Eskom	Technical Specification	Generation

Title: **Kriel BFPT and Main Oil Cooler Bundle Replacement Technical Specification**

Unique Identifier:	**1650**
Alternative Reference Number:	**N/A**
Area of Applicability:	**Engineering**
Documentation Type:	**Technical Specification**
Revision:	**1**
Total Pages:	**17**
Next Review Date:	**N/A**
Disclosure Classification:	**CONTROLLED DISCLOSURE**

Compiled by	Functional Responsibility	Authorised by
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1. INTRODUCTION

Kriel Power Station is situated approximately 10 kilometres from the town of Kriel in Mpumalanga. Access to the station is by road.

The Power Station comprises of 6 x 500 MW turbo-generator boiler units. Each turbo-generator includes an HP, IP and LP turbine, which exhausts to a surface condenser .

This document provides the technical specifications for the Kriel BFPT and main oil cooler replacement.

2. SUPPORTING CLAUSES

2.1 SCOPE

The specification covers as minimum the design, manufacturing and delivery of replacement tube bundle for the Kriel main turbine (6 off) and Boiler Feed Pump Turbine (BFPT) (6 off) lube oil coolers. i.e. 12 off tube bundles. Refer to Section 3 for detailed scope of work.

2.1.1 Purpose

The purpose of this document is to provide the *Contractor* with all the relevant details required to perform the work as defined in the scope.

2.1.2 Applicability

This document applies to Generation and all other relevant stakeholders that have an affiliation to this specific project including Kriel Power Station.

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] Pressure Equipment Regulations as defined in OHS Act (PER)

[2] SANS 347 Categorization and conformity assessment criteria for all pressure

[3] 240-106628253 Standard for welding Requirements on Eskom Plant

[4] 240-83539994 Standard for Non Destructive Testing (NDT) on Eskom Plant

[5] 240-86973501 Engineering Drawing Standard

[6] 240-145581571 Standard for the identification of contents of pipes and vessels

[7] ASTM B171 Standard Specification for Copper-Alloy Plate Sheet for Pressure Vessels, Condensers, and Heat Exchangers.

[8] ASTM B111 Standard Specification for Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock

[9] TEMA – Standards of the tubular exchanger manufacturers association

[10] PD 5500 Specification for Unfired Fusion Welded Pressure Vessels

[11] ASME VIII Div 1 Pressure Vessels

[12] BS EN 13445 Unfired Pressure Vessels

[13] ISO 3834 Quality Requirements for Fusion Welding of Metallic Material

[14] XXXXXX Kriel Tender Technical Evaluation Strategy for Main Turbine and Boiler Feed Pump Turbine Lube Cooler Bundle

2.2.2 Informative

N/A

3. SCOPE OF WORK

3.1 GENERAL REQUIREMENTS

1. This specification is for the manufacturing and delivery of 6 (six) replacement tube bundles for the Kriel main turbine and 6 (six) replacement tube bundles for the Boiler Feed Pump Turbine (BFPT) lube oil coolers, i.e. 12 bundles in total. A schematic of the coolers is given in the figures below. The cooler is installed in a horizontal orientation in the plant. Only the tube bundles consisting of the two tube plates, tubes, baffles and shrouds are to be manufactured and delivered. The coolers are of a one-pass design on water side (water inside the tubes) while oil flow is directed over the external finned surfaces of the tubes. The water flow rate in the main and BFPT coolers are 145 kg/s and 40 kg/s respectively. The oil flow quantity is unknown. The replacement cooler will be a like-for-like replacement cooler. The *Contractor* is however still responsible to verify the mechanical design in accordance with the selected design code and adjust if required within the parameters given in section 3.2 below.
2. The *Contractor* is responsible for the supply, manufacture and transport & delivery to Kriel of all items in the following sections of this document (hereafter referred to as “the works”) according to the applicable codes and standards and the requirements in this document.
3. After contract award the successful *Contractor* is responsible to confirm all measurements of the cooler bundles and shells to ensure that the new bundle dimensions are exactly the same as the installed bundles to ensure it will fit into the existing shells. The *Contractor* shall also inspect an actual shell on site after bundle is removed to verify shell inside diameters and position and orientation of nozzles, to ensure that baffle plates is spaced adequately away from shell side nozzles. The bundle is of floating design, thus during shell inspection the sealing arrangements on both tube plates and sealing ring must also be inspected to allow for adequate sealing of water and oil sides. These measurements are to be done before any material is ordered or manufacturing commence. One cooler bundle and shell will be made available for the *Contractor* for measurements. All dimensions given in this specification are for tendering purposes only.
4. The Coolers shall be assembled in South Africa including tube finning, tube expansions and pressure test.
5. The *Contractor* shall have a valid ISO 3834 Part 2 certification.
6. The *Contractor* shall demonstrate experience in manufacturing finned tube heat exchangers by submitting verifiable references.

3.2 DESIGN CONDITIONS AND REQUIREMENTS

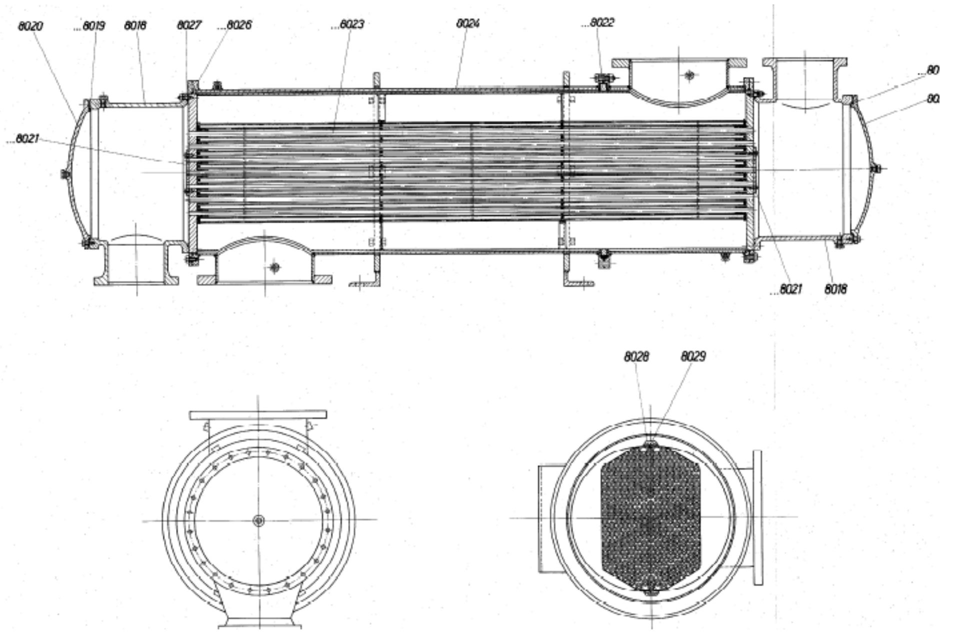

Figure 1: Schematic of the Kriel main turbine lube oil cooler. Note that the waterboxes and cooler shell is also shown which is not included in the contract.

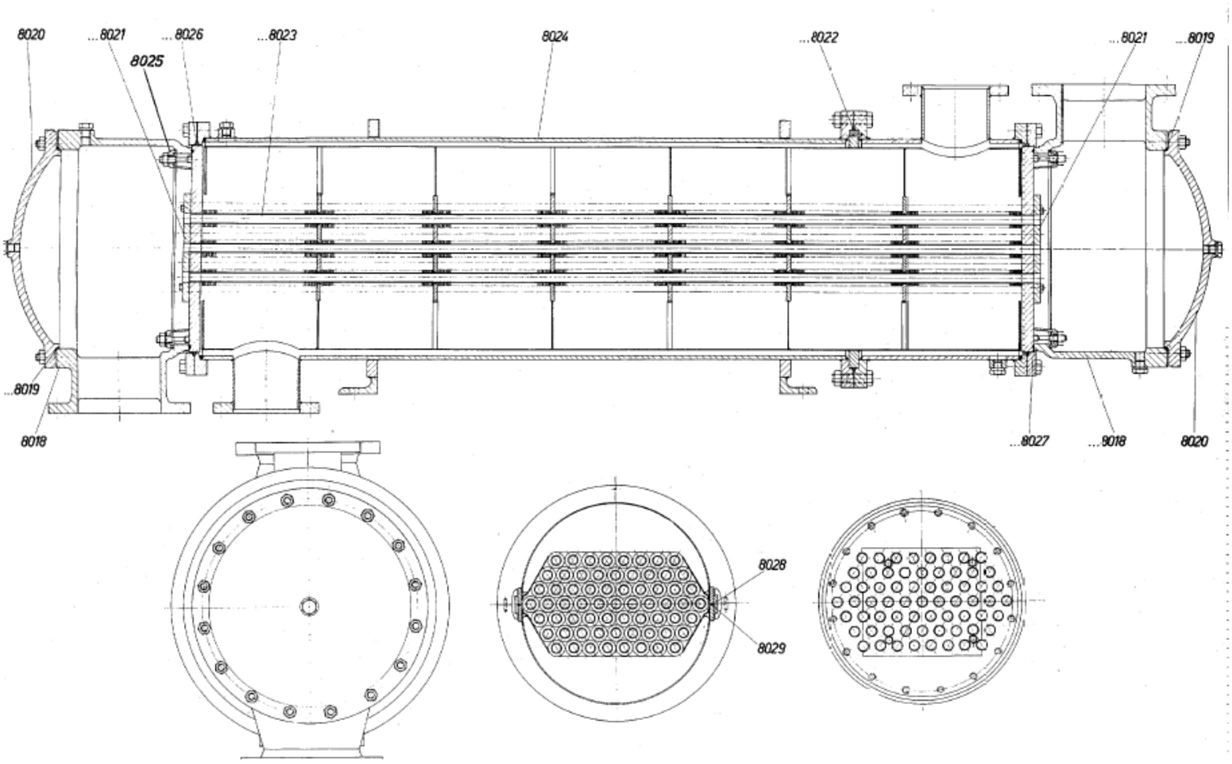

Figure 2: Schematic of the Kriel BFPT lube oil cooler. Note that the waterboxes and cooler shell is also shown which is not included in the contract.

Table 1: Approximate main dimensions for tendering purposes only

	Main	**BFPT**
Tube length, mm	3010	3010
Tube plate diameter, mm	860	500
Tube plate thickness, mm	45	30
Steel sealing ring thickness, mm	35	20
Steel sealing ring diameter, mm	940	550
Number of tubes, -	253	65

1. The design tube-side pressure is 400 kPa (g) with a design temperature of 60 °C.
2. Although the vessel is SEP in accordance with SANS 347, it must be designed and manufactured in accordance with an acceptable design code as given in the PER and SANS 347. For the coolers one of the following will be preferred:
    - PD 5500 Category 2
    - ASME VIII Div 1
    - BS EN 13445
3. Formally the design code will be stated as: “Generally in accordance with *insert selected code here*”.
4. Full mechanical design calculations as well as general arrangement drawings that includes bill of materials are required for the cooler bundles.
5. No process design is required. The tube size (OD and thickness), tube length and number of tubes must be the same as existing coolers.

3.3 TUBE PLATES

1. The tube plate material shall be a suitable copper-based material from ASME SB-171. *Contractor* to determine the exact grade. This is subject to Eskom Engineering approval.
2. The tube plate diameter and hole distribution shall be as per site measurements.
3. Tube plate thickness shall be calculated in accordance with the selected design code for the selected material mentioned above but shall not be less than the tube plate thickness as per sample.
4. *Contractor* shall ensure that tube plate is of sufficed strength to prevent any deformation during expansion process.
5. Tube plate calculations will form part of the design package.
6. The nominal tube plate hole diameter shall be as per TEMA requirements for a nominal tube outside diameter of 24 mm. If required, the relevant tables to be interpolated.
7. The tube plate hole diameter tolerance shall be in accordance to TEMA Standard Fit Tolerances.
8. The number of tube holes and orientation of holes shall be as per sample.
9. The surface finish of both tube plates in contact with packing material shall be in accordance to the TEMA requirements.

10. Permissible tube plate ligament variation as per relevant TEMA table.
11. Tube plate hole inside edges shall be free of burrs. Internal hole finishes shall be given a smooth workmanlike finish. A practical test is that cotton wool shall not attach to the surface if wiped over it. *Contractor* can propose a different finish for Eskom approval if required. Serrations in hole surfaces are permissible if required by the *Contractor's* design.
12. Both tube plates on both coolers shall accommodate the stainless steel studs to accommodate the water box flanges.
13. The zinc anodes shown in Figures 1 and 2 are not required.
14. The tube plates shall be supplied with BS EN 10204:2004 3.1 material certification.

3.4 BAFFLE PLATES

1. The baffle plate material shall be a suitable pressure vessel quality Carbon steel material like SA 516 Gr 70, BS EN 10028 P265 GH or BS 1501-151-430.
2. The Number of baffle plates shall be as per the respective samples and Figures 1 and 2.
3. Baffle plate cuts shall be as per sample.
4. All tubes shall be straddled by each baffle plate.
5. Due to the fins on the external tube diameter, segmented baffles to be used.
6. The baffle plate thickness and diameters shall be as per sample measurements.
7. The nominal baffle plate hole diameter shall be as per TEMA requirements.
8. The baffle plate hole diameter tolerance shall be in accordance to TEMA requirements.
9. Tube baffle plate inside edges shall be free of burrs. Internal hole finishes shall be given a smooth workmanlike finish.

3.5 TUBES AND FINS

1. Tube material shall be admiralty brass as per ASTM B111M: C44300 or ASME SB111M: C44300.
2. Cooler tubes shall be procured in accordance with section 3.10.
3. The minimum number of spare tubes to be procured per cooler is 3 additional tubes. The number of tubes shall be as per sample; 253 and 65 tubes for the main and BFPT coolers respectively.
4. Tube order length shall be determined by the *Contractor*.
5. Nominal tube outside diameter is 24 mm.
6. Nominal tube wall thickness is 1 mm.
7. Tolerances on outside diameter and wall thickness are in accordance with ASTM B111M requirements and the *Contractor* shall ensure the tubes is manufactured with acceptable tolerances on the OD of the tubes considering the tube plate tolerances (as per standard fit criteria).
8. The fin outer diameter is 39 mm and the find pitch is 2 mm.
9. The minimum total oil side heat transfer surfaces for the main and BFPT oil coolers are 572 and 147 m^2 respectively.

10. Smooth helical copper, type L, fins shall be tension-wound onto the tubes. The minimum fin thickness on the outer diameter shall be 0.4 mm.
11. The fin ends shall be attached to the tube wall by brazing/soldering while the fin is under tension. The *Contractor* shall provide a statement in the tender to demonstrate what method will be used to prevent the fins from unwinding.
12. The *Contractor* shall propose a method of verifying good thermal contact between the fins and tube wall for acceptance by the Employer. As a minimum the tension of the fins on each tube will be tested by “ringing” the fins.

3.6 SHROUD AND SEALING RING

1. A removable steel shroud, approximately 2 mm thick, shall be attached around the bundle with inlet and outlet oil openings as per samples.
2. The shroud shall be manufactured in two halves as per sample. The interface between the two haves shall minimize oil escaping and bypassing the heat exchangers.
3. One sealing ring is to be continuously seal welded to the shrouds. The sealing ring shall be machined round and flat in one piece in particular the outer diameter.
4. The surface finish of the outer diameter of the sealing ring in contact with the packing material shall be in accordance with the TEMA requirements.
5. After machining the sealing ring, the ring shall be split in two on the centre line, after which the two haves fill be fitted with two dowels to ensure alignment.
6. The position of the sealing rings along the length of the bundle shall be in accordance with the sample.
7. The connection between the baffle plates and shroud shall be in accordance to the *Contractor’s* design.
8. The oil inlet and outlet oil opening diameters shall be 160 and 320 mm for the BFPT and mail oil coolers respectively.
9. 100% surface NDT to be done on shroud to sealing ring weld.
10. The steel shroud and sealing ring material shall be a suitable pressure vessel quality Carbon steel material such as SA 516 Gr 70, BS EN 10028 P265 GH or BS 1501-151-430.

3.7 STUDS

1. Stainless steel studs and nuts shall be threaded into the tube plate shall be supplied as per sample. The number of studs is 24 and 16 for the main and BFPT coolers respectively (to be verified by the *Contractor* as per sample).
2. The length and diameter of the studs shall be as per sample.
3. The studs and nuts to secure the water boxes shall be a suitable stainless steel.

3.8 TUBE EXPANSION

3.8.1 Tube Expansion Requirements

1. Tubes shall be left with a 2-3 mm stick-out on both tube plates to facilitate tube plate coating at a later stage if required.
2. Each tube stick out shall be flared slightly, about 15 degrees total.
3. The tubes shall be attached to the tube plates by mechanical roller expansion using 3-pin rollers.
4. The *Contractor* shall provide a marked up tube plate drawing indicating the tubes that will be used as calibration tube plate holes to verify and test the wall thinning during expansion process and these will represent no less than 2% tube plate holes. Under no circumstances will more than 50 tubes l be expanded without a reference tube. These holes will be clearly marked on the tube plate, recorded on a tube plate drawing, and measured with a 3 pin bore gauge before loading of tubes into tube plate. These measurements are to be recorded on an electronic spread sheet.
5. In addition to the tube hole measurement requirements, the *Contractor* shall test 100% of tube holes on each tube plate with a no-go gauge. No holes shall be larger than the maximum hole tolerance as per TEMA standard.
6. All joints at the fixed end tube plate shall be made before any joints at the expansion end tube plate are attempted. The expanding procedure at the fixed end tube plate shall be as follows:
   - The tube will then be positioned with a 2-3 mm stick-out from the inlet/outlet face of the tube plate.
   - The *Contractor* shall propose an expansion map or sequence to minimise any distortion of tube plate.
   - The tube will then be expanded according to the requirements of this Works Information and values achieved in the mock-up tests.
   - Full expansion terminating 3 - 5 mm from oil side (shell side) of tube plate.
7. When all expanded joints at the fixed end tube plate have been completed, the joints at the floating tube plate can be made. The expanding procedure at the expansion end tube plate shall be as follows:
   - The initial expansions shall be in approximately 10 clusters of approximately 10 tubes each, with the clusters spread out uniformly across the tube plate. The purpose of this initial set of expansions is to prevent distortion of the tube plate which can otherwise occur due to forces imposed by the expansion process.
   - Once the clusters are complete the remaining tubes can be expanded.
   - After expansion all tube ends are to be trimmed back so that the maximum protrusion from the tube plate face is 2-3 mm.
   - If tubes are faced this to be done after expansion of both sides and all trimming waste is to be removed from the tube plate area. Tubes will be cleaned by blasting plugs (with compressed air or similar) trough to remove shavings and debris that is formed during this process.
8. The *Contractor* shall monitor and control the expanding process at all times in order to ensure that satisfactory tube-to-tube plate joints are created for every tube. As a minimum the following checks and controls shall be implemented:

- Roller expanders will be cleaned at least after every 25 tubes, and will be lubricated for each tube.
- During each expansion of a hole identified for calibration as defined above, the following shall be done:
  - Clean expander.
  - Rotate manually and inspect rollers and verify free movement and inspect mandrill shaft for defects (score, abrasion & pitting).
  - Verify torque setting on expander torque scale to be correct and ensure that locking mechanism is securely tightened.
  - Inspections shall also be made in the event of torque fluctuations or evidence of damage to the tube inside surface.
  - For each tube that enters the tube plate on the calibration holes, the average tube OD has to be recorded (value "D" as detailed below). Also the *Contractor* shall measure the average tube ID before the tube is expanded (Value "d" as detailed below). Alternatively the average tube wall formula can also be used provided at least 3 measurements are done

9. Re-expansion of joints shall be avoided where possible. The *Contractor* shall employ a system of marking, recording and controlling the expansion process which avoids accidental re-expansion.

3.8.2 Tube Expansion Measurements

1. At least 30 percent of all tubes, selected in a "Z" with reference to the tube plate, shall have back up documentation stating the expansion levels achieved. Measurements that will be recorded will be:
   - Tube plate hole ID before tube is inserted.
   - Tube OD before tube is inserted.
   - Wall thickness of tube before tube is inserted and measured at the mid point of the expansion depth/length. Should average wall thickness be used, a cross comparison between wall thickness / ID and OD will be supplied
   - Tube ID after expansion measured at the depth/length of expansion.
   - Results shall be in spreadsheet format, and backed with a full trace-able tube plate map indicating all measured tubes exactly.
2. The expansion records must be based on actual wall thickness and not average wall thickness. Wall thickness must be determined from (OD-ID)/2.
3. The following formula will be used for wall thinning and mock up testing:

$$T_w = \frac{(T - t) - (D - d)}{(d - t) * 100}$$

D = Diameter of tube plate hole, mm

d = Outside diameter of tube, mm

T = Tube inside diameter after expansion, mm

t = Tube inside diameter before expansion, mm

T_w = % wall thinning

4. Example recording: The following is provided to the *Contractor* as an example of recording the tube expansion data.

Description	Symbol	Result
Tube plate hole size	D	
Tube outside diameter	d	
Tube inside diameter before expansion	t	
Tube inside diameter after rolling	T	
% Expansion	Tw	

3.8.3 Requirements for Tube-to-Tube Plate Mock-up tests

1. Mock up test and pull out test must be completed before expanding any tubes in the cooler. Only one set of mock up tests are required in case of multiple coolers provided the same tube expander drives are used on the different units.
2. Two sample expansion mock up blocks shall be supplied to the *Employer* by the *Contractor* for testing and analysis.
3. The torque value on the expander to be adjusted until a pull out force value obtained during these tests for a nominal hole diameter as per TEMA requirements for wall thinning exceeding 4%. Maximum wall thinning for brass not to exceed 6% (12% expansion).
4. Before pull out test the measurements for wall thinning to be taken and calculate wall thinning as formula above.
5. The *Employer*'s representative shall witness the generation of the mock-up blocks.
6. Each of the “mock up” blocks must contain a minimum of 6 tubes. Blocks will ensure the complete range of tube hole ID’s as per TEMA allowances. At least 2 holes on smallest ID, two holes on largest ID, and two holes on average ID are required. Rest of the holes can be anywhere in range,

3.8.4 Requirements for pull out test

1. The *Contractor* is responsible for concluding the datum point pull-out and push-test.
2. The following should be determined from pull out tests and the following conclusions should be derived:
   - The corresponding force (torque value used for the mechanical expansion) for the greatest load bearing joint.
   - Documentation of the test results for subsequent use on the tube plate.
   - Tube or pull out tests for various tube hole diameters: The *Contractor* is responsible to ensure all the specified pull-out tests are conducted to assess the load-bearing capabilities of the expanded joints at various tube hole diameters.

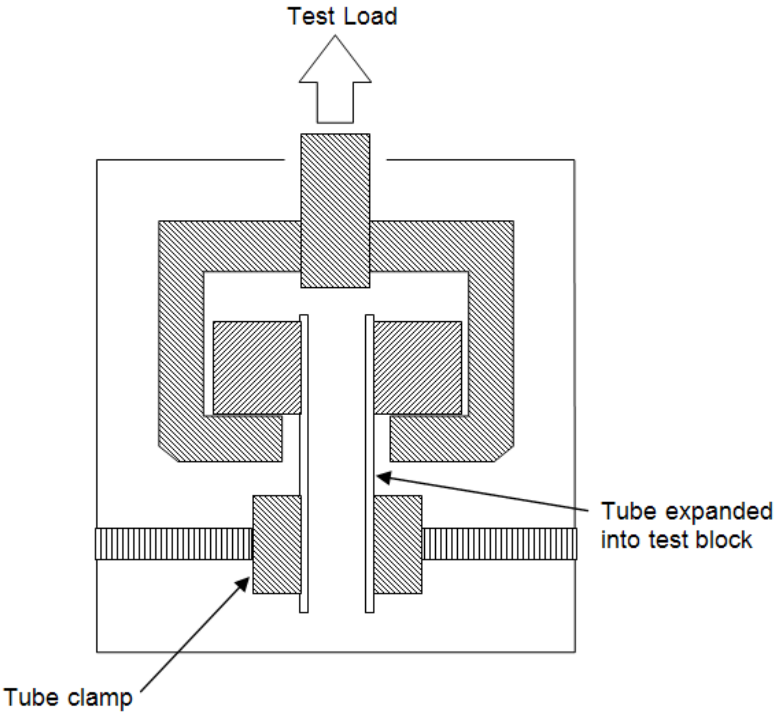

Figure 3: Pull-Out and Push-Out Test Apparatus

3.9 GENERAL MATERIAL REQUIREMENTS

1. The *Contractor* is responsible for supply of all materials. This includes, but is not limited to the tubes, fins, tube plates, baffles, shroud, sealing ring and any structural steel that is used. Any consumables required like gaskets, bolts and nuts shall also be supplied by *Contractor*.

3.10 TUBES MATERIAL REQUIREMENTS

1. *Contractor* to compile a procurement specification of the tubes. Procurement specification to be reviewed and agreed to by employer.
2. Tube material shall be admiralty brass as per ASTM B111M: C44300 or ASME SB111M: C44300.
3. Tubes to be supplied with a 3.1 material certification in accordance with BS EN 10204:2004.
4. *Contractor* is responsible to specify the required tube tolerances.
5. Chemical composition shall comply to ASTM or ASME specification.
6. The finished tubes shall be clean and free of foreign material, shall have smooth ends free of burrs, and shall be free of injurious external and internal imperfections from burrs and defects as per paragraph 15 of ASME B111M but without any superficial film.
7. The external and internal surfaces shall be clean, smooth and free from any drawing scratches that would affect the integrity of the future tube expansion process. No residual drawing lubricant is permitted.

8. All tubes shall be free from surface oxides/carbon film and supplied in the bright annealed condition with no pickling or passivation.
9. Each tube manufactured in accordance with this Specification shall be legibly marked by stencilling the ASTM UNS designation, the temper and heat number or batch number or batch number, outside diameter, thickness, length, name of supplier and the lot number.
10. The finished tubes shall comply with the mechanical requirements as per the ASTM or ASME specification.
11. All testing in accordance to the ASTM or ASME standard to be done.

3.11 LIFTING AND HANDLING

The cooler bundles are installed in a horizontal orientation in the plant. The *Contractor* shall provide an installation/lifting and rigging procedure and provide all the required lifting points on the cooler as required. During outages the bundle may be removed from the shell and positioned in a horizontal orientation for cleaning if required.

3.12 PACKAGING AND TRANSPORT

The *Contractor* shall propose a packaging, lifting and transport procedure of the cooler bundles to the Employer for acceptance. This procedure shall demonstrate that no excessive force will be imposed on the tube-tube plate joints during any of the above activities. In addition, the procedure will detail that the tubes and tube plates will be protected.

The steel parts of the cooler shall be provided of a suitable corrosion protection coating before packaging.

3.13 WELDING AND NDE REQUIREMENTS

3.13.1 Welding Requirements

1. *Contractor* responsible for the welding shall be ISO 3834-2 certified. The provided ISO 3834-2 certificate shall include the scope of accreditation that includes the design code to be used.
2. The following Eskom standard is applicable and must be complied with for all welding activities: *240-106628253 Standard for Welding Requirements on Eskom Plant.*

3.13.2 NDE Requirements

1. All required NDE shall be provide by the *Contractor*.
2. All NDE done shall comply with the following Eskom standards: *240-83539994 Standard for Non-Destructive Testing (NDT) on Eskom Plant.*

3.14 QUALITY REQUIREMENTS

1. No work will be done without a QCP that is approved by the *Employer*.
2. A QCP and dimensional drawings must be submitted to the *Employer* for the works 7 days before that part of the work is to commence.

3. QCP's and related documentation shall be subject to comment and approval by the *Employer*'s Quality Control personnel as well as Engineering. QCP's will make provision for signatures for interventions by at least the *Contractor*'s QC Representative and the *Employer*'s QC Representative and the *employer*`s engineer.
4. Each QCP will have a page for proof signatures, so that any signature can be traced to the individual who has endorsed any activity on QCP.
5. Intervention points will be signed as the work progresses and no back-dating will be allowed.
6. Notification for hold and witness points shall be in writing and shall be done at least 72 hours in advance.
7. All drawings to be "A approved" before pressure test.
8. The following minimum hold points must be included for the *Employer*'s Quality Control Department:
    - Approval of QCP
    - Review of expansion mock up tests results before actual expansion commence on the cooler.
    - Review material certificates
    - Final visual Inspection
    - Witness of Pressure Tests
    - Final Sign off and Acceptance
    - Final Data book Review

3.15 DRAWING REQUIREMENTS

1. The *Contractor* shall provide a drawing of the complete cooler with all relevant dimensions and full material list. Details of the tube bundle shall also be provided.
2. All Drawings to be provided shall be in accordance with the Engineering Drawing Standard – Common Requirement (240-86973501).
3. Drawings issued to Eskom may not be "Right Protected" or encrypted.

3.16 DOCUMENTATION REQUIREMENTS

1. All documents supplied by the *Contractor* shall be subject to Eskom's approval. Documents such as QCP's, Method Statements and other documents impacting the work must be approved by the *Employer* at least 7 working days prior to commencement of the Works.
2. Each revision of a document or drawing shall be accompanied with a list of the comments made by the *Employer* on the previous revision if applicable and the response/corrective action taken by the *Contractor*. Changes will be recorded in a revision table contained on/in each drawing/document. Any changes by *Employer* or *Contractor* will be captured in this revision table. On approval of the new revision all old revisions will be removed from production floor.
3. Documents and drawings shall indicate the *Employer*'s drawing number as allocated by the *Employer*. The *Contractor* may have his own document or drawing number on the document or drawing, but where reference is made among documents or drawings, the *Employer*'s number shall be used.

4. The *Contractor* shall compile a complete data book for all work done containing the following as a minimum if applicable:
   - Scope of work
   - Approved QCP / ITP
   - Inspection reports and Procedures
   - As built drawings including tube maps.
   - Mechanical design calculations.
   - Full traceable material certificates in accordance with EN 10204 3.1 and be traceable to the actual bill of materials, drawings and designs. Note this is only applicable to material where 3.1 certification are required.
   - Pressure test certificates, a photo copy of the nameplate including calibration certificates of pressure gauge.
   - Pressure test reports
   - All NCR/CAR's and corrective actions
   - Lifting, installation and rigging procedure for the cooler bundle on site.
   - Packaging, lifting and transport procedure.
5. All data books to be delivered within 1 month after cooler delivery.

3.17 PRESSURE TEST REQUIREMENTS

The *Contractor* shall manufacture suitable water boxes to allow for pressure testing of the tube side of the bundles at the *Contractor's* workshop. The pressure test shall be done at 600 kPa gauge pressure. Pressure test to be executed using normal tap water as test medium at ambient temperature. Any leaking tube-tube plate joints found during the test will be re-expanded once. This will be indicated on a tube plate map. If the tube is still leaking after a second expansion the Employer will be consulted.

3.18 CONFIGURATION MANAGEMENT AND DOCUMENT MANAGEMENT

1. Transmittal letters shall be provided with each document submittal. The transmittal letter shall include the *Contractor*'s drawing/document number, revision number, and title for each drawing or document attached.
2. Each drawing title shall be unique and shall be descriptive of the specific drawing content.

3.19 DRYING AND PRESERVATION

1. The *Contractor* shall submit the complete drying out and preservation procedures for the coolers. These procedures shall be approved by the *Employer* and the *Employer*'s quality representative prior to pressure testing.
2. After completion of all hydrostatic testing, the coolers shall be drained and dried out. *Contractor* to prove that the cooler is completely dry on the tube side
3. For storage periods of longer than a week, coolers shall be stored indoors or under a fixed roof to avoid exposure to direct sunlight and high ambient temperatures.

4. TENDER RETURNABLES

4.1 MANDATORY TENDER RETURNABLES

The submission of the returnables stated in this section is mandatory. Failure to submit any of these returnables will result in disqualification of the tender.

1. A letter signed by Contractor stipulating that the tubes will comply to ASTM B111M requirements.
2. Verifiable reference list of industrial (power or petrochemical industry) shell and tube heat exchangers designed and manufactured by the *Contractor* during the last 5 years. A minimum number of 10 shell and tube heat exchangers are required. The reference list shall contain the year of manufacture and client company name as a minimum.

4.2 QUALITATIVE TENDER RETURNABLES FOR EVALUATION PURPOSES

1. A completed Quality Control Plan or Inspection and Test Plan of a similar heat exchanger built by the *Contractor* in the past.
2. Exclusions or qualifications to the above Works Information. If there are no exclusions or qualifications then a specific statement to that effect is required.
3. An example of a method statement, from the *Contractor*, for tube expansion used for a similar vessel manufactured previously.
4. Contractor shall provide proof of ISO 3834-2 certification (all pages) for the company/manufacturer that owns and runs the workshop where the heaters will be built. The scope of accreditation of the ISO 3834-2 certificate shall include the design code to be used for this project.
5. Tools List: Table 2 below shall be included in the tender with columns 2 and 4 completed.

Table 2: Tool List to be completed

Minimum required quantity	Quantity available at *Contractor's* workshop	Tool / Equipment Description	Description, Type or Make where applicable
2		Tube expander drive	
4		3 Pin roller expanders	
N/A		Lubricant for expansion	
2		Tube facing tools	
5		Tube facing tool replacement blades	
1		Calibrated 3-Prong internal micrometer, min accuracy 0.01 mm	
1		Calibrated external tube vernier, min accuracy 0.01 mm	
1		Calibrated Torque analyser	

5. AUTHORISATION

This document has been seen and accepted by:

Name & Surname	Designation
Francois Du Preez	Corporate Consultant, Generation Engineering
Gontse Mathibedi	System Engineer, Kriel Power Station
Senamile Nzama	Engineer, Generation Engineering
Thembelani Ndlumbini	Turbine Plant Engineering Manager, Kriel Power Station
Rofhiwa Nelwamondo	Engineering Manager, Kriel Power Station

6. REVISIONS

Date	Rev.	Compiler	Remarks
March 2024	1	G Mathibedi	First Issue

7. DEVELOPMENT TEAM

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

- As above in Section 5

8. ACKNOWLEDGEMENTS

- N/A