UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Technical Guidelines for the Development of Small Hydropower Plants

Terms and Definitions

SHP/TG 001: 2019

DISCLAIMER

Technical Guidelines for the
Development of Small Hydropower Plants

Terms and Definitions

SHP/TG 001: 2019

ACKNOWLEDGEMENTS

The technical guidelines (TGs) are the result of a collaborative effort between the United Nations Industrial Development Organization (UNIDO) and the International Network on Small Hydro Power (INSHP). About 80 international experts and 40 international agencies were involved in the document's preparation and peer review, and they provided concrete comments and suggestions to make the TGs professional and applicable.

UNIDO and the INSHP highly appreciate the contributions provided during the development of these guidelines and in particular those delivered by the following international organizations:

- The Common Market for Eastern and Southern Africa(COMESA)

- The Global Network of Regional Sustainable Energy Centres (GN-SEC), particularly the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE), the East African Centre for Renewable Energy and Energy Efficiency (EACREEE), the Pacific Centre for Renewable Energy and Energy Efficiency (PCREEE) and the Caribbean Centre for Renewable Energy and Energy Efficiency (CCREEE).

The Chinese government has facilitated the finalization of these guidelines and was of great importance to its completion.

The development of these guidelines benefited greatly from the valuable inputs, review and constructive comments as well as contributions received from Mr. Adnan Ahmed Shawky Atwa, Mr. Adoyi John Ochigbo, Mr. Arun Kumar, Mr. Atul Sarthak, Mr. Bassey Edet Nkposong, Mr. Bernardo Calzadilla-Sarmiento, Ms. Chang Fangyuan, Mr. Chen Changju, Ms. Chen Hongying , Mr. Chen Xiaodong, Ms. Chen Yan, Ms. Chen Yueqing, Ms. Cheng Xialei, Ms. Chileshe Kapaya Matantilo, Ms. Chileshe Mpundu Kapwepwe, Mr. Deogratias Kamweya, Mr. Dolwin Khan, Mr. Dong Guofeng, Mr. Ejaz Hussain Butt, Ms. Eva Kremere, Ms. Fang Lin, Mr. Fu Liangliang, Mr. Garaio Donald Gafiye, Mr. Guei Guillaume Fulbert Kouhie, Mr. Guo Chenguang, Mr. Guo Hongyou, Mr. Harold John Annegam, Ms. Hou Ling, Mr. Hu Jianwei, Ms. Hu Xiaobo, Mr. Hu Yunchu, Mr. Huang Haiyang, Mr. Huang Zhengmin, Ms. Januka Gyawali, Mr. Jiang Songkun, Mr. K. M. Dharesan Unnithan, Mr. Kipyego Cheluget, Mr. Kolade Esan, Mr. Lamyser CastellanosRigoberto, Mr. Li Zhiwu, Ms. Li Hui, Mr. Li Xiaoyong, Ms. Li Jingjing, Ms. Li Sa, Mr. Li Zhenggui, Ms. Liang Hong, Mr. Liang Yong, Mr.Lin Xuxin, Mr. Liu Deyou, Mr. Liu Heng, Mr. Louis Philippe Jacques Tavernier, Ms. Lu Xiaoyan, Mr. Lv Jianping, Mr. Manuel Mattiat,Mr. Martin Lugmayr, Mr. Mohamedain Seif Elnasr, Mr. Mundia Simainga, Mr. Mukayi Musarurwa, Mr. Olumide Taiwo Alade, Mr.Ou Chuanqi, Ms. Pan Meiting, Mr. Pan Weiping, Mr. Ralf Steffen Kaeser, Mr. Rudolf Hüpfl, Mr. Rui Jun, Mr. Rao Dayi, Mr. SandeepKher, Mr. Sergio Armando Trelles Jasso, Mr. Sindiso Ngwenga, Mr. Sidney Kilmete, Ms. Sitraka Zarasoa Rakotomahefa, Mr. ShangZhihong, Mr. Shen Cunke, Mr. Shi Rongqing, Ms. Sanja Komadina, Mr. Tareq Emtairah, Mr. Tokihiko Fujimoto, Mr. TovoniainaRamanantsoa Andriampaniry, Mr. Tan Xiangqing, Mr. Tong Leyi, Mr. Wang Xinliang, Mr. Wang Fuyun, Mr. Wei Jianghui, Mr. WuCong, Ms. Xie Lihua, Mr. Xiong Jie, Ms. Xu Jie, Ms. Xu Xiaoyan, Mr. Xu Wei, Mr. Yohane Mukabe, Mr. Yan Wenjiao, Mr. Yang Weijun,Ms. Yan Li, Mr. Yao Shenghong, Mr. Zeng Jingnian, Mr. Zhao Guojun, Mr. Zhang Min, Mr. Zhang Liansheng, Mr. Zhang Zhenzhong,Mr. Zhang Xiaowen, Ms. Zhang Yingnan, Mr. Zheng Liang, Mr. Zheng Xiongwei, Mr. Zheng Yu, Mr. Zhou Shuhua, Ms. Zhu Mingjuan.

Further recommendations and suggestions for application for the update would be highly welcome.

Table of Contents

Foreword

The United Nations Industrial Development Organization (UNIDO) is a specialized agency under the United Nations system to promote globally inclusive and sustainable industrial development (ISID). The relevance of ISID as an integrated approach to all three pillars of sustainable development is recognized by the 2030 Agenda for Sustainable Development and the related Sustainable Development Goals (SDGs), which will frame United Nations and country efforts towards sustainable development in the next fifteen years. UNIDO's mandate for ISID covers the need to support the creation of sustainable energy systems as energy is essential to economic and social development and to improving quality of life. International concern and debate over energy have grown increasingly over the past two decades, with the issues of poverty alleviation, environmental risks and climate change now taking centre stage.

INSHP (International Network on Small Hydro Power) is an international coordinating and promoting organization for the global development of small hydropower (SHP), which is established on the basis of voluntary participation of regional, subregional and national focal points, relevant institutions, utilities and companies, and has social benefit as its major objective. INSHP aims at the promotion of global SHP development through triangle technical and economic cooperation among developing countries, developed countries and international organizations, in order to supply rural areas in developing countries with environmentally sound, affordable and adequate energy, which will lead to the increase of employment opportunities, improvement of ecological environments, poverty alleviation, improvement of local living and cultural standards and economic development.

UNIDO and INSHP have been cooperating on the World Small Hydropower Development Report since year 2010. From the reports, SHP demand and development worldwide were not matched. One of the development barriers in most countries is lack of technologies. UNIDO, in cooperation with INSHP, through global expert cooperation, and based on successful development experiences, decided to develop the SHP TGs to meet demand from Member States.

These TGs were drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of these TGs may be subject to patent rights. UNIDO and INSHP shall not be held responsible for identifying any such patent rights.

Introduction

Small Hydropower (SHP) is increasingly recognized as an important renewable energy solution to the challenge of electrifying remote rural areas. However, while most countries in Europe, North and South America, and China have high degrees of installed capacity, the potential of SHP in many developing countries remains untapped and is hindered by a number of factors including the lack of globally agreed good practices or standards for SHP development.

These Technical Guidelines for the Development of Small Hydropower Plants (TGs) will address the current limitations of the regulations applied to technical guidelines for SHP Plants by applying the expertise and best practices that exist across the globe. It is intended for countries to utilize these agreed upon Guidelines to support their current policy, technology and ecosystems. Countries that have limited institutional and technical capacities, will be able to enhance their knowledge base in developing SHP plants, thereby attracting more investment in SHP projects, encouraging favourable policies and subsequently assisting in economic development at a national level. These TGs will be valuable for all countries, but especially allow for the sharing of experience and best practices between countries that have limited technical know-how.

The TGs can be used as the principles and basis for the planning, design, construction and management of SHP plants up to 30MW.

- The Terms and Definitions in the TGs specify the professional technical terms and definitions commonly used for SHP Plants.
- The Design Guidelines provide guidelines for basic requirements, methodology and procedure in terms of site selection, hydrology, geology, project layout, configurations, energy calculations, hydraulics, electromechanical equipment selection, construction, project cost estimates, economic appraisal, financing, social and environmental assessments—with the ultimate goal of achieving the best design solutions.
- The Units Guidelines specify the technical requirements on SHP turbines, generators, hydro turbine governing systems, excitation systems, main valves as well as monitoring, control, protection and DC power supply systems.
- The Construction Guidelines can be used as the guiding technical documents for the construction of SHP projects.
- The Management Guidelines provide technical guidance for the management, operation and maintenance, technical renovation and project acceptance of SHP projects.

Technical Guidelines for the
Development of Small Hydropower Plants

Terms and Definitions

1 Scope

This document defines the professional technical terms and definitions commonly used for small hydropower (SHP) plants.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC TR 61364, IEC 62270/IEEE 1249, WMO-No. 385 and ICOLD Dictionary apply.

4 Hydrology

4.1 Hydrological observation

4.1.1
precipitation

liquid or solid products of the condensation or sublimation of water vapour falling from clouds or deposited from air on to the ground

Note 1 to entry: It is the amount of precipitation on a unit of horizontal surface per unit time.

[SOURCE: UNESCO/WMO, WMO-No. 385, Section 2 No. 1114]

4.1.2
precipitation days

number of days with daily precipitation more than 0.1mm within a specified period of time

4.1.3
precipitation duration

period of time during which continuous precipitation occurs at a specific point or within a specific area

[SOURCE: UNESCO/WMO,WMO-No. 385, Section 2 No. 1115]

4.1.4
precipitation intensity
rainfall intensity

rate at which precipitation occurs, expressed in units of depth per unit of time

[SOURCE: UNESCO/WMO, WMO-No. 385, Section 2 No. 1157]

4.1.5
effective rainfall

<surface hydrology>part of the rainfall which contributes to runoff

Note 1 to entry: In groundwater, it is the part of the rainfall which contributes to groundwater recharge.

Note 2 to entry: In agriculture, it is that part of the rainfall which remains in the soil and contributes to the growth of crops.

[SOURCE: UNESCO/WMO, WMO-No. 385, Section 2 No. 458]

4.1.6
probable maximum precipitation
PMP

maximum rainfall that can occur under modern climate conditions within a given period of time in a certain river basin area

4.1.7
evaporation

water volume of extracting moisture by converting liquid into vapour through heat conduction within a certain period of time

Note 1 to entry: It is often expressed in terms of the depth of water layer evaporated.

4.1.8
infiltration
percolation
seepage

flow of water through the soil surface into a porous medium

[SOURCE: UNESCO/WMO, WMO-No. 385, Section 2 No. 795]

4.1.9
infiltration intensity

speed at which water will enter a given soil at any given time

4.1.10
stage
water level

elevation of the free water surface of a water body relative to a specified datum

[SOURCE: UNESCO/WMO, WMO-No. 385, Section 2 No. 1621]

4.1.11
maximum (minimum) stage

maximum (minimum) instantaneous stage at a certain observation point within the specified duration

4.1.12
discharge
rate of flow

volume of water flowing through a river (or channel) cross section per unit time

[SOURCE: UNESCO/WMO, WMO-No. 385, Section 2 No. 391]

4.1.13
maximum (minimum)discharge

maximum (minimum) instantaneous fluid volume which passes through a certain cross section within a specified duration

4.1.14
mean discharge

averaged flow which passes through a certain cross section within a specified duration

EXAMPLE Daily, monthly or yearly mean flow.

4.2 Hydrologic data processing

4.2.1
isohyetal map

map showing the rainfall distribution by a contour connecting the points of equal rainfall

4.2.2
runoff isopleth map

map showing the runoff distribution depth by a contour connecting the points of equal runoff depth

4.2.3
hydrograph

graph showing the variation in time of data such as stage, discharge, velocity

[SOURCE: UNESCO/WMO, WMO-No. 385, Section 2 No. 733]

4.2.4
stage-discharge relation
rating curve

curve showing the relation between stage and discharge of a stream at a hydrometric station

[SOURCE: UNESCO/WMO, WMO-No. 385, Section 2 No. 1172]

4.2.5
storm -runoff relation curve

curve showing the relation between the storm and the corresponding runoff produced by it

4.2.6
flow-duration curve

curve showing the percentage of time during which the flow of a stream is equal to or greater than given amounts, regardless of chronological order

[SOURCE: UNESCO/WMO, WMO-No. 385, Section 2 No. 570]

4.3 Hydrological computation

4.3.1
bench-mark station

observation station that records the hydrometric data which helps in hydrologic computation

4.3.2
typical year
representative year

year that has hydrologic characteristic values close to the design value, along with its spatial and temporal distribution, which is used as the design basis

4.3.3
hydrologic series

series composed of hydrologic characteristic values in chronological order

4.3.4
series representativeness

extent of closeness of statistical property of the selected sample to the overall statistical property

4.3.5
design hydrograph

hydrograph of discharge, etc., at a certain frequency, for design of hydropower plants

4.3.6
reservoir back water

rise in water level upstream of the reservoir along the channel stream, after the reservoir is filled with water

4.3.7
frequency analysis

process of ascertaining the statistical parameters and design values of hydrologic variables from the existing hydrologic data according to the statistical characteristics of a certain hydrological phenomenon

4.3.8
return period
recurrence interval

long-term average time interval between a hydrological event of a specific magnitude and an event with equal or greater magnitude

[SOURCE: UNESCO/WMO, WMO-No. 385, Section 2 No. 1234]

4.3.9
design frequency

frequency of a certain hydrologic feature used for planning and designing any structure

4.3.10
design annual runoff

annual runoff corresponding to the design standard and its annual distribution

4.3.11
naturalized computation of runoff

analysis and computation of runoff data for that volume of river flow which is influenced by the human activities in the catchment

4.3.12
naturalized water volume

volume of water to be considered while computing runoff as the river flow decreases or increases due to the influence of human activities

4.3.13
annual distribution of runoff

distribution process of annual runoff by month, ten-day period, or daily

4.3.14
mean annual runoff

long-term average value of annual runoff

4.3.15
design flood

flood adopted for design purposes

Note 1 to entry: It can be the probable maximum flood, the total amount of flood or a flood corresponding to some adopted frequency of occurrence (e.g. 50, 100, 200 or 500 years), depending on the standard of safety to be provided.

4.3.16
probable maximum flood
PMF

flood that can occur under probable maximum precipitation

4.3.17
design flood for construction period

flow value that meets the temporary flood control design parameter during the construction period

5 Engineering geology

5.1
topography

study of all kinds of natural features and forms on the earth surface

5.2
geomorphology

study of all kinds of relief form on the earth surface

5.3
geologic structure

forms of deformation or displacement of rock stratum that make up the earth crust, under the action of the earth's internal forces

5.4
lithology

composition, colour, physicochemical properties and structure of the rocks that make up the rock formation

5.5
hydrogeology

study of phenomena of change and movement of groundwater in nature, including groundwater distribution and formation rules, physical properties and chemical composition of groundwater, groundwater resources and their rational utilization, adverse effects of groundwater on engineering construction and mining, and their mitigation

5.6
physical geology

ecological processes and phenomena which are produced by the external and internal forces of the earth and adversely affect engineering construction

EXAMPLE Faults; landslide; collapse; karst; suffosion; earthquake; debris flows; weathering; frost heave; thaw collapse; surface erosion.

5.7
weathering of a rock mass

process and phenomenon relating to the change in organizational structure, mineral chemical composition and physical behaviour of a rock mass under the combined action of solar radiation, temperature variations, wind, water (ice), gas and biological factors

5.8
landslide

phenomenon of rock mass, earth mass or debris moving down a slope under gravity

5.9
rockfall

phenomenon of rock falling abruptly down a steep slope

5.10
unloading deformation

deformation of surface rock and earth mass due to the adjustment of internal stresses caused by unloading, which occurs either due to natural geologic processes or engineering activity

5.11
creep

phenomenon of surface rock and earth mass moving slowly down a slope

5.12
debris flow
mudflow

sudden flood carrying a lot of solid matter like sediment and rocks, which takes place in a mountainous area, in most cases due to a rainstorm or intense melting of ice and snow

5.13
reservoir leakage

phenomenon of water loss from a reservoir through the rocks and earth mass of the reservoir basin, which can result in a loss of water volume and can also affect the stability of the dam

5.14
reservoir bank immersion

phenomenon of groundwater level rise in the area surrounding a reservoir zone due to water storage in the reservoir, and resulting in secondary geological hazards like swampiness, salinization and deterioration of the foundations of structures

5.15
reservoir bank caving
reservoir bank collapse

phenomenon in which caving of a bank slope occurs due to changes in the stability of the bank slope under the effects of water level changes and wave action in the reservoir, after or during the process of water filling

5.16
upward extension of reservoir deposition

phenomenon where back water is gradually elevated due to the continuous deposition of reservoir sediment, which causes the reservoir tail silt to develop upstream

5.17
limit state of sediment deposition in a reservoir

state of reservoir siltation having ceased as it reaches the equilibrium of sediment transport

5.18
geophysical prospecting

method for determining the geological structure as part of engineering investigation by observing, analysing and studying the differences in the physical properties of different geological bodies, and in combination with the relevant geological data

5.19
exploratory drilling

application of the mechanical engineering technology of deep drilling to determine the profile of the formation and retrieve strata samples to obtain the relevant geological parameters

6 Hydraulic engineering and energy

6.1
daily regulated hydropower plant

regulation of the supply of uniform inflow from the utilizable reservoir capacity, over a day, to handle the daily power demand of a hydropower plant

6.2
annual regulated hydropower plant

hydropower station with reservoir capacity sufficient to regulate the river water volume over a year

6.3
multiyear regulation of hydropower station

hydropower station with sufficient reservoir capacity to store the surplus water over the years in the reservoir and distribute the water stored in high-flow years over several low-flow years

6.4
non-regulated hydropower plant

hydropower station which operates without a regulating reservoir

6.5
regulated reservoir capacity

usable reservoir volume from the normal reservoir water level to the dead water level

6.6
installed capacity

nominal rated generating capacity of all turbine generator units in a hydropower plant

6.7
firm power
firm output

output of a hydropower plant in the hydrological period within the design dependability

6.8
average annual energy output

arithmetic mean value of the hydropower plant's annual energy output

6.9
load factor

ratio of average power demand to peak power demand for the period being considered

Note 1 to entry: Load factor can be computed on a daily, weekly, monthly or annual basis.

6.10
plant load factor

ratio of power generated to the maximum possible generation from a hydropower plant

6.11
load forecast

process of predicting the load data over a specific period of time in the future, on the premise of satisfying requirements according to the operational characteristics of the system, decisions on capacity increases, natural conditions and social influences

6.12
electric power and energy balance

balance of supply and demand of electric power and energy in an electric power system

6.13
normal water level

water level required for meeting the designated use under normal reservoir conditions

6.14
limited level during flood season

upper limit of water level allowed for impounding for utilization during the flood season

Note 1 to entry: It is, also the prime level of regulation when the reservoir is operated for flood control during the flood season.

6.15
dead water level

minimum allowed water level to be reached under normal reservoir conditions

6.16
gross head

elevation difference between the water surfaces at the intake and tailrace of a hydroelectric system

6.17
net head

head available for power generation at the turbine, incorporating all head losses in the water conveyance system, from intake to turbine inlet

6.18
maximum head

maximum head available for the operation of a unit

6.19
minimum head

minimum head available for the operation of a unit

6.20
design head

minimum head available for the rated output of a unit

6.21
arithmetic average head

arithmetic mean of the heads calculated over various time intervals (e.g. a day, ten days, a month) within a specified period

6.22
weighted average head

average head calculated for a relatively long operational period with the output power as the weight

7 Hydraulic structure

7.1 Structure type

7.1.1
permanent structure

structure used during the operational period of a project

7.1.2
temporary structure

structure used during engineering construction and maintenance periods

7.1.3
main structure

structure serving a major role in the project, which, in the case of an accident, can result in a severe disaster or seriously influence the benefit of a project

7.1.4
secondary structure

structure with a relatively minor role in the project which has little impact in the case of an incident

7.1.5
water retaining structure

hydraulic structure built to store water and/or raise the water level

7.1.6
water release structure

hydraulic structure built for releasing surplus water or discharging sediment and ice

7.1.7
water conveyance structure

hydraulic structure built for conveying water

7.1.8
water intake structure

hydraulic structure built for withdrawing the water from the source

7.1.9
construction diversion structure

cofferdams, diversion tunnels and other hydraulic structures for achieving the construction diversion objectives

7.1.10
canal structure

hydraulic structures built on channels

7.1.11
fish passage structure

structure built for the fish to migrate upstream and downstream of the dam

7.2 Dam

7.2.1
gravity dam

dam constructed of concrete and/or masonry, which relies on its weight for stability

[SOURCE: ICOLD Dictionary 41032/4-1]

7.2.2
arch dam

concrete or masonry dam which is curved in plan in order to transmit the major part of the water load to the abutments

[SOURCE: ICOLD Dictionary 41034/4-1]

7.2.3
earth-rock-fill dam

dam with the main body filled with local materials including earth, sand, sand gravel, cobble, rock block and decomposed rock

7.2.4
rolled earth-rock dam

dam that is filled with earth and rock in layers, where each layer is compacted by rolling

7.2.5
rockfill dam

embankment dam in which more than 50 % of the total volume comprises compacted or dumped pervious natural or crushed stone

[SOURCE: ICOLD Dictionary 46006/4-6]

7.2.6
concrete faced rock-fill dam

rock-fill dam having impervious reinforced concrete on the upstream face

7.2.7
earth dam
earthfill dam

embankment dam in which more than 50 % of the total volume is formed of compacted fine-grained material obtained from a borrow area

[SOURCE: ICOLD Dictionary 46002/4-6]

7.2.8
weir
barrage

low dam or wall across a stream to raise the upstream water level

Note 1 to entry: It is referred to as a termed fixed-crest weir when uncontrolled.

7.2.9
dam with hydraulic automatic flap gate

dam where the closing and opening arrangement of gates is regulated by virtue of the principles of lever balance and rotation i.e. by a hydraulic automatic controlling arrangement

7.3 Water gate/sluice

7.3.1
sluice

hydraulic structure of medium/low head built on a river or a canal to control the flow and regulate the water level by means of a gate

7.3.2
culvert-type sluice

sluice where the conveyance culvert is buried under the filling and a gate is installed at the culvert entrance

7.3.3
barrage with sluice

sluice built across a river for regulating the upstream water level and controlling the flow of the river

7.3.4
intake sluice

sluice built at the canal head for diverting and controlling the inflow rate

7.3.5
sand flushing sluice

sluice used for scouring or washing out the accumulated silt from the reservoir, barrage or desander

7.3.6
regulating sluice
check gate

sluice constructed in a river or a canal to regulate the upstream water level

7.4 Spillway

7.4.1
spillway

structure over or through which flood flows are discharged

[SOURCE: ICOLD Dictionary, 81001/8-1]

7.4.2
chute spillway

steeply sloping spillway channel

[SOURCE: ICOLD Dictionary, 81032/8-1]

7.4.3
side spillway

spillway the crest of which is roughly parallel to the channel immediately downstream of the spillway

[SOURCE: ICOLD Dictionary, 81011/8-1]

7.4.4
ski jump spillway

spillway chute or conduit at the bottom of which there is a reverse curve which throws water up into the air to dissipate energy at a safe distance from the dam

[SOURCE: ICOLD Dictionary, 81016/8-1]

7.4.5
shaft spillway

vertical or inclined shaft into which flood water spills

Note 1 to entry: If,the upper part of the shaft is splayed out and terminates in a circular horizontal weir, this is termed a bellmouth or morning glory spillway.

[SOURCE: ICOLD Dictionary, 81017/8-1]

7.4.6
siphon spillway

spillway with one or more siphons built at crest level

Note 1 to entry: This type of spillway is sometimes used for providing automatic surface level regulation within narrow limits, or when considerable discharge capacity is necessary within a short period of time.

[SOURCE: ICOLD Dictionary, 81026/8-1]

7.4.7
energy dissipation by hydraulic jump

energy dissipation method in the form of a hydraulic jump for eliminating the surplus energy of rapids released from the outsole of release structures, and changing torrent flow into slow flow to be connected with the downstream flow

7.4.8
energy dissipation by surface current

energy dissipation method that involves setting up a step-down floor or small flip bucket at the outflow of release structures; this directs the releasing torrent to the superstratum of the downstream flow and forms a spiral roll on the bottom

7.4.9
trajectory bucket energy dissipation

energy dissipation method that involves setting a trajectory bucket at outflow of release structures, to direct the releasing torrent to the air and form an aerated jet, which then falls into the downstream water pillow

7.4.10
stilling basin

hydraulic-jump-energy dissipation facility established downstream of water gates or water release structures

Note 1 to entry: It is protected by aprons and side walls.

7.4.11
energy dissipating bucket

bucket-shaped energy dissipating facility established downstream of water gates or water release structures for underwater jetting flow

7.4.12
baffle sill

continuous sill or tooth-shaped sill established at the end of the downstream apron of a water gate or water release structure to assist in energy dissipation from a hydraulic jump

7.4.13
baffle block
baffle pier

pier-shaped assistant energy dissipation structure to improve energy dissipation efficiency

Note 1 to entry: It is located in the hydraulic-jump energy dissipation pool.

7.4.14
chute block

pier-shaped assistant energy dissipation structure to improve energy dissipation efficiency, established at the toe of the inlet slope section of a hydraulic-jump energy dissipation pool

7.5 Power house

7.5.1
power house

structure required for accommodating a turbine generator unit and its auxiliary equipment, as well as for their installation, maintenance, operation and management services in the hydropower station

7.5.2
power house at dam toe

power house located close to the toe of the dam which does not bear the upstream hydraulic pressure of the dam directly and is also a power house of special layout

EXAMPLE An overflow-type power house or fly-over type power house.

7.5.3
riverbed power house

power house located in a river or a canal bearing the upstream hydraulic pressure directly

Note 1 to entry: It is also known as an in-stream power house.

7.5.4
river-side power house

power house located on a river bank which does not bear the upstream hydraulic pressure of the dam directly

7.5.5
power house within dam

power house located in the cavity of a dam body

7.5.6
underground power house

power house built in the underground cavity of mountains

7.5.7
semi-underground power house

power house built in a pit, having an underground vertical shaft with the top portion exposed above the surface

7.5.8
surface power house

power house built on a surface exposed to the atmosphere

7.5.9
control room

structure required for accommodating the instruments, devices and computers for monitoring and controlling all types of mechanical and electrical equipment for the whole plant

7.5.10
generator floor
generator storey

space above the main machine floor in the power house installed with vertical shaft units

7.5.11
turbine floor
turbine storey

space between the floor of the main machine floor and the spiral casing floor in a power house installed with vertical shaft units

7.5.12
spiral casing floor
spiral casing storey

space between the turbine floor and draft tube top elevation in a power house installed with vertical shaft units

7.5.13
draft tube floor
draft tube storey

space between the top elevation and the bottom elevation of the draft tube in a power house installed with vertical shaft units

7.5.14
valve gallery

gallery for the installation of the main valve in the lower structure of a power house

7.5.15
runner removal gallery

gallery to facilitate the removal of the runner from the turbine

7.5.16
erection and service bay

area provided for the assembly and disassembly of major generating components

7.5.17
switch yard

area used for the installation of various electrical switchgear

7.6 Forebay and penstock

7.6.1
forebay

water retaining structure required for storage, distribution and connecting the headrace channel or tunnel to the penstock of the turbine

7.6.2
daily regulation pond

water storage pond built for the daily regulation of water volume to meet the power demand

Note 1 to entry: In some cases, it is also used as the forebay.

7.6.3
penstock

pipe that conveys water under pressure from the reservoir, forebay or surge chamber, to the turbine

7.6.4
exposed penstock

penstock laid on the supporting structure above ground

7.6.5
underground penstock

penstock buried in the rock mass either with cement mortar or concrete filling between the penstock wall and surrounding rock

7.6.6
buried penstock

penstock laid in excavated ground and covered with sandy soil

7.6.7
embedded penstock

penstock in the dam body

7.6.8
bifurcation

pipe section at the bifurcation of penstock

Note 1 to entry: It can be classified as a three-beam bifurcated pipe, spherical bifurcated pipe, shell bifurcated pipe, crescent-rib reinforced wye piece or hem reinforced branch pipe.

7.6.9
anchor block

block structure required for fixing the position of a penstock, which mainly bears the different forces on the penstock, including water and its own weight in the longitudinal axis direction

Note 1 to entry: It maintains the penstock's stability.

7.6.10
support

supporting structure bearing the dead weight of penstock, the weight of water in the penstock and the friction force in longitudinal axis direction

Note 1 to entry: It can be classified as a saddle pier, anchored ring girder support, sliding ring girder support, roller support or rocker-mounted ring girder support.

7.6.11
expansion joint

joint provided to permit longitudinal expansion or contraction due to variations in ambient temperature or base displacement, and to permit slight rotation for differential settlements when a penstock passes through two structures

7.7 Surge chamber

7.7.1
surge chamber

water storage structure built at the tail of a long-pressure head race, or at the head of a pressure tailrace , for reducing the water hammer pressure in the penstock and improving the operating condition of the unit

Note 1 to entry: It can be classified as a cylindrical surge chamber, throttled surge chamber, restricted orifice surge chamber, double-chamber surge chamber, overflow surge chamber, differential surge chamber, or air cushion surge chamber.

7.7.2
surge tank

surge chamber which is built above ground

7.7.3
surge shaft

shaft-type surge chamber which is built underground in whole or in part

7.8 Tailrace structures

7.8.1
tailrace

discharge channel or tunnel from a turbine before water re-joins the main river channel

7.8.2
tailrace platform

service bridge built on the downstream side of a power house to accommodate the tail lock hoist

7.9 Tunnel, culvert and culvert pipe

7.9.1
hydraulic tunnel

water passage channel excavated underground in a mountainous area, and classified on the basis of function

EXAMPLE Diversion tunnel; flood-discharge tunnel; power tunnel; irrigation tunnel; emptying tunnel; sediment flushing tunnel.

7.9.2
pressure tunnel

hydraulic tunnel filled with water where the area around the tunnel wall bears the action of the hydraulic pressure

7.9.3
free-flow tunnel

hydraulic tunnel partially filled with water having free surface flow

7.9.4
service tunnel
service adit

tunnel used for servicing a power plant or providing access to a hydraulic tunnel

7.9.5
unlined tunnel

hydraulic tunnel having a mostly unlined inner wall

7.9.6
lined tunnel

hydraulic tunnel having an inner wall lined with concrete and steel

7.9.7
culvert

water passage structure having a closed section buried under filled earth

7.9.8
culvert pipe

pipe buried beneath the surface that is usually used as a water conveying pipe

7.10 Intake

7.10.1
tower intake

deep intake structure built at the head of a hydraulic tunnel for diverting water from a reservoir or the pipe embedded in a dam, in the form of tower and with gate installed inside to control the flow

7.10.2
shaft intake

intake structure built within a mountainous area having a hydraulic tunnel and in the form of a vertical shaft with a gate installed inside for controlling the flow

7.10.3
bank-tower intake

intake structure built on a bank side at the head of a hydraulic tunnel for diverting the water from a reservoir and in the form of a tower having a gate installed inside to control the flow

7.10.4
inclined intake

intake structure built on an artificially excavated slope of a reservoir (or dam slope) and in the form of a slide and having a gate installed on a rail to control the water flow

7.10.5
inclined-pipe inlet

tubular intake structure inclined on the upstream slope of an earth and rock-fill dam or the bank slope of a reservoir, having control gates installed at different elevations within the variation range of reservoir water levels

7.10.6
multilevel inlet

intake structure which can divert water selectively from a reservoir at different water levels

7.10.7
grated intake
Tyroler intake

barrage intake and engineering facility in which the gallery is built in the flooded dam for water intake, preventing the entry of large-sized sediment into the canal

7.10.8
siphon intake

intake and engineering facility in which water is diverted from the source through siphonic action

7.11 Sediment management facility

7.11.1
sedimentation basin
silting basin
desilting basin

structure used to settle sediment with particle diameter larger than the design sedimentation diameter from a sediment-laden flow

Note 1 to entry: It reduces sediment concentration in the flow and may be classified as a hydraulic flushing sedimentation basin, mechanical cleaning sedimentation basin, intermittent flushing sedimentation basin, sand sedimentation strip canal, curved sedimentation basin or continuous flushing sedimentation basin.

7.11.2
sand-guide sill

structure constructed in front of the water intake for controlling the motion and direction of bed load by generating a partial artificial transverse circulating flow

7.11.3
sand-guide channel
vortex tube

slot-type structure built at the bottom of a channel to intercept and remove the bed load

8 Engineering construction

8.1 Diversion

8.1.1
construction diversion

engineering measures taken for diverting water from the working area while construction is in process, either through a natural river or channel or through an artificial release structure in accordance with a predetermined plan in order to meet the construction conditions for the structure

8.1.2
open-channel diversion

diversion procedure for diverting a river to a downstream area through an open channel

8.1.3
culvert diversion

diversion procedure for diverting a river to a downstream area through a culvert

8.1.4
bottom outlet diversion

diversion procedure in which a river is diverted to a downstream area through a temporary or permanent bottom outlet in the dam body

8.1.5
dam-gap diversion

diversion procedure in which the water is released during the construction period through a gap reserved in the dam body

8.1.6
tunnel diversion

diversion procedure for diverting river water to a downstream area through a tunnel

8.1.7
plugging of diversion opening

work of plugging a diversion opening which has completed its diversion task

8.2 Closure

8.2.1
river closure

engineering measures taken for intercepting the river to divert the flow to a predetermined channel in order to facilitate the construction or maintenance of the structure

8.2.2
closure dyke

permeable weir body formed in the bank-off advancing process

8.2.3
closure gap

flow passage gap formed after the water passage section is taken by the closure dyke during the river closure process

8.2.4
bed protection for closure

measures taken to protect and reinforce the riverbed foundation in advance; this prevents the riverbed being undermined during the closure process

8.2.5
end-dump closure

closure process in which the closure materials are dumped from one bank or both banks of the river or channel until the flow is totally closed

8.2.6
full width rising closure

closure process in which the closure materials are dumped along the entire axis of a closure dyke so that the closure dyke rises up in a balanced manner until it is above the water level

8.3 Cofferdam

8.3.1
cofferdam

temporary dam to divert water from the worksite (of a diversion dam or other in-river structure), using a tunnel, culvert or ditch as appropriate, to enclose a portion of riverbed that can then be dewatered to allow foundation preparation

8.3.2
overflow cofferdam

cofferdam which allows water overflow from a weir crest under certain conditions in order to prevent it from being damaged

8.3.3
earth-rock-fill cofferdam

cofferdam which is filled mainly with earth and rock material

8.3.4
concrete cofferdam

cofferdam which is built with cast-in-place concrete

8.3.5
steel sheet-pile cofferdam

cofferdam which is formed using a single-row, double-row or lattice structure, composed of special steel sheet piles and filled with sand gravel and earth

8.3.6
longitudinal cofferdam

cofferdam along the water flow direction during stage diversion construction

8.3.7
transversal cofferdam

cofferdam intercepting the river or the upstream/downstream cofferdam with an axis essentially vertical to the flow direction during stage diversion construction and which is connected to the longitudinal cofferdam

8.4 Pit drainage

8.4.1
drainage sump

facility with a certain volume and depth, provided to collect and drain water from a foundation pit

9 Hydraulic machinery

9.1 Hydraulic turbines

9.1.1 Types of hydraulic turbine

9.1.1.1
reaction turbine

turbine in which only part of the available hydraulic energy is converted into kinetic energy at the inlet of the runner

Note 1 to entry: According to the flow direction at the runner, it is classified as a Francis turbine, Axial flow turbine, Deriaz turbine or Tubular turbine.

[SOURCE: IEC/ TR 61364:1999, 4.4.1]

9.1.1.2
Francis turbine
radial-axial flow turbine

reaction turbine with meridional flow which is approximately radial between, usually adjustable, guide vanes and gradually changes direction inside the fixed runner blades so that the flow approaches axial flow at the outlet of the runner

[SOURCE: IEC /TR 61364:1999, 4.4.1.1]

9.1.1.3
axial flow turbine

reaction turbine having approximately axial meridional flow between the runner blades

[SOURCE: IEC /TR 61364:1999, 4.4.1.3]

9.1.1.4
propeller turbine

axial turbine with radial inflow to the guide vanes, usually with a vertical shaft and an elbow draft tube with adjustable guide vanes and fixed runner blades, single-regulated

[SOURCE: IEC /TR 61364:1999, 4.4.1.3.1]

9.1.1.5
Kaplan turbine

axial turbine with radial inflow to the guide vanes, usually with a vertical shaft and an elbow draft tube with adjustable guide vanes and adjustable runner blades, double-regulated

[SOURCE: IEC TR 61364, section 4.4.1.3.1]

9.1.1.6
diagonal turbine

reaction turbine with a radial or diagonal flow to guide vanes and diagonal inflow to the runner

Note 1 to entry: Guide vanes may be adjustable or fixed, and the runner blades may be adjustable or fixed.

[SOURCE: IEC /TR 61364:1999, 4.4.1.2]

9.1.1.7
tubular turbine
straight-flow turbine

axial turbine with axial or diagonal inflow to the guide vanes, usually with a horizontal or inclined shaft

Note 1 to entry: The unit may be double, single or non-regulated.

Note 2 to entry: According to the layout form of the generator, it is classified as a rim-generator turbine, bulb turbine, pit turbine or shaft-extension-type tubular turbine.

[SOURCE: IEC/ TR 61364:1999, 4.4.1.3.2]

9.1.1.8
rim-generator turbine

tubular turbine in which the generator rotor is placed on the outer edge of the runner blade and the generator stator is fixed on the support around the outer surface of the flow passage

[SOURCE: IEC /TR 61364:1999, Figure 5]

9.1.1.9
bulb turbine

tubular turbine in which the generator is housed in a bulb in the water passage

Note 1 to entry: The unit may be directly driven or equipped with a gear box.

[SOURCE: IEC/ TR 61364:1999, Figure 3]

9.1.1.10
pit turbine

tubular turbine in which the generator is housed in a pit in the water passage.

Note 1 to entry: The generator is most frequently connected to the turbine shaft through a gear box.

Note 2 to entry: The pit allows direct dismantling of the generator and the gear box from above.

[SOURCE: IEC/ TR 61364:1999, Figure 4]

9.1.1.11
S-type turbine
shaft-extension-type tubular turbine

tubular turbine in which the generator is placed out of the S-shaped water passage

Note 1 to entry: The S-type unit is characterized by turbine with an S-shaped water passage. The turbine drives an externally mounted generator which may be driven directly or by a gear box.

[SOURCE: IEC/ TR 61364:1999, 4.4.1.3.2]

9.1.1.12
impulse-type turbine

turbine in which the available hydraulic energy is fully converted into kinetic energy at the outlet of the nozzle

Note 1 to entry: Flow regulation is by means of one or more nozzles. According to the modes of water flow from the nozzle acting on the runner, it may be classified as a bucket type turbine, inclined-jet turbine or a cross flow turbine.

[SOURCE: IEC /TR 61364:1999, 4.4.2]

9.1.1.13
bucket-type turbine
Pelton turbine

impulse turbine in which the runner has double-bowl buckets and the nozzle axes are located in the plane of symmetry of the buckets

[SOURCE: IEC TR 61364, section 4.4.2.1]

9.1.1.14
inclined-jet turbine
Turgo turbine

impulse turbine in which the runner has single bowl buckets

Note 1 to entry: Nozzle axes are inclined to the plane of the runner.

[SOURCE: IEC/ TR 61364:1999, 4.4.2.2]

9.1.1.15
crossflow turbine

action turbine with a very small degree of reaction

Note 1 to entry: The flow crosses the runner twice perpendicularly to its axis of rotation and the runner blades are arranged cylindrically.

[SOURCE: IEC/ TR 61364:1999, 4.4.3]

9.1.1.16
Deriaz turbine

machine characterized by diagonal flow between the stay vanes, guide vanes and runner blades, and which may have adjustable guide vanes and runner blades

[SOURCE: IEC /TR 61364:1999, 4.4.1.2]

9.1.1.17
vortex turbine

turbine driven by the vortex that forms in a vertical cylindrical tank with a round orifice at its bottom when it receives a flow of water from a canal at a tangent to the top of the cylinder

9.1.1.18
hydro kinetic turbine

turbine using the kinetic energy of flowing water in a river or canal to produce electrical power

9.1.1.19
screw turbine

turbine in which the water enters the screw at the top and the weight of the water pushes on the helical flights allowing the water to fall to the lower level and causing the screw to rotate

9.1.1.20
in-pipe turbine

turbine that is actuated by fluid moving through the pipeline and which leaves usable fluid pressure downstream of the turbine

9.1.1.21
pump as turbine

single machine designed to operate at one time as a turbine and at another time as a pump

9.1.1.22
Darrieus turbine

water turbine with three or more vertical straight blades with a hydrodynamic cross section rotating on a vertical axis

Note 1 to entry: It is suitable for extraction of kinetic energy from free-flowing water in a natural stream or canal. The axis is attached to an upper electric generator out of the water flow. It is similar to the device of the same name used as a wind turbine.

9.1.1.23
vertical shaft turbine

turbine with the main shaft laid out vertically

9.1.1.24
horizontal shaft turbine

turbine with the main shaft laid out horizontally

9.1.1.25
inclined shaft turbine

turbine with the intersection between the main shaft and horizontal plane more than 0° and less than 90°

9.1.2 Turbine parameters and turbine characteristics

9.1.2.1
rated value
rating

parameters of a turbine used to characterize turbine performance under certain working conditions

9.1.2.2
turbine net head

total head of difference of the turbine between inlet and outlet sections during normal operation

9.1.2.3
rated head

minimum net head required for a turbine to generate its rated power at its rated speed

9.1.2.4
design head of turbine

net head of a turbine operating at its highest efficiency

9.1.2.5
turbine discharge

volume of water flowing into a turbine inlet per unit time

9.1.2.6
rated discharge

flow required by a turbine to generate its rated power at rated head and rated speed

9.1.2.7
unit discharge

flow passing the turbine having a runner of 1m diameter at 1m head

9.1.2.8
no-load discharge of turbine

flow when the output power of the unit is zero where a turbine is rotating at its rated speed

9.1.2.9
rated speed

stable speed of a turbine selected during design

9.1.2.10
unit speed

rotating speed of a turbine having a 1m nominal runner diameter, operated at 1m head

9.1.2.11
runaway speed

maximum rotating speed when a turbine goes out of control and the load at the shaft end is zero

9.1.2.12
turbine input power

hydraulic power transmitted to the runner by the flow of water from the inlet to the outlet of a turbine runner

9.1.2.13
turbine output power

mechanical power generated by the main shaft of a turbine

9.1.2.14
rated output power of a turbine

continuous output power of a turbine generated at rated head and at rated speed

9.1.2.15
maximum output power of a turbine

maximum power that a turbine can safely generate at rated speed and within the specified operating head and discharge range

9.1.2.16
turbine efficiency

ratio of output power to input power of a turbine

9.1.2.17
weighted average efficiency

weighted average of efficiency within a specified operating range

9.1.2.18
optimum efficiency of a turbine
maximum efficiency of a turbine

efficiency of a turbine obtained under optimal working conditions, i.e. maximum efficiency

9.1.2.19
cavitation erosion of a turbine

material damage to the flow surface of a turbine caused by cavitation

9.1.2.20
cavitation

hydraulic phenomenon whereby liquid gasifies at low pressure and the vapour bubbles form and collapse virtually instantaneously causing a hydraulic shock to the containing structure

9.1.2.21
cavitation coefficient of a turbine

dimensionless coefficient denoting the conditions and properties of turbine cavitation

9.1.2.22
plant cavitation coefficient

cavitation coefficient under the operating conditions of a plant; this was formerly known as the "device cavitation coefficient" or "the plant device cavitation coefficient"

9.1.2.23
pressure beat

reciprocal change in pressure relative to the average pressure during a selected time interval

9.1.2.24
hydraulic resonance

oscillation in the hydraulic system at which the frequency of periodic hydrodynamic disturbance is consistent with the natural frequency of the hydraulic or mechanical system of the unit

9.1.2.25
static suction head

elevation difference between the cavitation datum and the tailwater level as specified for a reaction turbine

9.1.2.26
static discharging head of an impulse turbine

height from the pitch plane of the runner to the maximum design tailwater level for a vertical shaft impact turbine; height from the lowest point of pitch diameter of the runner to the maximum design tailwater level for a horizontal-shaft impact turbine

9.1.2.27
setting elevation of a turbine

sea level elevation of a horizontal surface which is used as the datum for the installation of a turbine

Note 1 to entry: For a vertical reaction turbine, it is the central elevation of the guide vane. For a vertical impulse turbine, it is the nozzle centre elevation. For a horizontal turbine, it is the central elevation of the main shaft

9.1.2.28

operating condition

operating conditions determined by rotational speed, head, flow rate and output power

9.1.2.29
optimum operating condition

turbine operating conditions required for optimal efficiency

9.1.2.30
on-cam operating condition

operating conditions in which the guide vane and blade are coordinated for optimal performance

Note 1 to entry: For axial flow or Deriaz turbines, whose guide vane and rotor blade can be adjusted, the operating condition in which the number of nozzles and injection needle stroke are coordinated for optimal performance for water-bucket and inclined-jet turbine.

9.1.2.31
rated condition

standard operating conditions determined according to the design requirements and given rated parameters

9.1.2.32
hydraulic thrust
water thrust

force acting on the runner of a turbine in the direction of the main shaft

9.1.2.33
specific speed of turbine

speed of a geometrically similar turbine which would produce a unit of power (one kilowatt) under a unit of head (one metre)

9.1.2.34
model test of turbine

characteristic test carried out on the model for determining prototype performance

EXAMPLE Energy (or efficiency) test; cavitation test; runaway test; stability test; dynamic characteristic test.

9.1.2.35
combined characteristic curve

set of equivalent curves which are drawn in the coordinate system of unit flow and unit speed and provide the efficiency, cavitation coefficient, guide vane opening, runner blade angle and pressure fluctuation of geometrically similar models, as well as the output power limit line

9.1.2.36
performance curve

set of equivalent curves which are drawn in the coordinate system of output power and head

Note 1 to entry: The output power limit line represents the prototype turbine efficiency, suction height, pressure fluctuation, guide vane opening and runner blade angle given in the diameter and rated speed of a runner.

9.1.2.37
runaway speed curve

relation curve drawn between the coordinate system of the guide vane opening and unit runaway speed

9.2 Hydro turbine generator

9.2.1 Types of hydro turbine generator

9.2.1.1
vertical-shaft generator

generator whose main shaft is arranged vertically

9.2.1.2
suspended-type generator

vertical shaft generator whose thrust bearing is located above the rotor of the generator

9.2.1.3
umbrella-type generator

vertical shaft generator whose thrust bearing is located below the rotor of the generator

9.2.1.4
horizontal-shaft generator

generator whose main shaft is arranged horizontally

9.2.1.5
bulb-type generator

generator mounted inside a bulb in the flow passage of a straight-flow type turbine

9.2.2 Parameters of a hydro turbine generator

9.2.2.1
synchronous speed

rotation speed of a generator determined by the frequency of the generator power supply system and the number of magnetic poles of the generator

9.2.2.2
no-load

operating conditions where the unit operates at rated speed and the generator has zero power output

9.2.2.3
moment of inertia

measurement of the inertia of the unit rotating parts spinning around a shaft

9.2.2.4
insulation grade

degree of heat resistance of insulating materials used in motor windings

9.2.2.5
short-circuit ratio

ratio of the exciting current required by no-load rated voltage, when the generator is operated at rated speed, to the exciting current required by stable rated current which is generated from a symmetrical short-circuit

9.3 Hydro turbine governing system

9.3.1
electro-hydraulic governor

governor which detects control parameters and stability, and which provides feedback through signals using electronic methods

Note 1 to entry: After electrical synthesis and amplification, the governor can drive the servomotor of a turbine through an electrical conversion and hydraulic amplification system.

9.3.2
microcomputer-based governor

electro-hydraulic governor used to measure, transform and process, using an industrial microcomputer as the core

9.3.3
double regulating governor

governor which can adjust both the guide vane and runner blades of a turbine or a jet needle and deflector at the same time

9.3.4
proportional-integral governor
PI governor

governor which carries out proportional-integral regulation

9.3.5
proportional-integral-derivative governor/PID governor

governor which carries out proportional-integral-derivative regulation

9.3.6
oil pressure unit

device which supplies pressurized oil to a speed control system and hydraulic operation valve

Note 1 to entry: The unit is generally composed of a pressure oil tank, return oil tank, pressure oil pump and other accessories.

9.3.7
bladder-type energy accumulator

energy storage device in a hydraulic pneumatic system which is usually filled with nitrogen

9.4 Oil, compressed air and cooling water supply systems

9.4.1 Oil system

9.4.1.1
turbine oil system

system which supplies lubricating and operating oil to the operating system of the bearing, governing system and inlet and outlet valve of a unit; a turbine oil system is capable of carrying out general oil quality treatment

9.4.1.2
insulating oil system

system that supplies insulation and arc extinguishing oil to transformers and oil circuit breakers

9.4.1.3
press filter

oil cleaning machine which consists of a filter bed (including a filter plate, filter frame, filter paper and oil tray), gear oil pump and safety valve; a press filter is used for filtering turbine oil or insulating oil to remove mechanical impurities and absorb small amounts of water

Note 1 to entry: A press filter is also known as an oil separator.

9.4.1.4
oil filter
oil purifier

device in an oil system responsible for removing impurities from oil

9.4.1.5
oil accumulator

container used for storing turbine oil or insulating oil, which is classified, according to its purpose, as a clean oil tank, a running oil tank, a dirty oil tank or a waste oil tank

9.4.2 Compressed air system

9.4.2.1
air compressor

machine that compresses free air (from the atmosphere) to the required pressure

9.4.2.2
air-cooled compressor

air compressor which distributes the heat generated during the process of air compression directly to the atmosphere through a radiator provided outside the piston cylinder

9.4.2.3
water-cooled compressor

air compressor which takes away the heat generated during air compression through the continuous flow of cooled water in a water jacket and special cooler

9.4.2.4
compressed air tank

pressure container for storing compressed air

9.4.2.5
air-water separator

device used for separating water and oil particles by changing the direction and speed of compressed air

9.4.3 Water supplying and discharging system

9.4.3.1
cooling water

water flow which can absorb heat from a heating device and carry it away

9.4.3.2
lubricating water

water flow which lubricates and cools relative moving parts with small gaps between them

9.4.3.3
water filter
water strainer

device that prevents the entry of objects such as weeds

9.4.3.4
pressure reducing device

device used for reducing high water (oil, or air) pressure to the required working pressure

9.4.3.5
water supply by gravity flow

water supply method using the natural head of a hydropower plant to guarantee the water pressure for a water supply system

9.4.3.6
water supply by gravity flow with pressure reducing device

water supply method by gravity flow with the installation of pressure relief devices in the water supply system to handle the excess pressure heads over the specified water pressure value

9.4.3.7
water feed by pump

water supply method in which water pressure and water quantity are supplied by a pump

9.4.3.8
composite water feed

water supply method by combination of a natural-flow (pressure reduction) supply method and pump-water supply method

9.4.3.9
main water supply

water supply provided for cooling of mechanical and electrical equipment under normal conditions

9.4.3.10
standby water supply

additional water supply required for the cooling of mechanical and electrical equipment when the main water supply is disconnected

9.4.3.11
service drainage system

drainage system used to remove accumulated water from a unit; it also serves as the water conveyance system for the power station during the unit's maintenance period

9.4.3.12
leak drainage system

drainage system used to remove leakage from plant and equipment

9.5 Valve

9.5.1
main shut-off valve

main valves and gates may be used to:

— isolate the machine from a conduit

— shut-off a conduit in case of emergency

— temporarily regulate non-regulated machines

[SOURCE: IEC /TR 61364:1999, 4.7.1]

9.5.2
butterfly valve

valve with a solid or lattice type disc pivoting around a diameter or an axis close to it

[SOURCE: IEC /TR 61364:1999, 4.7.1.1]

9.5.3
spherical valve

valve with a hollow spherical plug pivoting around a diameter and which, when open, forms an unobstructed continuation of the conduit

[SOURCE: IEC/ TR 61364:1999, 4.7.1.2]

9.5.4
gate valve

valve with a closing gate, generally sliding perpendicularly to the direction of flow

[SOURCE: IEC /TR 61364:1999, 4.7.1.3]

9.5.5
cylindrical valve
ring gate

valve with a cylindrical gate which moves along the axis of the cylinder

[SOURCE: IEC/ TR 61364:1999, 4.7.1.4]

9.5.6
needle valve

valve with a plug which moves in an axial direction, the discharge normally flowing into the conduit

[SOURCE: IEC/ TR 61364:1999, 4.7.1.5]

9.5.7
pressure reducing valve
throttle valve

valve that can be decompressed to maintain a constant outlet pressure or vary it within a certain range when the inlet pressure of the valve is higher than the pressure required by equipment behind the valve

9.6 Installation and testing of turbine generator units

9.6.1
static balancing

process whereby the mass distribution of a rotating component is regulated to ensure that, in the non-rotating state, the deviation of the centre of gravity relative to the geometric centre is within the allowable range

9.6.2
dynamic balancing

process whereby the mass distribution of rotating components is regulated to ensure that, in the rotating state, the unbalance force and couple is within the allowable range

9.6.3
datum axis

vertical or horizontal centre line used as a reference level for installation during unit installation

9.6.4
shaft runout

difference between a maximum and minimum reading measured by an indicator fixed on the circumference; the readings are recorded each time the actual axis rotates once around the reference axis (with no axial movement)

9.6.5
alignment of shaft

process whereby the direction and position of the axes of rotating components or parts are checked and adjusted to ensure that the technical requirements are met

9.6.6
barring

process whereby the unit's rotating parts are driven to rotate at low speed in order to align the axis of its shaft

9.6.7
load test

test conducted to check whether a unit, under various specified load conditions, has abnormal vibration, pendulum, oil leakage, water leakage, noise, excessive bearing temperature rise, and can operate in safe continuous operation

9.6.8
efficiency test

test required for measuring the output power, flow rate and water head of a unit under various operating conditions to determine its efficiency

9.6.9
vibration test

test required for measuring vibration frequency and amplitude characteristics of a unit caused by hydraulic, mechanical, electrical or synthetic factors

9.6.10
no-load test

performance test of a hydraulic unit under a no-load condition

9.6.11
load-rejection test
load-shutdown test

test carried out to determine whether the operation of the control mechanism, main engine and auxiliary equipment is safe and reliable when a hydraulic unit is under load rejection

Note 1 to entry: The test also measures the rise in water hammer pressure and the increase in rotational speed of a unit.

9.6.12
test run

preliminary acceptance test carried out after the installation of a hydraulic unit to check the unit's manufacturing and installation quality, as well as to determine whether the operational conditions meet the specified requirements

10 Hydro mechanical structure

10.1 Gate

10.1.1
gate

water retaining structure arranged at the through-flow orifice of a hydraulic structure which is operational and movable

10.1.2
emersed gate

gate whose top is above the water level without a water stop

10.1.3
submerged gate

gate whose top is submerged in water with a water stop installed on the top of the gate

10.1.4
main gate
service gate

gate that performs the main work and opens and closes when moving water

10.1.5
emergency gate

gate that cuts off the flow in order to treat or prevent accidents occurring in a downstream water channel

10.1.6
quick shutoff gate

emergency gate which can be closed quickly to avoid worsening of an accident when a water pipe breaks or unit runs away

10.1.7
bulkhead gate

gate which opens and closes in static water; used for retaining water temporarily during the maintenance of hydraulic structures, working gates and their gate slots

10.1.8
tailwater gate

gate installed at the outlet of the draft tube of a turbine

10.1.9
diversion gate

gate set in a diversion tunnel to intercept water

10.1.10
plain gate

gate that can be opened and closed along a straight line which has a flat surface baffle

10.1.11
radial gate
Tainter gate

gate which rotates around a horizontal pivot axis and has an arc baffle during opening and closing

10.1.12
sliding gate

plane gate mounted on slides or sliding blocks on the side of columns

10.1.13
stoplog

simple water gate with several horizontal beams superimposed in the closed orifice of the gate groove where the orifice is sealed

10.1.14
floating bulkhead gate

gate that can float and sink in water by filling and draining water within the enclosed box of the gate

10.1.15
flap gate

rectangular gate which pivots at its top or bottom, usually located in the draft tube

[SOURCE: IEC/ TR 61364:1999, 4.7.1.7]

10.2 Trash rack and trash-removal device

10.2.1
trash rack

structure used to prevent the entry of trash and floating objects in the diversion channel and penstock intake

10.2.2
trashrack cleaning machine

mechanical equipment for removing the deposit on the surface of a trash rack

EXAMPLE Toothed-harrow-type, rotary-grille-type, hydraulic-grab-type and pressure-trash-harrow-type cleaning machines.

10.3 Hoist and crane

10.3.1
hoist

machine used for opening and closing the gate

10.3.2
fixed winch hoist

machine which uses a wire rope as a traction piece that rotates around a reel to lift the gate

10.3.3
hydraulic hoist

machine which opens and closes the gate using oil pressure in the oil pressure system

10.3.4
screw hoist

machine which opens and closes the gate by using the lifting screw rob of the drive mechanism

10.3.5
gantry hoist

lifting machine which has a portal frame and is capable of moving along a track

10.3.6
platform hoist

winding hoist installed on a carrier and which is movable

10.3.7
bridge crane

hoisting machinery with a bridge structure and capable of moving along a track

11 Electrical system

11.1 System operation mode

11.1.1
minimum operation mode

system operation mode in which the generation output, voltage level and network structure (including the grounding neutral point of the transformer) meets the minimum load demand

Note 1 to entry: In setting the calculation of relay protection, it refers to the operation mode in which the short-circuit current flowing through the relay protection device is the minimum when the system is at minimum load over a long time and the system's equivalent impedance is at maximum.

11.1.2
maximum operation mode

system operation mode in which generation output, voltage level and network structure (including the grounding point of neutral point of the transformer) meet the maximum load demand

Note 1 to entry: In setting the calculation of relay protection, it refers to the operation mode in which the short-circuit current flowing through the relay protection device is at maximum when the equivalent impedance of the system is at minimum under the above conditions.

11.1.3
accident operation mode

type of special operation mode adopted to ensure safe power supply to users in the case of a system failure or accident

11.2 Main electrical connection

11.2.1
main electrical connection

connection mode used to connect the main electrical equipment of a power plant and substation (e.g. generators, switchgear, busbars and transformers) in a certain sequence

11.2.2
transformer-line unit connection

connection mode in which a transformer is connected to a line directly (without passing through busbar) by a circuit breaker and isolation switch

11.2.3
unit connection; generator-transformer unit connection

connection mode in which the generator is connected directly (via an isolation switch, or a circuit breaker and the corresponding isolation switch) to the transformer as a unit, and the power is fed into the higher voltage grid

11.2.4
multi-generator-transformer unit connection

connection mode in which multiple generators are connected to a transformer as one unit via a circuit breaker and an isolation switch

11.2.5
combined generator-transformer unit connection

connection mode in which multiple generator-transformer units are connected together

11.2.6
single-bus connection

connection mode in which each incoming and outgoing line is connected to a bus via a circuit breaker and a bus isolation switch

Note 1 to entry: When the bus is segmented with a section-breaker, it is called a single-bus section connection; if another bypass bus is connected via a bypass breaker, it is called a single-bus connection with bypass.

11.2.7
double-bus connection

connection in which each loop is connected to either of the two buses via a circuit breaker and two optional isolation switches. When a working bus is segmented with a section-breaker, it is called a double-bus section connection; if another bypass bus is connected via a bypass breaker, it is called a double-bus connection with bypass

11.2.8
bridge connection

connection in which two sets of transformers are connected to the line groups by a circuit breaker as the bridge

Note 1 to entry: When the bridge circuit breaker is located inside or outside of the transformer-circuit group breaker, it is sometimes referred to as an inner bridge connection or an outer bridge connection, respectively.

11.3 Transformer

11.3.1
main transformer

major transformer used to transmit power for the power plant or substation

11.3.2
three-winding transformer

single-phase or three-phase transformers with one primary winding and two secondary windings; the three windings are usually called high-voltage, medium-voltage and low-voltage windings

11.3.3
interconnecting transformer

transformer used to connect two different transmission systems in a substation or power plant; each side can be used as the primary side or the secondary side, according to the change in power flow

11.3.4
auto-transformer

transformer whose primary and secondary windings have a common part and both have magnetic, as well as direct, electrical connections

11.3.5
oil immersed transformer

transformer whose core and windings are impregnated with oil

11.3.6
dry-type transformer

transformer whose core and windings are not impregnated with oil

11.3.7
transformer tapping

tap on a coil of a transformer used to change the voltage ratio

11.3.8
on-load tap-changer

device suitable for operating a transformer under excitation or load and used to change the split connection position of transformer windings

11.3.9
impedance voltage of transformer
short-circuit voltage of transformer

voltage which when applied at the rated frequency to the line terminals of the winding on one side of the polyphase transformer or the single-phase transformer would make the rated current flow through the terminals of the other side of the winding which is short-circuited

Note 1 to entry: For multi-winding transformers, it is defined as the voltage at rated frequency which when applied to the line terminals of the winding on one side of the polyphase transformer or the single-phase transformer would cause the rated current equivalent to the minimum power of the pair to flow through the winding on the other side of the pair which is short-circuited.

11.3.10
no-load loss of transformer

active power absorbed by a transformer when the winding on one side of the transformer is open and the rated voltage at the rated frequency is applied to the winding on the other side

11.3.11
load loss of transformer

active power absorbed by a transformer when the winding on one side of the transformer is short-circuited and voltage is applied to the winding on the other side at the rated frequency to make the rated current flow through it

11.3.12
rated power of transformer
transformer rating

apparent power in the design of a transformer (parallel reactance or arc-suppression coil) which is guaranteed by the manufacturer and used as the test basis

Note 1 to entry: The two windings of the double-winding transformer have the same rated power.

Note 2 to entry: For multi-winding transformers, the rated power of each winding needs to be provided.

11.4 Switchgear installation

11.4.1 Switching device

11.4.1.1
circuit breaker

switches that connect and disconnect high-voltage circuits and have the ability to disconnect short-circuit currents

11.4.1.2
low oil circuit breaker

circuit breaker used to extinguish the electric arc between the switch contacts when there is little oil in the container

11.4.1.3
vacuum circuit breaker

circuit breaker whose contact disconnects in a high vacuum bubble

11.4.1.4
sulfur hexafluoride gas circuit breaker
SF_6 gas circuit breaker

circuit breaker which uses sulfur hexafluoride gas as an insulating and arc-suppression medium

11.4.1.5
load switch

switch that connects and disconnects a circuit, with the ability to disconnect the load current

11.4.1.6
isolating switch
disconnecting switch

switch that connects and disconnects a no-load circuit

Note 1 to entry: This switch has no arc-suppression structure and only acts as electrical isolation.

11.4.1.7
earth switch

switch (generally connected to an isolating switch) that is installed to ensure the safety of the working operator by earthing the inspected electrical equipment or lines directly

11.4.1.8
high-voltage aggregated switchgear

complete set of electrical distribution devices used to assemble a high-voltage circuit breaker, isolating switch, transformer and its control, measurement signal and protection equipment in a metal cabinet according to the requirements of the main connection, and which can complete the functions of control, measurement and protection of the opening and closing of an electrical circuit

11.4.1.9
reactor

electrical apparatus used in a circuit or power system because of its inductance and which is connected in parallel

11.4.1.10
current-limiting reactor

reactor connected in series and used to limit the current when the system fails

11.4.1.11
neutral-earthing reactor

current-limiting reactor that is connected between the system neutral point and the ground in order to limit the earth current at times of system failure

11.4.1.12
arc-suppression coil

single-phase reactor connected between the neutral point of an unearthed system and the ground to compensate the capacitive current to the ground in the case of a single-phase earthing fault

11.4.1.13
fuse

electrical apparatus that disconnects a circuit by melting the wire with its own heat when the current exceeds the specified value

11.4.2 Transformers for measurement and protection

11.4.2.1
current transformer

electromagnetic induction converter equipment whose secondary current is directly proportional to the primary current in normal use with the phase difference close to zero and when the connection is correct

Note 1 to entry: The secondary current can be used by instruments and relays.

11.4.2.2
potential transformer

electromagnetic induction converter equipment whose secondary voltage is essentially proportional to the primary voltage in normal use with the phase difference close to zero and when the direction of the connection is correct

Note 1 to entry: The secondary voltage can be used by instruments and relays.

11.4.2.3
combined transformer

electromagnetic induction converter composed of a current-voltage transformer and installed in the same enclosure

11.4.3 Bus and cable

11.4.3.1
bus-bar
bus

wire (conductor) that collects and distributes incoming and outgoing wire (conductor)

11.4.3.2
power cable

cable for power transmission and distribution

11.4.3.3
control cable

small current cable for measurement, control, protection and signal; usually a multi-core cable

11.5 Excitation system

11.5.1
excitation system

system that provides a special power supply for the excitation of a synchronous generator and its circuit, detection and protection control equipment and an automatic device system

11.5.2
SCR excitation system
thyristor excitation

excitation system which uses a Silicon-Control-Rectifier (SCR) rectifying element to change the output current of the excitation transformer connected to the main bus or AC exciter coaxial in the main engine into DC excitation current

11.5.3
excitation system with alternate-current exciter

excitation system which supplies excitation current to the main engine after rectification with the AC exciter coaxial, with the main engine as the power supply

11.5.4
brushless excitation system

excitation system in which a coaxial AC exciter directly provides excitation current through a rotary rectifier

11.5.5
automatic excitation control

process where the voltage at a generator terminal or reactive power is automatically regulated to obtain a predetermined value by automatically regulating the excitation current of the generator rotor

11.5.6
automatic excitation controller
automatic voltage regulator

regulating device which automatically regulates the excitation current of a generator under given conditions in order to regulate the output voltage or reactive power of the synchronous generator, namely the device which realizes automatic excitation regulation

11.5.7
build-up excitation

process which helps the generator to establish the initial voltage during the start-up process in order to cause the excitation system to obtain the necessary operating voltage

11.5.8
automatic de-excitation
automatic field-suppression
automatic field-discharge

process where the excitation current of a rotor winding is reduced to a minimum

11.5.9
forced excitation

process of increasing the generator excitation rapidly in order to make the generator voltage rise quickly when the voltage of a generator declines below the allowable value

11.5.10
forcing factor
forcing multiple

ratio of nominal maximum voltage to rated excitation voltage of an excitation system for a synchronous motor in a forced excitation state

11.5.11
excitation response

rate of voltage increase or decrease when the voltage of the excitation system is changed

11.5.12
forced field discharge
forced decrease of excitation

process where the excitation current of the generator is rapidly reduced to make the generator voltage drop close to the rated voltage when the generator terminal voltage exceeds the allowable value

11.6 Supervisory control and protection system

11.6.1 Supervisory and control system

11.6.1.1
remote control

control of a device from a distant point

[SOURCE: IEC 62270:2013]

11.6.1.2
off-site control

controls that are not resident at the plant (e.g.,at a switchyard or another plant)

[SOURCE: IEC 62270:2013]

11.6.1.3
manual control

control in which the system or main device, whether direct or power-aided in operation, is directly controlled by an operator

[SOURCE: IEC 62270/IEEE 1249:2013]

11.6.1.4
centralized control

control location one step removed from local control; remote from the equipment or generating unit, but still within the confines of the plant (e.g.,controls located in a plant control room)

[SOURCE: IEC 62270:2013]

11.6.1.5
automatic control

arrangement of electrical controls that provides for switching or controlling or both, of equipment in a specific sequence and under predetermined conditions without operator intervention

[SOURCE: IEC 62270:2013]

11.6.1.6
automatic generation control
AGC

capability to regulate the power output of selectable units in response to total power plant output, tie-line power flow, and power system frequency

[SOURCE: IEC 62270:2013]

11.6.1.7
automatic voltage control
AVC

capability to regulate a specific power system voltage via adjustment of unit excitation within the limits of unit terminal voltage and VAR capability

[SOURCE: IEC 62270:2013]

11.6.1.8
automation hierarchy

design and implementation of automation functions in a multilevel structure, such as local level, group level, unit level

[SOURCE: IEC 62270:2013]

11.6.1.9
local control

<auxiliary equipment> controls that are located at the equipment itself or within sight of the equipment.

Note 1 to entry: For a generating station, the controls that are located on the unit switchboard or governor control station.

[SOURCE: IEC 62270:2013]

11.6.1.10
local control unit
LCU

independent and locally located computer-based function unit which includes controller, I/Os and related application software to carry out data acquisition and control functions on function-based equipment of a hydropower plant

EXAMPLE Generating units; plant auxiliaries; switchyard; dam; spillway.

[SOURCE: IEC 62270:2013]

11.6.1.11

closed loop control

automatic control in which control actions are based on signals fed back from the controlled equipment or system

[SOURCE: IEC 62270:2013]

11.6.1.12
cold standby

configuration consisting of two control processors arranged such that if a fault occurs on the master control processor, the slave (or second) control processor starts

[SOURCE: IEC 62270:2013]

11.6.1.13
data acquisition system

system that receives data from one or more remote points

Note 1 to entry: Data may be transported in either analogue or digital form.

[SOURCE: IEC 62270:2013]

11.6.1.14
database

collection of stored data regarding the process variables and processing procedures

[SOURCE: IEC 62270:2013]

11.6.1.15
data bus

control network technology in which data stations share one single communication system medium

Note 1 to entry: Messages propagate over the entire medium and are received by all data stations simultaneously.

[SOURCE: IEC 62270:2013]

11.6.1.16
digital-to-analogue conversion
d/a conversion

production of an analogue signal whose magnitude is proportional to the value of a digital input signal

[SOURCE: IEC 62270:2013]

11.6.1.17
distributed processing

design in which data is processed in multiple processors

Note 1 to entry: Processing functions may be shared by the processors throughout the control system.

[SOURCE: IEC 62270:2013]

11.6.1.18
event

discrete change of state (status) of a system or device

[SOURCE: IEC 62270:2013]

11.6.1.19
hot standby

configuration of two control processors, each with a dedicated central processing unit (CPU) and dedicated power supply, operated in a synchronous fashion with communications between the two processors whereby one takes over if the other fails, without interruption of the processing

[SOURCE: IEC 62270:2013]

11.6.1.20
mean-time-to-repair
MTTR

time interval (hours) that may be expected to return failed equipment to proper operation

[SOURCE: IEC 62270:2013]

11.6.1.21
open loop control

form of control without feedback

[SOURCE: IEC 62270:2013]

11.6.1.22
proportional integral derivative
PID

<control system> control action in which the output is proportional to a linear combination of the input, the time integral of the input, and the time rate of change of the input

[SOURCE: IEC 62270:2013]

11.6.1.23
programmable logic controller
PLC

digital electronic operating system, designed for use in an industrial environment, which uses a programmable memory for the internal storage of user-oriented instructions to implement specific functions such as logic, sequencing, timing, counting and arithmetic, to control, through digital and analogue inputs and outputs, various types of machines or processes

[SOURCE: IEC 62270:2013]

11.6.1.24
protocol

structured data format and a set of rules for the communication procedure required to initiate and maintain communication

[SOURCE: IEC 62270:2013]

11.6.1.25
reliability

characteristic of an item or system expressed by the probability that it will perform a required mission under stated conditions for a stated mission time

[SOURCE: IEC 62270:2013]

11.6.1.26
response time

elapsed time between the moment when a signal is originated in an input device until the moment the corresponding processed signal is made available to the output device(s), under defined system loading conditions

[SOURCE: IEC 62270:2013]

11.6.1.27
resistance temperature detector
RTD

device for which the electrical resistivity is a known function of the temperature

[SOURCE: IEC 62270:2013]

11.6.1.28
sequential control

mode of control in which the control actions are executed consecutively

[SOURCE: IEC 62270:2013]

11.6.1.29
supervisory control and data acquisition
SCADA

system operating with coded signals over communication channels in order to provide control of equipment and to acquire information about the status of the equipment for display or recording functions

[SOURCE: IEC 62270:2013]

11.6.1.30
user interface

functional system used specifically to interface the computer-based control system to the operator, maintenance personnel, or engineer

[SOURCE: IEC 62270:2013]

11.6.1.31
set-point command

command in which the value for the required state of operational equipment is transmitted to a controlled station where it is stored

[SOURCE: IEC 60050-371:1984]

11.6.1.32
electromagnetic compatibility
EMC

ability of equipment or a system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment

[SOURCE: IEC 60050-161:1990]

11.6.1.33
black start-up

starting the power plant unit without relying on other units of the plant or an external power grid source

11.6.1.34
uninterruptible power systems
UPS

minimum value at which the measuring point can be recognized

Note 1 to entry: The resolution of an event is the recognizable minimum time interval value at which it occurs

11.6.1.35
resolution

minimum value at which the measuring point may be recognized. The resolution of an event is the recognizable minimum time interval value at which it occurs

11.6.1.36
sequence of events
SOE

records of important events and the moments and sequence in which they occur

11.6.1.37
video monitoring system

system which uses video means to monitor targets

11.6.2 Relay protection

11.6.2.1
main protection

relay protection that can cut off the protected object first and selectively within the shortest time limit in the case of any fault within the scope of protection in order to guarantee that other parts which do not have any fault can continue running, or to inhibit and end relay protection under abnormal working conditions

11.6.2.2
backup protection
reserve protection

relay protection that can cut off the protected object within a certain time when the main protection or the protection of the adjacent equipment (or circuit breaker) refuses to act

11.6.2.3
microprocessor-based protection

relay protection with a microprocessor chip as the main body, which transforms an analogue signal into a digital signal through sampling and executing preset functions through operational and logic judgements

11.6.3 Synchronizing system

11.6.3.1
synchronizing

operation method which results in one synchronous motor or generator being brought into another synchronous motor or generator or power supply with respect to voltage, frequency and phase

11.6.3.2
manual precise synchronization

operation method in which the voltage, frequency and phase angle are manually regulated to make, as far as possible, the electrical state of a synchronous generator consistent with that of another when one synchronous generator is running in parallel with another synchronous generator or power system

11.6.3.3
automatic precise synchronization

operation method in which the voltage, frequency and phase angle are regulated by an automatic device to make the electrical state of a synchronous generator consistent with that of another when one synchronous generator is running in parallel with another synchronous generator or power system

11.7 Lightning protection and grounding

11.7.1
lightning arrester
surge arrester

type of electrical apparatus which protects electrical equipment from hazards due to high transient over-voltage, limits the duration of after-flow, and frequently limits the amplitude value of after-flow

11.7.2
protection gap

gap between the live part and the ground to restrict an over-voltage which can generate hazards

11.7.3
earthing
grounding

connection between the grounding body and electrical equipment, pole tower or over-voltage protection device using a metallic conductor

Note 1 to entry: Sometimes, the overhead ground wire employs small-gap grounding.

11.7.4
earthed body
grounding body

metallic conductor buried in the ground and in direct contact with the ground

11.7.5
working earthing

earthing which ensures that the electric circuit or equipment meets operational requirements

EXAMPLE The earthing of a low-voltage neutral point of a transformer.

11.7.6
safety earthing
protective earthing

earthing carried out to meet personal safety requirements

EXAMPLE The earthing of metallic cases of motor and electrical apparatus.

11.7.7
earth resistance
resistance of earthed conductor

sum of the resistance of an earthed lead wire between the earthed body and underground zero-potential surface, the resistance of the earthed body, the transition resistance between the earthed body, the soil and the overflow resistance of the soil

11.7.8

natural earthing

naturally available earthed bodies

EXAMPLE Reinforcement; water diversion pipelines; metallic gate slots of buildings.

11.7.9
artificial earthed body

grounding body buried artificially to meet the earthing requirements of electrical equipment

11.7.10
earthing network

underground network constituted by earthed bodies buried in the ground and earthed connection wires between earthed bodies

11.8 Plant service power and near region and construction power supply

11.8.1
service power of plant

electric energy and electric power required to maintain normal running and overhauls to power plants

11.8.2
service power supply system

power supply system comprising a service transformer, service bus, switching device and feeder line in the power plant

11.8.3
load of plant

power load required in a power plant to maintain normal operation and overhaul, including the power consumption of the power generator unit, transformers and auxiliary machinery, the power consumption for overhaul, and the power loads for the lighting and DC system

11.8.4
common power demand of plant

common power demands in the plant other than those of each power generator unit and the auxiliary machinery

11.8.5
unit service power

power of the auxiliary machinery of the power generator unit

Note 1 to entry: This sometimes includes the cooling system of the main transformer connected with the unit.

11.8.6
reserve source
standby source

reserve power source in case the working power source fails due to a fault or other reason

11.8.7
self-start-up load

total load of the motors that participate synchronously in self-start-up

11.8.8
self-start-up capacity

maximum self-start-up motor capacity allowed by the service transformer on the premise of meeting requirements of the allowable minimum self-start-up voltage of the service bus

11.8.9
minimum self-start-up voltage

minimum voltage value that ensures the asynchronous motor does not lose stability during running

11.8.10
near region power supply

power supply to the loads in the regions (such as plant areas, auxiliary production workshops, living quarters, etc.) near to the power plant

11.8.11
working lighting

lighting required for normal working and overhaul in the various work sites inside a power plant

11.8.12
accident lighting

lighting supplied to on-duty personnel for continued working in case of the interruption of working light due to a fault

11.8.13
lighting supply network

low-voltage AC and DC network supplying power for working lighting and accident lighting

11.8.14
AC and DC changeover

automatic or manual changeover of switching to the DC power source in the case of an AC power source fault, and the switching back to the AC power source once the AC power source recovers to normal status

11.9 Direct-current system

11.9.1
DC operational power source

DC power source supplying power to control, signal and automatic devices, as well as relay protection, tripping and closing coils of switching devices and emergency lighting

11.9.2
storage battery

DC power source equipment transforming electric energy into chemical energy for storage

11.9.3
trickle charging
floating charge

continuous charging to a storage battery to compensate the self-discharge consumption of the storage battery and supply power to DC constant loads

11.9.4
DC constant load

current value of uninterrupted power supply from the DC bus under normal running conditions

11.9.5
DC surge load

instantaneously increased current value borne by the storage battery

11.9.6
DC emergency load

current value which needs to be supplied by the DC bus in the case of the AC power source being lost and the whole plant (site or station) power being off

11.10 Communication

11.10.1
communication

process of transmitting, converting and processing information (language, texts, images, etc.) through electric or electronic facilities

11.10.2
in-station communication

mutual communication between any two management departments in the power station and between the power station and various relevant organizations in the regions

11.10.3
dispatching communication

communication between the power station and the dispatching and management department

11.10.4
construction communication

dispatching management communication facility established according to specific situation of the dispatching management of the power plant construction site

12 Social and environmental impact assessment

12.1
environmental impact assessment
EIA

assessment of environmental change and its impact due to the construction of a hydropower project

12.2
environmentally sensitive area

natural or cultural conservation area, at any level, which is highly sensitive to pollution or ecological influencing factors as a result of a construction project

12.3
reduction and cut-off reach

river section whose volume of water is reduced significantly or critically, compared with the water volume under natural conditions, even in flow separation status

12.4
eco-environmental water demand

minimum water demand required to maintain ecological functions of a river channel, lake wetland or a whole river and estuary

12.5
ecological flow

minimum flow required to maintain basic river morphology and basic ecological functions

12.6
reservoir inundated area

frequently submerged or inundated areas below the normal reservoir level and temporarily submerged areas above the normal reservoir level due to reservoir flood backwater, wind waves, ship waves and ice jams

12.7
soil and water conservation

prevention and control of soil and water loss, improvement and rational utilization of water and soil resources, maintenance and improvement of land productivity, mitigation of floods, droughts and sandstorms conducive to giving full scope to the ecological, economic and social benefits of water and soil resources, establishing a good ecological environment, supporting sustainable development of production activities and social public welfare undertakings

13 Economic evaluation and project investment

13.1
price level year

time period that the project investment is calculated as per the unit cost according to the relevant policies over a specified period of time

Note 1 to entry: Also called the price level year of the investment.

13.2
static investment

cost investment required during the project construction period calculated as per the price level of a certain year

13.3
dynamic investment

sum of the costs of investment which includes raised costs during the budget preparation period and construction period of the project, as well as the interest on fixed capital-investment loans during the construction period

13.4
economic evaluation

analysis and evaluation of the economic feasibility and economic rationality of a project

13.5
financial evaluation

analysis and evaluation of expense, efficiency and debt repayment capability of an engineering project from the perspective of finance, as well as its financial viability and profitability and other measures – according to the current fiscal and tax system and prices of the relevant country

13.6
cost per kilowatt

cost spent on installed capacity per kilowatt

13.7
cost per kilowatt-hour

generation cost of electric energy per kilowatt-hour

13.8
interest during construction
IDC

financial interest to be repaid during the construction period, accounted for as part of the total project investment

13.9
power purchase agreement

power acquisition agreement signed between the power grid company and the power plant

13.10
feed in tariff

price at which the power grid purchases the power and electricity from a power plant at the point where the power plant connects to the electrical grid

13.11
annual operation cost

sum of various types of expenditure incurred each year for maintaining normal operation of the plant, including water rates, fuel costs, material expenses, maintenance costs, wages and other expenses

13.12
annual depreciation

expenses required for converting the value of fixed assets that are gradually lost during usage into annual expenditure

13.13
payback period

period determined by adding the expected cash flows for each year until the sum is equal to, or greater than, zero

13.14
date of commissioning

date on which the equipment of the hydropower plant is put into operation after installation and testing

Note 1 to entry: During the commissioning period further tests are carried out and the overall performance of the equipment improved.

Appendix A
(Informative)
Index entry for terms

Bibliography

[1] IEC 60050-161:1990, *International Electrotechnical Vocabulary (IEV) — Part 161: Electromagnetic compatibility*

[2] IEC 60050-371:1984, *International Electrotechnical Vocabulary (IEV) — Part 371: Telecontrol*

[3] IEC/TR 61364:1999, *Nomenclature for hydroelectric powerplant machinery*

[4] IEC 62270:2013[1], *Guide for computer-based control for hydroelectric power plant automation*

[5] United Nations Educational, Scientific and Cultural Organization (UNESCO)/World Meteorological Organization (WMO), WMO-No. 385, *International Glossary of Hydrology*

[6] International Commission on Large Dams, *ICOLD Dictionary*[2]

[7] Chinese Standard SL 26-2012, *Technical terms in water resources and hydropower project*

[8] Alternate Hydro Energy Center (AHEC)/Indian Institute of Technology Roorkee (IITR), *Standards/Manuals/ Guidelines for Small Hydropower Development*

[9] U.S. Army Corps of Engineers, Engineer Manual EM 1110-2-1701, *Engineering and Design: Hydropower*

[10] U.S. Army Corps of Engineers, Engineer Manual EM 1110-2-3006, *Engineering and Design: Hydroelectric Power Plants Electrical Design*

[11] Food and Agriculture Organization of the United Nations (FAO), *Fish passes — Design, Dimensions and Monitoring*

[12] British Hydropower Association (BHA), *A Guide to UK Mini-Hydro Development*

[13] European Small Hydro Association (ESHA) (2004), *Guide on How to Develop a Small Hydropower Plant*

1 Also published as IEEE 1249:2013.

2 Available at: https://www.icold-cigb.org/GB/dictionary/dictionary.asp.

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Vienna International Centre
P.O. Box 300 · 1400 Vienna · Austria
Tel.: (+43-1) 26026-0
E-mail: info@unido.org
www.unido.org

INTERNATIONAL NETWORK
ON SMALL HYDROPOWER

136 Nanshan Road
Hangzhou · 310002 · P.R.China
Tel.: (+86-571)87132793
E-mail: secretariat@inshp.org
www.inshp.org