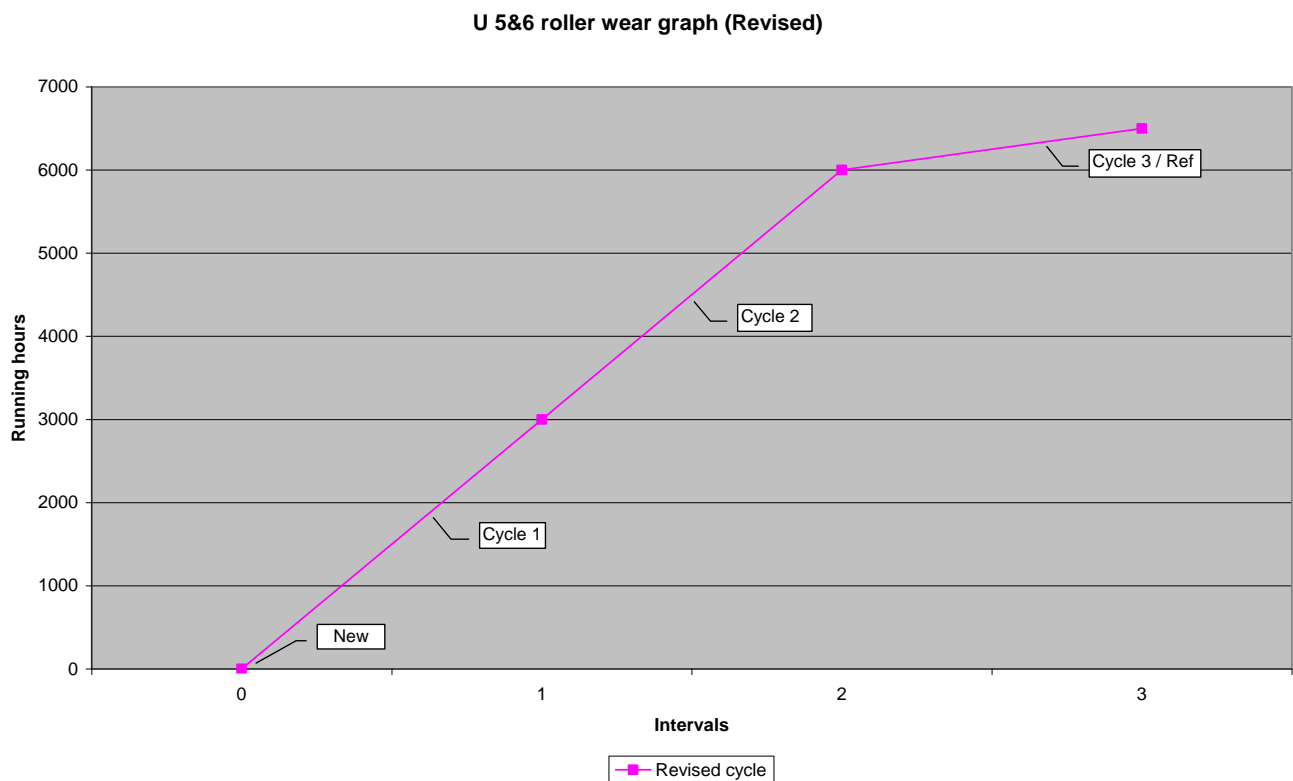


Figure 5: Mill maintenance philosophy

The operational hours of each individual mill is recorded on the milling plant express. Besides the operational hours the report also contains an estimate of grinding media wear and activity schedule, estimated hours to next activity, estimated due date for next activity based on average wear rates. Additional information regarding electrical and control instrumentation services, mill drive motor, mill drive gearbox data, roller bearings and other information relevant to the milling plant is updated and recorded on the Milling Plant Report

TASK: RING CHANGE “C” SERVICE

MILL PARTICULARS

RUNNING HOURS:

a) **MILL TOTAL:**h

G/BOXhrs

b) **RINGS:**

(I) **TOP:**h

(ii) **BOTTOM**h.

c) **BALLS:**h

d) **TO NEXT SERVICE**h

SIZEmm

1. Serial numbers of major components

- 1.1. Mill Gearbox
- 1.2. Mill Motor
- 1.3. Feeder Gearbox
- 1.4. Feeder Motor
- 1.5. Clean out conveyor motor.
- 1.6. Clean out conveyor gearbox.
- 1.7. Bottom & Top Ring
- 1.8. Balls NB: The numbers are painted on the balls.

2. BALLS

- 2.1. Inspect balls and record condition (visible crack damage).
- 2.2. Record existing / removed ball sizes. (NB: each individual ball).
- 2.3. Record fitted ball sizes. (NB: each individual ball).

3. RINGS

- 3.1. Examine rings for cracks, chipping wear and record same.
- 3.2. Take dimensions "A" and "C", on old/existing rings as shown on diagram for both the top and bottom rings.
- 3.3. Record dimensions A and C on new rings.

4. CLASSIFIER & DISCHARGE DUCTING

- 4.1. Check classifier cones and repair if required.
- 4.2. Check skirts and repair if required.
- 4.3. Check inner cone and repair if required.
- 4.4. Check the classifier vanes for erosion and the vane spindles for wear, as well as vane bottom caps. Make sure the vanes are adjusted to the settings obtained from Engineering Department (BAB/M1/V2/SS/PG 20). (37 Degrees as of March 2000).
- 4.5. Check discharge ducting and repair if required.
- 4.6. Inspect vane seals and repair if required.
- 4.7. Inspect vortex finder and carry out any necessary repairs.

5. SPIDER

- 5.1. Check the ball and socket coupling connecting the loading rams to the top ring spider plates. The clearance "X" must not be less than 6mm.
- 5.2. If clearance is less, the coupling must then be renewed. Clean out the coal from under ball before measuring. If pins are broken, renew pins.
NOTE: Pins must always be more than half way into slot to prevent RAM from rotating.
- 5.3. Measure the thickness of all spider wear plates. If the guides are less than 25mm thick, all the plates must be renewed.
- 5.4. Measure the thickness of the Mill guide plates, and if there is a significant step on the leading wear plate it must be turned or renewed to have a smooth surface.
- 5.5. Measure the spider guide gaps. If the gaps are more than 12mm all the wear plates are to be renewed, turned or swooped and shimmed at the leading spider wear plates to a minimum clearance of 10mm. Ensure that all four spider arms are in contact on the leading side. (BAB/M1/V1/S3/PG50).
- 5.6. Measure the gap between the spider and top ring at places provided counting from left

- 5.7. to right once inside inspection door. If the gap is more than 0,4mm, inform the Supervisor for action to be taken.
- 5.8. Renew spider arm and carrier bolts, torque setting 740Nm.
- 5.9. Inspect sealant between spider and top ring.

6. LOADING RAMS

- 6.1. 10 Reconditioned loading rams to be fitted.
- 6.2. 10 New dust bellows to be fitted.
- 6.3. Re-tension all bellows.
- 6.4. Hydraulic cabinet to be cleaned out and new oil to be put in system. - HLP 68 in Auto Loading Cabinet.
- 6.5. Hydraulic hand-pump to be overhauled. - HLP 100 in Hydraulic Cabinet.
- 6.6. Both filters on system to be renewed.
- 6.7. System to be pressure tested and all leaks repaired (gas and oil).

7. YOKE

- 7.1. Measure the gap between the yoke and bottom ring through the reject brush inspection door at places provided. Turn table clockwise and count position 1 as first position after table key. If gap is more than 0,4mm, inform your Supervisor for action to be taken. (BAB/M1/V1/S3PG 38).
- 7.2. Inspect sealant between yoke and bottom ring and record condition.

8. MILL BODY

- 8.1. Check that all bolts and nuts inside and on Mill body are tight and check that all the locking arrangements on the nuts are intact.
- 8.2. Check for damaged or broken components and renew if required.
- 8.3. Check Mill body liner plates for wear and renew where required.
- 8.4. Check and tighten the Mill foundation bolts.
- 8.5. Check throat plates for wear and cracks and repair/renew if required. Throat area to be 0.59m² (Throat area to be measured and filled in on sheet specified in section 16).
- 8.6. Check all compensators for leaks.
- 8.7. Ensure lagging and cladding on inlet ducts and on underside of mill.

9. REJECT SYSTEM

- 9.1. Check relief gates for free movement and sealing.
- 9.2. Check the condition of the reject brush ploughs and renew if required.
- 9.3. Measure the clearances between the brushes and reject chamber liner plates. The brushes are to be renewed/re-adjusted if gap is more than 50mm (BAB/M1/V1/S2/PG44).
- 9.4. Inspect the reject chamber liner plates and renew if required and check the reject box inspection doors gaskets and renew if required. Check the gas releaser on the reject boxes for correct operation and repair if required.
- 9.5. Check reject boxes inner door for correct operation and the spindle gland and repack if required.
- 9.6. Check rejects line and renew or replace sections where necessary. (DO NOT PATCH LINE)
- 9.7. Check the jet pulsation pump isolating valve for correct operation and repair if required.
- 9.8. Remove the audco valve spindle extension and install a grease stick after overhauling.
- 9.9. Operate and check the valve for correct operation.
- 9.10. Check the seal water-isolating valve for correct operation and repair if required.
- 9.11. Check the water seal drain valve for correct operation and repair if required.

- 9.12. Remove the water seal drain plug and clean out the water seal. Replace the drain plug ensuring that it will not leak.
- 9.13. Renew jet pulsation pump nozzle if necessary.
- 9.14. Inspect jet pulsation pump and renew discharge venturi if pump is not functioning properly.
- 9.15. Inspect reject box casing and gratings.

NOTE: Take note reject system sow is applicable to all the units.

10. GEARBOX

- 10.1. Remove the bibby coupling guard and open the coupling springs. Clean off all the grease and remove the springs. Inspect the springs and coupling for wears and renews if required.
- 10.2. Measure the gap between the couplings and check the alignment at four places. Re-align motor to gearbox if required. If the alignment is out and the gearbox has moved, inform the Supervisor immediately before re-aligning the motor.
WITNESS POINT: (THE SUPERVISOR IS TO CHECK ALIGNMENT BEFORE THE COUPLING IS BOXED UP RECORD THE READING). BAB/M1/V2/S6/PG102.
- 10.3. Ensure that the gearbox seal grease nipples are open and inject 0,5 kg grease into the labyrinth seal and fill the automatic lubricator on the input shaft seal with BP Energrease LS –EP 2.
- 10.4. Inspect the condition of the crown wheel and pinion gears that are visible. Report any abnormalities to your Supervisor\Plant specialist.
- 10.5. Clean and check the lubricating oil filters. If any metal particles are found inform your Supervisor.
- 10.6. Measure the backlash on the input shaft coupling. BAB/M1/V2/S6/PG86/88.
- 10.7. Inspect gear lubricant nozzles for functioning and record.
- 10.8. Inspect and clean gearbox breathers.
- 10.9. Inspect gearbox lube oil pump.
- 10.10. Torque to be checked on gearbox casing bolts.
- 10.11. Torque to be checked on gearbox foundation bolts.
- 10.12. Lube oil system to be filtered.
- 10.13. Check oil nozzles if they are functioning.
- 10.14. Inspect oil cooler and pipework for any leaks.

11. MILL SUMP

- 11.1. Check the Mill foundation springs and report any abnormalities i.e. broken springs and Engineering to your Supervisor.
- 11.2. Inspect gerb dampers and advise your Supervisor if water is present.
- 11.3. Inspect sump pump and record condition and check operation.

12. COAL FEEDER

- 12.1. Feeder to be opened for inspection and to verify scope of work. (Belt to be removed at this stage).
- 12.2. Clean out conveyor chain to be removed, links to be inspected for wear and free movement. All drive sprockets also to be inspected for wear and to be renewed if required.
- 12.3. Clean out conveyor drive shearing pin bushes and shearing pin to be renewed.
- 12.4. Clean out conveyor take up pulley together with adjuster to be serviced, bearings to be renewed.
- 12.5. Feeder loading table to be inspected for wears and renewed if required. (i.e: if thinner than 4mm).
- 12.6. Inlet chute side skirting plates to be renewed with new VRN 500 plates.

- 12.7. Top support rollers to be inspected, repaired or replaced as required. Bearings to be renewed.
- 12.8. Drive head pulley, together with gearbox drive coupling to be inspected, pins and head pulley bushes to be replaced as required. Non drive end side bearing to be replaced as required together with seals.
- 12.9. Tension rolls and tension roll pivot to be inspected and repaired. Bearings to be renewed.
- 12.10. Belt take-up and cleaning take-up pulley assemblies to be serviced. Bearings to be renewed. Chamber on takes up pulley to be checked. Grease pathways to be cleaned out and checked to ensure they are clean and clear.
- 12.11. Clean out conveyor drive shaft assembly to be inspected including main worm gear and bearing and repaired. Coupling to gearbox must be in good condition, replace or repair as required. Check and ensure that setscrew on coupling is tight to secure the key. Sprocket to be inspected and renewed if required. Non drive end bearing assembly to be inspected and repaired as required.
- 12.12. Chain returns supports to be checked for wear. Repair or replace as required.
- 12.13. Clip jointed belts to be installed on feeder during assembly.
- 12.14. All access doors and inspection doors to be checked.
- 12.15. Belt takes up spindle rubbers to be checked and changed if required.
- 12.16. All flexible grease pipes to be cleaned out and new grease installed. All pipes to be clipped out of way from moving parts.
- 12.17. Gearboxes to be filled with correct lubricant. (GRXP-320) – Main gearbox. GRXP-680 – Clean out conveyor.
- 12.18. Seal air supply valve to be checked and repaired as required. Pipes to be cleaned out.
- 12.19. Check no coal on belt alarm and coal outlet blockage paddles alarm and repaired as required.
- 12.20. Angle iron to be fitted above clean out conveyor chain12.20)Raw coal pipe squares to round to be inspected for wear and repaired.
- 12.21. Check the clearance between the coal inlet chute side skirting and the upper surface of the belt. The clearance must not exceed 8mm at leading edge (side closest to door).Re-adjust if required, to 6mm, at leading edge with rear edge gap being at least 9mm (skirt to be set up at an angle to ensure coal is not drawn in and trapped between belt and skirt)

NOTE: MAKE SURE ALL THE BEARINGS IN THE FEEDER HAVE BEEN RENEWED. (USE 6209-2RS BEARING TYPE FOR THE TAKE-UP PULLEY)

“Spring washers are to be used when attaching the feeder back plate.”

- 12.22. Measure feeder bar for height above belt as shown on diagram. A tolerance of 1mm is allowed. If distance is larger, re-adjust distance to 135mm. (Profile area to be $0,072\text{m}^2 \pm 0,001$).
- 12.23. Check the feeder belt tension. The tension is correct when the grease nipple on the tension roller is opposite the centre mark on the indicator plate. Re-adjust tension if required. To tension the feeder belt, carry out the following procedure:
 - a) Set the two counters, situated one on each side of the access door, to Zero.
 - b) Adjust the belt tension by turning the take-up screw in a clockwise direction.
 - c)

NOTE: DO NOT TURN ANY ONE OF THE TENSION NUTS MORE THAN FOUR TURNS AT A TIME.

- d) The counter readings must always be the same after both the tension nuts have been turned any time.
- e) Measure the sag of the clean out conveyor chain and if necessary, adjust the sag by turning the tension nuts. The sag should not be more than 3% of the centre distance between the drive sprocket and driven sprocket.BAB/M1/V2/S7/PG68.

- f) Arrange for the plant isolation permit to be cleared and apply for a "Sanction For Test" on the feeder Conveyor. NOTE: DO NOT ATTEMPT TO DO ANY WORK INSIDE THE FEEDER ONCE THE PERMIT HAS BEEN CLEARED.
- g) The feeder belt has a guide ridge running along the centre of the underside of the belt. The ridge runs in a groove in the pulley and should the tracking of the belt be incorrect, the guide ridge will move out of the groove and a hump will appear on the upper surface of the belt. (BAB/M1/V2/S7/PG64).
- h) Via agreed communications ask the appointed person to run the feeder belt at slow speed for at least 10 revolutions of the belt. Check the general condition of the belt and look for signs of humping at the head and tail pulley. If intermittent humping is seen, it could be as a result of a build-up of coal dust in the pulley grooves. Therefore, first check and clean the pulley grooves before attempting to correct the tracking.
- i) If no humping occurs at slow speed, ask for the belt to be run high speed. Again check the head and tail pulley for humping.
- j) If the belt is humping at slow or high speed and the pulley grooves are clean, adjust the tracking.

12.24. Tracking the Feeder Belt. (BAB/M1/V2/S7/PG66).

- a) To track the head pulley, increase the tension of the take-up screw on the same side of the feeder, towards which the belt is required to move. Take care not to over adjust the tracking.
- b) To track the take-up pulley adjust the tension pulley setting on the opposite side of the feeder, towards which the belt is required to move. Take care not to over adjust the tracking.
NOTE: AFTER TRACKING BELT ON ONE PULLEY ALWAYS CHECK THE TRACKING ON THE OTHER PULLEY.
- c) After all tracking adjustments have been made, ask for the belt to be run at fast speed and finally check the tracking.
- d) When checking the belt for final tracking, also check the clean-out conveyor for worn links and broken scraper blades.

NOTE: IF ANY REPAIRS ARE NECESSARY ON THE CLEAN-OUT CONVEYOR, REQUEST THE RESPONSIBLE PERSON TO RE-APPLY FOR A PLANT ISOLATION PERMITS ON THE FEEDER.

13 RAW COAL PIPES

- 13.1. Record condition of raw coal Pipe Square to round. If worn renew square to round.
- 13.2. Record condition of second sections raw coal pipe. If worn, renew second section raw coal pipe.
- 13.3. Record condition of third sections raw coal pipe.
- 13.4. State condition of the raw coals compensatory and if worn renews.
- 13.5. State condition of fourth section raw coal pipe and renew if necessary. Also record distance between bottom of 4th stage and mill table on form stipulated in section 16.

12 CW SYSTEM

- 14.1. Check CW system for leaks and repair if necessary.
- 14.2. Clean and pressure test cooler.

- 14.3. Clean out and repair CW flow indicator and clean sight glass.

13 MILL MOTOR

- 15.1. Drain motor bearing oil.
15.2. Refill motors bearings with oil (THB 46) and inspects for oil leaks.
15.3. Check foundation bolts for tightness.

NOTE: Attached Babcock Mill performance sheet to be filled in and a copy to be sent to Milling plant system engineer.

14 PF PIPING AND OUTLET DUCT

- 16.1 Inspect outlet compensator for damage
16.2 Inspect duct tiles & plate work for wear (including area ± 3 metres past outlet compensator) and repair tile work if required, also ensure that platershop does plate fabrication for repairs.
16.4 Do not place tiles on top of worn tiles. Remove section of tile work and retiles using 12mm thick tiles.
16.5 Inspect outlet thermocouple protection flatbar for wear. If worn inform platershop to renew same and inspect on final acceptance inspection if done.
16.6 Ensure thermocouples are connected
16.7. Vortex finder height to be measured and recorded in form stipulated in section 16.
16.8. Mill outlet turret which is your classifier outlet duct where missing tile must be replaced, holed areas must be patched, holed compensator must be patched until opportunity arises for proper replacement
16.9. Bearing failures on the distribution boxes must be replaced when required
16.10. Distribution box motors and actuator to be replaced when required with assistance from EMD for any power supply isolations involved
16.11 Distribution box internal inspections for worn out inserts (top & bottom), missing tiles be replaced, damper stuffing boxes must be repacked during the opportunity outages
16.12 Replace both bottom and top distribution box stiffeners when required
16.13 Repair or replace distribution box housing when required
16.14 All sealing doors gaskets to be replaced when worn out
16.15 Do plant walk down on the pf pipework including, bends, straights, square to round and do repair the holed areas with proper window patching.
16.16 Replace missing pf pipe bend and straight tiles during inspections opportunity
16.17 Check pipe work couplings for misalignment and pf leaks, repair when necessary.

WITNESS POINT:-

.....

Mill Specialist Signature Date

Notification No:

5.6 HISTORY REQUIREMENTS

				INSTR. NO A	H	B	I	1	0	5	3
				INSTR. NO B	H	B	I	1	0	5	8
				INSTR. NO C	H	B	I	1	0	5	9
DUVHA POWER STATION - BABCOCK MILL SERVICE INSTRUCTION											
INFORMATION REQUIREMENTS				SECTION: HMD MILL SECTION							
A SERVICE 3 DAYS				INTERNAL INSPECTION PROJECTS							
B SERVICE				INTERNAL INSPECTION AND BALL CHANGE				7 DAYS		MILL	
C SERVICE				INTERNAL INSPECTION, BALL AND RING CHANGE				15 DAYS		PILOT	
Nr.	SERVICE			ACTIVITY DESCRIPTION	INSPECTION		REFERENCE				
	A	B	C		SHEET NO.		NO.				
				SERIAL NUMBERS OF MAJOR COMPONENTS							
1	X	X	X	a) MILL GEARBOX	NM1001/PAGE1		BAB/M1/V2/S6				
	X	X	X	b) MILL MOTOR	NM1001/PAGE1						
	X	X	X	c) FEEDER GEARBOX	NM1001/PAGE1		BAB/M1/V2/S7				
	X	X	X	d) FEEDER MOTOR	NM1001/PAGE1		BAB/M1/V2/S7				
	X	X	X	e) CLEAN OUT CONVEYOR MOTOR	NM1001/PAGE1		BAB/M1/V2/S7				
	X	X	X	f) CLEAN OUT CONVEYOR GEARBOX	NM1001/PAGE1		BAB/M1/V2/S7				
	-	-	X	g) BOTTOM AND TOP RING	NM1001/PAGE1		BAB/M1/V2/S3				
	-	X	X	h) BALLS	NM1001/PAGE1		BAB/M1/V2/S3				
2				GRINDING BALLS			BAB/M1/V1/S3				
	X	X	X	a) INSPECT BALLS & RECORD CONDITION (CRACKS, DAMAGE)	NM1001/PAGE2		BAB/M1/V1/S3				
	X	X	X	b) RECORD EXISTING/REMOVED BALL SIZES	NM1001/PAGE1		BAB/M1/V1/S3				
	-	X	X	c) RECORD FITTED BALL SIZES	NM1001/PAGE1		BAB/M1/V1/S3				

3				GRINDING RINGS		BAB/M1/V1/S3
	X	X	X	a) INSPECT RINGS AND RECORD CONDITION (CRACKS, CHIPPING, ABNORMAL WEAR)	NM1001/PAGE2	BAB/M1/V1/S3
	X	X	X	b) RECORD EXISTING/REMOVED RING DIMENSIONS	NM1001/PAGE1	BAB/M1/V1/S3
	-	-	X	c) RECORD NEW RINGS DIMENSIONS	NM1001/PAGE1	BAB/M1/V1/S3

5.6 HISTORY REQUIREMENTS

Nr.	SERVICE			ACTIVITY DESCRIPTION	INSPECTION	REFERENCE
	A	B	C		SHEET NO.	NO.
				SERIAL NUMBERS OF MAJOR COMPONENTS		
4				CLASSIFIER		
	X	X	X	a) INSPECT CLASSIFIER CONE & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S5
	X	X	X	b) INSPECT SKIRTS & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S5
	X	X	X	c) INSPECT INNER CONE & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S5
	X	X	X	d) INSPECT CLASSIFIER VANE BLADE & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S5
	-	X	X	e) INSPECT PF DISCHARGE DUCT & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S5
	-	-	X	f) INSPECT/REPACK VANE SEAL	NM1001/PAGE2	BAB/M1/V2/S5
	-	X	X	g) INSPECT VORTEX FINDER AND RECORD CONDITION		BAB/M1/V2/S5
5				SPIDER		
	X	X	X	a) RECORD CLEARANCE "X" ON SWIVEL CUP	NM1001/PAGE1	BAB/M1/V2/S3
	X	X	X	b) INSPECT COUPLING & PINS AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S3
	-	X	X	c) RECORD THICKNESS OF SPIDER GUIDE WEAR PLATES	NM1001/PAGE1	BAB/M1/V2/S3
	-	X	X	d) RECORD THICKNESS OF MILL GUIDE PLATES	NM1001/PAGE1	BAB/M1/V2/S3
	-	X	X	e) RECORD THE SPIDER GUIDE GAPS ON THE NDE WEARPLATES WITH ZERO GAP ON THE SIDE OF SPIDER ARM WEARPLATES	NM1001/PAGE1	BAB/M1/V2/S3

	-	-	X	f) RECORD GAP BETWEEN THE SPIDER & TOP RING AT PLACES PROVIDED	NM1001/PAGE1	BAB/M1/V2/S3
	-	-	X	g) RENEW SPIDER ARM & CARRIER BOLTS	NM1001/PAGE2	BAB/M1/V2/S3
	-	X	X	h) INSPECT SEALANT BETWEEN SPIDER AND TOP RING	NM1001/PAGE2	BAB/M1/V2/S3

5.6 HISTORY REQUIREMENTS

Nr.	SERVICE			ACTIVITY DESCRIPTION	INSPECTION	REFERENCE
	A	B	C		SHEET NO.	NO.
				SERIAL NUMBERS OF MAJOR COMPONENTS		
6				LOADING SYSTEM		
	X	X	X	a) CHECK BELLOWS FOR PERISHING & RENEW IF REQUIRED		BAB/M1/V1/S4
	X	X	X	b) RETENTION ALL BELLOWS		BAB/M1/V1/S4
	-	-	X	c) HYDRAULIC CABINETS TO BE CLEANED OUT AND NEW OIL TO BE PUT IN SYSTEM		
	-	-	X	d) HYDRAULIC HAND PUMP TO BE OVERHAULED		
	-	X	X	e) BOTH FILTERS ON SYSTEM TO BE CLEANED		
	-	-	X	f) ALL HYDRAULIC PIPES TO BE FLUSHED		
7				YOKE		BAB/M1/V1/S3
	-	X	X	a) RECORD GAP BETWEEN THE YOKE & THE BOTTOM RING	NM1001/PAGE1	BAB/M1/V1/S3
	-	X	X	b) INSPECT SEALANT BETWEEN YOKE & BOTTOM RING AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S3
8				MILL BODY		BAB/M1/V1/S2
	X	X	X	a) INSPECT ALL BOLT & NUTS INSIDE & ON MILL BODY FOR TIGHTNESS & LOCKING ARRANGEMENT	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	b) INSPECT MILL FOR DAMAGED COMPONENTS & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	c) INSPECT MILL LINER PLATES & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S2

	X	X	X	d) INSPECT MILL FOUNDATION BOLTS FOR TIGHTNESS	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	e) INSPECT THROAT PLATES FOR WEAR & CRACKS	NM1001/PAGE2	BAB/M1/V1/S2

5.6 HISTORY REQUIREMENTS

Nr.	SERVICE			ACTIVITY DESCRIPTION	INSPECTION	REFERENCE
	A	B	C		SHEET NO.	NO.
				SERIAL NUMBERS OF MAJOR COMPONENTS		
9				REJECT SYSTEM		BAB/M1/V1/S2
	X	X	X	a) INSPECT RELIEF GATE FOR FREE MOVEMENT & SEALING. RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	b) INSPECT REJECT BRUSH PLOUGHS & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	c) RECORD CLEARANCES BETWEEN THE BRUSHES & REJECT CHAMBER LINER PLATES	NM1001/PAGE1	BAB/M1/V1/S2
	X	X	X	d) REPLACE ALL REJECT BOX INSPECTION DOOR GASKETS & INSPECT REJECT BOX VENT VALVE	NM1001/PAGE2	BAB/M1/V1/S2
	-	X	X	e) INSPECT THE REJECT BOX INNER DOOR SPINDLE GLAND	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	f) INSPECT REJECT LINE AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	g) INSPECT JET PULSION PUMP ISOLATING VALVE & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	h) GREASE JET PULSION PUMP ISOLATING VALVE & CHECK OPERATION	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	i) INSPECT SEAL WATER ISOLATING VALVE & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	j) INSPECT WATER SEAL DRAIN VALVE & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	k) CLEAN THE WATER SEAL	NM1001/PAGE2	BAB/M1/V1/S2
	-	-	X	l) OVERHAUL JET PULSION PUMP	NM1001/PAGE2	BAB/M1/V1/S2

5.6 HISTORY REQUIREMENTS

Nr.	SERVICE			ACTIVITY DESCRIPTION	INSPECTION	REFERENCE
	A	B	C		SHEET NO.	NO.
				SERIAL NUMBERS OF MAJOR COMPONENTS		
10				GEARBOX		
						BAB/M1/V2/S6
	-	X	X	a) INSPECT THE BIBBY COUPLING & SPRINGS & RECORD CONDITION. GREASE AS REQUIRED & BOX UP	NM1001/PAGE2	BAB/M1/V2/S6
	-	X	X	b) RECORD THE GAP BETWEEN THE TWO COUPLINGS & STATE THEIR ALIGNMENT	NM1001/PAGE1	BAB/M1/V2/S6
	-	X	X	c) GREASE THE LABYRINTH AND INPUT SHAFT SEAL		BAB/M1/V2/S6
	-	-	X	d) INSPECT THE VISIBLE CROWN WHEEL & PINION GEARS & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S6
	X	X	X	e) CLEAN AND INSPECT OIL FILTERS & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S6
	-	X	X	f) RECORD THE BACKLASH ON THE INPUT SHAFT	NM1001/PAGE1	BAB/M1/V2/S6
	X	X	X	g) INSPECT GEAR LUBRICANT NOZZLES FOR FUNCTIONING	NM1001/PAGE2	BAB/M1/V2/S6
	X	X	X	h) TOP UP GEAR BOX OIL LEVEL & REPLACE BREATHERS		BAB/M1/V2/S6
	-	X	X	i) INSPECT GEARBOX LUB OIL PUMP		BAB/M1/V2/S6
	-	X	X	j) TORQUE TO BE CHECKED ON GEARBOX CASING BOLTS		BAB/M1/V2/S6
	-	X	X	k) TORQUE TO BE CHECKED ON GEARBOX FOUNDATION BOLTS		BAB/M1/V2/S6
	-	-	X	l) LUB OIL SYSTEM TO BE FILTERED		
11				MILL SUMP	NM1001/PAGE2	BAB/M1/V2/S8

	X	X	X	a) INSPECT THE MILL FOUNDATION SPRINGS AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S8
	X	X	X	b) INSPECT GERB DAMPERS AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S8
	X	X	X	c) INSPECT SUMP PUMP OPERATION AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S8

5.6 HISTORY REQUIREMENTS

Nr.	SERVICE			ACTIVITY DESCRIPTION	INSPECTION	REFERENCE
	A	B	C		SHEET NO.	NO.
				SERIAL NUMBERS OF MAJOR COMPONENTS		
12				COAL FEEDER	NM1001/PAGE2	BAB/M1/V2/S7
	X	X	X	a) INSPECT AND SET FEEDER BAR	NM1001/PAGE2	BAB/M1/V2/S7
	X	X	X	b) INSPECT COAL FLOW & DISCHARGE ALARM PADDLE FOR FREE MOVEMENT AND RECORD CONDITION	NM1001/PAGE1	BAB/M1/V2/S7
	X	X	X	c) INSPECT ALL FEEDER BEARINGS GREASE PIPES & SEALS AND RECORD CONDITION	NM1001/PAGE1	BAB/M1/V2/S7
	X	X	X	d) CHECK GAP BETWEEN COAL INLET CHUTE SIDE SKIRTING & BELT	NM1001/PAGE2	BAB/M1/V2/S7
	X	X	X	e) INSPECT FEEDER BELT TENSION & RECORD BELT CONDITION	NM1001/PAGE2	BAB/M1/V2/S7
	X	X	X	f) RECORD THE SLACK OF THE CLEAN OUT CONVEYOR CHAINS AT POINTS 'E' & 'F'	NM1001/PAGE1	BAB/M1/V2/S7
	X	X	X	g) INSPECT THE CHAIN SUPPORT PLATES AT BOTH ENDS OF THE CONVEYOR FOR WEAR AND RECORD CONDITION	NM1001/PAGE1	BAB/M1/V2/S7
	X	X	X	h) INSPECT CLEAN OUT CONVEYOR AND RECORD CONDITION	NM1001/PAGE1	BAB/M1/V2/S7
	X	X	X	i) INSPECT FEEDER TABLE FOR WEAR	NM1001/PAGE2	BAB/M1/V2/S7
	X	X	X	j) TEST RUN FEEDER & CHECK BELT ALIGNMENT & TRACKING AT LOW/HIGH SPEED	NM1001/PAGE2	BAB/M1/V2/S7
13				RAW COAL PIPE	NM1001/PAGE2	BAB/M1/V1/S1
	X	X	X	a) INSPECT THE RAW COAL PIPE SQUARE TO ROUND AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S1

	X	X	X	b) INSPECT SECTION TWO OF RAW COAL PIPE AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S1
	X	X	X	c) INSPECT SECTION THREE OF RAW COAL PIPE AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S1
	X	X	X	d) INSPECT THE RAW COAL COMPENSATOR AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S1
	X	X	X	e) INSPECT SECTION FOUR OF RAW COAL PIPE AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S1

5.6 HISTORY REQUIREMENTS

Nr.	SERVICE			ACTIVITY DESCRIPTION	INSPECTION	REFERENCE
	A	B	C		SHEET NO.	NO.
				SERIAL NUMBERS OF MAJOR COMPONENTS		
14				CW SYSTEM		
	X	X	X	a) INSPECT FOR LEAKS AND REPAIR		
	-	-	X	b) CLEAN & PRESSURE TEST OIL COOLER		
	-	-	X	c) CLEAN OUT & REPAIR CW FLOW INDICATOR		
15				MILL MOTOR		
	-	-	X	a) DRAIN OIL FROM BEARINGS		
	-	-	X	b) OPEN AND INSPECT BEARINGS		
	-	-	X	c) BOX UP BEARINGS REFILL WITH OIL & INSPECT FOR OIL LEAKS		
	-	X	X	d) CHECK FOUNDATION BOLT TIGHTNESS		
	-	-	X	e) BIBBY COUPLING TO BE SPLIT ALIGNMENT DONE AND BOXED UP		
16	X	X	X	FILL IN ATTACHED BABCOCK MILL PERFORMANCE SHEET		

UNIT	1	2	3	4	MILL	A	B	C	D	E	F	SERVICE TO BE DONE BY HMD MILL SECTION		
	/ /						/		/					
					(I) SERVICE ISSUED		/		/					
					(II) SERVICE COMPLETED		/		/					
					(III) SERVICE RETURNED		/		/					
RUNNING HOURS					(I) MILL TOTAL	HRS					SERVICE	A	B	C
					(II) RINGS: TOP	HRS					NAME			
					BOTTOM	HRS								
					(III) BALLS	HRS								
PREVIOUS SERVICE					(I) SERVICE HOURS	HRS					SIGN			
					(II) BALL SIZE	MM								
NEXT SERVICE					(I) HOURS	HRS					DATE			
					(II) BALL SIZE	MM								

5.6 HISTORY REQUIREMENTS

SI No. 1	SERIAL No. OF MAJOR COMPONENTS	
COMPONENT	EXISTING/ REMOVED	REPLACE D
MILL GEARBOX		
MILL MOTOR		
FEED GEARBOX		
FEEDER MOTOR		
BOTTOM RING		
TOP RING		
BALL No. 1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		

SI No. 5	SPIDER DIMENSIONS IN mm			
THICKNESS OF ...	SPIDE GUIDE WEAR PLATE		MILL GUIDE PLATE	
	LEADING	TRAILING	LEADING	TRAILING
NORTH	mm	mm	mm	mm
EAST	mm	mm	mm	mm
SOUTH	mm	mm	mm	mm
WEST	mm	mm	mm	mm
SI No. 5	SPIDER GUIDE GAPS ON THE NDE WEARPLATE			
	BEFORE WORK		AFTER WORK	
NORTH	mm		mm	
EAST	mm		mm	
SOUTH	mm		mm	
WEST	mm		mm	
SI No. 5	GAP BETWEEN SPIDER & TOP RING			
NUMBER 1	mm			
2	mm			
3	mm			

5.6 HISTORY REQUIREMENTS

SI No. 2	GRINDING BALL SIZES IN mm	
	EXISTING/REMOVE D	REPLACED
BALL NO. 1	mm	mm
2	mm	mm
3	mm	mm
4	mm	mm
5	mm	mm
6	mm	mm
7	mm	mm
8	mm	mm
9	mm	mm
10	mm	mm
11	mm	mm

SI No. 6	YOKE DIMENSIONS IN mm
GAP BETWEEN YOKE AND BOTTOM RING	
NORTH	mm
EAST	mm
SOUTH	mm
WEST	mm

SI No. 8	REJECT SYSTEM DIMENSIONS IN mm
CLEARANCES BETWEEN BRUSHES & REJECT CHAMBER LINER PL	
ANGLE BRUSH INNER EDGE	mm
ANGLE BRUSH INNER EDGE	mm
STRAIGHT BRUSH INNER EDGE	mm
STRAIGHT BRUSH INNER EDGE	mm

SI No. 3	GRINDING RING SIZED IN mm			
	EXISTING/REMOVED		REPLACED	
	BOTTOM	TOP	BOTTOM	TOP
NORTH WEST 'A'				
NORTH EAST 'A'				
SOUTH WEST 'A'				
SOUTH EAST 'A'				
NORTH WEST 'C'				
NORTH EAST 'C'				

SI No. 9	GEARBOX DIMENSIONS IN mm			
BACKLASH ON THE INPUT SHAFT			mm	
GAP BETWEEN THE TWO COUPLING			mm	
ALIGNMENT		BEFORE ALIGNMENT	AFTER ALIGNMENT	
		RADI AL	AXIA L	RADI AL
		→ + -] [- + -] [-		
ST No. 11		COAL FEEDER DIMENSIONS IN		

SOUTH WEST 'C				
SOUTH EAST 'C'				
INNER DIAMETER				
OUTER DIAMETER				

	mm
SLACK OF CLEAN OUT CONVEYOR	
"E"	mm
"F"	mm

ST No. 5	SPIDER DIMENSIONS IN mm		
CLEARANCE "X" ON THE SWIVEL CUP			
No. 1	mm	No. 6	mm
No. 2	mm	No. 7	mm
No. 3	mm	No. 8	mm
No. 4	mm	No. 9	mm
No. 5	mm	No. 10	mm

CONTINUED

5.6 HISTORY REQUIREMENTS

					REF. NO.				N	M	1	0	0	1																																	
DUVHA POWER STATION																																															
BABCOCK MILL SERVICE INSPECTION RECORD																																															
UNIT	<table border="1" style="display: inline-table; text-align: center;"> <tr><td>1</td><td>2</td><td>3</td><td>4</td></tr> <tr><td colspan="4">/ /</td></tr> </table>				1	2	3	4	/ /				MILL (I) SERVICE ISSUED II) SERVICE COMPLETED III) SERVICE RETURNED				<table border="1" style="display: inline-table; text-align: center;"> <tr><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td></tr> <tr><td colspan="3">/</td><td colspan="3">/</td></tr> <tr><td colspan="3">/</td><td colspan="3">/</td></tr> <tr><td colspan="3">/</td><td colspan="3">/</td></tr> </table>				A	B	C	D	E	F	/			/			/			/			/			/			SERVICE TO BE DONE BY HMD MILL SECTION		
1	2	3	4																																												
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A	B	C	D	E	F																																										
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								SERVICE E			<table border="1" style="display: inline-table;"> <tr><td>A</td><td>B</td><td>C</td></tr> </table>		A	B	C																																
A	B	C																																													
SI No. 2 GRINDING BALLS					CONDITION																																										
BALLS					OK NOT OK		REMARK S																																								
SI No. 3 GRINDING RINGS					CONDITION																																										
(a) TOP RINGS					OK NOT OK		REMARK S																																								
(b) BOTTOM RING					OK NOT OK		REMARK S																																								
SI No. 4 CLASSIFIER					CONDITION																																										
a) CLASSIFIER CONE					OK NOT OK		REMARK S																																								
b) SKIRTS					OK NOT OK		REMARK S																																								
c) INNER CONE					OK NOT OK		REMARK S																																								
d) VANE BLADES					OK NOT OK		REMARK S																																								
e) DISCHARGE DUCT					OK NOT OK		REMARK S																																								
f) VANE SEALS					OK NOT OK		REMARK S																																								
g) VORTEX FINDER					OK NOT OK		REMARK S																																								

SI No. 5 SPIDER	CONDITION		
b) COUPLING & PINS	OK|NOT OK	REMARK S	
g) BOLTS (TIGHTNESS)	OK|NOT OK	REMARK S	
h) SEALANT CONDITION	OK|NOT OK	REMARK S	
SI No. 6 YOKE	CONDITION		
b) SEALANT	OK|NOT OK	REMARK S	
SI No. 7 MILL BODY	CONDITION		
a) BOLTS (TIGHTNESS)	OK|NOT OK	REMARK S	
b) DAMAGED COMPONENTS	OK|NOT OK	REMARK S	
c) MILL LINING	OK|NOT OK	REMARK S	
d) FOUNDATION BOLTS	OK|NOT OK	REMARK S	
e) THROAT PLATES REPAIRED	OK|NOT OK	REMARK S	

5.6 HISTORY REQUIREMENTS

SI No. 8 REJECT SYSTEM	CONDITION		
a) RELIEF GATE	OK|NOT OK	REMAR KS	
b) REJECT BRUSH PLOUGHS	OK|NOT OK	REMAR KS	
d) INSPECTION DOOR GASKET	OK|NOT OK	REMAR KS	
e) INNER DOOR SPINDLE GLAND	OK|NOT OK	REMAR KS	
f) REJECT LINE	OK|NOT OK	REMAR KS	
g) JET PULSION PUMP V/V	OK|NOT OK	REMAR KS	
h) SEAL WTR ISOLATING V/V	OK|NOT OK	REMAR KS	
l) WTR SEAL DRAIN V/V	OK|NOT OK	REMAR KS	
j) WATER SEAL	OK|NOT OK	REMAR KS	
l) OVERHAUL JET PULSION P/P	OK|NOT OK	REMAR KS	
SI No. 9 GEARBOX	CONDITION		
a) BIBBY COUPLING & SPRINGS	OK|NOT OK	REMAR KS	
c) LABYRINTH & INPUT SHAFT SEAL GREASED	OK|NOT OK	REMAR KS	
d) CROWN WHEEL & PINION GEARS	OK|NOT OK	REMAR KS	
e) OIL FILTERS	OK|NOT OK	REMAR KS	
g) GEAR LUBRICATION NOZZLE FUNCTION	OK|NOT OK	REMAR KS	
SI No. 10 MILL SUMP	CONDITION		
a) FOUNDATION SPRINGS	OK|NOT OK	REMAR KS	

b) GERB DAMPER	OK|NOT OK	REMAR KS	
c) SUMP PUMP OPERATION	OK|NOT OK	REMAR KS	
SI No. 11 COAL FEEDER	CONDITION		
a) FEEDER BAR	OK|NOT OK	REMAR KS	
b) FEED FLOW ALARM PADDLE	OK|NOT OK	REMAR KS	
b) DISCHARGE ALARM PADDLE	OK|NOT OK	REMAR KS	
c) GREASE PIPES & SEALS	OK|NOT OK	REMAR KS	
d) BELT TENSION	OK|NOT OK	REMAR KS	
f) CHAIN SUPPORT PLATES	OK|NOT OK	REMAR KS	
g) CLEANOUT CONVEYOR	OK|NOT OK	REMAR KS	
h) FEEDER TABLE WEAR	OK|NOT OK	REMAR KS	
l) TEST RUN FEEDER	OK|NOT OK	REMAR KS	
SI No. 12 RAW COAL PIPES	CONDITION		
a) SQUARE TO ROUND PIPES	OK|NOT OK	REMAR KS	
b) SECOND SECTION	OK|NOT OK	REMAR KS	
c) THIRD SECTION	OK|NOT OK	REMAR KS	
d) COMPENSATOR	OK|NOT OK	REMAR KS	
e) FOURTH SECTION	OK|NOT OK	REMAR KS	
NAME:		SIGN:	
		DATE:	

APPENDIX 5: BABCOCK & WILCOX MILLS TASK: BALL CHANGE (“A, B & C” SERVICES)

SERVICE ACTIONS

“A, B & C” SERVICE BALL CHANGE

MILL PARTICULARS	
UNIT:	
MILL:	
DATE:	a) SERVICE ISSUED :.../.../....
	b) SERVICE COMPLETE:.../.../....
	c) SERVICE RETURNED:.../.../....
RUNNING HOURS: a)	MILL TOTAL: .....h
	G/BOX .....hrs
b) RINGS:	(I) TOP: .....h SER NO.
	(ii) BOTTOM .....h SER NO.
	c) BALLS: .....h
	d) TO NEXT SERVICE .....h
	e) SERVICE HOURS .....h
MILL WEAR RATE:	TOP
RINGS	
	BOT HRS/mm
	BALLS HRS/mm
NUMBER OF BALLS	HRS/mm

SERVICE ACTIONS

1. **Serial numbers of major components**
 - 1.1. Mill Gearbox
 - 1.2. Mill Motor
 - 1.3. Feeder Gearbox
 - 1.4. Feeder Motor
 - 1.5. Bottom & Top Ring
 - 1.6. Balls (new 985mm balls only).
2. **GRINDING BALLS**
 - 2.1. Crack test each ball in turn by tapping with a hammer, ball must have a ringing sound.
 - 2.2. Record existing / removed ball sizes.
 - 2.3. Record fitted ball sizes.
3. **GRINDING RINGS**
 - 3.1. Examine rings for cracks, chipping or abnormal wear. For further action report findings to Supervisor.
 - 3.2. Take dimensions "A" and "C" of the rings in use as shown on diagram for both the top and bottom rings.

If the ring thickness is less than 45mm, NO BALL CHANGE IS PERMITTED.

4. CLASSIFIER & DISCHARGE DUCTING

- 4.1. Check classifier cone and repair if required.
 - 4.1.1. Angle should be [Unit 1 37.5° Unit 2 37° Unit 3 37° Unit 4 36° as of March 2000].
 - 4.1.2. Use profile guage to check angles.
- 4.2. Check skirts and repair if required.
- 4.3. Check inner cone and repair if required.
- 4.4. Check the classifier vanes for erosion and the vane spindles for wear. Make sure the vanes are adjusted to the settings obtained from performance monitoring department.

5. SPIDER

- 5.1. Check the ball and socket coupling connecting the loading rams to the top ring spider plates. The clearance "X" must not be less than 6mm. If clearance is less, the coupling must then be renewed. Clean out the coal from under ball before measuring. If pins are broken, renew pins.

NOTE: Pins must always be more than half way into slot to prevent RAM from rotating.

- 5.2. Measure the thickness of all spider wear plates. If the guides are less than 25mm thick, all the plates must be renewed.
- 5.3. Measure the thickness of the Mill guide plates, and if there is a significant step on the leading wear plate it must be turned or renewed to have a smooth surface.
- 5.4. Use chain block to ensure all four (4) spider head leading side wear plates are tight against mill plates. Measure all four (4) trailing end gaps. Gaps must be 10mm.

6. LOADING RAMS

- 6.1. Check bellows for perishing and renew if required.
- 6.2. Retention on all bellows.
- 6.3. Both filters on system to be cleaned.
- 6.4. System to be pressure tested and all leaks repaired (gas and oil).

7. YOKE

- 7.1. Measure the gap between the yoke and bottom ring through the reject brush inspection door at places provided. Turn table clockwise and count position 1 as first position after table key. If gap is more than 0,4mm, inform your Supervisor for action to be taken.
- 7.2. Inspect sealant between yoke and bottom ring.

8. MILL BODY

- 8.1. Check that all bolts and nuts inside and on Mill body are tight and check that all the locking arrangements on the nuts are intact.
- 8.2. Check for damaged or broken components and renew if required.
- 8.3. Check Mill body liner plates for wear and renew where required.
- 8.4. Check and tighten the Mill foundation bolts.
- 8.5. Check throat plates for wear and cracks, renew if required.
- 8.6. Check all compensators for any leaks.
- 8.7. Clean slots from coal build up.
- 8.8. Measure throat area and alter to be within limits ($0,59 \text{ m}^2 \leq \text{area} \leq 0,61 \text{ m}^2$).
- 8.9. Measure the spider guide gaps. If the gaps are more than 12mm all the wear plates are to be renewed, turned or swooped and shimmed at the trailing spider wear plates to a minimum clearance of 8mm. Ensure that all four spider arms are in contact on the leading side.
- 8.10. Check cladding and lagging.

9. REJECT SYSTEM

- 9.1. Check condition of relief gate and seal pipes.
- 9.2. Check the condition of the reject brush ploughs and renew if required.
- 9.3. Check brush carrier securing boltholes, if worn renew carrier.
- 9.4. Measure the clearances between the brushes and reject chamber liner plates. The brushes are to be renewed/readjust if gap is more than 50 mm.
- 9.5. Check the reject box inspection door gaskets and renew if required.
- 9.6. Check reject box inner door for correct operation and the spindle gland and repack if required.
- 9.7. Check reject door indicator.
- 9.8. Check reject line and renew or replace sections where necessary. (DO NOT PATCH LINE)
- 9.9. Check the jet pulsion pump isolating valve for correct operation.
- 9.10. Remove the valve spindle extension and install a grease stick. Operate and check the valve for correct operation.
- 9.11. Check the water seal drain valve for correct operation and repair if required.
- 9.12. Remove the water seal drain plug and clean out the water seal. Replace the drain plug ensuring that it will not leak.
- 9.13. Overhaul jet pulsion pump if not functioning properly.

10. GEARBOX

- 10.1. Remove the bibby coupling guard and open the coupling springs. Clean off all the grease and remove the springs. Inspect the springs and coupling for wear and renew if required.
- 10.2. Measure the gap between the couplings and check the alignment at four places. Re-align motor to gearbox if required. If the alignment is out and the gearbox has moved, inform the Supervisor immediately before re-aligning the motor. (THE ASSISTANT SUPERVISOR IS TO CHECK ALIGNMENT BEFORE THE COUPLING IS BOXED UP).
- 10.3. Ensure that the gearbox seal grease nipples are open and inject 0,5 kg grease into the labyrinth seal and fill the automatic lubricator on the input shaft seal with BP EnergreaseLS 3.
- 10.4. Clean and check the lubricating oil filters. If any metal particles are found inform your Supervisor.
- 10.5. Measure the backlash on the input shaft coupling.
- 10.6. Inspect gear lubricant nozzles for functioning.
- 10.7. Inspect oil cooler and pipework for any leaks.
- 10.8. Check the oil level and top up if required.

11. MILL SUMP

- 11.1. Check the Mill foundation springs and report any abnormalities to your Supervisor.
- 11.2. Inspect gerb dampers and repair if necessary.
- 11.3. Check the sump pump for correct operation.

12. COAL FEEDER

- 12.1. Check the clearance between the coal inlet chute side skirting and the upper surface of the belt. The clearance must not exceed 8mm. Re-adjust if required, to 6mm. **NOTE: 6mm Gap at leading edge and 8mm at trailing edge.**
- 12.2. Renew side skirting if worn out.
- 12.3. Measure feeder loading bar distance as shown on diagram. A tolerance of 1 mm is allowed on 135mm and if distance is larger re-adjust distance to 135mm. (Profile area to be $0,072m^2 \pm 0,001$).
- 12.4. Check the coal flow and discharge alarm paddle for erosion and freedom of movement and replace or repair if required.
- 12.5. Check all feeders bearing grease pipes and seals. Renew if required.

- 12.6. Check the feeder belt tension. The tension is correct when the grease nipple on the tension roller is opposite the centre mark on the indicator plate. Re-adjust tension if required.
- 12.7. Check feeder gearbox oil level, top up if necessary.
- 12.8. Side skirtings to inspect and thickness to be taken. If less than 2,5mm – review.
- 12.9. To tension the feeder belt, carry out the following procedure:
- 12.9.1. Set the two counters, situated one on each side of the access door, to Zero.
- 12.9.2. Adjust the belt tension by turning the take-up screw in a clockwise direction.
- NOTE: DO NOT TURN ANY ONE OF THE TENSION NUTS MORE THAN FOUR TURNS AT A TIME.**
- 12.9.3. The counter readings must always be the same after both the tension nuts have been turned any time.
- 12.9.4. Measure the sag of the clean out conveyor chain and if necessary, adjust the sag by turning the tension nuts. The sag should not be more than 3% of the centre distance between the drive sprocket and driven sprocket.
- 12.9.5. Check the chain support plates at both ends of the conveyor for wear and renew if necessary.
- 12.9.6. Check the clean out conveyor for wear or stretching and repair if required.
- 12.9.7. Inspect feeder table for wear.
- 12.9.8. Use spring washers when replacing the back plate.
- 12.9.9. Inspect clean out conveyor drive bushes and shearing pin.

NOTE: DO NOT ATTEMPT TO DO ANY WORK INSIDE THE FEEDER ONCE THE PERMIT HAS BEEN CLEARED.

- g) The feeder belt has a guide ridge running along the centre of the underside of the belt. The ridge runs in a groove in the pulley and should the tracking of the belt be incorrect, the guide ridge will move out of the groove and a hump will appear on the upper surface of the belt.
- h) Via agreed communications ask the appointed person to run the feeder belt at slow speed for at least 10 revolutions of the belt. Check the general condition of the belt and look for signs of humping at the head and tail pulley. If intermittent humping is seen, it could be as a result of a build-up of coal dust in the pulley grooves. Therefore, first check and clean the pulley grooves before attempting to correct the tracking.
- i) If no humping occurs at slow speed, ask for the belt to be run at high speed. Again check the head and tail pulley for humping.
- j) If the belt is humping at slow or high speed and the pulley grooves are clean, adjust the tracking.
- k) Tracking the Feeder Belt
- n) To track the head pulley, increase the tension of the take-up screw on the same side of the feeder, towards which the belt is required to move. Take care not to over adjust the tracking.
- p) To track the take-up pulley adjust the tension pulley setting on the opposite side of the feeder, towards which the belt is required to move. Take care not to over adjust the tracking.

NOTE: AFTER TRACKING BELT ON ONE PULLEY ALWAYS CHECK THE TRACKING ON THE OTHER PULLEY.

- q) After all tracking adjustments have been made, ask for the belt to be run at fast speed and finally check the tracking.
- r) When checking the belt for final tracking, also check the clean-out conveyor for worn links and broken scraper blades.

5.5

NOTE: IF ANY REPAIRS ARE NECESSARY ON THE CLEAN-OUT CONVEYOR, REQUEST THE RESPONSIBLE PERSON TO RE -APPLY FOR A PLANT ISOLATION PERMIT ON THE FEEDER.

13. RAW COAL PIPES

- 13.1. Record condition of raw coal pipe square to round.
- 13.2. Record condition of second section raw coal pipe.
- 13.3. Record condition of third section raw coal pipe.
- 13.4. State condition of the raw coal compensator and if worn renew.
- 13.5. State condition of fourth section raw coal pipe and renew if necessary.

14. CW SYSTEM

- 14.1. Check mill CW system for leaks and repair if necessary.

15. MILL MOTOR

- 15.1. Check bearing oil levels.
- 15.2. Correct any oil leaks.
- 15.3. Check foundation bolts for tightness.

SERVICE ACTIONS

- 1. Open the ball removal door.
- 2. Remove the 4 lifting rod cover plates on top of the classifier and position the 4 support stools over the lifting rod access holes.
- 3. Place 4 hydraulic jacks into the 4 support stools. (Use hydraulic jacks with hollow rams).
- 4. Couple the 4 hydraulic jacks to a single manifold and couple the manifold to a pneumatically driven power pack.

SERVICE ACTIONS

NB: Couple all pipes onto jacks first before connecting pipes onto power pack only then may air hose be fitted on to power pack.

- 5. Install 4 lifting rods through the ram of the hydraulic jacks.
 - 6. Place a plain washer onto the lifting rod and screw on a nut.
 - 7. Fit special wire sling to the spider and top grinding ring using a "bite" (Appendix 1).
Protect the slings from corners by fitting protector brackets.
 - 8. Screw the bottom support nut so that the threads of the lifting rod appear through the top of the support. Fit a plain washer to the lifting rod and screw on a nut.
 - 9. Tension each lifting assembly by tightening the bottom support nut on to the retracted hydraulic jack.
- NOTE: Inspect sling protection again to prevent damage to slings.**
- 10. Pressure the 4 hyd jacks so that they extend. When the bottom support nuts are almost touching the top plates of the support stools, stop the jacks extending.
 - 11. Inspect gap between caps and mill body internally and ensure correctness.
 - 12. Screw down the 4 top nuts of the ring lifting rods until they are touching the four support stools.
 - 13. Operate the hydraulic pump to retract the hydraulic jacks.
 - 14. Screw the bottom support nuts down until they again make contact with the top of the hydraulic jacks.

15. Repeat points 10, 11, 12, 13 & 14 till the top ring has lifted so that the top ring lip is 30mm clear of the top of the grinding balls. Make sure the ring is lifting level by looking at the spider arms continuously.

NOTE: Ensure sling protections are in place.

16. Lock the lifting equipment by tightening the top nut against the support stool top plate and after retracting the jack; screw the bottom nut down onto the jack.
17. When removing and loading balls, make sure there are always 3 balls in the mill and that they are evenly distributed.
18. Always ensure that balls are carefully placed in bottom ring track and not rolled in uncontrolled.
19. Ensure that the forklift does not damage the bottom ring and the coal chute (note well).

SERVICE ACTIONS

WITNESS POINT:

.....

Plant specialist Signature Date

Notification No:

1. Number air blocks from mill ball loading door clock wise to avoid faulty measurements.
2. Using the right documentation (appendix 1) record measurements taken.
3. Use 600mm steel rules and throat gap gauge to take sizes of slots in air blocks.
4. Measure miscellaneous area evident at flapper door and between mill bottom ring and nose cones.
5. Measure classifier blades setting by using vane gauge.
6. Measure coal chute to table clearance. Clearance taken from table to where raw coal pipe ends. (Distance A appendix 2).
7. Measure vortex finder depth (distance B appendix 2).
8. Use info on appendix 1 and load onto applicable spreadsheet to determine total throat area.
9. If area isn't between 0,59m² and 0,61 m² in form the plant specialist immediately.
10. Plant specialist to determine which throat plates need to be closed.

NOTE: Start with the top slots when closing the throat plates. (Use a flat bar (± 6mm)).

11. Measure coal chute to table clearance (580mm).

WITNESS POINT:

.....

Plant specialist Signature Date

Notification No:

Check and replace (if required) P.A. damper bearings.

NB: Proceed as follows:

- (a) Loosen the four bolts on the bearing hold down plate.
- (b) Loosen the grub screws and pull the bearing towards the worker, just to give the small clearance between bearing plate and the damper casing.
- (c) Tighten the grub screws onto the damper shaft and turn the bearing to see if turns freely. (If not, please replace with a new bearing).
- (d) Check the condition of the bearing seal and grease it (if required) and also replace all the missing grease nipples.)
- (e) If using a new bearing – grease it with the recommended grease type. (BP-HTG).
- (f) Push the bearing back, align it properly and tighten the hold down bolts.
- (g) Make sure that the grub screws are also tightened onto the damper shaft.
- (h) After the P.T.W. has been cleared, make sure that the damper operates freely by driving it from the operators desk for fully open and fully closed settings while witnessing it from the plant as well.

WITNESS POINT:

.....
Plant specialist Signature Date

5.6 HISTORY REQUIREMENTS

				INSTR. NO A	H	B	I	1	0	5	3
				INSTR. NO B	H	B	I	1	0	5	8
				INSTR. NO C	H	B	I	1	0	5	9
DUVHA POWER STATION - BABCOCK MILL SERVICE INSTRUCTION											
INFORMATION REQUIREMENTS				SECTION: HMD MILL SECTION							
A SERVICE		INTERNAL INSPECTION						3 DAYS			
PROJECTS											
B SERVICE		INTERNAL INSPECTION AND BALL CHANGE						7 DAYS		MILL	
C SERVICE		INTERNAL INSPECTION, BALL AND RING CHANGE						15 DAYS		PILOT	
Nr.	SERVICE			ACTIVITY DESCRIPTION	INSPECTION		REFERENCE				
	A	B	C		SHEET NO.		NO.				
				SERIAL NUMBERS OF MAJOR COMPONENTS							
1	X	X	X	a) MILL GEARBOX	NM1001/PAGE1		BAB/M1/V2/S6				
	X	X	X	b) MILL MOTOR	NM1001/PAGE1						
	X	X	X	c) FEEDER GEARBOX	NM1001/PAGE1		BAB/M1/V2/S7				
	X	X	X	d) FEEDER MOTOR	NM1001/PAGE1		BAB/M1/V2/S7				
	X	X	X	e) CLEAN OUT CONVEYOR MOTOR	NM1001/PAGE1		BAB/M1/V2/S7				
	X	X	X	f) CLEAN OUT CONVEYOR GEARBOX	NM1001/PAGE1		BAB/M1/V2/S7				
	-	-	X	g) BOTTOM AND TOP RING	NM1001/PAGE1		BAB/M1/V2/S3				
	-	X	X	h) BALLS	NM1001/PAGE1		BAB/M1/V2/S3				
2				GRINDING BALLS			BAB/M1/V1/S3				

	X	X	X	a) INSPECT BALLS & RECORD CONDITION (CRACKS, DAMAGE)	NM1001/PAGE2	BAB/M1/V1/S3
	X	X	X	b) RECORD EXISTING/REMOVED BALL SIZES	NM1001/PAGE1	BAB/M1/V1/S3
	-	X	X	c) RECORD FITTED BALL SIZES	NM1001/PAGE1	BAB/M1/V1/S3
3				GRINDING RINGS		BAB/M1/V1/S3
	X	X	X	a) INSPECT RINGS AND RECORD CONDITION (CRACKS, CHIPPING, ABNORMAL WEAR)	NM1001/PAGE2	BAB/M1/V1/S3
	X	X	X	b) RECORD EXISTING/REMOVED RING DIMENSIONS	NM1001/PAGE1	BAB/M1/V1/S3
	-	-	X	c) RECORD NEW RINGS DIMENSIONS	NM1001/PAGE1	BAB/M1/V1/S3

5.6 HISTORY REQUIREMENTS

Nr.	SERVICE			ACTIVITY DESCRIPTION	INSPECTION	REFERENCE
	A	B	C		SHEET NO.	NO.
				SERIAL NUMBERS OF MAJOR COMPONENTS		
4				CLASSIFIER		
	X	X	X	a) INSPECT CLASSIFIER CONE & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S5
	X	X	X	b) INSPECT SKIRTS & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S5
	X	X	X	c) INSPECT INNER CONE & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S5
	X	X	X	d) INSPECT CLASSIFIER VANE BLADE & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S5
	-	X	X	e) INSPECT PF DISCHARGE DUCT & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S5
	-	-	X	f) INSPECT/REPACK VANE SEAL	NM1001/PAGE2	BAB/M1/V2/S5
	-	X	X	g) INSPECT VORTEX FINDER AND RECORD CONDITION		BAB/M1/V2/S5
5				SPIDER		
	X	X	X	a) RECORD CLEARANCE "X" ON SWIVEL CUP	NM1001/PAGE1	BAB/M1/V2/S3
	X	X	X	b) INSPECT COUPLING & PINS AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S3
	-	X	X	c) RECORD THICKNESS OF SPIDER GUIDE WEAR PLATES	NM1001/PAGE1	BAB/M1/V2/S3
	-	X	X	d) RECORD THICKNESS OF MILL GUIDE PLATES	NM1001/PAGE1	BAB/M1/V2/S3
	-	X	X	e) RECORD THE SPIDER GUIDE GAPS ON THE NDE WEARPLATES WITH ZERO GAP ON THE SIDE OF SPIDER ARM WEARPLATES	NM1001/PAGE1	BAB/M1/V2/S3
	-	-	X	f) RECORD GAP BETWEEN THE SPIDER & TOP RING AT PLACES PROVIDED	NM1001/PAGE1	BAB/M1/V2/S3
	-	-	X	g) RENEW SPIDER ARM & CARRIER BOLTS	NM1001/PAGE2	BAB/M1/V2/S3
	-	X	X	h) INSPECT SEALANT BETWEEN SPIDER AND TOP RING	NM1001/PAGE2	BAB/M1/V2/S3

5.6 HISTORY REQUIREMENTS

Nr.	SERVICE			ACTIVITY DESCRIPTION	INSPECTION	REFERENCE
	A	B	C		SHEET NO.	NO.
				SERIAL NUMBERS OF MAJOR COMPONENTS		
6				LOADING SYSTEM		
	X	X	X	a) CHECK BELLOWS FOR PERISHING & RENEW IF REQUIRED		BAB/M1/V1/S4
	X	X	X	b) RETENTION ALL BELLOWS		BAB/M1/V1/S4
	-	-	X	c) HYDRAULIC CABINETS TO BE CLEANED OUT AND NEW OIL TO BE PUT IN SYSTEM		
	-	-	X	d) HYDRAULIC HAND PUMP TO BE OVERHAULED		
	-	X	X	e) BOTH FILTERS ON SYSTEM TO BE CLEANED		
	-	-	X	f) ALL HYDRAULIC PIPES TO BE FLUSHED		
7				YOKE		BAB/M1/V1/S3
	-	X	X	a) RECORD GAP BETWEEN THE YOKE & THE BOTTOM RING	NM1001/PAGE1	BAB/M1/V1/S3
	-	X	X	b) INSPECT SEALANT BETWEEN YOKE & BOTTOM RING AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S3
8				MILL BODY		BAB/M1/V1/S2
	X	X	X	a) INSPECT ALL BOLT & NUTS INSIDE & ON MILL BODY FOR TIGHTNESS & LOCKING ARRANGEMENT	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	b) INSPECT MILL FOR DAMAGED COMPONENTS & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	c) INSPECT MILL LINER PLATES & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	d) INSPECT MILL FOUNDATION BOLTS FOR TIGHTNESS	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	e) INSPECT THROAT PLATES FOR WEAR & CRACKS	NM1001/PAGE2	BAB/M1/V1/S2

5.6 HISTORY REQUIREMENTS

Nr.	SERVICE			ACTIVITY DESCRIPTION	INSPECTION	REFERENCE
	A	B	C		SHEET NO.	NO.
				SERIAL NUMBERS OF MAJOR COMPONENTS		
9				REJECT SYSTEM		BAB/M1/V1/S2
	X	X	X	a) INSPECT RELIEF GATE FOR FREE MOVEMENT & SEALING. RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	b) INSPECT REJECT BRUSH PLOUGHS & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	c) RECORD CLEARANCES BETWEEN THE BRUSHES & REJECT CHAMBER LINER PLATES	NM1001/PAGE1	BAB/M1/V1/S2
	X	X	X	d) REPLACE ALL REJECT BOX INSPECTION DOOR GASKETS & INSPECT REJECT BOX VENT VALVE	NM1001/PAGE2	BAB/M1/V1/S2
	-	X	X	e) INSPECT THE REJECT BOX INNER DOOR SPINDLE GLAND	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	f) INSPECT REJECT LINE AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	g) INSPECT JET PULSION PUMP ISOLATING VALVE & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	h) GREASE JET PULSION PUMP ISOLATING VALVE & CHECK OPERATION	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	i) INSPECT SEAL WATER ISOLATING VALVE & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	j) INSPECT WATER SEAL DRAIN VALVE & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S2
	X	X	X	k) CLEAN THE WATER SEAL	NM1001/PAGE2	BAB/M1/V1/S2
	-	-	X	l) OVERHAUL JET PULSION PUMP	NM1001/PAGE2	BAB/M1/V1/S2

5.6 HISTORY REQUIREMENTS

Nr.	SERVICE			ACTIVITY DESCRIPTION	INSPECTION	REFERENCE
	A	B	C		SHEET NO.	NO.
				SERIAL NUMBERS OF MAJOR COMPONENTS		
10				GEARBOX		
						BAB/M1/V2/S6
	-	X	X	a) INSPECT THE BIBBY COUPLING & SPRINGS & RECORD CONDITION. GREASE AS REQUIRED & BOX UP	NM1001/PAGE2	BAB/M1/V2/S6
	-	X	X	b) RECORD THE GAP BETWEEN THE TWO COUPLINGS & STATE THEIR ALIGNMENT	NM1001/PAGE1	BAB/M1/V2/S6
	-	X	X	c) GREASE THE LABYRINTH AND INPUT SHAFT SEAL		BAB/M1/V2/S6
	-	-	X	d) INSPECT THE VISIBLE CROWN WHEEL & PINION GEARS & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S6
	X	X	X	e) CLEAN AND INSPECT OIL FILTERS & RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S6
	-	X	X	f) RECORD THE BACKLASH ON THE INPUT SHAFT	NM1001/PAGE1	BAB/M1/V2/S6
	X	X	X	g) INSPECT GEAR LUBRICANT NOZZLES FOR FUNCTIONING	NM1001/PAGE2	BAB/M1/V2/S6
	X	X	X	h) TOP UP GEAR BOX OIL LEVEL & REPLACE BREATHERS		BAB/M1/V2/S6
	-	X	X	i) INSPECT GEARBOX LUB OIL PUMP		BAB/M1/V2/S6
	-	X	X	j) TORQUE TO BE CHECKED ON GEARBOX CASING BOLTS		BAB/M1/V2/S6
	-	X	X	k) TORQUE TO BE CHECKED ON GEARBOX FOUNDATION BOLTS		BAB/M1/V2/S6
	-	-	X	l) LUB OIL SYSTEM TO BE FILTERED		
11				MILL SUMP	NM1001/PAGE2	BAB/M1/V2/S8
	X	X	X	a) INSPECT THE MILL FOUNDATION SPRINGS AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S8
	X	X	X	b) INSPECT GERB DAMPERS AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S8
	X	X	X	c) INSPECT SUMP PUMP OPERATION AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V2/S8

5.6 HISTORY REQUIREMENTS

Nr.	SERVICE			ACTIVITY DESCRIPTION	INSPECTION	REFERENCE
	A	B	C		SHEET NO.	NO.
				SERIAL NUMBERS OF MAJOR COMPONENTS		
12				COAL FEEDER	NM1001/PAGE2	BAB/M1/V2/S7
	X	X	X	a) INSPECT AND SET FEEDER BAR	NM1001/PAGE2	BAB/M1/V2/S7
	X	X	X	b) INSPECT COAL FLOW & DISCHARGE ALARM PADDLE FOR FREE MOVEMENT AND RECORD CONDITION	NM1001/PAGE1	BAB/M1/V2/S7
	X	X	X	c) INSPECT ALL FEEDER BEARINGS GREASE PIPES & SEALS AND RECORD CONDITION	NM1001/PAGE1	BAB/M1/V2/S7
	X	X	X	d) CHECK GAP BETWEEN COAL INLET CHUTE SIDE SKIRTING & BELT	NM1001/PAGE2	BAB/M1/V2/S7
	X	X	X	e) INSPECT FEEDER BELT TENSION & RECORD BELT CONDITION	NM1001/PAGE2	BAB/M1/V2/S7
	X	X	X	f) RECORD THE SLACK OF THE CLEAN OUT CONVEYOR CHAINS AT POINTS 'E' & 'F'	NM1001/PAGE1	BAB/M1/V2/S7
	X	X	X	g) INSPECT THE CHAIN SUPPORT PLATES AT BOTH ENDS OF THE CONVEYOR FOR WEAR AND RECORD CONDITION	NM1001/PAGE1	BAB/M1/V2/S7
	X	X	X	h) INSPECT CLEAN OUT CONVEYOR AND RECORD CONDITION	NM1001/PAGE1	BAB/M1/V2/S7
	X	X	X	i) INSPECT FEEDER TABLE FOR WEAR	NM1001/PAGE2	BAB/M1/V2/S7
	X	X	X	j) TEST RUN FEEDER & CHECK BELT ALIGNMENT & TRACKING AT LOW/HIGH SPEED	NM1001/PAGE2	BAB/M1/V2/S7
13				RAW COAL PIPE	NM1001/PAGE2	BAB/M1/V1/S1
	X	X	X	a) INSPECT THE RAW COAL PIPE SQUARE TO ROUND AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S1
	X	X	X	b) INSPECT SECTION TWO OF RAW COAL PIPE AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S1
	X	X	X	c) INSPECT SECTION THREE OF RAW COAL PIPE AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S1
	X	X	X	d) INSPECT THE RAW COAL COMPENSATOR AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S1
	X	X	X	e) INSPECT SECTION FOUR OF RAW COAL PIPE AND RECORD CONDITION	NM1001/PAGE2	BAB/M1/V1/S1

5.6 HISTORY REQUIREMENTS

Nr.	SERVICE			ACTIVITY DESCRIPTION	INSPECTION	REFERENCE
	A	B	C		SHEET NO.	NO.
				SERIAL NUMBERS OF MAJOR COMPONENTS		
14				CW SYSTEM		
	X	X	X	a) INSPECT FOR LEAKS AND REPAIR		
	-	-	X	b) CLEAN & PRESSURE TEST OIL COOLER		
	-	-	X	c) CLEAN OUT & REPAIR CW FLOW INDICATOR		
15				MILL MOTOR		
	-	-	X	a) DRAIN OIL FROM BEARINGS		
	-	-	X	b) OPEN AND INSPECT BEARINGS		
	-	-	X	c) BOX UP BEARINGS REFILL WITH OIL & INSPECT FOR OIL LEAKS		
	-	X	X	d) CHECK FOUNDATION BOLT TIGHTNESS		
	-	-	X	e) BIBBY COUPLING TO BE SPLIT ALIGNMENT DONE AND BOXED UP		
16	X	X	X	FILL IN ATTACHED BABCOCK MILL PERFORMANCE SHEET		

5.6 HISTORY REQUIREMENTS

BABCOCK MILL SERVICE INSPECTION RECORD

UNIT	1	2	3	4	MILL	A	B	C	D	E	F	SERVICE TO BE DONE BY HMD MILL SECTION				
	/	/					/	/								
							/	/								
							/	/								
RUNNING HOURS					(I) SERVICE ISSUED							SERVICE	A	B	C	
					(II) SERVICE COMPLETED								NAME			
					(III) SERVICE RETURNED											
					(I) MILL TOTAL	HRS						SIGN				
					(II) RINGS: TOP	HRS										
					BOTTOM	HRS										
					(III) BALLS	HRS										
PREVIOUS SERVICE					(I) SERVICE HOURS	HRS						DATE				
					(II) BALL SIZE	MM										
NEXT SERVICE					(I) HOURS	HRS										
					(II) BALL SIZE	MM										

SI No. 1	SERIAL No. OF MAJOR COMPONENTS	
COMPONENT	EXISTING/ REMOVED	REPLACED
MILL GEARBOX		
MILL MOTOR		
FEED GEARBOX		
FEEDER MOTOR		
BOTTOM RING		
TOP RING		
BALL No. 1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		

SI No. 5	SPIDER DIMENSIONS IN mm			
THICKNESS OF ...	SPIDE GUIDE WEAR PLATE		MILL GUIDE PLATE	
	LEADING	TRAILING	LEADING	TRAIL- ING
NORTH	mm	mm	mm	mm
EAST	mm	mm	mm	mm
SOUTH	mm	mm	mm	mm
WEST	mm	mm	mm	mm

SI No. 5	SPIDER GUIDE GAPS ON THE NDE WEARPLATE	
	BEFORE WORK	AFTER WORK
NORTH	mm	mm
EAST	mm	mm
SOUTH	mm	mm
WEST	mm	mm

SI No. 5	GAP BETWEEN SPIDER & TOP RING	
NUMBER 1	mm	
2	mm	
3	mm	

5.6 HISTORY REQUIREMENTS

SI No. 2	GRINDING BALL SIZES IN mm	
	EXISTING/REMOVED	REPLACED
BALL NO. 1	mm	Mm
2	mm	Mm
3	mm	Mm
4	mm	Mm
5	mm	Mm
6	mm	Mm
7	mm	Mm
8	mm	mm
9	mm	mm
10	mm	mm
11	mm	mm

SI No. 3	GRINDING RING SIZED IN mm			
	EXISTING/REMOVED		REPLACED	
	BOTTOM	TOP	BOTTOM	TOP
NORTH WEST 'A'				
NORTH EAST 'A'				
SOUTH WEST 'A'				
SOUTH EAST 'A'				
NORTH WEST 'C'				
NORTH EAST 'C'				
SOUTH WEST 'C'				
SOUTH EAST 'C'				
INNER DIAMETER				
OUTER DIAMETER				

ST No. 5	SPIDER DIMENSIONS IN mm		
CLEARANCE "X" ON THE SWIVEL CUP			
No. 1	mm	No. 6	mm
No. 2	mm	No. 7	mm
No. 3	mm	No. 8	mm
No. 4	mm	No. 9	mm
No. 5	mm	No. 10	mm

SI No. 6	YOKE DIMENSIONS IN mm
GAP BETWEEN YOKE AND BOTTOM RING	
NORTH	mm
EAST	mm
SOUTH	mm
WEST	mm

SI No. 8	REJECT SYSTEM DIMENSIONS IN mm	
CLEARANCES BETWEEN BRUSHES & REJECT CHAMBER LINER PL		
ANGLE BRUSH INNER EDGE	mm	
ANGLE BRUSH INNER EDGE	mm	
STRAIGHT BRUSH INNER EDGE	mm	
STRAIGHT BRUSH INNER EDGE	mm	

SI No. 9	GEARBOX DIMENSIONS IN mm			
BACKLASH ON THE INPUT SHAFT			mm	
GAP BETWEEN THE TWO COUPLING			mm	
ALIGNMENT	BEFORE ALIGNMENT		AFTER ALIGNMENT	
	RADIAL	AXIAL	RADIAL	AXIAL
<div style="text-align: center;"> → <div style="display: flex; justify-content: space-around; width: 100%;"> <div style="text-align: center;">+ -] [-</div> <div style="text-align: center;">+ -] [-</div> </div> </div>				

ST No. 11	COAL FEEDER DIMENSIONS IN mm
SLACK OF CLEAN OUT CONVEYOR	
"E"	mm
"F"	mm

CONTINUED

5.6

5.6 HISTORY REQUIREMENTS

SI No. 8 REJECT SYSTEM	CONDITION	
a) RELIEF GATE	OK|NOT OK	REMARKS
b) REJECT BRUSH PLOUGHS	OK|NOT OK	REMARKS
d) INSPECTION DOOR GASKET	OK|NOT OK	REMARKS
e) INNER DOOR SPINDLE GLAND	OK|NOT OK	REMARKS
f) REJECT LINE	OK|NOT OK	REMARKS
g) JET PULSION PUMP V/V	OK|NOT OK	REMARKS
h) SEAL WTR ISOLATING V/V	OK|NOT OK	REMARKS
l) WTR SEAL DRAIN V/V	OK|NOT OK	REMARKS
j) WATER SEAL	OK|NOT OK	REMARKS
l) OVERHAUL JET PULSION P/P	OK|NOT OK	REMARKS
m) INSPECT REJECT BOX CASING AND GRATINGS	OK|NOT OK	REMARKS
SI No. 9 GEARBOX	CONDITION	
a) BIBBY COUPLING & SPRINGS	OK|NOT OK	REMARKS
c) LABYRINTH & INPUT SHAFT SEAL GREASED	OK|NOT OK	REMARKS
d) CROWN WHEEL & PINION GEARS	OK|NOT OK	REMARKS
e) OIL FILTERS	OK|NOT OK	REMARKS
g) GEAR LUBRICATION NOZZLE FUNCTION	OK|NOT OK	REMARKS
SI No. 10 MILL SUMP	CONDITION	
a) FOUNDATION SPRINGS	OK|NOT OK	REMARKS
b) GERB DAMPER	OK|NOT OK	REMARKS
c) SUMP PUMP OPERATION	OK|NOT OK	REMARKS
SI No. 11 COAL FEEDER	CONDITION	
a) FEEDER BAR	OK|NOT OK	REMARKS
b) FEED FLOW ALARM PADDLE	OK|NOT OK	REMARKS
b) DISCHARGE ALARM PADDLE	OK|NOT OK	REMARKS
c) GREASE PIPES & SEALS	OK|NOT OK	REMARKS
d) BELT TENSION	OK|NOT OK	REMARKS
f) CHAIN SUPPORT PLATES	OK|NOT OK	REMARKS
g) CLEANOUT CONVEYOR	OK|NOT OK	REMARKS
h) FEEDER TABLE WEAR	OK|NOT OK	REMARKS
l) TEST RUN FEEDER	OK|NOT OK	REMARKS
SI No. 12 RAW COAL PIPES	CONDITION	
a) SQUARE TO ROUND PIPES	OK|NOT OK	REMARKS
b) SECOND SECTION	OK|NOT OK	REMARKS
c) THIRD SECTION	OK|NOT OK	REMARKS
d) COMPENSATOR	OK|NOT OK	REMARKS
e) FOURTH SECTION	OK|NOT OK	REMARKS

NAME:

SIGN:

DATE:

5.6 HISTORY REQUIREMENTS

1. Were any of the wire slings damaged during the lifting of the top ring?
2. Were there any abnormalities present when lifting the top ring.
3. Was the ring lift action level at all times?.....

1. What is the condition of the air blocks?
2. Was the air blocks blocked with coal and if, so what percentage?
3. What is the condition of the flapper door?
4. What is the condition of the classifier vanes?

SPARES USED

STOCK NO	DESCRIPTION	USED
----------	-------------	------

.....

APPENDIX 6: BABCOCK & WILCOX MILLS

TASK: INSPECTION, REPORTS AND REPAIRS FOR 1 DAY OUTAGES

SERVICE ACTIONS

INSPECT THE FOLLOWING:

1. REJECT BOX

- a. Check the grating for any abrasive damage holes. Check if light is in operation.
- b. Check the hopper casing for holes and abrasions, also check gasket between mill housing and reject box.
- c. Check that the deflector plate isn't bent, cracked or worn
- d. The inner door handle for any damage of the window
- e. Check for holes cracks or any damage of the window washer water supply bend.
- f. For cracks, blockage and holes on the overflow drain pipe.
- g. Water seal drain valve extension. If any damages, carry out repairs.

2. REJECT LINE

- a. Check the pipework and 1 St joint after jet pump flange for abrasion damage or holes
- b. Check that audco valve handle square and not damaged.
- c. The dist piece between reject box and jet pulsing pump for any holes abrasions and damages.

3. REJECT CHAMBER

- a. Check the casing wall for holes, worn patches and cracks.
 - b. The outlet casing for holes, wear and cracks.
 - c. The PA ducting for holes, leaks and abrasions.
4. Trench covers that they are not bent, broken or missing.
5. Check covers outlet ducting casing for holes cracks and any apparent damage.
6. Check the raw coal pipe for holes and cracks from feeder outlet to mill inlet (have scaffold build to inspect feeder outlet) pay special attention to wall thickness at feeder outlet
- Inspect mill outlet duct, paying particular attention to themill outlet duet roof.

5.5 SERVICE ACTIONS

7. CLASSIFIER

- a. Check all vanes for cracks and broken pipes.
- b. Check the stays for not being bent worn or cracked.
- c. Check the inner cone for abrasions, cracks and holes.
- d. Check vane wear shoes and renew if necessary.
- e. Inspect Vortex finder and record length (should be 894mm).

8. THROAT CASING

- a. Check the frame for cracks holes and any apparent damage.
 - b. Check the throat for damage and that the gap is between 9.5 to 10mm.
 - c. The deflector lines for holes and cracks.
 - d. The gap between the throat and grinding ring to be between 9.5 and 10mm.
 - f. Throat area to be between 0.59m² and 0.61m² on a refurbished/new mill.
 - e. Flapper door and flapper deflector plates for excessive wear and holes.
9. Handrails walkways and door hinges for any damage.

10. SUMP

- a. Check the covers and hinges.
- b. The ladder for cracks, broken parts and any bent parts.
- c. Check the handrail kick plates for any loose or broken plates.
- d. Check seal between kick plates and boiler floor.

11. FEEDER

- a. Check the side door hatches for holes cracks and wear.
- b. Raw coal inlet deflector plates for wear holes cracks and that it isn't bent.
- c. Cleanout conveyor angle iron chain cover not damaged or cracked.
- d. To assist fitter.

12. If any damage to the above mentioned raise defects.
13. Fill in the information requirements and the QCP of inspection.

2. HYDRAULIC PIPES

Inspect the hydraulic pipes for wear and tear. Replace if necessary.

WITNESS POINT:

.....
Plant specialist Signature Date
Notification No:

5.6 HISTORY REQUIREMENTS

WHAT WAS THE CONDITION OF THE FOLLOWING AND WHAT ACTION WAS TAKEN TO RECTIFY IT?

1. REJECT BOX

		CONDITION
A.	ACTION TAKEN GRATING	.....
B.	HOPPER CASING	.....
C.	DEFLECTOR PLATE	.....
D.	INNER DOOR HANDLE	.....
E.	WINDOW WASHER WATER SUPPLY BEND	.....
	OVERFLOW DRAIN PIPE	.....
	WATER SEAL DRAIN	.....
	V/V EXTENSION	.....

2. REJECT LINE

		CONDITION
A.	ACTION TAKEN PIPEWORK 1ST JOINT	.....
	AFTER JET PUMP FLANGE	.....
	AUDCO V/V HANDLE	.....
	SQUARE	.....

C.	DIST PIECE BETWEEN	.....
	REJECT BOX JET	.....
	PULSATION P/P	.....
	
3.	REJECT CHAMBER	
	ACTION TAKEN	CONDITION
A.	CASING WALL	.....
B.	OUTLET CASING	.....
C.	PA DUCTING	.....
	
4.	TRENCH COVERS	.....
	
5.	OUTLET DUCTING	.....
	CASING	.....
	

5.6 HISTORY REQUIREMENTS

6.	RAW COAL PIPE	.....
	
7.	CLASSIFIER	
A.	ALL VANES	.....
	
B.	STAYS	.....
	
C.	INNER CONES	.....
	

8. THROAT CASING

A.	FRAME	.....
	THROATS (SLOT GAP)	.....
	
C.	DEFLECTOR PLATES	.....
	
	ACTION TAKEN	CONDITION
D.	GAP THROAT AND	.....
	GRINDING RING	.....
	
E.	FLAPPER DOOR AND	.....
	

	FLAPPER DEFLECTOR	.....
	
	PLATES	.....
	
9.	HANDRAILS, WALKWAY	.....
	
	DOOR HINGES	.....
	
10	SUMP	
A.	COVERS AND HINGES	.....
	
B.	LADDER	.....
	
C.	HANDRAIL KICK PLATES	.....
	
11	FEEDER	
A.	SIDE DOOR HATCHES	.....
	
B.	RAW COAL INLET	.....
	
	DEFLECTOR PLATES	.....
	
C.	CLEAN OUT CONVEYOR	.....
	
	ANGLE IRON CHAIN	.....
	
	COVER	.....
	

SPARES USED

STOCK NUMBER	DESCRIPTION	USED
.....

APPENDIX 7: LOESCHE MILLS (UNITS 5 & 6) TASK: HYDRAULIC CYLINDER REPLACEMENT

PURPOSE

This work instruction is drawn up to Renew Hydraulic Cylinder on Loesche Mills.

SERVICE ACTIONS

NOTE: Ensure that you are familiar with the risk assessment, health and safety precautions and hazards as well as the isolations pertaining to this instruction before attempting any of the following:

1. Release all hydraulic pressures (working and lifting) by pressing Y3 valve to drain pressure.
2. Loosen bolts and remove coupling between cylinder and rocker fork 8@(M20x170).
3. Fit chain block to landing around mill and by using a sling secure hydraulic cylinder in position.
4. Remove retaining pin of shock absorber.
5. Close 2 isolating valves on hydraulic lines connected to accumulators.
6. Loosen cap screws on flanges of control lines on cylinder and use plastic bags to seal flanges. (NB (No. rags).
7. Loosen hydraulic lines connected to accumulators, just after isolating valve and loosen U-bolt at bracket.
8. Loosen and remove retaining bolt and plate at main connecting pin as well as retaining flanges next to accumulators.
9. Use hydraulic jack to remove main pin.
10. Using the chain blocks remove old cylinder.
11. Clean area before fitting the new cylinder especially where the main pin enters.
12. Remove and clean spacer from old cylinder and fit to new cylinder.
13. Fit new cylinder in position and make sure the hole of cylinder is aligned with holes in casing where main pin enters.
14. Lubricate main pin with copper compound and fit into position.
15. Carefully align main pin and using the jack, pull main pin into position.
16. Fit retaining pin and shock absorber to hydraulic cylinder.
17. Connect hydraulic control lines to cylinder using new allen cup screws (M12x45m material grade 10.9). Torque allen cup screws to 65 Nm using the diametrically opposite sequence method.
18. Open two isolating valves.
19. Fit retaining flanges next to accumulators.
20. Fit coupling and tighten 8 @ M20x170 bolts with impact wrench.
21. Operator to start Hydraulic pump in the control room.
22. Operate Y1 and Y2 valves (manually).
23. Loosen bleeding screw on top of main hyd cylinder and wait until all air is released and clean oil that is coming through and tighten.
24. Make sure rollers lift and there is no oil leaks.
25. Area left cleaned (work area).

WITNESS POINT:

Plant specialist	Signature	Date

Notification No:

5.6 HISTORY REQUIREMENTS

1. Which cylinder was changed?.....
2. Why is the cylinder changed?.....
3. What is the serial number of cylinder?

OLD:

NEW:

SPARES USED

STOCK NUMBER:	DESCRIPTION	USED

APPENDIX 8: LOESCHE MILLS TASK: ROLLER ASSEMBLY REPLACEMENT

PURPOSE

This work instruction is drawn up to renew a Roller Assembly on the Loesche Mill.

5.1 RISK ASSESSMENT, HEALTH AND SAFETY PRECAUTIONS & HAZARDS

SERVICE ACTIONS

NOTE: Ensure that you are familiar with the risk assessment, health and safety precautions and hazards as well as the isolations pertaining to this instruction before attempting any of the following:

1. Remove roller assembly cover by loosening all bolts except two in top of cover, until ready to lift same with mobile crane.
2. Remove labyrinth screws both side of rocker and take care not to damage the gasket.
3. From the inside of the mill remove the front liner.
4. Remove rocker arm cone pin assemblies. (6 of)

5. Loosen and remove M42 main bolts.
6. Remove seal air pipe (goose neck) only on left hand side of rocker.
7. Install swing out device into position and prepare to swing roller out.
8. Swing roller out till roller is in the vertical position.
9. Loosen T-Head bolts and by using tyre lifting clamp, lift the tyre of.
10. Remove three bolts and washers on taper lock bush and by using the bolts jack off the bush in tapped holes provided.
11. Use "T-Head eye bolts" and lift roller out.
12. Clean all equipment and bolts using paraffin.
13. Fit new roller assembly.
14. Fit taper lock and tighten bolts. **Torque to 900NM.** (NB: Renew the bolts and spring washers fit locking wires) –welders-. (Only use 1½" drive impact wrench)
15. Fit tyre onto roller using tyre lifting clamp.
16. Fit all T-Head bolts and tighten in the right manner.
17. Weld locking wires on nuts of T-Head bolts.
18. Swing roller in position till hub and fork holes line up.
19. Insert the expanding sleeve/taper pin units into hub and fork hole.
20. Tighten all connecting bolts. (M42 main bolts).
21. Tighten expanding sleeve/taper pin units.
22. Set the buffer stop correct.
23. Fit new gasket on rocker covers and replace rocker cover.

WITNESS POINT:

Mill specialist	Signature	Date

Notification No:

1. Why was the roller changed.....
2. What was the condition of the sealing and sliding rings?.....
3. How many hours was done by the roller?.....

SPARES USED

STOCK NUMBER:	DESCRIPTION	USED

APPENDIX 9: LOESCHE MILLS (UNITS 5 & 6)

TASK: INSPECTION, REPORTS & REPAIRS

SERVICE ACTIONS

NOTE: Ensure that you are familiar with the risk assessment, health and safety precautions and hazards as well as the isolations pertaining to this instruction before attempting any of the following:

1. Date of inspection:
2. Mill number:
3. Mill running hours inspection:
4. Take roller tyre wear measurements on each roller assembly and record same:
5. a..... b. c.
6. Measure table segment wear at three different places and record wear
.....

7. Ensure that all three roller assemblies turn freely
8. Check tyres and tables segments for any signs of cracks
9. Measure and record clearance between each tyre and table segment
10. a..... b. c.
11. (correct clearance to be 6 mm)
12. Inspect louvre and armour ring for wear.
13. Inspect roller assembly armouring and mill body liners for wear
14. Inspect dam ring segment for wear 115 mm
15. Check and record throat gap
(measure in at least three places and record average gap)
16. Check classifier blade settings, ensure that all blades are set in the same plane, and check condition of blades.
17. Check and ensure that the classifier blade locknuts are all tight
18. Inspect classifier grit return flaps for wear and ensure that all operate freely
19. Check for wear on classifier cone sections
20. Check and ensure that all locking devices are intact and all bolts and nuts in position and tight.
21. Inspect reject scrapers for damage or wear.
22. Take sample roller assembly lubricant and record condition.
23. Check gearbox oil level (standing level) and take oil sample for analysis
24. Clean gearbox oil filter and breathers thoroughly.
25. Check gearbox oil cooler for cleanliness
26. Check the following systems for any signs of leaks:
 - Gearbox lubrication oil system
 - Hydraulic loading system
 - Gearbox cooling water system
27. Check hydraulic loading accumulator nitrogen pressure (Correct pressure 35 bars - refer to hydraulic section in manual for charging procedure.)
28. Check mill internally for signs of wear
29. Take gearbox and roller assembly lubricant sample
30. Inspect ducts for possible damage
31. Tighten cover bolts
32. Inspect the labyrinth seal
33. Check and record labyrinth clearance between output flange and seal (may not exceed 1.5 mm)
34. Check and record clearance between Labyrinth and table sealing (may not exceed 2 mm)
35. Check and Record the condition of the protective lining in the raw coal feed pipe for signs of wear and renew if necessary
36. Check the condition of all seals and gaskets
37. Check the inner doors for proper sealing
38. Repair all identified Primary and Seal air leaks on the system
39. Seal Air Ring main covers under the dust Traps, should be opened at every mill inspection and possible Fly ash deposits removed.
40. Check and record seal air pressure supplied to the rocker arm
41. Check and record buffer stop setting
42. Check pneumatic components for cleanliness and sound operation
43. Check accumulator nitrogen pressure 3.5 MPa
44. Clean SA fan filters
45. Clean hydraulic oil filter
46. Check for erosion wear on all mill internals
- 47.

WITNESS POINT:

Mill specialist	Signature	Date

Appendix 10: LOESCHE MILLS - REFURBISHMENT

TASK: INSPECTION, REPORTS AND REPAIRS FOR 21 DAYS OUTAGES

10.1. COAL FEEDER INLET

1. Visually inspect the coal gate condition for holes and patch if necessary
2. Check the coal chute for blockages and unblock it if required
3. Perform visual inspection of the liner material and replace if necessary.
4. Perform visual inspection of the liner material & bolts and replace if necessary.
5. Visual inspection for condition and measure height between belt and pipe. Repair, if necessary.

10.2. VOLUMETRIC FEEDER

1. Visual inspection for condition and measurement of belt thickness in wear areas.
2. Visual inspection for all the skirts
3. Measure bar profile area and adjust accordingly. Perform visual inspection of access door condition and replace gasket.
4. Visual inspection for flap movement by hand, greasing of bearing and flap itself.
5. Inspect condition of bull eye windows and replace broken glasses.
6. Visually inspect the raw coal inlet pipe for holes and replace/patch it if damaged.
7. Visual inspection for tile condition on a square to round chute for holes and do patching if necessary.

10.3. FEEDER MAIN CONVEYOR

1. Visual inspection for condition and measurement of belt thickness in wear areas, replace the belt if damage is high.
2. Visual inspection and verify diameter for ovality and replace damaged bearings. (Take-up pulley)
3. Visual inspection and verify diameter for ovality and replace damaged bearings. (Head pulley)
4. Remove and inspect the coupling for wear.
5. Do oil change on drive gearbox
6. Clean and grease drive motor bearings.
7. Inspect idlers for free movement & surface condition and replace bearings on top support rollers
8. Visually inspect and measure the adjusting rod on the take up gear assembly
9. Visually inspect and verify diameter against specification and replace bearings on the tension roller, pivot and booster.
10. Visually inspect of scraper condition (if installed) and position it properly. Install the new scraper if not installed

10.4. FEEDER CLEAN-OUT CONVEYOR

1. Visually inspect/check condition of the sprocket teeth on the sprocket wheel and check the teeth profile
2. Do oil change on drive gearbox and grease bearings on top of gearbox
3. Clean and regrease the bearings on the motor side
4. Visually inspect the take up shaft sprocket assembly and lubricate.
5. Visually inspect the condition of the adjusting rod on the take up gear assembly
6. Visually inspect for completeness the cleanout chain conveyor
7. Classifier
8. Inspect coal inlet pipe for holes and blockages and replace it if required

9. Inspect condition of compensator and flanges and replace it if required.
10. Visually inspect upper and lower classifier for uneven wear
11. Verify the tightness on all bolts.
12. Visually inspect the inner cone sidewall plates for erosion and replace it if holed or low wall thickness
13. Visually inspect raw coal return flaps for condition and repair where it deemed necessary.
14. Visually inspect the inner cone support bracket
15. Visually inspect the classifier blades condition and correctly set the blade angles 45°.
16. Visually inspect and set the vortex finder length, patch areas with high erosion wear if noted

10.5. PF PIPE SYSTEM

1. Inspect condition of tiling, duct top plate and flange trueness on pf outlet duct
2. Replace PF Outlet Duct Compensators if torn
3. Inspect the condition of pf outlet duct inspection doors and replace gaskets.

10.6. MILL BODY AND INTERNBALS

1. Visually inspect tile condition, liners that are worn and replace all damaged as required.
2. Inspect and replace gaskets to ensure effective sealing of the maintenance/inspection doors.
3. Inspect, repair or replace surfaces, bolts and seals to ensure effective sealing of the roller access doors.
4. Inspect condition of plenum chamber doors and repair/replace as necessary and also inspect the plenum chamber then fix if necessary
5. Inspect condition of reject scrapers and replace if necessary.
6. Replace table segments and tyres
7. Inspect condition of dam ring (measure the height), repair if necessary and tighten bolts.
8. Replace/restore the clamping rings
9. Replace louvre ring
10. Replace worn armour ring plates
11. Inspect condition of labyrinth sealing and adjust or replace as required.
12. Visually inspect the throat and measure the gap in between and blocked throats to be cleared

10.7. REJECT SYSTEM

1. Visually inspect the reject slide gates for free shaft movement.
2. Install a new type reject box as per 6A mill modification
3. Visually inspect the reject suction and discharge piping for corrosion, erosion and blockages and repair if required
4. Inspect the jet pulsion isolation valve condition if it is well operational
5. Inspect condition of jet pulsion pump and renew nozzle/venturi, if necessary.
6. Inspect seal water and seal drain valve condition, replace flange gasket.
7. Install new gaskets on all flanges and inspection doors
8. Air Supply System
9. Inspect the condition of primary air inlet to mill duct including PA ring main, unblock blockages if any and repair if required.
10. Inspect condition of PA inlet duct inspection door and replace gasket.
11. Inspect condition of PA inlet duct compensators, fastening thereof and align as required.

10.8. MILL DRIVE SYSTEM

1. Check for correct functioning of gear lubricant nozzles on mill gearbox
2. Renew labyrinth gland housing and ribbon.
3. Remove guard and inspect all bolts and rubber condition of a mill-motor coupling.
4. Do oil change based on the latest oil analysis report
5. Verify motor/drive alignment and correct, if required.

10.9. MILL GRINDING ELEMENTS

1. Replace all segments
2. Replace all tyres

3. Inspect the condition of roller hub, shaft, bearings (x2), slippers, seals, hub cover assembly and replace if necessary
4. Replace a cylinder on rollers if required
5. Change oil on all rollers
6. Set up the rollers after refurbishment +/- 6mm gap
7. Set up the buffer stoppers.
8. Inspect labyrinth condition on the rocker arms and replace if necessary, repack the glands

10.10. BEARINGS LUBRICATION

1. Torque all bolts when assembling and verify the connection of the pins.
2. Seal Air System
3. Visual inspection for wear, bolt tightness on the base and re-align motor to fan after replacing all the bearings
4. Visually inspect seal air ring line for condition and leaks. Repair or replace as deemed necessary.
5. Remove and clean seal air fan filters
6. Lubricate all bearings
7. Hydraulic loading System
8. Inspect the condition of all accumulators and the gauges if are operational and visible
9. Open the pump to motor coupling and inspect for any damage or loose particles
10. Visually inspect the oil tank level, clean breather and a sight glass.
11. Visually check the hydraulic pipes and cylinders for oil leaks and fix them as required

10.11. DAMPERS

- 10.11.1. Inspect the Quick close damper bearings if they are not seized and replace them if required
- 10.11.2. Lubricate all bearings
- 10.11.3. Inspect the Maintenance damper bearings and replace if seized
- 10.11.4. Visually inspect the door gaskets on all dampers
- 10.11.5. Verify if the damper seals properly both Quick close and Maintenance dampers

10.12 LUBE OIL

- 10.12.1. Visually inspect the lube oil filters and replace them if damaged/worn

WITNESS POINT:

Plant specialist	Signature	Date

Appendix 11: LOESCHE MILLS – SEAL AIR FANS

1. Weekly inspect the greasing on bearings and top up
2. Weekly clean the fan filters of accumulated dust
3. Weekly check for coupling condition if there are no cracks developing and replace if necessary
4. Weekly check for air leaks on the pipe compensators including the gearbox ribbon
5. Weekly verify the fan outlet if it still within set limits.
6. Monthly clean the runner, check and correct out of balance runners
7. Replace the fan bearings as per the report from condition and monitoring as and when required
8. Visually check the runners for cracks on all the toe of the welds during bearing replacements opportunity inspections
9. Record the bearing clearances after replacing the bearing
10. Make sure the whole train is levelled with minimum usage of shims
11. Do alignment according to Eskom specification as and when required on the fans
12. Do in-situ balancing on newly installed runners
13. Six monthly clean the bearings and re-grease
14. Annually do internal inspections on the blower runner, inspect holding down bolts for looseness and correct when necessary.
15. Do assessment inspections and generate a scope of work during supervisory plant walk down

WITNESS POINT:

Plant specialist	Signature	Date

APPENDIX 12: KEY PERFORMANCE INDICATORS (KPI'S)

1 Principles behind KPI's developed for this contract

These principles have been taken into consideration for the establishment, selection and management of KPI's for this contract:

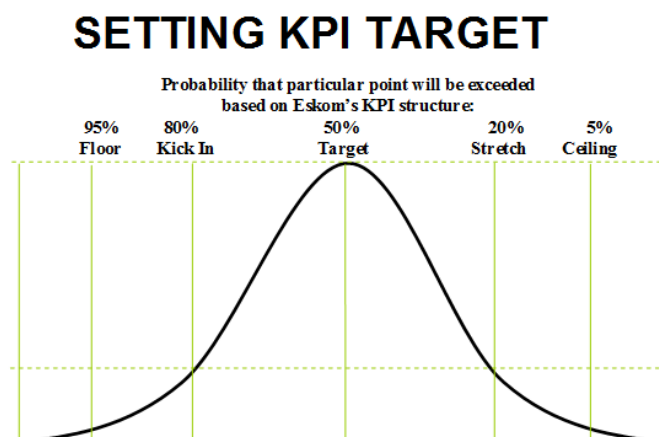
- Alignment with regards to philosophy and objectives of this contract.
- Delay damages shall not be used in Task Orders due to the penalty arrangements in the incentive scheme.
- The incentive is for the Employer to benefit from exceptional performance by the Contractor and for the Contractor to earn related returns for his efforts.
- The Service Manager and the Contractor will manage and control the KPI process.
- A high standard of professional and ethical behaviour is expected from both Parties in the use and administration of this contract.

Essential elements of KPI's

- The initial KPI's and gate keepers and any future KPI's and gate keepers set for this contract shall have these features:
- They must be simple to understand.
- The results or measurement of KPI's and gate keepers must be easy to obtain, compute & record (preferably from existing systems).
- They must be auditable as they are used for payment.
- They must be few in numbers (otherwise each measure is diluted).
- They must be accepted by both the Employer and the Contractor.
- They must be objective.
- Targets should be in line with Station targets.

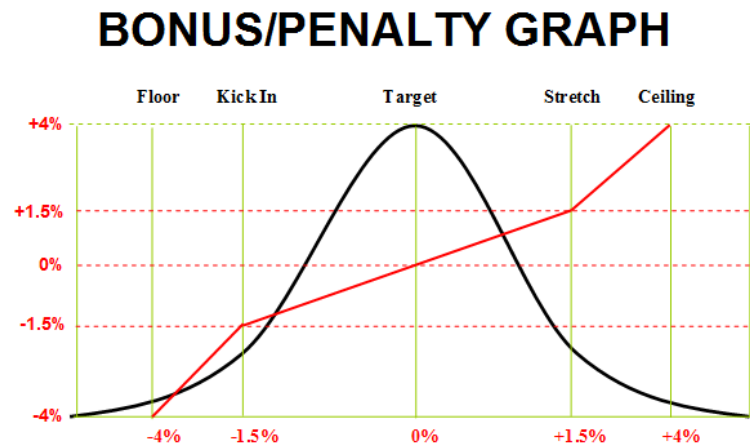
Setting KPI targets

The setting of KPI targets will take into account business expectations and historic performance on the applicable KPI to determine the targets based on the probability that a particular point will be exceeded as illustrated in the following sketch.



Calculating KPI bonus and penalty payments

The following illustrates how the bonus or penalty percentages have been set. These percentages are then applied to the Contractor's turnover for Duvha Power Station to give the applicable bonus or penalty amount due to the Contractor or Employer respectively.



APPENDIX 13: SERVICES REQUIRED

Babcock & Wilcox Mills

Service	Running Hours	Service Duration (hrs)	Service Type	Major Activity	Reference Documents Providing Guidance on Services Required
BABCOCK					
A1i	1755	8	Short inspection	Ball & ring measurement	APPENDIX 6
A1	3510	40	Minor repairs	Ball change	APPENDIX 5
A2i	5265	8	Short inspection	Ball & ring measurement	APPENDIX 6
A2	7020	40	Minor repairs	Ball change	APPENDIX 5
A3i	8775	8	Short inspection	Ball & ring measurement	APPENDIX 6
A3	10530	40	Minor repairs	Ball addition	APPENDIX 5
B1i	11530	8	Short inspection	Ball & ring measurement	APPENDIX 6
B1	12530	40	Minor repairs	Ball change & addition	APPENDIX 5
B2i	13530	8	Short inspection	Ball & ring measurement	APPENDIX 6
B2	14530	40	Minor repairs	Ball change & addition	APPENDIX 5
B3i	15530	8	Short inspection	Ball & ring measurement	APPENDIX 6
B3	16530	40	Minor repairs	-	APPENDIX 5
C1i	17290	8	Short inspection	Ball & ring measurement	APPENDIX 6
C1	18050	40	Minor repairs	Ball change	APPENDIX 5
C2i	18810	8	Short inspection	Ball & ring measurement	APPENDIX 6
C2	19570	40	Minor repairs	Ball change	APPENDIX 5
C3i	20330	8	Short inspection	Ball & ring measurement	APPENDIX 6
C3	21090	120	Major refurbishment	Ball & ring change	APPENDIX 4
PM's on a 3 months frequency are done on A1, A2, A3, B1, B2, B3, C1, C2, and C3 services.					
PM's on a 6 months frequency are done on A2, B1, B3, and C2 services only.					
PM's on a 2 year frequency are done on C3 service.					

Loesche Mills

Service	Running Hours	Service Duration (hrs)	Service Type	Reference Documents Providing Guidance on Services Required
Min	3000	24	Internal Inspection, Wear Rate Measurements, Minor Repairs, Reports	APPENDIX 9
Ins	6000	8	Internal Inspection, Wear Rate Measurements, Reports	APPENDIX 9
Maj	6500	120	Major Refurbishment, Grinding Elements Change, Reports	APPENDIX 7, 8, 9, 10 & 11