ICS 29.240
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NB

ENERGY INDUSTRY STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

NB/T 11514-2024

Code for design of 35kV and under alternative superconductor cable transmission line

35kV及以下交流超导电力电缆线路设计规程

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Foreword

This document was issued on 24 May 2024 by the National Energy Administration of the PRC and takes effect on 24 November 2024.

It is a NB/T standard: recommended rather than compulsory, but it is the text a Chinese reviewer applies when assessing a submission.

It is classified under ICS 29.240, Chinese classification P 62.

This standard was prepared in accordance with the requirements of the plan of the National Energy Administration for the formulation and revision of industry standards in the energy field and the plan for the translation of foreign language versions. The drafting group carried out extensive investigation and research, carefully summarised practical experience, and prepared this standard on the basis of wide consultation.

The main technical content of this standard is: general provisions; terms; basic requirements; cable route; cable laying; selection of the cable construction; selection of the cable accessories; cable supports and fixings; the cable cooling system; and the configuration of the protection and monitoring devices.

This standard is administered by the National Energy Administration, and the organizations named in it are responsible for the interpretation of the specific technical content.

1 Scope

NB/T 11514-2024 is the Chinese design code for alternating current superconducting power cable lines at 35 kV and below, cooled by liquid nitrogen. It exists because superconducting cable has stopped being a laboratory demonstration in China and started being installed in cities, and a utility cannot energise something it has no design rules for. The reason to install one is density: a superconducting cable carries several times the current of a conventional cable of the same diameter with no resistive loss in the conductor, which is decisive in an old city centre where the load has grown but there is no room to dig a wider duct and no site for a new substation. The cost of that capability is that the cable is

a cryogenic system, not just a cable. It has to be held near 77 K along its whole length by a circulating liquid nitrogen plant that must never stop; it contracts measurably when cooled, so it is deliberately fixed by slip fixing that lets it move; and if any part of it warms past the transition temperature it quenches - the irreversible loss of the superconducting state - and the line has to be protected against that as a fault mode of its own. This code covers all of it. It defines the terms, including the cryostat, the single-core, three-core and three-phase concentric constructions, the terminations and joints, slip fixing and quench. It sets the grid connection rules, including the requirement for a dedicated substation bay and for checking the operating mode under normal and abnormal conditions. It covers route selection and the three laying methods - duct, trough and tunnel - then the selection of the cable construction itself, geometry, conductors, insulation and metallic sheaths, cryostat and oversheaths, followed by the accessories, terminations, joints and grounding methods, and the supports and fixings. A full chapter covers the cooling system, its configuration, its power and water supply and the equipment room that houses it, and another covers the protection and monitoring devices, automatic safety devices, the cable monitoring system, online channel monitoring and information communication and security. Two appendices give the calculation methods for the joint manhole length and for the design segment length of the line. It was issued on 24 May 2024 by the National Energy Administration and took effect on 24 November 2024.

1.0.1 This standard is formulated in order to standardise the design principles and the technical requirements of alternating current superconductor power cable lines at 35 kV and below.

1.0.2 This standard applies to the engineering design of alternating current superconductor cable lines at 35 kV and below that use liquid nitrogen as the cooling medium.

1.0.3 The design of a superconductor cable line shall be combined with the development needs of the local power grid and with the short and long term plans, and the relevant technical and economic justification shall be carried out.

1.0.4 In addition to complying with this standard, the design of a superconductor cable line shall also comply with the provisions of the relevant current national standards.

2 Terms

2.0.1 superconductor cable

A power cable whose conductor is of superconducting material and which operates in a low temperature environment.

2.0.2 superconductor cable cryostat

The vacuum insulated vessel that wraps around the outside of the superconductor cable conductor and provides the low temperature environmental conditions for the operation of

that conductor.

2.0.3 single-core superconductor cable

A superconductor cable containing only one phase conductor within the cryostat.

2.0.4 three-core superconductor cable

A superconductor cable in which the three phase conductors are arranged in independent structures within the cryostat.

2.0.5 three-phase concentric superconductor cable

A superconductor cable in which the three phase conductors are arranged in a concentric structure within the cryostat.

2.0.6 superconductor cable termination

The device installed at the end of a superconductor cable to ensure the connection of the superconductor cable to other electrical equipment.

2.0.7 superconductor cable joint

The accessory that connects two lengths of superconductor cable, used to form a continuous electrical path and continuous thermal insulation.

2.0.8 slip fixing

The method of fixing that allows the superconductor cable to move along the direction of the cable, or to move slightly transversely, as it expands and contracts with temperature.

2.0.9 quench

The irreversible transition process of a superconductor or a superconducting device from the superconducting state to the normal state.

3 Basic requirements

3.0.1 When a superconductor cable line is connected to the power grid, full use shall be made of the existing grid resources in the light of the local grid plan, and the line shall comply with the local grid structure and the grid operation management specifications.

3.0.2 Where a superconductor cable is connected to a substation, a dedicated bay shall be used for the connection.

3.0.3 The operating mode of a superconductor cable line shall be checked under both normal and abnormal operating conditions.

3.0.4 The design of the connection of a superconductor cable line to the system, and the power supply safety criteria, shall also comply with the provisions of the current industry standard DL/T 5729 Technical guide for planning and design of distribution networks.