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Technical guidelines for the development of small hydropower plants —

Part 1: Vocabulary

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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Contents

Page

Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Terms related to hydrology	1
4.1 Hydrological observation	1
4.2 Hydrologic data processing	3
4.3 Hydrological computation	3
5 Terms related to engineering geology	5
6 Terms related to hydraulic engineering and energy	6
7 Terms related to hydraulic structure	8
7.1 Structure type	8
7.2 Dam	9
7.3 Water gate/sluice	10
7.4 Spillway	10
7.5 Power house	12
7.6 Forebay and penstock	13
7.7 Surge chamber	14
7.8 Tailrace structures	15
7.9 Tunnel, culvert and culvert pipe	15
7.10 Intake	16
7.11 Sediment management facility	16
8 Terms related to engineering construction	17
8.1 Diversion	17
8.2 Closure	17
8.3 Cofferdam	18
8.4 Pit drainage	18
9 Terms related to hydraulic machinery	19
9.1 Hydraulic turbines	19
9.1.1 Types of hydraulic turbine	19
9.1.2 Turbine parameters and turbine characteristics	22
9.2 Hydro turbine generator	25
9.2.1 Types of hydro turbine generator	25
9.2.2 Parameters of a hydro turbine generator	25
9.3 Hydro turbine governing system	26
9.4 Oil, compressed air and cooling water supply systems	26
9.4.1 Oil system	26
9.4.2 Compressed air system	27
9.4.3 Water supplying and discharging system	27
9.5 Valve	28
9.6 Installation and testing of turbine generator units	29
10 Terms related to hydro mechanical structure	30
10.1 Gate	30
10.2 Trash rack and trash-removal device	31
10.3 Hoist and crane	32
11 Terms related to electrical system	32
11.1 System operation mode	32
11.2 Main electrical connection	33
11.3 Transformer	34

11.4	Switchgear installation	35
11.4.1	Switching device.....	35
11.4.2	Transformers for measurement and protection.....	36
11.4.3	Bus and cable	36
11.5	Excitation system.....	37
11.6	Supervisory control and protection system	38
11.6.1	Supervisory and control system.....	38
11.6.2	Relay protection	42
11.6.3	Synchronizing system.....	42
11.7	Lightning protection and grounding.....	43
11.8	Plant service power and near region and construction power supply	44
11.9	Direct-current system.....	45
11.10	Communication	45
12	Terms related to social and environmental impact assessment	46
13	Terms related to economic evaluation and project investment	47
	Annex A (informative) Workshop contributors	49
	Bibliography	51
	Alphabetical index of terms	52

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was 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 this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

International Workshop Agreement IWA 33 was approved at a workshop hosted by the Standardization Administration of China (SAC) and Austrian Standards International (ASI), in association with the International Center on Small Hydro Power (ICSHP), held in Hangzhou, China, in June, 2019.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

A list of all parts in the IWA 33 series can be found on the ISO website.

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, in North and South America and in 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.

The technical guidelines for the development of small hydropower plants contained in this document 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 this document 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. This document 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.

This document is 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 this document's preparation and peer review. This document can be used as the principles and basis for the planning, design, construction and management of SHP plants up to 30 MW.

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Technical guidelines for the development of small hydropower plants —

Part 1: Vocabulary

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>
<https://standards.iteh.ai/catalog/standards/sist/12f0c9b3-b60e-4d8e-af4d-775914edcbc0/iwa-33-1-2019>

4 Terms related to 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 0,1 mm 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 stage

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

4.1.12

minimum stage

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

4.1.13

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]

4.1.14

maximum discharge

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

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4.1.15**minimum discharge**

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

4.1.16**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 Terms related to 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 Terms related to 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

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7 Terms related to 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

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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]
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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