

	<b>Standard</b>	<b>Technology</b>
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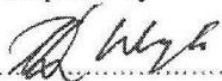
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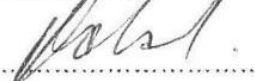


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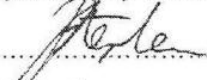


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## **1. INTRODUCTION**

To determine a baseline of the coal qualities suitable for a specific Power Station, Engineering together with RT&D derived the acceptable and rejection coal qualities for each Power Station with utilising the Coal Quality Effect Model tool. This model uses actual plant design and STEP performance data as provided by the power stations to determine the acceptable and the rejection coal quality (absolute minimum) that the boiler plant can tolerate.

This document defines the acceptable and rejection coal qualities, required to sustain its design maximum continuous rating, for each commercially operated Fossil Fuel Fired Power Station in the Eskom fleet. This document will be applicable to the following groups:

- *Technology Division (Engineering) as a reference for new designs and/or design reviews for future plant modifications,*
- *Generation Division as a reference for discussions and investigations regarding the boiler performance under their control, and*
- *Primary Energy Division as a reference for negotiations of new contracts and/or reviewing and adjustments to the existing contracts.*

The coal specifications as indicated in this document should eliminate any confusion and/or perceptions of what is considered to be the most acceptable coal quality for a power station, to sustain full load at all times, by all the different role players.

On completion of the approval for this specification, the following steps need to be completed by all role players to modify the coal specification:

- *Investigate means of improving the plant by replacing components or enhancing its performance by means of modifications to accommodate the poorer quality coals, or*
- *Investigate means of improving the quality of the coal supply to a power station by installing beneficiation plants, re-negotiating of the coal contracts, etc. to meet the qualities of the coal as stipulated in this document*
- *Once the above investigations are conducted the Coal Impact Total Cost of Ownership model should be used to evaluate the best solution and to test its economic viability to ensure the lowest cost option is selected for the power station to meet its rated output in the future*
- *Should both the modifications to the plant and/or coal quality prove not to be economical viable for one or other reason, then a decision to de-rate the power station's rated output to ensure a reliable output; i.e. to operate the plant within regulations requirements and design specifications*

## **2. SUPPORTING CLAUSES**

### **2.1 SCOPE**

The coal quality specification details the acceptable and rejection coal quality for all the Eskom's coal-fired Power Stations. This specification is defined by the power station's ability to produce the designed rated output without any coal related load losses.

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## **2.2 PURPOSE**

The coal qualities in this Specification shall form the baseline for the coal supply contract negotiations and the engineering design reviews and/or modification for a power station.

## **2.3 APPLICABILITY**

This document shall apply throughout Eskom Holdings Limited Divisions. The coal specifications given in this document are valid from the date of approval by SCOT.

## **2.4 NORMATIVE/INFORMATIVE REFERENCES**

### **2.4.1 Normative**

Parties using this document shall use the most recent edition(s) of the document(s) listed in this section.

- [1] 36-680 - Fossil Fuel Firing Regulations
- [2] Government Gazette No 35894 – National Environmental Management: Air Quality Act. 2004 (Act no 39 of 2004)
- [3] C-Schedule data from Power Station design and guarantee contracts
- [4] Performance data as per STEP available for each Power Station
- [5] Financial data of each Power Station as per the SAP system
- [6] 240-54041252 – Standard for Boiler, Coal and Ash Plant Sizing on Existing Power Stations
- [7] BS 1016: Part 16: 1981 – Methods for reporting analysis and testing of coal and coke
- [8] RP/FUEL/QS/10/08 – Ash/Calorific value variations
- [9] Engineering Change Management Procedure – 240-53114002
- [10] RP/FUEL/QS/12/131 – Devolatilisation Index
- [11] 474-9273 – Bulk Materials Handling Plant Design Capacity Requirements

### **2.4.2 Informative**

- [1] ISO 9001 Quality Management Systems.

## **2.5 DEFINITIONS**

<b>Definition</b>	<b>Explanation</b>
Acceptance Test Coal Quality	This is the coal quality used during the acceptance test of a boiler and the results of the acceptance test are normally <u>adjusted</u> by correction factors to determine the performance of the boiler as per guarantee coal specification.
Ash Elemental Analysis	Ash elemental analysis determines the amount of the major mineral compounds present in the ash expressed as simple oxides: SiO <sub>2</sub> , Al <sub>2</sub> O <sub>3</sub> , Fe <sub>2</sub> O <sub>3</sub> , CaO, MgO, Na <sub>2</sub> O, K <sub>2</sub> O, SO <sub>3</sub> , MnO, P <sub>2</sub> O <sub>5</sub> , and TiO <sub>2</sub> . These elements are normally used to calculate the slagging potential of a certain coal.
Boiler Guarantee Coal Specification	The Boiler Guarantee Coal Specification means the coal specification by the Original Equipment Manufacturer (OEM) where the plant will operate at its guaranteed efficiencies.

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Definition	Explanation																													
Coal Quality Effect Model	The Coal Quality Effect Model is a techno-economic tool developed specifically to determine the impact of coal quality on the equipment in the coal chain for power generation technology. It is not a combustion model per se, but rather a mass and energy balance calculating the mass flows for a certain fuel specification. The results are then compared against the designed capacities to determine the limitations in the combustion train.																													
Coal Quality Conversion Table	<table><tr><th>Desired Basis</th><th rowspan="2">As analysed [air dry (ad)]</th><th rowspan="2">As received (ar)</th><th rowspan="2">Moisture free (mf)</th><th rowspan="2">Moisture ash free (maf)</th></tr><tr><th>Given Basis</th></tr><tr><td>As analysed [air dry (ad)]</td><td></td><td><math>\frac{100 - \text{Mar}}{100 - \text{Mad}}</math></td><td><math>\frac{100}{100 - \text{Mad}}</math></td><td><math>\frac{100}{100 - (\text{Mad} + \text{Aad})}</math></td></tr><tr><td>As received (ar)</td><td><math>\frac{100 - \text{Mad}}{100 - \text{Mar}}</math></td><td></td><td><math>\frac{100}{100 - \text{Mar}}</math></td><td><math>\frac{100}{100 - (\text{Mar} + \text{Aar})}</math></td></tr><tr><td>Moisture free (mf)</td><td><math>\frac{100 - \text{Mad}}{100}</math></td><td><math>\frac{100 - \text{Mar}}{100}</math></td><td></td><td><math>\frac{100}{100 - \text{Amf}}</math></td></tr><tr><td>Moisture ash free (maf)</td><td><math>\frac{100 - (\text{Mad} + \text{Aad})}{100}</math></td><td><math>\frac{100 - (\text{Mar} + \text{Aar})}{100}</math></td><td><math>\frac{100 - \text{Amf}}{100}</math></td><td></td></tr></table>	Desired Basis	As analysed [air dry (ad)]	As received (ar)	Moisture free (mf)	Moisture ash free (maf)	Given Basis	As analysed [air dry (ad)]		$\frac{100 - \text{Mar}}{100 - \text{Mad}}$	$\frac{100}{100 - \text{Mad}}$	$\frac{100}{100 - (\text{Mad} + \text{Aad})}$	As received (ar)	$\frac{100 - \text{Mad}}{100 - \text{Mar}}$		$\frac{100}{100 - \text{Mar}}$	$\frac{100}{100 - (\text{Mar} + \text{Aar})}$	Moisture free (mf)	$\frac{100 - \text{Mad}}{100}$	$\frac{100 - \text{Mar}}{100}$		$\frac{100}{100 - \text{Amf}}$	Moisture ash free (maf)	$\frac{100 - (\text{Mad} + \text{Aad})}{100}$	$\frac{100 - (\text{Mar} + \text{Aar})}{100}$	$\frac{100 - \text{Amf}}{100}$				
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Moisture ash free (maf)	$\frac{100 - (\text{Mad} + \text{Aad})}{100}$	$\frac{100 - (\text{Mar} + \text{Aar})}{100}$	$\frac{100 - \text{Amf}}{100}$																											
DimBo model	The Dimensioning and Boiler model is a modelling tool used to size and design steam generators with or without combustion processes and other complex heat exchanger systems in a steady state operation and is used to determines the mass flow rates and analysis, temperatures and specific enthalpies, heating surfaces, heat transfer, process parameters and mass and energy balances.																													
Drop Tube Furnace Analysis	The Drop Tube Furnace (DTF) is a laboratory scale furnace that simulates the important conditions of temperature, residence time and oxidising environment within a pulverized fuel furnace. It is used to determine the ignition parameters such as; volatile characteristics, activation energy to ignite char and burn out time of the char under controlled laminar conditions.																													
Generation Heat Rate Monitoring System (GHRMS)	The Station Thermal Efficiency Program is used by Power Stations to determine the thermal performance of their plant.																													
Gross Calorific Value	The Gross Calorific Value (GCV, also named High Heating Value, HHV) of a coal sample is the total amount of energy that can be released by combustion of a unit mass of coal including the energy consumed to vaporise the moisture in the coal (latent heat of vaporisation).																													
Moisture Free	Means that all the coal qualities indicated in this report does not contain any moisture. <table><tr><th colspan="2">Coal Matter</th><th rowspan="2">ASH</th><th colspan="2">Total Moisture</th></tr><tr><th>FIXED CARBON</th><th>VOLATILE MATTER</th><th>AIR DRIED MOISTURE</th><th>SURFACE MOISTURE</th></tr><tr><td colspan="2">Dry Ash Free (DAF)</td><td colspan="3"></td></tr><tr><td colspan="2">Moisture Free or Dry Basis (DB)</td><td colspan="3"></td></tr><tr><td colspan="2">Air Dried (AD)</td><td colspan="3"></td></tr><tr><td colspan="2">As Fired or As Received (AR)</td><td colspan="3"></td></tr></table>	Coal Matter		ASH	Total Moisture		FIXED CARBON	VOLATILE MATTER	AIR DRIED MOISTURE	SURFACE MOISTURE	Dry Ash Free (DAF)					Moisture Free or Dry Basis (DB)					Air Dried (AD)					As Fired or As Received (AR)				
Coal Matter		ASH	Total Moisture																											
FIXED CARBON	VOLATILE MATTER		AIR DRIED MOISTURE	SURFACE MOISTURE																										
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Moisture Free or Dry Basis (DB)																														
Air Dried (AD)																														
As Fired or As Received (AR)																														

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Definition	Explanation
Net Calorific Value	<p>The Net Calorific Value<sup>1</sup> (NCV, also named Low Heating Value, LHV) is calculated by subtracting the energy liberated during condensation (LHV) from the GCV.</p> $Q_{\text{net,v,ar}} = Q_{\text{gross,v,ar}} - 0,206 H_{2\text{ar}} - 0,023(TM_{\text{ar}} + 0,1 \text{ Ash}_{\text{ar}})$ <p>Where:</p> <p>v = constant volume</p> <p>TM<sub>ar</sub> = Total moisture content on an “as received” basis</p> <p>H<sub>2ar</sub> = Hydrogen content on an “as received” basis</p> <p>Ash<sub>ar</sub> = Ash content (%) on an “as received” basis</p>
Pilot Scale Combustion Test Facility Analysis	The 1 MW <sub>th</sub> Single Low NOx variable swirl burner Pilot Scale Combustion Test Facility (PSCTF) is able to simulate the pulverised coal combustion performance of full scale boilers. Areas of assessment include combustion efficiency of the coal particulates, fouling/slagging potentials, gaseous emissions, flame properties, flue gas temperature profiles, etc.
Proximate Analysis	The proximate analysis of a coal describes its chemical composition in terms of moisture, ash content, volatile matter and the fixed carbon (by difference).
Quality Monitoring Periods	The general accepted maximum quality monitoring period at power stations is the average quality over a 24-hour period, or as otherwise stipulated in the contract with the supplier. It is highly recommended that the monitoring period for moisture content should not be more than 8 hours. Pre-qualification of stockpiles are an acceptable measure of quality however, it is recommended that the receiving power station have structures in place to sample and monitor the quality when it is off loaded from trucks or trains.
Station Sign-Off Specification	The Station Sign-off Specification refers to the official sign-off on coal qualities, as requested by PED, for import coal by power stations during 2009. In certain cases only the lower or the upper limit of a coal quality were stated instead of a full proximate analysis.
Ultimate Analysis	The ultimate analysis describes the elemental composition of the coal in terms of Carbon (C), Hydrogen (H), Nitrogen (N), Sulphur (S), and by difference the Oxygen (O <sub>2</sub> ). Additionally, specific physical and mechanical properties of coal and particular heat content are also determined.

### 2.5.1 Disclosure Classification

**Controlled Disclosure:** Controlled Disclosure to external parties (either enforced by law, or discretionary).

## 2.6 ABBREVIATIONS

Abbreviation	Explanation
CITCO	Coal Impact Total Cost of Ownership
CoE	Centre of Excellence
CQEM	Coal Quality Effect Model
DHP	Dust Handling Plant
DTF	Drop Tube Furnace
ESP	Electrostatic Precipitator
FEGT	Furnace Exit Gas Temperature

<sup>1</sup> BS 1016:Part 16:1981 - Methods of reporting analysis and testing of coal and coke

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<b>Abbreviation</b>	<b>Explanation</b>
FFFR	Fossil Fuel Firing Regulation
FFP	Fabric Filter Plant
GHRMS	Generation Heat Rate Monitoring System
LOMP	Life of Mine Plan
MCR	Maximum Continuous Rating
mf	Moisture free
MW <sub>th</sub>	Megawatt thermal
NO <sub>x</sub>	Oxides of nitrogen
OEM	Original Equipment Manufacturer
PED	Primary Energy Division
PSCTF	Pilot Scale Combustion Test Facility
PSM	Power Station Manager
RT&D	Research, Test & Development
SCOT	Steering Committee of Technology
SSC	Submersible Scraper Conveyor

## **2.7 ROLES AND RESPONSIBILITIES**

<b>Role</b>	<b>Responsibility</b>
Boiler CoE	Boiler CoE is required to use this specification as the design basis for any future modifications on the plant
Power Stations	Power Stations is required to use this specification to evaluate its current and/or further coal qualities
PED	PED is required to use this specification as basis for negotiations of new contracts and/or modifications to existing contracts

## **2.8 PROCESS FOR MONITORING**

N/A

## **2.9 RELATED/SUPPORTING DOCUMENTS**

This Specification supersedes the following:

- [1] 474-41 – Minimum Coal Quality Specifications for ESKOM Power Stations at Staithe/Silo Inlet

The following related documents to be maintained with this Specification.

- [1] 240-54041252 – Standard for Boiler, Coal and Ash Plant Sizing on Existing Power Stations  
[2] 474-9273 – Bulk Materials Handling Plant Design Capacity Requirements

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### 3. COAL QUALITY SPECIFICATIONS

#### 3.1 COAL QUALITY EFFECT MODEL

The CQEM was initially developed for the determination of bonuses and penalties that should be applied to the coal contracts as well as the minimum coal specification that the boiler can tolerate. Duvha had been selected as the pilot Power Station for development of the CQEM, which was based on similar principles of the earlier Kendal Power Station operating coal limit model. The Duvha CQEM had been validated against actual plant performance and the thermodynamic calculations were verified against the Mass and Energy Balance model developed by Production Unit 3 Engineering. The results of the validation and verification processes have shown that the CQEM is an effective tool to determine the impact of coal quality on the plant. Thereafter, it had been requested that a Coal Quality Effect Model be developed for each of the coal fired power stations within the Eskom fleet including the return to service power stations (Camden, Grootvlei & Komati) and the new build power stations (Medupi & Kusile).

The CQEM consists of sub-models to assist in determining the effect that coal quality may have on the different plant equipment as installed in the boiler plant. These models are:

- *Efficiency model (Mass & Energy)*
- *Mill heat balance model*
- *Erosion model (at economiser inlet)*
- *Gaseous Emission Model*
- *Flue gas particulate cleaning model, and*
- *Cost models that incorporates maintenance costs, operational costs and Life Of Plant Plan (LOPP) costs*

The information used as input in developing the CQEM is:

- *Coal data from either the Power Station, PED or S&I, or a combination thereof*
- *Station Thermal Efficiency Program (STEP) reports*
- *Design data from OEM schedules, modification data or a combination thereof*
- *Actual Plant data from tests carried out on the plant to validate the DimBo models*

The CQEM calculated results are compared to the maximum capabilities of each plant component as installed or modified in order to determine the plant limitation. From this the minimum coal specifications are calculated. The plant referred to include the following:

- *Unit output*
- *FD fans*
- *Mills – including drying capacity*
- *PA fans*

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- ID fans
- Precipitators/Filter bag plants
- Ash plant – including ash storage site capacity
- Coal plant
- Erosion rates at economiser gas inlet
- Gaseous emissions
- Cost related to coal quality changes based on the data provided by the power stations

The minimum coal quality specification for each Power Station is determined by the relevant CQEM with the following assumptions:

- **ACCEPTABLE COAL QUALITY** - is the coal specification at which the plant is capable of operating at 100% MCR without any load losses or changes to maintenance or operating philosophies and agrees with the Regulation 6.3.2. of the FFFR.
- **REJECTION COAL QUALITY** – is the worst (absolute minimum) coal specification that can be tolerated by the plant while still producing the desired output with no load losses due to coal quality. 95% of all coal supplied to a power station shall be within the rejection coal quality as specified in this document. However, a change in maintenance and/or operating philosophies may be required<sup>2</sup> for example: more frequent ashing and/or sootblowing, reduction in operating hours between mill services and/or even between unit outages due to higher erosion rates on tubes, velocity distribution screens, ducting, etc.

### 3.2 MODIFICATIONS TO PLANT

Any modifications to the equipment in the coal chain by the power stations to either increase or decrease the capacity specification of the original installed equipment shall be communicated to Boiler Engineering CoE in order to re-calculate the maximum capacities and adjust the minimum coal specification for that power station accordingly. These modifications shall only be carried-out using the Engineering Change Management Procedure<sup>3</sup> of Technology. The process will consider, but not be limited to the following:

- Coal conveying and storage systems
- Milling plant and burners
- Draught plant (including FD, PA, ID fans and air heaters)
- Precipitators/Fabric Filter Plants
- Ash plant (including Submersible Scraper Conveyor (SSC), Dust handling plants, Ash pumps, conveying systems and ash dump/dam space)

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<sup>2</sup> To be evaluated at each Power Station on a case by case basis

<sup>3</sup> 240-53114002 – Engineering Change Management Procedure

- *Changes to works power consumption*
- *Changes to pressure part systems effecting the heat transfer in boilers*

### **3.3 MODIFICATIONS TO MINIMUM COAL QUALITY SPECIFICATION**

Any coal from a new or existing supplier (new supply contract) to be supplied to a power station with qualities outside the boundaries of the coal quality specification provided in the tables and where the quantities of such a supply exceeds 20% of the monthly consignment, shall be accompanied by "Request for coal quality change", a proximate, an ultimate and ash elemental analysis report of samples taken according to the SAMREC code with a full motivation as to the reason for change. These reports, together with estimated quantities, duration of supply and expected range of qualities shall be submitted to Technology for review and assessment to determine the influence it shall have on the plant and will thereafter be accepted or rejected.

During this review of the new coal quality submission, the following shall be taken into account:

- *Energy requirements*
- *Remnant Life of Power Station*
- *Environmental requirements*
- *Equipment capacities*
- *Costs*

Should the coal from a new or existing supplier contribute less than 15% of the monthly consignment of a power station, PED will negotiate with the power station provided a full spectrum of qualities and quantities accompanies the request to accept the coal at a certain power station. The Power station may choose to request for assistance from Technology Group to determine the impact of such coal on their plant.

### **3.4 COAL ANALYSIS REQUIREMENTS FOR PLANT PERFORMANCE REVIEWS**

#### **3.4.1 Proximate Analysis**

The proximate analysis (according to the latest standard of analysis) has to accompany the new coal qualities submission or plant modification and must include of the following data:

- *Ash content [% - moisture free basis]*
- *Volatile matter content [% - moisture free basis]*
- *Fixed Carbon content [% - moisture free basis]*
- *Inherent moisture content [%]*
- *Additional analysis for Power Station monitoring and contracting purposes*
- *CV content [MJ/kg – moisture free basis]*
- *Total moisture content [%]*

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- *Abrasiveness Index as per Eskom/Mining House method or latest standard of analyses [mgFe/kg of coal]*
- *Hardgrove Index*
- *Sulphur content [% - moisture free basis]*

### 3.4.2 Ultimate Analysis

An ultimate analysis shall be carried-out on the new coal which will be used to determine the air and flue gas mass and volume flow rates required by the combustion process. The ultimate analysis must include at least the following results (on air dried basis):

- *Carbon content [%]*
- *Hydrogen content [%]*
- *Nitrogen content [%]*
- *Oxygen content [%]*
- *Sulphur content [%]*

### 3.4.3 Ash Elemental Analysis

A full ash elemental analysis shall accompany the submission for a change in coal quality request to determine the slagging potential within the combustion chamber.

The following formulae (as a standard within Eskom) or the latest standard will be used as a guideline to determine the slagging potential of the coal sample

Index	Units	Formula	Slagging Risk	
			Low	High
Silica ratio		$S_R = [Si_2O \times 100] / [Si_2O + Fe_2O_3 + CaO + MgO]$	> 90	< 75
Calculated Viscosity	Poise	$CV_{1426^\circ C} = 10^Z$ Where $Z = 0,05784 \times S_R$	> 2000	< 350
Base/Acid ratio		$BA = [Fe_2O_3 + Na_2O + K_2O + CaO + MgO] / [Si_2O + Al_2O_3 + TiO_2]$	< 0,09	> 0,3
Iron Index	%	$Fi = Fe_2O_3 \times BA$	< 0,6	> 2,0
Iron + Calcium	%	$Fe + Ca = Fe_2O_3 + CaO$	< 7,0	> 12,0

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#### 3.4.4 Additional Analysis

If required or where uncertainties do exist, coals will be subjected to coal combustion performance evaluations at the DTF and PSCTF for comparison against previous test results and plant performances. A 5 ton representative sample of the final product from the mine/power station will be required by RT&D to perform these tests.

#### 3.5 ASSUMPTIONS

The following assumptions were incorporated into the determination of the coal qualities for each Power Station.

- 97% boiler MCR = 100% turbine MCR unless otherwise specified
- 90% of design capacity or modified maximum capacity of the limiting auxiliary plant is used to determine the acceptable coal quality. The reason being is to ensure combustion stability and auxiliary plant operation stability at 100% turbine MCR without any load loss while catering for variability in coal quality
- Mill drying capacity = Maximum primary air inlet temperatures (i.e. as measured directly before mill inlet) while maintaining designed mill outlet temperature. If the maximum primary air temperature at mill inlet is not available, the maximum air heater outlet temperature minus 15°C (to cater for attemperating air in-leakage) will be utilised
- The plant equipment in the coal chain is at an optimal operating condition and the maintenance strategies and the operating philosophies adopted will maintain this optimal performance
- The ash content is used as input to the CQEM model and the Eskom generic CV/ash relation curve<sup>4</sup> as developed by RT&D (or the most recent accepted CV vs Ash curve) is used to determine the CV. The equation is as follows:
- $CV \text{ content (mf)} = (\text{Ash mf} \times -0,40285) + 33.66$
- It is important to note that the rejection level is based on the above equation and does include variations in coal quality above the median line in the graph.

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<sup>4</sup> RP/FUEL/QS/10/08 - Ash/Calorific Value variations

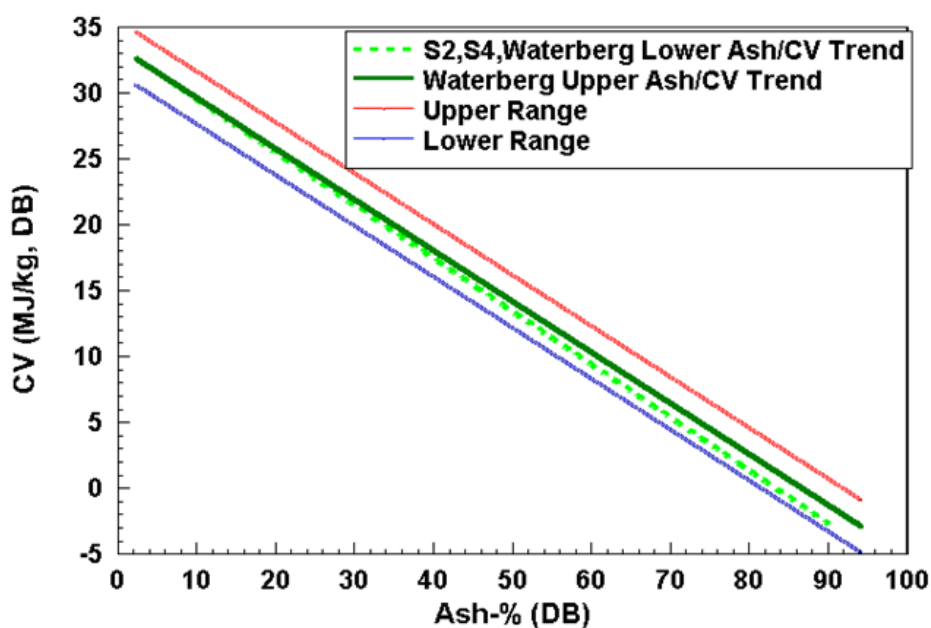


Figure 1: Ash/CV relationship of RSA coals

- The acceptable and rejection volatile content for the purpose of this document shall be determined from the devolatilised limit curve<sup>5</sup> as represented in figure 2 below as follows:
- Devolatilised volatile matter content limit*  $mf = [(Ash\ content\ mf \times -0,190816) + 25,2077]$

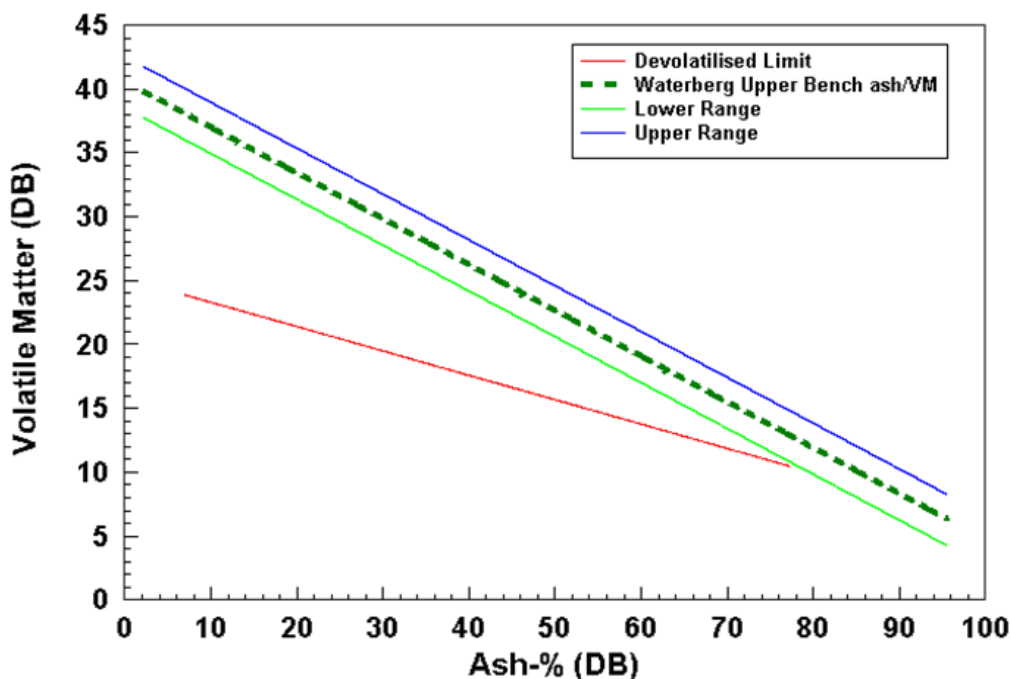


Figure 2: Ash/Volatile (on moisture free basis) plot of RSA coals (included devolatilised curve)

<sup>5</sup> RP/FUEL/QS/12/131 - Devolatilisation Index

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To determine the acceptable and rejection volatile matter for this specification purposes, 1,5% and 0.0% is added for Mpumalanga coals and 6,5% and 4,0% for Waterberg coals to the devolatilised limit respectively.

- *Sulphur content*

The sulphur content is calculated based on the Variation Requests to the National Air Quality Officer by Generation Environmental Department during December 2013 which (if approved) will require that the power stations must adhere to their new respective license agreements in terms of SO<sub>2</sub> emissions. The limits are incorporated into the table of each station.

Therefore, the rejection sulphur content specification is calculated (100% conversion of total Sulphur) to achieve 20% (maximum error) less than the respective license agreed SO<sub>2</sub> emission limit as indicated in the tables, normalised to 10% O<sub>2</sub>. Where the calculations shows that a higher sulphur content than 1,6% (mf) can be allowed, the rejection sulphur content is capped at 1,6% (mf).

The sulphur content is not specified for the acceptable coal, however PED should strive to always negotiate the least sulphur content possible below the rejection level.

- *Unit Efficiency*

The unit efficiency indicated in the tables is based on data from the GHRMS from 2002 to 2007.

- *FEGT (Furnace Exit Gas Temperature)*

The furnace exit gas temperatures as shown in the tables were obtained from the C-schedules. These values should be used as a guideline to determine the influence of ash fusion temperatures on slag formation at furnace exit.

### **3.5.1 Future power stations**

Coal for new build power stations can be either supplied from a “green fields” (new) mine or a “brown fields” (existing) mine. With a “brown field” mine, the history of coal qualities previously supplied shall be reviewed in conjunction with borehole samples for the future horizon of the mine (sampled according to the SAMREC code) to obtain a full picture of the coal qualities over the Life of Mine Plan (LOMP) and the variability of these qualities over time. In the case of a “green field” mine, borehole samples will be gathered in accordance to the SAMREC code to ensure a representative sample is obtained before the final decision with regards to the ratification of a coal quality. During negotiations with the future supplier, Technology Group consultants shall be involved in the review of the coal qualities and will recommend any changes if required.

Once the best sustainable quality of coal is determined for the life of the new power station, these qualities shall be supplied to the boiler designers as the design quality parameter. However, there are also two concepts to follow when new power stations are being built.

- *A known Coal quality for the boiler design*
- *Should the coal quality be known before the boiler parameters are specified, the specified coal qualities shall be used within the boiler tender documents. Should the Tenderer not be able to meet the coal qualities specified, then the coal qualities need to be reviewed for any beneficiation processes, if required*
- *No Coal quality specification prior to boiler design freeze*
- *If the boiler specifications are known prior to the finalisation of the coal qualities, Primary Energy Division will be required to investigate and obtain coal qualities in line with the boiler specifications*

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### 3.6 FUTURE RESEARCH REQUIREMENTS

The following research requirements are necessary to improve the quality of this document:

	Requirement	Responsibility
1.	Development of a coal DNA to improve the Ash/CV and Ash/Volatile matter relationship for each source of coal.	RT&D
2.	Investigate the basic chemical analysis error for future use in coal contracting and negotiations.	PED
3.	Research to be conducted to determine the impact of the different types of stones in coal has on the Abrasive Index.	RT&D
4.	Research to be carried-out to determine the impact of the different types of stones on the CV content as determined in the Bomb calorimeter.	RT&D

### 3.7 MINIMUM COAL QUALITIES

During August 2009, Power Stations were requested to provide a set of minimum/maximum coal quality requirements<sup>6</sup> which formed the basis of the Request for Information (RFI) and subsequent Request for Proposal (RFP) that had been issued to the market to ascertain coal sources. However the qualities provided by some Power Stations was not a representative coal analysis, but was a mere list of minimum/maximum values of calorific value, ash content, total moisture content and volatile matter based on historical operating experience during a period when the load factors were low.

Subsequently, with the use of the verified and updated CQEM models, the minimum coal qualities required for each of Eskom's coal-fired power stations were determined regarding the ability of the plant to produce MCR and are given below. The tables contain three sets of data, namely

- Design Coal Quality

This is the original coal quality which forms the basis of the boiler plant design and was used by the OEM's of the boilers to guarantee boiler plant performance

- Acceptable Coal Quality (to meet FFFR)

This is the quality at which the limiting plant on a power station will operate at 90% of its maximum capacity and is seen as the acceptable coal quality (depending on the moisture content). Burning these coals, the power station shall have no load losses due to coal quality (ascendancy of air quality limits excluded)

- Rejection Coal Quality (as determined by CQEM)

This is the absolute minimum (not average quality) coal quality that a power station can receive and still produce full load (ascendancy of air quality limits excluded). 95% of all future coal supply to a power station should have a coal quality better than the specified qualities in these columns.

Each power station table depicts the influence of moisture; i.e. the moisture content is directly proportional to the CV content. The mill heat balance results determine the sustainability of the milling plant performance as well as achieving the relevant output for the boiler plant to operate at 100% turbine MCR. The moisture content also influences the performance of the coal transport and storage systems upstream of the mills. Therefore, the evaluation of different coal flow ability characteristics needs to be conducted for these systems to determine the maximum moisture content that can be tolerated.

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<sup>6</sup> The 2009 sign-off qualities is only valid until 2015 as per agreement between PED and Generation



Thus, during the selection process of a suitable coal quality for a specific boiler plant (utilising the tables attached), the limitations of the coal transportation and storage systems must be considered. Once the maximum moisture content has been determined for both the materials handling plant and the boiler plant then the associated Rejection coal quality column will become the minimum coal specification for that Power Station.

After the establishment of the minimum coal quality requirements based on the maximum moisture content for a power station, the results will be subjected to the Coal Impact Total Cost of Ownership model which will establish the economic impact of the specified coal quality on the power station's performance parameters.

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### 3.7.1 ARNOT POWER STATION

Acceptable coal quality						
TM	IM	CV	GCV	Nett CV	Ash	Vol
%	%	MJ/kg	MJ/kg	MJ/kg	%	%
ar	ad	mf	ar	ar	mf	mf
6.0	4.1	24.48	23.01	22.12	22.79	22.36
7.0	4.1	24.66	22.93	22.03	22.34	22.44
8.0	4.1	24.85	22.86	21.94	21.87	22.53
9.0	4.1	25.04	22.79	21.84	21.40	22.62
Ave	4.10					22.49

#### Sizing

	Design	Rejection
Top size	25 mm	0% >60 mm & <5% >50 mm
-3.35 mm	-	> 25%
-1.0 mm	-	> 10%

SO<sub>2</sub> emission limit = 2500 mg/Nm<sup>3</sup>

SO<sub>2</sub> emission limit = 2000 mg/Nm<sup>3</sup> with 20% Error

Rejection coal quality											Assumptions (Blr)			Moisture load	Ash load	Sulphur load
TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	Design FEGT	Sec A/H leakage	Furn in-leakage	Oxygen	g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	%	%	%			
ar	ad	mf	ar	ar	mf	mf	mf									
4.5	4.1	22.91	21.88	21.08	26.68	20.12	1.22	>450	<55	1490	13.0	5.0	2.5	1.964	11.645	0.532
6.0	4.1	22.92	21.54	20.71	26.66	20.12	1.22							2.618	11.632	0.532
7.0	4.1	23.02	21.41	20.56	26.41	20.17	1.22							3.041	11.470	0.530
8.0	4.1	23.18	21.32	20.45	26.03	20.24	1.23							3.452	11.229	0.531
9.0	4.1	23.44	21.33	20.45	25.36	20.37	1.24							3.839	10.817	0.529
Ave	4.10					<20.22	>1.23									

#### Design coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	0.5	AFT	Max mill output unit 1	Max mill output units 2 - 6
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	t/hr	t/hr
ar	ad	mf	ar	ar	mf	mf	mf					
8.10	4.10	25.20	23.21	22.49	21.70	25.90	1.10	253	58	1235	65	35.6
7.90	4.10	24.10	22.20	21.47	23.00	23.70	0.90	382	58	1235	65	38.5
Nominal mills for full load											3/3	5/6

Based on units 2 - 6 @ 400 MW

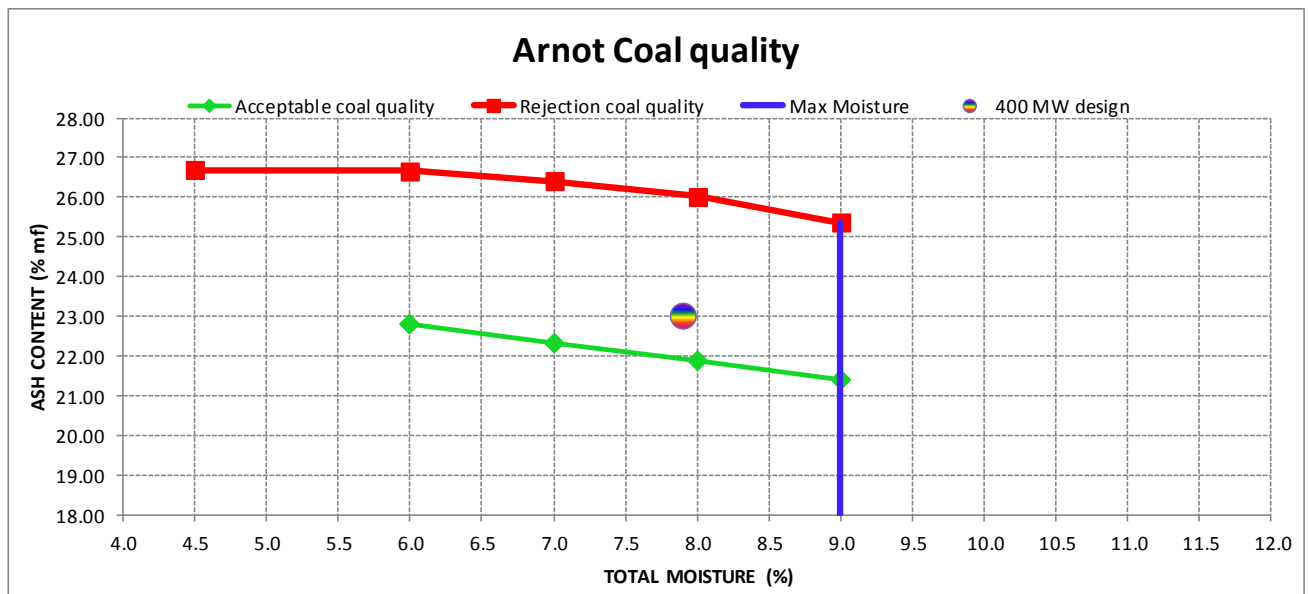
#### Plant limitations:

Coal plant (TM content)  
Mill drying capacity (TM content)  
Mill capacity (CV content)  
FD fan capacity (CHONS)

#### Reference

Arnot CQEM Rev 8 (18.02.2014)

Original design  
400 MW design



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### 3.7.2 CAMDEN POWER STATION

#### Acceptable coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol
%	%	MJ/kg	MJ/kg	MJ/kg	%	%
ar	ad	mf	ar	ar	mf	mf
7.0	3.2	24.43	22.72	21.80	22.91	22.34
8.0	3.2	24.72	22.74	21.79	22.20	22.47
9.0	3.2	25.01	22.76	21.79	21.47	22.61
10.0	3.2	26.07	23.46	22.44	18.85	23.11
Ave	3.20					22.63

#### Sizing

	Design	Rejection
Top size	50 mm	0% >60 mm & <5% >50 mm
-3.35 mm		> 28%
-1.0 mm		> 15%

SO<sub>2</sub> emission limit = 4000 mg/Nm<sup>3</sup>

SO<sub>2</sub> emission limit = 3200 mg/Nm<sup>3</sup> w ith 20% Error

#### Rejection coal quality

Gross Blr Efficiency = 89.0%

#### Assumptions (Blr)

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	Design FEGT	Sec A/H leakage	Furn in- leakage	Oxygen
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	%	%	%
ar	ad	mf	ar	ar	mf	mf	mf						
3.5	3.2	21.07	20.34	19.58	31.24	19.25	1.60						
6.0	3.2	21.65	20.35	19.53	29.82	19.52	1.60						
7.0	3.2	21.88	20.35	19.51	29.23	19.63	1.60						
8.0	3.2	22.13	20.36	19.49	28.62	19.75	1.60						
9.0	3.2	23.17	21.09	20.17	26.03	20.24	1.60						
10.0	3.2	24.43	21.99	21.01	22.91	20.84	1.09						
Ave	3.20					<19.87	>1.51						

Moisture load	Ash load	Sulphur load
g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>
1.661	14.823	0.759
2.772	13.776	0.739
3.199	13.356	0.731
3.615	12.932	0.723
3.884	11.232	0.690
4.093	9.378	0.445

#### Design coal quality

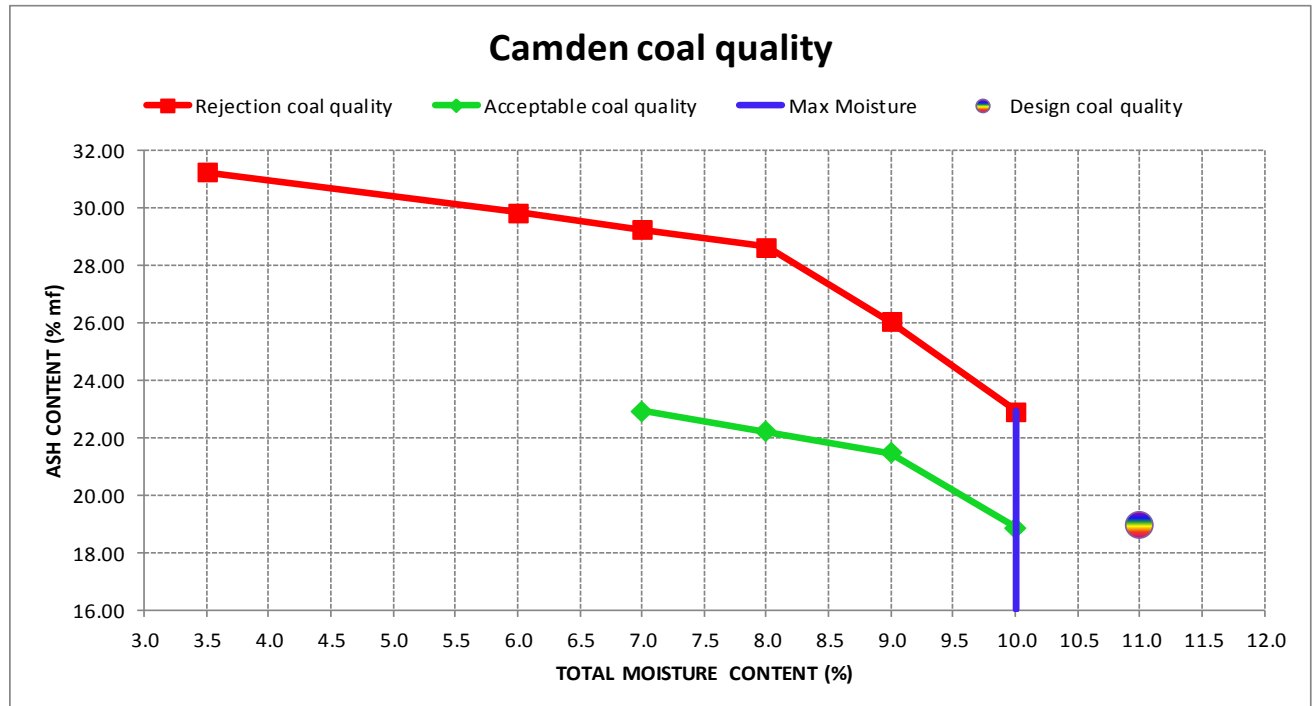
TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	AFT	Max mill output
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	t/hr
ar	ad	mf	ar	ar	mf	mf	mf				
11.00	5.00	25.95	23.10	22.06	18.95	25.79	2.00	-	52	1190	27.30
Nominal mills for full load											4/5

#### Plant limitations:

Coal plant (TM content)  
Mill Drying capacity (TM content)  
Mill capacity (CV content)

#### Reference

Camden CQEM rev 5 (18.02.2014)



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### 3.7.3 DUVHA POWER STATION

Acceptable coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol
%	%	MJ/kg	MJ/kg	MJ/kg	%	%
ar	ad	mf	ar	ar	mf	mf
6.0	3.0	22.27	20.93	20.12	28.28	19.81
7.0	3.0	22.44	20.87	20.04	27.85	19.89
8.0	3.0	22.62	20.81	19.96	27.41	19.98
9.0	3.0	22.79	20.74	19.87	26.98	20.06
10.0	3.0	22.97	20.79	19.80	26.54	20.14
Ave	3.00					19.98

Sizing

	Design	Rejection
Top size	50 mm	0% >60 mm & <5% >50 mm
-3.35 mm		>35%
-1.0 mm		> 15%

SO<sub>2</sub> emission limit = 2600 mg/Nm<sup>3</sup>

SO<sub>2</sub> emission limit = 2080 mg/Nm<sup>3</sup> w ith 20% Error

Rejection coal quality Gross blr efficiency = 90.26

							Assumptions (Blr)				
TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	Design FEGT	Sec A/H leakage
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	%
ar	ad	mf	ar	ar	mf	mf	mf				
3.5	3.0	20.08	19.38	18.61	33.71	18.78	1.01	>550	<58	1250	18.0
6.0	3.0	20.52	19.29	18.47	32.62	18.98	1.03				
7.0	3.0	20.70	19.25	18.42	32.18	19.07	1.04				
8.0	3.0	20.88	19.21	18.36	31.73	19.15	1.04				
9.0	3.0	21.06	19.17	18.30	31.27	19.24	1.05				
10.0	3.0	21.87	19.69	18.80	29.26	19.62	1.09				
Ave	3.00					<19.21	>1.05				

Moisture load	Ash load	Sulphur load
g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>
1.743	16.788	0.503
2.924	15.896	0.500
3.382	15.549	0.501
3.832	15.198	0.499
4.273	14.846	0.499
4.572	13.377	0.497

Design coal quality

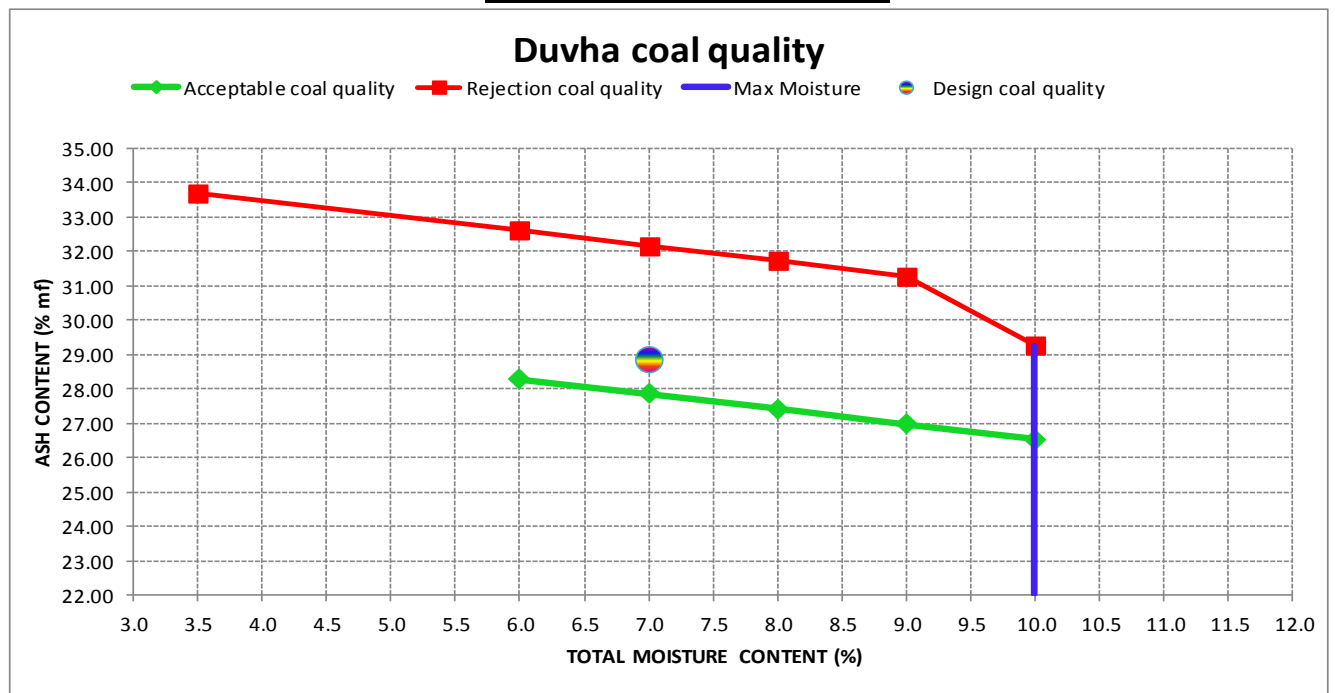
TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	AFT	Max mill output
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	t/hr
ar	ad	mf	ar	ar	mf	mf	ad				
7.00	2.00	23.32	21.69	20.98	28.85	22.42	1.46	580.00	58.00	1285	65.0
Nominal mills for full load											5/6

Plant limitations:

Staithe flow ability (Total moisture content)  
Mill Drying capacity (Total moisture content)  
Mill capacity (CV)

Reference

Duvha CQEM rev 24 (18.02.2014)



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### 3.7.4 GROOTVLEI POWER STATION

#### Acceptable coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol
%	%	MJ/kg	MJ/kg	MJ/kg	%	%
ar	ad	mf	ar	ar	mf	mf
7.0	4.0	20.27	18.85	17.97	33.23	20.37
8.0	4.0	20.74	19.08	18.18	32.08	20.59
9.0	4.0	21.63	19.68	18.79	29.86	21.01
10.0	4.0	22.53	20.27	19.37	27.64	21.43
Ave	4.00					20.85

#### Sizing

	Design	Rejection
Top size	25 mm	0% >60 mm & <5% >50 mm
-3.35 mm	-	> 15%
-1.0 mm	-	> 10%

SO<sub>2</sub> emission limit = 3800 mg/Nm<sup>3</sup>

SO<sub>2</sub> emission limit = 3040 mg/Nm<sup>3</sup> w with 20% Error

#### Rejection coal quality

Gross blr efficiency = 88.82%

							Assumptions (Blr)						
TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	Design FEET	Sec A/H leakage	Furn in-leakage	Oxygen
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	%	%	%
ar	ad	mf	ar	ar	mf	mf	mf						
4.5	4.0	19.57	18.69	17.84	34.98	18.53	1.60	>450	<55	1138	18.0	12.0	3.0
7.0	4.0	19.57	18.20	17.31	34.98	18.53	1.60						
8.0	4.0	19.85	18.26	17.36	34.28	18.67	1.60						
9.0	4.0	20.75	18.88	17.98	32.04	19.09	1.60						
10.0	4.0	21.58	19.42	18.52	29.99	19.49	1.60						
Ave	4.00					<18.94	>1.60						

Moisture load	Ash load	Sulphur load
g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>
2.300	17.876	0.818
3.577	17.876	0.818
4.030	17.269	0.806
4.337	15.439	0.771
4.634	13.898	0.741

#### Design coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	AFT	Max mill output units 1 - 4 & 6	Max mill output Unit 5
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	t/hr	t/hr
ar	ad	mf	ar	ar	mf	mf	mf					
9.00	5.00	22.89	20.83	19.99	24.74	23.68	0.74		60	1390	28.8	26
Nominal mills for full load											5/6	5/6

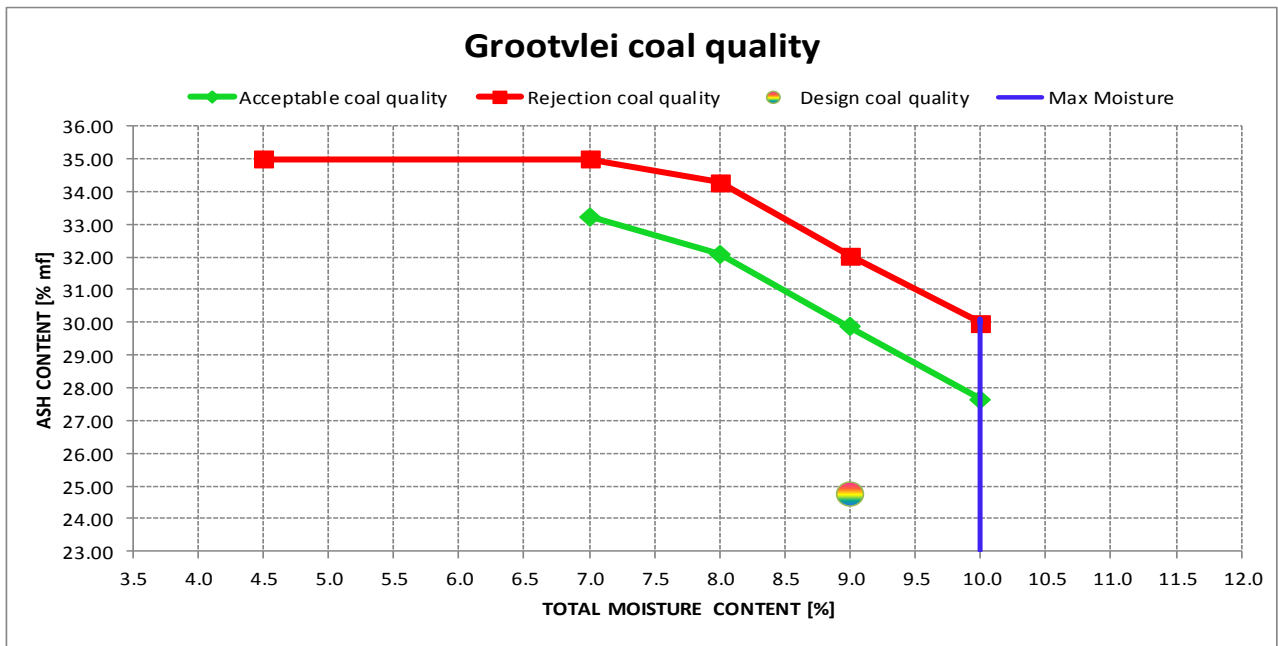
Based on Blrs 1 - 4 & 6

#### Plant limitations:

Mill drying (TM content)  
Ash plant capacity (Ash content)

#### Reference

Grootvlei CQEM rev 5 (18.02.2014)



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### 3.7.5 HENDRINA POWER STATION

Acceptable coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol
%	%	MJ/kg	MJ/kg	MJ/kg	%	%
ar	ad	mf	ar	ar	mf	mf
6.0	3.0	22.36	21.02	20.35	28.05	21.36
7.0	3.0	22.50	20.93	20.24	27.70	21.42
8.0	3.0	22.64	20.83	20.12	27.35	21.49
9.0	3.0	22.79	20.74	20.01	26.98	21.56
Ave	3.00					21.46

Sizing

	Design	Rejection
Top size	25 mm	0% >35 mm & <5% >30 mm
-3.35 mm	-	> 20%
-1.0 mm	-	> 15%

SO<sub>2</sub> emission limit = 3800 mg/Nm<sup>3</sup>

SO<sub>2</sub> emission limit = 3040 mg/Nm<sup>3</sup> with 20% Error

Rejection coal quality

Gross blr Efficiency = 89.06%

Assumptions (Blr)

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	Design FEET	Sec A/H leakage	Furn in-leakage	Oxygen
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	%	%	%
ar	ad	mf	ar	ar	mf	mf	mf						
3.5	3.0	20.24	19.53	18.91	33.32	18.85	1.60						
6.0	3.0	20.85	19.60	18.92	31.80	19.14	1.60						
7.0	3.0	21.10	19.63	18.93	31.17	19.26	1.60						
8.0	3.0	21.34	19.64	18.92	30.57	19.37	1.60						
9.0	3.0	21.47	19.54	18.80	30.26	19.43	1.60						
Ave	3.00					<19.30	>1.60						

Moisture load	Ash load	Sulphur load
g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>
1.729	16.465	0.791
2.878	15.252	0.767
3.317	14.770	0.758
3.748	14.322	0.750
4.192	14.091	0.745

Design coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	AFT	Max mill output 1-7	Max mill output 8-10
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	t/hr	t/hr
ar	ad	mf	ar	ar	mf	mf	mf					
9.00	4.00	24.83	22.60	21.73	23.96	23.96	0.83	253	53	1340	24.8	21.3
Nominal mills for full load											5/6	5/6

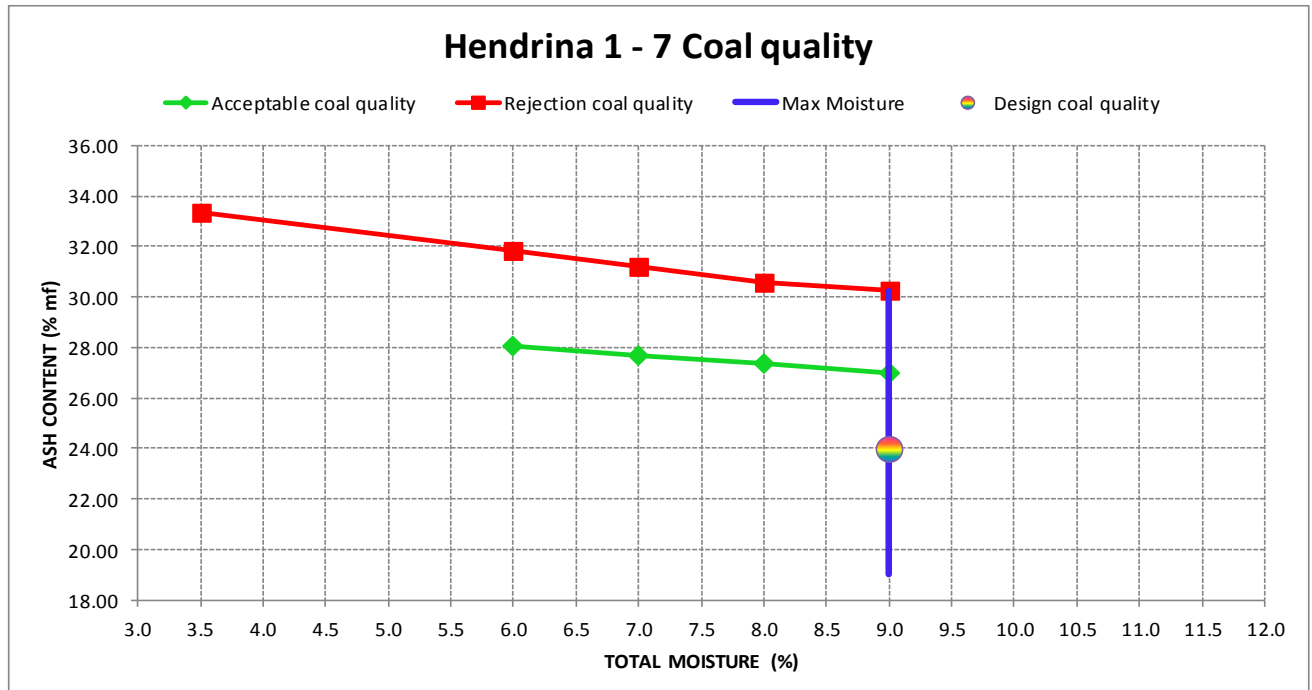
Based on boilers 1 - 7

Plant limitations:

Coal handling plant (TM content)  
Mill capacity (CV content)

Reference

Hendrina CQEM rev 8 (18.02.2014)



**CONTROLLED DISCLOSURE**

### 3.7.6 KENDAL POWER STATION

#### Acceptable coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol
%	%	MJ/kg	MJ/kg	MJ/kg	%	%
ar	ad	mf	ar	ar	mf	mf
6.0	3.1	19.21	18.05	17.37	35.88	19.86
7.0	3.1	19.40	18.04	17.33	35.40	19.95
8.0	3.1	19.59	18.03	17.30	34.92	20.04
9.0	3.1	19.79	18.01	17.26	34.42	20.14
Ave	3.10					20.00

#### Sizing

	Design	Rejection
Top size	50 mm	0% >60 mm & <5% >50 mm
-3.35 mm		> 28%
-1.0 mm		> 15%

SO<sub>2</sub> emission limit = 3000 mg/Nm<sup>3</sup>

SO<sub>2</sub> emission limit = 2400 mg/Nm<sup>3</sup> with 20% Error

#### Rejection coal quality Gross blr Efficiency = 89.13%

											Assumptions (Blr)		
TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	Design FEET	Sec A/H leakage	Prim A/H leakage	Oxygen
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	%	%	%
ar	ad	mf	ar	ar	mf	mf	mf						
3.5	3.1	16.98	16.38	15.74	41.41	17.31	1.00	>450	<55	1193	13.0	2.0	2.5
6.0	3.1	17.41	16.36	15.67	40.34	17.51	1.02						
7.0	3.1	17.59	16.36	15.64	39.90	17.59	1.03						
8.0	3.1	17.77	16.35	15.61	39.45	17.68	1.04						
9.0	3.1	17.95	16.34	15.58	38.99	17.77	1.05						
Ave	3.10					<17.64	>1.04						

Moisture load	Ash load	Sulphur load
g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>
2.061	24.390	0.590
3.446	23.172	0.587
3.980	22.688	0.587
4.503	22.203	0.586
5.013	21.718	0.587

#### Design coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	AFT	Max mill output
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	t/hr
ar	ad	mf	ar	ar	mf	mf	ad				
10.10	3.10	20.38	18.32	17.55	37.31	22.00	0.78	250.00	55.00	1230	103.68
Nominal mills for full load											4/5

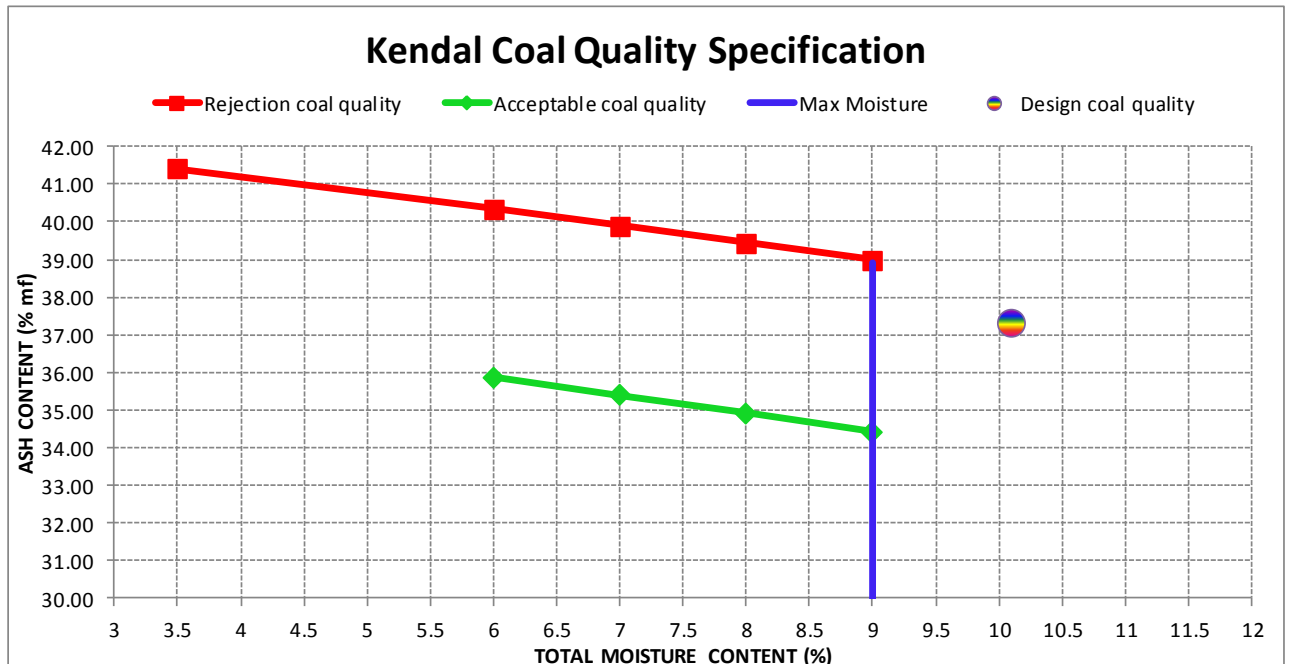
#### Plant limitations:

Milling plant inlet chute (TM content and fines <1 mm)

Mill Capacity (CV content)

#### Reference

Kendal CQEM rev 6 (20.02.2014)



**CONTROLLED DISCLOSURE**

### 3.7.7 KOMATI POWER STATION

Acceptable coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol
%	%	MJ/kg	MJ/kg	MJ/kg	%	%
ar	ad	mf	ar	ar	mf	mf
7.0	3.0	22.80	21.20	19.80	26.96	21.56
8.0	3.0	23.03	21.19	19.75	26.39	21.67
9.0	3.0	23.26	21.17	19.69	25.82	21.78
10.0	3.0	23.50	21.15	19.64	25.22	21.90
Ave	3.00					21.73

Sizing

	Design	Rejection
Top size	25 mm	0% >60 mm & <5% >50 mm
-3.35 mm	-	> 25%
-1.0 mm	-	> 15%

SO<sub>2</sub> emission limit = 3200 mg/Nm<sup>3</sup>

SO<sub>2</sub> emission limit = 2560 mg/Nm<sup>3</sup> with 20% Error

Rejection coal quality

Gross blr Efficiency = 89.2%

Assumptions (Blr)

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	Design FEGT	Sec A/H leakage	Air in- leakage	Oxygen
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	%	%	%
ar	ad	mf	ar	ar	mf	mf	mf						
3.5	3.0	20.02	19.32	18.31	33.85	18.75	1.15						
7.0	3.0	20.67	19.22	18.08	32.25	19.05	1.21						
8.0	3.0	20.87	19.20	18.02	31.76	19.15	1.23						
9.0	3.0	21.07	19.17	17.96	31.25	19.24	1.24						
10.0	3.0	21.28	19.15	17.89	30.74	19.34	1.26						
Ave	3.00					<19.20	>1.23						

Moisture load	Ash load	Sulphur load
g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>
1.748	16.905	0.574
3.387	15.604	0.584
3.834	15.221	0.588
4.271	14.831	0.589
4.700	14.448	0.591

Design coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	AFT	Max mill output units 1-3	Max mill output units 4&5	Max mill output units 6&7	Max mill output units 8&9
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	t/hr	t/hr	t/hr	t/hr
ar	ad	mf	ar	ar	mf	mf	mf							
6.40	2.50	27.44	25.68	24.86	21.54	25.64	1.43	170	56	1160	24.1	21.6	25.2	30.6
Nominal mills for full load											3/3	3/3	3/3	3/4

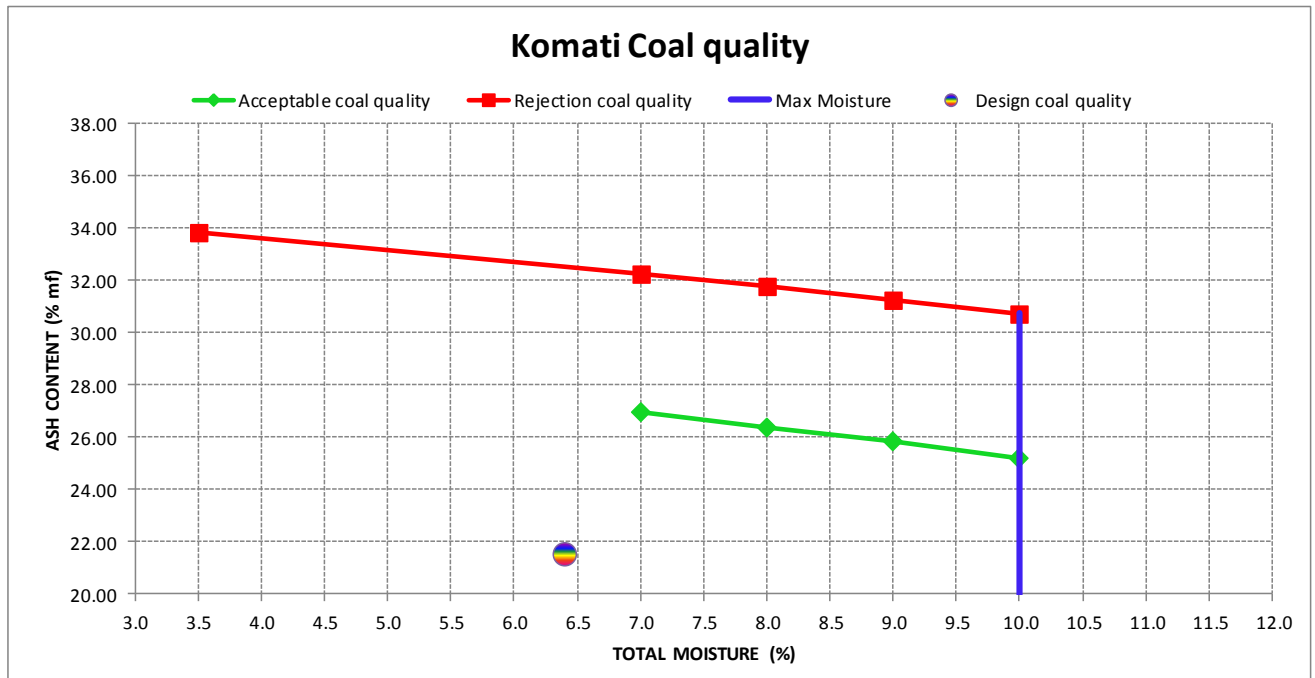
Based on blr 4 & 5

Plant limitations:

Coal Plant (TM content)  
Mill capacity (CV content)

Reference

Komati CQEM rev 4 (20.022014)



**CONTROLLED DISCLOSURE**



### 3.7.8 KRIEL POWER STATION (BOILERS 1 – 3)

#### Acceptable coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol
%	%	MJ/kg	MJ/kg	MJ/kg	%	%
ar	ad	mf	ar	ar	mf	mf
6.0	3.0	23.54	22.12	21.28	25.13	21.91
7.0	3.0	23.77	22.10	21.24	24.56	22.02
8.0	3.0	24.00	22.08	21.20	23.99	22.13
9.0	3.0	24.23	22.05	21.16	23.40	22.24
Ave	3.00					22.08

#### Sizing

	Design	Rejection
Top size	25 mm	0% >50 mm & <5% >45 mm
-3.35 mm	-	> 35%
-1.0 mm	-	> 15%

SO<sub>2</sub> emission limit = 2800 mg/Nm<sup>3</sup>

SO<sub>2</sub> emission limit = 2240 mg/Nm<sup>3</sup> with 20% Error

#### Rejection coal quality

Gross blr efficiency = 89.55%

#### Assumptions (Blr)

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	Design FEGT	Sec A/H leakage	Furn in-leakage	Oxygen
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	%	%	%
ar	ad	mf	ar	ar	mf	mf	mf						
3.5	3.0	20.80	20.07	19.31	31.92	19.12	1.09	>450	<54	1190	15.0	5.0	3.5
6.0	3.0	21.33	20.05	19.24	30.60	19.37	1.12						
7.0	3.0	21.55	20.04	19.21	30.06	19.47	1.13						
8.0	3.0	21.77	20.03	19.18	29.51	19.58	1.16						
9.0	3.0	22.00	20.02	19.15	28.95	19.68	1.17						
Ave	3.00					<19.53	>1.14						

Moisture load	Ash load	Sulphur load
g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>
1.683	15.345	0.523
2.813	14.344	0.527
3.248	13.949	0.526
3.674	13.554	0.530
4.091	13.161	0.530

#### Design coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	AFT	Max mill output
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	t/hr
ar	ad	mf	ar	ar	mf	mf	mf				
9.50	4.50	24.54	22.21	21.42	21.77	24.20	1.23	170	54	1225	50.0
Nominal mills on load for full load											5/6

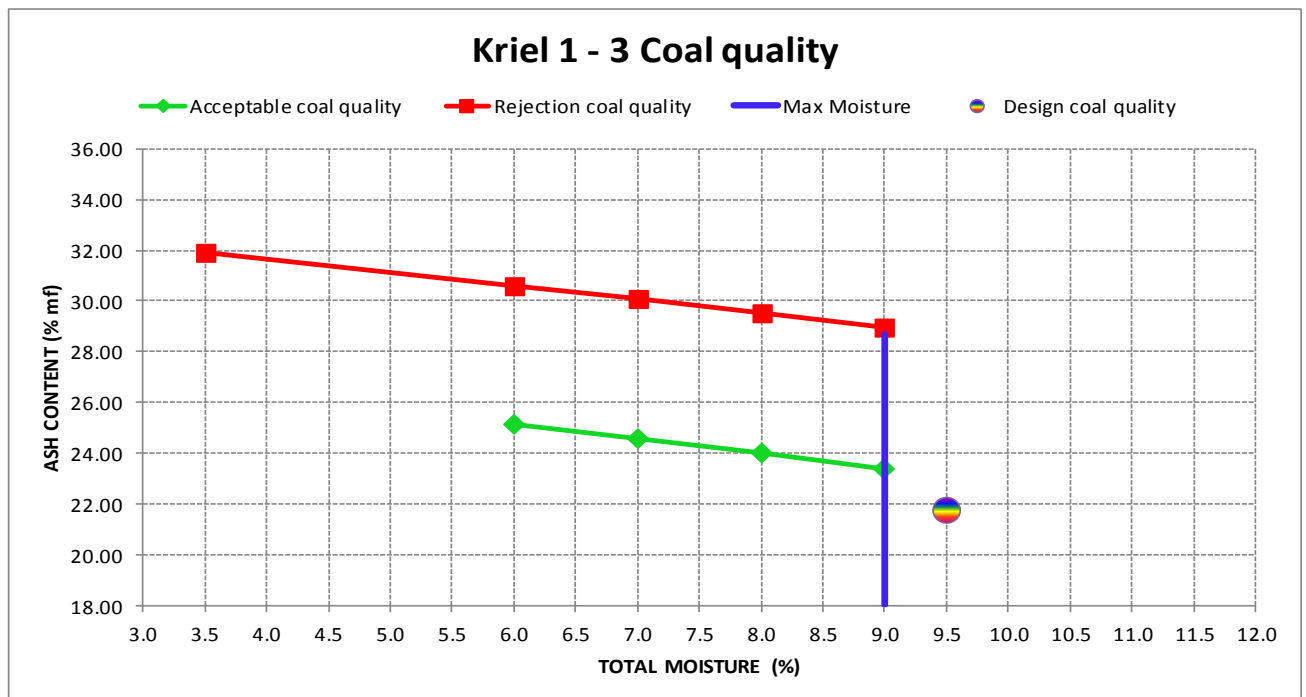
#### Plant limitations:

Coal handling plant (TM content)

Mill capacity (CV content)

#### Reference

Kriel CQEM rev 8 (22.02.2014)



**CONTROLLED DISCLOSURE**

### 3.7.9 KRIEL POWER STATION (BOILERS 4 – 6)

Acceptable coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol
%	%	MJ/kg	MJ/kg	MJ/kg	%	%
ar	ad	mf	ar	ar	mf	mf
6.0	3.0	19.83	18.64	17.81	34.34	20.15
7.0	3.0	20.01	18.61	17.77	33.88	20.24
8.0	3.0	20.20	18.58	17.72	33.41	20.33
9.0	3.0	20.39	18.56	17.67	32.94	20.42
Ave	3.00					20.29

Sizing

	Design	Rejection
Top size	25 mm	0% >50 mm & <5% >45 mm
-3.35 mm	-	> 35%
-1.0 mm	-	> 15%

SO<sub>2</sub> emission limit = 2800 mg/Nm<sup>3</sup>

SO<sub>2</sub> emission limit = 2240 mg/Nm<sup>3</sup> with 20% Error

Rejection coal quality

Gross blr efficiency = 88.85%

Assumptions (Blr)

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	Design FEGT	Sec A/H leakage	Furn in- leakage	Oxygen
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	%	%	%
ar	ad	mf	ar	ar	mf	mf	mf						
3.5	3.0	17.62	17.00	16.26	39.82	17.61	0.97						
6.0	3.0	18.05	16.96	16.17	38.76	17.81	0.99						
7.0	3.0	18.22	16.95	16.13	38.32	17.90	1.00						
8.0	3.0	18.40	16.93	16.10	37.87	17.98	1.01						
9.0	3.0	18.59	16.91	16.06	37.42	18.07	1.02						
Ave	3.00					17.94	>1.01						

Moisture load	Ash load	Sulphur load
g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>
1.987	22.601	0.550
3.325	21.479	0.549
3.841	21.029	0.549
4.347	20.577	0.549
4.843	20.134	0.549

Design coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	AFT	Max mill output
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	t/hr
ar	ad	mf	ar	ar	mf	mf	mf				
8.32	3.32	20.34	18.65	17.77	30.67	21.27	1.09	350	54	1225	62.0
Nominal mills on load for full load											5/6

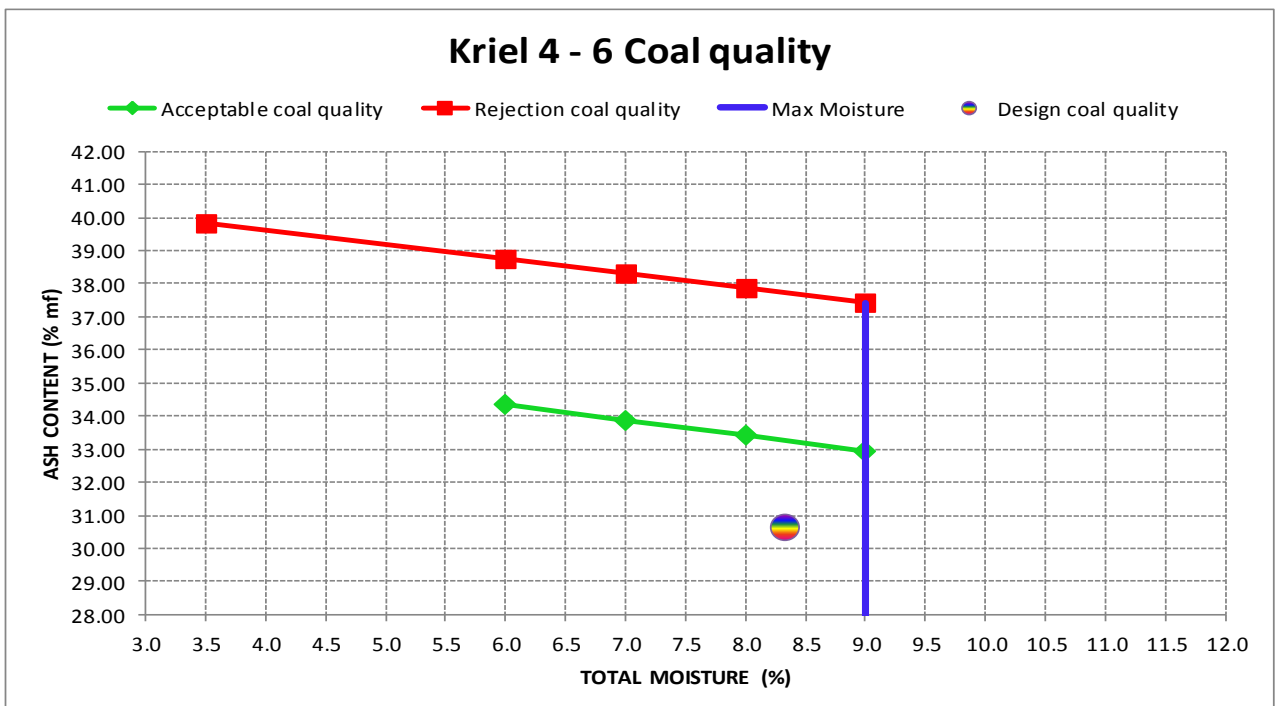
Plant limitations:

Coal handling plant (TM content)

Mill capacity (CV content)

Reference

Kriel CQEM rev 8 (22.02.2014)



**CONTROLLED DISCLOSURE**

### 3.7.10 KUSILE POWER STATION

Acceptable coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol
%	%	MJ/kg	MJ/kg	MJ/kg	%	%
ar	ad	mf	ar	ar	mf	mf
5.0	3.10	19.00	18.05	17.26	36.38	19.77
6.0	3.10	19.22	18.07	17.26	35.84	19.87
7.0	3.10	19.45	18.09	17.26	35.27	19.98
8.0	3.10	19.68	18.10	17.26	34.71	20.08
Ave	3.10			17.26		19.92

Sizing

	Design	Rejection
Top size	25 mm	0% >60 mm & <5% >50 mm
-3.35 mm	-	> 25%
-1.0 mm	-	> 15%

SO<sub>2</sub> emission limit = 500 mg/Nm<sup>3</sup>

Rejection coal quality

Gross blr efficiency = 89.4%

Assumptions (Blr)

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	Design FEGT	Sec A/H leakage	Prim A/H leakage	Oxygen
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	%	%	%
ar	ad	mf	ar	ar	mf	mf	mf						
4.0	3.1	17.83	17.12	16.35	39.29	17.71	1.34	>450	<50	1180	13.0	10.0	3.0
6.0	3.1	18.25	17.15	16.35	38.26	18.91	1.34						
7.0	3.1	18.46	17.17	16.35	37.72	19.01	1.34						
8.0	3.1	18.68	17.19	16.35	37.18	19.11	1.34						
Ave	3.10			16.35		<18.69	>1.34						

Moisture load	Ash load	Sulphur load
g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>
2.243	22.033	0.751
3.288	20.968	0.734
3.791	20.428	0.726
4.282	19.901	0.717

Design coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	AFT	Max mill output
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	t/hr
ar	ad	mf	ar	ar	mf	mf	mf				
7.00	3.10	19.35	18.00	17.26	36.99	19.79	0.93	350	55	1230	115.3
Nominal mills for full load										4/5	

Plant limitations:

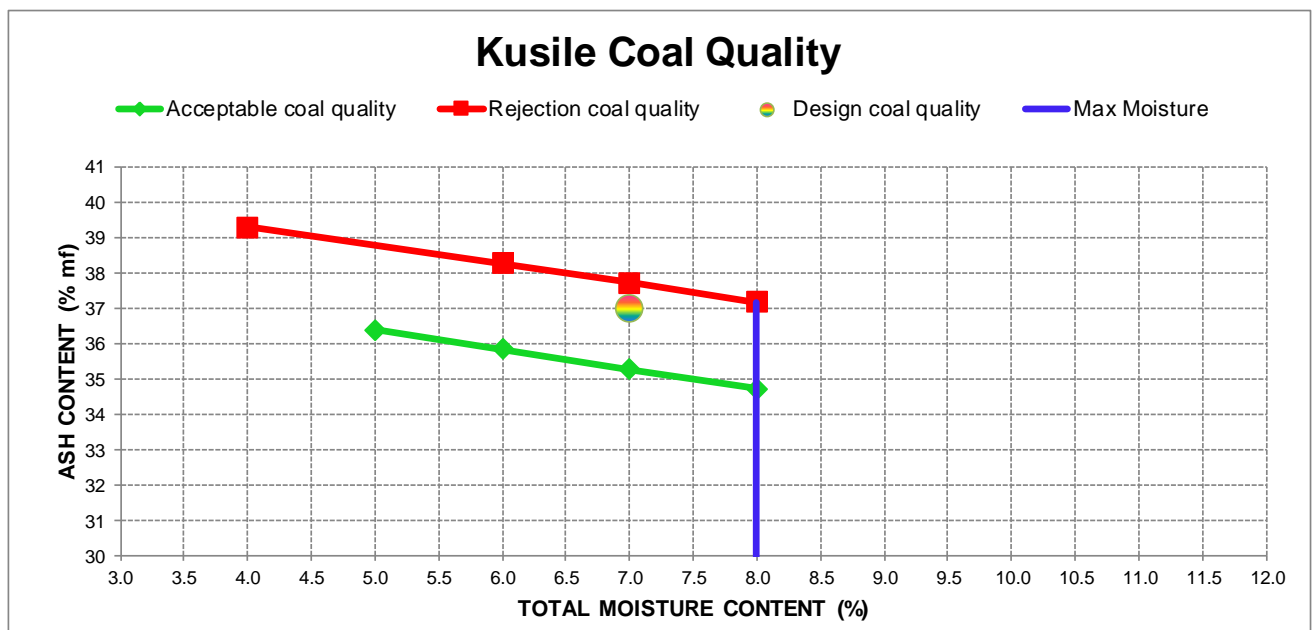
Design data B114115-02-99-IB07-00001-AA

Rejection based on LHV = 16,35 MJ/kg (ar)

Acceptable based on LHV 17.26 MJ/kg (ar)

Reference

Kusile CQEM rev 5 (22.02.2014)



CONTROLLED DISCLOSURE

### 3.7.11 LETHABO POWER STATION

Acceptable coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol
%	%	MJ/kg	MJ/kg	MJ/kg	%	%
ar	ad	mf	ar	ar	mf	mf
8.0	5.0	17.94	16.51	15.70	39.01	19.26
9.0	5.0	18.12	16.49	15.57	38.57	19.35
10.0	5.0	18.30	16.47	15.62	38.12	19.43
11.0	5.0	18.48	16.45	15.58	37.67	19.52
Ave	5.00					19.39

Sizing

	Design	Rejection
Top size	25 mm	0% >60 mm & <5% >50 mm
-3.35 mm	-	
-1.0 mm	-	> 15%

SO<sub>2</sub> emission limit = 3100 mg/Nm<sup>3</sup>

SO<sub>2</sub> emission limit = 2480 mg/Nm<sup>3</sup> with 20% Error

Rejection coal quality

Gross blr efficiency = 88.15%

Assumptions (Blr)

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	Design FEGT	Sec A/H leakage	Prim A/H leakage	Oxygen
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	%	%	%
ar	ad	mf	ar	ar	mf	mf	mf						
5.5	5.0	15.89	15.02	14.25	44.11	16.79	0.98						
8.0	5.0	16.29	14.99	14.17	43.11	16.98	1.01						
9.0	5.0	16.46	14.98	14.14	42.70	17.06	1.02						
10.0	5.0	16.63	14.97	14.11	42.27	17.14	1.03						
11.0	5.0	16.86	15.01	14.12	41.70	17.25	1.04						
Ave	5.00					<17.11	>1.02						

Moisture load	Ash load	Sulphur load
g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>
3.461	27.759	0.616
4.910	26.459	0.617
5.468	25.944	0.617
6.013	25.416	0.621
6.524	24.731	0.618

Design coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol	S	AI	HGI	AFT	Max mill output
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	t/hr
ar	ad	mf	ar	ar	mf	mf	mf				
10.50	4.50	18.34	16.41	15.55	34.97	21.70	1.12	335	50	1210	80.0
Nominal mills on load for full load											5/6

Plant limitations:

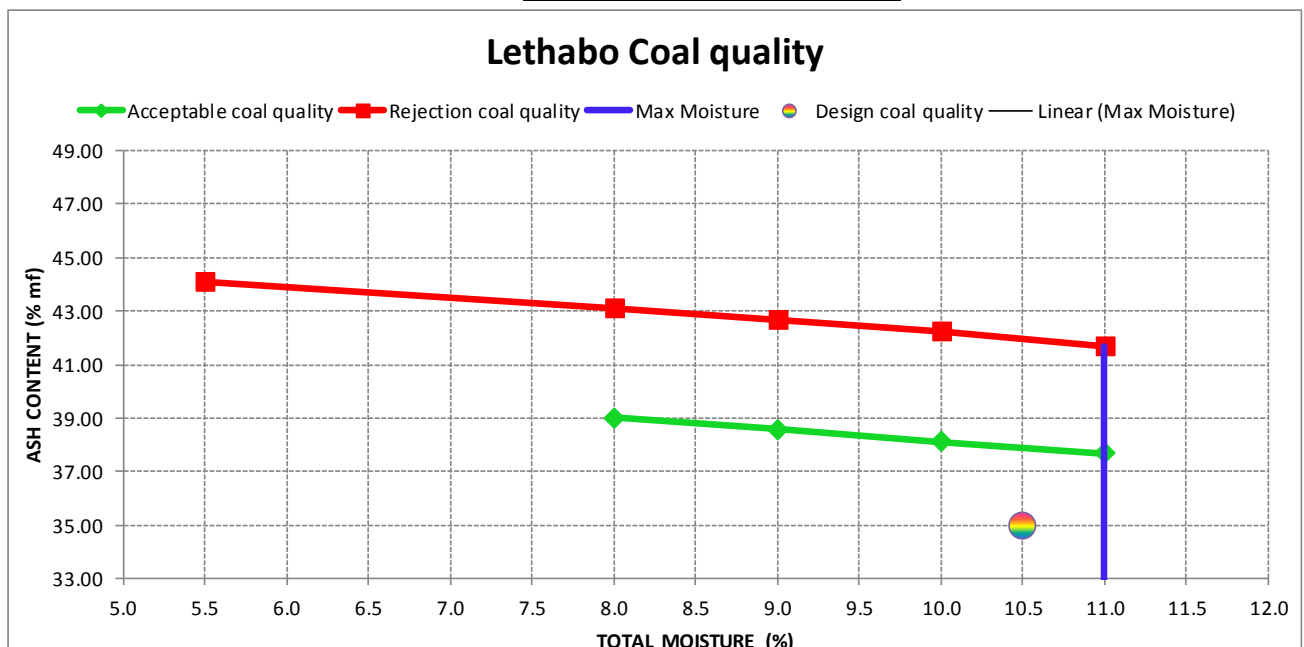
Coal plant (Total moisture)

Mill drying capacity (Total moisture)

Mill capacity (CV content)

Reference

Lethabo CQEM rev 8 (22.02.2014)



**CONTROLLED DISCLOSURE**

### 3.7.12 MAJUBA POWER STATION

Acceptable coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol
%	%	MJ/kg	MJ/kg	MJ/kg	%	%
ar	ad	mf	ar	ar	mf	mf
7.0	4.1	21.90	20.36	19.55	29.20	21.14
8.0	4.1	21.90	20.15	19.31	29.20	21.14
9.0	4.1	21.90	19.93	19.07	29.20	21.14
10.0	4.1	21.90	19.71	18.84	29.20	21.14
Ave	4.10					21.14

Sizing

	Design	Rejection
Top size	25 mm	0% >50 mm
-3.35 mm	-	> 30%
-1.0 mm	-	> 10%

SO<sub>2</sub> emission limit = 3200 mg/Nm<sup>3</sup>

SO<sub>2</sub> emission limit = 2560 mg/Nm<sup>3</sup> with 20% Error

Rejection coal quality

Gross blr efficiency = 90.23%

Assumptions (Blr)

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	Design FEGT	Sec A/H leakage	Prim A/H leakage	Oxygen
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	%	%	%
ar	ad	mf	ar	ar	mf	mf	mf						
4.5	4.1	21.14	20.18	19.43	31.09	19.28	1.33						
7.0	4.1	21.14	19.66	18.86	31.09	19.28	1.33						
8.0	4.1	21.14	19.44	18.63	31.09	19.28	1.33						
9.0	4.1	21.14	19.23	18.40	31.09	19.28	1.33						
10.0	4.1	21.14	19.02	18.17	31.09	19.28	1.33						
Ave	4.10					<19.28	>1.33						

Moisture load	Ash load	Sulphur load
g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>
2.129	14.710	0.627
3.312	14.710	0.627
3.785	14.710	0.627
4.258	14.710	0.627
4.731	14.710	0.627

Design coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	AFT	Max mill output
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	t/hr
ar	ad	mf	ar	ar	mf	mf	mf				
10.10	3.10	21.00	19.76	17.99	31.20	21.98	0.84	450	52	1220	105.0
Nominal mills for full load											4/5

Based on Blrs 4 - 6

Plant limitations:

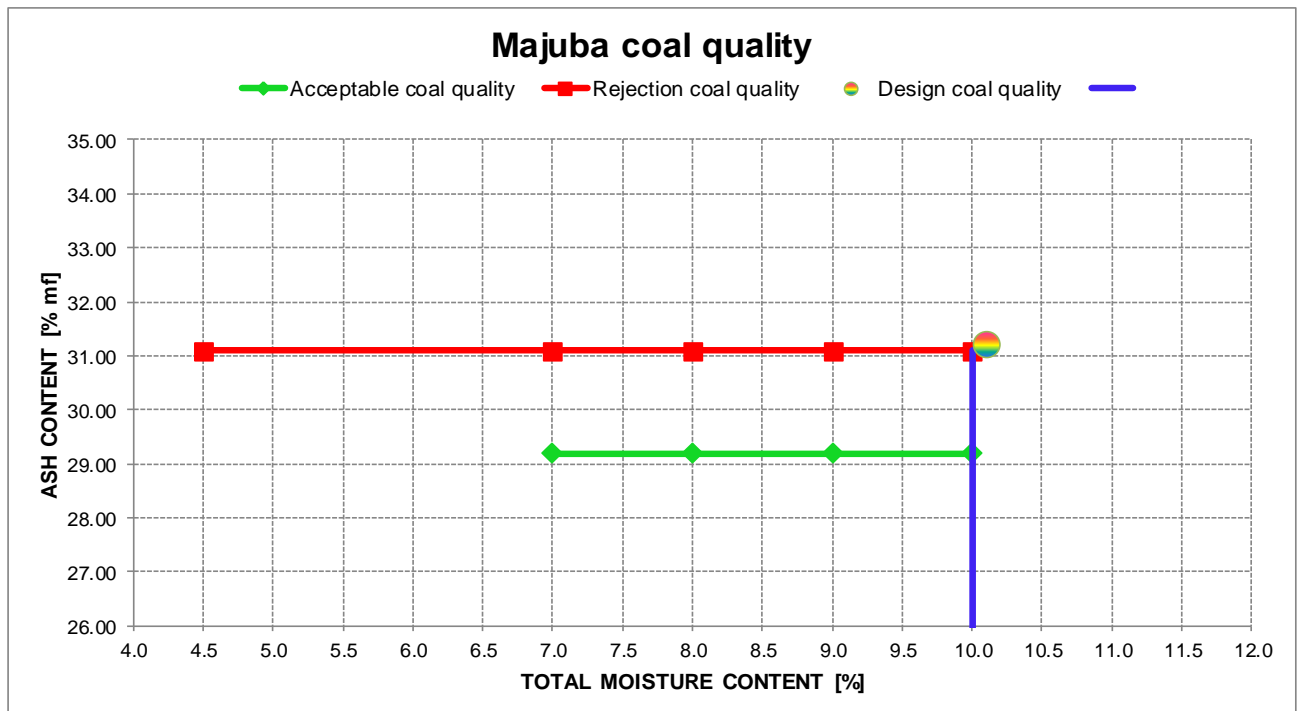
Coal handling plant (Total moisture)

Ash handling plant (Ash content)

Low temp bags in FFP - Strategic decision

Reference

Majuba CQEM rev 9 (22.02.2014)



**CONTROLLED DISCLOSURE**

### 3.7.13 MATIMBA POWER STATION

Acceptable coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol
%	%	MJ/kg	MJ/kg	MJ/kg	%	%
ar	ad	mf	ar	ar	mf	mf
8.0	2.4	19.72	18.14	17.26	34.60	25.11
9.0	2.4	19.72	17.95	17.04	34.60	25.11
10.0	2.4	19.76	17.78	16.86	34.51	25.12
11.5	2.4	21.61	19.13	18.19	29.91	26.00
Ave	2.40					25.33

Sizing

	Design	Rejection
Top size	25 mm	0% >50 mm
-6.67 mm	-	> 55%
-1.0 mm	-	> 20%

SO<sub>2</sub> emission limit = 3700 mg/Nm<sup>3</sup>

SO<sub>2</sub> emission limit = 2960 mg/Nm<sup>3</sup> with 20% Error

Rejection coal quality

Gross blr efficiency = 90.53%

											Assumptions (Blr)		
TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	Design FEGT	Sec A/H leakage	Prim A/H leakage	Oxygen
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	%	%	%
ar	ad	mf	ar	ar	mf	mf	mf						
4	2.4	18.81	18.06	17.34	36.86	22.17	1.40	>450	<47	1210	18	2	2.5
8.0	2.4	18.81	17.31	16.51	36.86	22.17	1.40						
9.0	2.4	18.81	17.12	16.31	36.86	22.17	1.40						
10.0	2.4	18.81	16.93	16.10	36.86	22.17	1.40						
11.5	2.4	20.36	18.02	17.17	33.01	22.91	1.50						
Ave	2.40					<22.36	>1.43						

Moisture load	Ash load	Sulphur load
g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>
2.126	19.595	0.746
4.253	19.595	0.746
4.784	19.595	0.746
5.316	19.595	0.746
5.648	16.212	0.736

Design coal quality

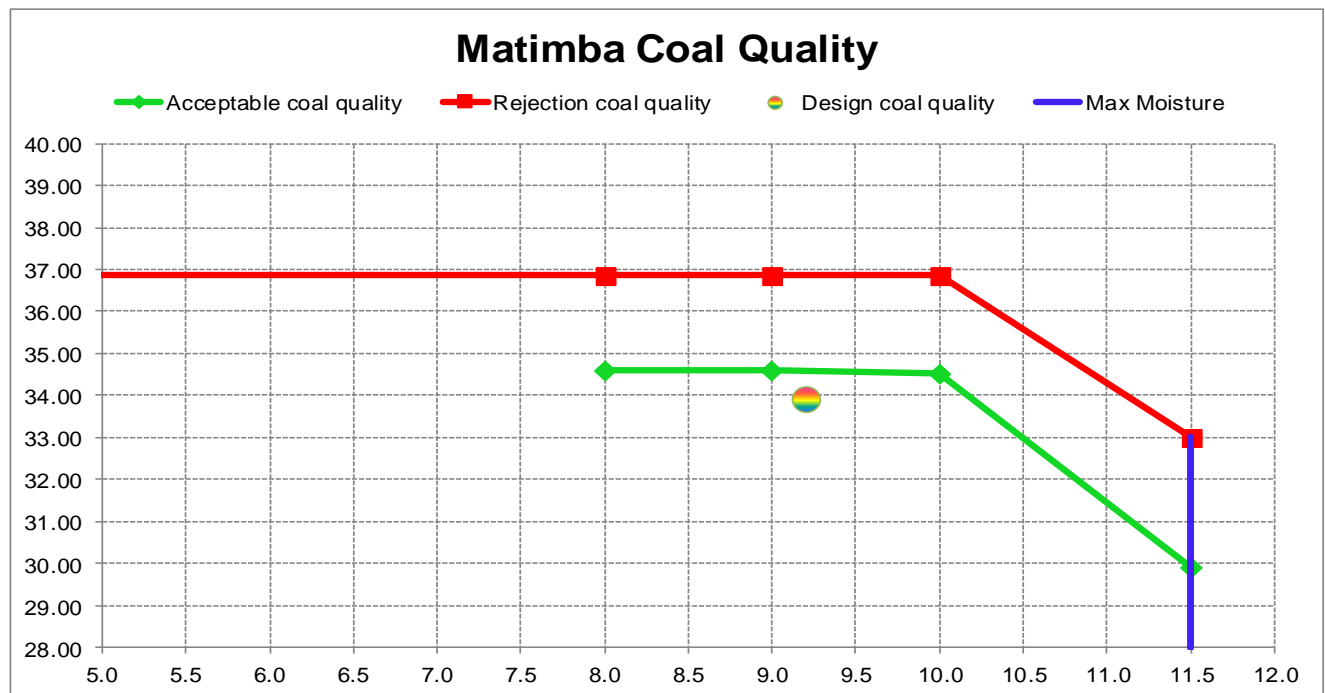
TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	AFT	Max mill output
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	t/hr
ar	ad	mf	ar	ar	mf	mf	mf				
9.20	2.40	21.16	19.21	18.34	33.90	27.70	1.54	250	50	1230	103.0
Nominal mills for full load											4/4

#### Plant limitations:

Coal handling Plant (Total moisture)  
Mill drying capacity (Total moisture)  
Dust handling plant (Ash content)

#### Reference

Matimba CQEM rev 5 (22.02.2014)



CONTROLLED DISCLOSURE

### 3.7.14 MATLA POWER STATION

Acceptable coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol
%	%	MJ/kg	MJ/kg	MJ/kg	%	%
ar	ad	mf	ar	ar	mf	mf
7.0	4.0	21.44	19.94	19.05	30.33	20.92
8.0	4.0	21.47	19.76	18.85	30.25	20.94
9.0	4.0	21.70	19.75	18.83	29.68	21.04
10.0	4.0	21.94	19.75	18.81	29.09	21.16
Ave	4.00					21.01

Sizing

	Design	Rejection
Top size	25 mm	0% >60 mm & <5% >50 mm
-3.35 mm	-	> 30%
-1.0 mm	-	> 10%

SO<sub>2</sub> emission limit = 2900 mg/Nm<sup>3</sup>

SO<sub>2</sub> emission limit = 2320 mg/Nm<sup>3</sup> with 20% Error

Rejection coal quality

Gross blr efficiency = 89.92%

Assumptions (Blr)

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	Design FEGT	Sec A/H leakage	Prim A/H leakage	Oxygen	Moisture load	Ash load	Sulphur load
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	%	%	%	g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>
ar	ad	mf	ar	ar	mf	mf	mf									
4.5	4.0	20.62	19.70	18.85	32.36	19.03	1.14	>450	<55	1143	13	2	3	2.182	15.691	0.552
7.0	4.0	20.62	19.18	18.29	32.36	19.03	1.14							3.394	15.691	0.552
8.0	4.0	20.62	18.97	18.07	32.36	19.03	1.14							3.879	15.691	0.552
9.0	4.0	20.62	18.77	17.85	32.36	19.03	1.14							4.364	15.691	0.552
10.0	4.0	20.62	18.56	17.63	32.36	19.03	1.14							4.849	15.691	0.552
Ave	4.00					<19.03	>1.14									

Design coal quality

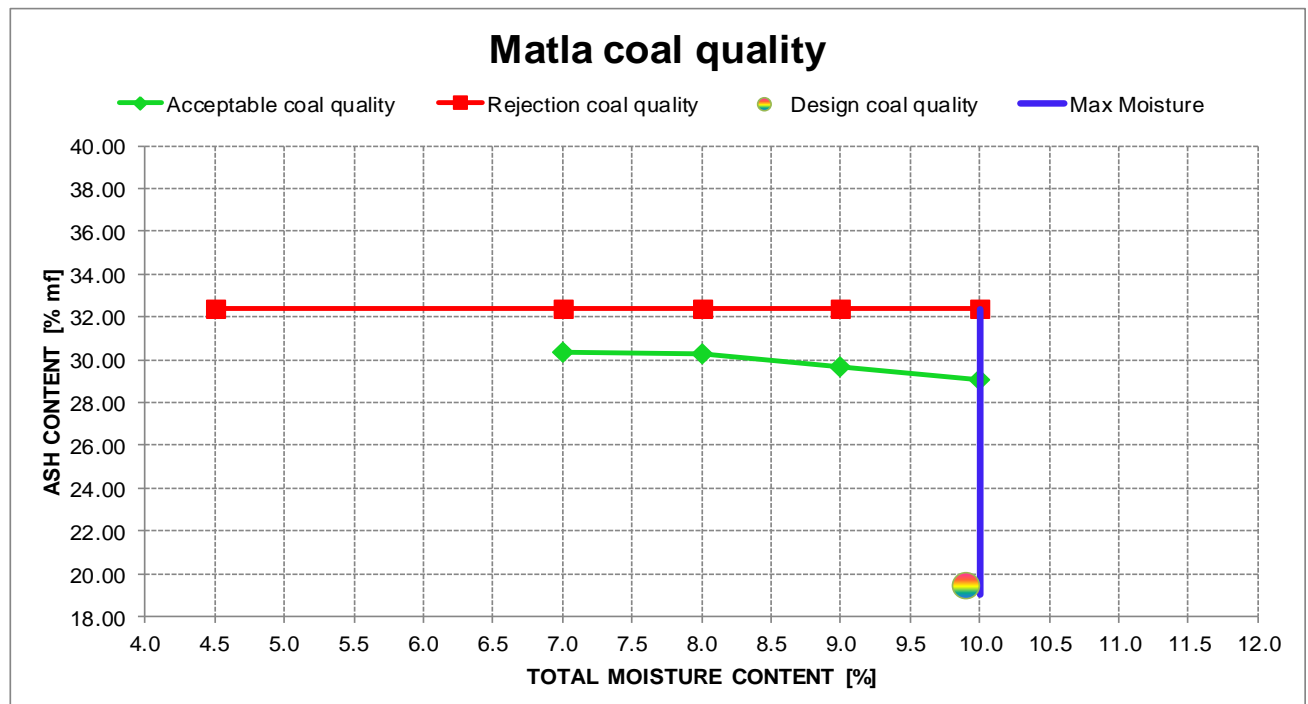
TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	AFT	Max mill output
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	t/hr
ar	ad	mf	ar	ar	mf	mf	mf				
9.90	5.00	24.00	21.62	20.77	19.42	24.80	1.11	200	50	1170	67.6
Nominal mills for full load											5/6

#### Plant limitations:

Coal handling Plant (Total moisture)  
Combined ash plant (Ash content)

#### Reference

Matla CQEM rev 10 (22.02.2014)



**CONTROLLED DISCLOSURE**

### 3.7.15 MEDUPI POWER STATION

#### Acceptable coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol
%	%	MJ/kg	MJ/kg	MJ/kg	%	%
ar	ad	mf	ar	ar	mf	mf
9.0	2.4	20.45	18.61	17.80	32.80	25.45
10.0	2.4	20.69	18.62	17.80	32.20	25.56
11.0	2.4	20.94	18.64	17.80	31.57	25.68
12.0	2.4	21.20	18.65	17.80	30.94	25.80
Ave	2.40					25.62

#### Sizing

	Design	Rejection
Top size	25 mm	0% >60 mm & <5% >50 mm
-3.35 mm	-	> 25%
-1.0 mm	-	> 15%

SO<sub>2</sub> emission limit = 4000 mg/Nm<sup>3</sup> until 2026

SO<sub>2</sub> emission limit = 500 mg/Nm<sup>3</sup> from 2027

#### Rejection coal quality

Gross blr efficiency = 89.16%

#### Assumptions (Blr)

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	Design FEGT	Sec A/H leakage	Prim A/H leakage	Oxygen
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	%	%	%
ar	ad	mf	ar	ar	mf	mf	mf						
5	2.4	18.29	17.37	16.63	38.16	21.93	1.60						
9.0	2.4	19.17	17.44	16.63	35.98	22.34	1.60						
10.0	2.4	19.40	17.46	16.63	35.41	22.45	1.60						
11.0	2.4	19.63	17.47	16.63	34.82	22.56	1.60						
12.0	2.4	19.87	17.49	16.63	34.22	22.68	1.60						
Ave	2.40				<22.51	>1.60						4	

Moisture load	Ash load	Sulphur load
g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>
2.734	20.867	0.875
4.696	18.773	0.835
5.156	18.257	0.825
5.603	17.736	0.815
6.038	17.218	0.805

#### Design coal quality

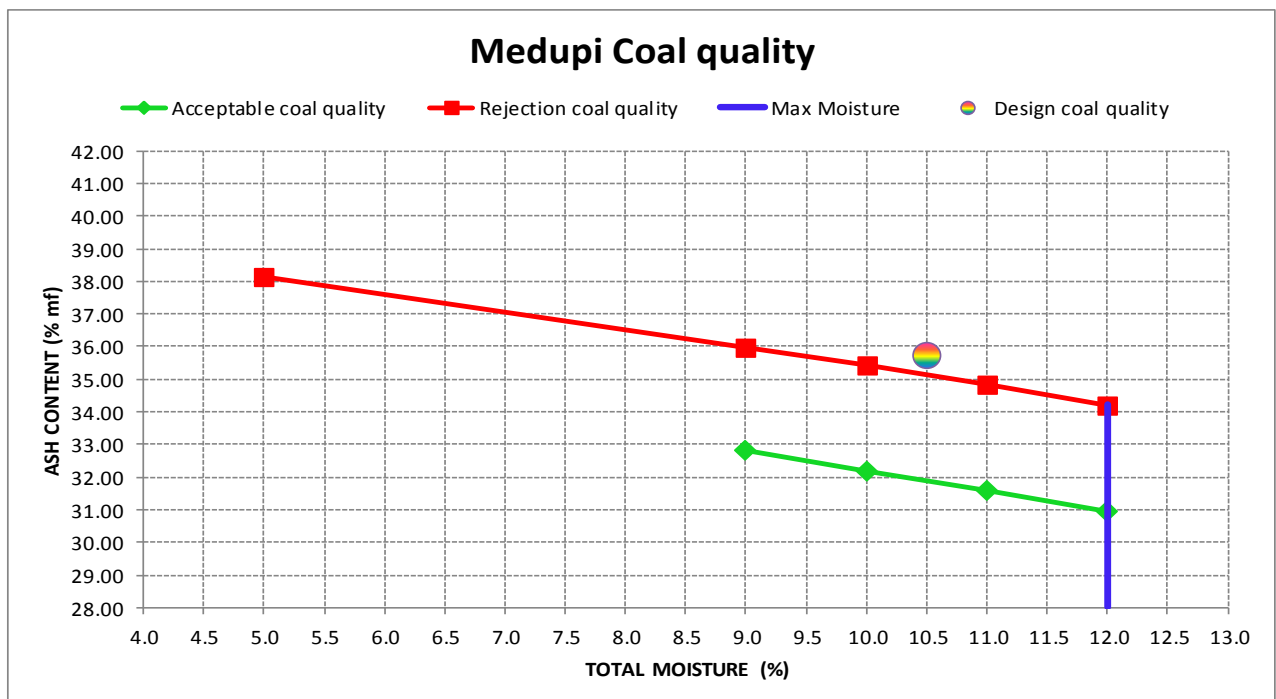
TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	AFT	Max mill output
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	t/hr
ar	ad	mf	ar	ar	mf	mf	mf				
10.50	2.50	20.87	23.21	17.87	35.71	26.43	1.23	500	51	1250	115.3
Nominal mills for full load											4/5

#### Plant limitations

Rejection based on LHV = 16.6 MJ/kg (ar) ▼  
Acceptable based on LHV = 17.8 MJ/kg (ar)  
Refer to: B114116-02-99-IB07-00001-AA

#### Reference

Medupi CQEM rev 4 (22.02.2014)



**CONTROLLED DISCLOSURE**



### 3.7.16 TUTUKA POWER STATION

#### Acceptable coal quality

TM	IM	CV	GCV	Nett CV	Ash	Vol
%	%	MJ/kg	MJ/kg	MJ/kg	%	%
ar	ad	mf	ar	ar	mf	mf
6.0	4.1	22.49	21.14	20.31	27.73	21.42
7.0	4.1	22.68	21.09	20.25	27.25	21.51
8.0	4.1	22.88	21.05	20.18	26.77	21.60
9.0	4.1	23.07	20.99	20.11	26.30	21.69
Ave	4.10					21.55

#### Sizing

	Design	Rejection
Top size	50 mm	0% >60 mm & <5% >50 mm
-3.35 mm	-	>35%
-1.0 mm	-	>15%

SO<sub>2</sub> emission limit = 3400 mg/Nm<sup>3</sup>

SO<sub>2</sub> emission limit = 2720 mg/Nm<sup>3</sup> with 20% Error

#### Rejection coal quality

Gross blr efficiency = 90.26%

TM	IM	CV	GCV	Nett CV	Ash	Vol	Sulphur	AI	HGI	Design FEGT	Sec A/H leakage	Prim A/H leakage	Oxygen
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	%	%	%
ar	ad	mf	ar	ar	mf	mf	mf						
4.5	4.1	20.31	19.39	18.63	33.15	18.88	1.40	>450	<50	1250	18.0	15.0	3.0
6.0	4.1	20.59	19.35	18.56	32.45	19.02	1.41						
7.0	4.1	20.78	19.33	18.51	31.97	19.11	1.43						
8.0	4.1	20.98	19.30	18.46	31.48	19.20	1.44						
9.0	4.1	21.17	19.27	18.39	31.00	19.29	1.45						
Ave	4.10					<19.15	>1.43						

Moisture load	Ash load	Sulphur load
g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>	g/MJ <sub>mf</sub>
2.216	16.326	0.687
2.914	15.762	0.686
3.368	15.384	0.686
3.813	15.006	0.685
4.251	14.642	0.684

#### Design coal quality

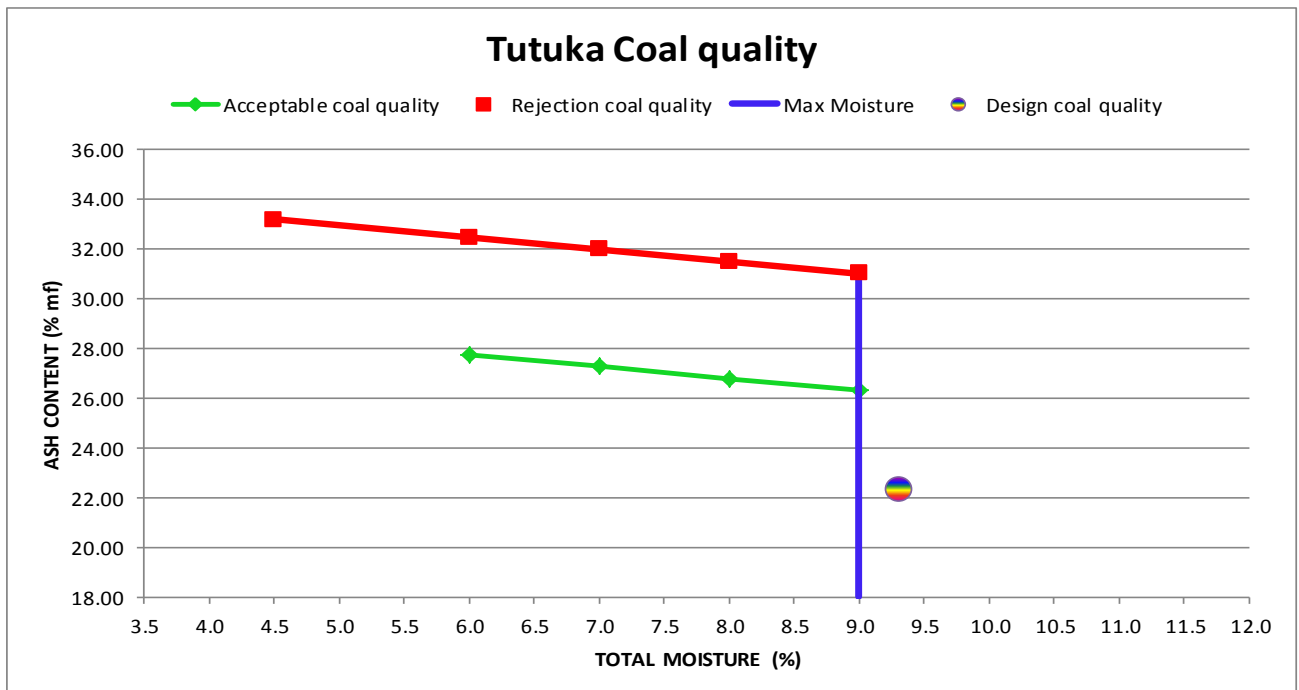
TM	IM	CV	GCV	Nett CV	Ash	Vol	S	AI	HGI	AFT	Max mill output
%	%	MJ/kg	MJ/kg	MJ/kg	%	%	%	mgFe/kg coal	-	°C	t/hr
ar	ad	mf	ar	ar	mf	mf	mf				
9.30	4.30	25.18	22.84	22.06	22.40	24.50	1.37	255	50	1190	63
Nominal mills on load for full load											5/6

#### Plant limitations:

Coal handling plant (total moisture)  
Mill capacity (CV)

#### Reference

Tutuka CQEM rev 8 (22.02.2014)



**CONTROLLED DISCLOSURE**

## **4. AUTHORISATION**

This document has been seen and accepted by:

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J Nair	Power Station Manager (Hendrina)
C Nani	Power Station Manager (Kendal)
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T Conradie	Power Station Manager (Kriel)
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R Lacock	Power Station Manager (Tutuka)
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J Hector	Senior Manager – Production Engineering Integration Coal (Process)
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## **5. REVISIONS**

<b>Date</b>	<b>Rev.</b>	<b>Compiler</b>	<b>Remarks</b>
July 2013	0	DC van Wyk	Revision of old specification (474-41)
March 2014	0.1	DC van Wyk	Draft Document
April 2014	1	DC van Wyk	Final Document for Authorisation and Publication

## **6. DEVELOPMENT TEAM**

The following people were involved in the development of this document:

- *Christo van Wyk*
- *Priven Rajoo*

## **7. ACKNOWLEDGEMENTS**

N/A

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