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1 Introduction

These Technical Requirements define requirements applicable to electrically powered valve actuators for use in nuclear power plants.

General requirements are specified in TBE 100:1 and additional requirements if any, are stated in the Technical Specification.

2 Definitions

Valve actuators

An electrically powered apparatus including all electrical and mechanical components that are needed to operate and control the functions of a valve

3 Product Requirements

3.1 General requirements

Operational life

Valve actuators shall be designed for an operational life of at least 20 000 operation cycles and/or 25 years. If the requirement cannot be met for certain components of the actuators, this shall be clearly pointed out in the documentation. Such components shall be easily accessible and replaceable.

Functionality

The valve actuators may be designed to provide a hammer blow function when starting in either direction (open or close), independent of whether they are motor driven or manually operated. If this design is required it will be stated in the Technical Specification.

3.2 Requirements according to nuclear guides

For valve actuators the following standards shall apply:

IEEE 382-2006	Trial-Use Guide for Type Test of class 1 Electric Valve Operators for Nuclear Power Generating Stations.
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Additional Swedish requirements are shown in specific TBE and KBE documents according to the Technical Specification. Verification of these requirements and requirements from other nuclear guides shall be done as specified in the Inspection Plan (KBE IP-xxx).

Different environmental requirements may apply, depending on whether the actuators are located inside or outside the reactor containment. See Technical Specification.

3.3 Standardisation

In addition to what has been specified in section 1 and 3.2 above, the following alternative standards shall apply for attachment of actuators to valves:

ISO 5210	Industrial valves - Multi-turn valve actuator attachments.
DIN 3338 (1987)	Multi-turn valve actuator attachment; dimensions of type C driving components.
DIN 3210	Types and sizes of electric actuators for valves, rated torque – mating dimensions, specification

3.4 Protective earth connection

Scope

Facilities for protective earth connection shall be provided.

Internal units

Internal units, mounted on earthed equipment, may be earthed through the normal mounting screws. To ensure good earth connection contact, all insulating paint shall be removed under and also some distance around the contact surfaces. After the surfaces have been cleaned, they shall be given an anticorrosion treatment, e.g. a coat of zinc-rich paint. Screws or bolts with serrated washers may also be used to penetrate the contact point, provided that the washers are approved for the purpose.

3.5 Corrosion

Corrosion protection

All parts shall, in a satisfactory way, be protected against corrosion, with due consideration of the specified operating environment.

Contact elements

Contact elements in connectors and switches shall be made of such materials that corrosion or oxidation, which could impair the contact function, will not occur.

3.6 Surface treatment and painting

The Manufacturer/Supplier shall, on request, submit the surface treatment and painting program to the Purchaser for approval.

For many applications paint suitable for decontamination is required. This is in that case specified in the Technical Specification. Otherwise paints may be approved by the Purchaser to be according to the Manufacturer/Supplier standard.

3.7 Marking, rating plates

Language

Normally marking plates shall be in Swedish. English or German may be accepted after the Purchaser's approval.

Design

External rating plates shall not be fastened by glue. Paper labels shall not be used. Rating plates shall be made of durable material and the text shall be legible during the entire operational lifetime of the equipment.

Identity marking

All units shall have a unique identity marking with manufacturers name, type designation and serial number. Each design change shall result in a corresponding revision of the marking.

3.8 Limit switches

3.8.1 General requirements

Mechanical design

Limit switches with their motion transfer devices and mounting arrangements shall be sturdy. Adjustments and settings may not change when the switch is subjected to environmental stresses within specified limits.

Contacts

Limit switches shall incorporate either one changeover, or one making and one breaking contact. The motion transfer mechanism shall be designed to allow over-travel with no risk of change to the setting or damage to the switch.

Load capacity

The switches shall be capable to make, break and carry at least 0.3 A at 110 VDC and an inductive load with a 40 ms time constant (L/R). On request, documentation to verify the contact rating and mechanical life data shall be available.

Contact function

The contact function shall be distinct. Environmental stresses within specified limits shall not cause inadvertent make or break action, contact vibration or contact bounce, when the switch is at rest in either position.

3.8.2 Torque switches

Function

Valve actuators shall be provided with torque switches. Maximum opening and closing torque shall be independently adjustable, and the setting range shall be at least 50-100% of the rated torque of the valve actuator.

Valve actuators with self-locking feature the switch operation shall be such, that after tripping, the contacts shall remain in the tripped position until the actuator is operated in the opposite direction.

Repeatability

Repeatability and long-term stability shall be within $\pm 5\%$ of the set torque value.

Setting error

The setting error may not exceed $\pm 10\%$ of max setting value.

Stability

Once set, the torque value setting shall remain unchanged without adjustment, for the service interval as specified by the Manufacturer/Supplier.

3.8.3 Limit switches

Valve actuators shall be provided with at least two travel limit switches, one for the open position and one for the closed position.

The setting range shall be sufficient to cover the specified number of turns per stroke. Adjusted values shall be stable.

3.8.4 Auxiliary switches

Valve actuators shall be designed to allow installation of at least two extra, mutually independent travel limit switches. These switches shall fulfil the same requirements as the original. The switches shall be adjustable within the entire operating range specified for the valve actuator.

3.9 Continuous position indication

Valve actuators shall be designed to allow installation of continuous position indication equipment.

3.10 Connectors

Design

If the valve actuators are provided with plug-in connectors for their power and control cables, the connectors shall be sturdy. Matching connector halves shall be mechanically keyed, to prevent accidental mating of incompatible parts.

Strain relief

Connectors shall be fitted with a strain relief for the cable, and an arrangement for secure locking of mated connectors. Connectors shall be easily accessible.

Conductor area

Power connectors shall have terminals for at least 2.5 mm² conductor area.

3.11 Conductors

Conductor area and insulation

Conductor areas and insulation shall be selected to suit the particular application. Cables shall normally be built up of stranded leads with an area of at least 0,75 mm².

Insulation material

The insulation materials used shall withstand the environmental conditions specified, shall be self-extinguishing and shall not emit any corrosive or in any other way harmful substances when heated.

3.12 Terminals

3.12.1 General rules

Connection points

Connections shall be made at permanent connection points such as connectors or terminal blocks. Soldering is normally not permitted.

Workmanship

Damage caused by substandard stripping practices, e.g. nicks in the insulation material or cut wire strands, will not be accepted.

3.12.2 Screw terminals

External connections

For external connections, one conductor only shall be connected at each screw terminal.

Internal connections

For internal connections, at most two conductors shall be connected to the same screw terminal, and then under the following conditions only:

1. Solid conductors and stranded conductors shall not be connected to the same terminal.
2. If two solid conductors are connected to the same screw terminal, their diameters shall be equal.
3. If two stranded conductors are connected to the same screw terminal, the ratio of their diameters shall not exceed 2:1.

Multi-strand core protection

When multi stranded leads are connected at screw terminals in which the strands are not held well together, core sleeves shall be used.

Cable lugs

In addition to the rules above, the use of ring cable lugs and pin cable lugs is normally permitted. Other termination types may be used only if approved by the Purchaser.

Cable lug mounting

At most two cable lugs may be connected to the same screw terminal. A washer shall always be placed under the nut or screw head. Cable lugs shall be aligned at such angles, that no mechanical deformation will result when the terminal is tightened. Ring cable lugs shall always be secured by means of a screw, simply clamping the lug under a shell clamp or busbar clamp is not permitted.

3.13 Operation

Motor operated and manual operation

It shall be possible to operate the valve either operated by means of the electric drive motor or manually by means of a handwheel. The handwheel shall not rotate, when motor drive is used.

Valve actuators having a mode selector for motor/manual operation, shall be fitted with a device which automatically disengages the handwheel when the motor starts, irrespective of the selector setting. A marking plate with all information needed for manual operation shall be provided. Manual operation shall always be possible, irrespective of any electrical faults in the actuator. The handwheel direction of rotation for open/close shall be indicated.

Reversing and self-braking function

The valve actuator, including gearbox, shall not be damaged by direct reversing of the motor. Forces from the valve shall not change the valve position, irrespective of the valve position at which such forces occur.

3.14 Electric motors

General requirements

Electric motors for valve actuators shall comply with applicable Technical Requirements for asynchronous motors, TBE 103, with the exception that the requirement of start at 70% of rated voltage is reduced to start at 85% of rated voltage. Alternative voltage requirements, if any, will be stated in the Technical Specification.

Motor rating

Electric motor ratings shall be dimensioned so that the maximum torque available at the valve actuator shall be sufficient to open and close the valve with margin at minimum rated voltage, maximum winding temperature and within specified time.

The ratings are not required for continuous duty.

3.15 Mechanical design

Mounting

The Manufacturer/Supplier shall present which mounting positions the valve actuator is designed for.

Dimensional design

Valve actuators shall be mechanically designed to withstand the stresses encountered if a stall event failure should occur at minimum temperature and maximum motor supply voltage. If the valve actuator is not capable of withstanding this load, the Supplier/Manufacturer shall state which parts will be overloaded to an extent where inspection and replacement of parts may be needed, and at what torque's or trusts such overloads occur.

3.16 Lubrication

The lubricant shall withstand the specified environment.

Accessibility

All lubrication nipples shall be easy to reach with a lubrication gun. Valve actuators shall be fully lubricated and ready for use when delivered.

Pressure test

Valve actuators installed in the reactor containment shall withstand, without lubricant leakage, increases and decreases of pressure during containment tightness testing (as required by TBE 102:1).

3.17 Special requirements for control valve actuators

Valve actuators for control valves shall be provided with electromagnetic brakes which, when deenergised, will reliably hold the valve actuator position against the highest possible static and dynamic loads which may develop in the valve.

Control valve actuators with brake motors

Brake linings or brake pads shall be easy to replace. Unless otherwise specified, brake magnets shall have the same power supply as the motor. If solid state rectifiers or other semiconductors are to be used, the Supplier/Manufacturer shall obtain approval from the Purchaser.

Control valve actuators with two-phase servo motors

Control valve actuators shall be capable of operating continuously against mechanical travel limits at maximum rated voltage without risk of damage from overheating.

4 Documentation

In addition to documentation required in TBE 100:1 and KBE 100 the following documents shall be provided:

- Specification.
- Description of design and function, torque/speed graph.
- Total number of operation cycles permitted during a brief time period.
- Lubrication recommendations for the valve actuator, including gearbox (if fitted).

5 Agreements between Manufacturer/Supplier and Purchaser

This checklist should be used as a base between Manufacturer/Supplier and Purchaser when discussing tenders or orders

1	Review and complementary addition of the Technical Specification	
2	Review of valid Inspection Plan and Inspection procedures	
3	Verification of seismic requirements	
4	Type of motor; cast iron or aluminium	
5	Temperature rise tests at rated voltage and output	
6	Torque/speed curve	
7	Connection point for earth wire – dimension and design	
8	Surface treatment, section 3.4 in TBM	
9	Drain hole	
10	Noise level	
11	Equivalent diagram	
12	Temperature sensors and other accessories	
13	Ability to handle pressure variations in connection with pressure tests of the reactor containment	
14	Lubrication interval	
15	Does the organic material involved meet the current environmental requirements	
16	Is material sensitive for radiation included in the motor, e.g. lubricating grease	
17	Do the valve actuator have self-locking feature	
18	Need for a pressure relief valve	
19	Which calculation model has been used for rating the actuator	
20	Centre of gravity and assembly weight	