	TITLE: STANDARD SPECIFICATION FOR TWO WAY BUTTERFLY VALVES FOR STEAM SERVICE	SPECIFICATION NO. PE-SS-999-100-M016	
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1.0 GENERAL AND SCOPE

1.1 This standard specification covers the design, material, constructional features, manufacture, inspection and testing at the Vendor's and/or his Sub-vendor's works, suitable painting and packing requirements of two way butterfly valves (soft seated) complete with all accessories as specified hereinafter and dispatch to site.

1.2 SCOPE OF SUPPLY

Requirement of butterfly valves, as per this specification, shall be of size ≥ 1200 mm NB (design generally as per AWWA only) and the class rating of valves shall be selected as per "Requirements of Steam service Butterfly Valves" as attached Annexure-A and the Technical Data Sheet and Materials of construction attached as Annexure-A1 or at Section -C of this specification.

1.3 RECOMMENDED SPARES

An offer for **Recommended Spares** for valves (3 years operation) and for actuators (5 years of operation) shall be submitted with unit rates with validity for 5 years. Bidders to submit list of these Recommended Spares for Butterfly valves and actuators indicating clearly the valve part name of the valve & actuator alongwith their quantities as recommended by the bidder for each size/type/rating of Main valves and actuators, for 3 years operation for valves and for actuators (5 years operation). Details of these each spares shall be clearly indicated along with separate price of each spares. The details of these Recommended Spares are required by BHEL/Customer for future ordering and therefore must be quoted by the bidders for evaluation.

2.0 CODES AND STANDARDS:

2.1 The design, dimensions, manufacture, inspection and testing of the butterfly valves shall comply with the requirements of latest revisions of American Water Works Association (AWWA - C504- Current revision year 2004). Intermediate Size not covered in AWWA C504 shall be extrapolated of nearest sizes available in AWWA C504.

2.2 However, butterfly valves designed, manufactured and conforming to BS 5155 and MSS-SP-67 shall suit the service conditions/ design parameters and the Materials of construction as specified in Annexure-A & A1 or attached at Section-C of this specification. For Butterfly valves designed and manufactured as per BS 5155/ MSS-SP-67 or equivalent, the POD test methods (valve & gear box) and testing procedures shall generally follow the guidelines of AWWA C504 only in all respect except that the body & seat hydrostatic and disc strength test shall be conducted at pressures specified in BS 5155 or the applicable code. Actuators shall also meet the requirements of P.O.D test of AWWA C504/ AWWA C504..


2.3 In case of any conflict between the above Code/Standard, the interpretation of the specification by the purchaser's Engineer shall be final & binding.

3.0 DESIGN REQUIREMENTS:

3.1 The butterfly valves shall be suitable for Indoor/outdoor installation with shaft either in horizontal or vertical position.

3.2 The valve shall have double off-set type disc (design with shaft eccentric to disc) and long/short body design as specified in Annexure-A / or at Sec-C of Vol IIB.

3.3 The butterfly valves shall be with butt welded/ flanged end body as specified in Annexure-A & A1 and designed to ensure bubble tight shut off at the rated pressure of valve.

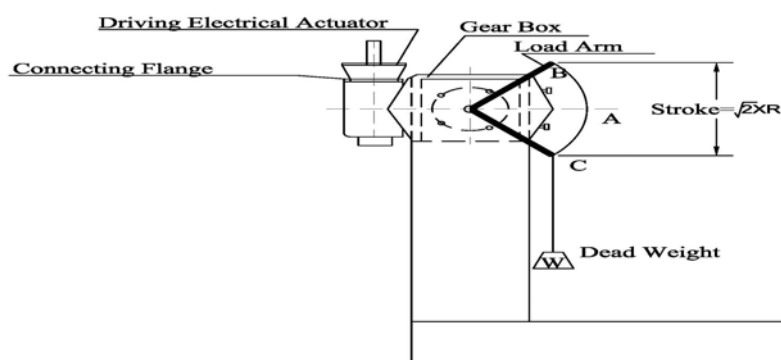
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3.4 The butterfly valve shall be suitable for handling the fluid as specified in Annexure- A& A1

3.5 **VALVE P.O.D. TEST** :-Bidder to carry out P.O.D. (Proof-of-design) Test as per AWWA C504. In case, the valve POD Test done earlier for 500MW NTPC protect, bidder to submit Test Report of POD test for same model/ type/size/ rating for verification. Valve operators (Gear Box and Electric Actuator) shall be designed & tested in accordance with latest editions of AWWA C 504 and AWWA C 540 (actuator) respectively. Gear Box shall be so designed to hold the valve disc in intermediate position between full open and full closed position without creeping or fluttering.

3.6 **GEAR BOX P.O.D. TEST :- BIDDER TO NOTE THAT VALVE POD AND GEAR BOX POD TESTS SHOULD BE DONE INDIVIDUALLY AND SEPARATELY ON EACH ONE OF THE VALVE & THE GEAR BOX. GEAR BOX P.O.D. TEST (CYCLE TESTING) SHALL BE DONE AS PER THE PROCEDURE AS DESCRIBED BELOW OR AS PER THE PROCEDURE AGREED WITH THE PURCHASER BY THE BIDDER...:-**

Gear box POD Test (cycle testing) shall be carried out only at full rated torque of gear box, through out the full cycle of testing i.e. at no point during each full cycle of testing, the applied torque should be less than the full rated torque of Gear Box. Refer Sketch below for Gear Box P.O.D set up Test. Dead weight and length of arm shall be so selected that the torque generated at point "C" and "B" shall IN NO CASE be less than the full rated torque of the gear box.



TEST SET UP

FIG. 1

3.7 Valve POD test charges/ Gear box POD test charges or any other test charges, required as per this technical specification, shall not be included in the unit quoted prices of main valves as these tests are the mandatory requirements of valve governing standard AWWA C504 and the enquiry specification. Hence the bidder is required to do these tests without any charges to BHEL, in case of order on the bidder i.e. NO EXTRA CHARGES ON THIS ACCOUNT IS ADMISSIBLE TO BIDDERS FROM BHEL.


3.8 These valves are for vacuum service and shall be provided with gland sealing arrangement which shall be vacuum tested with vacuum and helium gas (refer Quality Plan).

4.0 ACCESSORIES:

4.1 The butterfly valve shall be complete with Gear Box/Hand wheel/Electric actuator and to be selected as per the technical details given in Annexure-A' &A1

5.0 CONSTRUCTIONAL FEATURES:

5.1 Valve Body

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5.1.1 The valve body shall have integral hubs for shaft bearing housing. The minimum body shell thickness and minimum diameter of seat bore shall be as per the requirement of the applicable table of AWWA-C504. Material of construction of body and valve parts shall be as per materials indicated in Annexure-A & A1.

5.1.2 An arrow shall be embossed/ engraved and painted on outside of body to clearly indicate the direction of flow.

5.2 Valve Shaft

5.2.1 The shaft of each butterfly valve shall be securely attached to the disc through Bolting, Rivetting, threading, upsetting or cross pinning, adequately locked.

5.2.2 The shaft material shall be as specified in Annexure-A&A1. Valve shaft design shall consist of one piece unit extending completely through the valve disc. or may be the "Stub Shaft" type which consists of two separate shafts inserted into the disc. Each stub shaft shall be inserted into the valve disc. hubs for a minimum distance of at least 1.5 times shaft diameter. The connection between the shaft and the disc. shall be designed to transmit shaft torque equivalent to at least 75% of the torsional strength of the shaft diameter. The shaft shall be capable of nondestructive separation from the disc. The minimum shaft diameter sizing shall be such that the smallest diameter of shaft shall be capable of transmitting the maximum calculated valve operating torque without the torsional shear stress exceeding 40% of the tensile yield strength of the shaft material. In addition, maximum valve shaft stresses in full size portion of shaft shall not exceed the lesser of 1/5 of tensile strength or 1/3 of yield strength of the material used such that it will safely sustain the maximum differential pressure across the closed valve and transmit the maximum torque required to operate the valve.

5.2.3 Surface finish for shaft shall be of mirror finish/ very fine finish (16 RMS approx minimum) in the area of gland packing


5.3 Valve Disc:

The valve disc shall have no external ribs transverse to the flow and shall sustain full differential pressure across a closed valve disc without exceeding a working stress of one fifth of the tensile strength of the material used. The thickness of the valve disc shall not be more than 2 ¼ times the shaft diameter listed in AWWA C504. The valve disc. shall be designed to rotate 90° from full open to tight shut off position. Material of Disc shall be as per the Annexure-A&A1.

5.4 Body Seat & Disc Seal(Valve seat)

The disc. seal (valve seat) shall be of suitable grade resilient material, adequately reinforced, securely attached to the disc, replaceable type and shall be designed to provide bubble tight shut off in both directions at all operating differential pressures upto and including the rated pressure of valve class. The disc seal shall be attached to the disc by clamping/ retaining continuous circular ring & easily replaceable, bolting or other suitable methods as per the standard design of the manufacturer in line with design indicated in AWWA C504. Disc seal Material shall be as specified in the Annexure-A&A1.

The mating seat surface in the valve body shall be of stainless steel ring and shall be securely attached to the body by clamping, bolting or other suitable methods of suitable SS316 weld overlay. All clamps, retaining rings (continuous type), nuts and screws used with clamps and retaining rings shall be of stainless steel as specified in the Annexure-A&A1.

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5.5 Valve Bearing:

Each butterfly valve shall be fitted with sleeve type bearings contained in the hub of the valve body. The bearing shall be of self lubricating type and the coefficient of friction of bearing material shall not exceed 0.25 when rubbing at the maximum bearing pressure. Thrust pad shall also be provided for vertical shaft installation. The material of the bearing shall be as specified in the Annexure-A/A1, the bottom bearing also shall have accessibility for easy maintenance, may have bottom flanges to remove bottom bearing.

5.6 Shaft Seal:

Wherever the shaft project through the valve body for actuator connection, a shaft seal shall be provided. Shaft seal shall be designed for use of Standard 'O' rings seals and they shall be contained in a removable corrosion resistant recess. Shaft seals shall be designed to allow its replacement without removal of the valve shaft.

5.7 The handwheel shall be of malleable iron only.

5.8 Body Ends:

These shall be as butt welded as per ASME B 16.25 / AWWA C-504/ as specified in Annexure-A&A1.

5.9 Nameplate:

Each valve shall be fitted with a circular Stainless steel 2MM thick nameplate indicating the valve Tag No. and service description given in Technical Data sheet-A&A1. All details shall be engraved 1 mm deep and filled with black enamel paint.

5.10 All valves shall be fitted with indicators so that intermediate position of opening at 10⁰ intervals/ open or shut positions may be readily seen.

5.11 The stops which limit the travel of any valve in the 'Open' or 'Shut' position shall be arranged exterior to the valve body.

5.12 All valves shall be closed by rotating the handwheel in a clockwise direction when looking at the face of the handwheel. The pulling force required on handwheel rim shall not exceed 25 Kgf when operating the valve under full flow and operating pressure. The face of each handwheel shall be clearly marked with the words 'Open' and 'Shut' with arrows adjacent to indicate the direction of rotation to which each refers.


5.13 Special attention shall be given to the operating mechanism for large size valves in order that quick and easy operation is obtained and maintenance is kept to a minimum.

5.14 Eyebolts shall be provided where necessary to facilitate handling heavy valves or part of valves.

5.15 Wherever practicable, heavy valves of total weight including actuator, drive motor, integral bypass etc. equal to or greater than 500 Kgs. shall be provided with suitable lugs to permit direct suspension by hanger rods or direct resting on bottom support, as applicable.

5.16 The valves as well as accessories shall be designed for easy disassembly and maintenance.

5.17 The disc shall rotate through 90⁰ from full open to the tight shut position. The disc shall be contoured to ensure the least possible resistance to the flow and suitable for

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throttling operation. While the disc is in throttled position, the valve shall not create any noise or vibration.

6.0 SPECIAL FEATURES:

6.1 Gland Sealing Arrangement:

Butterfly valves, provided with glad sealing arrangement, shall be vacuum tested. All valves required with this arrangement shall be provided with G3/8" connection (duly plugged) for water sealing. Sealing water shall be supplied at 4 ata and 50°C unless otherwise specifically indicated for the particular project.

6.2 Motorised Valves:

6.2.1 The motorised valves shall be provided with electric actuators of any of the following make.(approved by customer):

- i) Rotork
- ii) AUMA
- iii) Limitorque
- iv) Antrieb


A particular type and make of the actuator shall be selected based on the Technical Specification of valve actuators attached and to meet customer's specific requirements.

The actuator shall be designed for the maximum differential working pressure. However the selected actuator stall torque shall be minimum 1.5 times the valve unseating torque requirement at maximum differential working pressure (design pressure). Also it has to be established that the offered actuator will open/close with design pressure & timing 60 +/- 10 seconds (unless otherwise mentioned in specific requirements) or as indicated in specific requirements/ Annexure--A&A1 with testing of valve with actuator. All electric actuators shall be tested for seat tightness test at 1.1 times of design/ operating pressure.

6.2.2 Electric Actuator sizing calculations (valve torque, shall be furnished with the offer for the selected actuator. This Actuator sizing calculations to be submitted by the bidder with their offer, shall indicate in detail, the total required operating Valve Torque required for opening as well as for closing of valve with break-up of seating or un-seating torque, dynamic torque, bearing friction torque etc. The calculations shall be furnished for both with shaft vertical and with shaft horizontal. Opening and closing times shall be furnished. Bidder to submit technical details of gear box (mechanical advantage, speed reduction ratio, turns to close, max. output of torque etc.) and also submit GA drawing for Gear Box indicating materials of construction and hardness of worm & worm wheel etc. The bidder to indicate in their technical offer the size/type/ rated torque/ make & model of selected Electric Actuator and Gear box model.

6.2.3 Motor of actuators shall be provided with class "F" insulation for the design of class "B" insulation.

6.2.4 A particular make and type of actuator shall be selected based on the Technical specification (spec no PE-SS-999-145-1007) of valve actuators. However basic design shall be of three types i.e standard (basic type/conventional type syncroset i.e. without integral starters) /with integral starter/smart / intelligent. Control connection types shall be standard (convectional without integral starters) i.e with cable glands & cable lugs / 9 pin plug and socket wired & suitably mounted in starter box itself to terminate open/close command and status feedback signals with external control systems along with 1 No. additional same 9 pin spare plug & socket for ON-OFF duty. For inching duty 1 No. additional 9 pin plug and socket wired & suitably mounted in the starter box itself for actuators with 4-20mA for position transmitter alongwith necessary glands for power cables, Type of motor protection shall be thermistor /thermostat –one for each phase (trip unit to be included for

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thermistor type for standard type actuator for mounting in MCC & for integral starter type it shall be a part of actuator).

- 6.2.5** The actuator shall be provided with hand wheel (gearing and disengaging) & the same shall be adequate to open and close the valve under full unbalanced design pressure and shall be completely assembled on the respective valve and shop tested before shipment.
- 6.2.6** **All motor operated globe valve's actuator for regulating duties shall be suitable for inching operation i.e S-4 25% / S2 - 150 min starts per hour. For on/off it shall S2-15 minutes**
- 6.2.7** **Type Test Certificate for Type Tests carried out as per IS 9334 on similar actuator shall be furnished for PURCHASER's review. If type test has not been carried out on similar actuator, then the vendor shall carry out the type tests (type tested actuators shall not be supplied). Performance tests of the actuators such as operation of limit switches, smooth functioning, noise, vibration, opening and closing time, torque required etc shall also be done.**
- 6.2.8** The motors, gearing and disengaging handwheel shall be adequate to open and close the valve under full unbalanced design pressure and shall be completely assembled on the respective valve and shop tested before shipment.
- 6.2.9** Gear box and Electric Actuator shall also meet the inspection & testing requirements of latest revision of AWWA C504 in addition to technical specification requirements given at 6.2.3 above.
- 6.2.10** .Inspection and Testing of actuator shall, if required, has to be carried out as per customer/ BHEL approved Quality Plan for Electric actuator.

7.0 INSPECTION AND TESTING:-

All inspection & Testing for valve, Gear box and actuators shall be as per the requirements of AWWA C504. Gear box P.O.D. (cycle) test shall be carried out at the full gear box rated torque during complete cycle testing.

The minimum NDT/testing and inspection requirements for valve, Gear Box, electric actuator etc. shall be as per the attached Quality Plan. However, in case of order, final inspection and testing shall be carried out as per the customer approved quality Plans and drawings which to be got finalized as per customer Technical Requirements without any price implications.


8.0 PERFORMANCE GUARANTEE:

- 8.1** The vendor shall guarantee the material & workmanship of all components as well as operation of the equipment as per the requirements of the specification.
- 8.2** The vendor shall also guarantee for each of the butterfly valve for the following:
- Pressure drop as per the approved drop vs. opening curve.
 - The valve opening and closing time.

9.0 SURFACE PREPARATION & PAINTING

Surface preparation shall be done SSPC-SP-3/ Power Tool Cleaning followed by 2 coat of Heat Resistance Aluminium paint to IS 13183 Gr. I, paint shade Aluminium and total DFT of paint= 80 microns minimum; unless otherwise specifically indicated for the particular project.

10.0 CLEANING AND PROTECTION FOR DESPATCH:

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- 10.1 Each valve shall be drained, cleaned, prepared and suitably protected in such a way so as to minimize the possibility of damage and deterioration during transit and storage.
- 10.2 Discs of all valves shall be unseated when they are despatched but care shall be taken to ensure that there is no risk of damage to the disc.
- 10.3 Body ends shall be suitably sealed to protect them against damage during transit and storage.
- 10.4 Valve Tag Nos. shall be incorporated in all the despatch documents.

11.0 **DRAWINGS/DOCUMENTS TO BE SUBMITTED WITH THE BID**

- 11.1 G.A. drg for the offered valves showing following information:
- i) Complete cross sectional arrangement of the valves indicating gear box, actuator and all accessories.
 - ii) Bill of material incorporating all the materials of construction of various parts.
 - iii) Dimensional details, dismantling clearance, valve weight, test pressure etc.
 - iv) Special features such GA drawing for selected gear box with all technical details and electric actuator etc.
 - v) List of sub-vendors for castings & forgings.
 - vi) Experience list for specified size/ rating only.
- 11.2 Detailed Electric Actuator sizing/ torque calculations for seating or unseating torque, dynamic torque and bearing friction torque indicating various coefficients of seating or unseating, dynamic torque, flow, bearing friction etc.
- 11.3 Wiring diagram and Data sheets for actuators.
- 11.4 Cv testing reports, if any, already carried out for Butterfly valves size greater than 1200 NB
- 11.5 BHEL's standard Quality Plan duly stamped & signed as token of acceptance.
- 11.6 Relevant Proof-of-Design (P.O.D.) test procedure for offered valve, disc strength test procedure and Gear box POD (cycle) test procedure etc. along with Data sheet. Test certificates (test results) of POD test for valve and POD (cycle) test for Gear box. Also procedures for Gland leak test (Top & bottom flanges) with helium gas and Vacuum test for Gland sealing arrangement .
- 11.7 Confirmation that there is no deviations to Standard specification of Two way butterfly valves for steam service.

12.0 **POST CONTRACT DOCUMENTS**

Requirement of drawings/ documents to be furnished after award of contract/ LOI, shall be as follows unless specified for the project.

	DOCUMENT	NO.OF CD-ROMS (SETS)	NO OF COPIES	
			FOR APPROVAL	AFTER APPROVAL



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	SUBMISSION OF GA DRGS./ DOCS (SUCH AS ACUATOR DATA SHEET ETC.) EACH TIME FOR APPROVAL	--	10 Prints + one soft copy	--
	FINAL SUBMISSION OF DRGS & DOCS AS BUILT DRGS. & DOCS.	*	---	25
	DATA SHEETS, DESIGN CALCULATIONS. ACTUATOR DATA SHEET ETC.	--	10 + one soft copy	--
	MATERIALS TEST CERTIFICATES, TEST REPORTS, IBR CERTIFICATES ETC.	--	3	7 + one original
	QUALITY PLANS	*	10	--
	O & M MANUALS DRAFT FINAL	-- *	11+ one soft copy --	-- 25
		TOTAL 4CDs. (EACH CD SHALL CONTAINS ALL MARKED AS*)		