Eskom	Tutuka Power Station Works Information	Auxiliary Engineering

Title:	**Scope of Work for Tutuka Flue Stack Structural Inspections**	Unique Identifier:	**15ENGGEN-700**
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1. INTRODUCTION

The successful tenderer will be expected to carry out the following activities on both chimneys:

i. Perform visual inspections with a camera on 250m high concrete windshield and flues. Areas to be inspected are access restricted,
ii. Take concrete samples and analyse for strength and degradation. Care must be taken to not damage reinforcing,
    a. Sample test certificates to be supplied (sampling and testing to be in accordance with the relevant SANS standards)
iii. Repair sampled areas as per the approved methodology,
iv. Perform non-destructive testing and assess life expectancy of structures,
v. Measure expansion gaps,
vi. Compile report detailing scope of work for remedial actions (including method of repair), next inspection and life expectancy as per [15],
vii. Prepare scope of work including bill of quantities and cost estimates for repair work,
viii. Technical supervision during repairs,
ix. *Consultant* to supply as built drawings of the windshields and chimneys only (stair cases, elevators etc not required),
    a. These drawings will be overlaid with a grid system to identify location of defects.
    b. The *Consultant* will transfer and assign copyright to the *Employer* allowing the *Employer* to reproduce and distribute the drawings as they so wish.
    c. The owner of the copyright must be displayed on the drawing (s)
x. The *Consultant* is responsible for providing specialist access for external and internal inspections.
xi. The *Consultant* shall make provision for secondment of one Tutuka Civil Engineer to the designer's offices to complete designs as part of their professional development and skills transfer.
xii. In the repair scope the *Consultant* must provide the paint spec for the top of the smoke stacks.

The *Consultant* shall take note that the internal inspection of the flue ducts will only be performed during the Unit outage, The *Employer* will forward the schedule of Unit outages where access will be granted.

2. SUPPORTING CLAUSES

2.1 SCOPE

The scope of the works includes the destructive and non-destructive testing and inspections of the Tutuka flue stacks. The inspections must be followed up with a detailed report including recommendations for the works that needs to be performed to ensure the structural integrity of the Flue Stacks, maintenance strategy, relevant drawings and Bill of Quantities.

2.1.1 Purpose

The purpose of the document is to provide requirements for scope of work to perform structural inspections on the Tutuka Flue stacks.

2.1.2 Applicability

This document will apply to Tutuka Power station.

2.2 NORMATIVE/INFORMATIVE REFERENCES

The applicable reference documents are listed below. These documents (latest revision) form part of this specification to the extent as specified in this specification. In the event of a conflict between the text of this specification and the applicable parts of the Eskom documents listed below, the text of this specification takes precedence. However, this specification does not supersede applicable laws and regulations (including the SANS standards), unless a specific exemption has been obtained from the relevant authorities.

2.2.1 Normative

[1]	15ENG GEN-699	Tender Technical Evaluation for Tutuka Flue Stack Structural Inspections
[2]	15ENG MN-676	Tutuka AKZ Coding Procedure
[3]	240-144332407	Guideline for Eskom Power Stations Concrete Remedial Work
[4]	240-50317699	Manage Technical Queries Procedure
[5]	240-53113685	Design Review Procedure
[6]	240-53114002	Engineering Change Management (ECM) Procedure
[7]	240-53114186	Document and Records Management
[8]	240-53665024	Engineering Quality Manual.
[9]	240-54179170	Technical Documentation Classification and Designation Standard
[10]	240-56364545	Structural Design and Engineering Standard and
[11]	240-65459834	Project Documentation Deliverable Requirement Specification
[12]	240-66920003 Projects	Documentation Management Review and Handover Procedure for Gx Coal
[13]	240-76992014 Work Instruction	Project / Plant Specific Technical Documents and Records Management
[14]	240-86973501	Engineering Drawing Standard
[15]	240-99527377	Inspection Manual for Civil Works at Eskom's Power Stations.
[16]	ISO 9001:2008	Quality Management Systems
[17]	QM-58	Supplier Contract Quality Requirements Specification
[18]	SANS 1200	Construction Works
[19]	SANS 2001	Construction Works
[20]	SANS 5863	Concrete tests – Compressive strength of hardened concrete.
[21]	SANS 5865	Concrete tests – The drilling, preparation, and testing for compressive strength of cores taken from hardened concrete.

Drawings

[22]	0.61/3326	Set 1, precipitators and main flues to chimney - general arrangement plan
[23]	0.61/3327	Set 1, precipitators and main flues to chimney - general arrangement section
[24]	0.61/3841	275m Multiflue chimney - general layout

[25]	0.61/4325	Chimneys 1 and 2 300m multiflue chimney hindrance light hf20e construction of double pipe details
[26]	0.61/4326	Chimneys 1 and 2 300m multiflue chimney ventilation louvres on +23,00 and 283,50m details
[27]	0.61/4399	Chimney 1 - construction programme
[28]	0.61/4559	Chimney no1-2, 275m multiflue chimney - general layout and lining details
[29]	0.61/4781	275m chimney 1 and 2 staircase general layout
[30]	0.61/4782	275m chimney 1 and 2 reinforced concrete slabs formwork drawing
[31]	0.61/4783	275m chimney 1 and 2 shell general layout and reinforcement
[32]	0.61/4784	275m chimney 1 and 2 duct openings additional reinforcement details
[33]	0.61/4785	275m chimney 1 and 2 ventilations openings reinforcement details
[34]	0.61/4786	275m chimney 1 and 2 t20,50m level carbels details
[35]	0.61/4787	275m chimney 1 and 2 +50,50m level carbels details
[36]	0.61/4788	275m chimney 1 and 2 +80,50; +136,50; +162,50; +188,50 and 214,50m levels carbels details
[37]	0.61/4789	275m chimney 1 and 2 +240,50m level carbels details
[38]	0.61/4790	275m chimney 1 and 2 +265,30m level carbels details
[39]	0.61/5018	Chimneys 1 and 2 - 300m multiflue chimney - foundation details
[40]	0.61/5542	Chimney 1 and 2 - door for ladder at +266,50m details
[41]	0.61/5543	Chimney 1 and 2 - steel landings at +271,50m details
[42]	0.61/5545	Chimney 1 and 2 - concrete slab at +266,50m reinforcement bottom layer
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[45]	0.61/5548	Chimney 1 and 2 - concrete slab at +24220 +216,00 +190,00 +164,00 +138,00 +110,00 +82,00m reinforcement bottom la
[46]	0.61/5549	Chimney 1 and 2 - concrete slab at +24220 +216,00 +190,00 +164,00 +138,00 +110,00 +82,00m stirrips and lateral re
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[53]	0.61/5556	Chimney 1 and 2 - concrete slab at +22,00m - reinforcement top layer

[54]	0.61/5973	275m chimney 1 and 2 - +22m connection angle iron with steel flue at reinforcement concrete slab
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[56]	0.61/9350	Chimney 1 and 2 275m drawing list and steel consuption
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[69]	0.61/10402	Chimney 2 +196,0 to +246,0m shell reinforcement details
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[81]	0.61/10414	Chimney no 2 +242m,+216m,+190m,+164m,+138m,+110m and +82m reinforcement bottom layer reinforced concrete slabs details
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[83]	0.61/10416	Chimney no2 +242m,+216m,+190m,+164m,+138m,+110m and +82m reinforcement top layer reinforced concrete slabs details

[84]	0.61/10417 details	Chimney no2 +52m reinforcement bottom layer reinforced concrete slab
[85]	0.61/10418 details	Chimney no2 +52m stirrups and lateral reinforcement reinforced concrete
[86]	0.61/10419	Chimney no2 +52m top layer reinforcement reinforced concrete slab details
[87]	0.61/10420 details	Chimney no2 +22m bottom layer reinforcement reinforced concrete slabs
[88]	0.61/10421 slabs details	Chimney no2 +22m stirrups and lateral reinforcement reinforced concrete
[89]	0.61/10422	Chimney no 2 +22m top layer reinforcement reinforced concrete slab details
[90]	0.61/10423	Chimney no 2 steel duct layout
[91]	0.61/10424	Chimney no 2 steel duct details
[92]	0.61/10425	Chimney no 2 steel duct installation details
[93]	0.61/10426	Chimney no 2 +265,30m corbels details
[94]	0.61/10564	Chimney 2 275m multiflue chimney +237,50m steel landings details
[95]	0.61/11132	Chimney no 1 access platform to personnel hoist steel details
[96]	0.61/11133	Chimney no 1 handrail on levels +22,00m-+242,00m details
[97]	0.61/11139	Chimney 1 and 2 flat grid slabs reinforcement concrete details
[98]	0.61/11140	Chimney 1 and 2 stair case details
[99]	0.61/11141	Chimney 1 and 2 access stairs details
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[101]	0.61/14807 Sheet 002 layout section	Tunnel on columns line 32 south of chimney tunnel (s/s south) cable tray
[102]	0.61/14812	Chimney tunnel grid line 22 to 32 cable tray layout
[103]	0.61/16662	Cable tunnel chimney substation east layout
[104]	0.61/16666	Cable tray chimney tunnel grid lines 12-22 layout
[105]	0.61/16667	Cable tray chimney tunnel grid lines 22-32 layout
[106]	0.61/16669	Cable tray chimney tunnel grid lines 32-42 layout
[107]	0.61/16670	Cable tray chimney tunnel grid lines 42-52 layout
[108]	0.61/16671	Cable tray chimney tunnel grid lines 52-62 layout
[109]	0.61/17721	Chimney 1 and 2 pollution monitoring equipment access platform]
[110]	0.61/17722	Chimney 1 and 2 pollution monitoring equipment stainless steel portholess
[111]	0.61/22133 Sheet 001	Chimney tunnel columns line 32 tray layout
[112]	0.61/22133 Sheet 002	Chimney tunnel columns line 32 tray layout
[113]	0.61/24410	Chimney tunnel - grid 52 to 62 cable tray layout

2.2.2 Informative

[114] 240-99527377: Inspection Manual for Civil Works at Eskom's Power Stations.

[115] SANS 1200: Standardised specification for civil engineering construction

[116] 240-56364545: Structural design and engineering standard

[117] 39-60: Contract quality requirements

[118] 360-TUT-ADDB-D00180-8 Tutuka Power Station Structures and Buildings Visual Inspection Report

[119] 360-TUT-AABB-D00139-83, Tutuka Power Station, Technical Specification for Remedial Works on Existing Infrastructure

[120] Occupational Health and Safety Act (85/1993)

2.3 DEFINITIONS

2.3.1 Classification

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

2.4 ABBREVIATIONS

Abbreviation	Description
AKZ	Plant labelling code
DT	Destructive Testing
ECSA	Engineering Council of South Africa
ISO	International Standards Organisation
ITP	Inspection and Testing Program
NDT	Non-destructive Testing
NOx	Nitrogen Oxides
Pr. Eng	Professional Engineer
Pr. Tech	Professional Technologist
QCP	Quality Control Plan
SANS	South African National Standards
SOx	Sulphur Oxides

2.5 ROLES AND RESPONSIBILITIES

2.5.1 Auxiliary Engineering

a. Initiator of project

2.6 PROCESS FOR MONITORING

Design reviews will be conducted to verify the contents of this document.

2.7 RELATED/SUPPORTING DOCUMENTS

N/A

3. TUTUKA FLUE STACK STRUCTURAL INSPECTIONS WORKS INFORMATION

3.1 OVERVIEW

The *Consultant* shall appoint an experienced professional civil engineer or civil technologist (ECSA Pr Eng / Pr Tech registered) specialising in reinforced concrete structures to perform detailed inspections, investigations and full structural assessment and design works where necessary, development of contract documentation inclusive for repair and maintenance methodologies, for the two windshield chimney structures and six flue ducts at Tutuka Power Station all in order to ensure the safe use of the windshield chimneys and flue ducts. All inspections and investigations shall be performed in accordance with: 240-99527377, *Inspection Manual for Civil Works at* Eskom's Power Stations [114] for chimneys.

The chimney and flue ducts structural elements in its entirety shall be inspected in detail and subjected to full detailed structural assessments. Structural elements include of the chimney and flue ducts include but are not limited to:-

- Concrete windshield internal and external,
- Brick flues or lining internal and external,
- Concrete support slabs,
- Bearing pads,
- Lightning protection and other fixtures at the chimney top,
- Waterproofing at the top slab,
- Chimney lift structure,
- Steel staircase,
- Thermal insulation,
- Flue insulation,
- Condition and visibility of windshield paint.

The *Consultant* shall provide all temporary works, access, plant, materials, equipment and tools required to perform all inspections and investigations necessary. The *Consultant* shall inform the *Employer* in advance of all access limitations and obstructions preventing execution of the services. The *Employer* is aware that access to inspect the flue ducts and brick lining is limited and will only be provided during outage of specific Unit.

All civil and structural work is carried out by a professional engineer or technologist, registered with the Engineering Council of South Africa (ECSA). The *Consultant* shall provide a method statement to the *Employer* for review and acceptance prior to the commencement of any *works* by the *Consultant*. The method statement includes the following as a minimum:-

a) The detailed investigation approach, methodology and sequencing of works including a description of all investigative works necessary, all types of testing required, and all tools, equipment, materials, temporary works necessary to perform the works;

b) Detailed description of any speculated structural assessments, analyses and design deemed necessary which is to be confirmed as required following completion of point (a) above.

The *Consultant* takes note that the *Employer* also performed a conditional visual inspection in May 2019, and has identified several defects at the chimneys. These were consolidated into a report together with photographic evidence and which forms the starting point of the *Consultant's services*: 360-TUT-ADDB-D00180-8, *Tutuka Power Station, Structures and Buildings Visual Inspection Report [118].*

The Technical Specification: 360-TUT-AABB-D00139-83, *Tutuka Power Station, Technical Specification for Remedial Works on Existing Infrastructure [119],* also developed by the *Employer,* for the remedying of certain identified defects is also utilised by the *Consultant* as a starting point in developing the Works Information for repair works (See PHASE C, section 3.2).

The reports provided by the *Employer* serve only as a guide to the *Consultant* and are provided for information purposes to assist the *Consultant* in execution of the services.

The creation, issuing and control of all drawings is in accordance with: 240-86973501, Engineering Drawing Standard [14] – Common Requirements.

Drawings issued to the *Employer* will be a minimum of 2 hard copies signed by the responsible professional registered structural engineer or technologist and in electronic format. The *Consultant* submits electronic drawings that can be opened with or compatible to Micro Station (DGN) format, and scanned drawings in pdf format. Drawings issued to *Employer* may not be "Right Protected" or encrypted.

The *Consultant* takes note that review and acceptance of any document or drawing by the *Employer* in no way relieves the *Consultant* of his liability for the works. He remains liable for all works conducted as per this Contract.

The *Employer* owns the *Consultant's* right over material prepared for this Contract by the *Consultant. The Consultant shall submit their assignments, drawings and or reports and, if applicable, interim assignments or progress reports, in accordance with the dates specified in the Contract.*

All original documents furnished/supplied by *Consultant* to the *Employer* and all documents, plans, computer programmes and other data prepared by the *Consultant* in connection with this Contract shall be lodged with the *Employer* and shall become the property of Eskom.

The copyright and Intellectual Property in all documents prepared by the *Consultant* in terms of this Agreement and the Letters of Appointment shall be vested in Eskom, which shall have the right to adapt them for other projects or otherwise apply or dispose of at its sole discretion.

The *Consultant* provides documents which transfer these rights to the *Employer.* The *Employer* has the right to reuse that information without copyright limitations or without requiring authorisation from the *Consultant* for the reuse thereof.

3.2 DESCRIPTION OF THE *SERVICES*

Phase A: Detailed Visual Inspections and Assessments

The detailed visual inspections of the chimneys must be done during the outage of the flue duct or arranged and agreed with *Employer* and includes the following key focus inspection points, as a minimum:-

a) Inspect for major geometrical imperfections of the windshell and flue ducts;
b) Inspect for signs of cracks in the windshell;
c) Inspect for water seeping through the windshell;
d) Inspect for any signs of localised windshell spalling;
e) Inspect the annular foundations at windshell for visible signs of differential settlement;
f) Inspect the nature and extent of chemical attack on the brick material and on the mortar
g) Inspect the condition of the chimney lift support structure;
h) Inspect for cracks in the connections of bracing components; and
i) Inspect safety of walkways, handrails, cat ladder etc

During the detailed inspections and investigations, the *Consultant* is expected to perform the necessary tests on the concrete elements in order to ensure the safe use of the smoke stacks. The assessments and test will include but not limited to:

a) Readings of surface hardness (Schmidt hammer);
b) Depth of carbonation, tested at critical / key points;
c) Concrete strength by taking core samples;
d) Concrete cover, tested at critical/ key points;
e) Potential half-cell method for corrosion testing;
f) Sulphate/ Chloride/Nitrate attack;
g) Environmental factors, as detailed below;
    - Analysis of concrete, brick and mortar samples (chemical analysis);
h) Windshield and flue ducts Life expectancy under normal and abnormal conditions; and
i) 3D laser scan survey and model to measure the deformations and possible settlement and loading patterns of the as-built windshell structures and report on the deformations found Excessive deformations will be highlighted for further investigation.

The *Consultant* shall inspect for signs of structural distress and / or indication of deterioration. Photographic records shall be compiled to assist and document findings of inspections and investigations executed by the *Consultant*. Observations shall be referenced to the photographs The *Consultant* to submit the findings report for *Employer*'s approval.

The *Consultant* shall make provision for secondment of one Tutuka Civil Engineer to the designer's offices to complete designs as part of their professional development and skills transfer.

PHASE B: Design Works

Structural assessment and design works comprises of the following:

a) Life expectancy of the windshield and flue ducts under abnormal conditions:

The *Consultant* performs a design analysis which includes calculation of loading and the applicable design checks to ensure the safety and structural integrity of the windshield and flue ducts and in order to determine the residual life of the chimney. The structural analyses includes but not limited to:-

- Linear-elastic analysis;
- Failure analysis for cracked structures using finite element analysis technique.

Structural assessment analyses and designs (where required) for repair of the defects identified based on the root cause, in order to prevent recurrence of the defects. All designs are carried out in accordance

with the *Employer*'s design standard: 240-56364545, *Structural Design and Engineering Standard* [10] and 240-144332407, *Guideline for Eskom Power Stations Concrete Remedial Work [3].*

The *Consultant* shall make provision for secondment of one Tutuka Civil Engineer to the designer's offices to complete designs as part of their professional development and skills transfer.

PHASE C: Development of Contract Documentation

Development of a comprehensive Works Information compiled in accordance with the NEC 3 form of contract for the repair works to be constructed by a *Contractor,* including all supporting documentation i.e. reports, construction drawings, bill of quantities, technical specifications and procedures. The SANS 2001 [19] and SANS 1200 [18] series of standardised specifications are used with necessary amendments. The Works Information is submitted to the *Employer* for review and acceptance. The construction of all repair work will be done by others in accordance with the accepted Works Information.

The *Consultant* will compile a detailed bill of quantities with price estimates.

PHASE D: Technical Supervision

The technical supervision (As per construction regulations) should be priced separately and not form part of scope of work in this *Contract*, as the execution of such works is dependent on when the *Employer* appoint others to conduct the repair works.

Technical supervision of the *works* which includes the following tasks as a minimum:

a) Technical quality assurance during execution to ensure that such is executed as per the approved scope of work, technical specifications and procedures;

b) Reviewing, witnessing and approving (by signature) intervention points captured in the *Contractor's* Quality Control Plan, where applicable to Engineering;

c) Raising Notice of Defects/ Non Conformance Reports, where work performed by the *Contractor* is not in compliance with the approved scope of work, technical specifications and procedures;

d) Review and acceptance by signature of *Contractor's* method statements, rigging studies (where applicable) construction data books and other related documents developed by the *Contractor;*

e) Review of *Contractor*'s design calculations where rigging is from existing infrastructure;

f) Responding to technical queries and clarifications from the *Contractor;*

PHASE E: Civil Maintenance Philosophy for Smoke Stacks

The *Consultant* to compile and submit customised maintenance and inspection strategy for the *Employer*'s chimney and flue stacks. The maintenance and inspection strategy include but not limited to the inspection and maintenance tasks, frequency duration, skills, and machine/equipment required for implementing maintenance on chimney structure until the end of Tutuka lifespan i.e. 2050

3.3 DELIVERABLES

The *Consultant* provides the following at each of the phases, where applicable:

a) **PHASE A** - The *Consultant must* produce a detailed report indicating all findings with photographic evidence from the investigative works, for review and acceptance by the *Employer.* The report also indicates all necessary structural assessments and design works to be conducted in PHASE B. The report is signed by a professional engineer or technologist registered with ECSA and includes the following as a minimum:

- The detailed investigation approach;
- Results of visual inspections;
- Description of all testing conducted, raw data and test results;
- Survey data;
- Measurements and photos taken;
- Drawings / sketches etc;
- A detailed description of all structural assessments, analyses and designs deemed necessary together with design criteria and design philosophy to be followed;
- Skills transfer.

b) **PHASE B** – The report produced in PHASE A is revised to include the results from all structural assessments, inspections, analyses and design, for review and acceptance by the *Employer*. The report is signed by a professional engineer or technologist registered with ECSA and includes the following as a minimum:

- Structural analysis models including inputs and outputs;
- Detailed design calculations;
- All assumptions made;
- Identified risks and mitigation/corrective measures
- Detailed findings and recommendations/ remedial work required;

c) **PHASE C** - Upon acceptance of the detailed report by the *Employer*, the *Consultant* submits a comprehensive Works Information for all repair works, compiled in accordance with the NEC3 form of contract complete with all supporting documentation i.e. reports, technical specifications, construction drawings, procedures and bill of quantities. The SANS 2001 [19] and SANS 1200 [18] series of standardised specifications are used with necessary amendments. The Works Information is submitted to the *Employer* for review and acceptance.

d) **PHASE D** – The *Consultant* to submit the estimated price to perform the quality control and assurance during the execution of the works. The quotation or estimated price separately and it shall not form the part of scope of work in this *Contract*, as the execution of such works is dependent on when the *Employer* appoints the *Contractor* to conduct the repair works.

e) **PHASE E** – The *Consultant* submits customised maintenance and inspection strategy for the *Employer*'s chimney and flue stacks for the *Employer*s approval.

3.4 EXISTING INFORMATION

Tutuka Power Station is located within the Gert Sibande District, in the Lekwa Municipality, approximately 21 km northeast of the town Standerton in the Mpumalanga Province. Tutuka's first unit was put in commercial on 1 June 1985 and the last unit on 4 June 1990 Tutuka Power Station is an important link in the 765kV extra-high-voltage transmission system linking Mpumalanga with the Western Cape and KwaZulu-Natal. The technical details are as follows:-

- Six 609MW units;
- Installed capacity of 3654MW

Tutuka Power Station is equipped with six flue ducts (three per windshield) consisting of two reinforced concrete windshield structure housing three brick flues each. Figure 1 below shows the positioning of chimneys at Tutuka Power Station.

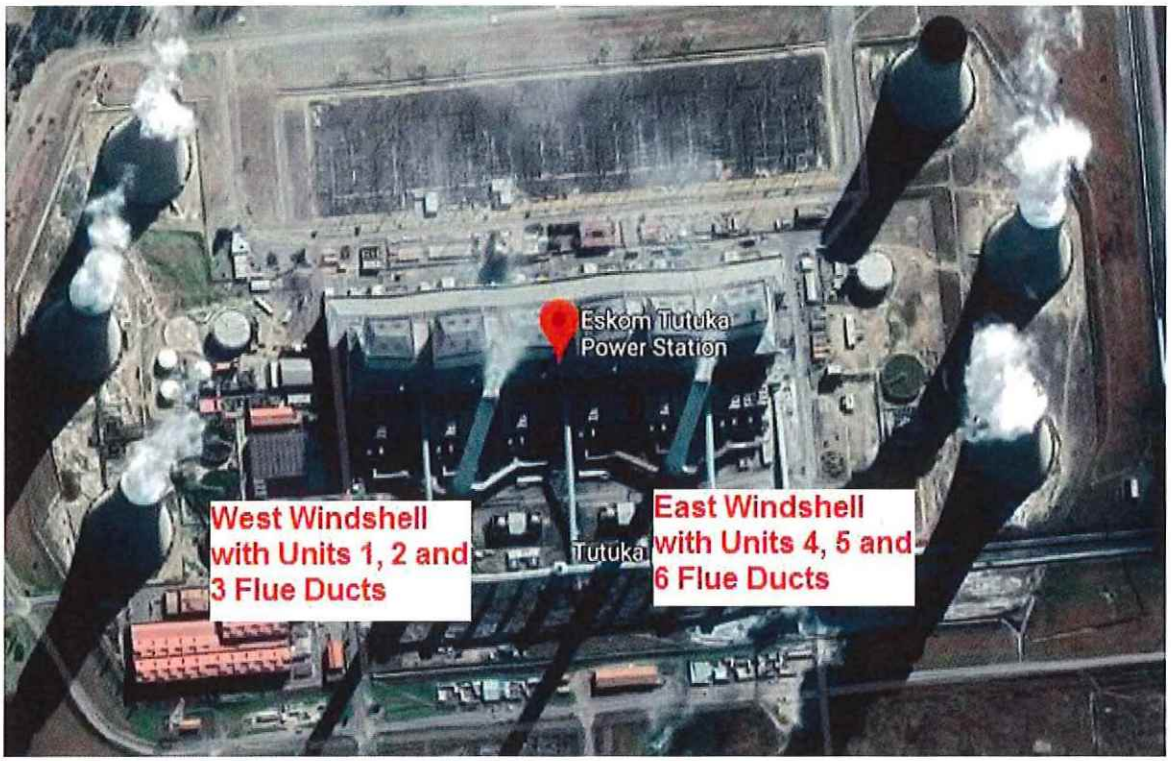

Figure 1: Layout of Tutuka Power Station

From the Eskom Inspection Manual for Civil Works at Eskom's Power Stations ([114]), chimney structures, there are essentially two different building materials combined. The structure constitute of the windshield which is the reinforced concrete structure and flue duck which comprises brickwork (See 2.2.1 for a list of drawings relating to the chimneys).

These two materials are in turn subjected to different exposure conditions, thus different forms of behaviour and ageing are to be expected. The normal operating temperature of chimneys at Tutuka Power Station is 138°C. Under fault conditions, the temperature may lower to 120°C and this actually occurs very suddenly. Because of these flue gas temperature variations, uneven, heating and large temperature gradients may results in the cracking of the brick lining disintegrating, particularly where the lining is not insulated.

The brick flues have a typical internal diameter of about 8m and a wall thickness of about 100mm above the bottom cone section. The wall thickness in the 2m high cone section may vary between 150mm and 285mm. A mineral wool layer typically provides thermal insulation to the brickwork. Table 3-1 below illustrates the dimension of the chimneys.

Table 3-1: Chimney Dimension Information

Power Station	No	Height (m)	Inside Diameter (at base) (m)	Inside Diameter (at top) (m)	Typical wall thickness (mm)
Tutuka	2	275	23.87	18.05	700 at base 400 at top

Access to the top of a chimney is provided by means of a cat ladder attached to a concrete shell.

Many of Eskom's chimney shells were cast in rings by means of a climbing formwork system in 1.20m high sections. The shell has a cylindrical shape at the base and rests on a ring-shaped foundation. The annular ring beam is founded either on piles or on a mass concrete foundation.

In most instances the brickwork lining was constructed in free-standing cylindrical lifts. These lining lifts are supported directly on concrete corbels in the shell. Where the quality of the brick is not specified on drawings, it is assumed that high quality clinker bricks laid on blast furnace cement mortar were used. The minimum space between the lining and the shell typically varies between 60mm and 115mm. The ventilation of this air space is provided by means of radially-placed asbestos cement pipes, through the concrete shell just below each corbel, at identical intervals.

Cast iron capping rings are provided at the top of the chimneys. The chimneys are also equipped with lightning protection.

Typically the brick flues of a multiple flue chimney are supported on concrete platforms. The platforms consist of a reinforced concrete slabs and reinforced concrete beams, supported on elastromeric bearing pads onto reinforced concrete corbels and onto the windshield. The elements of a multiple flue chimney are:

- **Concrete windshield**
  The top 40m of the chimney is treated with acid resistant paint. Rainwater falling onto the top support slab drains off through a series of weep holes in the windshield.
- **Brick flues**
  Three are situated within each of the windshields.
- **Concrete support slabs**
  The reinforced concrete slabs support the individual brick flues.
- **Bearing pads**
  The bearing pads between the concrete corbels and the support slabs
- **Lightning protection and other fixtures at the chimney top**
- **Waterproofing at the top slab**
  Typically waterproofing consists of acid resistance ceramic tiles on top of a mortar screed. The tiles have an adequate slope to drain rainwater away. The jointing material is also acid resistant.
- **Chimney lift**
  The steel gantry tower is braced back to the inner face of the windshield at regular intervals.
- **Brick Lining**
  The brick lining should be inspected for integrity with special focus on structural stability. The nature and extent of any chemical attack on the brick material and mortar.
- **Steel staircase**
  The stairs provides access. The steel structure is supported by columns which are founded on plinths at ground level and is anchored to the inner face of the windshield at regular intervals.
- **Thermal insulation**
  Mineral wool is used as thermal insulation

3.5 OPERATING PHILOSOPHY

The chimneys are always operated when the unit is on load. The primary function of the chimneys is to remove flue gases containing ash, SOx and NOx to atmosphere.

Due to the operational philosophy of the Power Station, the flue ducts will not be able to be inspected when the unit is on load. An arrangement will be made with the *Consultant* to come when and as required to perform the detailed inspections, tests and surveys which will most likely be during the outage of respective unit.

The *Consultant*'s report will be subjected to review and acceptance by *Employer*'s Chief Structural Engineer from the CoE Department of Structural Design or any other Consulting Engineering specialist that may be appointed by the *Employer*.

3.6 SCOPE OF WORK FOR THE FLUE STACK INSPECTIONS

3.6.1 Scope overview

- *Consultant* to perform detailed assessment and visual inspection;
- Identify and quantify defects such as spalled areas etc,
- Identify and quantify area of structural distress where cracks are larger than 0.4mm and observed large deflection,
- Determine depth of carbonation for all structural surfaces exposed to the weather (Phenolphthalein test)'
- Determine the life of passivating layer,
- Produce a detailed report with a photographic record and repair methodologies that must be implemented,
- A quality control plan must be supplied by the *Consultant* for *Employer's* approval,
- Perform visual inspections assessing for signs of structural distress and degradation on each chimney (internal and external) and windshield,
- Concrete cores will be taken from each windshield over the height of the windshield. A reinforcement detector will be used to determine the position of the reinforcement in order to prevent coring through reinforcement. These cores will be chemically tested in an accredited laboratory to assess the sulphur content, carbonation and chloride content in the concrete due to the down-wash of the flue gases. The areas where cores were removed must be repaired by the *Consultant*. Sampling will be in accordance with [21]. Method to be detailed in the method statement.
- Structural measurements and non-destructive testing will be performed on the concrete structure (windshields, slabs etc) to assess the life expectancy of the structures. Necessary remedial actions will then be recommended to ensure the integrity of the structures over the remaining life of the Power Station (2050). This will consists of measurements and tests such as concrete surface hardness, depth of concrete cover to reinforcement, sulphur and chlorides content, and carbonation depths. Testing will be in accordance with the relevant SANS standard ([20], [21]). Method to be detailed in the method statement.
- An electromagnetic cover-meter will be used to determine the concrete cover depths to the reinforcement.
- Concrete surface hardness and compressive strength will be tested by using a Schmidt impact hammer.

- An important parameter indicating the potential for corrosion and consequent deterioration of reinforced concrete is the depth of carbonation. The depth of carbonation will be measured on the concrete structures at various locations using the phenolphthalein indicator test.
- An internal inspection of the brick flues with the assistance of a specialist *Contractor*, which will provide the platform or cage and winches. This specialist *Contractor* must be provided by the *Consultant*.
- Measurement of flue expansion gaps to assess whether remaining gaps are greater than 30mm.
- The windshield on the outer face will be inspected by means of a theodolite or similar equipment to determine and graphically plot any defects visible such as cracks, honeycombing, degradation, etc
- Inspect the acid resistant protective cover at the top 25m of the windshield for any degradation (provide paint specification).
- Compile a structural assessment report based on the non-destructive test results and inspection that includes images, remedial actions/recommendations (including method of repair), maintenance strategy, bill of quantities with price estimates, life expectancy. The report must be as per [15].
- The *Consultant* must compile a scope of work for repair (NEC). The *Consultant* will remain responsible for ensuring the scope is executed as per design/specification.
- *Consultant* to supply as built drawings:
    - These drawings will be overlaid with a grid system to identify location of defects.
    - The *Consultant* will transfer and assign copyright to the *Employer* allowing the *Employer* to reproduce and distribute the drawings as they so wish.
    - The owner of the copyright must be displayed on the drawing (s)

The *Consultant* will inspect and assess the following elements in the chimneys:

- Windshield-internal and external (including paint condition and visibility),
- Brickflues-Internal and gaps,
- Steel inlet duct into the chimney,
- Ash build up inside the chimney,
- Intermediate support slab-spaced approximately 25m apart,
- Steel stairway,
- Insulation to the brickflues,
- Lift structure and connections,
- Lightning Conductor,
- Flue insulation,
- Acid resistant protective cover on the top 25m of the windshield.

3.6.2 Obligation

The *Consultant* is responsible for ensuring the inspection and subsequent report is a true reflection of the status of the structure. The *Consultant* is responsible for supplying a detailed repair strategy including bill

of quantities for any remedial actions that are required to ensure structural integrity is maintained. The *Consultant* will remain responsible for ensuring the repair scope is executed as per design/specification.

3.7 QUALITY AND INSPECTION REQUIREMENTS

3.7.1 Quality Assurance

1. The *Consultant* complies with the quality requirements as stipulated [117].
2. The *Employer* reserves the right to evaluate the *Consultant*'s and its subcontractors' Quality Management System documentation. The *Employer* or its representatives also reserve the right to carry out appraisals and quality audits of the *Consultant's* and its subcontractors' Quality Management Systems, at any time before and during the period of the contract, to verify compliance with and maintenance of the quality system and contract requirements.
3. The *Consultant* and its subcontractors must have a Quality Management System that complies with the applicable requirements of [16].
4. The requirements of the Code of Practice for Quality Management System [16] as applicable to this scope of work are included as requirements of this specification.
5. The *Consultant* will be responsible for the complete quality assurance requirements to be imposed on his sub-contractors and suppliers of materials, in terms of [16] and [17].
6. The *Consultant* will comply in full with the above *Employer*'s quality assurance requirements and any amendments thereto which the *Employer* considers necessary or expedient during the contract.

3.7.2 Quality Control and Inspection

1. The *Consultant* will exercise strict and adequate quality control during all phases of the work.
2. The *Consultant* will prepare suitable quality control plans (QCP's) and Inspection and Test Plans (ITP's) for all work carried out.
3. The *Employer*, the Inspection Authority, the *Employer* QC Representative and the *Consultant* must review these QCP's/ITP's jointly and the actual scope of quality control and inspection required for the Contract agreed upon.
4. The QCP's/ITP's must be subject to the *Employer*'s approval and must indicate all inspection and test points, the methods and procedures to be used and the acceptance criteria to be applied.
5. The *Consultant* is required to notify the *Employer* 24 hours in advance of witness and hold intervention points.

3.8 WORK DONE

The *Consultant* is responsible for executing the required work in accordance with this tender specification and must remain responsible for any discrepancies, errors or omissions of any sort on the submitted data, program, layouts or shop drawings, whether it has been approved or not approved.

Deviations from the work will not be accepted. When the standards of the equipment specified cannot be met in terms of specific design requirements; substitution or alternative equipment may be considered provided that the substituted equipment does not reduce the intended performance, operation, duty-rate, and redundancy and reliability requirements of the specification.

Deviations or substituted equipment not clearly shown and detailed in the Deviation Schedule, will not be considered or accepted and will not limit the *Consultant*'s responsibility to provide equipment in terms of the specification.

Should approval for the revised equipment not be obtained from the *Employer*, the *Consultant* will be liable for all costs associated with providing equipment in terms of the specification.

3.9 EQUIPMENT

The *Consultant* shall provide all labour, tools, machinery and equipment necessary to safely perform the required work, test and surveys. All equipment that will be used to perform the tests, surveys etc. must be calibrated and valid calibration certificates submitted to the *Employer* before the work commences.

Consultant to provide their own resources to secure security of tools, materials, and machinery/equipment that will be stored on site. *Employer* will not be liable to account for any costs related to damages or thief of *Consultant*'s tools, materials, and machinery and equipment.

3.10 DOCUMENTS INCLUDED IN THE WORKS INFORMATION

All Eskom documents listed in section 2.2 are available and can be obtained for Tutuka Power Station. Take note that in some cases only limited information may be available.

For other information that may be required the applicable system engineer at Tutuka Power Station can be contacted for assistance *Employer* shall furnish all available data in the form of operation & maintenance manual, drawings, previous inspections and assessments reports and any other information in its possession or which he is able to obtain, pertinent to and reasonably required by the *Consultant* to carry out the Services under this Contract.

The *Consultant* shall submit their assignments, drawings and or reports and, if applicable, interim assignments or reports, in accordance with the dates specified in the Contract.

All original documents furnished/supplied by *Consultant* to *Employer* and all documents, plans, computer programmes and other data prepared by the *Consultant* in connection with this *Contract* shall be lodged with the *Employer* and shall become the property of the *Employer*.

The copyright and Intellectual Property in all documents prepared by the *Consultant* in terms of this Agreement and the Letters of Appointment shall be vested with the *Employer*, which shall have the right to adapt them for other projects or otherwise apply or dispose of at its sole discretion.

3.11 QUALITY MANAGEMENT

The *Consultant* shall develop and implement a system for collation or quality verification records, including change management records, Inspection Test Plans/Quality Control Plans (QCP), Manufacturing, Construction and Commissioning Record Books (Data Books).

3.11.1 Data Books

Data Books shall be maintained by the *Consultant* to substantiate conformance to product specifications and requirements. All records shall be safely stored (easily retrievable) following the final completion of the works at takeover. These records shall include as a minimum:

- Quality Management documentation
- Safety clearances (to be granted prior commissioning)

- Construction, layout and component approvals
- Routine test certificates
- Construction and as-built drawings and approvals
- Statutory certification
- Data Books (Record Books)

The data books shall be reviewed by the *Employer* for 10%, 30%, 50%, 70% and 100%.

All manufacturing and construction data books shall be completed and approved when the *Consultant* apply for final inspection at construction completion.

At takeover application, all manufacturing, construction and commissioning data books shall be completed and approved and handed over to the *Employer*.

3.12 DOCUMENTATION MANAGEMENT AND CONFIGURATION MANAGEMENT

The *Consultant* and Tutuka configuration management shall be responsible for the following during the design change:

- As-built plant drawings;
- Document Management
- Plant coding and Labelling;
- Design change management.

3.12.1 Document Management

All documents supplied by the *Consultant* shall be subject to Eskom's approval. The language of all documentation shall be in English. The *Consultant* shall include the *Employer*'s drawing number in the drawing title block. This requirement only applies to design drawings developed by the *Consultant* and his Subcontractors. Drawing numbers will be assigned by the *Employer* as drawings are developed.

3.12.1.1 Document Identification

The *Consultant* is required to submit the Vendor Document Submission Schedule (VDSS) as per agreed dates to the delegated Eskom Representative. Eskom will pre-allocate document numbers on the VDSS and send back to the *Consultant* through the delegated Eskom Representative. The VDSS is revisable and changes must be discussed and agreed upon by all parties. Changes in the VDSS can be additional documentation to be submitted, changes in submission dates or corrections in documentation descriptions, document numbers, etc. The *Consultant*'s VDSS shall indicate the format of documents to be submitted.

3.12.1.2 Drawings Format and Layout

The creation, issuing and control of all Engineering Drawings will be in accordance to the latest revision of Engineering Drawing Standard [14]. Drawings issued to Eskom will be a minimum of one hardcopy and an electronic copy. All *Consultants* are required to submit electronic drawings in Micro Station (DGN) format, and scanned drawings in pdf format.

No drawings in TIFF, AUTOCAD or any other electronic format will be accepted. Drawings issued to Eskom may not be "Right Protected" or encrypted.

3.12.1.3 Document Submission

All project documents must be submitted to the delegated Eskom Representative with transmittal note according to "Project / Plant Specific Technical Documents and Records Management Work Instruction" [13]. In order to portray a consistent image it is important that all documents used within the project follow the same standards of layout, style and formatting as described in the Work Instruction. The *Consultant* is required to submit documents as electronic and hard copies and both copies must be delivered to the *Eskom Representative* with a transmittal note.

In addition, the *Consultant* shall be provided with the following standards which must be adhered to:

- "Documentation Management Review and Handover Procedure for Gx Coal Projects" [12]
- "Project Documentation Deliverable Requirement Specification" [11]
- "Technical Documentation Classification and Designation Standard" [9]

3.12.2 Engineering Change Management

All Design change management shall be performed in accordance to the latest revision of the "Eskom Project Engineering Change Management Procedure" [6] and the *Employer* shall ensure that *Consultant* is provided with latest revisions of this procedure. Any uncertainty regarding this procedure should be clarified with the *Employer*. All design reviews will be conducted according to the "Design Review Procedure" [5].

3.12.3 As-Built Plant Drawings

The *Consultant* shall be responsible to update all existing drawings of the "as-built plant" with the new system information.

New drawings are to be supplied where changes have been made to the plant.

The creation, issuing and control of all Engineering Drawings will be in accordance to the latest revision of Engineering Drawing Standard [14]. Drawings issued to Eskom will be a minimum of one hardcopy and an electronic copy. All *Consultant*s are required to submit electronic drawings in Micro Station (DGN) format, and scanned drawings in pdf format. No drawings in TIFF, AUTOCAD or any other electronic format will be accepted. Drawings issued to Eskom may not be "Right Protected" or encrypted.

3.12.4 Plant Coding

Plant Coding shall be undertaken by the *Employer* and as such the service provider shall make available the following documentation to code:

Employer will only code the AKZ code defining Documentation listed above. The *Employer* will assign a coding practitioner who will interact with the Service Provider in coding the plant as listed above. It may be required that the person be based at the Service provider's offices full time. The Service Provider will then be required to include allocated codes to all other designs and related documentation. It is also the responsibility of the Service Provider to consistently apply the AKZ codes throughout the rest of the technical documentation.

The Service provider shall ensure that all documentation is coded (as per the codes assigned by the Practitioner) prior submission to *Employer* for review.

Tutuka power station coding and plant labelling shall conform to the following Plant standards:

- "Tutuka AKZ Coding Procedure" [2].

3.12.5 Procedures, Guidelines & Other Documents

The applicable procedures, guidelines and other relevant documentation to commission, operate, maintain and engineer the plant/system shall be supplied with the system, by the *Consultant*. This will include as a minimum the following:

- Piping and instrumentation diagrams
- General arrangement and layout drawings
- System description providing all technical specifications
- Operating and control philosophy
- Data sheets and equipment lists
- Temperature rating of detection bulbs
- Testing and commissioning procedures.
- Quality Control Plan

3.13 OTHER PROJECT DELIVERABLES

In addition to the technical scope, the *Consultant* is to ensure the following are included in his/her submission:

3.13.1 Project planning

- Programme detailing the duration of each activity from the day the order is placed. For production purposes, one calendar week per belt will be allocated for the inspection. Any deviations should be noted.
- List of any special equipment required to execute the work
- An example of the *Consultant*s QCPs
- An organogram for the core crew, in particular the names and qualifications of the supervisors
- An example of the *Consultant*s procedures

Consultant to submit programme and organogram for *Employer*'s approval.

3.13.2 Deviations, Exclusions and qualifications

- List of any deviations or qualifications to this specification must be provided

3.13.3 References

- Verifiable experience of the *Consultant* or sub-contractor or joint venture partner regarding the scope.
- Verifiable references are to be provided. The reference list is to include but not limited to, details of the project, plant owners, date and duration of the project.

4. AUTHORIZATION

This document has been seen and accepted by:

Name	Designation
Kyle Enslin	Tutuka Civil Engineer

Name	Designation
Nompumelelo Dlamini	Tutuka Civil Engineering Manager
Funeka Grootboom	Civil/Structural CoE: Chief Engineer
Monyane Mokoena	Tutuka Auxiliary Engineering Manager
Egard Janse Van Rensburg	Tutuka Engineering: Senior Technologist
Mike Molepo	Tutuka Boiler Engineering
Ntombifuthi Ngcobo	Tutuka Engineering Manager
Lucky Dlamini	Tutuka Project Manager
Patrick Nkosi	Tutuka Operations Manager
Lehlohonolo Mogwase	Tutuka Environmental: Senior Advisor
David Sindane	Tutuka Quality: Senior Advisor
Thokozani Maseko	Tutuka Safety Department

5. REVISIONS

Date	Rev.	Compiler	Remarks
July 2020	3	K Enslin	• "*Contractor*" changed to "*Consultant*" • Drawings added • More authorisations added
October 2017	2	K Enslin	Works information edited to include more deliverables
July 2017	1	K Enslin	Document compiled to identify scope

6. DEVELOPMENT TEAM

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

- Kyle Enslin,
- Koos Radebe.

7. ACKNOWLEDGEMENTS

- Andile James,

- Nompumelelo Dlamini.