Eskom	Specification	Peaking

Title: Technical Specification for Drakensberg Pumped Storage Scheme

Guide Vane Seals

Unique Identifier:	**31A/11111-P2-A**
Alternative Reference Number:	**27281454, 27281455, 27281456 & 27281457**
Area of Applicability:	**Peaking** **Engineering**
Documentation Type:	**Specification**
Revision:	**1**
Total Pages:	**14**
Next Review Date:	**N/A**
Disclosure Classification:	**Controlled Disclosure**

1. BACKGROUND

Drakensberg Pumped Storage Scheme consists of four pumped storage units. Each unit has a main unit shaft as one of the major components. The shaft rotates by means of water flowing through a runner of the turbine, which turns the rotor of the generator and generate electricity to the national grid of South Africa. The flow rate of the water is controlled with guide vanes in conjunction with a governor system.

The governor systems consist of various wearing components to allow the guide vane servomotors, operating ring and guide vanes to move. These wearing components are planned to be replaced during the upcoming Turbine Refurbishment outages planned for Drakensberg PSS.

The guide vanes are guided by bushes and lubricated by grease. The guide vane bushes are designed to house seals to ensure proper lubrication of the bushes and to seal the water from entering the bush-journal interface which will tend to wash out the lubricant and lead to accelerated wear on the bushes.

This Technical Specification outlines the required specification for each of the required guide vane bush seals as well as what will be expected from the *Supplier* supplying the *goods* for the duration of the supply.

2. DESCRIPTION OF THE *GOODS*

2.1 *Employer*'s objectives

The *Employer's* objective is to have spare guide vane seals available for the execution of Drakensberg Turbine Refurbishment outages, currently scheduled to start in August 2025 (DRP U3), October 2025 (DRP U4), March 2027 (DRP U2) and April 2027 (DRP U1). Take note that these dates might change.

2.2 Brief description of the *goods*

The scope of work includes the following:

a) The *Supplier* designs, manufactures, inspects, supplies and delivers the following components to the *Employer's* site (Eskom Drakensberg Pumped Storage Scheme):

Table 1: *Goods* to be supplied (Batch 1 and Batch 2 combined)

Item	Qty.	Item Description
1	90	Middle bush single acting main lip seal
2	90	Middle bush double acting seal
3	250	Middle bush gland packing seals
4	90	Bottom bush single acting grease release lip seal
5	90	Bottom bush double acting seal
6	90	Bottom bush single acting main lip seal
7	90	Guide vane bottom blade collar seal

Refer to the batch descriptions in Section 2.3

b) The *Supplier* replaces all damaged or defective seals.
c) The *Supplier* provides manufacturing drawings to the *Employer*, indicating all details required for future manufacturing. The *Employer* reserves the right to use the manufacturing drawings for future manufacturing at a manufacturer of the *Employer's* choice.

2.3 Batch Delivery Description

Batch 1 includes one half of all *goods*, including some spares as listed in Table 2. This list of quantities is drafted to be ready for the first and second Turbine Refurbishment outage at Drakensberg Unit 3 and Unit 4, which is currently planned to start on 20 August 2025 and 2 September 2025 respectively and therefore need to be on site on 20 July 2025.

Table 2: Batch 1 Quantities

Item	Qty.	Item Description
1	45	Middle bush single acting main lip seal
2	45	Middle bush double acting seal
3	125	Middle bush gland packing seals
4	45	Bottom bush single acting grease release lip seal
5	45	Bottom bush double acting seal
6	45	Bottom bush single acting main lip seal
7	45	Guide vane bottom blade collar seal

Batch 2 includes the remainder of all components as listed in Table 3 below and will be required to be delivered in June 2026. A slight adjustment in seal design might be implemented between the delivery of Batch 1 and the manufacturing and delivery of Batch 2, depending on the performance of the *goods* as delivered in Batch 1. The *Employer* will provide the go-ahead to start manufacturing batch 2 in writing once the decision is finalised by the *Employer.*

Table 3: Batch 1 Quantities

Item	Qty.	Item Description
1	45	Middle bush single acting main lip seal
2	45	Middle bush double acting seal
3	125	Middle bush gland packing seals
4	45	Bottom bush single acting grease release lip seal
5	45	Bottom bush double acting seal
6	45	Bottom bush single acting main lip seal
7	45	Guide vane bottom blade collar seal

3. WORK TO BE PERFORMED BY THE *SUPPLIER* FOR THE SUPPLY OF THE *GOODS*

3.1 Specifications

The *Supplier* adheres to the following in providing the *goods*:

a) The *Employer's* safety rules
b) The *Employer's* codes of practice
c) All the documents stated therein.

3.2 Scope of work

The *goods* include the following:

a) The *Supplier* designs the *goods* as described in Table 1.
b) The *Supplier* manufactures, inspects, supplies and delivers the *goods* as described in Table 1 to the *Employer's* site (Eskom Drakensberg Pumped Storage Scheme). Refer to Section 2.3.
c) The *Supplier* replaces all damaged or defective seals.

3.3 *Supplier's* design

a) The *Supplier* designs and provides all equipment and jigs necessary to manufacture the *goods* as per Table 1.
b) The *Supplier* provides manufacturing drawings to the *Employer*, detailing all details required for future manufacturing. The *Employer* reserves the right to use the manufacturing drawings for future manufacturing at a manufacturer of the *Employer's* choice.

4. WORK TO BE PERFORMED BY THE *EMPLOYER* FOR THE *GOODS*

4.1 Design review

The *Employer* conducts design reviews of the proposed design of the seals.

4.2 Inspection

The *Employer* has the right to perform various inspections, witness and hold points during the manufacturing and quality checks of the *goods* at the premises of the *Supplier*.

The *Employer* performs visual inspection on delivery of the *goods* at the *Employer*'s site (Drakensberg Pumped Storage Scheme).

4.3 Disassembly of current guide vane seals

The *Employer* removes the currently installed guide vane bush seals when required.

4.4 Installation of the new guide vane seals

The *Employer* installs the new guide vane bush seals when required.

4.5 Storage of the new guide vane seals

The *Employer* stores the guide vane bush seals (as per the list of items in Table 1) in a safe area on the *Employer*'s premises (Drakensberg Pumped Storage Scheme) after delivery of *goods* by the *Supplier*.

5. *EMPLOYER'S* PHILOSOPHY

5.1 Engineering philosophy

Fully operational capability of the Pump/Turbine unit, improved reliability and maintainability of the Turbine system at Drakensberg PSS.

5.2 Maintenance philosophy

New spare guide vane bush seals will ensure that proper maintenance can be executed during the Turbine Refurbishment outages.

6. DRAWINGS

The existing seal design as implemented at Drakensberg is detailed in Drawing 18.48/5935. This design will not be applicable for the application for the planned changes to be implemented on the sealing surfaces (guide vane journals) and therefore require redesign. Extracts of this drawing are used in Figure 4, Figure 5, Figure 7, Figure 8 and Figure 9.

Reference [1] – Drawing 18.48/5935 - Units 2 & 3, Middle & Bottom Guide Vane Bush Lip Seals

7. SPECIFICATIONS

The *Supplier* adheres to the following standards in providing the items to be supplied:

Table 2: Standards

Reference Number	Title	Date or revision
240-53665024	Engineering Quality Manual	1
OHSA No. 85 of 1993	Occupational Health and Safety Act.	1993 as amended
ISO 9001	Requirements for Quality management systems.	2015

7.1 Material design specifications

The seals to be used on the guide vane middle- and bottom bushes must have high abrasion resistance, flexibility and durability. The material must be able to seal against low pressures of 1 bar, as well as high pressures of 72 bar. The polyurethane seals must be water and oil resistant. The material is required to withstand a speed of at least 0.1m/s.

The seals must be manufactured from polyurethane and is required to comply to the technical specification as detailed in Table 3, column 4 (Specification).

Table 3: Polyurethane Seal Material Specification

Property	Unit	Existing Design	Specification
Material		Polyurethane Adiprene L169/ L100	Polyurethane
Pressure Range*	bar	1 - 72	1 - 72
Temperature Range	°C	0 - 25	0 - 25
Running Speed**	m/s	0.5	≥ 0.1
Shore Hardness	Durometer A	93	88 - 93
100% Modulus	MPa	12.4	7 - 14
Tensile Strength	MPa	34.5	≥ 30
Elongation at Break (200mm/min)	%	400	≥ 350
Tear Strength (ASTM D-470)	kN/m	26.2	≥ 10
Compression set*** (Method B)	%	40	≤ 40
Resilience, Rebound	%	40	≥ 40
Abrasion Resistance	NBS Index	300	≥ 170

* The specific pressure specification for each seal is discussed in the dimensional design.

** The specific running speed specification for each seal is discussed in the dimensional design.

*** The compression set is required to be ≤ 40% for an ordinary U-profile seal. Should the seal be of a different design to ensure sealing during high pressure (70 bar) and low pressure (1 bar) conditions, the compression set is allowed to go as high as 55%. The *Employer* will review the seal material design in such a case.

7.2 Dimensional design specifications

The following sections will discuss the specification of each of the seals, which must be used by the *Supplier* to perform their design. The general layout of the placement of the seals are illustrated in Figure 1, Figure 2 and Figure 3.

The *Employer* is open to groove design changes if required by the *Supplier* to accommodate the *Supplier's* proposed seal design. The *Employer* will review the seal design as well as the seal groove design in such a case.

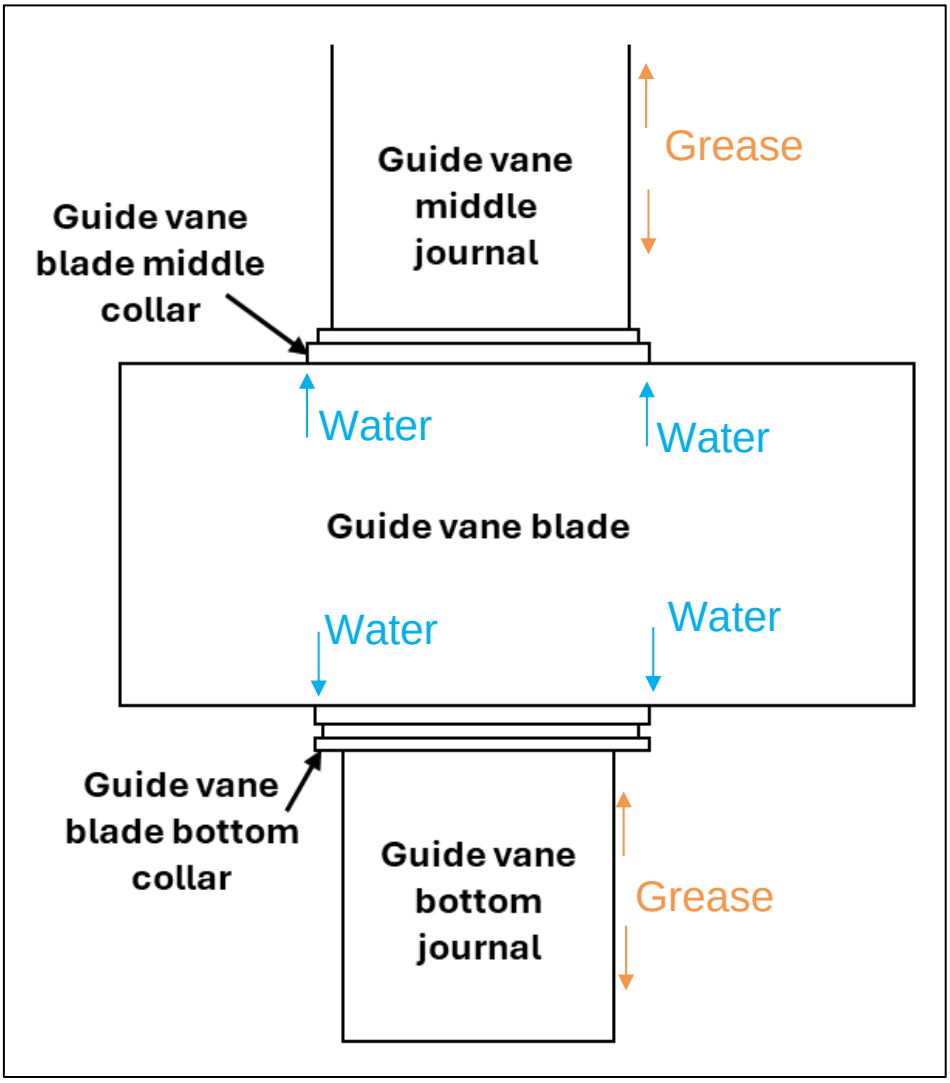

Figure 1: Guide vane and journal side view - illustration of bottom and middle journal location

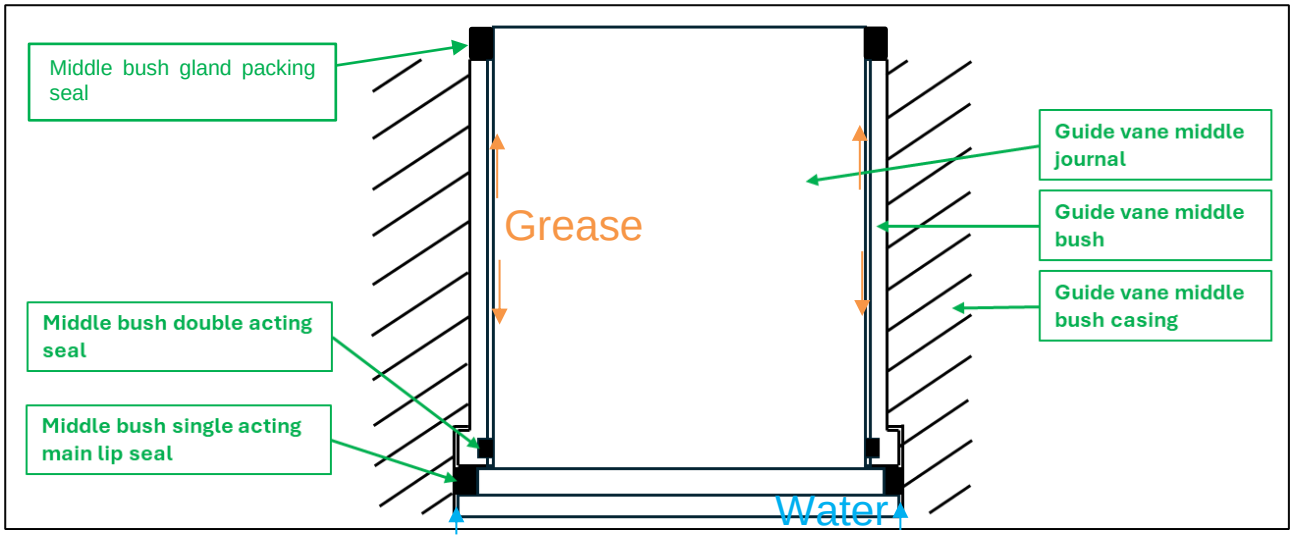

Figure 2: Guide vane middle bush & journal assembly side view - illustrating location of seals

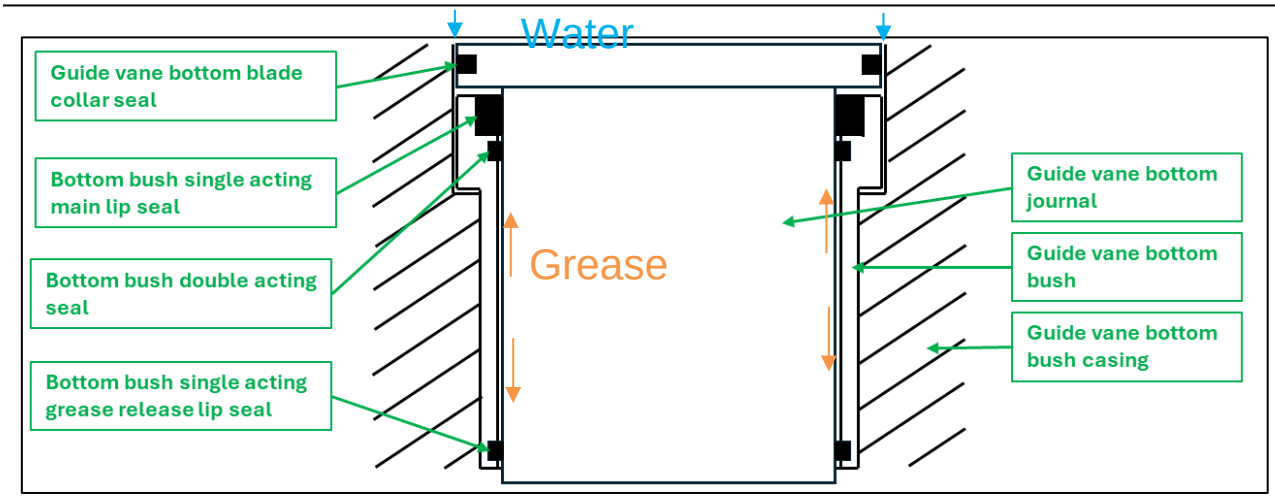

Figure 3: Guide vane bottom bush & journal assembly side view - illustrating location of seals

7.2.1 Guide vane middle bush seals

Refer to Figure 1, Figure 2, Figure 4, Figure 5 and Figure 6.

7.2.1.1 Middle bush single acting main lip seal

This seal must be a rod seal design, preferably a U-profile seal. This piston seal has a static outer lip and a softer flexible inner lip to reduce scoring on the journal (shaft).

The function of this seal is to eliminate water passing from the high-pressure water side to the bush. The seal will only be exposed to pressurised water (1 bar to 72 bar) from one side of the seal as illustrated in Figure 4.

The seal must have a nominal height of 22mm. The seal groove (where the outside diameter of the seal will be located) is of material stainless-steel 316 and has a diameter of Ø380.00 to Ø380.50mm. The sealing surface of the seal is of material stainless-steel (JIS SCS1) with a surface finish of 0.8µm Ra or better and a diameter of Ø350.41 to Ø350.50mm.

The material of the seal must be Polyurethane and meet the specifications as outlined in Table 3. The operating rubbing speed specification for the seal design is 0.1 m/s or more.

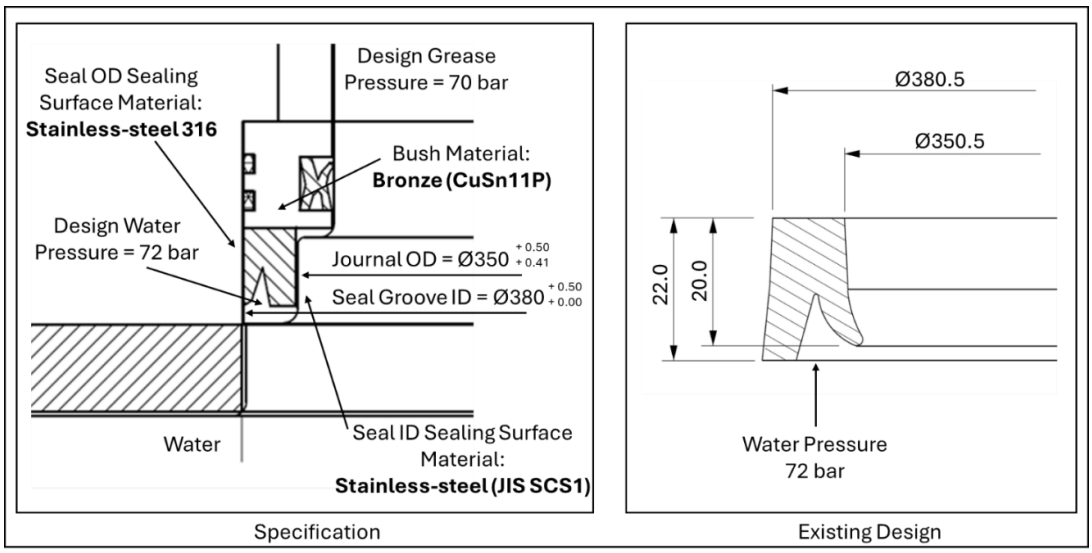

Figure 4: Middle bush single acting main lip seal illustration *[1]*

7.2.1.2 Middle bush double acting seal

This seal must be a double acting U-seal design, able to seal from both sides. This gland seal has a solid static outer lip and softer flexible inner lips to reduce scoring on the journal (shaft).

The main function of this seal is to ensure grease does not leak into the waterway and to ensure the lubrication is maintained inside the bush. The top side of the double acting seal will be exposed to pressurised grease of up to 70 bar for short durations (60 seconds per day) and then atmospheric pressure for the remainder of each day. The secondary function is to eliminate water leaking into the lubrication side of the middle bush (possibly passing a leaking middle bush single acting main lip seal). Therefore, the seal will be exposed to pressurised water (1 bar to 72 bar) from the bottom side of the seal as illustrated in Figure 5.

The seal groove has a height of 15mm and therefore the seal is required to be less than 15mm to ensure no interference fit from top to bottom. The seal groove (where the outside diameter of the seal will be located) is of material Bronze (CuSn11P) and has a diameter of Ø346.45 to Ø346.50. The sealing surface of the seal is of material stainless-steel (JIS SCS1) with a surface finish of 0.8µm Ra or better and a diameter of Ø328.50 to Ø328.557.

The material of the seal must be Polyurethane and meet the specifications as outlined in Table 3. The operating rubbing speed specification for the seal design is 0.1 m/s or more.

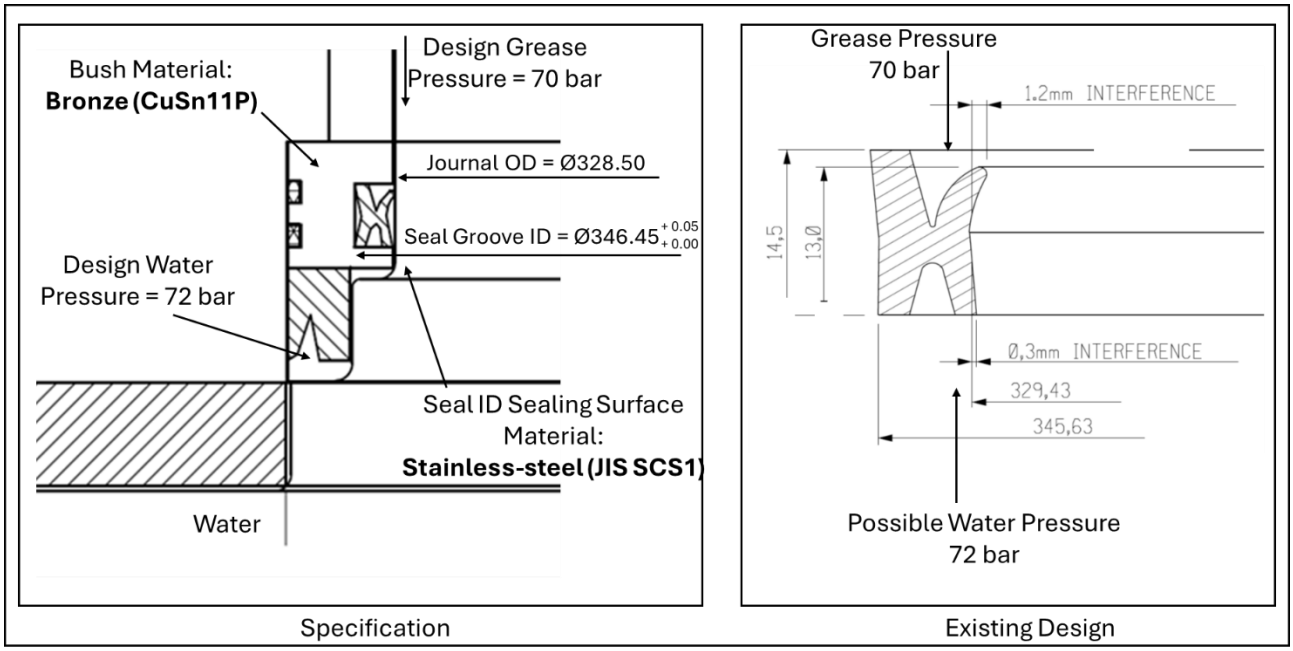

Figure 5: Middle bush double acting seal illustration *[1]*

7.2.1.3 Middle bush gland packing seal

This seal must be of a gland packing design, preferably a V-profile seal. The function of this seal is to maintain the grease between the guide vane middle journal and guide vane middle bush for lubrication purposes and eliminate grease leaking onto the turbine head cover. The seal will only be exposed to pressurised grease (at approximately 70 bar maximum pressure) from one side of the seal as illustrated in Figure 6.

The seal must have a nominal height of 18mm. The seal groove (where the outside diameter of the seal will be located) is of material carbon steel and has a diameter of approximately Ø370.00 to Ø371mm. The sealing surface of the seal is of material stainless-steel (JIS SCS1) with a surface finish of 0.8µm Ra or better and a diameter of Ø328.50 to Ø328.557.

The material of the seal must be Polyurethane and meet the specifications as outlined in Table 3. The operating rubbing speed specification for the seal design is 0.1 m/s or more.

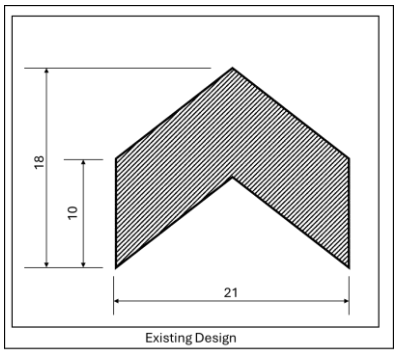

Figure 6: Middle bush gland packing seal illustration

7.2.2 Guide vane bottom bush seals

Refer to Figure 1, Figure 3, Figure 7, Figure 8, Figure 9 and Figure 10.

7.2.2.1 Bottom bush single acting grease release lip seal

This seal must be a rod seal design, preferably a U-profile seal. This piston seal has a static outer lip and a softer flexible inner lip to reduce scoring on the journal (shaft).

The function of this seal is to eliminate water passing from the pressure water side to the bush. The seal will be exposed to pressurised water (1 bar to 10 bar) from one side of the seal as illustrated in Figure 7. The seal will also cause slight restriction to the grease release, ensuring the grease pressure inside the housing is maintained for a short duration before released.

The seal groove has a height of 15mm and therefore the seal is required to be less than 15mm to ensure no interference fit from top to bottom. The seal groove (where the outside diameter of the seal will be located) is of material Bronze (CuSn11P) and has a diameter of Ø315.50 to Ø315.55. The sealing surface of the seal is of material stainless-steel (JIS SCS1) with a surface finish of 0.8µm Ra or better and a diameter of Ø298.60 to Ø298.657.

The material of the seal must be Polyurethane and meet the specifications as outlined in Table 3. The operating rubbing speed specification for the seal design is 0.1 m/s or more.

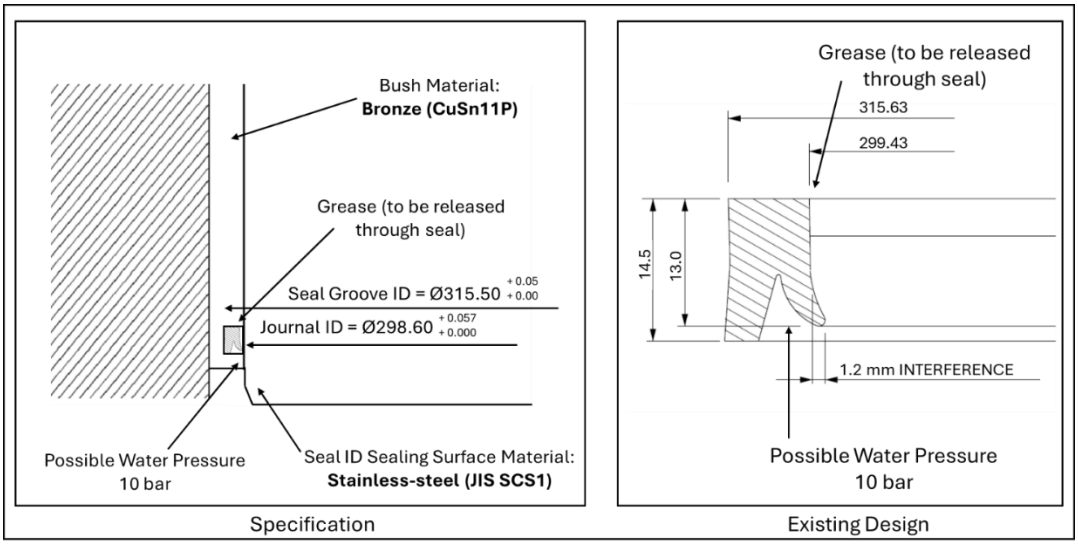

Figure 7: Bottom bush single acting grease release lip seal illustration *[1]*

7.2.2.2 Bottom bush double acting seal

This seal must be a double acting U-seal design, being able to seal from both sides. This gland seal has a solid static outer lip and softer flexible inner lips to reduce scoring on the journal (shaft).

The main function of this seal is to ensure grease do not leak into the waterway and to ensure the lubrication is maintained inside the bush. The bottom side of the double acting seal will be exposed to pressurised grease of up to 70 bar for short whiles (60 seconds a day) and then atmospheric pressure for the remainder of each day. The secondary function is to eliminate water leaking into the lubrication side of the bottom bush (possibly leaking from a leaking bottom bush single acting main lip seal). Therefore, the seal will be exposed to pressurised water (1 bar to 72 bar) from the top side of the seal as illustrated in Figure 8.

The seal groove has a height of 15mm and therefore the seal is required to be less than 15mm to ensure no interference fit from top to bottom. The seal groove (where the outside diameter of the seal will be located) is of material Bronze (CuSn11P) and has a diameter of Ø315.50 to Ø315.55. The sealing surface of the seal is of material stainless-steel (JIS SCS1) with a surface finish of 0.8µm Ra or better and a diameter of Ø298.60 to Ø298.657.

The material of the seal must be Polyurethane and meet the specifications as outlined in Table 3. The operating rubbing speed specification for the seal design is 0.1 m/s or more.

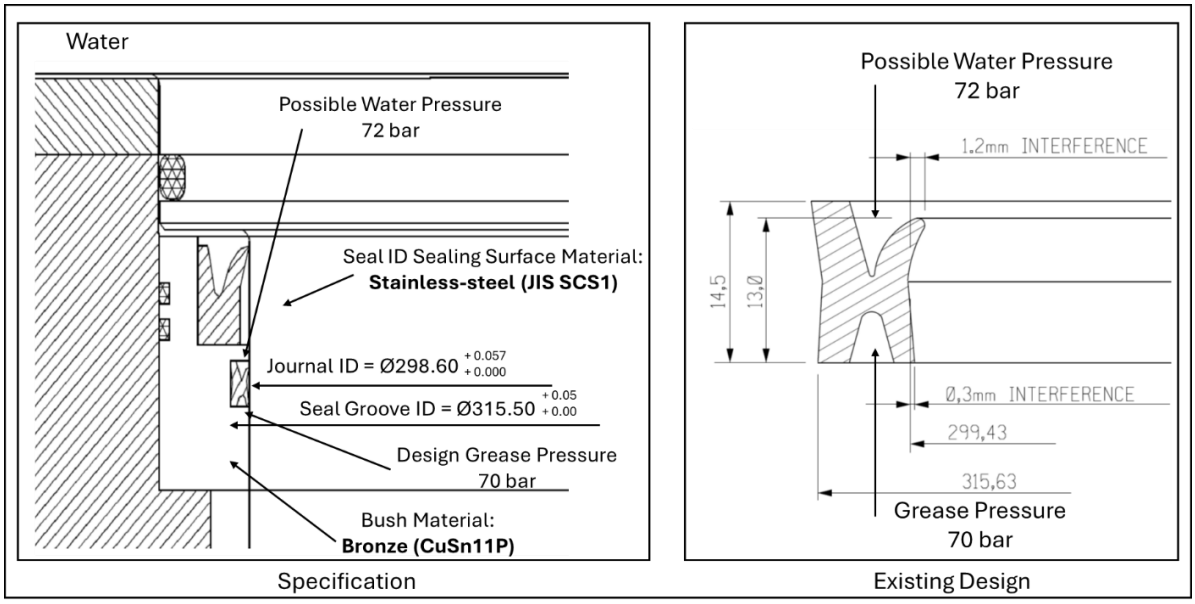

Figure 8: Bottom bush double acting seal illustration *[1]*

7.2.2.3 Bottom bush single acting main lip seal

This seal must be a rod seal design, preferably a U-profile seal. This piston seal has a static outer lip and a softer flexible inner lip to reduce scoring on the journal (shaft). The function of this seal is to eliminate water passing from the high-pressure water side to the bush. The seal will only be exposed to pressurised water (1 bar to 72 bar) from one side of the seal as illustrated in Figure 9.

The seal groove has a height of 35mm and therefore the seal is required to have a nominal height of 33mm to ensure no interference fit from top to bottom. The seal groove (where the outside diameter of the seal will be located) is of material Bronze (CuSn11P) and has a diameter of Ø340.00 to Ø340.05. The sealing surface of the seal is of material stainless-steel (JIS SCS1) with a surface finish of 0.8µm Ra or better and a diameter of Ø398.60 to Ø398.657.

The material of the seal must be Polyurethane and meet the specifications as outlined in Table 3. The operating rubbing speed specification for the seal design is 0.1 m/s or more.

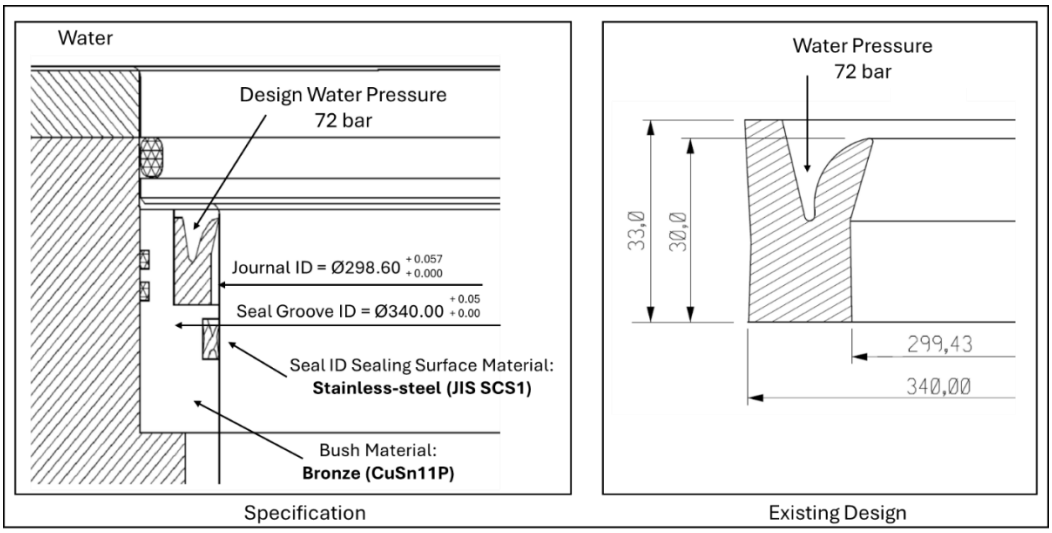

Figure 9: Bottom bush single acting main lip seal illustration *[1]*

7.2.2.4 Guide vane bottom blade collar seal

This seal must be a 'D' seal design. The function of this seal is to eliminate water passing from the high-pressure water side of the guide vane blade to the guide vane bottom bush casing and ultimately the guide vane bottom bush. The seal will only be exposed to pressurised water (1 bar to 72 bar) from one side of the seal as illustrated in Figure 10.

The seal groove has a height of 15.0 to 15.027mm and therefore the seal is required to have a nominal height of 14.5 to 15.0mm to ensure no interference fit from top to bottom. The seal groove (where the inside diameter of the seal will be located) is of material stainless-steel (JIS SCS1) and has a diameter of Ø349.911 to Ø350.00. The sealing surface of the seal is of material stainless-steel 316 with a surface finish of 0.8µm Ra or better and a diameter of Ø370.00to Ø370.23.

The existing seal design (as illustrated in Figure 10) will not be changed.

The material of the seal must be Polyurethane and meet the specifications as outlined in Table 3. The operating rubbing speed specification for the seal design is 0.1 m/s or more.

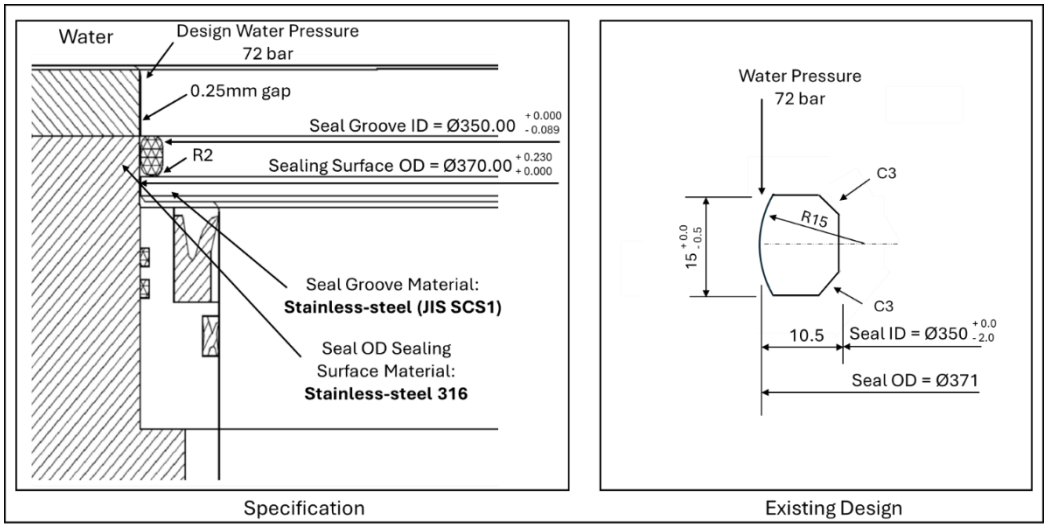

Figure 10: Guide vane bottom blade collar seal illustration

8. CONSTRAINTS ON HOW THE *SUPPLIER* PROVIDES THE *GOODS*

8.1 Dimensional verification

The *Supplier* provides a dimensional check sheet for each seal delivered. The dimensional check sheet includes the inner diameter, outer diameter, height, interferences (preloads), clearances and lip dimensions for each seal.

8.2 Hardness testing

The *Supplier* performs hardness testing on each batch of the supplied seals. The *Supplier* submits copies of all tests performed, indicating the results of all hardness tests performed to the *Employer* for acceptance with the delivery of each batch of seals.

8.3 Material data sheets

The *Supplier* provides a signed confirmation letter (on a letterhead of the *Supplier*) with a data sheet of the seal material for each batch, confirming the material data sheets represents the material of the batch of seals supplied. The *Supplier* provides the confirmation letters and material data sheets to the *Employer* for acceptance with the delivery of each batch of seals.

8.4 Defects

The *Supplier* replaces all damaged or defective seals with new seals.

8.5 Packaging & Labelling

The *Supplier* ensures the seals are packaged in a way to prevent damage of the seals during transport. The packaging is clearly labelled with the identification of each seal.

8.6 Dispatch, delivery and offloading

a) The *Supplier* delivers the *Goods* safely to the *Employer's* site (Eskom Drakensberg Pumped Storage Scheme, Jagersrust, Kwa-Zulu Natal, RSA) without any damage. Refer to Section 2.3.
b) The *Supplier* ensures that all material and equipment is packaged, transported and delivered in such a way that the parts are not damaged during transport and delivery.
c) The contents of each package are clearly marked.
d) The *Supplier* replaces all damaged or defective components.

8.7 Quality management

a) The *Supplier* submits a quality control plan (QCP) to the *Employer* for acceptance as part of the tender returnable documents. This QCP includes inspection, hold and witness points.
b) The *Employer* reserves the right to revise the QCP after purchase order placement.
c) The *Supplier* submits the final QCP to the *Employer* for acceptance within one week after purchase order placement.

8.8 Safety management

a) The *Supplier* complies with the Occupational Health and Safety Act. (OHSA No. 85 of 1993)
b) The *Supplier* takes every precaution to ensure safety and to protect the *goods*.
c) The *Supplier* is responsible for the safety and security of his personnel, materials on site and the *goods* at all times during manufacturing and delivery of the *goods*.
d) The *Supplier* adheres to the safety regulations pertaining to the *Employer's* Power Station (Drakensberg Pumped Storage Scheme).
e) The *Supplier* provides all the required safety and personal protective equipment to his staff for the duration of the contract.

8.9 Environmental management

a) The *Employer's* Power Station (Drakensberg Pumped Storage Scheme) is situated in an environmentally sensitive area.
b) The *Supplier* acquaints himself with all statutory and local environmental regulations and adheres to these without exception.
c) The *Supplier* complies with the Hazardous Chemical Regulations when using any hazardous chemicals, as well as complying with the requirements of the National Environmental Management Act of 1988.

8.10 Installation

8.10.1 Security

General access to the *Employer*'s Power Station (Drakensberg Pumped Storage Scheme) is controlled and it is mandatory that the *Supplier* adheres to all security regulations in force during the period of the contract.

8.10.2 Other construction activities

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

8.11 Title to site materials

The *Supplier* has no title to plant and/or materials resulting from him/her supplying the *goods*.

8.12 Documentation

8.12.1 Pre-implementation documentation

The *Supplier* submits the following to the *Employer* for acceptance (within one week of purchase order placement):

a) Approved and fully signed-off quality control plan
b) Check sheet templates

The *Supplier* notes the following:

a) Metric sizes, as specified by the International Standards Organization and agreed to by the South African Metrication Boards, are used.
b) SI units are used on drawings, pamphlets, calculations and documents.

8.12.2 Post-implementation documentation

The *Supplier* submits one hardcopy and one electronic version of all documentation described below on delivery of the *goods* to the *Employer* for acceptance with the delivery of each batch of seals.

a) All completed dimensional check sheets as described in Section 8.1.
b) All hardness testing results as described in Section 8.2.
c) All confirmation letters and material data sheets as described in Section 8.3.
d) A completed and fully signed-off quality control plan.
e) Manufacturing drawings for each of the seals.

8.13 Completion

Completion is when the following has been done by completion date:

a) The *Supplier* has done everything required to provide the *goods*.
b) The *Supplier* has delivered the *goods*, and the *goods* are accepted by the *Employer*.

c) The *Supplier* has provided all as-built documentation described in Section 8.12.2 and is accepted by the *Employer*.
d) The *Supplier* submitted all other docs as required to the *Employer* for acceptance.

9. REQUIREMENTS FOR THE PROGRAM

a) The *Supplier* submits the finalized program and quality control plan within one week after purchase order placement.
b) The program and quality control plan indicates the start date, completion date and duration of each activity.
c) The *Supplier* indicates the following on his program and quality control plan submitted to the *Employer* for acceptance for batch 1:

- The time required from notification of work (purchase order placement for batch 1 and written confirmation of go-ahead from *Employer* for batch 2) to obtaining material.
- Manufacturing of the *goods*.
- Final inspection of the *goods*.
- Delivery to the *Employer's* Site (Eskom Drakensberg Pumped Storage Scheme, Jagersrust, Kwa-Zulu Natal, South Africa)

10. SERVICES AND OTHER THINGS PROVIDED BY THE *EMPLOYER*

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

10.1 Area for site establishment and storage

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

Note: All other services and things needed to provide the *goods*, is supplied by the *Supplier.*