

<b>Technical Requirements for Electrical Equipment</b>  <small>Title</small> <b>General Technical Requirements and Explanations</b>	Document TBE 100:1
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# 1 General

These Technical Requirements state the general technical requirements necessary for electrical equipment intended for use in nuclear power stations.

Quality assurance and inspection requirements that are binding for the Manufacturer/Supplier, and general instructions to the Manufacturer/Supplier concerning inquiries, tenders, purchase orders and delivery of electrical equipment to Swedish nuclear power stations are specified in KBE 100-x.

TBE 100:1 is intended for Manufacturers/Suppliers of electrical equipment, and indicates the general technical requirements of the equipment. It also states the instructions and explanations required for a correct delivery. TBE 100:1 does not include the requirements that are imposed on system design or on installation, testing, etc. in the plant. TBE100:1 is valid for all electrical equipment.

TBE 100:2 covers cybersecurity requirements valid for programmable electronics.

Commercial conditions and general delivery requirements for each acquisition are accounted for in the Manufacturers/Suppliers Tender, according to the requirements in the inquiry and are acknowledged by the Purchaser in the purchase order.

For each inquiry there is a Technical Specification, TS. The TS compiles all requirements on the product and applicable TBE/KBE documents.

Depending on type of component requirements are specified in Product related Technical Requirements. Description of the normal operation environment is given in TBE 101. Description of the environmental conditions during DBE is given in TBE 102:x. The Inspection Plan states the scope of inspection and inspection documentation.

When requirements in different documents are contradictory, the requirements given in the TS shall take precedence. Contradictions that may affect the Delivery shall be stated in the Tender.

# 2 Definitions

If the definition is taken from a standard, or equal, the source is specified in brackets.

## Certificate of Identity

A certificate issued by the Manufacturer/Supplier relating to the identity between the equipment in a particular delivery and the equipment which has passed through type inspection. See KBE EP-180.

## DBE

Design Basis Events *postulated events used in the design to establish the acceptable performance requirements for the structures, systems, and components* (IEC/IEEE 60780-323:2016)

## Electrical equipment room

An area intended for electrical equipment only that does not contain hot or pressurized process equipment.

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## Environment

The outer conditions to which a product is exposed. The environment is comprised of environmental factors and its severity is determined by the severities of the factors involved.

### Environmental factor - nuclear specific

Environmental factor that normally is not considered during design, manufacturing and verification of equipment for the process industry. Environmental factors specific for nuclear power are ionising radiation, normal and high temperatures combined with long operating time and the combinations of pressure, temperature and steam atmosphere that may arise as a consequence of plant accidents.

### Environmental Qualification/EQ

Environmental Qualification is a verification of design limited to demonstrating that the electric equipment is capable of performing its safety function under significant environmental stresses resulting from design basis accidents in order to avoid common cause failures. (Regulatory Guide 1.89, 1984)

The term EQ in RG 1.89 only concludes the verification of safety function during harsh environments after line breaks.

### Equipment Qualification

The generation and maintenance of evidence to ensure that the equipment will operate on demand to meet the system performance requirements during normal and abnormal service conditions and postulated design basis events. (IEC/IEEE 60780-323:2016)

A systematically performed verification that a product fulfils stated requirements and a formal examination and acceptance performed by the plant owner.

### Examination Procedure

Document (KBE EP or equal) in which test procedure, acceptance criteria and documentation requirements are specified.

### Inquiry

A request from the Purchaser to the Manufacturer/Supplier for a technical and commercial Tender for the specified product and scope of delivery.

### Inspection Plan

Document which defines scope of inspection for a delivery. One of the General Inspection Plans, KBE IP, is normally valid as scope of inspection requirements and Preliminary Inspection Plan in conjunction with Inquiry. Before purchase order, a delivery- or product-bound Final Inspection Plan based on KBE IP is drawn up with the Manufacturers/Suppliers procedures and other agreed changes embedded.

### KBM

Quality Regulations for Mechanical equipment

### LOCA

Loss of coolant accident. DBE which implies great environmental stress on equipment located in the reactor containment.

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### **Manufacturer**

The company or the manufacturing unit within the company that has the technical responsibility of ensuring that the product, including documentation, is designed, manufactured, inspected, approved and delivered in accordance with stipulated requirements.

### **Purchaser**

The plant owner unless otherwise stated in the purchase order.

### **Qualified life**

Period for which an equipment has been demonstrated, through testing, analysis and/or experience, to be capable of functioning within acceptance criteria during specific operating conditions while retaining the ability to perform its safety functions in accident condition or earthquake (IEC/IEEE 60780-323:2016)

### **RC**

Reactor Containment. A structural element around the reactor, dimensioned for the stress and strain that can occur during design basis events.

### **SSE**

Safe Shutdown Earthquake. Earthquake of specified strength after which the plant can be brought back to a safe operating mode.

### **Supplier**

The Supplier can be the Manufacturer but can also be another company - or unit within a company responsible for the delivery as defined by the purchase order.

### **TBM**

Technical Regulations for Mechanical Equipment

### **TS**

Technical Specification. Document that summarizes all technical and quality related requirements on a product. Reference to requirements stipulated in TS also includes requirements stipulated in documents referred to.

### **Verbal forms**

In order to make clear what the user shall do, the following verbal forms are used in TBE/KBE documents:

Requirements – shall, shall not

Recommendations – should, should not

Permission – may, need not

Possibility and capability – can, cannot

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## 3 General Product Requirements

### 3.1 Basic requirements

The product shall conform to Swedish legislation and to Swedish safety regulations.

The product shall conform to EU directives concerning the type of product in question. I.e. Low Voltage Directive, Machine Directive, EMC Directive and Pressure Equipment Directive.

The product shall be designed and manufactured in a manner that does not jeopardise the specified function or accuracy as a result of normal ageing, manufacturing tolerances, components and input material or due to specified variations in operational and environmental conditions after the product is installed.

Specified level of quality shall be maintained by means of good and proven design, appropriate materials, professional manufacturing methods, the employment of competent and experienced personnel and by monitoring the factors that can affect the performance and the quality of the product.

In order to facilitate maintenance and spare part inventory, components shall as far as possible be standardized with regard to type and design.

In all respects, the product shall be a well-proven design and its performance shall fulfil the requirements of the TS with margin.

### 3.2 Standardization

Design, manufacturing, testing, inspection and verification of the product shall follow accepted product standards.

Preferably relevant Swedish, European or international standards shall be used.

In the Tender, the Manufacturer/Supplier shall specify standards to which the product or the delivery conforms.

### 3.3 Electrical safety regulations

The product shall conform to Swedish electrical safety regulations.

Specific requirements relating to protective earth and connection to the grounding system in the plant are given in the TS or in product specific TBE.

### 3.4 Cybersecurity

Manufacturer/Supplier shall have guidelines regarding cybersecurity during design, manufacturing and verification. (TBE 100:2)

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### 3.5 Environmental withstanding

The product shall be designed with a margin for the function specified to withstand the environmental conditions to which it is subjected during transportation, storage, installation and operation.

Environmental severities and requirements in the plant are described in TBE 101/102:x via the TS. It should be possible to utilize higher stresses specified in the Manufacturers/Suppliers product specification or data sheet.

#### 3.5.1 Enclosure class

The product shall meet applicable enclosure class defined in IEC 60529 as follows:

At least IP 21 for equipment in severity A according to TBE 101  
At least IP 54 for equipment in severity B according to TBE 101  
At least IP 55 for equipment in severity C according to TBE 101  
At least IP 65 for equipment in severity D according to TBE 101  
At least IP 65 for equipment in severity E according to TBE 101

### 3.6 Product quality and long-term performance

The product shall have an acceptable level of quality and acceptable reliability for the intended application to support the long-time operation of the plant. The specified level of quality shall be complied with by means of good and proven design, suitable material and manufacturing methods, well-trained and experienced personnel and supervision of factors which might affect the inherent quality of the product.

If periodic maintenance and replacement of parts is required by the Manufacturer/Supplier to maintain the function of the equipment, this shall be specified in the Tender and included in the documentation for the delivery.

### 3.7 Availability

The product shall be designed and manufactured to provide the highest possible availability in the specified function and at specified operation conditions. With regard to standard products, the Manufacturer/Supplier shall have a controlled activity in order to collect operational experience. Statistics and data shall be presented to the Purchaser on request. For further information, see KBE 100.

### 3.8 Selection of components

To the greatest possible extent, components shall be well-proven standard products commonly found on the open market. Specially selected specimens may only be used after approval by the Purchaser.

On request, the Manufacturer/Supplier shall be able to confirm the reliability and suitability for the intended function of all components included in the product by analysis, testing or through documented operational experience.

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A component list containing information as component type and Manufacturer shall be available. Original texts on components may not be removed.

Parts in the component that are prone to ageing, and which are essential for the function or for environmental protection, shall be easily replaceable.

The Manufacturer/Supplier shall, in the Tender, specify criteria and/or intervals for periodic replacement of components or parts which have limited service life.

### 3.9 Selection of material

Halogen based materials such as fluorine rubber, neoprene, chloropolyethene, sulfone-rubber, Teflon, PVC etc. are not allowed in the plant without approval of the Purchaser.

The Purchaser shall specify field of application, environment and operating temperature. The Manufacturer/Supplier normally suggests an appropriate specification of material. Polymeric materials are subjected to ageing, especially at rising temperature and by radiation. The Manufacturer/Supplier should due to this, recommend replacement intervals for the product or affected parts.

The component may not emit corrosive gases when used in normal or extreme operation.

The amount of corrosive gases emitted in case of fire and documentation on fire-load shall be reported on request by the Manufacturer/Supplier.

Materials in contact elements, connectors and components shall be chosen so that corrosion or oxidation does not occur. Silver used as a contact material, silver-plated surfaces on components or silver as a barrier layer under gold-plating, may not occur without the approval by the Purchaser, since silver in combination with certain types of air pollution can cause corrosion.

### 3.10 Galvanic isolation of electric circuits and signal interchange

Electric circuits that have galvanic isolation from other circuits or earth shall have a dielectric strength according to the table below. Exceptions apply to electronic circuits with a rated voltage  $\leq 60$  V.

Rated Voltage	Dielectric Strength
$\leq 60$ V	500 VAC for electronic equipment 1 000 VAC for other equipment
> 60 - 250 V	1 500 VAC for control circuits
> 60 - 300 V	2 000 VAC for other equipment
300 - 660 V	2 500 VAC

The requirement on insulation resistance is as minimum 100 Mohm.

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### 3.11 Main and auxiliary power supply

Any disruption in the power supply shall lead to a defined operational mode and may not result in damage to the product. The specified function shall remain intact following a disruption of any random duration.

Unless stated otherwise in the TS the rated frequency for AC supply voltage shall be 50 Hz.

The current peak and time duration at switching on shall be specified.

Auxiliary power supply in the plants is as a rule provided with battery backup, i.e., normally free from disruption. The Manufacturer/Supplier shall, in the Tender, present any special supply requirements, including the effect on the product in the event of transient interruptions in the power supply ( $\leq 20$  ms). Instructions concerning required fuses as well as selection and dimensioning of suitable protection devices are also to be stated by the Manufacturer/Supplier.

Voltage and frequency fluctuation are described in TBE 101.

### 3.12 Transient disturbances in main and auxiliary power supply

Manufacturer/Supplier shall on Purchasers request clarify effects on the equipment when voltage and frequency are out of specified levels.

The behaviour varies strongly depending on type of equipment. Applicable requirements are stated in Technical Specification.

Identified sensible components included in the delivery shall be described in a separate analyse report. Internal selectivity within interconnected units such as UPS-equipment should especially be considered.

The analyse on functional effects should at least cover the following aspects:

- Maximum and minimum amplitude of the disturbance
- Unsymmetrical disturbances
- Voltage leap of the disturbance

Requirements according to separate analyses shall be verified.

### 3.13 Corrosion protection and surface treatment

The product shall, for use in a specified environment, be satisfactorily protected against corrosion.

Requirements on surface treatment are stated in TBM or specified in TS.

### 3.14 Scope of inspection

Preferably, the Manufacturer/Supplier shall use normal internal regulations, procedures and methods in design, manufacturing, testing and inspection of items in the Delivery. The Manufacturer/Supplier shall be able to adapt the methods to the Purchasers requirements.

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The specified General Inspection Plan (KBE IP) details the minimum scope of inspection to be performed and documented for the type of product and equipment supplied.

Further instructions are available in KBE 100.

### 3.15 Special processes

Crimping, soldering, wire-wrapping, shrinking and surface treatment are special processes and are, therefore, to be performed according to qualified methods by specially trained personnel or by correctly set automatic processes.

### 3.16 Marking

In-plant identification marking shall be conducted by the Manufacturer/Supplier according to instructions from the Purchaser.

Supplied units shall be provided with clear and durable marking plates or other types of durable marking to enable identification following installation and to facilitate operation, inspection and maintenance. Marking signs shall be written in Swedish or English and the data stated shall follow international standardised designations. The marking shall include type designation, Manufacturer and individual number (such as serial number or equivalent). If the design of the product is altered the designation shall also be altered. Marking signs shall be of resistant material and the text shall be readable during the products service life.

Standard products, manufactured and supplied in accordance with these Technical Requirements, shall for reasons of traceability be marked so that they are distinguishable from other standard products of the same type.

Internal connections shall be marked according to a system that supports troubleshooting by product documentation.

### 3.17 Connections

#### 3.17.1 General

When connecting multistranded conductors to terminals in which the strands are not well bundled together, core sleeves should be used. Loose conductor strands outside terminals are not permitted.

Screw terminals shall have wire protection. The screw shall not press directly on the conductor.

Other type than screw terminals shall be approved by the Purchaser.

Conductor strands shall not be tin coated, nor twisted more than its normal twist rate.

#### 3.17.2 Cable lugs

Ring cable lugs and pin cable lugs are normally permitted. Other types of terminations shall be approved by the Purchaser.

A maximum of two cable lugs may be connected to the same terminal. A washer shall always be fitted beneath the nut or the screw head. The cable lug shall be aligned so that no mechanical

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deformation occurs when the termination is tightened. Ring cable lugs shall always be secured by means of screws. Merely clamping the lug under a shell or busbar clamp is not permitted.

### 3.17.3 Connectors

Connectors shall be mechanically keyed to prevent incorrect assembly. Internal connectors in cabinets or devices may, after approval by the Purchaser, be protected from incorrect assembly by marking only. Strain relief and the means for secure and distinct locking of assembled connectors shall be provided. Connectors are preferably to be designed for contact crimping. Adjacent connectors shall be keyed, or clearly marked, so that only matching parts can be assembled.

Connectors shall be designed to prevent corrosion and oxidation, which may cause failures or spurious functions.

All equipment with connectors for external connections shall be delivered with matching connector halves. External connectors and their connecting halves shall be equipped with dust covers.

### 3.17.4 Crimping

The Manufacturer/Supplier shall inform the Purchaser which standards are applied during termination crimping. Instructions concerning the use and calibration of crimping tools shall be available.

### 3.17.5 Soldering

With the exception of electronics, soldering is not permitted for equipment covered by these Technical Requirements. Soldered connections on circuit boards are covered in TBE 104. In special cases, if soldering shall still be used as a method of connection, the following rules apply.

The Manufacturer/Supplier shall inform the Purchaser which standards apply to soldered connections. The standard used shall be documented and may be an international, national or company-specific standard. The standard used shall be approved by the Purchaser. More detailed information about standards for soldered connections is found in TBE 104. The standards described in that document include, in certain cases, even soldered connections apart from those for circuit boards.

### 3.17.6 Wire-wrap connections

Wire-wrap connections shall be carried out in accordance with the rules and recommendations in IEC 60352.

Wire lengths shall be sufficient for the wires to run without stretching around the sharp corners of wire-wrap pins. So called modified wire-wrapping is preferred. Each wire shall be routed so that it will be tightened rather than loosened if subjected to pulling forces, e.g. when the connection is inspected.

The wrapping shall be done so that at most three wires need to be removed to replace one wire.

Wire-wrap areas shall be provided with protective covers.

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### 3.18 External connections

It shall be possible to connect outer cabling to easily accessible terminal blocks or connectors. The devices for electric connection shall provide enough space for the cable, for the mode of connection and for cable fitting in the enclosing.

For external connections, only one conductor at each terminal point is allowed irrespective of which connection method is used.

The connection points shall after installation be easily accessible for visual inspection.

## 4 Requirements of Design for Equipment inside cabinets, boxes, tablets and desks

### 4.1 Contact protection

Equipment inside the enclosure shall comply with requirements corresponding to IP2x concerning contact protection when door/hatch is open.

### 4.2 Marking

The method of position marking of all devices and units shall be demonstrated for approval by the Purchaser.

Marking plates on the outside of cubicles and cabinets shall be made of aluminium with black engraved text and shall be fastened by screws.

Labels and signs regarding handling and operation shall for safety and operational reasons, be in Swedish.

Rating plates for components, such as current- and voltage transformers, shall be mounted so they can be read after mounting of the component.

### 4.3 Protective earthing

#### 4.3.1 General

All exposed chassis, metal covers and other metallic parts shall be designed for connection to protective earth PE.

PE terminal blocks may be used only if the mounting rail has an equivalent wire area compared to the connected PE conductors. The mounting rail shall be connected to the PE bus bar with a conductor of the same area.

#### 4.3.2 PE- and N-busbar design

The connection point for external PE-conductors in floor mounted cabinets shall be provided inside the cabinet.

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Other cabinets, boxes etc. shall be fitted with an external connection point. This connecting point shall be arranged for the connection of a copper cable or wire fitted with a crimped cable lug. The connection point for external PE-conductors shall have sufficient size to accept the maximum connectable cable area for the cabinet or box. In any case provisions shall be made for connection of external PE-conductors of at least 25 mm<sup>2</sup>.

Insulation measurement between N- and PE-conductors shall be possible without disconnecting the incoming PEN conductor.

#### 4.4 Lifting eyebolt

To facilitate transport and handling the cubicles shall be provided with a sufficient number of lifting eye bolts or lifting eye bolt fasteners.

#### 4.5 Internal wiring

Insulation material shall be suitable for the specified environmental conditions, be self-extinguishing and may not emit corrosive or otherwise harmful substances at temperatures up to the highest specified temperature.

Each conductor that may not be easy followed between its terminals points shall be provided with an individual designation. The designation shall be found at both ends of the conductor.

Conductors shall normally consist of multi-stranded or extra multi-stranded leads.

Insulation on wire-wrapped conductors should be highly resistant to mechanical pressure and cold flow.

Conductor routing shall be performed with sufficient excess length so that the stripped leads may be cut and connected again. Stripping damage, such as nicks and cut strands, may not occur. Conductors shall be run at a safe distance from heat emitting components.

Conductors shall be run in such a way that there is no risk of squeezing, wearing or breaking when cabinet doors or covers are opened or closed. Conductors should not be pulled tight around corners. Mechanical parts adjacent to cables and conductors should not have sharp edges which can cause damage to the insulation during operation or during installation, service, modification or expansion work. If a conductor needs to be run through a metal object or around a sharp corner of metallic material, the metal edges shall be rounded off or fitted with appropriate protection.

Devices for tension relief and fastening of cables and conductors shall be available.

Individual conductors in cable bundles shall be easily removable for replacement.

Insertion bridges approved by the terminal block manufacturer may be used on the internal side in addition to the internal connections.

For internal connections, a maximum of two conductors may be connected to the same screw connection point under the following conditions only.

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- Single strand conductors and multi-stranded conductors shall not be connected to the same terminal. Multi-strand conductors provided with core sleeves are accepted.
- If two single strand conductors are connected to the same terminal, the conductors shall have the same diameter.
- If two multi strand conductors are connected to the same terminal, the ratio between their diameters may not exceed 2:1.

## 4.6 Wire marking

Internal connections shall be marked according to a system that facilitates troubleshooting. Short connections that are easily traced do not need markings. Internal cables or its connectors shall be marked. The cable does not need wire marking if the wires are colour coded or otherwise marked to assure identification.

## 4.7 External connections

It shall be possible to run external cabling to accessible connection points. Connections shall be made to terminal blocks or connectors. The connection area shall be large enough to allow for connection of necessary number of conductors in a well-arranged way.

Connections to auxiliary power supply and process interfaces shall, if not otherwise agreed, be individually provided with test plug socket and be disconnectable.

Terminal blocks and connectors shall be marked with individual designations according to a system approved by the Purchaser.

Connection terminals shall be arranged in groups. An unobstructed distance of at least 100 mm shall be provided between groups of terminal blocks,

Terminal blocks shall be placed in the rear part of the cabinet. The free area between rows of terminal blocks shall be at least 120 mm in order to facilitate connection of external cables and so that their markings can be easily read. Between the rows of terminal blocks and the top or bottom of the cabinet, wherever the cable entry is, the free area shall be at least 350 mm. In smaller cabinets containing few cables and a limited space for terminal blocks, the distance may be smaller if approved by the Purchaser.

Terminal blocks shall be disconnectable with the exception of circuits for connection of current transformer secondary side.

Cable entry into enclosures shall normally be from below. In junction boxes cable entry from above and from the sides shall also be possible. The cable penetrations shall be designed so that EMC and enclosure classification requirements are met.

The connection of PE conductors shall be made to busbars or terminals that are specially intended for this purpose. The terminals shall be clearly marked with earth symbol. The connection of TE conductors shall be made to busbars or terminals that are specially intended for this purpose.

Cable conductors shall be marked in such a way that the termination point for each separate conductor can easily be identified.

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## 5 Nuclear Specific Requirements

### 5.1 Requirements According to Nuclear Regulations

Safety related equipment that is purchased with regard to these regulations, shall on equipment type basis be qualified in accordance with nuclear regulations.

Qualification shall either follow procedures in the Inspection Plan, or directly follow the nuclear guidelines or regulations to which these refer. Detailed programs approved by the Purchaser shall be available if the latter alternative is used.

A product that conforms to the requirements in the specified TS, TBE and KBE documents and whose performance can be verified in accordance to the specified Final Inspection Plan meets the technical requirements for electrical equipment according to nuclear regulations.

### 5.2 Selection of components

Electronic components that is sensitive to ionizing radiation, e.g. microprocessors should be avoided in environments where it may be exposed to an integrated ionizing radiation greater than 10 Gy TID (total integrated dose).

### 5.3 Equipment located inside the Reactor Containment

Enclosures shall be provided with drainage holes to avoid condense accumulation due to temperature cycling during normal operation.

Withstanding to smaller line breaks and to periodic leak and pressure tests shall be considered in design and installation.

### 5.4 Qualified life and long-term performance

For products qualified for DBE conditions according to TBE 102:1, a verified qualified life shall be stated. The qualified life (time or condition) shall be selected to give the best life cycle cost with defined technical limitations.

For products qualified for DBE conditions according to TBE 102:2 in mild environment usually don't have a verified qualified life. A verified qualified life (time or condition) shall be stated if analysis shows that the product has fault modes during a seismic event that will depend on significant ageing mechanisms.

### 5.5 Separation of safety related equipment

Equipment that is a redundant part of a reactor safety function shall meet requirements regarding separation, isolation and independence according to IEEE 384.

Digital and analogue inputs and outputs intended for signal interchange to and from a redundant part of safety related equipment (sub) shall contain an isolating device that has an electrical strength between input and output corresponding to the highest unjustified voltage that can appear at serious influence on equipment and cables included.

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## 6 Miscellaneous

### 6.1 Packaging and transport

The packaging of goods by the Manufacturer/Supplier shall be in a manner that ensures that no damage occurs during normal transportation handling and subsequent storing in the plant.

The Manufacturer/Supplier ensures that packing methods match the mode of transportation and that any requirements on cleanliness and environmental protection are complied with throughout the entire transport.

Instructions and procedures for packing and transportation shall be presented to the Purchaser on request.

### 6.2 Storage

The Manufacturer/Supplier shall provide the Purchaser with written instructions for long-term storage, so that characteristics, performance and length of service life remain intact for use after storage.

Special requirements from the Manufacturer/Supplier with the object of maintaining the integrity of the delivery or validity of guarantees shall be clearly presented prior to delivery.

### 6.3 Installation and Commissioning

Installation procedures for compliance with applicable EU directives should be enclosed to the delivery. The Manufacturer/Supplier shall on request examine the Purchasers documentation for installation, assist during installation, testing, commissioning and start-up.

### 6.4 Spare parts

It shall be possible to procure spare parts from the Manufacturer/Supplier. The Purchaser shall be informed of changes in design, spare part inventory, choice of material and manufacturing procedures that may affect operation and maintenance of products supplied.

The Manufacturer/Supplier is requested to suggest a suitable amount of spare parts for the Delivery in the Tender.

Traceability with regard to the date of manufacturing and storage conditions shall be available for parts that have limited length of service life.

### 6.5 Training

The Manufacturer/Supplier shall recommend training programs for Purchasers personnel in the Tender.

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## 7 Documentation

Operation, maintenance, trouble shooting and repairs are normally carried out by the Purchaser. The delivery shall therefore include detailed documentation in form of descriptions, data sheets, circuit diagrams, dimensional and location drawings, maintenance schedules, troubleshooting instructions, testing instructions, maintenance instructions and operating instructions.

The documentation concerning operation shall include guidance with step-by-step instructions, enabling the operator to manage the equipment. The documentation dealing with maintenance shall be extensive enough for a trained technician to make adjustments, conduct trouble-shooting and repairs down to the level of printed-circuit boards without any involvement from the Manufacturer/Supplier.

The Manufacturer/Supplier shall present the following Delivery documentation in conjunction with the Tender, i.e. in addition to the documentation that is required by KBE 100 and any product-bound requirements TBE xxx:

- Manufacturing company or manufacturing unit within company.
- Responsible for design (if other than the Manufacturer).
- Supplier (if other than the Manufacturer).
- Presentation of product types according to the Tender inquiry that conforms to requirements in the TS.
- Presentation of any non-conformance to requirements stipulated in the TS, including documents referred to therein.
- Standardisation complied with.
- Compliance with EU-directives.
- The Manufacturers/Suppliers specification and description of respective product.
- Specifications of used polymeric materials essential for the products performance or environmental protection.
- Presentation of any type inspection (type test, design verification) carried out with regard to performance and environmental durability (even such that is not included in the Inspection Plan).
- Presentation of design and performance revisions in relation to type tested product.
- Presentation of operational experience, error statistics, MTBF and MTTR values, material testing, etc. that the Manufacturer/Supplier wishes to refer to as a basis for judging reliability and length of service life.
- The Manufacturer's/Supplier's instructions concerning transportation, storage, installation, operation, cleaning, maintenance and repair.
- Specification of lubricants used in the product.
- Special instructions for installation to comply with requirements of EU-directives.

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The documentation that shall be presented in conjunction with the delivery shall be specified in the purchase order.

Units of measurements shall be expressed in accordance with the SI system.

The documentation shall be provided on paper and / or by computerized storage media, structured as agreed with Purchaser and with a clear table of contents.

When using a computerized storage media, the computer tools / software if other than Microsoft Office or Adobe Acrobat, shall be approved by the Purchaser.

Circuit diagrams, connection tables and other documentation and designations used shall be subject to agreement between the Manufacturer/Supplier and the Purchaser. Circuit diagrams, wiring tables, equipment lists shall be adapted to documentation at the plant. Circuit diagrams shall be supplied in agreed format. Internal connections shall be documented in form of tables. The list of apparatus shall comprise all components installed in each unit. The apparatus location drawing shall indicate where all components shall be found.

The documentation shall be written in Swedish. However, documentation that is not intended for operation or maintenance may be written in English or other language prior to agreement between the Manufacturer/Supplier and the Purchaser.

The documentation shall be marked with a purchase order number or equivalent. Descriptions, drawings, etc., of components, product versions or accessories which are not parts of the supplied equipment shall be clearly marked, crossed out or removed from the documentation.

The documentation shall comprise individual documents for each component and assembly, respectively. Each document and the finished equipment it belongs to shall be labelled with the same designation.

Document	Issue	Date	Supersedes
TBE 100:1	6	2022-11-17	5

## 8 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	Acceptance of TS and deviations, if any	
2	Application of standard	
3	Quality Assurance	
4	Expected life and periodical exchange of components and details	
5	Selection of components	
6	Data of reliability, if requested in the Inquiry	
7	Dimensioning of fuses and protective devices for power supply	
8	Isolation of signal interchange	
9	Dimensioning in general	
10	In-plant identification marking	
11	Scope of inspection and inspection documentation	
12	CE requirements, marking and certificates	
13	Vibration/balancing	
14	Galvanic isolation/separation	
15	Design rules and methods	
16	Position marking	
17	Electrical documentation	
18	Program for type inspection and qualification	
19	Installation and commissioning	
20	EMC	
21	Spare parts	
22	Training	

Document	Issue	Date	Supersedes
TBE 100:1	6	2022-11-17	5