Technical Requirements for Electrical Equipment	Beteckning / Document TBE 110
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Contents

1 Introduction

These Technical Requirements set out the general requirements for electrical reactor containment penetration units, concerning design, manufacturing and documentation.

The requirements specified in TBE 100:1 apply in addition to those given in this document.

2 Definitions

Conductor

Conductor is referred to as the conductor through the penetration and its connection leads together.

HELB

High Energy Line Break. A high energy line is a line with a diameter larger than 1" (25.4mm) carrying a medium, which may have higher pressure than 2 MPa and / or higher temperature than 100°C, this for more than 100 hours per year.

Severe Accident/ H5-event

Very unlikely event Beyond Design Basis Accident.

3 Product requirements

3.1 Standards and regulations

Electrical penetration units shall comply with applicable requirements of the regulations and standards listed below and in the given order of precedence.

1.	Swedish regulations for electrical installations	See TBE 100:1, chapter 3
2.	IEEE 317	Electrical Penetration Assemblies in Containment Structures for Nuclear Power Generating Stations

3.2 Electrical insulation

3.2.1 Dielectric strength

In terms of dielectric strength, the penetration, including its connection cables, shall be designed to meet applicable requirements according to IEEE 317.

3.2.2 Insulation resistance

The insulation resistance between conductors and between conductors and earth shall fulfil the requirement in IEEE 317.

3.3 Rated current

Without overloading, each conductor in the penetration shall be able to carry a current according to IEEE 317.

3.4 General design requirements

3.4.1 Mechanical parts

Electrical penetrations through the reactor containment walls are to be regarded as parts of a pressure vessel, and shall be designed according to requirements in applicable TBM documents.

The penetration function shall be designed with double barriers.

3.4.2 Electrical parts

The electrical conductors in the penetration shall be designed and installed to resist the thermal and electrodynamic loads arising from overcurrents and the thermal loads occurring when the plant is started or shut down.

The penetration shall be designed in such a way that heating resulting from eddy currents induced by electromagnetic induction from the conductors is avoided.

All conductors/cables which are parts of the penetration assembly shall match the connecting cables in terms of electrical material properties and conductor cross-section, shielding and impedance.

3.5 Environment

In the environmental conditions specified below, with exception of Severe Accident/H5-event, the penetrations shall fulfil their function without restriction, i.e. they shall maintain the containment integrity and maintain all electrical characteristics.

3.5.1 Radiation

The entire penetration (including cables) shall be designed to withstand an accumulated radiation dose stated in Technical Specification.

3.5.2 Operating conditions

Outside the reactor containment: according to TBE 101, severity as specified in the Technical Specification.

Inside the reactor containment: Normal environment as specified in TBE 101, severity C.

3.5.3 Design basic event (DBE) inside reactor containment

Pressure and temperature as specified in TBE 102:1.

3.5.4 Design basic event (DBE) outside reactor containment

If penetrations are mounted in rooms that may be exposed to HELB incident, the environment is specified in TBE 102:1.

3.5.5 Severe Accident/H5-event

At Severe Accident/H5-event the mechanical integrity of the penetration shall remain unchanged i.e. the leakage shall not be greater than what prescribed in paragraph 3.6.1. Temperature, pressure and time are specified in Technical Specification.

3.5.6 Fire resistance

Penetrations shall meet the requirements in IEEE 317 (ISO 834).

3.6 Tightness, leakage monitoring

3.6.1 Leakage

The leakage rate of a complete penetration assembly shall be less than 1×10^{-2} standard cm^3/s of dry nitrogen at specified design pressure and a temperature of $20 \pm 15°C$.

3.6.2 Tightness monitoring

To enable continuous monitoring of tightness, the penetrations shall be internally pressurized between the barriers. There shall be monitoring equipment and a test valve in connection with the pressurized space. This monitoring equipment shall be possible to operate and read at the outside of the reactor containment.

3.7 Corrosion, surface finish

Surfaces shall be treated in such a way that they will have high resistance to corrosion according to TBY, Technical requirements for surface treatment.

3.8 Conductors

3.8.1 Material and design

Material and design shall be chosen according to requirements in TBE 111.

3.8.2 Shielded cables

All conductors and shields shall be connected to lead-through conductors. Coaxial or triaxial conductors shall retain their concentric symmetry and impedance characteristics within the penetrations.

3.9 Marking, rating plates

3.9.1 General remarks

All markings shall be clear and legible and impossible to remove accidentally. Texts shall be written in Swedish or English.

External rating plates shall not be secured by means of glue. Rating plates shall be manufactured from durable materials, which will not bleach or be damaged by the specified environment. The text shall be legible during the qualified lifetime of the equipment.

3.9.2 Connection leads

Connection leads shall be marked with the same designations on both sides of the penetration.

4 Installation

Detailed installation instructions shall be included in the delivery. This is applicable to both installation of penetrations and equipment for tightness monitoring. Information shall also be given about volume in each penetration module and the whole penetration assembly by the Manufacturer/Supplier.

5 Documentation

In addition to documentation required in TBE 100:1 and KBE 100 the following are required:

- Specifications for materials included
- Volume calculation for modules and the complete penetration.
- Documentation according to TBM

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

6 Agreement 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 complete the Technical Specification
2	Review of current Inspection Plan and Examination Procedures
3	Determination of connection lead length at in- and outside
4	Specification of function time requirement
5	Determination of surface treatment
6	Determination of connection method for connecting conductors
7	Specification of conductors characteristics
8	Determination of conductor areas
9	Functional time requirement
10	Will submergence occur