Eskom
Rotek Industries

Name : **Cosmas Tembo**
Designation: **Works Engineer**
Turbo Gen Services Works

Ref: X-1384127-407 Rev: 0

To: B Barnes, M. Nkosi

Copy to: X Ngidi

Date: 22 March 2021

Subject: NCORA SMALL HYDRO POWER PLANT: UNIT 1 TURBINE OVERHAUL

1. PURPOSE

The purpose of this document is to define the services needed from a *Contractor* for provision of a reliable, comprehensive and cost effective services for fabrication, manufacturing, inspection, and testing of the hydro components for the *Employer*, ERI – TGS, Works.

2. DESCRIPTION OF THE WORKS

2.1 *Employer*'s objectives

The *Employer's* objective is to have a fully refurbished and functional turbine unit 1 to be installed at the site plant. The works includes

- 1x fabricate flywheel with *Employer* approved material
- 1 x manufacture runner with *Employer* approved material
- 1 x manufacture a full set of guide vanes and guide vane linkage assembly with *Employer* approved material
- 1 x repair turbine shaft damage
- 1 x refurbish spiral casing
- 1 x refurbish draft tube
- 1 x manufacture/refurbish rear end cover
- 1 x manufacture/refurbish front end cover
- Manufacture/supply turbine accessories.

2.2 Brief Description of the W*orks*

The *works* is the overhaul of Ncora Unit 1 turbine small hydropower plant

The inspection,refurbishement manufacturing and supply shall be carried out to specification and acceptable standards as indicated in Section 7. This will require that all staff performing the tasks to be fully qualified and certified in their specific fields. Nondestructive testing (NDT) of the finished product will also be required and this is to conform to the latest relevant ISO and SANS standards:

The final fabricated product must have a very low distortion, the final dimensions must be within the specified tolerances and with good surface finishes which are specified

3. WORK TO BE PERFORMED BY THE CONTRACTOR FOR THE WORKS

3.1 Specifications

The *Contractor* adheres to the following in providing the *works*:
a) The *Employer*'s safety rules
b) The *Employer*'s codes of practice
c) The *Employer*'s intervention points on the QCP.
d) All the specifications and standards and instructions stated in this document.

3.2 Scope of work

The *works* include the following:

3.2.1 The *Contractor* must submit material certificates, refurbishment method statements and Quality Control Plans to be used in the overhaul of Ncora U1 turbine to the *Employer* for approval before manufacturing commences
3.2.2 The *Contractor* submits Welding Procedures specifications meeting the approved materials material before manufacture
3.2.3 Inspect all materials and ensure it meets the specifications.
3.2.4 Refurbish the shaft, spiral casing, front & rear end covers and draft tube in accordance with method statement.
- 3.2.4.1 Truth check and repair of shaft damage and replace damaged sleeve for the main shaft.
- 3.2.4.2 NDT (MT&UT) inspection, thickness assessment, trueing of the flange faces, external painting, replacement of bolts, internal coating, weld repairs and water leak test for the **draft tube and spiral casing**.
- 3.2.4.3 NDT inspection, thread repairs, trueing of faces, replacement of phosphor-bronze wear ring, external painting and replacement of bolts for **front and rear covers**.

3.2.5 Fabricate/manufacture the flywheel, guide vanes, front and rear plates in accordance with drawings and specifications
3.2.6 Weld and stress relief the flywheel in accordance the weld procedures.
3.2.7 NDT (MTand PT and UT) in accordance with method statement.
3.2.8 Manufacture/supply and fit all accessories specified in Table 1
3.2.9 Water pressure test the spiral casing and draft tube in accordance with approved procedure.
3.2.10 Prepare & paint spiral casing and draft tube with suitable paint colour specification that is acceptable and apply coating wetted surfaces against hydro abrasion corrosion.
3.2.11 Update drawings or develop sketch with detail information.
3.2.12 The *Contractor* transports the fully assembled turbine and spares to the *Employer*'s site (Rotek Industries, TGS, Lower Germiston road, Rosherville, Johannesburg) without any damage after the refurbishment, testing and inspection are completed.

Table 1 : Turbine Accessories- Supply/manufacture

Item	Specification	Quantity
Guide vane bushes	To drawing	24
Wearing ring, stationary	To drawing, BS1400 AB1	1
Wearing ring, rotating	To drawing, BS 1400 AB1	1
Front plate	To drawing, Approved stainless steel	1
Rear plate	To drawing, Approved stainless steel	4
Front end cover	To drawing, Cast iron	1
Rear end cover	To drawing, Cast iron	1
Regulating ring	To drawing	1
Guide ring linkage assembly	As per drawings	12
Bolts, nuts and studs	As per list	set
Shaft sleeves	To drawing	2
Gland seal packing housing	To drawing	1
Thrust bearings	Mitchell bearings	2

More information can be found in Section 8.

3.3 *Contractor*'s design

The *Contractor* designs the following parts of the *works*:

a) The *Contractor* designs a special fixture/jig to keep the **flywheel** in correctshapeand configuration without distortion during fabrication.

b) The Contractor designs a special fixture/jig to ensure that all flange faces are aligned within tolearnce.

4. WORK TO BE PERFORMED BY THE EMPLOYER FOR THE WORKS

4.1 Scope of work

The *works* include the following:

4.1.1 Inspection

- The *Employer* shall review and amend the QCP from the *Contractor*, by including intervention points.
- The *Employer* shall review and evaluate weld procedure specifications and supporting procedure qualification records
- The *Employer* may perform visual inspection of the *works* at the site of the *Contractor* while the fabrication, machining, inspection and testing by the *Contractor* are executed.
- The *Employer* shall Perform final NDT (MT/UT/PT) inspections on all welded sections in accordance with Eskom standards.
- The *Employer* perform visual inspection with the delivery of the U1 turbine at the *Employer*'s site (Rotek Industries, TGS, lower Germiston road, Rosherville, Johannesburg).
- The *Employer* may provide check sheets for recording data by the *Contractor* where it is deemed necessary and critical during installation.

4.1.3 Storage of Turbine
The *Employer* stores the turbine shaft assembly in a safe area on the *Employer*'s plant (Rotek Industries, TGS, lower Germiston road, Rosherville, Johannesburg) after delivery by the *Contractor*.

5. EMPLOYER'S PHILOSOPHY

5.1 Engineering philosophy
The fabrication/manufacture of the flywheel, spiral casing, runner and guide vanes and all other turbine shaft components shall be carried out in accordance with internationally accepted standards to ensure proper spares on site. Refer to section 7.

5.2 Maintenance philosophy
The flywheel, spiral casing, runner and guide vanes and all other turbine shaft components after fabrication/manufacture shall conform to the design, sizes and tolerances as per information supplied from *Employer.*

6. DRAWINGS

The Employer will supply any available information deemed necessary to ensure proper refurbishment of the U1 turbine assembly. This may include drawings and/or specifications and or check sheets.

Drawing nos. 13.25/8336 to 13.25/8662

7. SPECIFICATIONS
The *Contractor* adheres to the following in providing the items to be supplied:

7.1 BS EN ISO 15614 Part 1 Level 2, Welding procedure qualification
7.2 SANS 3834-2:2006, Quality management for fusion welding of metallic materials Part 2: comprehensive quality requirements
7.3 BS EN ISO 5817:2014, Welding-Fusion-welded joints in steel
7.4 BS EN ISO 9606 Part 1, Qualification, testing of welders
7.5 BS EN ISO 9934-1:2016 NDT (MPI) Magnetic particle inspection standard,
7.6 BS EN ISO3452-1:2013 NDP (PT), penetrant inspection standard or latest vesrions.
7.7 BS EN ISO 1714 latest revision, Ultrasonic Testing of welded joints
7.8 Linear imperfections exceeding 5mm will not be accepted
7.9 Wearing ring material must be of Nickel aluminium bronze meeting ASTM B148-grade 955 standard or latest equivalent.
7.10 Paint specificatio
7.10 The flange faces must be square to the axis
7.11 Holes PCDs and pitch distance to be maintained to within 0.05 mm.
7.12 The machining surface finish must be at least Ra 0,8µm.

8. CONSTRAINTS ON HOW THE CONTRACTOR PROVIDES THE WORKS

8.1 Fabrication

The *Contractor* carry out fabrication of the flywheel and stress relieve in accordance with standards.

8.2 Welding procedures

a) The *Contractor* ensures that the welding procedure is submitted to the Employer for approval prior to executing the works and the procedures meet BS EN ISO 15614 Part 1 Level standards.
b) The *Contractor* performs works that conforms to SANS 3834-2:2006 and BS EN ISO 5817:2014 standards
c) The *Contractor* ensures welders have been tested in accordance with BS EN ISO 9606 Part 1 standard
d) The *Contractor* ensures that all repairs must be completed before final stress relief.

8.3 Design criteria

a)The *Contractor* designs the following parts of the *works*:
(i) The *Contractor* designs a special fixture/jig to ensure the **flywheel, spiral casing & runner are** without distortion after fabrication.
(ii)The *Contractor* designs a special fixture/jig to ensure the **holes** for **front & rear end covers, runner, spiral casing, front and rear plate** are on the same PCD and holes centres are aligned to within 0,05mm.

8.4 Factory testing

The *Contractor's* personnel performing the tests are qualified as a Level 2 or better NDE technician as per Eskom Standard ESKASAAA3 and according to latest relevant SANS or ISO standard.
The *Contractor* performs factory testing.
a) The *Contractor* records all relevant dimensions and features of the turbine components on a drawing and submits these recordings to the *Employer* for acceptance with the delivery of the U1 turbine assembly.
b) The *Contractor* checks the turbine components for structural integrity and weld soundness by means of a suitable method/s. The *Contractor* records this on information sheet.
d) The *Contractor* inspects the surface finish and record the condition on the dimensional verification sheet.
e) The *Contractor* checks all dimension that they meet the information as per drawing and submits these recordings on the dimensional verification sheet.
f) The Contractor inspects the turbine components for cracks and submits reports to the Employer for acceptance.
g) The Contractor inspects the **spiral casing and draft tube wall thicknesses** and submits reports to the Employer for acceptance.
*h) The Contractor checks the **spiral casing and draft tube** for leaks under pressure test, and records this on an information sheet.*

8.4.1 Test certificates

The *Contractor* submits copies of all tests, indicating the results of all tests performed to the *Employer* for acceptance within five (5) calendar days of being performed.

8.4.2 Dimensions and tolerances

a) The *Contractor* records the exact dimensions of the turbine components provide by the *Employe*r prior to the commencement of the work. The *Contractor* indicates all the required dimensions on a drawing or sketch.. The *Employer* provides drawings of the turbine components as indicated in Section 6.
b) The *Contractor* records all dimensions and tolerances of the finally machined/refurshined turbine components on a suitable check sheets. The *Contractor* determines tolerances where not available and submits to the *Employer* for confirmation and acceptance.
c) The *Contractor* submits a size conformation sheet, detailing all significant dimensions and features to the *Employer* for acceptance prior to the commencement of the *works.*

8.4.3 Turbine components inspections

a) The *Contractor* inspects the turbine components visually as discussed in Section 8.4.3.1.
b) The *Contractor* performs ultrasonic testing on the turbine components as discussed in Section 8.4.3.2.
c) The *Contractor* performs penetrant testing on welded sections of the turbie components as discussed in Section 8.4.3.3
d) The *Contractor* performs magnetic particle testing on turbine components after final machining/refurbishment as discussed in Section 8.4.3.4

8.4.3.1 Visual inspections

a) The *Contractor* inspects the turbine components to be refurbished prior to commencing any work. The *Contractor* measures the relevant sizes and submits the recorded values to the *Employer* for acceptance within five (5) calendar days after execution of these measurements.
b) The *Contractor* performs inspections during the refurbishment to ensure compliance with specifications.
c) The *Contractor* performs visual inspections under good lighting conditions after the final assembling of the U1 turbine assembly. No dents , scratches or repair defects is allowed. The *Contractor* submits a test report to the *Employer* for acceptance within five (5) days of execution of these inspections.

8.4.3.2 Ultrasonic testing (UT)

a) The *Contractor* performs ultrasonic testing to BS EN ISO 1714 and BS EN 12680 standards
b) The *Contractor* performs ultrasonic testing (UT) on the **flywheel, draft tube, Guide vane paddle and spiral casing**.
c) The *Contractor* ensures a wall thickness inspection map is carried put on the **draft tube, and spiral casing**.
d). The *Contractor* submits a test report to the *Employer* for acceptance within five (5) days of execution of these inspections.
e) The *Contractor* repairs all defects as discussed in Section 8.4.4.

8.4.3.3 Penetrant testing (PT)

a) The *Contractor* performs penetrant testing (PT) according to BS EN ISO3452 and BS EN 1371 standards.
b) The *Contractor* performs liquid/ dye penetrant testing (PT) to test for possible surface-breaking discontinuities such as hairline cracks, pinholes and micro surface porosity after machining.
c) The *Contractor* repairs all defects. Refer to Section 8.4.4.

8.4.3.4 Magnetic Particle testing (MT)

a) The *Contractor* performs 100% magnetic particle testing (MT) on all turbine components according to BS EN ISO 9934 and BS EN 1369 standards

b) The *Contractor* performs (MT) to test for possible surface-breaking discontinuities such as hairline cracks on all welds.
c) The *Contractor* repairs all defects. Refer to Section 8.4.4.

8.4.3.5 Truth Check

a) The *Contractor* performs turbine shaft runouts in accordance with specification
b) The *Contractor* will submit runout check sheet for Employer's approval

8.4.3.6 Water Leak Test

a) The *Contractor* performs water pressure test to approved procedure.
b) The *Contractor* performs leak test on the **spiral casing and draft tube**
c) The *Contractor* performs repairs all defects. Refer to section 8.4.4

8.4.3.7 Weight Measurements

a) The *Contractor* performs weight measurements of the **flywheel, spiral casing, draft tube, front and rear covers, turbine shaft, runner, guide vanes (individual & full set).**

8.4.4 Rectification of defects

a) Cracks and linear indications will not be accepted
b) Cracks and zones of incomplete fusion or penetration will not be accepted.
c) The *Contractor* repairs all defects.
d) The *Contractor* repeats the welding and testing process in the event of surface cracks and fabrication undercuts, that have not been accepted by the *Employer*.
e) Leaks will not be accepted under a water pressure test.
f) Any casting defects exceeding the specified acceptance standards shall be submitted to the *Employer* for consideration and concession

8.4.6 Final inspections

a) The *Contractor* ensures all welds and joints is free and near of weld splatter.
b) The *Contractor* ensures all edges and corners are free of burrs.
c) The *Contractor* ensures all components are free of any other damage.
d) The *Contractor* ensures all surface finishes as per the drawings as tabled in Section 6 and 7. The *Contractor* records all measurements and the measurements may be witnessed by the *Employer*.
e) All recorded measurements are submitted to the *Employer* within two (2) calendar days of being performed for acceptance.

8.5 Treatment and Painting and coating

a)The *Contractor* ensures that the **spiral casing and draft tube** are painted externally and coated internally to Eskom standard meet Eskom specification 36-1126 for corrosion protection plant & equipment with coatings
b) The *Contractor* ensures propose a painting and coating method for consideration by the *Employer*
c) The *Contractor* ensures that stainless steel is pickled and passivated after welding
d) The *Contractor* ensures that the spiral casing, draft tube, runner and guide vanes are coated with an *Employer* approved coating medium.

8.6 Preservation, Delivery and offloading

a) The *Contractor* ensures that all components are preserved with suitable coating for long term storage
b) The *Contractor* ensures that the components are transported and delivered to the *Employer* (Rotek Industries, TGS, lower Germiston road, Rosherville, Johannesburg).

c) The *Contractor* ensures that the components are properly packaged to prevent damage or deterioration and to be protected against liquid or dirt ingress during transportation, handling and storage.

8.7 Quality management

a) The *Contractor* submits a quality control plan (QCP) to the *Employer* for acceptance as part of the tender returnable documents. This QCP include inspection, hold and witness points. Refer to Section 9.
b) The *Contractor* submits the final QCP to the *Employer* for acceptance within one week after contract award. Refer to Section 9.

8.8 Safety management

a) The *Contractor* complies with the Occupational Health and Safety Act. (OHSA No. 85 of 1993)
b) The *Contractor* takes every precaution to ensure safety and to protect the *works* and temporary *works*.
c) The *Contractor* is responsible for the safety and security of his personnel, materials on site and the *works* at all times.
d) The *Contractor* adheres to the safety regulations pertaining to the *Employer*'s site (Rotek Industries, TGS, lower Germiston road, Rosherville, Johannesburg).
e) The *Contractor* provides all the required safety and personal protective equipment to his staff for the duration of the contract.

8.9 Installation

8.9.1 Security

General access to the *Employer*'s Works (Rotek Industries, TGS, lower Germiston road, Rosherville, Johannesburg) is controlled and it is mandatory that the *Contractor* adheres to all security regulations in force during the period of the contract.

8.9.2 Other construction activities

The *Contractor* notes that there may be other work taking place during the period when he/she is providing the *works* to the *Employer*'s Site and liaises with the other *Contractors* in this regard.

8.10 Title to site materials

The *Contractor* has no title to plant and/or materials resulting from him/her carrying out the *works*.

8.11 Documentation

8.11.1 Pre-implementation documentation (During tender process)

The *Contractor* submits amongst other commercial documents the following to the *Employer*

a) Quality control plans with scheduled duration (bar chart) and refurbishment method statements.
b) Welding procedure specification and supporting procedure qualification record
c) Welders and NDT technicians' qualifications
d) Welding procedure shall be qualified according to latest revision of BS EN ISO 15614 Part 1 Level 2
e) Flywheel fabrication method statement.
f) ISO 3834 certification

g) List of materials and specifications for manufacture of components
h) ISO 9001 certification
i) Water pressure test procedure.
j) Calibration certificates of inspection, test and equipment used

The *Contractor* notes the following:
a) Metric sizes, as specified by the International Standards Organization and agreed to by the South African Metrication Boards, are used unless specified in the drawings.
b) SI units are used on drawings, pamphlets, calculations and documents.

8.11.2 Post-implementation documentation
The *Contractor* submits one hardcopy and one electronic version of all documentation described below on take-over of the *works* to the *Employer* for acceptance within five (5) calendar days of being performed. Submit a data book that must include but is not limited to the following

a) A completed and signed-off quality control plan certificate.
b) Material test certificates
c) Copies of welding procedure specification and welders qualifications
d) Updated drawings and dimensional information sheet
e) NDT and leak testing certificates
f) Copy of water pressure test pressure.
g) List of weights for individual parts
h) Overall dimensions of the individual components
i) Shaft truth check (runout) report
j) Wall thickness inspection map
k) Paint and coating specifications
l) Preservation medium used and its specification.

8.12 Completion
Completion is when the following has been done by completion date:
- The *Contractor* has done everything required to provide the *works.*
- The *Contractor* has delivered the *works* and the *works* is accepted by the *Employer*.
- The *Contractor* has provided all as-built documentation described in Section 8.11.2 and is accepted by the *Employer*.
- The *Contractor* submitted all other documentation as required in this document to the *Employer* for acceptance.

9. REQUIREMENTS FOR THE PROGRAM

a) The *Contractor* submits a Gantt chart program/ quality control plan detailing how the *works* is executed with a timeline included to the *Employer* for acceptance as part of the tender returnable documents.
b) The *Contractor* submits the finalized program/ quality control plan within one week after contract award.
c) The program/ quality control plan indicates the start date, completion date and duration of each activity.
d) The *Contractor* indicates the following on his program/ quality control plan submitted to the *Employer* for acceptance:

- The time required from notification of work to obtaining material.
- Material certificates and preparation.
- Visual inspection, dimensional and NDT (MT, UT, PT) inspections
- Fabrication & welding and stress relieving (PWHT) drilling of flywheel
- Wall thickness mapping of the draft tube and spiral casing. achining & drilling of components
- Truth check the turbine shaft
- Manufacture of components
- Painting of draft tube and spiral casing.
- Inspection- MT, UT and Penetrant testing, leak test.
- Assembling and final inspection of the *works*.
- Preservation of components
- Delivery to the *Employer*'s Site (Rotek Industries, TGS, lower Germiston road, Rosherville, Johannesburg)
- Statutory and other non-working days included in the contract period and occurring just after the contract period.

e) The *Contractor* confirms that current test certificates apply to all identified in the program.

10. SERVICES AND OTHER THINGS PROVIDED BY THE EMPLOYER

The *Employer* provides the following to the *Contractor*:

10.1 Crane

A crane is available in the *Employer*'s receiving and dispatch. The *Contractor* ensures that all necessary arrangements and preparations are made for the use of this crane.

10.2 Area for and storage

The *Employer* indicates a storage yard to the *Contractor*.

All other services and things needed to provide the *works*, is supplied by the *Contractor*.

Regards,

C. Tembo

Works Engineer