Eskom	Standard	Asset Management

Title: **Standard for Large Bore Resilient Seal Butterfly Valves for use as Cooling Water Isolation Valves**

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1. INTRODUCTION

This specification serves as the Eskom standard for requirements and quality control measures for the procurement of new large bore double offset and concentric resilient seated butterfly valves used in cooling water systems in the Eskom fleet. The document specifies the minimum requirements and criteria that these valves are to comply with during design, manufacturing, installation and refurbishment.

2. SUPPORTING CLAUSES

2.1 SCOPE

This specification covers the minimum requirements for the design, manufacture, inspection, testing, supply and refurbishment of resilient seal butterfly valves to be used for large bore (≥600 NB) CW system pipelines, as cooling water isolation valves at Eskom power stations. The specification covers both new installations and replacement/refurbishment applications and is applicable to single, double offset and concentric designs.

2.1.1 Purpose

The purpose of this specification is to define Eskom's requirements for large bore resilient seal valves so that all such valves used on Eskom power stations are of consistent quality and technical design.

2.1.2 Applicability

This document is applicable to the Eskom Generation fleet, for the specification and procurement of single, double offset and concentric large bore resilient seated butterfly valves as installed in cooling water circuits.

This standard covers the following three types of resilient seated valves: a) fully rubber lined body with solid disc, b) fully rubber lined body with profile seal in disc and c) Non rubber lined with resilient seal in disc, refer to illustrations below. (Refer to Figure 1,2 and3)

2.2 NORMATIVE/INFORMATIVE REFERENCES

2.2.1 Normative

[1]	ISO 9001	Quality Management System - Requirements.
[2]	EN 10204	Metallic Products - Type Of Inspection Documents
[3]	240-101712128	Standard for internal corrosion protection of water systems, chemical tanks and vessels and associated piping with Linings
[4]	OHSACT	Occupational Health and Safety Act of 1993
[5]	240-55864767	Eskom Chemistry standard for cooling water
[6]	240-83539994	Requirements for Non-Destructive Testing (NDT) on Eskom plant
[7]	EN 12516	Industrial valves – shell design strength

2.2.2 Informative

[8]	ASTM F21:	Standard Test Method for Hydrophobic Surface Films by the Atomizer Test.
[9]	ASME B16.34	Valves - Flanged, threaded and welding ends
[10]	BS EN ISO 5210	Industrial valve - multi turn valve actuator attachments
[11]	BS EN ISO 5211	Industrial valve - part turn valve actuator attachments

[12] BS 6374-5: Lining of equipment with polymeric materials for the process industries.

[13] EN 1092-1/2: Flanges and their joints – Circular flanges for pipes, valves, fittings and accessories, PN designated – Part 1; Steel Flanges

[14] BS EN 558 Industrial valves - Face to face and centre to face dimensions of metal valves for use in Flanged pipe systems - PN and Class designated valves

[15] EN 593 Standard for design and manufacture of butterfly valves.

[16] BS10 British standard for flanges referenced in various tables such “A”, “D” etc.

[17] EN1092-1 Flanges and their joints Circular flanges for pipes, valves fittings and accessories (PN designated * replaces BS 4504)

[18] PED 97/23/EC Pressure Equipment Directive

[19] SANS/ISO 3834 - 2 Quality Requirements For Fusion Welding of Metallic Materials

[20] MSS SP68 High pressure butterfly valve with offset design.

[21] EN 1563 Founding Spheroidal Graphite Cast Irons

[22] EN 10028 Flat products made of steel for pressure purposes

[23] EN 10213 Steel castings for pressure purposes

[24] EN 10088 Stainless steel grades

[25] ISO 2409 Paints and varnishes – Cross cut test.

[26] ISO 8501-1: Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.

[27] ISO 8502-3: Preparation of steel substrates before application of paint and related products – Test for the assessment of surface cleanliness – Part 3: Assessment of dust on steel surfaces prepared for painting (pressure sensitive tape method).

[28] ISO 8502-6: Preparation of steel substrates before application of paint and related products – Test for the assessment of surface cleanliness – Part 6: Extraction of soluble contaminants for analysis – The Bresle method

[29] SANS 1198 The manufacture of rubber sheeting for rubber lining

[30] SANS 1201: The application of rubber linings to pipes, pipe fittings and vessels

[31] SANS 10037: Rubber, vulcanized or thermoplastic - Determination of tensile stress-strain properties

[32] 240-145581571: Standard for the Identification of the Contents of Pipelines.

2.3 DEFINITIONS

Break out Torque	Torque required on valve input shaft to ensure that the disc to seal interface resistance can be overcome to allow the disc to open so that media can pass through the valve passage.
Condenser T1	Condenser cooling water inlet side
Condenser T2	Condenser cooling water outlet side
Cooling water pump back up	Cooling water pump outlet isolation valve
Cooling water pump auto closing valve	Automatic closing hydraulic operated, weight assisted valve to protect CW pump from reverse flow
Cooling water duct	Main Cooling water pipework, also referred to as cooling water duct, that transports cooling water from the cooling water pumps to the condensers and eventually back to the cooling towers
Durometer	Scale to determine shore hardness of resilient materials
Hydrofoil disc	The contour and profile of the disc is smooth and with no sudden geometry changes that will provide turbulence in the flow path that might lead to excessive pressure drop across the valve disc.
Spot facing	Where a bolt hole is very close to the main body structure a slight undercut is machined into the body to allow for the bolt or nut to be tightened. This undercut is done such that the strength integrity of the body for pressure containment is not sacrificed.

2.4 CLASSIFICATION

Public Domain: Published in any public forum without constraints (either enforced by law, or discretionary).

2.5 ABBREVIATIONS

Abbreviation	Description
AMME	Asset management Mechanical engineering
AWWA	American Water Works Association
BS	British standard
BSPT	British Standard Pipe Thread
CAD	Computer Aided Drafting or Computer Aided Design
CW	Cooling Water
DE	Drive end
DN	Diameter nominal
EN	European Norm
EPDM	Ethylene Propylene Diene Monomer
ISO	International Standards Organisation
ITP	Inspection and Test Plan
MPI	Magnetic Particle Inspection
MSDS	Material safety data sheet
NB	Nominal Bore
NCR	Non Conformance Report

Abbreviation	Description
NDE	Non drive end
NDT	Non Destructive Testing
OD	Outside Diameter
PCD	Pitch Circle Diameter
PN	Pressure nominal
PT	Dye Penetrant test
QCP	Quality Control Plan
RT	Radiographic testing
SG	Spheroidal Graphite
T1	Condenser cooling water inlet
T2	Condenser cooling water outlet
UT	Ultrasonic test to test volumetric integrity of material
VJ	Viking Johnson
WPQR	Weld Procedure Qualification Record
WPS	Weld Procedure Specification

2.6 ROLES AND RESPONSIBILITIES

The System Engineer shall ensure that this specification is utilised for compiling an enquiry for any resilient seated butterfly valve procurement or refurbishment for use in CW systems. The Engineering manager is accountable to ensure that the system engineers apply the principles of this specification when dealing with large bore butterfly valves.

This document will allow the System Engineer to compile a comprehensive technical specification for the procurement or refurbishment of resilient seal butterfly valves.

This specification will form the basis for fair and accurate tender evaluations by the evaluation team.

The *Employer's* System Engineer and *Contractor* shall have a clear understanding of the installation and operational requirements.

This standard will also provide information and guidance to the maintenance team or refurbishment *Contractor* during valve refurbishment.

3. GENERAL VALVE OVERVIEW AND EXAMPLES

For resilient seal butterfly valves there are basically three distinctive different designs. The design style is dictated by the sealing arrangement and the positioning of the disc with respect to the body. Valves with the disc in the centre of the valve body is named concentric valves (refer to Figure 1), whereas valves where the disc is offset from the centreline of the valve body is known as eccentric valves, these can be single or double off-set. (refer to Figure 2)

3.1 CONCENTRIC DESIGN (RUBBER LINED BODY)

For concentric valves, the disc is positioned in the centreline of the body. The body is fully rubber lined and the rubber extends onto the flange faces. The sealing is achieved by the disc being turned into the rubber lined body. The interface of the disc into the rubber lining forms the sealing mechanism.

This design normally requires the highest torque when compared to the eccentric designs. (refer to Figure 1 and also as in Figure 15). This concentric design is common on the older stations, on the main CW duct isolation valves.

3.2 ECCENTRIC SINGLE AND DOUBLE OFF SET DESIGNS.

The disc edge is not positioned in the centreline of the body and is located towards the one flange face. To achieve this orientation the shaft does not pass through the middle of the body width. The disc has a boss at the backside of the disc to allow the spindle to be connected with the disc in an offset. If only this one offset is included in the design the valve is known as a single offset eccentric design.

The design may also include that the shaft is positioned slightly below the centreline of the valve. The advantage of this design is that due to the offset, as the valve is cycled to the closed position, the unbalanced force on the disc assists the valve in closing, which in turn reduces the closing torque required. This is then called a double offset valve design. (refer to Figure 2)

They are also known as the van Roll design

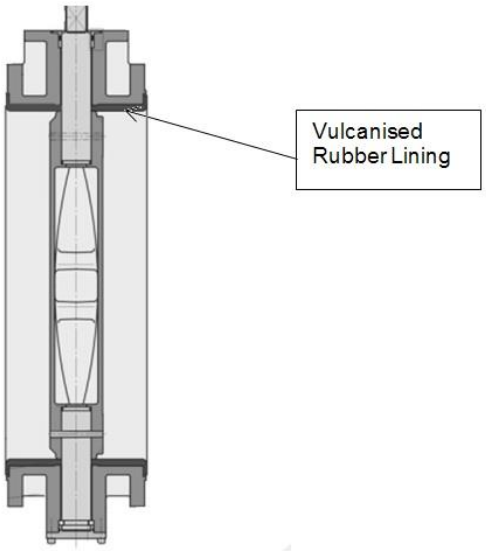

Figure 1: Concentric Rubber lined with solid disc

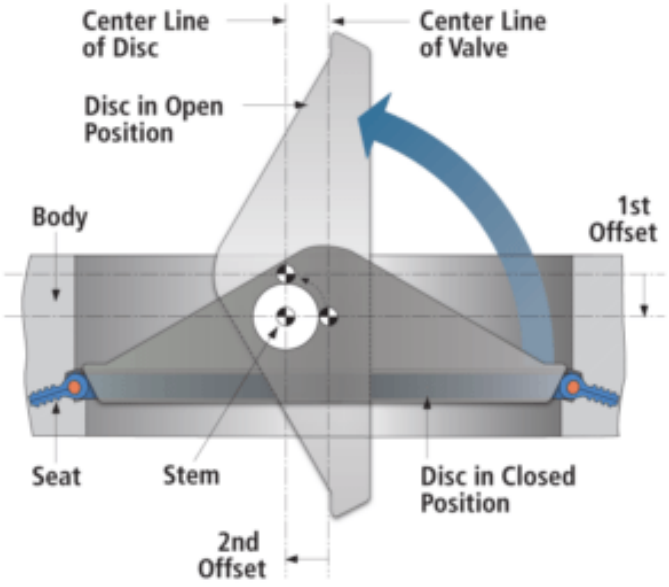

Figure 2: Eccentric single and double offset

3.3 ECCENTRIC LINED BODY DESIGN WITH PROFILE SEAT IN DISC

The body is rubber lined with a hard type of lining normally ebonite or an elastomer with a high hardness value in excess of 120 Shore A.

The design is normally a single offset eccentric design, however double offset designs are also possible.

This design of double offset rubber lined valve with profile disc seat is not common in Eskom, and none of these are installed in any of the main CW systems. The information is only for information, and not to be used when specifying valves for the main CW system. (refer to Figure 3)

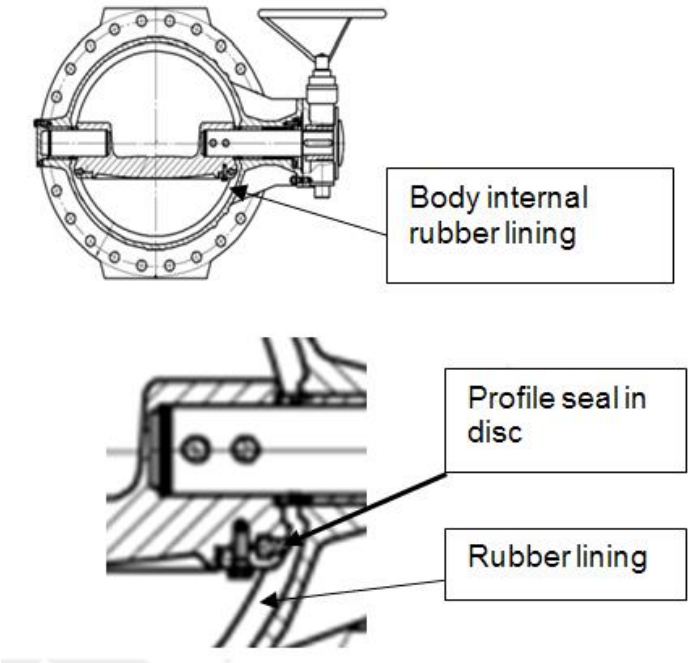

Figure 3: Lined body with Profiled disc seal

3.4 ECCENTRIC NON LINED DESIGN WITH PROFILE SEAT IN DISC

This design is the most common on the Cooling water systems in Eskom for both condenser and main Cooling water ducts.

Both single and double offset are installed, the system engineer must study the original drawings in order to familiarise himself with which valve is installed on the respective power station.

On these both the body and disc wetted part are protected from corrosion by means of an epoxy coating.

The advantage of the seal I disc design is that the resilient disc seal can be replaced without removing the valve from the installed positon. This may not be the best option for repair, but can restore the sealing capability to some acceptable degree until a full valve refurbishment can be undertaken.

These valve have a preferred direction for isolation and is not advisable to use in applications such as interconnector valves. For interconnector valves the concentric design or fully rubber lined with solid disc and should be used as the sealing capabilities in either direction is the same. (refer to Figure 4)

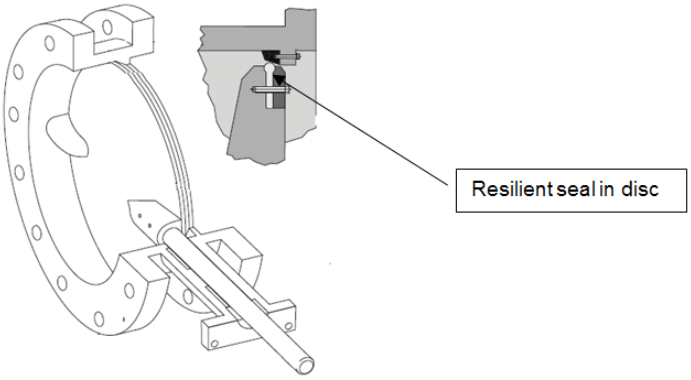

Figure 4: Non-lined bodied eccentric design with profile seat in disc

4. DESIGN REQUIREMENTS

4.1 VALVE BODY

4.1.1 General requirements

The valve body will be designed to the stipulated design pressure or to the existing valve design pressure, as prescribed by the system engineer. However the flanges shall be to the same flange drilling standard and code as the existing valve.

The body material selection will be in accordance with Section 5 (Materials of Construction), and be from a single piece casting or a manufactured body design

Items that need to be integral part of valve body:

- Flanges
- Lifting lugs
- Support feet for valves installed in a horizontal pipeline.
- Spindle bearing hubs
- An ISO 5211 gearbox mounting platform with F rating suitable for required valve input torque including safety factor allowance (refer to section 8 of document).

Where valves are required for current installations as a replacement, the face-to-face dimension must, where possible, be the same as that of the valve on site.

In the event that the new valve face-to-face dimension conforms to latest standards such as ISO 5752, and the site valve face-to-face dimension cannot be met, the requirements of section 4.1.2 and 4.1.3 will apply:

4.1.2 Condenser isolation valves

The existing valve is usually fitted complete with a double flanged expansion compensator up- or down-stream of the valve. One of three scenarios can then occur namely:

- New valve has exactly same face to face dimensions and no modification required on site - this is the preferred option

- The valve face-to-face dimension is larger than the installed valve. In this case the *Contractor* may deviate from the face-to-face dimension provided that the valve is supplied with a replacement double flanged expansion compensator to the same rating as currently installed. The combination then will be required to have the same dimensions as the combined expansion compensator and valve dimensions of the site installation.
- The valve face-to-face dimension is smaller than the installed valve. The *Contractor* can then either supply a replacement expansion compensator to take up the difference in face-to-face dimension if dimensions differ by more than 50mm or, if the variance in the old face-to-face dimension versus. The new face-to-face dimension is less than 50mm a spool piece manufactured from plate (EN 10028–2 grade P235GH as a minimum), may be installed as a wafer style loose flange drilled to same PCD and bolting as the installed valve. The internal diameter of this spool piece shall be coated with the same corrosion protection process as used for the wetted parts of the valve. The *Contractor* will also supply longer bolts and studs to accommodate this variance.

4.1.3 Main CW duct isolation valves

On main CW duct isolation valves such as interconnector valves or auto closing valves, one or both flanges are typically flexible couplings complete with a flange (VJ or Johnson couplings). For these valves the following three options are available:

- New valve has exactly same face to face dimensions and no modification required on site - this is the preferred option
- The new valve face-to-face dimension is larger than that of the installed valve. In this case the *Contractor* may deviate from the face-to-face dimension but must make provision during installation to cut the main CW duct back and re-fit the flanged flexible coupling.
- The new valve face-to-face dimension is shorter than that of the installed valve. The *Contractor* has to supply a matching flange welded to a spool piece of the same dimensions as per the site duct. This can then be fitted by using the flexible coupling. Again the internal surface of the flange and spool piece must be coated with the same process as the corrosion protection of the valve wetted parts.

4.2 RUBBER LINING FOR VALVE BODIES

4.2.1 General requirements

There are various body style designs in use, namely concentric body style soft rubber lined Refer to section 4.2.2

On non-rubber lined bodied valves the internal wetted surface excluding the valve seat is usually corrosion protected by means of a specialised coating product which shall comply with the requirements specified in section 11 of this document

For fully lined valves, Eccentric (single offset and double offset) as well as concentric designs, the lining shall be vulcanised onto the body, totally preventing contact of the flow media with any wetted part of the body.

Loose replaceable liner styles will not be accepted.

The following minimum criteria for rubber lining of the valve body shall apply. Should the *Contractor* offer a rubber lined disc it will also conform to the requirements of section 4.2.2 :

4.2.2 Concentric valves with soft rubber lining

The rubber used will conform to the requirements in Section 5 and where applicable section 11:. The rubber must have a Shore hardness of at least 60 A when measured with a Durometer. The upper hardness limit will be in accordance with *Contractor's* norms/design.

In all cases the contractor shall tender on the rubber lining (main offer) being fully vulcanised by autoclave processes. Pre-cured linings may be proposed as an alternative or secondary offer and subject review and acceptance by Eskom's Corrosion section and a Generation Asset Management specialist / consultant. Tenders offering only the alternative or secondary offer shall not be acceptable.

The rubber lining will cover all exposed and wetted parts of the valve body including the flange faces, and will be of a smooth contour.

The rubber lining will be applied such that it forms the primary seal between the shaft and the body.

4.3 NON-RUBBER LINED VALVE BODIES

Eccentric valve designs inclusive of single and double offset bodied valves with non-rubber lined valve bodies are very common in Eskom. These are typically found on the older Condenser cooling water and main CW isolation valves.

On both single and double offset valve designs, the casting includes a step/lip on the internal bore. This forms the backing to which the body seat is finally fitted. This lip is machined to allow a body seat to be fitted onto the body recess/bore. This seat is mostly a bolt on design; however there are designs where the seat is welded onto this "lip", provided the body is non cast iron or material with high carbon content (>1% carbon based on Chemical analysis). If the valve seat design is a weld on seat, the body will be a carbon steel casting or SG iron or a carbon steel fabricated body, cast iron will not be allowed.

The weld in seat design is preferred since no crevice exists between the seat and body thus minimising the likelihood of corrosion between the dissimilar materials or crevice corrosion

Should bolt on seat design's be offered, the *Contractor* will clearly indicate how the crevice between body and seat will be isolated from the line media, as to prevent the possibility of corrosion between the seat and landing area.

Also refer to Section 4.10.4.1 for further details regarding bolt on seat designs.

4.4 INTEGRAL MECHANICAL DISC STOP

On concentric as well as some double offset concentric designs, the possibility exists that the disc can be operated too far and passes through the closed position.

To return the valve disc to the normal position is in many cases not possible due to the seat and disc arrangement.

For this reason each body shall be fitted with a mechanical hard stop as in Figure 5. This will be integral to the valve internal area, and will prevent the disc turning passed this point. The stop will be designed such that it can withstand the force exerted by the valve disc when the supplied torque on the valve drive end shaft is 1.8 times the maximum break-out torque. *Contractor* to provide strength calculations to prove that this stop will withstand the requirements as mentioned above. Calculations can also be in the form of Finite Element Analysis (FEA). This will also apply to the CW pump auto closing valves (ACV). In many stations the CW pump auto closing valves are the same design as the pump back up valve, and just by altering the actuation device the valve can fulfil both applications.

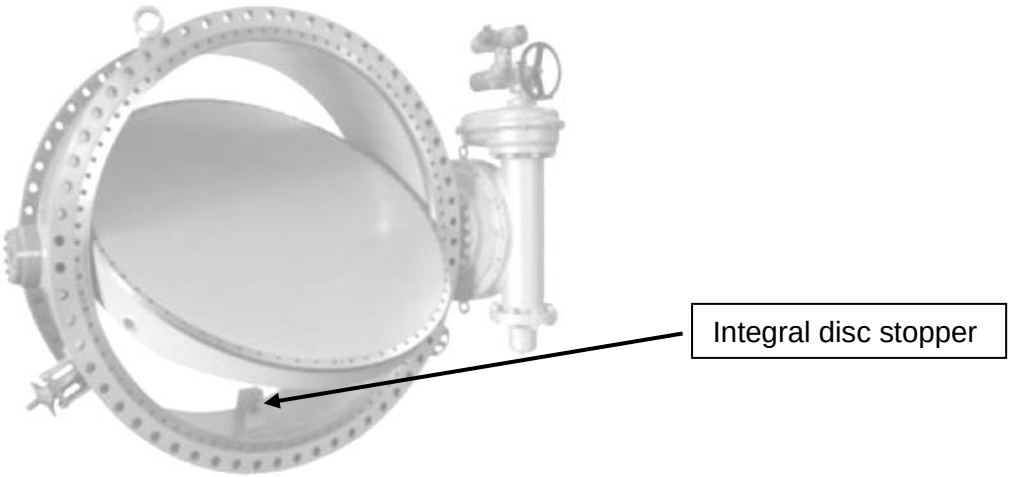

Figure 5: Integral disc stop

4.5 FLANGES

For valves where the bodies are castings, the flanges will be cast integral with the valve body.

In the case of fabricated valves, the flanges must be welded to the body and thus form an integral part of the valve body.

Flange OD/PCD and bolt-hole drilling will comply with the relevant flanges on site. Typical standards are BS10, BS4504, SANS 1123, or EN 1092-1 etc. Where these valves are manufactured from cast iron the flange faces will be flat faced, even if existing flange faces are raised face.. On non-cast iron/nodular iron bodied valves the flanges will be of raised face design.

The *Contractor* must ensure that sufficient space is left between the valve body and flange to tighten the bolt nuts; if not then spot facing must be implemented. Allowance must be made to ensure that for each bolt-hole on the flange a washer can be fitted during installation.

Where bolt-holes have to be blind holes due to the valve configuration, these are to be tapped to a minimum depth of 1.5 times the bolt diameter.

For all designs with fully rubber lined bodies the flange faces will be covered with the same rubber as the lining and the full flange sealing face. This will be applied in the same operation as when the internal lining is applied. The flange will thus be subjected to the full vulcanising process.

4.6 DISCS

The disc shall be of a continuous casting, or maybe manufactured by means of fabrication. The discs of concentric valves shall be such that they have an optimum hydrofoil design. For manufactured disc design, the spindle bosses may be welded onto the disc/blade. For such design, during tender the weld interface detail/weld strength shall be clearly indicated.

For the seal-in-disc design, (regardless if the disc is uncoated or epoxy coated), the leading edge of the disc from below the seal ring or seat, shall be overlaid with stainless steel to EN 10028-7 1.4404 and be machined back to the required tolerances. Should the media corrosiveness require materials other than EN 10028-7 1.4404, the *Contractor* may suggest alternatives after studying historical water chemistry data records that will be supplied from site as part of the enquiry. (Not applicable to soft rubber coated discs, Shore hardness 80 A or less).

Discs will be manufactured from materials listed in Section 5. Where water chemistry requires (as stipulated in the enquiry document), the disc will be fully coated, as described in Section 11.

If the discs are manufactured from plate, no welded joints will be allowed on the actual disc diameter. Stubs etc. will be welded to the solid one-piece plate disc.

The disc and body will be designed such as to ensure that stresses under no circumstance of normal isolation or operation, will exceed the requirements of EN 12516. The *Contractor* will also supply a proof design test in accordance with EN 12516.

The spindle design can be either stub spindles or a full-length spindle. If stub spindles are used the design must indicate that disc deflection due to point loading will not cause permanent disc deflection under normal operation.

The preference for the disc and spindle arrangement for concentric valves is that the disc is of hydrofoil design with the shafts not exposed or protruding into the media flow. This is to prevent vortices and eddy current formation. This design is typically found on concentric designs with solid discs and soft rubber lined bodies.

For double offset valves, the disc spindle boss(s), regardless of whether two short spindles or one full-length spindle is used, will be such that the minimum length is not less than 1.25 times the spindle maximum diameter. For single shafts, this is applicable to both disc to shaft connection points – DE and NDE. In the event of a stub shaft design, the bosses will be closed so that no media can penetrate to the spindle. The side where the shaft penetrates the disc shall be sealed as described in Section 4.9.

4.7 SPINDLES

Spindle material will be as per the Materials of Construction in Section 5.

In the event that the *Contractor* intends to offer an alternative, a full detailed engineering motivation is to be provided for acceptance by the *Employer*.

Except for concentric valves, (where the liner provides the seal against the disc and body to prevent media contact with the spindle), the spindle to disc boss interface will be sealed by means of “O” rings or similar seals. .For bosses where the one side is blind (closed from the media); the shaft to boss connection needs to be sealed by “O” rings. If the boss is of open design, both entry and exit sides of the shaft must be sealed with “O” rings or similar seals.

As this is not possible when keyways are used for disc-to-shaft connections, the *Contractor* must advise how this interface will be sealed if a keyway connection is offered.

On final assembly, the NDE shaft must be fitted with a fixed indicator to indicate the disc position in relation the valve body. The indicator must be such that if removed the valve spindle to gearbox quarter segment connection integrity must not be affected.

The keyway interface with the gearbox or actuator will be such that the keyway machined in the spindle is in line with the disc position. This leads to say that if the keyway is parallel with the valve body thickness the disc will be in closed positon and when 90° with the body thickness the disc will be open. Should the interface not be a keyway, a clear reference marking will be cut on the Drive end spindle end to indicate the actual valve disc position in correlation with the valve disc.

4.8 DISC TO SPINDLE CONNECTION

4.8.1 General requirements relating to all pin designs

Pins will always be an interference fit.

During refurbishment, all pins will be replaced and will comply with the requirements of each pin design as detailed below.

The disc and spindle will be connected by means of at least two taper pins on the DE spindle half, and at least one pin on the NDE spindle half.

Pin entry and exits will be isolated from the media by means of threaded plugs. (Figure 6 and 7).

Shafts will be assembled into the disc boss before the pilot hole is drilled for the pin.

4.8.2 Taper pins with full bore mechanical plugging devices (Blind hole)

There are 3 different taper pin designs regarding disc to shaft connection. Each design will be discussed in section 4.8.2.1 thru to 0.

4.8.2.1 Blind taper pin design

With the disc and shaft assembled after pilot hole is drilled, the taper hole for the pin will be drilled through the one side of the shaft boss all the way through the spindle and at least to 2/3 depth at the opposite side of the boss.

Before the pin is fitted, the hole will cleaned with a taper reamer to ensure all burrs and longitudinal scratch marks are removed, the taper pin will machined to the same taper angle as that of the reamer

The boss at the pin small end will have a hole drilled through the boss, this will then be threaded and be plugged by a solid plug of maximum ½ inch BSPT to seal any cavity below the pin. During dismantling of the valve, this pug can be removed to allow the pins to be driven out, (Refer to Figure 6). On assembly, this hole will be left open; to allow for trapped air to escape as the taper pin is seated. Once the pin is seated in the taper, the BSPT plug will be screwed in to seal of the pin from the media.

On the large diameter end, where the pin is inserted into the disc, the pin is prevented from coming undone by means of a full-bore threaded cap that is screwed down onto the top of the pin. No clearance will exist between the pin and the end cap. This encapsulates the pin completely from the media, as the mechanical threaded cap isolates the pin from the entry point, and locks the pin in place.

As final protection the cap and plug (at either end of the pin holes) are filled with an epoxy coating, (same as for the valve wetted parts), thus completely isolating the pin and cap from the media. However if the disc is rubber coated, the top side of pin and mechanical plug will be encapsulated with the same rubber as was used for the disc coating.

Under no circumstances will the pin be held in place by a single grub screw that is drilled and tapped on the periphery interface of the pin and the disc boss. All mechanical locking mechanisms will be the same OD as that of the pin end.

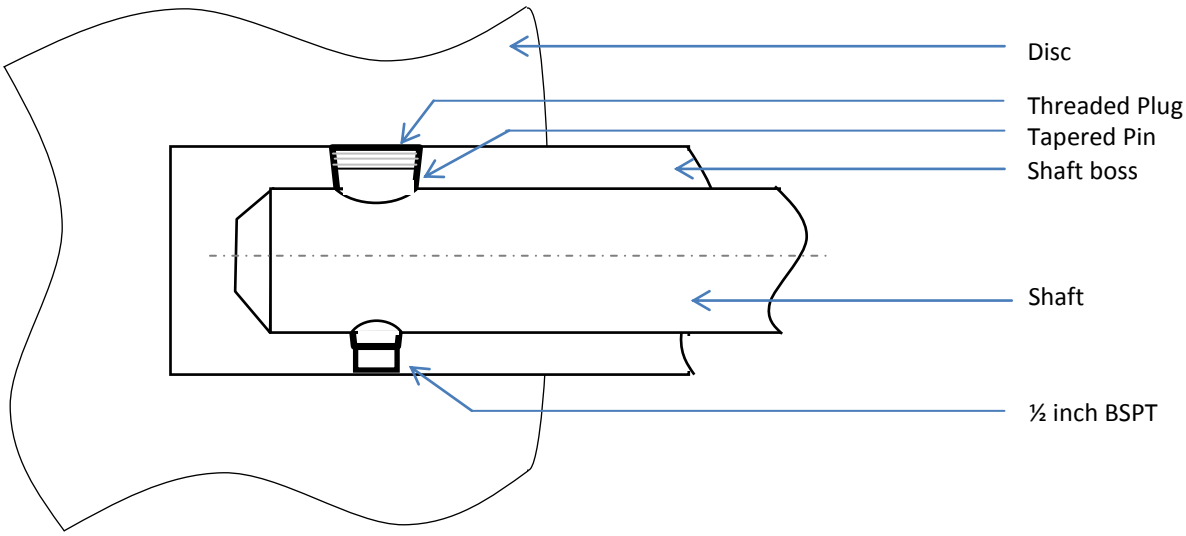

Figure 6: Blind Taper Pin

4.8.2.2 Full length taper pin design

The requirements will be as per section 4.8.2.1, with the only difference that the pin small end does not stop blind for the exit point.

The small end on the pin must be at least 2=3mm below the outer surface of the boss, to allow coating to seal the pin from the line media. (Refer to figure 7)

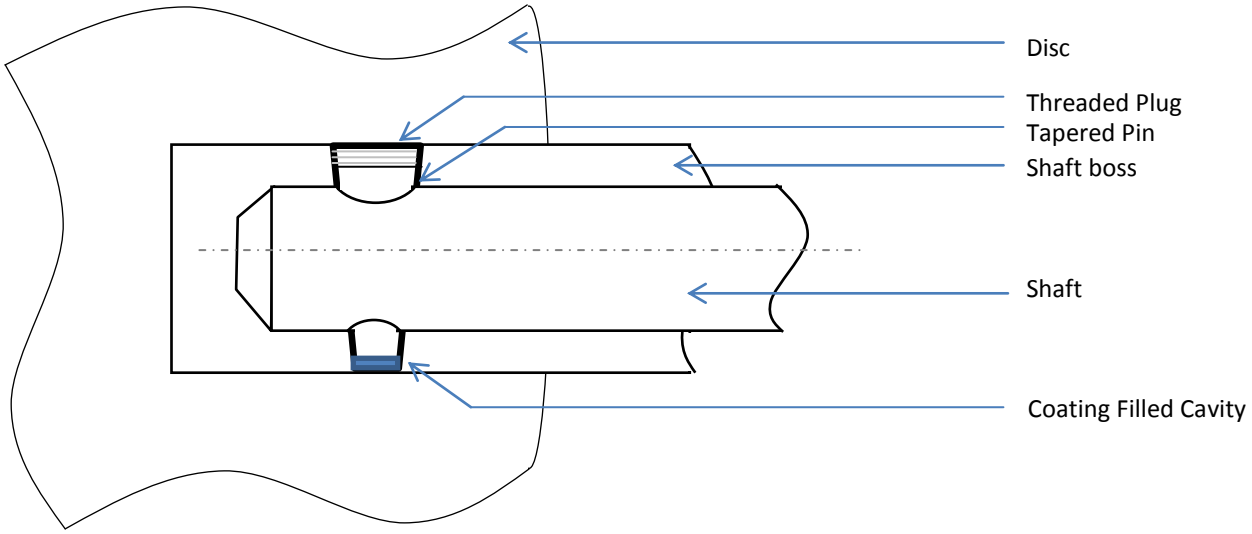

Figure 7: Full Length Taper Pin

Non taper pins with full bore mechanical plugging devices

Should the parallel-sided (non-taper) pin design be offered, the following criteria will apply:

- The holes will be drilled such that they pass through the center of the spindle. No design will be accepted where the pins are fitted off center to the spindle centerline (refer to Figure 8).
- The hole for the pin will be drilled through the disc spindle boss all the way through the spindle.
- Each pin location hole, on the entry and exit sides, will have a threaded plug of at least the same OD as the pin, screwed into the hole, which will make contact with the pin. Thus, the pin has to be shorter than the pin location hole, and of the thickness of the two plugs, to allow these threaded plugs to be fitted on either side of the pin. The plugs are not to stand proud of the disc boss.
- Under no circumstance will the pin be welded to the disc.
- Under no circumstance will the pin be held in place by a single grub screw that is drilled and tapped on the periphery interface of the pin and disc.
- During valve refurbishment the pin bore will be machined by reamer or suitable tools to be perfectly parallel, and thus new pins will be fitted to suit the new pin hole diameter to achieve an interference fit of the pin.

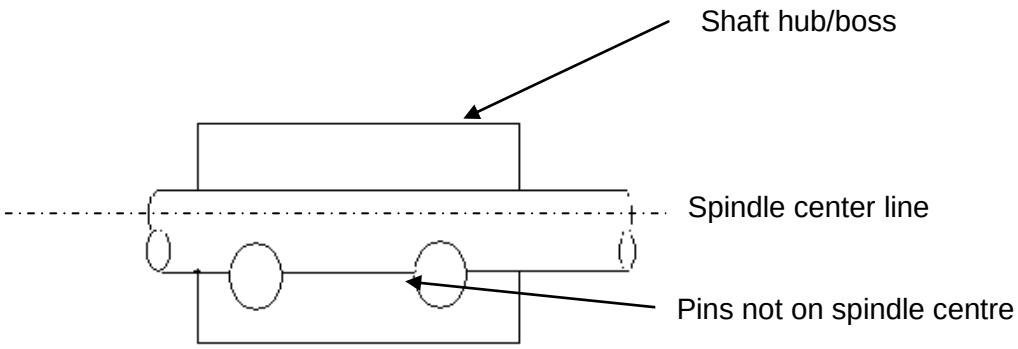

Figure 8: Pin offset from centre of spindle - not allowed

4.8.3 Integral drives

The hydrofoil-designed disc has a smooth surface on both sides of the disc when compared to that of a stub or boss design (refer to Figure 10). Connection of the spindle to the disc can be accomplished via a mechanical integral drive or internal keyway, or pins through the disc surface.

Integral drive can be achieved by having the spindle end (on the disc entry side) machined square, splined, hexagonal or octagonal, or with an internal keyway with a matching female connection in the disc itself. These connections are preferred as they minimise hysteresis, and the connection is removed from submersion in the wetted part of the valve. For sizes larger than 1000 mm the hydrofoil design as indicated in Figure 9, is not commonly used, and hence the pin option will be used on sizes of greater than 1000 mm nominal bore and a typical disc profiles is shown in Figure 10

Figure 9: Hydrofoil design

Figure 10: Stub Shaft Design

For keyway designs the design will at such that the stress in the keyway area is at least 50% in excess of the yield strength of the weaker component, (disc or spindle) when maximum closing torque is exerted on the disc spindle. The *Contractor* shall provide design calculations thereof. The keyway should be fitted in the lowest stress concentration area of the disc hub.

4.9 SPINDLE BEARINGS

On both DE and NDE sides of the spindle, end bearings will be fitted. Bearing bushes may be of one or two piece design.

Bearings will be of proven self-lubricating design.

Where required thrust bearings will also be fitted, and these will also be self-lubricating.

Thrust bearings on double offset design valves will not be re-adjustable on site (after being adjusted by the manufacturer), to prevent disc movement and thus preventing seal or seat movement that will affect the integrity of the double offset seal. Thrust bearings must only be adjusted during full dismantling of the valve or on re-assembling after maintenance.

Bearings will be located in bearing bosses that are integral with the body of the valve, cartridge type bearing / seal arrangement is preferred refer to 4.9.1

Material of construction will be as per Section 5.

4.9.1 Spindle bearing seals

Bearings on both DE and NDE will be sealed from the media flowing through the valve.

Cartridge type bearings on both NDE and DE will be preferred. These bearings will also have integral “O” rings fitted to act as a seal for media leakage to atmosphere.

The seal material selection will be done after evaluating the chemistry of the media flowing through the valve. Seals can be of “O” ring, cup seal or lip seal design, or a combination of these.

Low maintenance gland packing or sealing such as “O” rings will be preferred, with at least a double “O” ring at the open connection to atmosphere on both NDE and DE shafts.

The *Contractor* may offer gland packing type sealing. The gland packing and stuffing box will be of live loaded design. Both packing and stuffing boxes will be designed in such a manner as to allow for packing replacement with the valve installed in the line. The gland packing will be of asbestos free design, and a full MSDS will be included in the final data pack of the valve.

The wetted side of the bearings will also be sealed against the media by “O” ring seals or similar proven design as described above, if cartridge type bearings are not used.

The sealing shall be designed as a dry shaft system, meaning that no media must be present between the “O” Rings in the body spindle boss area.

4.10 SEAT AND SEAL (VALVE TRIM)

4.10.1 General:

The selected seal/seat (valve trim) will allow the valve to be opened and closed at full differential line design pressure. During seat leakage testing the valve will seal with no visible leakage in accordance with EN 12266 Leak rate A.

4.10.1.1 Uni and bi-directional valves:

Eskom makes use of both Bi and Uni-directional valves. The seal and valve design can be bi-directional or Uni-directional. For bi-directional valves, the valves will be tested and will seal in both preferred and non-preferred directions in accordance with the EN 12266 Leak Rate A (No visible leaks).

Uni-directional valves will isolate in accordance with EN 12266 Leak rate A.

Irrespective of whether Bi-directional or Uni-directional, the valve body shall be clearly marked with an marking indicating the high pressure and low pressure sides on the flanges. For T1 and T2 the one flange will be marked Duct side and the other Condenser side. During isolation the higher pressure is on the T1 duct side but for the T2 it is also to the duct side because when the condenser is drained, the only pressure that the valve is subjected to is the resident pressure in the ducts.

To illustrate what is meant above for the T1 and T2, by the preferred direction of isolation versus direction of flow, consider the following:

- The normal flow of a condenser T2 valve is from the condenser to the hot duct and eventually the cooling tower. However, when the condenser is isolated, the T2 valve must isolate the condenser from the hot duct. The isolation direction for the T2 valve is therefore directly opposing the normal direction of flow.

For the Back-up and Auto closing valve, The one flange will be marked Pump side and the other duct side. When these valves close the high pressure side will be the duct side.

The flange that will be toward the “pressure side” when the valve is isolated must be marked as described above with the words as applicable “Duct side”, “pump side” or “Condenser side”.

This marking shall be hard stamped on the flange OD and a clearly visible information plate will be fitted.

During installation care must be executed to ensure correct installation of the valve.

On certain Power stations there are a number of “interconnecting valves” installed. The *Contractor* will liaise with the ***Employer's*** site personnel as to which side is normally the pressure side of the valve for interconnector valves the high pressure side can be in either direction dependant on the flow configuration. For condenser isolation, unidirectional valves can be used, but for main CW ducts the pressure direction requires mostly the use of a bi-directional valve.

4.10.2 Seals

For non-rubber lined valves, or rubber lined valves fitted with a profile seal in the disc, the seal ring will be as per Section 5. The minimum tensile strength shall be 12 MPa. The compression set at 23 °C shall be less than 13%.

For double offset valves, the seal in the disc shall be of rubber with a Shore hardness of no less than 60 A. After the ageing test of the rubber, the Shore hardness will not differ from when new, by more than 5. The rubber shall comply with the requirements of ISO 11346.

The seal shall be of one piece molded rubber for sizes below 800mm. For sizes above 800mm the seal can be manufactured in sections from extrusion, but ends must be vulcanized. Glued or chemically bonded joints will not be accepted.

The sealing rubber ring will be free of any visible signs of porosity, cavities, tears or irregular shapes that can affect the sealing in the long term.

The seal ring shall be of self-energizing design, meaning that the line pressure will enhance the sealing effort of the seal and will ensure that the valve still seals tight, even if full differential pressure is not applied.

Double offset design seal rings will be of tadpole, music note, T pillar or Spyret type self-energizing design (Refer Figure 11, 12, 13 and 14).

“O” ring type seals, as well as flat types with rounded nose (these are non-self-energizing) will not be allowed.

During valve refurbishment, the *Contractor* should advise how sealing ring arrangement (in case of flat seal or “O” ring design) can be upgraded to provide superior sealing compared to that of flat sealing or “O” ring design.

The seal ring on double offset valves shall be replaceable with the valve fitted in the line. Maintenance manuals need to indicate this.

The sealing on concentric body designs with fully vulcanized rubber lined bodies, will be such that the disc seals directly onto the lining surface as indicated in Figure 15.

On double offset designs the leading edges of the disc will be protected from erosion by:

- A high Ni-Cr overlay that can be directly applied to the base subject to approval of the overlay procedure by Eskom's metallurgical department. However, for ductile iron discs, stainless steel can be welded provided a suitable butter layer is introduced and accepted by Eskom's Metallurgical and Welding departments. Subject to the water chemistry these edges will still be over coated as specified under the coating section (Section 11).

4.10.2.1 Seal in disc design examples

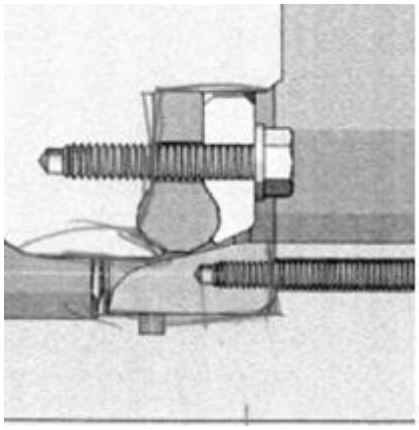

Figure 11: Music note

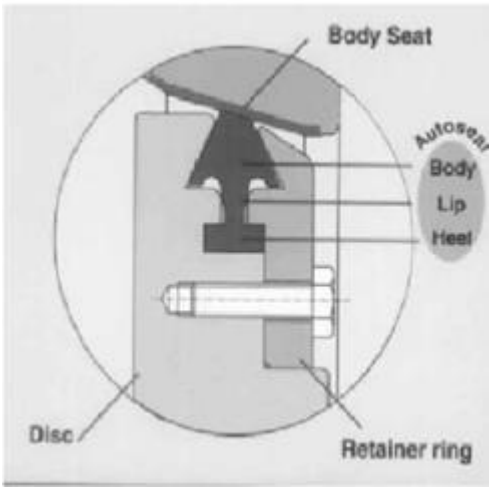

Figure 12: Spyret seal

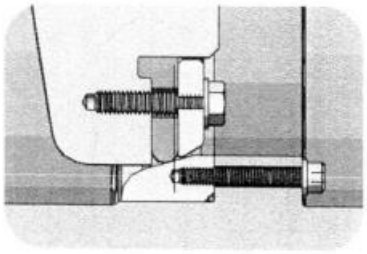

Figure 13: Tadpole Design

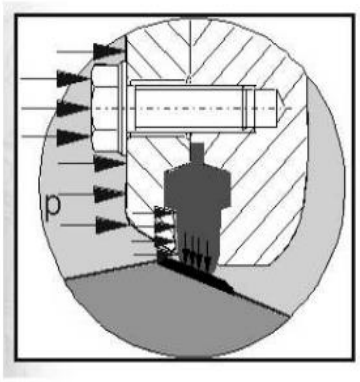

Figure 14: T Pillar design

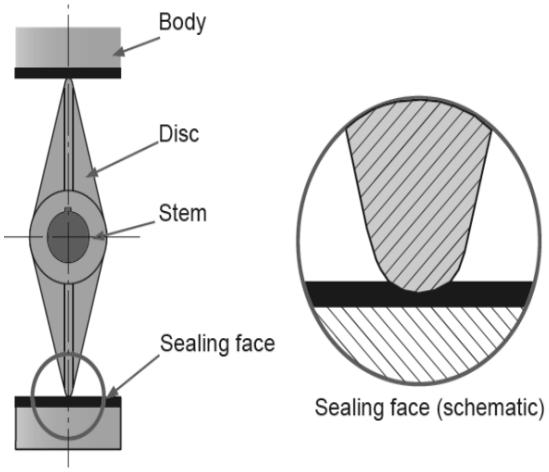

Figure 15: Rubber lined body disc seal directly on lining

4.10.3 Seal clamping ring (Seal in disc design)

The seal clamping ring will be of bolted design unless otherwise stipulated (as a result of water quality). Materials are to be as per Section 5 of this specification. Seal clamping rings of non stainless steel will be fully coated after installation. For clamping rings manufactured from stainless steel they may be uncoated, however this is dependent on the water analysis on site. The *Employer's* corrosion department at RT&D may request that the stainless steel clamping rings are to be coated. Bolt heads shall be countersunk i.e. will not protrude above the clamping ring surface.

The clamping ring bolting will be designed such that they can be locked in place and cannot loosen during operation. Countersunk screws will be of Allen key design.

The clamping ring edge will be profiled to minimize turbulence on the edge of the ring whilst the valve is in the open position to minimize the turbulence effect on the edge of the clamping ring.

4.10.4 Valve body seats

4.10.4.1 Seal in disc design – non rubber lined

The surface shall be micro finished (polished) for lowest friction and to prolong service life.

One of the following two body seat designs options will be allowed.

Option 1

The seat ring landing surface will form an integral part of the valve body, and will be wear and corrosion resistant. The design will be such that it will prevent infiltration of media between the seat and the body that could lead to crevice corrosion.

Such integral designs include for example include welded seats, bolt on seats where the bolts are epoxy coated, or Ebonite lined seats. Under no circumstances will the body seat be an epoxy coating on top of the base body material.

Option 2

Cast steel, ductile iron or SG iron valves that have weld-in stainless steel seats, will not be allowed unless a butter layer is introduced between the base material and the seat, and such process is approved before manufacture by the *Employer's* Weld and Metallurgical departments. This is to prevent degradation of the high chrome content to migrate to the carbon steel substrate during the welding process.

Weld overlay of high Ni-Cr can be done directly to the base materials listed above provided the weld process is approved by the *Employer* prior to manufacture.

4.10.4.2 Fully lined valve with solid disc design (Concentric)

The bore of the valve will be lined with EPDM/FPM/Nitrile rubber (as per section 5). This rubber lining will form the basis for disk-seal contact. The rubber lining will be autoclave vulcanized. Rubber lined valves where the lining has been applied by chemical agents or by a gluing process, will not be accepted.

The minimum Shore hardness will be 60, even after the aging test. Proof of an ageing test is to be submitted to the *Employer* as part of the data book.

5. MATERIALS OF CONSTRUCTION

The material below indicates the minimum criteria for the materials of construction. The Contractor may offer alternative materials. These alternative materials will be subjected to the *Employer's* approval.

Table 1: Material Selection

COMPONENT	MATERIAL TYPE	SPECIFICATION
Cast bodies	SG Iron Cast steel	EN 1563 grade EN-GJS400-15 or 400/18 EN10213 grade GP240GH
Fabricated bodies	Carbon steel plate	EN 10028 -2 grade P235GH or
Cast discs	SG Iron Cast steel Stainless steel	EN 1563 grade EN-GJS 400/15 or EN-GJS 400/18 EN10213-2 grade 240GH EN Codes EN 10213 GX2CrNi19-11 (1.4309), EN 10213 GX5CrNiMo19-11 (1.4409) ASTM Codes: ASTM A743 CF8 (304) ASTM A743 CF3 (304L) ASTM A743 CF8M (316) ASTM A743 CF3M (316L)
Fabricated discs	Carbon steel plate	EN 10028 -2 grade P235GH
Seal ring	Resilient material	FPM / EPDM or Nitrile (NBR) minimum Shore hardness of 60

Seal retaining ring	Ductile cast Iron/carbon steel (Clean Water)	EN1563 400/15 or 18 (coated) or EN10025 S235JR (coated)
	Stainless steel (CW water)	EN 10088 1.4571 or EN10028 (1.4401) as a minimum, if water chemistry warrants it then duplex stainless steel 1.4462
	Stainless steel (aggressive CW or sea water)	If water chemistry warrants it then duplex stainless steel to EN 10088 X2CrNiMo(n) 22.5.3 (1.4462)
	Water analysis supplied by *Employer*	The *Contractor* can offer an alternative, provided an engineering motivation with respect to strength and corrosion resistance can be provided
Body seat	Lined body and seal in disc design (double offset)	
	Epoxy coated valves	Welded or bolted in design -- EN ISO 18274 grade 2.4806 (High chrome nickel overlay) **Or** Screwed in seat design EN 10028-7 X5CrMoNi17-12-2 (1.4401)
	Epoxy coated body in very corrosive water (analysis to be supplied to *Contractor)*	Duplex stainless steel Duplex Stainless steel to EN 10088 X2CrNiMo(n) 22.5.3 (1.4462) or EN 10028 (1.4301)
	Rubber lined with solid disc (concentric design)	Internal rubber lining will form the basis of the body seal. Materials for rubber lining is FPM / NBR / EPDM with hardness of minimum 60 Shore A
Internal fasteners	Stainless steel	Stainless steel to EN10028-7 X6CrNiMo (tri stabilized) 17.12.2

		If water chemistry warrants it then Duplex stainless steel to EN 10088 X2CrNiMo(n) 22.5.3 (1.4462)
Spindles, disc pins	High tensile stainless steel	EN 10088 1.4122 or Stainless steel ASTM A276 Gr 431 S29 (1.4057)
External fasteners	Stainless steel	Stainless steel bolts to EN 10088 A4 high tensile grade 80
Internal spindle seals	Radial lip seal/cup seal/o ring	FPM/Nitrile/EPDM
Spindle bearings/bushes	Self-lubricating aluminum bronze	EN 1982 CC 483-k, with self-lubricating qualities
Thrust bearing	Self-lubricating aluminum bronze	EN 1982 CC 483-k, with self-lubricating qualities
Corrosion Protection Systems	Epoxy coated and/or rubber lining as per valve design/type described earlier above.	Organic coating/lining systems for corrosion protection as per the requirements in 240-101712128 & 240-106365693: “Standards for the Internal and External Corrosion Protection of Water Systems, Chemical Tanks and Vessels and Associated Piping with Linings The following standards apply to rubber lining: SANS 1198; BS 6374-5: SANS 1201; SANS 10037: Also note that all surface preparation requirements and primer application steps in Section 11 are applicable to both organic coating and rubber lining.

6. QUALITY REQUIREMENTS

The *Contractor* shall prepare a detailed Inspection and Test Plan (ITP) detailing the inspection and testing to be applied to all stages of valve manufacture. All manufacturing will be done in accordance with the agreed ITP. The ITP shall be subject to the *Employer’s* approval and shall indicate all inspection and test points, the methods and procedures to be used, and the acceptance criteria to be applied. Following review by the *Employer*, agreed quality surveillance requirements such as witness points and hold points shall be indicated on the ITP. The *Contractor* shall abide to the requirements of Eskom Quality Manual QM58.

7. NON-DESTRUCTIVE TESTING

In order to prove the integrity of certain items of the valve parts, the following non-destructive testing acceptance standards will be applicable and will be in line with Eskom NDT standards. Acceptance NDT standards will be as follows:

a) PT to EN ISO 23277 (for weld seams)
b) PT to BS ISO 1371 (for castings)
c) MPI to EN ISO 17638 and EN ISO 23278
d) RT to BS EN 1435 (RT)
e) UT to EN ISO11666, EN ISO 23279 and EN ISO 17640
f) UT for thickness above 8mm to EN ISO 17640

All NDT reports will form part of the final data book.

7.1 CAST BODIES OR DISCS IN SG IRON

a) The as-received casting will be tested on both internal and external surfaces by means of Dye Penetrant testing (PT) for linear indications in the “as received condition” from the foundry. Any linear indications in excess of the acceptance criteria as detailed in BS EN 1371 will cause the casting to be rejected.
b) Dye penetrant testing will not be used to quantify SG iron castings for porosity.
c) Where machining is done on the SG iron casting, on completion of the machining process, the newly exposed areas will be tested by PT.
d) During valve refurbishment, both the entire body and disc will be tested for indications by means of PT.

7.2 BODIES OR DISCS CAST IN CARBON STEEL

a) Bodies will be tested on both internal and external surfaces by means of PT, or MT inspection, for linear indications and porosity in the “as received condition” from the foundry, before any machining commences. Any defects larger than what is allowed in BS EN 1371 will be reported by the *Contracto*r and a repair procedure will be submitted to *Employer’s* Engineering for acceptance.
b) After final machining is complete, all machined areas will be re-inspected as in (a) above to observe any defects that may have opened up during machining and all defects will be reported to the *Employer’s* Engineering representative for acceptance.
c)
d) The *Contractor* will not perform weld repairs on defects found during NDE, unless allowed by the *Employer’*.

7.3 BODIES OR DISCS FABRICATED FROM PLATE MATERIAL

The plate edges intended to be used for the fabrication process will be 100% ultrasonically tested (UT) for laminations. Plate with laminations will not be used.

After cutting to size for rolling or forming of plate, the edges will again be tested by means of UT for laminations. Any defect will render the plate liable to be rejected.

All accessible welding will be UT or RT tested for imperfections of the weld, and will be repaired before final assembly. Should an RT or UT not be practical then those welds will be subjected to PT/MPI

7.4 SOLID BAR FOR SPINDLES

All solid bars will be 100% UT tested for indications, and material will only be used if defect free.

8. GEARBOX AND ACTUATORS

Different methods of actuation can be required and will be stipulated in the enquiry document. Actuation can be by means of electrically or hydraulically operated actuators.

8.1 ELECTRIC ACTUATOR AND GEARBOX

Valves will be fitted with a gearbox before pressure testing. The stops on the gearboxes will be set during the seat/seal leakage tests. On successful pressure test the stops will be sealed to prevent

tampering. Valves will close on limit, but end stops on gearboxes are to be set as back-up in the event that the limit switches fail.

Gearboxes will be rated to at least an IP68 in accordance with EN 60529 ingress protection.

Gearbox design will be such that the lubrication will not require replacement or replenishing earlier than valve normal service intervals.

Gearboxes will not be of “Scotch Yoke” or travelling nut design. Neither will gearboxes be allowed that makes use of an intermediate sleeve between the valve DE shaft and gearbox shaft boss, because if the sleeve is removed then the self-locking of the gearbox and valve shaft is lost.

Gearboxes will be of “rack and pinion” or “pinion and segment” design.

Gearbox design will be of “self-locking principle”, this means that under no circumstance must any unbalanced force exerted on the disc, cause the valve disc to move from the current position with gearbox intact. Disc position can thus only be altered by external input to the valve shaft.

The gearbox must not be removed from the valve after pressure and leak tests.

Gearbox and actuator combination is to be selected such that when operating the actuator hand wheel in a clockwise direction; it will move the valve to the closed position.

A minimum of 50% safety factor will be used for the gearbox and 30% for the actuator. The ratings of the gearbox and actuator shall be matched to the valve torque requirements including safety factors as mentioned. The *Contractor* will provide *Employer* with the power and torque calculations.

If a key is used to link the gearbox to the valve spindle, the keyway shall be in line with the valve disc position, this lead to say that when valve is open the keyway will be in line of the flow direction, and when valve is closed the keyway will be perpendicular to the flow direction.

Actuator feedbacks options must be same as the current installation, unless a new C&I upgrade requires any additional interfaces. The feedback will include a combination of items below. The scope of work document must clearly indicate which of the items below are required:

- Potential free change-over contacts for ‘open’ and ‘close’ positions.
- Potential free torque switches for ‘open’ and ‘close’ directions.
- A 4-20 mA four wire signal proportional to position feedback.
- Torque ‘open’ and torque ‘close’ contacts.
- Motor temperature and switchgear contacts.
- Feedback ‘open’ and feedback ‘closed’ contacts.
- Feedback ‘not open’ and feedback ‘not closed’ contacts.
- Command ‘open’ and command ‘close’ contacts.
- Common supply and common contacts.

Actuator torque switches to be set during the leak test. A functional test will be performed on the assembly before the leak test.

Actuators may be removed from the gearbox after pressure testing to prevent damage during transport, but the gearbox will remain fitted to the valve.

The gearbox will have an adjustable end stop for both open and closed positions, but this will be sealed after successful leak testing.

The gearbox will be fitted with a clear and fixed position indicator. This position indicator has to be aligned during the leak testing of the valve. The indicator must be a permanent marking or feature and must be tamper proof after it has been fitted. A scale from 0° to 90° is to be fitted to this indicator and must be divided into a minimum of 10° increments from open to close. For fully closed to 10% open, the markings will be 1° increments.

8.2 HYDRAULIC ACTUATION

Due to the number of variants used on site such as with or without counterweight, integral power pack, stand-alone power pack, etc., this requirement will be described in the enquiry document as a site specific requirement.

The product offered by the *Contractor* shall have a direct interface with the existing plant, more modernized designs may be offered, provided it can be fully integrated.

9. MECHANICAL LOCK-OUT FACILITY OR ACCIDENT PREVENTION SYSTEM

As a minimum, a system similar to one of the following shall be fitted to all new valves, including the CW pump Auto closing valves. Reason for installing the lockout on the Auto Closing valve is that except for the actuation method the CW Pump Auto Closing valve and CW pump back up isolation valves are the same and they can be used interchangeably by changing the actuation mechanism.

9.1 OPTION 1 – MECHANICAL LOCK OUT

For safe access to work, as part of the standard isolation and permit to work to be issued, the valve has to be fitted with a manual lock-out device. This manual lock-out device is to be completely separate from the gearbox or actuator and may not be interlocked to the gearbox. The lock-out device is required for both the closed and open positions of the valve.

This lock-out facility shall be designed (and proof of calculations will be provided by the *Contractor)*, to withstand a torque of 130% that of the maximum torque rating of the gearbox/actuator combination.

A typical example of a locking device is shown in figure 16.

Figure 16: Mechanical Lockout device

9.2 OPTION 2 – ACCIDENT PREVENTION SYSTEM

In the event that a mechanical lockout as described in Section 9, Option 1 is not fitted accident prevention system as described below shall be fitted.

To provide safe access to the pipeline when the isolation valve is closed, the isolation valve shall be equipped as per the example given in Figure 17. This will provide safe access for workers into the pipeline, while the system is still pressurized. It shall enable maintenance downstream of the pipeline whilst the upstream side is fully pressurized.

The lock-out system shall lock the disc of the isolation valve in its closed position, by means of anchors (e.g. fixed and manual), and shall be independent of the valve

The manual anchor shall be equipped with a lockable hand wheel and an indicator will be supplied to indicate if the hand wheel is in the open or closed position.

The system shall be of proven design and design calculations will be provided to demonstrate that the device can withstand all actuator forces and the maximum differential line pressure. The spindles of the manual anchor where it enters the valve body will be of a live loaded gland packing design.

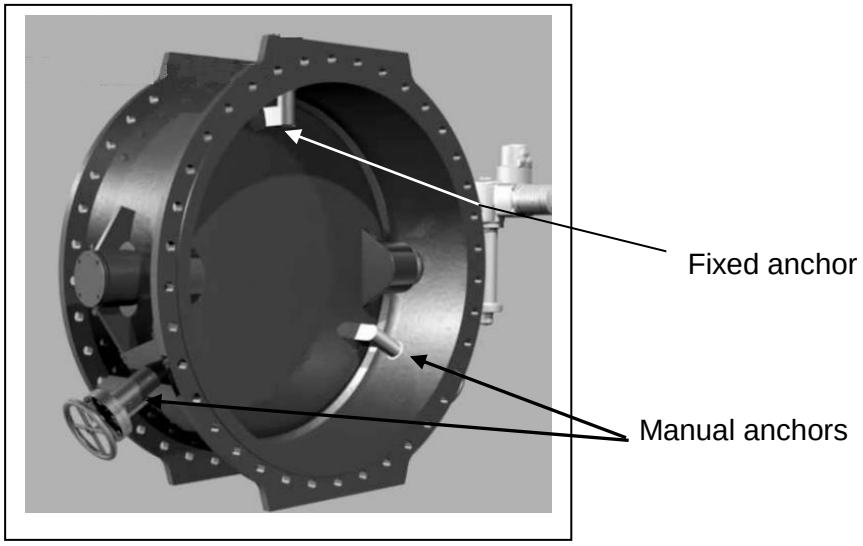

Figure 17: Accident Prevention system

10. HYDRAULIC PRESSURE TEST AND LEAK TEST

Although an initial body pressure test can be done before machining of the casting commences, a final body hydrostatic test will be done on the assembled valve. For the body hydraulic pressure test the valve disc will be opened partially to subject the complete body to hydraulic pressure.

Should the body pass the pressure test, the valve disc is then closed and a seat leakage test is performed. After the seat leakage test is successfully completed, the gearbox end stops, as well as the actuator torque and limit switches, are set at the closed position,

For all new valves, the body hydrostatic test will be done at 1.5 times the design pressure, and the seat leakage test will be done at 1.1 times the maximum system pressure (specified by The *Employer's* Engineering department) as specified in BS EN 12266 Parts 1 and 2. Further, after the test has been completed as per BS EN 12266, the valve will be depressurised and cycled at least once from the closed position to approximately 5% open and then reclosed. The valve seal will then be subjected to a follow up pressure test, and be pressurised to at least the maximum system pressure for 10 minutes. During this follow-up test the valve will also seal drip tight.

For refurbished valves, the body test may be reduced to 1.1 times the design pressure, but all other requirements shall be complied with

11. COATING SPECIFICATION

Should the *Contractor* propose an alternative coating system, this may be done on approval of the *Employer's* RT&D corrosion department representative. The requirements described below must be submitted as a main offer. Failure to submit this main offer may lead to disqualification of the tender.

The following table provide coating requirements

Table 2: Coating Requirements

This table to be considered as Annexure D of 240-101712128: "Specification for the Corrosion Protection of Water Systems, Chemical Tanks and Vessels and Associated Piping with Linings"	
Basic Requirements:	
Environment - External	External valve surfaces exposed to inland atmospheric conditions.
Material - External	Ferrous substrate.
Surface Preparation - External	Abrasive blast clean to Grade Sa 2.5 Surface profile as specified by the coating manufacturer
Generic System - External	Primer: Two component re-coatable epoxy zinc phosphate primer (75 – 100 micron). Finishing: Two component polyurethane acrylic finishing coat (50 – 75 micron).
Environment - Internal	Immersed, cooling water, pH 8,1 to 8,6, temperature range 25°C to 45°C, flow rates of up to 2,0 metres per second.
Material - Internal	Ferrous substrate.
Surface Preparation - Internal	Abrasive blast clean to Grade Sa 3 Surface profile as specified by the coating manufacturer
Generic System - Internal	Rubber Lining as per requirements in section 4.2 and 5
AND/OR dependant on valve type and design in section 4.2	
Generic System - Internal	Two component solvent free amine cured epoxy coating 2 coats @ 300 micron per coat NDFT (nominal dry film thickness) Immediately prior to coating all pitting, omega cavities, honey combing, voids or any other surface defects shall be stripe coated by brush in a stippling manner to ensure complete wetting out of the surface defect. Total dry film thickness of the coating system: 675 to 850 micron (with the use of a primer). Total dry film thickness of the coating system: 600 to 750 micron (without the use of a primer).
Special Requirements: 1. Corrosion Protection shall only proceed once all mechanical, fabrication, manufacturing activities i.e. cutting and welding have been completed and released in terms of the manufacturing/fabrication Quality Control Plan (QCP). 2. Rounded edges are required in order to be able to apply the corrosion protection system	

uniformly and to attain adequate coating DFTs on sharp edges, refer to ISO 12944-3 should more detail be required. All sharp edges from the original fabrication shall be rounded or chamfered and burrs around holes and along other cut edges shall be removed. All edges to be rounded off with a grinder to a radius of 3mm or more.

3. Weld beads with a surface irregularity exceeding 3mm or with sharp crests having a radius less than 3mm shall be ground.

4. All welds shall be free of slag, slag inclusions and pinholes. Adjacent areas shall be free of weld spatter, which shall be removed by grinding or scraping.

5. The contractor shall be wholly responsible for the surface preparation and corrosion protection system application. Coated surfaces shall meet the DFT as required by this specification sheet and aspects thereof in referenced documents.

6. All materials, i.e. paint, primers, adhesives, rubber liner, solvents, cleaning agents for a specific corrosion protection system shall be supplied by the same manufacturer. The solvents used shall be those recommended and manufactured by the manufacturer.

7. Prior to final surface preparation all substrates shall be tested for chloride contamination, according to ISO 8502-6. Casting substrates which may be pitted and/or rough and porous are inherently susceptible to soluble salt contamination.

8. Soluble salt testing shall be performed by the Bresle soluble salt test method. If not within acceptable limits (as per the manufacturer requirement but not exceeding 100mg/m2), the surfaces shall then be washed/decontaminated by High Pressure (HP) water washing using fresh/clean water (with a conductivity reading of maximum 100 µS/cm) at a minimum pressure of 300 bar. A salt decontamination chemical additive with demonstrated capability of removing salts may be used in conjunction with HP cleaning.

9. Soluble salt testing shall be repeated on representative test patches which shall be blast cleaned to Grade Sa 3 (ISO 8501-1) for internal surfaces and Sa 2.5 for external surfaces. If acceptable then proceed with blasting and application steps – if not then repeat HP washing until the salt contamination has been removed to within acceptable limits.

10. Prior to any surface preparation all surfaces that are, or are likely to be contaminated with oil or grease as a result of the fabrication/manufacturing process shall be solvent cleaned with a suitable water-soluble biodegradable alkaline cleaner/detergent or with appropriate organic solvents.

11. Cleaning may be performed by using rags for small areas, or a spray gun for large areas. The detergent/solvent-cleaned surfaces shall then be thoroughly washed down with fresh/clean water ensuring that the oil-water emulsion formed is completely removed from the metal.

12. Degreased and water washed surfaces shall be checked for residual oil and grease using the atomized water spray test as per ASTM F21 and further degreasing shall be carried out if residual oil or grease is found to be present. A black light test shall be used to check for oil contamination. Zero oil and grease contamination is the acceptable limit. Washing with fresh/clean water containing a suitable degreasing agent of partially painted components shall

take place between coats, if surfaces are found to be contaminated.

13. Surface preparation by abrasive blasting shall be performed by means of conventional hand held blasting equipment capable of removing mill scale and suitably preparing the substrate to the required cleanliness.

14. The requirement for surface preparation of surfaces for immersion condition or internal surfaces is strictly Grade Sa 3 (ISO 8501-1), in which case the surfaces shall be blast cleaned to white metal where all traces of rust, mill scale and other foreign matter are removed.

15. In general, Grade Sa 2 ½ (ISO 8501-1), i.e. very thorough blast cleaning where at least 95% of the mill scale, rust and other matter is removed, is specified in the case of most external protective coating systems for atmospheric exposure.

16. All compressed air for blasting activities shall be free from entrained moisture and oil. All traps shall be in a functional condition. The compressed air shall be tested at regular intervals using clean white clothes to assess cleanliness and dryness. This requirement shall be included in the QCP.

17. After surface preparation, all dust, grit blasting media or any other deleterious matter shall be removed from the surfaces by vacuuming. The process shall be repeated until the required level of dust and debris removal is achieved. It is imperative that all surface dirt and contaminants are completely removed before coating or the adhesion of the coating shall be impaired.

18. Immediately before coating or rubber lining activities, blast cleaned steel shall not exhibit more than “dust quantity rating” 2 when tested in accordance with ISO 8502-3.

19. Power and hand tool cleaning is only applicable to very localised touch ups or patch repairs. Specific requirements for patch repairing a coating system are defined in section 4.8.6 of 240-101712128 and 240-106365693. Hand-tool cleaning for isolated/localised areas may be utilised provided the required standard of finish is achieved. For all immersion applications final mechanical cleaning shall be by bristle blaster in order to create a required or specified surface profile.

20. Cleaning by means of hand or power-tools, i.e. wire brushes, chipping hammers, scrapers, grinders, sanders, needle descalers, bristle blasters etc. may only be used where accepted by the Eskom engineer and where the position and condition of the substrate metal is such that efficient cleaning and surface profile can be achieved and where the protective coating system is designed for application to brushed or ground surfaces i.e. specifically formulated surface tolerant coatings.

21. Oil and grease deposits shall be removed prior to cleaning as detailed earlier in this specification. Special attention shall be paid to drillings, bolt holes, etc.

22. Different grades and types of blasting media exist. It is important that the correct abrasive be used in combination with a specific coating system to achieve the specified surface profile. The required blast profile height should be carefully considered. The contractor shall select an

appropriate abrasive type and mesh size to attain the specified surface profile.

23. Only inert mineral grit or steel grit abrasives shall be used. Sand or silica based abrasives shall not be used. Abrasive material for blast cleaning shall be used in accordance to the manufacturer's specifications and in line with local environmental regulations. The abrasive shall be clean, sound, hard particles free from foreign substances such as dirt, oil, grease, toxic substances, organic matter and water soluble salts.

24. It is important that good quality abrasives are used in order to minimize the amount of waste grit and dust generated and contamination of the surfaces.

25. At all times care shall be taken to ensure adequate protection of any surfaces and parts not requiring blast cleaning and coating.

26. Equipment name plates and identification plates shall be protected from coatings. No coatings shall be applied over any surfaces where these will adversely affect the performance of the item or component.

27. The use of re-cycled blasting media for the final blast is strictly prohibited.

28. All abrasive media shall be stored in an area that is completely dry, covered and protected from weather.

29. The profile height of the blasted surfaces should be within the range of the specified coating system or primer coat in the case of rubber lining. Refer to the manufacturers Product Data Sheets. Unless otherwise specified by the coating/rubber lining manufacturer, a profile height of 25 microns to 90 microns is recommended for most coatings systems.

30. It is important that the blast profile does not exceed the specified DFT of the primer or first coat. Blast cleaning of rough, severely pitted or corroded surfaces may result in high profiles i.e. > than 100 microns. In these cases, the primer or first coat shall be applied by brush/roller to ensure complete wet-out of the pitted/jagged surface. In addition a different primer or first coat may be required. However, agreement should be reached between the contractor and coating/rubber lining manufacturer as to the most suitable profile range, with due consideration of the application method, for a specific coating system.

31. The contractor shall consider and detail these potential scenarios or eventualities in the required Method Statement which shall be reviewed by Eskom for acceptance/rejection prior to any work. Ultimately, the contractor shall be responsible for any risk that could arise or be attributed to this choice.

32. The contractor shall ensure that during surface preparation and coating/rubber lining activities the relative humidity (RH) in open, undercover shop environments is less than 80% RH. Ambient temperatures shall be between 15°C and 30°C or as per the manufacturer recommendations, whichever is the more stringent. The maximum/minimum substrate temperature at the time of coating/rubber application shall be strictly in accordance with the product data sheet.

33. During stable weather conditions environmental parameters shall be measured and recorded at least 4 times per shift. During periods of inclement or cold weather conditions the environmental parameters shall be measured and recorded hourly. In the event that the latest two readings of any of the parameters indicate a deteriorating trend which would likely exceed parameter/s or limits then no final surface preparation or application shall be permitted. All measurements shall be recorded at the steel surface. Dew point requirements shall be as per the Product Datasheet or 240-101712128.

34. For all inspections of all surface preparation and coating/rubber lining activities the surfaces shall be clean allowing unhindered visual access to the surface. The contractor shall provide sufficient and adequate lighting (Cool White) to enable inspections. Cell phone lighting is not acceptable.

35. In order to avoid recontamination and flash rusting of the surfaces, the primer or first coat shall be applied within 8 hours after final surface preparation of the steel surfaces. Under no circumstances shall the blast be permitted to stand overnight.

36. Many modern organic coatings can be applied without the use of a primer. However, should a primer coat be required for holding of the blast, or otherwise, the contractor shall indicate/describe the reasoning for the need of such a primer i.e. as a holding primer or as a means of enhancing adhesion of the system. Details shall be provided in the Method Statement for the type of primer, generic resin, solvent borne or free, maximum DFT and compatibility with subsequent coats.

37. The detailed Method Statement shall be submitted and reviewed by Eskom for acceptance/rejection prior to any work. Ultimately, the contractor shall be responsible for any risk that could arise or be attributed to the system selection.

38. The spray operator shall be equipped with a “wet comb” and frequently monitor the wet film thickness to prevent/reduce a wide spread of DFT’s.

39. In the case of coatings, after allowing sufficient time for the first coat to cure, all edges, weld seams, bolts and nuts, and other crucial areas shall be given an additional stripe coat, by brush application, with the same material as the following coat. Should the use of a primer be omitted, stripe coating shall be carried out between applications of the first coat and the subsequent coat.

40. As instructed in the table above and to reiterate, immediately prior to coating all pitting, omega cavities, honey combing, voids or any other surface defects shall be stripe coated by brush in a stippling manner to ensure complete wetting out of the surface defect.

41. For coating systems multiple coats shall be applied as per the table at the top of this specification sheet. Single coat systems are not permissible.

42. In the case of coatings where more than one coat is applied, the colour of each coat shall be different from the previous coat. In the case where aesthetic requirements are secondary, repairs after final testing shall be carried out using a different colour. In other cases two finishing coats of the same colour may be applied to achieve complete colour uniformity.

43. All finishing colours for external surfaces shall be in accordance with the Eskom requirements; 240-145581571: Standard for the Identification of the Contents of Pipelines.

44. Where more than one coat is being applied in an open exposed yard environment, surface preparation and washing shall be carried out between coats.

45. Where the coating has completely cured or allowed to age before finishing, before application of a subsequent coat the surface shall be prepared by light sanding, scrubbing with potable water using a bristle brush and drying before over-coating.

46. Application of subsequent coats shall be in accordance with the specified system. The required over-coating intervals as mentioned in the latest Product Data Sheet shall be observed and adhered to.

47. The number of coats and DFT per coat required to achieve the total film DFT shall be agreed between the contractor and coating manufacturer and will be dependent upon the method of application chosen.

48. The total DFT of the applied coating system shall comply with the recommended minimum and maximum DFT limits as recommended in the latest Product System Data Sheet and this specification.

49. The range of DFTs of each coat shall be as follows; 90% of random readings shall be equal to or greater than the minimum specified DFT. No individual reading shall be less than 80% of the specified DFT. In the case of solvent borne coatings no individual reading shall be greater than 150% of the manufacturer's maximum specified DFT. All deficient film DFTs shall be rectified prior to release of components.

50. The coating shall be evenly applied to form a smooth, continuous, unbroken layer free from misses, sags, runs, tears and other defects that could affect the integrity of the coating.

51. Flange faces will be coated with a single primer layer as in point 30 above.

52. The contractor shall perform pinhole detection using appropriate "spark" testing equipment at a voltage setting as per the coating/rubber lining manufacturer's requirements. Wet sponge testing shall not be acceptable.

53. With the exception of access limitations or as instructed by the Eskom engineer all areas of coating damage shall be patch repaired in a different or contrasting colour and by brush application. The extent of the damage shall be carefully inspected to assess which coats in the system have been damaged and which surface preparation methods are most suitable and appropriate. The Eskom engineer shall accept/reject the contractor's recommended method of surface preparation i.e. mechanical power and hand tool cleaning.

54. When more widespread repairs are required and when the damage extends to the steel

substrate abrasive blast cleaning to Grade Sa 3 (ISO 8501-1) is required.

55. All coats in the system shall be re-instated. Areas to be primed shall be cleaned of dust, dirt, grease, salts or other deleterious matter and all edges of existing paint shall be feathered back to a hard edge. The patch primer used shall be in accordance with the requirements of the relevant coating system. The over-coating onto an existing coating by subsequent intermediate and finishing coats (where applicable) shall be stepped at 25 mm intervals to produce a feathered edge. Specifics of such instances shall be assessed on a case by case basis.

56. All shop coated or rubber lined surfaces shall be inspected and examined for coating damage on arrival at site. If the damage is excessive it may be preferable to repair the transport damage before installation/assembly/erection whilst access is easier.

57. Provision shall also be made for the repair of handling damage to the coating or rubber lining after installation/assembly/erection/scaffolding removal. For coatings spot repairs shall reinstate each of the previous coats and shall commence directly after the localised surface preparation. In the case of rubber lining the contractor shall include a specific section in the method statement proposing patch repair procedures for acceptance/rejection by Eskom.

58. All immersed surfaces shall again be pinhole tested (only after completion of all handling, moving and equipment and scaffolding removal) to ensure the coating or rubber lining is pinhole free and if required additional repairs shall be performed and once cured then the repair areas shall be retested. The process to be repeated until a pinhole free coating is achieved. In the case of rubber linings and depending on the nature, extent and concentration of damage larger sections of rubber lining may be required as instructed by Eskom.

59. After completion of the coating activities sufficient curing time of the coating system shall be given prior to immersion as per the requirements of the Product Data Sheet.

60. Accelerated curing is not permitted. All coated surfaces shall be adequately ventilated until full cure has been achieved. At the end of the curing period and before immersion the full cure of the applied coating shall be verified by the contractor and/or coating manufacturer.

12. ACCESS FOR INSPECTION

a) The Employer's quality surveillance representative and/or the Employer's Engineering representative shall have free access, , to the *Contractor's* and its *sub-Contractor's* facilities for the purpose of inspecting the work performed and/or witnessing testing/inspection performed by the *Contractor* during the fabrication process.
b) All manufacturing and test procedures as well as all inspection and test reports shall be made available in the *Contractor's* manufacturing facility to the *Employer's* Engineering representative and */ or Employer's* quality representative for review.
c) The Employer's quality surveillance representative and/or the Employer representative shall be informed in advance of a scheduled witness or hold point event. If work identified as a witness or hold point is assembled and rendered inaccessible without approval of the Employer's representative having been given the opportunity to inspect the work, then such work shall be disassembled and made accessible for inspection. If hold and witness points are not adhered to an NCR will be raised for correction at the contractors expensive and time

13. NAME PLATES

The following minimum information will be on the valve name plate:

- The design code.
- Manufacturer's name.
- Design pressure (kPa)
- Design temperature (minimum and maximum)
- Maximum allowable operating pressure (MPOP)
- Serial number
- Operating running Torque.
- Break out torque
- Flange specification
- Body material
- Disc material.
- Valve type – double offset resilient seal (state if rubber lined or not)
- Uni- or Bi directional

14. PREPARATION FOR TRANSPORT

Valves will be supplied adequately packaged or crated so that no damage can occur during transport or off-loading by means of a forklift or slings and overhead cranes. Special care should be taken with coated areas.

Each valve will be individually wrapped in a durable protective packaging such as a re-enforced PVC or re-enforced Nylon wrapping.

The wrapping will be sealed to prevent environmental conditions such as rain or dust to settle on the valve sealing faces. Furthermore the wrapping will be UV resistant as these valves are normally not stored under roof.

Both the up and downstream flange will be covered with a solid cover (plywood or galvanised sheeting) before the wrapping is applied.

The valve will be inspected at the Contractor's works before it is transported to the Power Station to the acceptance of the *Employer*, this to be included on QCP as an Employer's hold point.

As the gearbox is to remain on the valve during transport, the transport crate/palette will be such that adequate support is provided at all times to the gearbox to prevent any damage to the gearbox. The palette/crate will be marked so as to prevent accidental lifting or rigging of the valve at the gearbox.

The above requirements apply to both new and also refurbished valves.

15. DELIVERY TO SITE

The *Contractor* is responsible for the co-ordination and execution of the various functions involved in delivery to site. Such functions include the following:

- Transport
- Delivery
- Off loading

16. DOCUMENTATION

16.1 MANDATORY DOCUMENTATION TO BE SUBMITTED WITH TENDER:

During the enquiry the items listed below will be considered mandatory, to be supplied with the tender. Failure to supply the required documents will cause the tender to be rejected.

a) Years of experience in double eccentric/Concentric valves design (depending on what is requested)
b) Years of experience in manufacturing of resilient seal butterfly valves, specific to type as per enquiry butterfly valves, for size ≥ 600mm)
c) Reference list of similar valves supplied in the last 10 years, specifically in South Africa to either the Employer or to water reticulation systems for ≥ 600mm.
d) Organizational chart clearly indicating personnel responsible for Design, Manufacturing and Quality Assurance.
e) Complete with tender submission, the *Contractor* will provide an outline drawing for each valve. The minimum information to be indicated on the drawing will include:
    i. Outline dimensions
    ii. Weight
    iii. Flange drilling,
    iv. Actuator mounting platform/hand wheel data
    v. Materials of construction of main components.
    vi. Details of mechanical lock-out facility
    vii. Torque values (Running and break out)
f) Typical Program for the complete project (bar chart)
g) Typical Quality Control Plan (QCP) or ITP (inspection and test plan)
h) Clear statement defining which contractor's entity will perform the surface preparation and coating activity - is it in-house or sub-contracted?
i) The tender to include a coating procedure.
j) Complete catalogue/brochure of the intended valve.
k) Any exclusions or qualifications or deviations to this specification or site specific scope of work must be listed as part of the tender; else the tender will be rejected. Should there be no exclusions or deviations then a letter to be included in the tender stating full compliance.

16.2 DOCUMENTS TO BE SUBMITTED WITHIN 1 WEEK AFTER AWARD OF CONTRACT

a) Method Statement to explain in sufficient detail the following:

    i. Specific detail of the required mechanical work on the valve. The interface between coating and mechanical work will be clearly defined, with respect to integration of activities.

    ii. Information with respect to interfaces with activities (as in point above) performed by other *Contractors*/*sub-contractors*.

b) Explanation of sequence/order of work areas to minimize unnecessary handling of valve after coating has been applied, and to prevent mechanical damage during manufacturing process.

c) The valve *Contractor/manufacturer*, in consultation with the applicator and coating manufacturer, shall compile a detailed application procedure for the works. This detailed procedure shall be submitted to the *Employer* for review and approval.

d) The valve *Contractor/manufacturer* and applicator shall submit a detailed program showing how the works will be carried out and completed.

e) Detailed program for the complete project (bar chart), and it must include each step of coating process.

f) Detailed drawings that will be used for manufacturing.

g) Coating application procedure including latest revisions of specified coating Material Product Data Sheets and Material Safety Data sheets

h) Actual QCP's and ITP's to allow *Employer* to add the required intervention points. A section for coating to be included. Individual QCPs and ITPs must be kept for each valve.

i) All relevant welding documents (WPS and WPQR).

j) Pressure testing procedure.

k) Details of the packaging / wrapping material that will be utilized before valve is transported to site

16.3 DOCUMENTS TO BE SUBMITTED ON DELIVERY

a) Valve Material Certificates in accordance to EN 10204 (of 2004) 3.1 as a minimum for mayor items such as body, disc, spindles, pins, seat ring, seal, and clamping rings.

b) Valve body hydrostatic test certificate.

c) Seat leakage test certificate (EN 12266 parts 1 and 2).

d) List indicating and identifying all valve spares, with all material certificates.

e) In event that any part is from forging process, the heat treatment certificate to be included.

f) Valve, gearbox and actuator maintenance, installation and operating manuals.

g) Certificates of coating material as well as material safety datasheet of the coating product.

h) Coating integrity check sheet indicating the dry film thickness test report and pinhole test.

i) An Electronic copy of valve outline drawing .PDF format for record keeping at Eskom.

j) Heat treatment records.

k) Official copies of material test certificates, and pressure test reports (1 hard copy and one soft copy).

l) Welder qualification certificates would welding be part of the manufacturing process.

m) Non-destructive test reports.

n) Test equipment calibration certificates.

o) All NCR's and proof of rectifications.

17. REFURBISHMENT REQUIREMENTS

17.1 REPAIR AT *CONTRACTOR*S WORKS:

17.1.1 Rubber lining:

For fully rubber lined valves, the rubber lining will be inspected for cracks, tears or any mechanical damage.

Rubber hardness will also be tested with a Durometer and if above 80 Shore hardness the rubber lining will be replaced.

The vulcanised liner will be replaced as a unit and no patch repair will be allowed. All rubber curing / vulcanising will be in an autoclave. Chemical bonded liners without vulcanising in an autoclave will be rejected.

As part of tender a rubber lining replacement procedure will be submitted.

17.1.2 Valve body:

Valve body external will be inspected visually for mechanical damage.

For non-rubber lined valves the valve body internals will also be inspected for mechanical damage

After the valve body has been dismantled and cleaned the following areas will undergo surface NDT for crack-like indications:

a) Casted bodies: Flange to body sectional changes both on outside and inside of valve body.

b) Fabricated bodies: All flange to body weld interfaces.

c) Gearbox/actuator mounting platform and sectional change from body to platform base.

d) Shaft/bearing bosses.

e) On fabricated valve bodies all long and seam welds on body pressure envelope.

f) All corrosion pits depth or profiles to be recorded and photos to be taken for the databook. Under no circumstances will coating be used to restore mechanical integrity damage. Pits with a depth of 3-5 mm depth can be filled with epoxy during the coating process, provided the pit/crevice does not affect the mechanical integrity of the valve body.

g) All welding on the wetted parts and all external stiffening webs will undergo surface NDT for indications (PT/MPI)

17.1.3 Valve disc:

a) Casted discs: NDT (PT) the spindle boss to disc sectional change.

b) Fabricated discs: Surface NDT all welded areas (Spindle boss to disc) as well as any other welding on the disc.

c) During refurbishment the shaft boss to disc interface will be fully surface NDT tested, regardless if it is welded design or integral casting. Any indications/defects will be highlighted with recommended repair actions.

d) Inspect disc for mechanical damage and corrosion damage.

e) On disassembly the shaft bore in the disc must be measured for ovality, and should not exceed 0.25mm on any axis of measurement

f) On fabricated discs inspect disc surface for any deformation.

g) Inspect shaft/bearing bosses ID for any corrosion or mechanical damage.

h) In some instances the disc seal landing surface could be badly corroded due to the crevice corrosion or due to the seal that failed. Provided that the disc leading edge is still intact, the corrosion pits below the seal area can be filled with Epoxy as will be used for the coating of the disc. (Refer to Figure 18 below)

i) In cases where the disc leading edge is badly affected by corrosion (refer to Figure 19), the following scope will apply:

   i. The disc has to be machined down to remove the corrosion damage to a depth of at least 10mm.

   ii. The width of the machined back area should at least be the same as original seal surface landing area diameter (Refer to Figure 20)

   iii. The ring will be fastened to the disc by countersunk screws.

   iv. The backing ring will be manufactured as one solid piece, and not in segments to prevent corrosion between the segmented slots and the blade surface.

v. The back side of the backing ring will be equipped with an “O”-ring groove machined and a suitable “O”-ring will be fitted, to prevent any media to get trapped between the bottom of the ring and the disc.

vi. After fitting the ring, the crevice between ring ID of the ring and OD of the disc step will be filled with coating to ensure that no open crevices exist between ring and disc interface.

j) For any design where the pin is held in place by a grub screw the following modification wil be carried out as part of the refurbishment. The *Contractor* will provide a method statement to align the pin design to similar than that described in section 4.8.2.

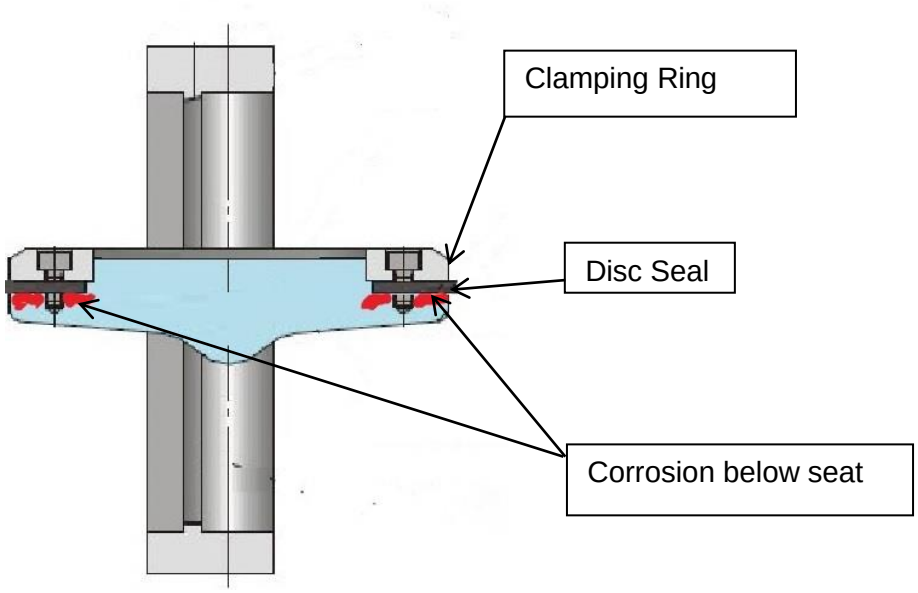

Figure 18: Disc Corrosion below seal

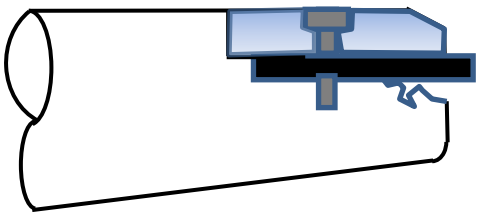

Figure 19: Disc leading edge corroded

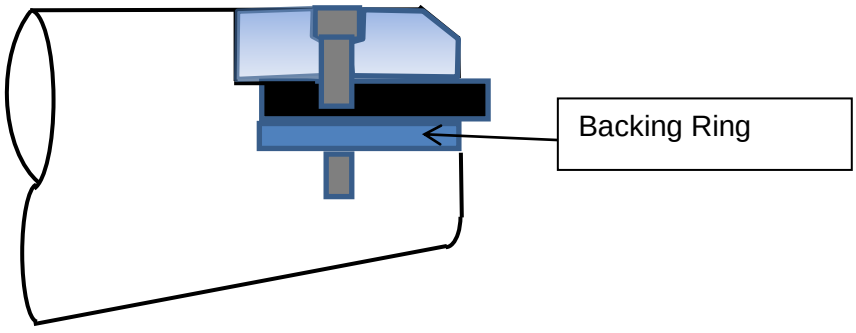

Figure 20: Disc leading edge repair insert

17.1.4 Disc to spindle connection

17.1.4.1 Pinned connections:

Where disc to spindle connection is achieved via taper pin principle, the disc and spindle should be fitted together before the disc is assembled in the body. The taper bores have to be cleaned by means of a reamer to ensure a perfect smooth taper.

New taper pins have to be fitted that match the taper pin bore exactly (slight interference). The pin's large end must be lower than the top of the disc so that a plug such as in Figure 6 can be fitted. This is to protect the pin from corrosion and to mechanically lock the pin.

On final assembly, no part of the pin must be bare. The top and bottom must be fully encapsulated in the coating.

17.1.4.2 Integral drive connections:

Both the male and female parts need to be inspected for damage of the drive splines and drive, mating areas. Should any damage be noted, the integral drive should be repaired so that no hysteresis (free play) exists between drive and disc.

On assembly this interface must be protected from the media in order to prevent corrosion.

17.1.5 Seal clamping ring:

In event that any corrosion or mechanical damage is noted on the clamping ring during dismantling of the valve, the clamping ring should then be replaced. The clamping ring will fulfil the requirements of section 4.10.3 of this document.

17.1.6 Hydraulic and leakage testing after assembly:

The hydraulic and leak tests after refurbishment will comply with all requirements of Section 10 of this standard, with the only exception that the hydraulic body test can be reduced to 1.1 times the design pressure.

17.1.7 Additional requirements during refurbishment

All criteria as per Section 10 through to Section 16 will apply to refurbished valves as well.

All replacement parts will comply with materials of construction as listed in Section 5 of this document

17.2 IN SITU REPAIR:

The seal-in disc design, (Refer to Figure 2) allows for limited maintenance with valves installed.

The *Contractor* will supply a method statement indicating compliance to the items below as a minimum, The *Contractor* shall also indicate any additional actions that he plan to undertake.

Before attempting to perform any maintenance, ensure that both up and downstream ducts are drained and locked out.

The *Contractor* has to supply a complete method statement including testing the valve sealing on completion of the works, as part of the tender

a) Inspect the disc surface and clamping ring for corrosion and erosion, check for loose fasteners or any distortion, as well as and torn or damaged seals. Also ensure that all disc locking pins are intact and still in good state, if corroded or damaged it should be replaced on a remove one, replace one basis.

b) Should the clamping ring edge be worn away, the seal will not be held firm and the valve sealing capability will be reduced. If the clamping ring is in a poor state of repair, it should be replaced. A new ring can be fitted with the valve installed, but due to limited access into the duct, the clamping ring can be in various segmented sections either semi-circle, quadrants or smaller segments, provided that each segment is mechanically attached to the valve disc by fasteners. When cutting the clamping ring a narrow blade must be used to minimise the gap between the various joints, when re-assembling the clamping ring.

c) When the clamping ring and seal are removed, inspect the seal landing area / backing ring (if fitted) on the disc for pitting, and loss of material due to corrosion. The disc seal landing area (Figure 18), provides the support and required stability of the seal. If this landing is corroded, so that the seal support integrity is affected, the seal will not be held in place and will “flap around”. In such event that the leading edge cannot be repaired satisfactory, it is advisable to remove the valve and perform a full factory repair as explained in section 17.1.

d) In event that the vale was previously repaired, a backing ring might already be fitted. Inspection of the backing ring will include visual inspection around the backing ring contact area with the disc for signs of corrosion. As this backing ring should be one continuous ring and not segments, any damage on this ring will warrant that the valve has to be removed and this backing ring be replaced as per section 17.1.3 (h)

e) General corrosion pits, where disc integrity is not affected can be filled with epoxy but should not be used to rebuild lost material on the disc edge, as it does not provide any tensile rigidity.

f) In order to clean and inspect the valve gearbox, firstly the valve disc must be mechanically fixed to prevent sudden movement of the disc when the gearbox is removed. Open and clean the gearbox and inspect the internals:

    i. Dismantle the drive and driven gearing (rack and pinion / Scotch yoke etc.), inspect the gearing tooth for signs of excessive wear. Replace worn components

    ii. Inspect all bearing and bushes, and replace any suspect components.

    iii. With the internals of the gearbox cleaned perform PT/MT inspection around all bearing and thrust areas, and repair / replace as required.

    iv. Ensure that the threads of the end stop adjustment bolts are in a good state.

    v. Re-assemble gearbox and lubricate with suitable lubricant.

    vi. Remove the mechanical lock out device that was fitted during gearbox activities.

g) Before fitting the new seal to the disc, the body seat must be inspected; it might be required to move the valve disc by means of a manual hand wheel. During inspection look specifically for any damage or the sealing face that should be blended. Finally the seat surface finish should be cleaned by polishing the surface with emery paper no coarser than 360 grit.

h) The seal should not be cut in any way; but has to be installed as one complete unit.

i) Ensure that the disc is positioned so that the disc edge is perpendicular to body seat ring. Set the gearbox mechanical end stop and the actuator limit in this position.

j) During installation of the new seal, the clamping ring should be fitted but the bolts should only be finger tightened.

k) After all bolts are fitted, using a feeler gauge to measure the gap between the valve seat and rubber seal. Start tightening the clamping ring bolts until a clearance of around 0.1mm is observed all the way around the seal periphery.

l) Then after achieving the condition as explained in (k) above, tighten each bolt by another half a turn. Care should be taken to not overtighten the bolts which will increase the opening and closing torque. The possibility also exists that the seal edge will be cut/ damaged as soon as the disk closes.

m) Before filling the duct with water, operate the valve to a position that the disc is parallel with the duct (fully open); again set the gearbox end stop and actuator stops in this fully open position.

n) Fill the duct upstream of the valve and observe the valve seal for drop free operation. When a leak is observed tighten the clamping ring bolts until the leak is resolved. Never only tighten one bolt where the leak is, but also pull the bolts on either side of the leak up as well. For valves installed in a vertical duct, i.e. closed valve disk is in horizontal position, the top of the valve can be flooded and the seal verified with a leakage test.

18. TENDER EVALUATION CRITERIA

The following tables provide the tender evaluation criteria Table 3 and Table 4 provide criteria for new valves whereas Table 5 and Table 6 are for refurbished valves.

Table 3: Mandatory requirements for new valves

Section	Criteria	Yes / No
16.1	Proof with references of experience in manufacturing/refurbishment of resilient seal butterfly valves ≥ 600mm	

Table 4: Scoring of Qualitative Criteria

Score	(%)	Definition
5	100	**COMPLIANT** • Meet technical requirement(s) AND; • No foreseen technical risk(s) in meeting technical requirements.
4	80	**COMPLIANT WITH ASSOCIATED QUALIFICATIONS** Meet technical requirement(s) with; • Acceptable technical risk(s) AND/OR; • Acceptable exceptions AND/OR; • Acceptable conditions.
2	40	**NON-COMPLIANT** • Does not meet technical requirement(s) AND/OR; • Unacceptable technical risk(s) AND/OR; • Unacceptable exceptions AND/OR; • Unacceptable conditions.
0	0	**TOTALLY DEFICIENT OR NON-RESPONSIVE**

Table 5: Qualitative Technical Evaluation Criteria for new or refurbished valves

Number	Criteria	Reference	Weight
1	Mechanical lock out.	Section 8	10
2	Omissions, deviations and exclusions from scope	Section 15.1	40
3	GA drawings as per section • Outline dimensions • Weight • Material of main components • Flange drilling • Running and break out Torque	Section 15.1	30
4	Typical QCP (manufacturing and coating activities)	Section 15.1	20

Table 6: Mandatory requirements for refurbished valves

	Proof with references of experience in manufacturing/refurbishment of resilient seal butterfly valves ≥ 600mm	**Yes / No**

19. AUTHORISATION

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20. REVISIONS

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21. ACKNOWLEGEMENTS

None