Eskom	Standard	Technology

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Executive summary

This document focuses on the use of crusher plants during construction of Eskom substations. The main objection for this document is to stipulate Eskom's requirements for crusher plants. This document discusses the robustness of different crushers mainly focusing on type of aggregates produced in terms of particle size as well as the limitation each crusher has during operation. Screening devices also form a major part of the crushing process because aggregates have to be separated in terms of particle size. Aggregate size is important since different sizes have different uses for example some may be used for yard stone, terracing, concrete and so on.

1. Introduction

The purpose for this document is to specify the required crusher plant to be used for a new substation or an existing one. During the construction of Eskom substation, preparation of the terrace, raw material from the source such as boulders, bed rocks may be encountered. The crusher plants become advantageous in the sense that Eskom can save on cost by simply re-using raw material by processing it into yard stone, aggregates for concrete and access roads and backfilling, etc. This document will ensure the selection of suitable crusher plant for Eskom substations by specifying size, capacity, grading and quality requirements.

2. Supporting Clauses

2.1 Scope

The scope of the document is limited for crusher plant to be used when crushing rock during the construction of terrace of substations.

2.1.1 Purpose

The purpose of this document is to ensure the correct usage of a crusher plant during the construction of substation terrace. This document also outlines the usage of the raw material obtained during construction of the terrace. It also states requirements for crushed and screened aggregates for gravel base, gravel backfill, yard stone, aggregates for concrete, access roads and backfilling.

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions.

2.2 Normative/Informative References

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

2.2.1 Normative

[1] ISO 9001 Quality Management Systems.

2.2.2 Informative

None

2.3 Definitions

2.3.1 General

Definition	Description
Aggregates	Consisting of a mixture of minerals separable by mechanical means.
Conveyor	An endless belt or chain, set of rollers, etc., for carrying materials or objects short distances, as from one part of a building to another.
Feeder	device that feeds a machine
Gyratory	Moving in a circle or spiral.
Plant	The equipment, including the fixtures, machinery, tools, etc., and often the buildings, necessary to carry on any industrial business.

Definition	Description
Reduction ratio	An expression of the number of times by which an original rock size has been reduced.
Screening	Undesirable material that has been separated from usable material by means of a screen or sieve:

2.3.2 Disclosure Classification

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

2.4 Abbreviations

Abbreviation	Description
CSS	Closed side set
OSS	Open side set
tph	Tonnage per hour

2.5 Roles and Responsibilities

- The compiler shall be responsible for compiling and reviewing the document.
- The Approver shall ensure the correctness and integrity of the technical content of document.
- The Senior manager shall authorize the document for use.

2.6 Process for monitoring

Not applicable.

2.7 Related/Supporting Documents

Not applicable.

3. Specification of crusher plant

3.1 Crusher plant Process

Crusher plants shall be classified according to the stage of crushing in terms of aggregate size achieved. Crusher plants consist of three defined stages which are as follows:

- Primary
- Secondary
- Tertiary.

The primary crusher basically receives rocks directly after blasting from the quarry and produces the first reduction in size. This output from the primary crusher is then fed to the secondary which further reduces the size of aggregates. At certain times aggregates have to pass through four or more times to achieve the desired size. The stages are spread through several stages due to the degree of breakage hence waste from the raw material. The reduction in size of raw material is defined from reduction ratio.

3.2 Types of Crushers

The contractor shall utilize industrially accepted plants which include the following crusher plant type:

- Jaw
- Gyratory
- Roll
- Impact
- Specialty.

This document will primarily discuss portable crushers which can be basically transported easily to a specific site and is operating efficiently as well profitably to both client and contractor.

Table 1: Illustrates the type of crusher vs. the reduction ratio range (courtesy of Dr. Assakkaf)

The major types of crushers	
Crusher type	**Reduction ratio range**
Jaw	
a. Double Toggle	
1. Blake	**4:1 – 9:1**
2. Overhead pivot	**4:1 – 9:1**
b. Single toggle: Overhead eccentric	**4:1 – 9:1**
Gyratory	
a. True	**3:1 – 10:1**
b. Cone	
1. Standard	**4:1 – 6:1**
2. Attrition	**2:1 – 5:1**
Roll	
a. Compression	
Single roll	**Maximum 7:1**
Double roll	**Maximum 3:1**
Impact	
a. Single rotor	**To 15:1**
b. Double roter	**To 15:1**
c. Hammer mill	**To 20:1**
Speciality crushers	
a. Rod mill	
b. Ball milll	

Jaw and gyratory crushers shall be for primary crushing. They are characterized by wide gape and narrow discharge and are designed to handle large quantities of material. The capacity of the crusher is determined by its size. The gape determines the maximum size of material that can be accepted. Maximum size that can be accepted into the crusher is approximately 80% of the gape. Jaw crushers are operated to produce a size reduction ratio between 4:1 and 9:1. Gyratory crushers can produce size reduction ratios over a somewhat larger range of 3:1 to 10:1.

The primary operating variable available on a crusher is the set and on jaw and gyratory the open side set (OSS) is specified. This reflects the fact that considerable portions of the processed material fall through the crusher at OSS and this determines the characteristics size of the product. The set of a crusher can be varied in the field and some crushers are equipped with automatically controlled actuated for the automatic control of the set.

Cone crushers are commonly used for secondary, tertiary and quaternary crushing duties. Two variations are available - standard and short head. The chief difference between cone and gyratory or jaw crushers is the nearly parallel arrangement of the mantle and the cone at the discharge end in the cone crusher. This is illustrated in Figure 5.2. Reduction ratios in the following ranges are common for cone crushers:

- 6:1 - 8:1 for secondaries
- 4:1 - 6:1 for tertiary and quaternary crushing.

The size distribution of the products tends to be determined primarily by the CSS since no particle can fall through during a single open side period and all particles will experience at least one closed side nip The CSS is adjusted by screwing the bowl up or down. Impact crushers the breakage is achieved by impact using either hammer action on the individual particles or by sudden impact from a high velocity trajectory. High reduction ratios of between 20:1 and 40:1 can be achieved with hammer type impact crushers. Only low reduction ratios of about 2:1 can be achieved with kinetic energy type impact crushers. The crushing action of a crushing machine is described most usefully through the classification -breakage cycle model. The operation of a crusher is periodic with each period consisting of a nipping action and an opening action. During the opening part of the cycle material moves downward into the crusher and some material falls through and out. A certain amount of fresh feed is also taken in.

3.2.1 Jaw Crushers

The contractor shall ensure that the Jaw crusher meets the following specifications:

Table 2 - Jaw Crusher unit components specification

Feed Opening (mm)	1200 x 830
Max feed size (mm)	750
Max motor power (kW)	132
CSS (mm)	75
Nominal Capacity (t/h)	605–790
Standard Jaw Plates	Wide Teeth (WT)/Corrugated (C)/Coarse Corrugated (CC)/Sharp Teeth (ST)/Heavy Duty (HD)

3.2.2 Gyratory Crushers

The contractor shall ensure that the Gyratory crusher meets the following specifications:

Table 3 - Gyratory Crusher unit components specification

Feed Opening (mm)	1300 x 1750
Capacity (tph)	1650-2560
Max motor power (kW)	375
OSS (mm)	125
Nominal Cap	885–1160
Standard Plates	Coarse Corrugated (CC)/Sharp Teeth (ST)/Heavy Duty (HD)

3.2.3 Impact Crushers

The contractor shall ensure that the Impact crusher meets the following specifications:

Table 4: Impact Crusher unit components specification

Feed Opening (mm)	1360 x 800
Hydraulic inlet opening (mm)	1360 x 1000
4 Bar rotor (mm) Ø	1150
Rotor speed (variable) (rpm)	502- 620
2 aprons	Hydraulic assist
Tip speed (variable) (m/s)	30 - 37

3.2.4 Rolls Crushers

The contractor shall ensure that the Rolls crusher meets the following specifications:

Table 5: Roll Crusher unit components specification

Roll diameter (mm)	1400x1400
Max feed size (mm)	600
Max motor power (kW)	2x110
Output size (mm)	0-50
Nominal Cap (t/h)	200-400
Type	Hydraulic

3.3 Crashing equipment selection

The information required should include, but shall not necessarily be limited to, the following items:

1) The kind of rock which required to be crushed.
2) The maximum size of the rock which is be feed and perhaps the size of the feed to the plant
3) The method of feeding the crushers.
4) The required capacity of plant.
5) The percent of material failing within specified size ranges.

3.4 Screening aggregate

Screening of crushed raw material is important in order to be able to separate the aggregate by size ranges. The contractor shall ensure that the screening device meets the following specifications:

Table 6: Roll Crusher unit components specification

Screening Box (m)	6 x 1.5
Max motor power (kW)	75
Transport Dimensions (m)	18.25
Nominal Cap (t/h)	600
Type	Mobile Doublescreen

4. Authorisation

This document has been seen and accepted by:

Name and surname	Designation
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5. Revisions

Date	Rev	Compiler	Remarks
Jan 2017	1	Senzo Duma	First issue

6. Development team

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

- Senzo Duma
- Dawie Senekal

7. Acknowledgements

Not applicable.