

ICS 27.140
CCS P59

NB

**ENERGY INDUSTRY STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

NB/T 10606-2021

**Code for Design of DC Auxiliary Power System for Hydropower
Plants**

水力发电厂直流电源系统设计规范

Issued on: April 26, 2021

Implemented on: October 26, 2021

Issued by: National Energy Administration of the PRC

Table of Contents

1 General Provisions	1
2 Terms	2
3 Basic Requirements	5
4 System Design	6
4.1 System Setting	6
4.2 System Voltage	6
4.3 Battery Set	7
4.4 Battery Charger	8
4.5 System Wiring	8
4.6 Protection	10
4.7 Supervision	10
5 Selection of Battery	13
5.1 Emergency Discharge Time of Battery	13
5.2 DC Loads Classification	13
5.3 DC Loads Statistics	14
5.4 Number of Batteries	16
5.5 Sizing of Battery	16
6 Selection of Battery Charger	18
6.1 Selection and Sizing of Battery Charger	18
6.2 Configuration of Battery Charger	18
7 Selection of DC Cables	20
7.1 Selection of DC Cables	20
7.2 Sizing of Cross-Sectional Area	20
8 DC Distribution Equipments and Cabinets	22
8.1 Circuit breaker	22
8.2 Fuse	23
8.3 Disconnecter	23
8.4 DC Cabinet	24
9 Other Equipment	25
9.1 Integrated AC and DC Power Supply Equipment	25
9.2 Miniature DC Power Supply Equipment	25
9.3 DC/DC Converter Device	26

9.4 Discharge Test Device	26
10 Equipment Arrangement and Installation	28
10.1 DC Cabinets Arrangement and Installation	28
10.2 Battery Arrangement and Installation	28
10.3 Requirements for Dedicated Battery Room	29
Appendix A DC System Short-circuit Current Calculation	30
Appendix B DC System Information List	32
Appendix C DC Loads Statistics	36
Appendix D Battery Selection and Sizing	43
Appendix E Battery Charger Selection and Sizing	49
Appendix F DC Cable Selection and Sizing	50
Appendix G DC Circuit Breaker Selection and Sizing	54
Explanation of Wording in This Code	58
List of Quoted Standards	59
Addition: Explanation of Provisions	61

Foreword

This document was issued on 26 April 2021 by the National Energy Administration of the PRC and takes effect on 26 October 2021.

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 27.140, Chinese classification P59.

This code was approved and issued by the National Energy Administration through Announcement 2021 No. 3, together with other energy industry standards; it is listed as item 19 of Annex 1, approved on 2021-04-26 and implemented from 2021-10-26.

In accordance with the requirements of the Notice of the National Energy Administration on Issuing the Second Batch of Energy Sector Standard Formulation (Revision) Plans for 2013 (Guo Neng Ke Ji [2013] No. 526), the drafting group carried out extensive investigation and research, carefully summarized practical experience and, on the basis of widely soliciting opinions, formulated this code.

The main technical contents of this code are: general provisions, terms, basic requirements, system design, selection of battery, selection of battery charger, selection of DC cables, DC distribution equipment and cabinets, other equipment, and equipment arrangement and installation.

This code is under the administration of the National Energy Administration and is proposed and routinely managed by China Renewable Energy Engineering Institute; the Energy Industry Hydropower Electrical Design Standardization Technical Committee (NEA/TC17) is responsible for the explanation of specific technical contents. Comments and suggestions arising during implementation should be sent to China Renewable Energy Engineering Institute (Address: No. 2 Liupukang Beixiaojie, Xicheng District, Beijing, Postcode: 100120).

Chief development organization of this code: PowerChina Zhongnan Engineering Corporation Limited.

Chief drafting staff of this code: Luo Yun, Huang Kaibin, Li Li, Wu Xiang, Liu Chunqing, He Hexun, Deng Shuangxue, Zhang Qiang, Xu Lijia, Zhu Yijun, Cai Xu, Ye Xiaoli.

Chief reviewers of this code: Liu Guoyang, Yu Qinggui, Liu Shuyu, Wang Jinfu, Huang Huimin, Chen Jun, Chen Jiaheng, Feng Hanfu, Lin Jiemei, Wang Weifu, Zeng Gengyun, Song Guo, Gong Yu, Chen Qiang, Zhu Jiayong, Wang Bo, Xia Yongqiang, Huang Xiansheng, Xiong Jing, Du Gang.

1 Scope

NB/T 10606-2021 is the Chinese design code for the DC auxiliary power systems of hydropower stations, including pumped storage plants. The DC system is the part of a power station that must keep working when everything else has failed: it supplies the protection relays, the control and signalling circuits, the circuit breaker trip coils, the emergency lighting and the uninterruptible supplies, and it does so from batteries when the AC supply is lost. The code sets the general provisions and a full set of defined terms, then the design of the system: the choice of nominal voltage, the number of battery sets and chargers, and the connection schemes for the main plant, the switchyard, the dam and the auxiliary buildings. It covers the calculation of DC loads and their classification by duty, the determination of battery capacity by the step-by-step and the capacity conversion methods, and the selection of battery type. The charging and floating equipment follows, with its rating, ripple and regulation, then the DC distribution network with its protective devices, their selectivity and the cable sizing for voltage drop. Insulation monitoring and earth fault location, the monitoring and control of the system, and the arrangement of battery rooms and distribution panels with their ventilation and fire protection complete the code. It applies to the design of hydropower and pumped storage stations in China.

1.0.1 This code is formulated with a view to making the DC auxiliary power systems of hydropower plants safe and reliable, economical and rational, technically advanced, energy-saving and environmentally friendly, and convenient to operate and maintain.

1.0.2 This code is applicable to the design of DC auxiliary power systems of new, reconstructed and expanded hydropower plants, including pumped storage power plants.

This code is not applicable to the design of DC power systems dedicated to communication

in hydropower plants.

1.0.3 This code specifies the basic principles, the equipment selection and calculation methods and the technical requirements for the main equipment in the design of DC auxiliary power systems of hydropower plants.

1.0.4 In addition to this code, the design of DC auxiliary power systems of hydropower plants shall also comply with the current relevant national standards.

2 Terms

2.0.1 DC auxiliary power system: a system providing DC electric energy in a hydropower plant, generally consisting of batteries, battery chargers, distribution devices, and monitoring and protection equipment.

2.0.2 Nominal voltage of DC auxiliary power system: the given value of voltage used to designate or identify the voltage of the DC auxiliary power system.

2.0.3 Integrated AC and DC power supply equipment: equipment combining the DC power system equipment with one or more of AC uninterruptible power supply (UPS) equipment, DC inverter power supply (INV) equipment and DC/DC converter devices, sharing the batteries and uniformly monitored, which supplies the DC loads, AC loads and communication DC loads of the power plant.

2.0.4 Valve-regulated lead-acid cell: a sealed lead-acid battery with a safety valve, which allows gas to escape through the safety valve when the internal gas pressure exceeds a predetermined value. Valve-regulated lead-acid batteries are generally divided into the absorbed (starved electrolyte) type and the gel type, and electrolyte cannot be added under normal conditions.

2.0.5 Battery set: an assembly of multiple batteries electrically connected together and used as a whole.

2.0.6 Floating charge: the battery is connected to a constant-voltage power source in a state close to its rated capacity; the constant-voltage source supplies the loads and at the same time provides supplementary charging to the battery.

2.0.7 Equalization charge: charging continued to bring all batteries in a battery set to the same state of charge, as well as supplementary charging after a deep discharge of the battery set.

2.0.8 Nominal voltage of battery: the voltage value used to designate or identify a single battery.

2.0.9 Final voltage of battery: the minimum discharge voltage that a single battery shall maintain at the end of discharge, as required by the consuming loads, within the specified discharge time.