

	Specification	Technology
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1. INTRODUCTION

The filter cages currently installed at Medupi and Kusile power stations are of two different revisions of the Contractor's drawings. The first filter cages that were installed on site were from drawing Z0101050 Rev E (Black cages) and later the Rev F (White cages). Both of these cages are the same in terms of the way that the two pieces connect to each other. The only difference between the two revisions is that Rev F the venturi is welded to the cage and in Rev E the venturi is connected via bended wires. The connection between the two cage pieces disconnect during operation and gets damaged easily. The venturi fitted to the Contractors cage is important to the pulsing system as the sizing of the pulsing rely on the venturi for an effective pulse.

Eskom will therefore purchase all new cages for Medupi and Kusile power stations in accordance with the improved connection design detailed in Eskom drawings [2], [3], [4].

2. SUPPORTING CLAUSES

2.1 SCOPE

The document describes the cage construction and material requirements for both Medupi and Kusile Power Station.

2.1.1 Purpose

The purpose of the document is to provide a clear specification to the contractor of how the filter cage should be constructed.

2.1.2 Applicability

This document applies to Group Generation

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] 0.84/58616 Medupi Power Station General Arrangement Units 1-6 FFP 16 Wire Cages for 160mm bags
- [3] 366-263277 Kusile Power Station General Arrangement Units 1-6 FFP 16 Wire Cages for 160mm bags
- [4] 0.84/59901 Medupi Power Station General Arrangement Units 1-6 Fabric Filter Plant Typical Cage Transport Crate

2.2.2 Informative

None

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2.3 DEFINITIONS

Definition	Description
Cell	Is a compartment that can be isolated for maintenance purposes. Each compartment consist of 660 bags

2.3.1 Disclosure Classification

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

2.4 ABBREVIATIONS

Abbreviation	Description
PJFF	Pulse Jet Fabric Filter
OEM	Original Equipment Manufacturer
RT&D	Research Testing and Development
OD	Outside diameter

2.5 ROLES AND RESPONSIBILITIES

N/A

2.6 PROCESS FOR MONITORING

N/A

2.7 RELATED/SUPPORTING DOCUMENTS

N/A

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3. SPECIFICATION

3.1 MATERIAL SELECTION

The Contractor is to provide material compliant to the specification below.

Medupi and Kusile power station is equipped with Pulse Jet Fabric Filter Plants (PJFF). Each unit consist of 28 cells, each cell has 660 filter bags installed. Each filter bag will have one assembled filter cage installed; the assembly consist of a top portion and a bottom section.

All the materials should be mild steel. The completed filter cage should be coated with SKS Black edging primer SNK10 or Ferro-Pak 615 or approved equivalent.

3.2 ADDITIONAL REQUIREMENTS ON THE CAGES

1. The Contractor manufactures the cage according to the details shown on the latest drawings [2], [3], [4] from the Employer.
2. The cages are free of sharp edges and burrs, which can damage the PJFF bag during installation or operation of the Pulse Jet Fabric Filter (PJFF).
3. The dimensions of the cage provided on the drawing include the coating thickness, if any.
4. The rings are induction welded onto the wires.
5. The wires are induction welded onto the Hem Cup and to the collar.
6. The Contractor ensures that the cage Vendor controls the design and fit of the coupling connection to accomplish the following:
 - 6.1. The cages does not deform during assembly.
 - 6.2. The cages can be disassembled and re-assembled as needed over the life of the cage without deformation of the cage or loss of joint integrity.
 - 6.3. The assembled coupling connection is firm and does not work loose during the life of the cages.
 - 6.4. The joint resists a minimum vertical load of 45 kg. A maximum load is established at the time of the sample inspection.
 - 6.5. It is preferred that no tools are required for the joint disassembly.
7. The cage straightness is measured along the cage length from a reference located 25mm from the cage top and bottom.
8. The collar and rings at joints are perpendicular to the cage vertical centre to meet cage straightness and plumbness.

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9. The welding specification 240-106628253 is adhered in instances where induction welding is not applied.
10. All the dimensions are provided in mm unless stated otherwise.
11. The splice connection used to connect the filter cage sections together are of the type shown in drawings [2] and [3]. The Contractor ensures that the cage Vendor uses a splice connection of this type to connect filter cage sections together.

Alternate splice connections may be used but must be approved by the Employer prior to use, this will only be considered once the tenderer has complied to the current specification. The alternate splice connection details must be submitted with the tender returnables as a technical deviation.
12. Sheet metal used in the top of the cage and bottom of the cage is of the thickness shown in Drawings [2] and [3] or if not specified a minimum of 1 mm.
13. The maximum spacing between the horizontal rings is 200 mm.
14. Each cage section shall have a stamp imprinted/embossed on with the OEM details for traceability and quality purposes. The bottom piece will have the stamp on the hem cup and the top section will have the stamp on the venturi.
15. The Contractor ensures that the cage Vendor furnishes and sends 2 filter bag cages to the supplier of the filter bags for fitting. The Employers engineering/QA inspects and accepts the cages prior to shipment to the bag manufacturer. The date for shipping to bag manufacturer will be determined later.
16. In the event that additional site services are required, the Contractor ensures that the cage Vendor furnishes a qualified representative for such service at the stipulated per diem rate in the Vendor's proposal.

3.3 TOLERANCES

Tolerances will be as per Drawings [2] and [3].

- Fractions – Linear = ± 1.5
- Diametral = ± 0.381
- Decimal – $X.XX = \pm 0.762 / X.XX = \pm 0.254$
- Angular - $\pm 1/4^\circ$

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3.4 TESTING AND INSPECTION REQUIREMENTS

3.4.1 At a minimum the cages shall be inspected for the following:

- Dimensions within tolerances as per Drawings [2] and [3] including cage diameter and overall cage length.
- Integrity, fit and suitability of the coupling connections (check fit-up to confirm no movement between mating pieces).
- Collar dimensions and square of collar to the cage as per Drawing [2] and [3].
- Hem cup dimensions as per Drawing [2] and [3].
- Cage straightness and verticality in the hung position.
- Check bow of mating cage pieces both before and after assembly to ensure no change (permanent deformation of the cage).
- Completeness and integrity of welds (particularly welds between wires and collar).
- Absence of sharp edges and burrs.

3.4.2 Inspections are conducted at the following minimum intervals:

- **DIMENSIONS**

Check dimensional tolerances listed in Section 1 at the beginning and periodically throughout the assembly process (1 sample per 25 cages for the first hundred cages, and one cage for every 100 cages thereafter).

- **WELDING**

Spot-check throughout the manufacturing process as required.

- **CAGE STRAIGHTNESS**

Assemble and check straightness one cage per 25 cages for the first hundred cages and one cage for every 100 to 250 cages thereafter (the appropriate frequency to be determined by the Employer Q.A. Inspector).

Suspend cage from level 'parallel' bars or a level simulated tubesheet in Vendor's shop. Measure offset of bottom of cage from a laser beam or alternate accurate means to establish 'absolutely vertical' relative to the centre of the tubesheet hole(s) or from a plumb bob line if conditions allow adequate measurement precision with this method.

The assembly of the cage is of random orientation. There is no bias to cage straightness and no straightening of the assembled cage.

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Cages after assembly is straight with a maximum bow of 12 mm. The test procedure is to place a vertical reference at the cage top and bottom using a laser or string line set 25 mm from the cage OD. The cage is rotated (in steps of 90 degrees – 4 measurements) with the minimum distance of any point along the cage length shall not be closer than 12 mm to the laser / string line.

Cages are rotated 360° and achieve plumbness at all positions.

- SHARP EDGES/BURS
Spot-check throughout the manufacturing process.

3.5 GENERAL REQUIREMENTS

3.5.1 Workmanship and Finish

Workmanship and finish is equal to established practice in modern shops. All materials being worked have clean surfaces. Fabricated members are neat and accurate. Reasonable tolerances are required for each component. See drawings [2] and [3] (Also Section 1) for tolerances required.

In no event shall any item delivered or to be delivered hereunder contain an amount of lead in excess of 0.06% by weight in the dried film.

3.5.2 Special Tools

The cages should be able to assemble and disassemble without the need for special tools. If the Contractor have special tools that can aid in the assembly and dis-assembly of the cages they should include four (4) sets of special tools required per every 18 480 (one unit) cages for the installation / erection, operating and routine maintenance of the supplied piece(s) of equipment, including any applicable lifting/hoisting rigging. Tools are new and of first class quality. This should also be supplied proportionally for orders less than 18480 cages. Tools are shipped to the Power Station in a suitable container clearly marked with the name of the equipment for which the tools are intended.

3.5.3 Shipping Requirements

- A typical shipping and storage crate for cages can be seen in APPENDIX D [4]. The material of construction (structural pine) shall be of adequate heft to provide the strength needed to protect the cages during transportation. A minimum of 50mm x 100mm or larger wood shall be used to frame the main structure. Connections shall be achieved by both nailing and use of screws. The ends shall be braced with a minimum 50mm x 100mm diagonal and webbing or alternate end caps shall be provided to prevent the cages from dislodging during transport.
- The cage crate is assembled with dual support levels. This is so the bottom cages are not damaged from supporting the weight of the stack.

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- The crate is covered with some form of durable cover suitable for both shipment and storage. Protective coverings may require UV inhibitors depending upon site storage conditions and schedule.
- Crates are capable of being lifted via standard fork lift from the side without damage to the crate.
- Crate bottom is dual layered allowing for unobstructed inserting of fork lift blades between the two layers.
- Crate is able to be lifted with a crane utilising slings without damage to the crate.
- The handling instructions are included with each bundle of cages showing proper loading, unloading and storage requirements.
- The weight of shipping units does not exceed 900 Kg.

3.5.4 Submittal Requirements

The following information is submitted as a minimum with the proposal:

- Weights
- Filter Bag Cage Drawing
- Packaging Details (crate design Drawing)
- Storage requirements
- Cage Dimensional Tolerances
- Milestone Schedule
- Completed Data Sheet (See Appendix A)
- Operating Experience List

3.5.5 Drawing approval

If the contractor is unable to supply cages as per the above specification, a re-design/alternative could be submitted with detailed justification to the Employer for approval before as part of the tender package. The Employer reserves the right to accept or not to accept any alternate solely at its discretion.

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4. AUTHORISATION

This document has been seen and accepted by:

Name & Surname	Designation
Alton Naidoo	Boiler Auxiliary Manager (Acting)
Ebrahim Patel	Senior Consultant: Air Pollution Control
Hendre Grobbelaar	Senior Consultant: Air Pollution Control
Hendrik van Riel	Senior Engineer: Air Quality Control
Jeanne Fourie	Engineer: Air Quality Control
Riana Nieuwoudt	Senior Engineer: Air Quality Control
Robbie van Rensburg	Corporate Consultant: Fabric Filter Plants
Saneshan Govender	General Manager: Plant Engineering (acting)

5. REVISIONS

Date	Rev.	Compiler	Remarks
January 2019	0.1	HW van Riel	Filter cage specification first Draft for Review
January 2019	0.2	HW van Riel	Final Draft with Comments incorporated
January 2019	1	HW van Riel	Final Document for Authorisation and Publication
August 2019	1.1	HW van Riel	Criteria revised and updated
August 2019	2	HW van Riel	Final Rev 2 Document for Authorisation and Publication

6. DEVELOPMENT TEAM

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

- Hendrik van Riel

7. ACKNOWLEDGEMENTS

- Ebrahim Patel

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APPENDIX A. FABRIC FILTER CAGE SPECIFICATIONS

A.1 TECHNICAL DESIGN INFORMATION (QUANTITIES INDICATED PER UNIT)

Filter Bag Cage Information	Units	
Total Number of Filter Bag Cages (excluding spares)	-	18480
Nominal Filter Cage Diameter	mm	160
Effective Cage Length	meters	8.247
Number of Cage Pieces	-	2
Number of Vertical Wires	-	16
Maximum Gas Temperature	°C	170
Cage Material	-	Mild steel
Coating Material	-	SKS Black Edging Primer or accepted, by <i>Project Manager</i> , equivalent

A.2 DATA PAGES

Name		
Service		
Quantity		
Manufacturer		
Recommended Type of Splice Joining Sections		
Cage Material		
Cage Coating Material (if applicable)		
Number of Vertical Wires on Cage		
Number of Horizontal Wires on Cage		
Filter Bag Cage Information	Units	
Diameter of Top Section	mm	
Diameter of Middle Section	mm	
Diameter of Bottom Section	mm	
Length of Top Section	m	
Length of Middle Section	m	
Length of Bottom Section	m	
Total Length When Spliced Together	m	
Cage Coating Material	- - -	
Cage Coating Thickness	mm	
Cage Coating Temperature Rating	°C	
Weight per Cage	kg	
Shipping Unit l x w x h	mm	
Shipping Unit Weight when Loaded	kg	
Shipping Point of Origin	---	
Shipping Container Type/Description	---	
Logical Port of Export (if needed)	---	

* Contractor to specify associated excursion time limit

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APPENDIX B. SITE INFORMATION

Medupi Power Station is located approximately 20 km West from Lephalale in Limpopo.

Latitude: 23°42'16.00"S

Longitude: 27°33'48.00"E

SITE AMBIENT CONDITIONS

Description	Value	Unit
Altitude	902.5	m
Atmosphere	Dry and Dusty with presence of ash	
Ambient temperature	-10 to 50	°C
Relative humidity		%
Rainfall, maximum		Mm/hr

Kusile Power Station is located approximately 40 km West from Emalahleni in Mpumalanga.

Latitude: 25°55'01.45"S

Longitude: 28°55'00.34"E

SITE AMBIENT CONDITIONS

Description	Value	Unit
Altitude	1503.25	m
Atmosphere	Dry and Dusty with presence of ash	
Ambient temperature	-10 to 50	°C
Relative humidity		%
Rainfall, maximum		Mm/hr

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APPENDIX C. VENDOR DOCUMENT SUBMISSION SCHEDULE

Tender Returnables (VDSS) – All documentation submitted should be specific to the applicability of the cage design and manufacturing and should not be general.

	Activity	Date
1.	General	
1.1.	Milestone Schedule	Tender Returnable
1.2.	Prelim Master Document List (MDL)	Tender Returnable
1.3.	Document/Configuration Management Plan, including (as a minimum) guidelines or procedures for plant labelling, document management and transmittals.	Tender Returnable
1.4.	Schedule (scope is procurement, fabrication and shipping only)	Tender Returnable
2.	Fabric Filter Bag Cages	
2.1.	Weights	Tender Returnable
2.2.	Filter bag cages fabrication drawing	Tender Returnable
2.3.	Cage Dimensional Tolerances	Tender Returnable
2.4.	Completed Data Sheet (See Appendix A)	Tender Returnable
2.5.	Sample cage	Tender Returnable
2.6.	Welding procedures specific for the cage	Tender Returnable
2.7.	Welders' qualifications specific to the cage	Tender Returnable
3.	Storage	
3.1.	Packaging details (crate design drawings)	Tender Returnable

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3.2.	Preservation and storage requirements	Tender Returnable
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Documents for Approval

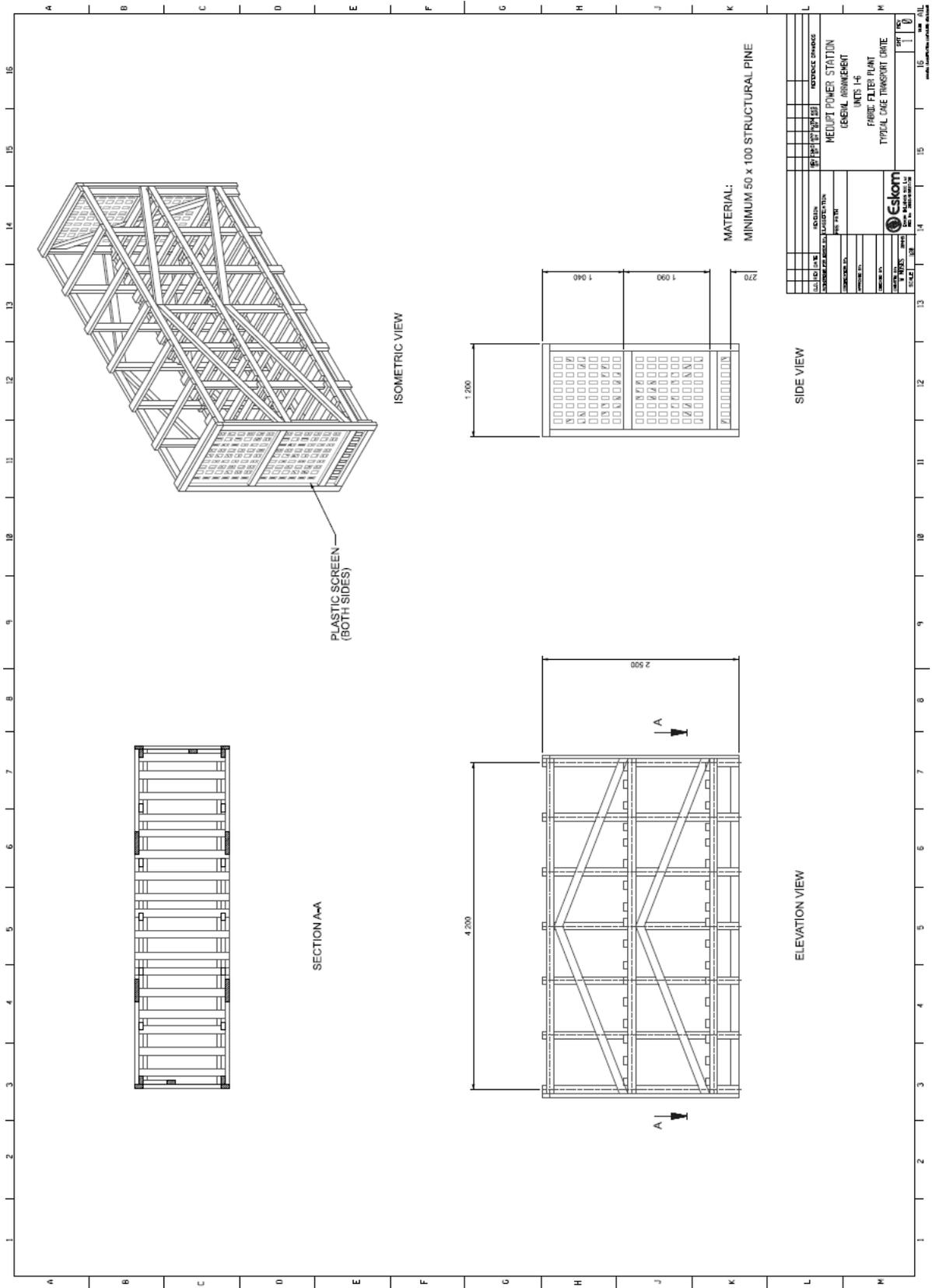
	Activity	Effective (Days = Calendar Days)
1.	General	
1.1.	Master Document List (MDL)	10 th of every month
1.2.	Welding procedures to be utilised	4 weeks after contract award*
2.	FFP Bag Cages	
2.1.	Final fabrication drawings	3 weeks after contract award *
2.2.	Erection plans and procedures	12 weeks after contract award
2.3.	Bill of material	12 weeks after contract award
2.4.	Quality plans and procedures	4 weeks prior to shipment
2.5.	Certificate	4 weeks prior to shipment *

* Requires the *Employers* approval

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APPENDIX D. TYPICAL CAGE CRATE DRAWING



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