STANDARDS/MANUALS/ GUIDELINES FOR SMALL HYDRO DEVELOPMENT

1.1
General-
Small Hydropower Definition and Glossary of Terms, List and Scope of Different Indian and International Standards/ Guidelines/ Manuals

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Lead Organization:

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PREAMBLE

There are series of standards, guidelines and manuals available on electrical, electromechanical aspect of moving machines and hydro power related issues from Bureau of Indian Standards (BIS), Rural Electrification Corporation Ltd (REC), Central Electricity Authority (CEA), Central Board of Irrigation & Power (CBIP), International Electromechanical Commission (IEC), International Electrical and Electronics Engineers (IEEE), American Society of Mechanical Engineers (ASME) and others. But most of these are developed keeping in view the large water resources/ hydropower projects. Use of the standards/guidelines/manuals is voluntary at the moment. Small scale hydropower projects are to be developed in a cost effective manner with quality and reliability. Therefore a need to develop and make available the standards and guidelines specifically developed for small scale projects was felt.

Alternate Hydro Energy Centre, Indian Institute of Technology, Roorkee initiated the exercise of developing standards/guidelines/manuals specifically for small scale hydropower projects under the sponsorship of Ministry of New and Renewable Energy, Government of India, in 2006. The available relevant standards / guidelines / manuals were revisited to suitably adopt them for small scale hydro projects. These have been prepared by experts in their respective fields. Wide consultations were held with all stake holders covering government agencies, government and private developers, equipment manufacturers, consultants, financial institutions, regulators and others through web, post and meetings. After taking into consideration the comments received and discussions held with the lead experts the standards/guidelines/manuals are now prepared and presented in this publication.

The experts have drawn some text and figures from existing standards, manuals, publications and reports. Attempts have been made to give suitable reference and credit. However, the possibility of some omission due to oversight cannot be ruled out. These can be incorporated in our subsequent editions.

These standards / manuals / guidelines are the first edition. We request users of these to send their views / comments on the contents and utilization to enable us to review these after about one year of its publication.

Standards/ Manuals/Guidelines series for Small Hydropower Development

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SMALL HYDROPOWER DEFINITIONS AND GLOSSARY OF TERMS, LIST AND SCOPE OF DIFFERENT INDIAN AND INTERNATIONAL STANDARDS/ GUIDELINES/ MANUALS

1.0 GENERAL

This guideline has been aimed to present all the terms/ nomenclatures being used in small hydropower (SHP) world over for the understanding of the users. The definitions of various terms related to different activities of SHP project from concept to commissioning have been included in this guideline to the possible extent. A comprehensive list of available standards, guidelines and manuals on civil, electrical, hydromechanical aspects from Bureau of Indian Standards (BIS), International Electromechanical Commission (IEC), International Electrical and Electronics Engineers (IEEE), American Society of Mechanical Engineers (ASME), American Society of Civil Engineers (ASCE) and others have been included in this guideline. List of relevant reference books, selected research publications, reports and guidelines published by related organizations such as Rural Electrification Corporation Ltd (REC), Central Electricity Authority (CEA), Central Board of Irrigation & Power (CBIP), US Army Corps of Engineers, United States Bureau of Reclamation (USBR) and others have also been included.

1.1 GLOSSARY

Abutment	A structure that supports the ends of a dam or bridge. An artificial abutment is sometimes constructed, as a concrete gravity section, to take the thrust of an arch dam where there is no suitable natural abutment.
Adit	A nearly horizontal underground excavation in an abutment having an opening in only one end. An opening in the face of a dam for access to galleries or operating chambers.
Afflux Bund	An embankment or dyke designed to ensure that the structure is not outflanked during flood flows. In some cases, it also acts as an embankment to prevent flooding to the country side due to an afflux.
Allowable bearing capacity	The maximum pressure that can be permitted on foundation soil, giving consideration to all pertinent factors, with adequate safety against rupture of the soil mass or movement of the foundation of such magnitude that the structure is impaired.
Alternating current (AC)	Electric current that reverses its polarity periodically (in contrast to direct current). In Europe the standard cycle frequency is 50 Hz, in N. and S. America 60 Hz. (1 Hz = 1 cycle /sec.).
Ambient temperature	Temperature of the surrounding air (or other medium).
Ampere (amp)	A unit of electric current or rate of flow of electrons. One volt across 1 ohm of resistance causes a current flow of 1 ampere.
Angle of repose	Angle between the horizontal and the maximum slope that a particular soil or geologic material assumes through natural processes. For dry granular soils, the effect of the height of slope is negligible; for cohesive soils, the effect of height of slope is so great that the angle of repose is meaningless.
Annual energy	Variable costs relating to energy production in a year, usually

cost	expressed in paise per kilowatt-hour.
Annual load factor	This factor is equal to energy generated in a year divided by the product of the peak demand for that year and the number of total hours in a year.
Annual operating cost	This is a general term which is sometimes called annual operating expense and includes all annual operation and maintenance expense, wheeling, purchased power, etc.
Apron	A protective layer of stone of concrete block or other material, extending out from a structure on or extending beyond the toe on the bed of a channel, or situated at some other location in the bed of a channel, laid in order to prevent erosion.
Aquatic life	Any plants or animals which live at least part of their life cycle in water.
Aqueduct	Elevated canal supported on bridge work crossing a water course or gully.
Arch dam	A concrete or masonry dam which is curved upstream in plan so as to transmit the major part of the water load to the abutments and to keep the dam in compression.
Atmospheric pressure	Pressure of air enveloping the earth, averaged as 14.7 psi at sea level, or 29.92 inches of mercury as measured by a standard barometer.
At-rest earth pressure	The value of the earth pressure when the soil mass is in its natural state without having been permitted to yield or without having been compressed
Auxiliary equipment	Accessory equipment necessary for the operation of a generating station.
Average annual runoff	For a specified area, the average value of annual runoff amounts calculated for a selected period of record that represents average hydrologic conditions.
Average daily flow	The flow of water passing a specified gauging station averaged over a day (24 hours).
Average energy	The total power generation produced by a power plant during all of the years of its actual or simulated operation divided by the number of years of actual or simulated operation.
Back pressure	A pressure that can cause water to backflow into the water supply when a user's water system is at a higher pressure than the public water system.
Backfill	Material used in refilling excavation, or the process of such refilling. Material used to fill an excavated trench.
Backfill concrete	Concrete used in refilling excavation in lieu of earth material.
Backflow	A reverse flow condition, created by a difference in water pressures, which causes water to flow back into the distribution system.
Backwater	A small, generally shallow body of water with little or no current of its own. Stagnant water in a small stream or inlet. Water moved backward or held back by a dam, tide, etc.
Backwater curve	The upstream longitudinal profile of the surface of water in stream or an open channel from a point where such water surface is raised above its normal level by a diversion structure.

Baffle	A flat board or plate, deflector, guide or similar device constructed or placed in flowing water to cause more uniform flow velocities, to absorb energy, and to divert, guide, or agitate the flow.
Baffle block (dentate)	One of a series of upright obstructions designed to dissipate energy as in the case of a stilling basin or drop structure. A block, usually of concrete, constructed in a channel or stilling basin to dissipate the energy of water flowing at high velocity.
Balancing reservoir	A reservoir or basin – constructed downstream of the intake to provide daily pondage to support daily peaking operation of a hydro plant.
Banking charge	Charge for storing energy for subsequent use so that it could be utilized as and when needed during the agreed period. Normally charged by the owner of the Grid (usually the State Electricity Board) from the SHP.
Barrage	A diversion dam comprising a series of spillway gates which occupy the main flow channel of a river. When the gates are lifted the main flow channel is once again available for handling flood flows and sediment discharges. Occasionally referred to as "movable barrages" from the French term "barrages mobiles".
Base load	The load at which, power plant is planned to run continually except for maintenance and scheduled or unscheduled outages. It is also the minimum constant amount of load connected to the power system over a given time period, usually on monthly, seasonal, or yearly basis.
Base loading	Running water through a power plant at a roughly steady rate, thereby producing power at a steady rate.
Bed load	Sediment that moves by rolling or sliding along the bed and is essentially in contact with the streambed in the bed layer.
Bed load sluice	A component of a lateral intake to trap and flush bed load from in front of the entry to intake or head regulator.
Bed material	Unconsolidated material, or sediment mixture, of which a streambed is composed
Bed-load discharge	The quantity of bed load passing a cross section of a stream in a unit of time.
Benefit cost ratio	The benefit cost ratio is the ratio of project benefits to investment (capital costs) generally expressed in terms of life time benefits and costs.
Bifurcation	A section of pipeline where the pipe is divided into two branching pipelines.
Boulder	A rock fragment, usually rounded by weathering or abrasion, with an average dimension of 12 inches or more: will not pass a 12-inch screen.
Bus bar	A heavy metal conductor used to carry a large current.
Butt joint (open joint)	In pipe, flat ends that meet but do not overlap.
Butterfly valve	A valve designed for quick closure that consists of a circular leaf, slightly convex in form, mounted on a transverse shaft carried by two bearings and wholly enclosed in a circular pipe, which may be opened

	and closed by an external lever. Often operated by a hydraulic system.
Buttress dam	A dam consisting of a watertight upstream part (such as a concrete sloping slab) supported at intervals on the downstream side by a series of buttresses
Bypass valve	Bypass (or turbine bypass) valve opens in step with closure of turbine wicket gates to divert flow from the turbine to a bypass pipe, thus allowing the turbine to be closed quickly without provoking excessive water hammer pressure rise on load rejection. Upon completion of a load adjustment the bypass valve closes slowly. This option provides good protection against water hammer resulting from load rejection but can only permit load acceptance at a slow rate. (*Alternative to surge tank*).
Camber	The extra height added to the crest of embankment dams to ensure that the freeboard will not be diminished by foundation settlement or embankment consolidation.
Canal	A channel, usually open, that conveys water by gravity to farms, municipalities, etc.
Canal fall	A structure designed to secure lowering of the water surface in a canal over a short distance and safe dissipation of the excess hydraulic energy.
Canal head works	The beginning of a canal
Capacitor	A dielectric device which momentarily absorbs and stores electric energy.
Capacity	The load for which an electric generating unit, other electrical equipment or power line is rated.
Capital costs	Costs (usually long-term debt) of financing construction and equipment.
Capital investment	A general term used to identify any money amount which is to be considered as an investment as opposed to an annual expense. Can be either interest bearing or non interest bearing.
Casing	A pipe lining for a drilled hole. The material that is installed in wells to prevent the collapse of the walls of the bore hole, to prevent pollutants from entering the well, and to house the pump and pipes.
Catchment Area	*See* drainage area.
Cavitation	A hydraulic phenomenon whereby liquid gasifies at low pressure and vapour bubbles form which collapse virtually instantaneously when the flow enters a zone of high pressure causing hydraulic shock to the containing structure. The can lead to severe physical damage to turbines runners and concrete structures.
Cavitation damage	Damage caused when partial vacuums formed in a liquid by a swiftly moving solid body (e.g. a propeller) pit and wear away solid surfaces (e.g. metal or concrete). The attack on surfaces caused by the implosion of bubbles of water vapor.
Centrifugal pump	A pump that moves water by centrifugal force developed by rapid rotation of an impeller.
Chamfer	To bevel or slope an edge or corner.
Check valve	Any device which will allow fluid or air to pass through it in only one direction.

Chute	Portion of spillway between the gate or crest structure and the terminal structure, where open- channel flow conditions will exist. A conduit for conveying free-flowing materials at high velocity to lower elevations.
Circuit	The complete path of an electric current, including the generating apparatus or other source; or, a specific segment or section of the complete path.
Circuit breaker	A safety device in an electrical circuit that automatically shuts off the circuit when it becomes overloaded. The device can be manually reset.
Class (pipe and fittings)	The working pressure rating of a specific pipe for use in water distribution systems which includes allowances for surges. This term is used for cast iron, ductile iron, asbestos cement, and some plastic pipe.
Clay	Fine-grained soil or the fine-grained portion of soil that can be made to exhibit plasticity (putty-like properties) within a range of moisture contents, and that exhibits considerable strength when air-dry.
Coating	The protective material applied to the outer surface of a material, frequently metalwork.
Cofferdam	A temporary dam to divert water around a work site (of a diversion dam or other in-river-structure) via tunnel, culvert or ditch, as appropriate, or to enclose a portion of river bed which can then be dewatered to permit foundation preparation etc.
Compensation flow	The minimum flow legally required to be released to the watercourse below an intake, dam or weir, to ensure adequate flow downstream for environmental, purposes and public use (synonymous with reserve flow and riparian flow).
Concrete dam	See arch dam, buttress dam, or gravity dam. See also masonry dam. A concrete dam generally requires a sound rock foundation.
Concrete lift	In concrete work, the vertical distance between successive horizontal construction joints.
Conductor	A substance, body, device, or wire that readily conducts or carries electrical current.
Conduit	A closed channel to convey water through, around, or under a dam. Covered portion of spillway between the gate or crest structure and the terminal structure, where open channel flow and/or pressure flow conditions may exist.
Consolidation	Reduction in particle spacing in a soil, and decrease in water content, resulting from an increase in external pressure.
Consumptive water use	Total amount of water used by vegetation, man's activities, and evaporation of surface water.
Contour	A line of constant elevation
Contracted weir	The crest and sides of a rectangular weir are far enough from the bottom and sides of the channel so that their effect on flow is negligible.
Control area	Part of a power system, or a combination of systems, to which a common electrical generation allocation scheme is applied.
Control structure (control house)	Concrete portion of an outlet works, located at the downstream end of the tunnel or conduit, housing the control (regulation) gates.

Conveyance loss (distribution loss)	Loss of water from a channel or pipe during conveyance, including losses due to seepage, leakage, evaporation and transpiration by plants growing in or near the channel.
Conveyance system efficiency	The ratio of the volume of water delivered to users in proportion to the volume of water introduced into the conveyance system.
Covenant	A formal binding sealed agreement or contract
Crest	The top surface of the dam.
Crest elevation (crest of dam, top of dam, dam crest)	The elevation of the uppermost surface of a dam, usually a road or walkway, excluding any parapet wall, railing, curb. etc.
Crest gate (spillway gate)	A gate on the crest of a spillway to control the discharge or reservoir water level.
Crest length (length of dam)	The distance, measured along the axis or centerline crest of the dam at the top level of the main body of the dam
Crest structure	Portion of spillway between the inlet channel and the chute, tunnel or conduit, which does not contain gates.
Crest width (top thickness)	The thickness or width of a dam at the level of the top of dam
Critical depth	The depth of flow when the Froude number equals one.
Critical discharge	The maximum discharge for a given specific energy, or the discharge which will occur with minimum specific energy.
Critical flow	When the Froude number is equal to one, the flow is critical and surface waves remain stationary in the flow. Flow at critical depth.
Cross drainage structure	An aqueduct or culvert transporting flow from a lateral stream across (above or under) a power canal.
Current (I)	The movement of electrons through a conductor, measured in amperes.
Curtain Wall / Cut-Off Wall	A wall-like structure, of masonry, plain or reinforced cement concrete or steel sheet pile, under the floor of a hydraulic structure with the object of: a. Dividing the work into suitable compartments, b. To reduce the percolation of water through permeable strata, c. To minimize the likelihood of undermining of the foundation by increasing the path of percolation and reducing the exit gradient, d. As a safeguard against erosion and under mining of the structures by scour, e. To intercept permeable strata in the foundation and / or, and f. To increase the resistance of the structure against sliding.
Cycle	A completed round of regularly recurring events or phenomena.
Cycling	Power plant operation to meet the intermediated portion of the load (9 to 14 hours per day).
Daily pondage or storage	Storage for which a reservoir has a daily filling and emptying cycle also called “daily storage”
Dam	A barrier built across the watercourse to impound, control or divert the water. It is also used to increase the hydraulic head at head works of a hydropower station. A dam typically reduces the velocity of water in a particular river segment and increases the depth of water by forming an impoundment behind the dam.

Dead capacity /Dead storage	The reservoir capacity from which stored water cannot be evacuated by gravity. Nominally, the "empty" level of a reservoir.
Demand	The rate at which electric energy is delivered to or by a system, part of a system, or a piece of equipment. It is expressed in kilowatts, kilovolt amperes, or other suitable units at a given instant or averaged over a designated period of time. The primary source of "demand" is the power-consuming equipment of customers. Synonymous with load.
Demand charge	That portion of the charge for electric supply based upon the customer's demand characteristics.
Dependable capacity	The capacity that can be relied upon to carry system load for a specified time interval and period, provide assumed reserve, and/or meet firm power obligations.
Desalinization	The removal of dissolved salts from water by natural means (leaching) or by specific water treatment processes.
Desander	*See* desilter
Design Flood	Flood adopted for design purposes, which may be probable maximum flood or standard project flood or a flood corresponding to some adopted frequency of occurrence (50, 100, 200, 500 years, etc.) depending on the standard of security to be provided.
Design water level	The maximum water elevation, including the flood surcharge, that a dam is designed to be able to withstand.
Designated frequency flood	Refers to the probability that a flood will occur in a given year.
Desilter	System of settlement basins for removal of suspended sediments greater than a specified (design) size. Desilters are of two generic types: • Continuous flushing type • Intermittent flushing type Also known as a desander or settling basin
Dewatering	Removal of water from foundation excavations by pumping, drainage ditches etc.
Differential head (unbalanced head)	The condition in which the water pressure on the upstream and downstream sides of an object differ.
Differential surge tank	A differential surge tank is a throttled surge tank with an additional riser pipe which may be inside the tank (internal riser) or outside the tank.
Direct access	An arrangement in which customers can purchase electricity directly from any supplier in the competitive market, using the transmission and distribution lines of electric utilities to transport the electricity.
Direct current (DC)	Electrical current flowing in one direction only and essentially free from pulsation.
Direct runoff	Water that flows over the ground surface or through the ground directly into streams, rivers, or lakes.
Disaster	An event that demands a crisis response beyond the scope of any single line agency or service (e.g., beyond the scope of just the police department, fire department, etc.) and that presents a threat to a community or larger area.

Discharge	Volume of water that passes a given point within a given period of time.
Discharge capacity	The maximum amount of water that can safely released from a given waterway.
Distribution lines	Power lines, like those in neighborhoods, used to carry moderate voltage electricity which is "stepped down" to household levels by transformers on power poles.
Distribution system	The portion of an electric system that is dedicated to delivering electric energy to end users. The distribution system "steps down" power from high-voltage transmission lines to a level that can be used in homes and business.
Diversion	A process which, having return flow and consumptive use elements, turns water from a given path.
Diversion capacity	The flow which can be passed through the canal head works at a dam under normal head.
Diversion channel (canal or tunnel)	A waterway used to divert water from its natural course.
Diversion dam	A dam built to divert water from a waterway or stream into a different watercourse
Diversion inlet	A conduit or tunnel upstream from an intake structure. Diversion inlet may be integral with the outlet works or be part of a separate conveyance structure that will only be used during construction.
Double regulated turbine	Turbine regulated by two flow control devices for example: - Kaplan turbine where runner pitch and wicket gates are both used in flow control. - Pelton turbine where needle valves and jet deflectors are both used in flow control.
Drainage	Process of removing surface or subsurface water from a soil or area.
Drainage area	Area contributing flow at a given point on a river
Drawdown	The depth by which the water surface of a reservoir is lowered from a given elevation as the result of releasing water.
Drum gate	A movable crest gate in the form of a sector of a cylinder hinged at the centerline.
Dyke	A raised bank, typically earthen, constructed along a waterway to impound the water and to prevent flooding.
Dynamic pressure	When a pump is operating, the vertical distance from a reference point (such as a pump centerline) to the hydraulic grade line.
Earth dam (earth fill dam)	An embankment dam in which more than 50 percent of the total volume is formed of compacted earth material generally smaller than 3-inch size.
Earth lining	Compacted layer of earth on surface of canal or other excavation.
Earth pressure	The pressure or force exerted by soil on any boundary. See active earth pressure, at-rest earth pressure, and passive earth pressure.
Earthquake	A sudden motion or trembling in the earth caused by the abrupt release of accumulated stress along a fault.
Earthwork	Any one or combination of the operations involved in altering or movement of earth.

Ecology	Branch of biological science which deals with relationships between living organisms and their environments.
Eddy	Circular current of water moving against the main current. See recirculation zone.
Efficiency	Ratio of useful energy output to total energy input, usually expressed as a percent. Effective operation as measured by a comparison of production with cost.
EGL	Energy grade line.
Elbow	A pipe fitting having two openings which causes a run of pipe to change direction 90 degrees.
Electric power system	Physically connected electric generating, transmission, and distribution facilities operated as a unit under one control.
Embankment	An earth structure the top of which is higher than the adjoining surface.
Emergency gate	A standby or auxiliary gate used when the normal means of water control is not available. The first gate in a series of flow controls, remaining open while downstream gates or valves are operating.
Emergency spillway	A spillway which provides for additional safety should emergencies not contemplated by normal design assumptions be encountered,
Energy	The capacity for doing work as measured by the potential for doing work (potential energy) or the conversion of this potential to motion (kinetic energy). Work, measured in Newton-meters (or Joules). Energy has several forms, some of which are easily convertible and can be changed to another form useful for work. Most of the world's convertible energy comes from fossil fuels that are burned to produce heat that is then used as a transfer medium to mechanical or other means in order to accomplish tasks. Electrical energy is usually measured in kilowatt hours and represents power (kilowatts) operating for some period of time period (hours), while heat energy is usually measured in British thermal units. 1 kWh = 3.6×10^3 Joules
EPC contract	Engineering, procurement and construction contract.
Erosion	A gradual wearing away of soil or rock by running water, waves, or wind. Concrete surface disturbance caused by cavitation, abrasion from moving particles in water, impact of pedestrian or vehicular traffic, or impact of ice floes.
Evacuation	The fifth of five Early Warning System components consisting of the plans, personnel, equipment, and facilities needed to move the population at risk to safety.
Evaporation	Water vapor losses from water surfaces, sprinkler irrigation, and other related factors.
Evapotranspiration	The combined effect of evaporation and plant transpiration.
Excavation.	The action or process of excavating (to dig or remove earth).
Excess capacity	Power generation capacity available on a short-term basis that exceeds the firm energy on a long-term contract offered to an electricity customer.
Exciter	Device on a generator for controlling generator power factor and generator output voltage.

Expansion joint	A separation between adjoining parts of a concrete structure which is provided to allow small relative movements, such as those caused by temperature changes, to occur independently.
Facilities	Structures associated with Reclamation irrigation projects, municipal and industrial water systems, power generation facilities, including all storage, conveyance, distribution, and drainage systems.
Facing	With reference to a wall or concrete dam, a coating of a different material, masonry or brick, for architectural or protection purposes,
Factor of safety	The ratio of the ultimate strength of the material to the allowable or working stress.
Failure	An incident resulting in the uncontrolled release of water from a dam. Destroyed and made useless, ceases to function as a dam. More severe and hazardous than a breach.
Fauna	All animals associated with a given habitat, country, area, or period.
Feeder canal	Canal between headwork intake and desilter carrying sediment laden water.
Financial analysis	Procedure that considers only tangible factors when evaluating various alternatives.
Firm energy (power)	Non-interruptible energy and power guaranteed by the supplier to be available at all times, except for uncontrollable circumstances.
Fish ladder (fish way)	An inclined trough which carries water from above to below a dam so that fish can easily swim upstream.
Fish way (fish ladder)	A structure consisting e.g. of a series of overflow weirs which in serve as a means for allowing migrating fish to travel upstream passed a barrier such as a dam or weir.
Flood	A temporary rise in water levels resulting in inundation of areas not normally covered by water.
Flood boundary	Line drawn or outer edge of colored (inundation) area on an inundation map to show the limit of flooding.
Flood hydrograph	A graph showing, for a given point on a stream, the discharge, height, or other characteristic of a flood with respect to time.
Flora	All plant life associated with a given habitat, country, or period. Bacteria are considered flora.
Flow	Quantity of water per second (m^3/s) flowing at a given location. May be expressed as: • Base flow, low/dry season flows sustained by contributions from ground water • Mean flow – flows averaged over discrete periods typical, daily, monthly or yearly. • Firm flow (or dependable flow) is determined as the flow available 90% to 100% of the time. • Secondary flow, flow in excess of firm flow that may be used to generate additional (secondary) energy in periods of high inflows in interconnected systems. • Peak flow, maximum flow due to a flood.
Flow augmentation	The release of water stored in a reservoir or other impoundment to increase the natural flow of a stream.

Flow duration curve	Distribution curve showing flow versus percent of time equaled or exceeded for specified periods.
Flow regulation	Operation of a storage reservoir to enhance firm and / or reduce spillage. Surplus water is held in storage and released in an orderly pattern to meet system demand. Flow regulation may be on a daily, weekly, seasonal, annual or multi-annual basis, depending on the reservoir volume.
Flume	A flume is an artificial water channel, usually made of wood or concrete and often elevated as part of an aqueduct or flume bridge.
Flushing	A method used to clean water distribution lines by passing a large amount of water through the system.
Fore bay (headrace)	Impoundment immediately upstream from a dam or hydroelectric plant intake structure.
Fore bay Tank	Storage tank for handling turbine flow changes due to load rejection / acceptance.
Foundation drains	Tile or pipe for collecting seepage within a foundation.
Free Board	The vertical distance between a specified water surface and the top of the non overflow section of a structure, embankment or canal dyke. Or The difference in elevation between the maximum water surface in the reservoir and the dam crest
Frequency	Refers to the rate of current reversals in AC electrical systems. The common system frequencies are 50 Hz in (Europe, most of Asia and India) and 60 Hz in North and South America.
Frequency demand scheduling	Method of irrigation scheduling similar to demand scheduling, but typically involves a fixed duration of the delivery, such as 24 hours.
Full supply level (FSL)	The water level corresponding to the "full" reservoir condition. In the case of simple overflow diversion weirs the FSL is equal to the crest elevation of the weir.
Fuse	A thin core of black powder surrounded by wrappings, which when lit at one end, will burn to the other at a fixed speed.
Gantry crane	A fixed or traveling, bent-supported crane for handling heavy equipment.
Gate	Movable devices in steel that are used to control water level and flow in headworks (intakes and spillway), canals, tunnels, powerhouse intakes and outlets, etc. Gates of the following types are common on hydropower projects: • Vertical lift gate (wheeled type or sliding type) • Radial gate in the form of a sector of a circle rotating about at trunnion. • Pneumatic or rubber gate in the form of an inflated tube attached to the crest of a dam (weir) Gates may be raised or lowered using wire cables, chain hoists, screw jacks or hydraulic pistons.
Gate seals	Elements along the perimeter of a gate to ensure water tightness. Typically made of rubber.

Gate valve	A valve with a circular-shaped closing element that fits securely over an opening through which water flows.
Gauge (gage)	Device for registering water level, discharge, velocity, pressure, etc. Thickness of wire or sheet metal.
Gauge pressure	Absolute pressure minus atmospheric pressure. The pressure within a closed container as measured with a gauge.
Gauging station	Specific location on a stream where systematic observations of hydrologic data are obtained through mechanical or electrical means.
Generation (electricity)	The process of producing electric energy by transforming other forms of energy; also, the amount of electric energy produced, usually expressed in kilowatt hours (kWh).
Generator	A machine that converts mechanical energy into electrical energy.
Geology	The science that deals with the physical history of the earth, the rocks of which it is comprised, and the physical changes which the earth has undergone or is undergoing.
Geophysics	Refers to the physics of the earth, e.g., seismology, oceanography, volcanology, geomagnetism, etc.
Gigawatt (gw)	Unit of power equal to 1 billion watts.
Gigawatt-hour (GWh)	One billion watt-hours of electrical energy.
Glacier (ice sheet)	A large thick mass of ice formed on land by the compacting and recrystallization of old snow and move under the influence of gravity. Glaciers survive from year to year, and creep down slope or outward due to the stress of their own weight.
Global positioning systems (GPS)	Space-based radio positioning systems that provide 24-hour, three-dimensional position, velocity, and time information to suitably equipped users anywhere on or near the surface of the Earth.
Governor	Device for controlling turbine operation, there are three conventional types of governor: • Speed governor, operates to keep turbine operating at the design rotational speed. • Water level control operates to keep forebay water level constant (between prescribed limits). • Load control governor operates to keep turbine operating at a selected load. . All three functions may be provided in a single modern digital governor.
Gravel Ejector	A gravel ejector intercepts and diverts bed load and some suspended sediment load moving close to the bed. Gravel ejectors are of two generic types: • Under sluice type • Vortex type A gravel ejector would be considered where the probability of some fraction of bed load entering an intake is considered to be significant. These structures are also known as silt ejectors and gravel traps.
Gravity arch dam	A dam designed to combine load resisting features of both a gravity and arch type dam.

Gravity dam	A dam constructed of concrete and/or masonry which relies on its weight and internal strength for stability.
Grid	A system of interconnected power lines and generators that is managed so that output of the generators is dispatched as needed to meet the requirements of the customers connected to the grid at various points
Gross generation	Total amount of electrical energy produced by a generating station or stations, measured at generator terminals.
Gross Head (H_G)	Difference in elevation between the water levels of the fore bay and tailrace.
Ground water table	The upper boundary of ground water where water pressure is equal to atmospheric pressure, i.e., water level in a bore hole after equilibrium when ground water can freely enter the hole from the sides and bottom.
Ground-fault circuit interrupter (GFCI)	An electrical device designed to protect people (not equipment) from electrical shock
GWh	Giga Watt hour is a unit of energy equal to a million kWh or 10^9 Wh.
Habitat	The locality or external environment in which a plant or animal normally lives and grows.
Head	Differential of pressure causing flow in a fluid system, usually expressed in terms of the height of a liquid column that pressure will support.
Head loss	The energy lost from a flowing fluid due to friction, transitions, bends, etc.
Head Pond	Reservoir upstream of diversion dam (or head works)
Head Regulator	An intake equipped with gates to control (regulate) flow entering a waterway system.
Head works	A complex comprising: spillway, diversion dam and intake for diversion of flow from the river into the water conductance system, for handling floods and for control of sediment.
Headwater	The waters immediately upstream of a dam. For power dams, also referred to as the water in the impoundment which supplies the turbines
Headwater level (HWL)	Generally refers to water level in the head pond, but sometimes refers to water level in the fore bay tank.
Hertz (Hz)	The number of complete electromagnetic cycles or waves in one second of an electrical or electronic circuit.
High-pressure gate	A gate consisting of a rectangular leaf encased in a body and bonnet and equipped with a hydraulic hoist for moving the gate leaf.
Hydraulic	Powered by water. Having to do with water in motion.
Hydraulic efficiency	Efficiency of a pump or turbine to impart energy to or extract energy from water. The ability of hydraulic structure or element to conduct water with minimum energy loss.
Hydraulic grade line (HGL) (Hydraulic gradient)	The hydraulic grade line lies below the energy grade line by an amount equal to the velocity head at the section.

Hydraulic transient	
Hydroelectric power	A facility at which the turbine generators are driven by falling water.
Hydrograph	A graphical representation of the stage or discharge as a function of time at a particular point on a watercourse; a time-discharge curve of the unsteady flow of water. Or A graph showing the variation of gauge/river stage, discharge, velocity, sediment concentration or sediment discharge or some other feature of flowing water with respect to time at a given place.
Hydrologic cycle	Cycle of water movement from atmosphere to Earth by precipitation and its return to the atmosphere by interception, evaporation, runoff, infiltration, percolation, storage, and transpiration.
Hydrology	Scientific study of water in nature: its properties, distribution, and behavior. The science that treats the occurrence, circulation properties, and distribution of the waters of the earth and their reaction to the environment.
Hydrometer	A device for measuring the specific gravity of fluids.
Impeller	A rotary pump member using centrifugal force to discharge a fluid into outlet passages.
Impermeable	Having a texture that does not permit water to move through quickly.
Impoundment	The body of water created by a dam.
In situ	In place, the original location, in the natural environment.
Installed capacity	A measure indicating the nominal generating capability of a project or unit, as designated by the manufacturer. Also termed *nameplate capacity.*
Institutionalized populations	People in schools, hospitals, nursing homes, prisons, federal buildings, or other facilities that require special care or consideration during emergencies by virtue of their dependency on others for appropriate protection.
Intake	A structure controlling entry of water from the river into the water conductor system or from a canal into a flume or pipeline. Intakes can be if several types, notably. • Lateral (or stream side intake). • Trench intake. • Tyrolean intake (a variation of trench intake for mountainous streams). • Penstock/ pipeline.
Intake structure	Concrete portion of an outlet works, including trashracks and/or fish screens, upstream from the tunnel or conduit portions.
Internal Rate of Return	The internal rate of return is the discount rate at which the sum of periodic benefits (revenues minus operating and maintenance costs) is equal to the present value of the initial investment.

Inverted syphon	A waterway passing underneath the bed of a water course with flow under pressure.
Kaplan turbine	Similar to propeller turbine but with adjustable runner blades and adjustable guide vanes, thus double-regulated.
Kilovolt-ampere (kVA)	1000 volt-amperes and approximately 89/100 of a kilowatt.
Kilowatt (kW)	Unit of electric power equal to 1,000 watts or about 1.34 horsepower. For example, it's the amount of electric power required to light ten 100-watt light bulbs.
Kilowatt-hour (kWh)	The unit of electrical energy commonly used in marketing electric power; the energy produced by 1 kilowatt acting for one hour. Ten 100-watt light bulbs burning for one hour would consume one kilowatt hour of electricity.
Kinetic energy	The energy of a body with respect to the motion of the body.
Laminar flow	Flow in which the head loss is proportional to the first power of the velocity.
Lateral intake	An intake located in a river bank usually as a component of plant head works drawing off water laterally from the stream or river.
Level	To make level or to cause to conform to a specified grade. Any instrument that can be used to indicate a horizontal line or plane.
Lining	Any protective material used to line the interior surface of a conduit, pipe, or tunnel. With reference to a canal, tunnel or shaft, a coating of asphaltic concrete, concrete, reinforced concrete, or shotcrete to provide water tightness, to prevent erosion, or to reduce friction.
Live storage (available)	Volume of water available at any time between actual water level and dead storage level in a reservoir.
Live storage capacity	Capacity (volume) available between full reservoir level and dead storage level.
Load(Electric)	The total customer demand for electric service at any given time. Or Amount of electrical capacity or energy delivered or required at a given point. Synonymous with electrical demand.
Load controller	*See* load governor.
Load factor	The ratio of production within a specified period (year, month etc.) to production that would result if the plant was operating at maximum (rated) output during that period.
Load governor	A load governor comprises an electronic sensing device and ballast load in parallel with the system load. The sensor measures frequency and detects deviations from the system frequency. The sensor then adjusts the ballast load by switching preset resistance elements on/off to correct such speed deviations. In effect the turbine / generator operates at constant capacity at all times and the load governor operates to equate system plus ballast load to turbine / generator output. Commonly used in mini hydro projects up to about 100 kW.
Low supply level	*See* minimum water level in a reservoir.

Manifold (Header)	A large pipe to which a series of smaller pipes are connected.
Manning's roughness coefficient (n)	A coefficient used to describe the relative roughness of a channel and overbank areas; used in hydraulic computations.
Manometer	An instrument for measuring pressure.
Masonry dam	Any dam constructed mainly of stone, brick or concrete blocks jointed with mortar.
Maximum demand	The greatest of all demands of the load that has occurred within a specified period of time.
Maximum flood level (MFL)	The maximum water level in the head pond resulting from the design flood assuming normal operation of flood control equipment, typically spillway gates.
Meander	Big bend and loops in a river channel as the river snakes through a flat land area.
Mega	A prefix meaning "million".
Megawatt (MW)	One million watts of electrical power (capacity).
Megawatt-hour (MWh)	One million watt- hours of electrical energy.
Memorandum of Understanding (MOU)	A formal document that states the intentions and/or responsibilities of the signatory parties.
Minimum water level (Min.W.L.)	The water level corresponding to "empty" reservoir condition. At levels below the Min. W.L. the plant design flow cannot be delivered and plant output would the reduced. Sometimes referred to as *minimum operating level.*
Mitigation	Special structures and / or operation practices to reduce or eliminate adverse environment effects of a hydropower development.
Morning glory spillway	A circular or glory hole form of a drop inlet spillway. Usually free standing in the reservoir and so called because of its resemblance to the morning glory flower.
Motor efficiency	The ratio of energy delivered by a motor to the energy supplied to it during a fixed period or cycle.
Natural floodway	The channel of a water course and those portions of the adjoining flood plain which are reasonably required to carry a selected probability flood
Negative pressure	Pressure within a pipe that is less than atmospheric pressure.
Net capability	The maximum load-carrying ability of the equipment, exclusive of station use, under specified conditions for a given time interval, independent of the characteristics of the load.
Net head (H_N)	Net head is equal to gross head less all hydraulic losses between reservoir/fore bay to tailrace except those chargeable to the turbine.
Net present value (NPV)	The difference between revenues and expenses, both discounted at a fixed periodic interest rate and time period, is the net present value (NPV) of the investment. Often the lifetime NPV is of interest.
Normal operating level (NOL)	The water level in the forebay tank when plant is operating under design conditions
Off peak	A period of relatively low demand for electrical power, such as the middle of the night.

Ogee crest	The shape of the concrete spillway crest that represents the lower profile of the undernappe of a jet of water flowing over a sharp-crested weir at a design depth.
Ohm	The unit of electrical resistance to current flow. The resistance in a conductor in which one volt of potential difference produces a current of one ampere.
On peak	A period of relatively high demand for electrical power.
Orifice	An opening with a closed perimeter and a regular form through which water flows.
Outage	The period during which a generating unit, transmission line, or other facility is out of service.
Outage	Period during which a generating unit, transmission line, or other facility is out of service.
Outflow	The amount of water passing a given point downstream of a structure, expressed in acre-feet per day or cubic feet per second.
Outlet	An opening through which water can be freely discharged from a reservoir to the river for a particular purpose.
Outlet capacity	The amount of water that can be safely released through the outlet works.
Outlet gate	A gate controlling the flow of water through a reservoir outlet.
Outlet Works	A combination of structures and equipment required for the safe operation and control of water released from a reservoir to serve various purposes, i.e., regulate stream flow and quality; release floodwater; and provide irrigation, municipal, and/or industrial water.
Output	The amount of power (or energy, depending on definition) delivered by a piece of equipment, station or system.
Over speed	The maximum speed a runner reaches when, under design conditions, all external loads are removed and turbine wicket gates are closed at the prescribed rate.
Parts per million (ppm)	A measurement of concentration on a weight or volume basis. Equivalent to milligrams per liter (mg/l).
Pascal (Pa)	The pressure or stress of one newton per square meter. 1 psi = 6895 Pa.
Pay-back-period	The number of years for the invested capital to be offset by financial benefits of a project. Also termed recovery or break-even period.
Payline	Lines of excavation, backfill, compacted backfill or embankment which are described in the specifications or shown on the drawings which describe or show the limits to which earthwork is paid for.
Peak demand (peak load)	A one hour period in a year representing the highest point of customer consumption of electricity.
Peak demand	Maximum electrical demand occurring within a specified period of time. Maximum power used in a specific time period
Peak flow	Maximum instantaneous flow in a specified period of time.
Peak load plant	Power plant that normally is operated to provide power during maximum load periods.
Peak load.	The maximum power load in a stated period of time
Peaking capacity	Capacity of generating equipment normally reserved for operation during the hours of highest daily, weekly, or seasonal loads.

Peaking plant	A plant which operates at high or maximum capacity during hours of peak (maximum) system demand and is shut down or operates at reduced output for the remainder of the day. For run-of-river projects peaking operation is only possible where the head pond reservoir in large enough to provide daily pondage or a balancing reservoir has been provided.
Peaking power	Power plant capacity typically used to meet the highest levels of demand in a utility's load or demand profile.
Penstock	Pressurized pipeline supplying water to the turbine from the Fore bay tank or reservoir. For low pressure pipelines at other locations in the water conductor system the term "pipeline" is preferred.
Penstock intake	Intake located at the upper end of a penstock
Penstock/pipeline intake	An intake controlling entry of water from the forebay or power canal into a penstock or pipeline.
Per capita use	The average amount of water used per person during a standard time period, generally per day.
Percolation rate	The rate at which water moves through porous media, such as soil.
Perennial stream	A stream that flows continually throughout the year.
Permeability	The measure of the flow of water through soil.
Piezometer	An instrument which measures pressure head or hydraulic pressures in a conduit or hydraulic pressures within the fill of an earth dam or the abutment; at the foundation because of seepage or soil compression; or on a flow surface of a spillway, gate, or valve.
Pile	Relatively slender structural element which is driven, or otherwise introduced, into the soil, usually for the purpose of providing vertical or lateral support.
Piping	The erosion of embankment or foundation material (soil) due to leakage.
Pitching	A protective covering of material on the earthen surface slope (side pitching) and beds (bed pitching) of rivers or cannels.
Plant	Station where mechanical, chemical, and/or nuclear energy is converted into electric energy.
Plant factor	Ratio of average energy production of a plant to the production obtained assuming the plant was operated continuously at its installed capacity (for the period under study)
Porosity	The ratio of the volume of void space to the total volume of an undisturbed sample.
Positive pressure	Pressure within a pipe that is greater than atmospheric pressure.
Potential energy	The energy of a body with respect to the position of the body.
Power	Mechanical or electrical force or energy. The rate at which work is done by an electrical energy or mechanical force, generally measured in kilowatts or horsepower. Also electrical energy generated, transferred, or used; usually expressed in kilowatts
Power canal	Canal downstream of desilter carrying clean water.
Power canal surge	A wave produced in a power canal by sudden shut down or start up of a turbine is termed a canal surge. On sudden shutdown a negative (rejection) surge is produced which is often manifest as a hydraulic

	bore. On startup the hydraulic effects of the positive surge (wave) are less dramatic.
Power demand	Rate at which electric energy is required and delivered to or by a system over any designated period of time.
Power factor	The ratio of the amount of power, measured in kilowatts (kW) to the apparent power measured in kilovolt-amperes (kVA).
Power house	The building that houses electric generating equipment and related auxiliaries.
Power plant	Structure that houses turbines, generators, and associated control equipment.
Power plant capacity	The capacity for power plants is the addition of nameplate rating in kW (kilowatts) of all generating units of a particular plant..
Pressure head	The amount of force or pressure created by a depth of one foot of water.
Private sector	Industry, volunteer, quasi-governmental, etc., having a role in emergency planning and preparedness.
Project	A single financial entity which can be composed of several units or divisions, integrated projects, or participating projects.
Propeller turbine	An axial flow turbine with adjustable guide vanes and fixed runner blades, thus single regulated.
Pumped-storage plant	Power plant designed to generate electric energy for peak load use by releasing water previously pumped into an elevated storage reservoir, usually during off-peak periods.
Purchased power	Normally this type is used to represent the purchase cost of energy for firming up the power supply.
Rate of return	The rate of return on investment in the ratio of annual benefits (net of annual cost) as a percentage of the original book value of the investment.
Rated capacity	That capacity which a hydro generator can deliver without exceeding mechanical safety factors or allowable temperature rise for design head and design flow. In general this is also the *nameplate rating.*
Rated head	Water depth for which a hydroelectric generator and turbines were designed.
Rating curve	A curve giving the relationship between flow and water level at a given location.
Reactive power	The portion of power that is produced by load inductances or capacitances.
Rectangular weir	A contracted or suppressed weir with a horizontal crest, rectangular in shape, having vertical sides.
Regulated turbine	A turbine in which the flow is controlled by a flow control device, such as needle valves, adjustable guide vane (wicket gates), variable runner blades or deflection arm.
Rehabilitation	The process of renovating a facility or system whose performance is failing to meet the original criteria and needs of the project.
Relative density	Used in construction control for cohesionless soils where the in-place density is compared to the minimum and maximum density of the soil from laboratory tests.
Relative humidity	The ratio of the amount of moisture in the air to the maximum amount

	of moisture the air could hold under the same conditions; usually expressed as a percentage.
Release	The amount of water released after use.
Relief valve	A valve which will allow air or fluid to escape if its pressure becomes higher than the valve setting.
Reserve Flow	See compensation flow or riparian flow.
Reservoir	A body of water impounded by a dam and in which water can be stored or An artificial lake into which water flows and is stored for future use
Restricted orifice surge tank	Similar to a simple surge tank except that the inlet is throttled to improve damping of oscillations by offering greater flow resistance.
Return-flow system (reuse system)	A system of pipelines or ditches to collect and convey surface or subsurface runoff from an irrigated field for reuse.
Revetment	An embankment or wall of sandbags, earth, etc., constructed to restrain material from being transported away.
Reynolds Number	A dimensionless parameter used in pipe friction calculations, and derived from pipe diameter, liquid velocity and kinematic viscosity.
Riparian flow	In the sense used in this Standard, riparian flow means the minimum flow that (by law) has to be released below a diversion dam to provide for domestic use, for protection of the aquatic environment or to meet the licensed water allocation of pre-existing (and valid) water use permit holders in the zone affected by a hydropower development. *(Synonym: compensation flow, reserve flow).*
Rip-rap	Stone, broken rock or concrete block revetment materials placed in layers on an embankment as protection against erosion.
Riser	Vertical pipe between surge tank cylinder and "T" Junction on pipeline (also see surge tank).
Rock fill dam	An embankment dam in which more than 50 percent of the total volume is comprised of compacted or dumped cobbles, boulders, rock fragments, or quarried rock generally larger than 3-inch size. The rock provides structural integrity for the dam around an impervious core.
Rotor	The rotating part of generator which support field windings
Runaway speed	The maximum speed a turbine would reach if the wicket gates remained open after loss of full load (100% load rejection).
Runner (wheel)	The rotating part of a turbine
Runoff	Net of precipitation less evapo-transpiration may be expressed as total runoff (synonymous to flow), unit runoff (as liters/s per km^2) or depth (precipitation – evapo-transpiration (in mm). Or The portion of precipitation, snow melt, or irrigation that flows over the soil, eventually making its way to surface water supplies
Run-of-river plant	Plant without storage reservoirs where water is used at the rate at which it "runs" in the river. The regulated inflow of one power plant is equal to the outflow from a power plant upstream

Saddle dam	A subsidiary dam of any type constructed across a saddle or low point on the perimeter of a reservoir.
Sand	Mineral grains whose particle size varies from a No. 4 sieve to a No. 200 sieve.
Sandstone	Sedimentary rock composed of sand-sized grains (usually quartz) cemented together.
Screen	A mesh or bar surface used for separating pieces or particles of different sizes. A filter.
Sediment	Any finely divided organic and/or mineral matter deposited by air or water in non- turbulent areas.
Sedimentation	Deposition of waterborne sediments due to a decrease in velocity and corresponding reduction in the size and amount of sediment which can be carried.
Seepage	The slow movement or percolation of water through soil or rock.
Seepage loss	Water loss by capillary action and slow percolation.
Semi-Kaplan turbine	Fixed guide vanes and adjustable runner blades, single regulated.
Shaft spillway	A vertical or inclined shaft into which water spills and then is conveyed through, under, or around a dam by means of a conduit or tunnel.
Shut-off-valve	A shut off valve is used to: • Isolate turbine from penstock • Shut off the conduit in case of an emergency • Temporarily regulate non-regulated turbines Shut-off valves can be of the following types: • Butterfly valves • Spherical valves • Gate valves (mini-hydro)
Silt ejectors	*See* gravel ejectors.
Silting	Filling with soil or mud deposited by water.
Simple surge tank	A simple surge tank is a tank connected by a short riser to the upstream pressure tunnel (or pipeline). The cross section area of the riser should be equal or greater than the cross section area of the tunnel (or pipeline).
Single regulated turbine	Regulated turbine with one flow control device.
Slide gate	A steel gate that upon opening or closing slides on its bearings in edge guide slots.
Sluice	An opening for releasing water from below the static head elevation.
Sluice gate	A gate that can be opened or closed by sliding in supporting guides.

<table>
<tr><td>Small/Mini/Micro/ Pico Hydro</td><td>This classification of hydropower is based on installed capacity of the power plant. Different countries follow different capacities for such classification. In India, these definition are as follows:
Village/Pico hydro up to 5 kW
Micro hydro up to 100 kW
Mini hydro 101 – 2000 kW
Small hydro 2001 – 25000 kW
Worldwide small hydro definitions are as follows
<table>
<tr><th>Country Name</th><th>Capacity (MW)</th></tr>
<tr><td>Italy</td><td>≤ 3</td></tr>
<tr><td>Dominican Republic, Guatemala, Macedonia</td><td>≤ 5</td></tr>
<tr><td>Mauritius</td><td>≤0.05</td></tr>
<tr><td>Marocco</td><td>≤8</td></tr>
<tr><td>Afghanistan, Burundi, Iran, Malaysia, Mali, Nepal, Norway, Sri Lanka, Tunisia, Kenya, Uganda, Zambia, Madagascar, Armenia, Austria, Croatia, Montenegro, Nigeria, Turkey, Serbia, Slovenia, Switzerland, Azerbaijan, Cambodia, Philippines, Indonesia, Senegal</td><td>≤10</td></tr>
<tr><td>Georgia</td><td>≤ 13</td></tr>
<tr><td>Bangladesh, Laos, Lesotho, Thailand</td><td>≤15</td></tr>
<tr><td>El Salvador, Peru</td><td>≤ 20</td></tr>
<tr><td>Bhutan, India, Mozambique</td><td>≤25</td></tr>
<tr><td>Argentina, Brazil, Mexico, Benin, United States</td><td>≤30</td></tr>
<tr><td>Canada, China, Pakistan, New Zealand</td><td>≤ 50</td></tr>
</table></td></tr>
<tr><td>Specific gravity</td><td>The ratio of the mass of a body to an equal volume of water.</td></tr>
<tr><td>Specific speed</td><td>From consideration of flow, dynamic and geometric similitude it can be shown that runners having similar specific speeds will have similar geometries and operating characteristics. Specific speed is a parameter defined as
$N_s = N_o \frac{\sqrt{p}}{H^{5/4}}$
where:
N_s = specific speed
N_o = design (synchronous speed (rpm)
P = power in kW (or horsepower)
H = Net head (m)
Selection of type of turbine and synchronous speed (N_s is normally, based on empirical equations giving Ns as a function of H.</td></tr>
<tr><td>Specific weight</td><td>The weight per unit volume.</td></tr>
<tr><td>Speed</td><td>Refers to the rate of rotation of a generator in rotations per minute (rpm). The following formula gives the relationship between generator speed and (electric) system frequency
$N = \frac{120f}{p}$</td></tr>
</table>

	Where: N= generator speed (rpm) f = system frequency (Hz) p = number of poles in generator (normally an even number)
Speed-no-load	It is the condition where the turbine generator unit is put on line at synchronous speed but with insignificant power output. It is then ready for picking up new load that may be added to the system.
Spills	Water releases that cannot be put to use for project purposes (includes flood flows).
Spillway	Structure for safely discharging flows in excess of turbine capacity past the diversion dam and head works. Spillway designs are based on rare flood flows. Typically the Q_{100} is used for SHP. There are two basic generic designs • Over flow spillway (weir) • Gated spillway, or • A combination of both
Spillway channel	An open channel or conduit conveying water from the spillway inlet downstream.
Spillway chute	A steeply sloping spillway channel that conveys discharges at super-critical velocities.
Spillway crest	The lowest level at which water can flow over or through a spillway.
Stage (of a river)	The elevation of water surface relative to a convenient (local) datum.
Static head	The difference in elevation between the pumping source and the point of delivery. The vertical distance between two points in a fluid.
Stator	That portion of a generator which contains the stationary (non-moving) parts that surround the moving parts (rotor).
Stator windings	The armature or stationary winding of a synchronous generator.
Stilling Basin	A short reach of paved channel downstream of a spillway within which a hydraulic jump, used for energy dissipation in hydraulic structures, is confined either partly or entirely.
Storage	The retention of water or delay of runoff either by planned operation, as in a reservoir, or by temporary filling of overflow areas, as in the progression of a flood wave through a natural stream channel.
Stream	Natural water course containing water at least part of the year.
Subcritical flow	Those conditions of flow for which the depths are greater than critical and the velocities are less than critical.
Subgrade	The soil prepared and compacted to support a structure or a pavement system.
Substation	Facility equipment that switches, changes, or regulates electric voltage.
Substation capacity	The substation capacities are given in kVA (kilovolt-amperes).
Sump	A pit or pool for draining, collecting, or storing water. A chamber located at the entrance to the pump which provides water to the pump.
Supercritical flow	Those conditions of flow for which the depths are less than critical and the velocities are greater than critical.

Suppressed weir.	A rectangular weir that has only the crest far removed from the channel bottom, the sides are coincident with the sides of the approach channel, so no lateral contraction of water passing through the weir is possible.
Surface runoff	Precipitation, snow melt, or irrigation in excess of what can infiltrate the soil surface and be stored. Surface runoff is a major transporter of non-point source pollutants.
Surge	A rapid increase in the depth of flow.
Surge chamber	A chamber or tank connected to a pipe and located at or near a valve that may quickly open or close or a pump that may suddenly start or stop.
Surge tank	A surge tank provides protection against excessive water hammer pressure rise on load rejection and provides a volume of water for facilitating turbine start up on load acceptance. **Types:** • Simple type with minimal flow restriction in riser • Restricted orifice type with orifice in riser to dissipate energy orifice may have different loss characteristics for inflow and outflow. • Differential type with main tank and central riser with port holes (intermediate in behavior between simple and orifice types).
Suspended load (suspended sediment)	Sediment that is supported by the upward components of turbulence in a stream and that stays in suspension for an appreciable length of time
Suspension	A method of sediment transport in which air or water turbulence supports the weight of the sediment particles, thereby keeping them from settling out or being deposited.
Switchyard	Area holding power transformers and related switchgear, circuit breakers etc.
Synchronous condensers	A synchronous machine running without mechanical load and supplying or absorbing reactive power.
Synchronous speed	The rotational speed of the generator such that the frequency of the alternating current produced is precisely the same as that of the system being supplied.
Tailrace	The channel located between a hydroelectric powerhouse and the river into which the water is discharged after passing through the turbines.
Tailrace curve	A curve relating tailrace W.L. at the powerhouse to flow in tailrace waterway.
Tail water	The water in the natural stream immediately downstream from a dam.
Tail water level	The water level immediately downstream of a dam or powerhouse.
Tee	A pipe fitting that has two threaded openings in line, and a third at right angles to them.
Temporary river diversion	Temporary works typically comprising cofferdams, diversion conduits (pipes or culverts) or ditches for the purpose of dewatering the river bed, or portion thereof, for foundation preparation and construction of in river structures.
Terrain	Ground surface

Top of dead capacity	The lowest elevation in the reservoir from which water can be drawn by gravity.
Topography	Physical shape of the ground surface.
Total capacity	The reservoir capacity below the highest of the elevations representing either the top of exclusive flood control capacity, the top of joint use capacity, or the top of active conservation capacity.
Transformer	Device for increasing (stepping up) or decreasing (stepping down) line voltage between generator to transmission line and transmission line to distribution line.
Transmission	The act or process of transporting electric energy in bulk.
Transmission line	Facility for transmitting electrical energy at high voltage from one point to another point. Transmission line voltages are normally 115 kilovolt or larger.
Transport capacity	The capacity of a river to carry sediment in suspension or to move sediment along the riverbed. Usually expressed as mass per unit of time
Trapezoidal weir	A contracted weir of trapezoidal shape in which the sides of the notch are given a slope of 1 horizontal to 4 vertical
Trash rack	Grating installed at the entrance to an intake to prevent floating debris from entering the water conductor (waterway) system or penstock
Trench Intake	An intake installed in the bed of a river abstracting water through a rack into a lateral trench leading to the water conductance system in one or other of the river's banks.
Tubular Turbine	Axial turbine with axial or diagonal inflow to the guide vanes, usually with horizontal or inclined shaft. The unit may be double, single or non-regulated. Tubular turbines include: bulb, pit and S-type units.
Tunnel	Covered portion of spillway between the gate or crest structure and the terminal structure, where open channel flow and/or pressure flow conditions may exist.
Turbine	A machine for generating rotary mechanical power from the energy of flowing water. Turbines are of the following types: • Francis, radial flow to runner • Kaplan, axial flow to runner • Pelton, impulse type with 1-6 jets impinging a series of runner wheel buckets. • Cross-flow, a variant of the impulse type where jet impinges on entry and exit to the runner.
Turbulent flow	That type of flow in which any water particle may move in any direction with respect to any other particle, and in which the head loss is approximately proportional to the second power of the velocity.
Tyrolean intake	A variant of the trench intake employed on mountain streams.
Unit	A turbine and connected generator that work together as a unit.
Unit Parameters	The following unit parameters give relationships between model and prototype characteristics. These parameters are very useful for the analysis, evaluation and prediction of the performance of turbines. Unit speed $(n_{11}) = \frac{D.N}{\sqrt{H_n}}$

	Unit flow $(q_{11}) = \frac{Q}{D^2.\sqrt{H_n}}$ Unit Power $(p_{11}) = \frac{P}{D^2.H_n^{3/2}}$ Unit torque $(m_{11}) = \frac{M}{D^3.H_n^{3/2}}$ Specific speed $(N_s) = \frac{N\sqrt{Q}}{H^{3/4}}$ Or $= \frac{N.\sqrt{P}}{H^{5/4}}$ Where: D is runner diameter (m) N is rotational speed (rpm) H_n is net head on turbine (m) M is output torque (m.N.)
Uplift	The upward pressure in the pores of a material (interstitial pressure) on the base of a structure.
Valve	A device used to control the flow in a conduit, pipe, or tunnel that permanently obstructs a portion of the waterway.
Velocity	Rate of flow of water expressed in feet per second or miles per hour.
Venturi	A pressure jet that draws in and mixes air.
Viscosity	The resistance of a fluid to flow. A liquid with a high viscosity rating will resist flow more readily than will a liquid with a low viscosity
V-notch weir	A weir that is V-shaped, with its apex downward, used to accurately measure small rates of flow.
Void	Space in a soil or rock mass not occupied by solid mineral matter.
Void ratio	The ratio of the volume of void space to the volume of solid particles in a given soil mass.
Volt(V)	The unit of measurement of electromotive force or electric pressure, akin to water pressure in pounds per square inch.
Voltage (E)	Electrical pressure, i.e. the force which causes current to flow through an electrical conductor.
Volt-ampere (VA)	A unit of apparent power in an ac circuit containing reactance.
Volt-amperes reactive (VARS)	The unit of measure for reactive power.
Vortex	A revolving mass of water (whirlpool) in which the streamlines are concentric circles and in which the total head is the same. Water rotating about an axis.
Water conductor system	System of canals, aqueducts, pipelines, tunnels - etc. for transporting water from intake to turbine. Sometimes termed *"waterway"*
Water conveyance efficiency	Ratio of the volume of irrigation water delivered by a distribution system to the water introduced into the system.

Water conveyance structure	Any structure that conveys water from one location to another.
Water cycle	The movement of water from the air to and below the Earth's surface and back into the air.
Water quality	The condition of water as it relates to impurities.
Water hammer	Water hammer is a pressure wave produced in water piping system due to rapid valve opening or closing. This phenomenon sometimes produces audible "thumping" sounds in a piping system.
Watershed (drainage area)	Surface drainage area above a specified point on a stream.
Waterways	*See* water conductor system
Watt	Basic unit of electrical power produced at one time.
Watt hour(Wh)	An electrical energy unit of measure equal to one watt of power supplied to, or taken from, an electrical circuit steadily for one hour.
Wave celerity	The speed at which a pressure wave will propagate through a penstock, pipeline or power tunnel.
Weir	An overflow structure built across an open channel to raise the upstream water level and/or to measure the flow of water.
Wheeling charges	Charges for transportation and delivery of electrical power at an agreed location.
Wicket gate	In hydropower applications a gate which pivots open around the periphery of a turbine or pump to allow water to enter.
Work plan	Plans those are prepared which detail the scope, direction, and purpose of a proposed Resource Management Plan.

1.2 INDIAN STANDARDS

1.2.1 River Valley Development

IS 6066- 2004	Recommendations for pressure grouting of rock foundations in river valley projects
IS 11293(Part 2)-2006	Guidelines for the design of grout curtains: Part 2 Masonry and Concrete dams.
IS 14344-2006	Design and construction of diaphragms for under seepage control - Code of practice
IS 4997-2004	Criteria for design of hydraulic jump type stilling basins with horizontal and sloping apron
IS 6512-2003	Criteria for design of solid gravity
IS 6934-2007	Recommendations for hydraulic design of high ogee over-flow spillways
IS 7365-2008	Criteria for hydraulic design of bucket type energy dissipators
IS 9297-2005	Recommendations for lighting, ventilation and other facilities inside the dam
IS 10135-2008	Code of practice for drainage system for gravity dams, their foundations and abutments (first Revision)
IS 10137-2004	Guidelines for selection of spillways and energy dissipaters
IS 11485-2004	Criteria for hydraulic design of sluices in concrete and masonry dams
IS 11527-2004	Criteria for structural design of energy dissipaters for spillways

IS 11772-2004	Guidelines for design of drainage arrangements of energy dissipators and training walls of spillways
IS 12200-2008	Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams
IS 12720-2004	Criteria for structural design of spillway training walls and divide walls
IS 12966(Part 1&2)-2008	Code of practice for galleries and other openings in dams: Part 1 General requirements
IS 13144-2008	Recommendations for provision of facilities outside dams
IS 13195-2004	Preliminary design, operation and maintenance of protection works downstream of spillways – Guidelines
IS 13551-2008	Criteria for structural design of spillway pier and crest
IS 14591-2004	Guidelines for temperature control of mass concrete for dams
IS 15058 -2008	Specification for PVC water stops at transverse contraction joints in masonry and concrete dams
IS 7563-2005	Code of practice for structural design of cut and cover concrete conduits
IS 4880 (Part 1 to 7)-2005	Code of practice for design of tunnels conveying water: Part 1 General design
IS 5878(Part 2 to 7)-2005	Code of practice for construction of tunnel conveying water: Part 2 Underground excavation in rock, Section 1 Drilling and blasting
IS 12633-2004	Guidelines for first filling and emptying of pressure
IS 7357-2005	Code of practice for structural design of surge tanks
IS 7396-2005	Criteria for hydraulic design of surge tanks: Part 1 Simple, restricted orifice and differential surge
IS 9761-2005	Hydropower intakes - criteria for hydraulic design
IS 11388-2005	Recommendations for design of trash racks for intakes
IS 4247(Part 1 to 3)-2008	Code of practice for structural design of surface hydroelectric power stations: Part 1 Data for design
IS 4461-2008	Code of practice for joints in surface hydro-electric power stations
IS 4720-2008	Code of practice for ventilation of surface hydro power station
IS 4721-2005	Code of practice for drainage and dewatering of surface hydroelectric power stations
IS 7207-2008	Criteria for design of generator foundation for hydroelectric power stations
IS 10824-2005	Code of practice for amenities in power houses
IS 7436-2003	Guide for types of measurements for structures in river valley projects and criteria for choice and location of measuring instruments: Part 2 Concrete and masonry dams
IS 8282(Part 1&2)-2005	Code of practice for installation, maintenance and observation of pore pressure measuring devices in concrete and masonry dams: Part 1 Electrical resistance type cell
IS 10334-2005	Code of practice for selection, splicing, installation and providing protection to the open ends of cables used connecting resistance measuring devices in concrete and masonry dams
IS 10434(Part 1&2)-2005	Installation, maintenance and observation of deformation measuring devices in concrete and masonry dams - Guidelines, Part 1 Resistance type joint meters (First Revision)

IS 13073(Part 1&2)-2008	Code of practice for installation, maintenance and observation of displacement measuring devices in concrete and masonry dams: Part 1 Deflection measurement using plumb lines
IS 13232-2003	Code of practice for installation, maintenance and observation of electrical strain measuring devices in concrete dams
IS 14278-2005	Stress measuring devices in concrete and masonry dams - Installation, commissioning and observations - Code of practice.
IS:11155-1994	Specification for Admixtures for Concrete
IS: 712-2005	Specification of building limes
IS:2116-2007	Specification for sand for masonry mortars
IS:2185-2005	Specification for concrete masonry units
IS 1192:1981	Velocity area methods for measurement of flow of water in open channels (first revision)
IS 1194:1960	Forms for recording measurement of flow of water in open channels
IS 3910:1992	Requirements for rotating element current meters (cup type) for water flow measurement (first revision)
IS 3918:1966	Code of practice for use of current meter (cup type) of water flow measurement
IS 3913:2005	Specification for suspended sediment load samplers (first revision)
IS 4477 (Part-2):1975	Methods of measurement fluid flow by means of venture meters: Part 2 compressible fluids
IS 4890:1968	Methods for measurement of suspended sediment in open channels
IS 9163 (Part 1): 1979 ISO9555-1:1973	Dilution methods of measurement of steady flow Part 1 constant rate injection method
IS 9922:1981 ISO 8363:1980	Guide for selection of method for measuring flow in open channels
IS 12752:1989 ISO 8368:1980	Guidelines for the selection of flow gauging structures
IS 13083:1991 ISO 4377:1990	Liquid flow measurement in open channels-flat-V weirs
IS 14673:1999 ISO 4360:1984	Liquid flow measurement in open channels by weirs and flumes – Triangular profile weirs
IS 14869:2000 ISO 4359:1983	Liquid flow measurement in open channels- Rectangular, trapezoidal and U-shape flumes
IS 15118:2002 ISO 4373:1995	Measurement of liquid flow in open channels – Part 1 Establishment and operation of a gauging station
IS 15119 (Part 2):2002 ISO 1100-2:1998	Measurement of liquid flow in open channels – Part 2 Determination of the stage-discharge relation
IS 15123:2002 ISO 4362:`1999	Hydrometric determination – Flow measurement in open channels using structures – Trapezoidal broad crested weirs
DOC.WRD 1 (338)	Measurement of liquid flow in open channels – Field measurement of discharge in large rivers and floods (based on ISO 9825: 1994)
IS 4410 (Part 1): 1991	Glossary of terms relating to river valley projects Part 1 Irrigation practice (first revision)
IS 4078: 1980	Code of practice for indexing and storage of drill cores (first revision)
IS 4453: 1980	Code of practice for exploration by pits, trenches, drifts and shafts

	(first revision)
IS 4464: 1985	Code of practice for presentation of drilling information and core description in foundation investigation (first revision)
IS 5313: 1980	Guide for core drilling observations (first revision)
IS 5497: 1983	Guide for topographical surveys for river valley projects (first revision)
IS 10060: 1981	Code of practice for subsurface investigation for power house sites
IS 13578: 1992	Subsurface exploration for barrages and weirs – Code of practice
IS 4008: 1985	Guide for presentation of project report for river valley projects (first revision)
IS 4186: 1985	Guide for preparation of project report for river valley projects (first revision)
IS 4877: 1968	Guide for preparation of estimate for river valley projects
IS 5510: 1969	Guide for soil surveys for river valley projects
IS 4622: 2003	Recommendation for structural design of fixed wheel gates (third revision)
IS 4623: 2000	Recommendation for structural design of radial gates (second revision)
IS 5620: 1985	Recommendation for structural design criteria for low head slide gates (second revision)
IS 6938: 2005	Code of practice for design of rope drum and chain hoists for hydraulic gates (second revision)
IS 7326(Part 1): 1992	Penstock and turbine inlet butterfly valves for hydropower stations and systems: Part 1 Criteria for structural and hydraulic design (first revision)
IS 7326 (Part 2): 1992	Penstock and turbine inlet butterfly valves for hydropower stations and systems: Part 2 – Guidelines for design and selection of control equipment (first revision)
IS 7326 (Part 3): 1976	Penstock and turbine inlet butterfly valves for hydropower stations and systems: Part 3 – Recommendations for operations and maintenance
IS 7332 (Part 1): 1991	Spherical valves for hydropower stations and systems: Part 1 – Criteria for structural and hydraulic design (first revision)
IS 7332 (Part 2): 1993	Spherical valves for hydropower stations and systems: Part 2 – Guidelines for design and selection of control equipment (first revision)
IS 7332 (Part 3): 1994	Spherical valves for hydropower stations and systems: Part 3 – Recommendation for operation and maintenance of spherical valves (first revision)
IS 7718: 1991	Recommendations for inspection, testing and maintenance of fixed wheel and slide gates (first revision)
IS 9349: 2006	Recommendations for structural design of medium and high head slide gates (second revision)
IS 10021: 2000	Guidelines for de-icing systems for hydraulic installations (first revision)
IS 10096 (Part 1/Sec 1): 1983	Recommendations for inspection, testing and maintenance of radial gates and rope drum hoists: Part 1 – Inspection, testing and assembly

	at the manufacturing stage Section 1 Gates
IS 10096 (Part 1/Sec 2): 1986	Recommendations for inspection, testing and maintenance of radial gates and rope drum hoists: Part 2 – Inspection, testing and assembly at the manufacturing stage Section 2 Rope Drum Hoists
IS 10096 (Part 2): 1983	Recommendations for inspection, testing and maintenance or radial gates and their hoists: Part 2 – Inspection, testing and assembly at the time of erection
IS 10096 (Part 3): 2002	Recommendations for inspection, testing and maintenance of radial gates and rope drum hoists: Part 3 after erection (first revision)
IS 10210.1993	Criteria for design of hydraulic hoists
IS 11228:1985	Recommendations for design of screw hoists for hydraulic gates
IS 11793:1986	Guidelines for design of float-driven hoisting mechanism for automatic gated control
IS 11855:2004	General requirements for rubber seals for hydraulic gates (first revision)
IS 13041:1991	Recommendation for inspection, testing and maintenance of hydraulic hoist (after erection)
IS 13591:1992	Criteria for design of lifting beams
IS 13623:1993	Criteria for choice of gates and hoists
IS 14177:1994	Guidelines for painting system for hydraulic gates and hoists
IS 15466:2004	Specification for rubber seals for hydraulic gates
DOC.WRD 12(379)	Recommendations for structural design criteria for low head slide gates (second revision of IS 5620:1985)
IS 3872:2002	Code of practice for lining of canals with burnt clay ties (first revision)
IS 3873:1993	Laying cement concrete/ stone slab lining on canals – code of practice (second revision)
IS 4515:2002	Stone pitched lining for canals – code of practice (second revision)
IS 4558:1995	Code of practice for under-draining of lined canals (second revision)
IS 4701:1982	Code of practice of earthwork on canals
IS 4893(Part 1):1992	Maintenance of canals – code of practice : Part 1 Unlined canals (second revision)
IS 4893(Part 2):1992	Maintenance of canals – code of practice : Part 2 lined canals (second revision)
IS 4893(Part 3):1992	Maintenance of canals – code of practice : Part 3 canals structures, drains, jungle clearance, plantation and regulation (second revision)
IS 5256:1992	Code of practice for sealing expansion joints in concrete lining on canals (first revision)
IS 5690:1982	Guide for laying combination lining for existing unlined canals (first revision)
IS 5968:1987	Guide for planning and layout of canal system for irrigation and power canals (first revision)
IS 6004:1980	Criteria for hydraulic design of sediment ejector for irrigation and power canals (first revision)
IS 6522:1972	Criteria for design of silt vanes for sediment control in off taking canals
IS 6936:1992	Guide for location, selection and hydraulic design of canal escapes (first revision)

IS 7112:2002	Criteria for design of cross section for unlined canals in alluvial soil (first revision)
IS 7113:2003	Code of practice for soil-cement lining for canals (first revision)
IS 7114:1973	Criteria for hydraulic design of cross regulators for canals
IS 7331:1981	Code of practice for inspection and maintenance of cross-drainage works (first revision)
IS 7495:1974	Criteria for hydraulic design of silt selective head regulator for sediment control in off taking canals
IS 7784(Part 1):1993	Code of practice for design of cross drainage works: Part 1 General features (first revision)
IS 7784(Part 2 /Sec 1):1995	Code of practice for design of cross drainage works: Part 2 specific requirement section 1
IS 7784(Part 2/Sec 2):2000	Code of practice for design of cross drainage works: Part 2 specific requirement section 2 super passages (first revision)
IS 7784(Part 2/Sec 3):2000	Code of practice for design of cross drainage works: Part 2 specific requirement section 4 level crossings
IS 7784(Part 2/Sec 4):2000	Code of practice for design of cross drainage works: Part 2 specific requirement section 4 level crossings
IS 7784(Part 2/Sec 5):2000	Code of practice for design for cross drainage works: Part 2 specific requirement section 5 siphon aqueducts (first revision)
IS 7871:1975	Criteria for hydraulic design of groyne walls (curved wing) for sediment distribution of off take points in a canal
IS 7873:1975	Code of practice for line concrete lining for canals
IS 7880:1975	Criteria for hydraulic design of skimming platform for sediment control in off taking canal
IS 7986:1976	Code of practice for canal outlets
IS 8835:1978	Guidelines for planning and design of surface drains
IS 9097:1979	Guidelines for laying lining of canals with hot bitumen or bituminous felts
IS 9447:1980	Guidelines for assessment of seepage losses from canals by analytical method
IS 9451:1994	Guidelines for lining of canals in expansive soils (second revision)
IS 9452(Part 1):1993	Code of practice for measurement of seepage losses from canals: Part 1 Ponding method (first revision)
IS 9452(Part 1):1993	Code of practice for measurement of seepage losses from canals: Part 2 inflow outflow method
IS 9452(Part 1):1993	Code of practice for measurement of seepage losses from canals: Part 3 by seepage meter method
IS 9698:1995	Lining of canals with polyethylene film – Code of practice (first revision)
IS 9913:2000	Code of practice for construction of cross drainage works (first revision)
IS 10430:2000	Criteria for design of lin3ed canals and guidelines for election of type of lining (first revision)
IS 10646:1991	Canal linings – Cement concrete tiles – Specification (first revision)
IS 11809:1994	Lining for canals by stone masonry – code of practice (first revision)
IS 12331:1988	General requirements for canal outlets
IS 12379:1988	Code of practice for lining water courses and field channels

IS 13143:1991	Joints in concrete lining of canals – sealing compound – specification
DOC WRD 13(340)	Guidelines for planning of parallel canals
DOC WRD 13(411)	Draft amendment no. 2 to IS 9451:1994 Guidelines for lining of canals in expansive soils (second revision)
DOC WRD 13(9001)	Guidelines for canal lining in dispersive soils
DOC WRD 13(349)	Guidelines for estimation of transmission losses in canals
DOC WRD 13(378)	Guidelines for adopting coefficient of friction (Rugosity coefficient) for design of canals
DOC WRD 13(447)	Code of practice for design of cross drainage works: Part 1 General features (first revision) Revision of IS 7784(Pt 1):1993
IS 4880 (Part 1): 1987	Code of practice for design of tunnels conveying water: Part 1 General design (first revision)
IS 4880 (Part 2): 1976	Code of practice for design of tunnels conveying water: Part 2 Geometric design (first revision)
IS 4880 (Part 3):1976	Code of practice for design of tunnels conveying water: Part 3 Hydraulic design (first revision)
IS 4880 (Part 4) : 1971	Code of practice for design of tunnels conveying water: Part 4 structural design of concrete lining in rock
IS 4880 (Part 5) : 1972	Code of practice for design of tunnels conveying water: Part 4 Structural design of concrete lining in soft strata and soils
IS 4880 (Part 6) : 1971	Code of practice for design of tunnels conveying water: Part 6 tunnel support
IS 4880 (Part 7): 1975	Code of practice for design of tunnels conveying water: Part 7 structural design of steel lining
IS 5330:1984	Criteria for design of anchor blocks for penstocks with expansion joints (first revision)
IS 5878 (Part 1):1971	Code of practice for construction of tunnels conveying water: Part 1 Precision survey and setting out
IS 5878 (Part 2 / Sec1):1970	Code of practice for construction of tunnel conveying water: Part 2 underground excavation in rock, section 2 ventilating, lighting, Mucking and Dewatering
IS 5878(Part 2/Sec 3):1971	Code of practice for construction of tunnels conveying water: Part 3 underground excavation in soft strata
IS 5878(Part 4):1971	Coded of practice for construction of tunnels conveying water: Part 4 tunnel supports
IS 5878(Part 5):1976	Code of practice for construction of tunnels conveying water: Part 5 concrete lining (first revision)
IS 5878(Part 6):1975	Code of practice for construction of tunnel conveying water: Part 6 steel lining
IS 6966 (Part 1):1989	Guidelines for hydraulic design of barrages and weirs: Part 1 Alluvial Reaches (first revision)
IS 7349:1989	Guidelines for operating and maintenance of barrages and weirs (first revision)
IS 7720:1991	Criteria for investigation, planning and layout of barrages and weirs (first revision)
IS 9461:1980	Guidelines for data required for design of temporary river diversion works

IS 9795 (Part 1):1981	Guidelines for the choice of type of diversion works: Part 1 Coffer dams
IS 10084(Part 1): 1982	Design of diversion works – criteria : Part 1 Coffer dams
IS 10084(Part 2): 1994	Design of diversion works – Criteria : Part 2 Diversion channels and open cut or conduit in the body of dam
IS 11130:1984	Criteria for structural design of barrages and weirs
IS 11150:1993	Construction of concrete barrages – Code of practice (first revision)
IS 12892:1989	Guidelines for the safety of barrage and weir structures
IS 13912:1993	Closure of diversion channel and open cut of conduit in the body of dam-Code of practice
IS 14592(Part 1): 1998	Guidelines for planning and design of river powerhouses integrated with barrages Part 1 investigation, planning and layout
IS 14815:2000	Design flood for river studies of barrages and weirs – Guidelines
IS 14955:2001	Hydraulic model studies of barrages and weirs – Guidelines
IS: 4720 – 2003	Code of practice for ventilation of surface hydro power stations
IS:2309-2005	Code of Practice-Protection of building and allied structure against lightning
IS: 659-19642001	Safety code for air conditioning
IS: 3103-2004	Code of Practice for Industrial Ventilation
IS:2309-2005	Code of Practice-Protection of building and allied structure against lightning

1.2.2 Hydro Mechanical Equipment

IS 5330 : 1984	Criteria for design of anchor blocks for penstocks with expansion joints
IS 7326 : Part 1 : 1992	Penstock and turbine inlet butterfly valves for hydropower stations and systems: Part 1 Criteria for structural and hydraulic design
IS 7326 : Part 2 : 1992	Penstock and turbine inlet butterfly valves for hydropower stations and systems: Part 2 Guidelines for design and selection of control equipment
IS 7326 : Part 3 : 1976	Penstock and turbine inlet butterfly valves for hydropower stations and systems: Part 3 Recommendations for operations and maintenance
IS 11625 : 1986	Criteria for Hydraulic Design of Penstocks
IS 11639 : Part 1 : 1986	Criteria for structural design of penstocks: Part 1 Surface penstocks
IS 11639 : Part 2 : 1995	Structural Design of Penstocks - Criteria - Part 2 : Buried/Embedded Penstocks in Rock
IS 11639 : Part 3 : 1996	Criteria for structural design of penstocks: Part 3 Specials for penstocks
IS 11639 : Part 3 : 1996	Criteria for structural design of penstocks: Part 3 Specials for penstocks
IS 207 : 1964	Specification for Gate and Shutter Hooks and Eyes
IS 207 : 1964	Specification for Gate and Shutter Hooks and Eyes
IS 778 : 1984	Specification for Copper Alloy Gate, Globe and Check Valves for Waterworks Purposes

IS 3042 : 1965	Specification for single faced sluice gates (200 to 1200 mm size)
IS 4410 : Part 16 : Sec 1 : 1999	Glossary of Terms Relating to River Valley Projects - Part 16 : Gates and Valves - Section 1 : Gates and Terms Related with Gates
IS 4410 : Part 16 : Sec 2 : 1981	Glossary of terms relating to river valley projects: Part 16 Gates and valves Section 2 Valves
IS 4622 : 2003	Recommendations for Structural - Structural Design of Fixed-Wheel Gates
IS 4622 : 1992	Fixed-wheel Gates Structural Design - Recommendations
IS 4623 : 2000	Recommendations for Structural Design of Radial Gates
IS 4854 : Part 1 : 1969	Glossary of terms for valves and their parts: Part 1 Screw down stop check and gate valve and their parts
IS 5620 : 1985	Recommendations for Structural Design Criteria for Low Head Slide Gates
IS 6938 : 2005	Design of Rope Drum and Chain Hoists for Hydraulic Gates - Code of Practice
IS 6938 : 1989	Code of practice for design of rope drum and chain hoists for hydraulic gates
IS 7718 : 1991	Recommendations for inspection, testing and maintenance of fixed wheel and slide gates
IS 9349 : 2006	Recommendations for Structural Design of Medium and High Head Slide Gates
IS 9349 : 1986	Recommendations for structural design of medium and high head slide gates
IS 10096 : Part 1 : Sec 1 : 1983	Recommendations for inspection, testing and maintenance of radial gates and their hoists: Part 1 Inspection, testing and assembly at the manufacturing stage Section 1 Gates
IS 10096 : Part 1 : Sec 1 : 1983	Recommendations for inspection, testing and maintenance of radial gates and their hoists: Part 1 Inspection, testing and assembly at the manufacturing stage Section 1 Gates
IS 10096 : Part 1 : Sec 2 : 1986	Recommendations for inspection, testing and maintenance of radial gates and their hoists: Part 1 Inspection, testing and assembly at the manufacturing stage Section 2 Rope Drum Hoists
IS 10096 : Part 1 : Sec 2 : 1986	Recommendations for inspection, testing and maintenance of radial gates and their hoists: Part 1 Inspection, testing and assembly at the manufacturing stage Section 2 Rope Drum Hoists
IS 10096 : Part 2 : 1983	Recommendations for inspection, testing and maintenance or radial gates and their hoists: Part 2 Inspection, testing and assembly at the time of erection
IS 10096 : Part 2 : 1983	Recommendations for inspection, testing and maintenance or radial gates and their hoists: Part 2 Inspection, testing and assembly at the time of erection
IS 10096 : Part 3 : 1992	Recommendations for inspection, testing and maintenance of radial gates and rope drum hoists: Part 3 After erection
IS 10096 : Part 3 : 2002	Recommendations for Inspection, Testing and Maintenance of Radial Gates and Rope Drum Hoists - Part 3 : After Erection
IS 10210 : 1993	Criteria for Design of Hydraulic Hoists for Gates
IS 11228 : 1985	Recommendations for design of screw hoists for hydraulic gates
IS 11855 : 1986	General Requirements for Rubber Seals for Hydraulic Gates

IS 11855 : 2004	Guidelines for Design and Use of Different Types of Rubber Seals for Hydraulic Gates
IS:12800(Part-3) - 1991	Guidelines for Selection of Hydraulic Turbine, Preliminary Dimensioning and Layout of surface hydroelectric Powerhouses Part 3 Small, Mini And -Micro -Hydroelectric Power Houses
IS: 12837 – 1989	Hydraulic turbines for medium and large power houses – guidelines for selection
IS 13623 : 1993	Criteria for choice of gates and hoists
IS 14177 : 1994	Guidelines for painting system for hydraulic gates and hoists
IS 15466 : 2004	Rubber Seals for Hydraulic Gates - Specification
IS 11388 : 1995	Recommendations for design of trash racks for intakes

1.2.3 Electrical Equipment

IS 3034-2007	Code of practice for earthing
IS:4722 - 2001	Rotating electrical machines
IS: 4889 -2007	Method for determining Efficiency Rotating Electrical Machines
IS:325- 2007	Three phase induction motors
IS: 325-2007	Specification for three phase induction motor
IS:8789- 1996	Values of performance for three-phase induction motors
IS:8789-2007	Values of performance for three-phase induction motors
IS:2704(Pt IV)-2002	Protective current transformers for special purpose applications
IS: 2026 (Part 1 to 4) (1997)	Specifications for Power Transformer
IS-1180	Outdoor distribution Transformer up to and Including 100 KVA
IS:3231-2001, IS:722-1991and IS1248-2003	Protection relays
IS:3043-2006	Code of practice for earthing
IS:3043-2001	Code of Practice for earthing in power plants
IS:3043-1998	Installation of Grounding/Earthing of Power Line.
IS:13300 -2007	Nickel Cadmium Aircraft Batteries (aerobatic and Non-Aerobatic) - specification
IS:2147-1962	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS:L1554-2005	PVC insulated (heavy duty) electric cables For working voltages up to and including 1100 V
IS:13947 -2004	Specification for low voltage switchgear and control gear – Part 5 – Control circuit devices and switching elements - section – 1 Electromechanical Control Circuit Devices
IS: 7098(Part-11)-2005	Cross-linked polyethylene insulated PVC sheathed cables for working voltages from 3.3 KV up to and including 11 kV
IS:7098-2005	XLPE Cables
IS: 3961-2001 – Part	Recommended current ratings for cables
IS: 8130 -2001	Conductors for insulated electric cables and flexible cords
IS: 5831- 2001	PVC insulation and sheath of electric cables
IS: 3646-2003-Part 1	Code of Practice for interior illumination (illumination glare index)
IS: 732- 2005	Code of Practice for wiring installation
IS: 9537-2000	Specification for conduits for electrical installation

IS: 2309 -2005	Code of practice for the protection of buildings and allied structures against lightning (second revision)
IS: 807 -2006	Code of practice for design, manufacture, erection and testing (structural portion) of cranes and hoist
IS: 3177-2003	Code of practice for Electrical Overhead Traveling Cranes and Gantry Cranes
IS: 3177-2006	Code of practice for Electrical Overhead Traveling Cranes and Gantry Cranes
IS: 1646 -2002	Code of practice for fire safety of buildings (general): Electrical Installation
IS: 3034 -2007	Fire safety of industrial buildings: Electrical generating and distributing stations
IS: 9921Part 1 to 5 (2007)	Alternating currents disconnectors (isolators) and earthing switches rating, design, construction, tests etc.
IS: 2705 Part 1 to 4 (2007)	Current transformer
IS: 3156 Part 1 to 4 (2007)	Voltage transformer
IS:2544-1973	Porcelain Post Insulators for systems with normal Voltage greater than1000V
IS: 2544 (2006)	Porcelain insulators for system above 1000 V
IS:5350-1970	Dimensions of Indoor and Outdoor Porcelain Post Insulators and Post Insulator Units for Systems with nominal Voltage greater than 1000 V
IS: 5350 (2004) – Part III	Post insulator units for systems greater than 1000 V
IS: 5621 (2004)	Hollow Insulators for use in electrical equipment
IS: 3716 (2006)	Application guide for insulation co-ordination
IS: 2165 (2006)	Phase to earth insulation co-ordination
IS: 2099 (1986)	Bushings for alternating voltage above 1000V
IS2099-2003	Specification for bushing for alternating voltages above 1000 V
IS: 3639 (1966)	Fittings and accessories for power transformer
IS: 1180 (1989)	Outdoor Type three phase distribution transformer upto and including 100 kVA, 11 kV
IS: 13118 (1991)	Specification for high-voltage alternating current circuit breakers
IS: 11171-2001	Specification for dry type transformers
IS: 6304 -2002	Stationary batteries- lead acid type with pasted negative plates
IS: 1652-2002	Plante Cells
IS: 1651-2002	Tubular Cells
IS: 8320 -2000	General requirement and method of tests for lead acid storage batteries
IS: 15549-2005	Stationary Valve Regulated Lead Acid Batteries (VRLA)
IS: 10918-2007	Vented Type Ni-Cd battery
IS: 1554 (Part-1)-2005	PVC insulated (heavy-duty) electric cables for working voltage up to and including 1100 V
IS: 1554 (Part-11)- 2005	PVC insulated (heavy-duty) electric cables for working voltage from 3.3kV up to and including 11 kV
IS:694-2005	PVC insulated cables for working voltages up to and including 1100 V

IS: 9563-2006	Specification for carbon monoxide filter self – Rescuers
IS: 2629-2006	Recommended practice for hot dip galvanising
IS:2629-1985	Recommended practices for hot dip galvanizing of iron & steel
IS: 2189-2008	Code of Practice – Selection, Installation and Maintenance of Automatic Fire Detection and Alarm System
IS: 3844-2000	Code of Practice for installation and Maintenance of Internal Fire Hydrants and hose reels on Premises
IS: 3844-2005	Code of Practice for installation and Maintenance of Internal Fire Hydrants and hose reels on Premises
IS:6382-2000	Code of Practice for Design and Installation of fixed Carbon Dioxide Fire Extinguishing System
IS:3156-2002	Voltage transformers
IS:L3156(Pt.I)-2002	General requirements of VTs
IS:3156(Pt.II)-2002	Measuring voltage transformers
IS:3156(Pt.III)-2002	Protective voltage transformer
IS:3156(Pt.IV)-2002	Capacitor voltage transformers
IS:2705(Pt.I)-2002	General requirements of CTs
IS:2705(Pt.II)-2002	Measuring current transformers
IS:2705(Pt.III)-2002	Protective current transformer
IS:1651-2007	Stationary cells and batteries lead-acid type (with tubular positive plates)
IS:13118-2007	Specification for high voltage alternating – current circuit breakers
IS:13947-2004-Part 1	Specification for low voltage switchgear and control gear
IS:5613(Pt I, Sec I) 2007	Code of practice for design, installation and machine of over head power lines
IS: 13947-2004	General requirements of Switchgear and Control gear for voltage not exceeding 1000 V ac.
IS: 6380-2002	Specification of elastomeric insulation and sheathed electric cables
IS: 9968-2005	Specification for elastomer insulated cables
IS:2825-2002	Code for unfired pressure vessels
IS:13118-2002	High voltage alternating current circuit breakers
IS:2705 (Part I, II, III & IV)) -2002, IEC 60044.1 (1996)	Current Transformer
IS:10918-2003	Specification of vented type nickel – cadmium batteries
IS:722-1991-Part 1	AC Meters
IS:3070-2004	Lightning Arrestor for alternating current system
IS: 3070 part 1 to 3 (1989)	Lightning arrestors
IS:9385(Part I to III)-2002	33 kV Drop Out Fuse
IS:9920 (Part I to IV)-2001	High voltage switchyard
IS: 9920 Part I to IV (2007)	Alternating current switches for rated voltages above 1000 volts and less than 52 kV
IS:731-1971	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 V
IS:731-2001, IS:1248-	Insulators and Fittings

2003 and IS:2544-2001	
IS:1248-2003 and IS:722-1991	Electrical indicating instrument
IS:4091-1979	Design and construction of foundation for transmission line poles
IS:4091-2006	Transmission lines/Poles
IS 2121-1981	Conductor and earth wire accessories for overhead power line
IS:2121-2002	ACSR Conductor
IS 2121-2002	Conductor and earth wire accessories for overhead power lines.
IS:2633-1986	Method of testing weights, thickness & uniformity on H.D.G. articles
IS-2633-2006	Methods of testing uniformity of coating of zinc coated articles.
IS-3637-2001	Gas operated relays
IS-3639-2001	Fittings and accessories of power transformers
IS-8603-2001	Dimensions for porcelain transformer bushings for use in heavily polluted atmosphere (36 kV class)
IS-5578-2006 and IS-11353-2002	Specification for marking and arrangement for switchgear, bus-bar main connection & Auxiliary wirings.
IS-5578 -1970 and IS-11353-1970	Making and arrangement for switchgear Bus-bar main connections and auxiliary wiring.
IS:398-1994	Aluminium Conductor for overhead Transmission Purposes (ACSR/AAAC)
IS:398 (Part II) 1996	Stringing of Conductor
IS 398-2002	Aluminium conductor for overhead transmission purposes. (ACSR/ACC)
IS:4826-1976	Hot-dip galvanizing coatings on round steel wires
IS 4826-2006	Hot-dip galvanizing coatings on round steel wires.
IS 5082-1998	Wrought Aluminium and Aluminium alloy bars, rods, tubes and section of electric purpose.
IS:2551-1963	Installation of Danger Board
IS:2486 (Part II) 1989	Stringing of Conductor
IS:2486-1993	Insulator fitting for overhead power lines with a normal voltage greater than 1000 V
IS:209 -1992	Installation of Insulators
IS:4759-1979	Hot-dip galvanizing coatings on structural steel & allied products
IS:13134-1992	Guide for the selection of insulators in respect of polluted conditions
IS:5561-1970	Electric power connectors
IS:5561-1970	Terminal connectors
IS-8686-1977	Static Protective Relays
IS:802-1995	Use of structural steel in overhead transmission Lines
IS-11726/ISO-2954 (1975)	Requirements for Instruments for Measuring Vibration Severity of Rotating and Reciprocating Machines
IS-11727-1996	Measurement and Evaluation of Vibration Severity in Situ of Large Rotating Machines with Speed Range from 10 to200 rev/s

1.2.4 Cement and Concrete

IS 269-2008	Specification for ordinary Portland cement, 33 grade
IS 383 -2007	Specification for coarse and fine aggregates from natural sources for concrete

IS 456:2000	Code of practice for plain and reinforced concrete
IS 457 -2005	Code of practice for general construction of plain and reinforced concrete for dams and other massive structures
IS 516-2008	Method of test for strength of concrete
IS 1199-2008	Methods of sampling and analysis of concrete
IS 1489(Part 1)-2005	Specification for Portland pozzolana cement: Part 1 Fly ash based
IS 2386(Part 1 to 8)-2007	Methods of test for aggregates for concrete
IS 2430-2005	Methods for sampling of aggregates for concrete
IS 2502-2008	Code of practice for bending and fixing of bars for concrete reinforcement
IS 2505-2008	Concrete vibrators - immersion type –general requirements
IS 2506-2005	General requirements for screed board concrete vibrators
IS 2645-2007	Integral waterproofing compounds for cement mortar and concrete –Specification
IS 3085-2007	Method of test for permeability of cement mortar and concrete
IS 3535-2008	Methods of sampling hydraulic cement
IS 3558-2008	Code of practice for use of immersion vibrators for consolidating concrete
IS 4031(Part 1 & 2)-2005	Methods of physical tests for hydraulic cement: Part 1 Determination of fineness by dry sieving
IS 4032-2005	Method of chemical analysis of hydraulic cement
IS 4926-2007	Ready mixed concrete - Code of practice
IS 5525-2008	Recommendations for detailing of reinforcement in reinforced concrete works
IS 5816-2008	Method of test for splitting tensile strength of concrete
IS 6925-2008	Methods of test for determination of water soluble chlorides in concrete admixtures
IS 7246-2008	Recommendations for use of table vibrators for consolidating concrete
IS 7320-2008	Specification for concrete slump test apparatus
IS 8112-2008	Specification for 43 grade ordinary Portland cement
IS 8142-2007	Method of test for determining setting time of concrete by penetration resistance
IS 9012-2007	Recommended practice for shotcreting
IS 9103-2008	Specification for admixtures for concrete
IS 9284-2007	Method of test for abrasion resistance of concrete
IS 10080-2008	Specification for vibration machine for casting standard cement mortar cubes
IS 10086-2008	Specification for moulds for use in tests of cement and concrete
IS 10262-2004	Recommended guidelines for concrete mix design
IS 12269-2008	Specification for 53 grade ordinary Portland
IS 12468-2005	General requirements for vibrators for mass concreting; Immersion type
IS 12600-2005	Specification for low heat Portland cement
IS 13311(Part 1 & 2)-2008	Methods of non-destructive testing of concrete
IS 14687-2005	Guidelines for falsework for concrete structures

SP 23(S&T)	Handbook on concrete mixes
SP 34(S&T)	Handbook on concrete reinforcement and detailing

1.2.5 Stones

IS 1121(Part 1&4)-2008	Methods of test for determination of strength properties of natural building stones: Part I Compressive strength
IS 1122-2008	Method of test for determination of true specific gravity of natural building stones
IS 1123-2008	Method of identification of natural building stones
IS 1124-2008	Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones
IS 1125-2008	Method of test for determination of weathering of natural building stones
IS 1126-2008	Method of test for determination of durability of natural building stones
IS 1127-2008	Recommendations for dimensions and workmanship of natural building stones for masonry work
IS 1129-2008	Recommendation for dressing of natural building stones
IS 1130-2008	Specification for marble (blocks, slabs and tiles)

1.2.6 Cement Matrix Products

IS 458-2003	Precast concrete pipes (with and without 1 reinforcement) - Specification
IS 783-2007	Code of practice for laying of concrete pipes
IS 785-2004	Specification for reinforced concrete poles for overhead power and telecommunication lines
IS 1332-2005	Specification for precast reinforced concrete street lighting poles
IS 1916-2004	Specification for steel cylinder pipe with concrete lining and coating

1.2.7 Concrete Reinforcement

IS 432(Part 1&2)2004	Specification for mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement: Part I Mild steel and medium tensile steel bars
IS 1566-2004	Specification for hard-drawn steel wire fabric for concrete reinforcement
IS 1786-2004	Specification for high strength deformed steel bars and wires for concrete reinforcement

1.2.8 Structural Engineering and Structural Sections

IS 800-2003	Code of practice for general construction in steel
IS 806-2002	Code of practice for use of steel tubes in general Mar 2002 1 building construction
IS:1730-2004	Steel plates, sheets, strips and flats for structural and general purposes-dimensions

IS 1732-2004	Dimensions for round and square steel bars for structural and general engineering purposes
IS 7215-2006	Tolerances for fabrication of steel structures
IS 12843-2006	Tolerances for erection of steel structures
IS: 226-1975	Structural Steel (standard quality)
IS: 1977-2001	Specification for structural steel (ordinary quality)
IS-1239 (Part I)-1995	Mild steel Tubes
IS: 2026-2006 and IS:7205-2006	Structural work
IS:2713 (Part I to III (1980)	Installation of Steel Tubular Pole
IS:2062-1992	Structural Steel (fusion welding quality)
IS:808-1989	Rolled steel beams, channels and Angle Sections
IS:1367-1980	Nuts & threaded fasteners
IS:961-1975	High tension structural steel
IS:6639-1972	Hexagonal bolts & steel structure

1.2.9 CED 39 Earthquake Engineering

IS 1893(Part 1)- 2008	Criteria for earthquake resistant design of 1 structures: Part 1 General Provisions and
IS 1893(Part 4)-2008	Criteria for earthquake resistant design of structures: Part 4 Industrial structures including
IS 4326-2008	Code of practice for earthquake resistant design and construction of buildings
IS 13920-2008	Ductile detailing of reinforced concrete structures subjected to seismic forces- Code of practice

1.2.10 Structural Safety

IS 875 (Part 1to5)-2003	Code of practice for design loads (other than earthquake)for buildings and structures Part 1 Dead loads - Unit weights of building material and stored materials (Second Revision) (Incorporating IS:1911-1967)

1.2.11 Plastic Piping System

IS 3076-2006	Specification for low density polyethylene pipes for potable water supplies
IS 4984-2008	Specification for high density polyethylene pipes for potable water supplies
IS 4985-2005	Specification for unplasticised PVC pipes for potable water supplies
IS 7634(Part 1&2)	Code of practice for plastic pipes work for potable water supplies
IS 7834(Part 1&3)	Specification for injection moulded PVC fittings with solvent cement joints for water supplies: Part 1 General requirements
IS 9271-2004	Specification for unplasticized polyvinyl chloride 1 UPVC single wall corrugated pipes for drainage

IS 13592-2008	Specification for UPVC pipes for soil and waste discharge systems inside buildings including ventilation and rainwater system
IS 14333-2007	High density polyethylene pipes for sewerage - Specification
IS 14402-2001	Specification for GRP pipes, joints and fittings for use for sewerage, industrial waste and water (other than potable)

1.2.12 Sanitary Appliances and Water Fittings

IS 651:1992	Specification for salt glazed stoneware pipe and fittings
IS 771(Part 1to7)	Specification for glazed fire-clay sanitary appliances
IS 772-2007	Specification for general requirements for enameled cast iron sanitary appliances
IS 774-2004	Specification for flushing cistern for water closets and urinals (other than plastic cistern
IS 778-2005	Specification for copper alloy gate, globe and check valves for water works purposes
IS 781-2005	Specification for cast copper alloy screw down bib taps and stop valves for water services
IS 782-2007	Specification for caulking lead
IS 1701-2007	Specification for mixing valves for ablutionary and domestic purposes
IS 1703-2005	Specification for copper alloy float valves (horizontal plunger type) for water supply fittings
IS 1711-2005	Specification for self-closing taps for water supply purposes
IS 1726-2007	Specification for cast iron manhole covers and frames
IS 1795-2005	Specification for pillar taps for water supply purposes
IS 2326-2008	Specification for automatic flushing cisterns for urinals
IS 2373-2007	Specification for water meters (bulk type)
IS 2548(Part 1&2)	Specification for plastic seats and covers for water- closets
IS 2556(Part 1to17)	Specification for vitreous sanitary appliances (vitreous china)
IS 2685-2007	Code of practice for selection, installation and maintenance of sluice valves
IS 2692-2008	Specification for ferrules for water services
IS 2963-2007	Specification for copper alloy waste-fittings for wash basins and sinks
IS 3004-2005	Specification for plug cocks for water supply purposes
IS 3006-2007	Specification for chemically resistant glazed stoneware pipes and fittings
IS 3042-2008	Specification for single faced sluice gates (200 to 1200 mm size)
IS 3311-2007	Specification for waste plug and its accessories for sinks and wash-basins
IS 3950-2007	Specification for surface boxes for sluice valves
IS 4038-2005	Specification for foot valves for water works purposes
IS 4346-2005	Specification for washers for use with fittings for water services
IS 7231-2004	Specification for plastic flushing cisterns for Water closets and urinals
IS 8931-2008	Specification for copper alloy fancy single taps, combination tap assembly and stop valves for water services

IS 9140	Method of sampling of vitreous and fire clay sanitary appliances
IS 9338-2005	Specification for cast iron screw-down stop valves and stop and check valves for water works purposes
IS 9739-2007	Specification for pressure reducing valves for domestic water supply systems
IS 9758-2007	Specification for flush valves and fittings for water closets and urinals
IS 9762-2004	Specification for polyethylene floats (spherical) for float valves
IS 9763-2005	Plastic bib taps, pillar taps, angle valves, hot and cold water services – Specification
IS 11246-2007	Specification for glass fibre reinforced polyester resins (GRP) squatting pans
IS 12234-2008	Specification for plastic equilibrium float valve for cold water services
IS 12701-2006	Specification for rotational moulded polyethylene water storage tanks
IS 13049-2007	Specification for diaphragm type (plastic body) float operated valves for cold water services
IS 13114-2007	Specification for forged brass gate, globe and check valves for water works purposes
IS 13349-2007	Specification for single faced cast iron thimble mounted sluice gates
IS 13983-2004	Specification for stainless steel sinks for domestic purposes
IS 14399(Part 1&2)	Hot press moulded thermosetting glass fibre reinforced (GRP) sectional water storage tanks
IS-3589-2001	Steel pipe for water and sewage
IS:10221-2008	Code of practice for coating and wrapping of underground MS pipe line

1.2.13 Flooring, Wall Finishing and Roofing

IS 653-2006	Specification for linoleum sheets and tiles
IS 1198-2006	Code of practice for laying, fixing and maintenance of linoleum floor
IS 1237-2006	Specification for cement concrete flooring tiles
IS 1443-2006	Code of practice for laying and finishing of cement concrete flooring tiles
IS 1542-2003	Specification for sand for plaster
IS 2571-2006	Code of practice for laying in-situ cement concrete flooring
IS 4457-2001	Specification for ceramic unglazed vitreous acid resisting tile
IS 6278-2006	Code of practice for white-washing and colour
IS 12866-2003	Specification for plastic translucent sheets made from thermosetting polyester resin
IS 13630 (Part 1&15)	Ceramic Tiles – Methods of Test, Sampling and 10545-2 Basis for Acceptance Part 1 Determination of dimensions and surface quality
IS 15224-2007	Code of practice for laying of plastic translucent sheets made from thermosetting polyester resin (GRP) above or in conjunction with asbestos cement sheets/aluminium sheets

1.2.14 Doors, Windows and Shutters

IS 1038-2006	Specification for steel doors, windows and ventilators
IS 1081-2006	Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators
IS 1361-2006	Specification for steel windows for industrial buildings
IS 4021-20006	Specification for timber door, window and ventilator frames
IS 4351-2003	Steel door frames - Specification
IS 6248 -2006	Specification for metal rolling shutters and rolling grills
IS: 1361-1978,2001	Specification for steel windows for industrial buildings

1.2.15 Miscellaneous

IS: 5556 (2006)	Serrated lock washers – specification
IS:3943-2002	Specification of voice pipe and voice pipe fitting
IS: 655-1999	Specification for metal air ducts
IS:3155-2001	Specification for Makhanna products
IS- 4379-2002	Identification of the contents of industrial Gas cylinders
IS-7285-2202	Seamless High carbon steel cylinders for permanent and high pressure liquefiable gases
IS 15832: 2008	Glossary of Technical Terms Related to Environmental Impact
IS 15442: 2004	Parameters for environmental impact assessment of water resources project.
IS 15845: 2009	Environmental Management Plan for Hydropower /Irrigation/Flood Control/ Multipurpose River Valley Projects

1.3 INTERNATIONAL STANDARD

1.3.1 International Electromechanical Commission (IEC)

IEC 60308: 1970	International code for commissioning, operation and maintenance of hydraulic turbines.
IEC 60609: 1978	Cavitation pitting evaluation in hydraulic turbines, storage pumps and pump-turbines.
IEC 60994: 1991	Guide for field measurement of vibrations and pulsations in hydraulic machines (turbines, storage pumps and pump turbines)
IEC 61362: 2012	Guide to specification of hydro-turbine control systems1
IEC 61366	Hydraulic turbine of giving outputs higher than rated outputs to match 10% overload capability of the generators.
IEC-60034-1: 1983	Rotating Electrical Machines Rating and Performance
IEC-60034-2A-1972	Rotating Electrical Machines Methods for determining losses and efficiency of electrical machinery from tests (excluding machines for traction vehicles
IEC-60034-5-1991	Classification of degrees of protection provided by enclosures for rotating electrical machines (IP Code)
IEC-60085-1987	Classification of materials for the insulation of electrical machines
IEC- 60041 (1991-11)	Field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pump-turbines

IEC-60041 Corr. 1 (1996-03)	Corrigendum 1 – Field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pump-turbines
IEC 60041 (1991-11)	Field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pump-turbines
IEC 60193 (1999-11)	Hydraulic turbines, storage pumps and pump-turbines – Model acceptance tests
IEC 60308 (2005-01)	Hydraulic turbines – Testing of control systems
IEC 60545 (1976-01)	Guide for commissioning, operation and maintenance of hydraulic turbines
IEC 60609-1 (2004-11)	Hydraulic turbines, storage pumps and pump-turbines – Cavitation pitting evaluation – Part 1: Evaluation in reaction turbines, storage pumps and pump-turbines
IEC 60609-1 (1997-11)	Cavitation pitting evaluation in hydraulic turbines, storage pumps and pump-turbines – Part 2: Evaluation in Pelton turbines
IEC 60805 (1985-09)	Guide for commissioning, operation and maintenance of storage pumps and of pump-turbines operating as pumps
IEC 60994 (1991-02)	Guide for field measurement of vibrations and pulsations in hydraulic machines (turbines, storage pumps and pump-turbines)
IEC 60994 Corr. 1 (1997-04)	Corrigendum 1 – Guide for field measurement of vibrations and pulsations in hydraulic machines (turbines, storage pumps and pump-turbines)
IEC 61116 (1992-10)	Electromechanical equipment guide for small hydroelectric installations
IEC 61362 (1998-03)	Guide to specification of hydraulic turbine control systems
IEC 61362 Corr.1 (2000-03)	Corrigendum 1 – Guide to specification of hydraulic turbine control systems
IEC/TR 61364 (1999-07)	Nomenclature for hydroelectric power plant machinery
IEC 61364 Corr.1 (2000-08)	Corrigendum 1 – Nomenclature for hydroelectric powerplant machinery
IEC/TR61364(1999-07)	Nomenclature for hydroelectric power plant machinery
IEC/TR 61366-1 (1998-03)	Hydraulic turbines, storage pumps and pump-turbines – Tendering Documents – Part 1: General and annexes
IEC/TR 61366-2 (1998-03)	Hydraulic turbines, storage pumps and pump-turbines – Tendering Documents – Part 2: Guidelines for technical specifications for Francis turbines
IEC/TR 61366-3 (1998-03)	Hydraulic turbines, storage pumps and pump-turbines – Tendering Documents – Part 3: Guidelines for technical specifications for Pelton turbines
IEC/TR 61366-4 (1998-03)	Hydraulic turbines, storage pumps and pump-turbines – Tendering Documents – Part 4: Guidelines for technical specifications for Kaplan and propeller turbines
IEC/TR 61366-5 (1998-03)	Hydraulic turbines, storage pumps and pump-turbines – Tendering Documents – Part 5: Guidelines for technical specifications for Tubular turbines
IEC/TR 61366-6 (1998-03)	Hydraulic turbines, storage pumps and pump-turbines – Tendering Documents – Part 6: Guidelines for technical specifications for

	Pump turbines
IEC/TR 61366-7 (1998-03)	Hydraulic turbines, storage pumps and pump-turbines – Tendering Documents – Part 7: Guidelines for technical specifications for Storage turbines
IEC 62256 (2008-01)	Hydraulic turbines, storage pumps and pump-turbines – Rehabilitation and performance improvement
IEC 62270 (2004-04)	Hydroelectric power plant automation – Guide for computer-based control
IEC-62006-2010	Hydraulic Machines - Acceptance Tests of Small Hydroelectric Installations
IEC-60034-1: 2004	Rotating Electrical Machines, Rating and Performance
IEC-60034-9-2003	Rotating Electrical Machines - Part 9: Noise Limits
IEC-60034-2A-1987	Rotating Electrical Machines Methods for determining losses and efficiency of electrical machinery from tests (excluding machines for traction vehicles
IEC-60034-5-1991	Classification of degrees of protection provided by enclosures for rotating electrical machines (IP Code)
IEC-60085-1987	Classification of materials for the insulation of electrical machines
IEC 60085-2007	Electrical insulation – Thermal evaluation and designation
IEC-60354 (1993)	Guide for loading of oil immersed transformers
IEC: 60076 (Part1to5) (2011)	Specifications for Power Transformer
IEC: 60076 (Part 1 to 5) (2000-05)	Specifications for Power Transformer
IEC: 62271 (2002)	High voltage alternating current circuit breakers
IEC: 60502-2005	Extruded solid dielectric insulated power cables for rated voltages from 1 kV up to 30 kV
IEC 60502-2009	Extruded solid dielectric insulated power cables for rated voltages from 1 kV up to 30 kV
IEC: 60331-2009	Fire resisting characteristics of electric cables
IEC 60332-3-24:2008	Tests on electric cables under fire conditions . Part 3-24: Test for vertical flame spread of vertically-mounted bunched wires or cables
IEC: 60332-2009Part3	Tests on electrical and optical fibre cables under fire conditions
IEC: 60947 4-1-2002 and (Part 4-1)	Contactors and motor-starters – electromechanical contactors motor-starters
IEC:IEC-60947-1-011	Degrees of Protection of Enclosures of LV Switchgears and Controllers
IEC: 60076-11:2004	Dry type transformers
IEC:61125-1996	Recommended practice for preparation of equipment specifications for speed governing of hydraulic turbines intended to drive electric generators
IEC **6**0034-18-32-2010	Functional evaluation of insulation system test procedures for form – would windings – evaluation by electrical endurance
IEC 60034-2010	Direct action indicating electrical measuring instruments
IEC 60055-2005-Part 2	Paper-insulated metal-sheathed cables for rated voltages up to 18/30 kV
IEC 62271.100-2008-Part 100	High voltage switch gear and controls -Alternating current circuit breakers

IEC 60068-2008-Part 2-27	Environmental testing Tests – Test Eq. and guidance shock
IEC 60071-2011-Part1	Insulation co-ordination
IEC 60072-1994	Dimensions and output ratings for rotating electrical machines
IEC 60073-2002	Basic and safety principals for man machine interface marking and identification coding principles for indicators and actuators
IEC 60076-2008 Part12	Power Transformers
IEC 60086-2011	Primary Batteries
IEC 60095-2009-Part 2	Lead Acid Starter Batteries
IEC 60099-2009-Part4	Surge arresters
IEC 62271-2012-Part 102	High voltage switch gear and controls
IEC 60 137-2008	Insulated bushings for alternating voltages above 1000 V.
IEC 60947.1-2011	Low voltage switch gear and control gear- part1
IEC 60947 -2009Part 2	Low voltage switchgear and control gear -2
IEC 60168-2000	Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1000 V
IEC 60044-1-2000	Current transformers
IEC 60044-2-2003	Inductive voltage transformers
IEC 60189-2007-Part 3	Low frequency cables and wires with P.V.C. insulation and PVC sheath
IEC 60214-2003-Part 1	Performance requirements and test methods
IEC 60227-2012- Part7	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V.
IEC 60228-2004	Conductors for insulated cables
IEC 60230-1966	Impulse tests on cables and their accessories
IEC 60255-2010Part27	Measuring relays and protection equipment
IEC 60287-2006Part 2	Electrical cables calculation of current rating
IEC 60947.4.3-2012	Low voltage switch gear and control gear
IEC 60296-2012	Fluids for electro-technical applications
IEC 62271.200-2011	High voltage control gear and switch gear
IEC 60304-1982	Standard colours for insulation for low frequency cables and wires
IEC 60344-2007	Guide to the calculation of resistance of plain and coated copper conductors of low-frequency cables and wires.
IEC 60076.7-2005	Loading Guide for oil immersed transformers
IEC602271.101-2010	Report on synthetic testing of high voltage alternating current breakers.
IEC 60439-2006-Part 5	Low voltage switchgear and control gear assemblies
IEC 60446-2007	Identification of insulated and bare conductors by colours
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