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PARTICULAR SPECIFICATION

M17: MECHANICAL ACTUATOR EQUIPMENT

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PARTICULAR SPECIFICATION M17: MECHANICAL ACTUATOR EQUIPMENT

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M17.1	SCOPE	

This specification covers the detailed design parameters, manufacture, supply, installation, test

and commissioning of actuators. The Particular Specification shall be read in conjunction with the Project Specification.

M17.2 INTERPRETATIONS

M17.2.1 Abbreviations

In this Specification the following abbreviations will apply:-

ANSI	: American National Standards Institute
ASTM	: American Society for Testing and Materials
BS	: British Standards Institution
SANS	: South African National Standards
SIS	: Swedish Institute of Standards
DIN	: Deutsch Industry Normen
ISO	: International Organisation for Standardization
ASME	: American Society of Mechanical Engineers
SAECC	: South African Electrolytic Corrosion Committee
AGMA	: American Gear Manufactures Association
IEC	: International Electrotechnical Commission

M17.2.2 Standards

All design standards for the actuators shall be subject to the latest amendments and editions of the following standard specifications:-

BS 5304	: Code of practice for safeguarding of machinery
SANS 9096-1: 1994	: Testing of welders, where applicable to the type of welding required
BS 292 Part 1: 1987	: Dimensions of ball bearings, cylindrical and Spherical roller bearings
SANS 10162-4	: Structural use of Steel Part 4: The design of cold-formed stainless steel structural
SANS 10044-3	: Welding Part 3: The fusion of steel (including stainless steel): Tests for the approval of welding procedures
SANS 10044-4	: Welding Part 4: The fusion welding of steel (including austenitic stainless steel): Tests for the approval of welders working where weld procedure approval is not required.

M17.2.3 General Requirements

This specification must be read in conjunction with the following specifications:-

E01: Particular Specification for Electric Motors

G01: Particular Specification for Colour Codes

G02: Particular Specification for Corrosion Protection

M17.3 DESIGN OF ACTUATORS

M17.3.1 General Design Parameters

Actuators shall be designed such that the following requirements are met:-

- To facilitate manufacture, inspection, installation, maintenance, cleaning and repairs,

- To ensure safe and satisfactory operation and an acceptable life expectation under the ambient conditions prevailing at the Site,
- To prevent undue stresses being produced by expansion due to temperature changes.
- To keep maintenance costs to a minimum,
- To comply with the legal requirements in respect of safety as well as the prevention of water and air pollution,
- To satisfy any specific requirement contained in the statutory codes and legislation, and
- To be suitable for operation 365 days per year, 24 hours per day under specified design conditions.

M17.4 ACTUATORS

M17.4.1 Design Parameters

Actuators shall be designed for a minimum maintenance free life of 10 000 open/close/open cycles, assuming the maximum seating torque at the end of each stroke.

The running torque shall be designed for the specific conditions of the Gate/Valve, with a minimum safety factor of 1.0 for clean water and wastewater of the maximum unseating/seating torque during each stroke.

The torque charts supplied by the manufacturer shall provide values for the unseating torque, the run torque and the open torque.

The available torque transmitted through an electric actuator to the valve output shaft, shall be rated to include the safety factor (25% for water treatment and 75% for wastewater treatment of the maximum unseating torque) in addition to the maximum torque required to fully open or close the gate/valve under the maximum working pressures and prevailing flow conditions.

The maximum output speed for the actuators shall be 90 rpm.

Operation

Actuators shall have a function to hold the gate/valve in any fixed position for a given amount of time. All gates/valves shall be capable of being opened and closed under unbalanced pressure equal to the nominal pressure.

Performance

The actuator must be self-locking so that the actuator stays in its last position. The self-locking feature must stay active if the actuator is changed into handwheel mode. The actuator must be able to be fitted in mounting orientations.

The Contractor shall submit drawings and/or calculations used for specifying the gate/valve torque at tendering stage. All actuators shall be complete with provision for manual operation.

M17.4.2 Life Tests

Actuators shall be stalled against a solid object 25 times in order to prove durability.

The standard life test is based on 25 000 open/close/open cycles at 75% rated torque rising to 100% at each end of travel. 10% of actuators installed shall be subjected to these tests.

M17.4.3 Actuator Housing

The actuator shall be enclosed in a double sealed, water tight enclosure and shall afford the protection to IP68. All the joints shall be O-ring protected. Provision shall be made for a weep hole to release any seepage water from the gate/valve in order to protect the gearbox/actuator from contamination.

M17.4.4 Gearing

All gearing shall be lubricated and designed to withstand the full stall torque of the motor. The actuator shall be directly mounted on the gearbox. The gearing shaft bearings, torque limiting clutch mechanism and limit switches shall be enclosed and adequately lubricated. A seal shall be provided on the input shaft of the gearbox to prevent water from entering the gearbox.

M17.4.4.1 Lubrication

The gearbox lubricants shall be such that the gearbox can be mounted at any angle without any lubricant leaking from the gearbox enclosure. The gears shall be fully covered with lubricant in order to prevent corrosion.

M17.4.5 Actuator Mounting and Setting

Actuators shall be mounted directly onto the gate/valve body or gearbox. Should a particular application require an adaptation device, any such device shall be a specific proprietary design for a particular type of gate/valve. A comprehensive design of any such adaptation shall be submitted to the Engineer for approval.

The attachment of the actuator to the gate/valve body shall be such that the actuator may be detached without disturbing the valve position.

The gate/valve manufacturer shall ensure that there is no visible movement of the actuator on the mounting adaptor or gate/valve body when the actuator is in operation.

M17.5 ACTUATOR CONTROLS

The actuator controls shall be housed in such a way as to prevent breathing and condensation build-up. One plug and socket connection shall be used for the connections between the actuator and control housing for easy access and removal.

The control housing shall be designed so that it can rotate against the actuator in 90 degree steps or can be mounted remotely from the actuator.

All actuators shall have the following controls:

- Programmable signal relays
- Non-intrusive settings with wireless programming interface for connecting programming device or all settings done in a non-intrusive manner i.e. all settings must be possible without opening or removing covers.
- Monitoring and diagnostics of faults displayed on a LCD display.
- Logging of operating data.
- Integral Motor Starts
- Integral Pushbutton starters:
 - Local/off/remote selector switch
 - Open/stop/close pushbutton station
- Reversing starters
- Control transformer
- Phase discriminator
- Monitor relay

- Position Indicators
- Limit switches
- Torque Switches

All digital signals for PLC monitoring and controls must be via potential free contacts capable of switching at least 500 mAmps at 230 Volts A.C.

M17.5.1 Integral Motor Starters

Integral or remote mounted actuators and control stations will be acceptable.

The reversing contactor starter shall be mechanically and electrically interlocked and rated appropriately to the motor size and suitably for 50 starts per hour.

M17.5.2 Integral Pushbutton starters

A pad-lockable local control station with a selector switch for PLC/Manual control (provided by others) shall be part of the control for all actuated valves or penstocks.

In Manual control the actuator shall be controlled by external open/close pushbuttons.

The contacts for this control are voltage-free.

M17.5.3 Position Indicators

Actuators shall be fitted with a mechanical continuous indicator showing gate/valve opening position. The scale of the position indicator shall clearly indicate the opening and closing position as well as the degree of opening in mid-position of the gate/valve. Installation of an electronic current feedback must be possible. They shall be driven by a gearing selected in a way that at least 83% of the possible travel is used. The feedback drive must be fully assembled by the actuator manufacturer.

M17.5.3.1 Limit Switches

The actuator shall have two limit switches which shall be directly geared to the output shaft of the actuator without any slippage clutch device. One limit switch shall be for the open end position and the other limit switch for the close end position.

The limit and torque switches shall be independent of one another. The limit switches shall be set up to trip the actuator before the actuator torque limit switches are activated.

The limit switches shall be adjustable, allowing adjustment to the travelling gate/valve shaft. Adjustment of the limit switches must be possible without opening or removing covers.

The addition of switches must be possible without opening the lubricated main gear case. The limit switches must be driven by a self-lubricated counter gear drive designed for high repeatability and easy adjustment.

Limit Switch Housing

The limit switch housing shall be manufactured from non-corrosive material. No plastic parts shall be used for the drive mechanism for torque and limit switches as well as for the position indicator.

M17.5.3.2 Torque Switches

The actuator shall contain two torque switches, one at each end of travel. The torque switches shall be designed to trip when the gate/valve load exceeds the torque setting. The torque

switches shall be calibrated in Nm for easy reading and resetting.

Adjustment of the torque switches must be possible without opening or removing covers.

M17.5.4 Programming

Within the control it shall be possible to program the function of the end position switching, i.e. torque switch or limit switch dependent. It must also be possible to program the control for the opening and closing directions independent of each other.

Actuators shall be local and remote electrically operated. All torque and turn settings as well as configurations shall be effected using a hand held a non-intrusive infra red setting tool.

M17.5.5 Internal Wiring

All internal connections within the integral control and between the different boards should be made by plug and socket connections except for motor power cables. All plugs and sockets shall be sized differently in order to prevent confusion.

M17.5.6 External Wiring Connection

The external wiring connection shall be done by one plug and socket for all control and motor wires. Provisions shall be made for three cable entries, one for the motor cable, one for the control cable and one for the possible feedback signal. All conduit entries shall have standard metric screw threads.

The compartment into which the cables are terminated shall be sealed from the balance of the actuator so that in the event of leakage through the cable glands no damage will occur to the actuator.

Cable entries shall be sealed against the ingress of water by means of tapped steel plugs. The use of plastic plugs for this purpose is not acceptable.

M17.5.7 Interfacing for External Wiring must be provided as Follows

- a) For all on/off, open/close, circulate/by pass (i.e. all non-modulating valves) the following interfacing must be provided:
 - Potential free N/O contacts for:
 - Opened position
 - Closed position
 - Remote selection
 - Digital Inputs from an external source for:
 - Open
 - Close
 - Manual selection
- b) For all modulating valves, the following interfacing must be provided:
 - Potential free N/O contacts for:
 - Opened position
 - Closed position
 - Remote selection
 - Digital Inputs from an external source for:
 - Open
 - Close
 - Manual selection. If this "Manual" selection is made, the digital "Open" and "Close" inputs must control the valve operation and the analogue input for position control must have no effect and must not interfere with the digital inputs.

- An active 4 – 20 mA output from the valve, to be supplied to an external load of max 500Ω. This output from the valve is for position indication.
- Input of 4 – 20 mA from an external source for position control.

M17.6 MANUAL OVER-RIDE

The actuator shall have a manual over-ride hand wheel. All valves shall be capable of being opened or closed under unbalanced pressure equal to the nominal pressure. The effort required to open or close the gates/valves under unbalanced pressure shall not exceed 90 N. The maximum time for any valve or penstock to be manually turned to the fully open or close position shall be 5 minutes or not more than 600 turns on the hand wheels.

The manual operation shall be via power gearing in order to minimise the required rim pull and to facilitate the change over from the motor to manual operation. A seized or inoperable motor shall not prevent manual operation.

M17.7 ELECTRIC MOTOR

Modulating actuators shall be designed for up to 1200 starts per hour and non-modulating actuators for up to 60 starts per hour.

The actuator shall be fitted with a low inertia high torque electric motor. The electric motor shall have a minimum duty rating of four consecutive complete cycles or a continuous operation of 15 minutes, whichever is more onerous.

The motors shall be time rated IEC 34 at a nominal motor load and at least 33% of maximum valve torque for 15 min. The motors shall be protected by thermostats embedded in the motor windings, one for each phase which shall have a facility for being overridden for emergency shutting off of the gate/valve.

Each electric motor shall be fitted with a suitable reduction gearing design to unseat the gate/valve under 75% of the test pressure and to operate the valve while the water flowing through the gate/valve reaches velocities of up to 5 m/s.

Refer to Particular Specification E01: Electric Motors for a detailed specification for Electric motors.

M17.7.1 Heater

A self-regulating anti-condensation heater shall be provided in the motor housing.

M17.7.2 Output Drive

The output drive shall be in accordance to ISO 5210. The output drive shall be separate from the main actuator housing in order to remove the complete actuator from the gate/valve while the gate/valve is kept in position by the output drive of the actuator.

M17.7.3 Motor Housing

The electric motor shall be totally enclosed in one non-ventilated, insulating cast iron casing.

M17.8 POWER SUPPLY

The actuator shall be designed to operate from a 400V three-phase or 230V single phase 50Hz A.C power supply. The actuator shall be capable of operating at the rated duty with a 15%

variation of the applied voltage measured at the actuator.

The actuator shall be provided with necessary auxiliary equipment to provide low voltage power required by its control circuits.

M17.8.1 Transformers

Each actuator shall have its own power supply. Easily replaceable fuses shall protect the primary and secondary windings. Two separate coil chambers shall separate the primary and secondary side of the transformer. The power supply shall incorporate a phase discriminator as to prevent the incorrect direction of travel as well as a phase failure device to ensure no actuator operation when the incoming phase fails.

The power supply shall be rated for the supply of starter coils, the heater integral to the actuator and for signals of voltage-free contact from the remote control of the actuator. The signal from the phase discriminator and phase failure device shall be separated from the other controls by an opto-coppler in order to avoid any noise from the incoming lines being transmitted into the logic.

M17.9 **SPARES AND TOOLS**

The Tenderer must submit on the appropriate schedule a priced list of spare parts which is recommended should be kept by the water treatment plant for maintenance of the plant.

Spares which the Management decides to order must be manufactured simultaneously with the rest of the equipment and be subject to the same tests for dimensions, tolerances, strength, etc. All spares must be packed separately and the cases appropriately marked. All spares must be new and unused.

A full range of spares must be kept locally for not less than 15 years.

Tenderers must submit a provisional price (where applicable) for a complete set of spanners, keys and tools required for the operation, adjustment and overhaul of the plant supplied. All spanners, keys and tools shall be new and unused.

M17.10 **PROOF OF MAINTENANCE**

The period of maintenance will extend over a period of 12 months calculated from the date of the handover Certificate. However, should a portion or all of the plant and equipment fail / or require rectification during this period, the Engineer reserves the right to extend the Period of Maintenance in respect of such portion or all of the plant and equipment for a further period of not more than 12 months calculated from the date of Commissioning of such plant and equipment after rectification

M17.11 **METAL PREPARATION AND CORROSION PROTECTION**

Refer to Particular Specification G02: Corrosion Protection

M17.12 **COLOUR CODES**

The standard final colour codes for equipment supplied under this Contract shall be in accordance with Particular Specification G01: Colour Codes.

M17.13 **QUALITY MANAGEMENT (QM) AND QUALITY ASSURANCE**

QM shall be categorised as 'critical and major' for this section of the Project.

M17.13.1 **Manufacture**

Tenderers shall submit with their tender a detailed Project Quality Plan, stating how they control the flow of paperwork from commencement of the Project through final handover to the Client, a sample of their Quality Control Plan, (QCP) and Project Quality Plan, (PQP) both during the course of the Project, manufacture and finally, installation.

All items of equipment shall be subject to inspections by the Engineer during design and manufacture per these QCP's.

In general, it is anticipated that this Project shall be in accordance with the relevant ISO 9000 requirements.

M17.13.2 **Installation**

The successful Tenderer shall submit a QCP covering all aspects of the installation of each item of equipment to be installed under this Project. The Engineer shall be requested to attend certain stages of completion of installation to ascertain compliance with the Specifications and to witness the Contractor's site inspections at the Engineer's discretion.

M17.14 **SYSTEM PERFORMANCE**

Works testing

Each item of equipment shall be subject to inspection and testing prior to despatch from the works. All performance test results shall be made available to the Engineer for verification or when the QCP's require intervention or hold points for inspection.

In the case of gearboxes, they shall be subject to testing under operating conditions for at least 12 hours on the test bed. All results shall be available for inspection

Before commissioning

- Check for correct oil level in gearboxes and that motors are greased properly.
- Ensure all HD bolts are torqued down correctly.
- The alignment and levelling of each assembly shall be checked and the results shall be available for inspection by the Engineer.
- The electrical functions and control shall be checked by a responsible inspector prior to attempting to start any motor on this Project.

After Initial Commissioning

- Ensure all oil pumps and flow or pressure switches are functional
- Ensure that the equipment is operating smoothly and that all limit switches are operating.

M17.14.1 **Before Expiry of the Defects Liability Period**

The Engineer requires the Contractor to visit the site every quarter to inspect for the correct operation of the installed equipment. A report after each visit shall be submitted in writing

M17.15 **OPERATION MANUALS**

The Contractor must compile and provide copies of a complete operation and maintenance manual for the equipment provided. The manual shall contain comprehensive information as set out hereafter.

- A complete recommended spares list
- A lubrication and maintenance schedule showing all maintenance and lubrication operations, their recommended frequency and the grades of lubricant required

- A maintenance brochure describing all maintenance, adjustment and replacement procedures
- All dismantling and reassembly procedures
- Maintenance procedure for corrosion protection painting systems
- The Contractor shall amplify and amend such drafts until the Engineer is satisfied that they will fulfil the purpose of ensuring that the Employer's staff is adequately instructed to operate and maintain the works. Once the drafts have been approved by the Engineer, the Contractor shall prepare suitably bound copies and deliver them to the Engineer.

The manuals shall be drawn up in English.

M17.16 MEASUREMENT AND PAYMENT

Measurement and payment will distinguish between supply/delivery and installation/commission as well as per installation point.

The respective tender rates shall cover all costs from supply to commission of each actuator but excluding the electrical power supply and electrical cable connection.

The tendered rates or sums shall cover the cost of design, drawings, manufacture, supply, testing at the manufacturers works, delivery to site, off loading, installation, site testing, setting into operation, the supply of O & M manuals, commissioning and maintenance during the warranty period of all equipment specified and also for anything not specifically mentioned but obviously required, (e.g. all ancillaries, including all bolts, fastenings and brackets, safety guards and any work or material required for the proper installation of such equipment) to enable the equipment to be installed and/or function safely and correctly as specified. No claims whatsoever for extras will be allowed on the grounds that a necessary piece of equipment or a part thereof is not specifically mentioned.