

Hydropower Glossary

This glossary provides definitions for about 300 terms commonly used in conjunction with hydropower. The glossary can be a useful tool to those new to hydro, as well as a valued reference piece for veterans.

Acceptance Test: A test performed on a piece of equipment (such as a hydraulic turbine) to validate its performance. This test can be accomplished on a physical model, at the factory, or in the field at a hydro facility on the prototype equipment. Note: For turbine runners, the first field acceptance test of a new runner design historically has been referred to as a model test.

Acre-Foot: A unit of volumetric measure that would cover 1 acre to a depth of 1 foot. It is equal to 43,560 cubic feet.

Actuator: A device that transforms an input signal (primarily electrical) into motion. Electrical motors, pneumatic actuators, hydraulic pistons, and relays are examples of actuators. A liner actuator produces a movement proportional to the input signal.

Adit: A nearly horizontal underground entrance in an abutment with an opening in only one end. An adit (i.e., passage-way) is often excavated or formed into the face of a dam for access to galleries or operating chambers, or into a tunnel for inspection access.

Aeration: The process by which air is circulated through, mixed with, or dissolved into a liquid or solid.

Afterbay: A downstream channel or pond for conducting water away from a

hydro plant or re-regulating flows from the plant.

Air Gap: A measure of the radial distance between the rotor and stator in a generator. Magnetic flux linking the rotor and stator travels across this gap.

Ampacity: Current-carrying capacity, expressed in amperes, of a conductor or cable under stated thermal conditions.

Anadromous Fish: Fish – such as salmon, shad, and eels – that migrate up rivers from the sea to spawn in fresh water.

Anchor Bolt: A bolt used to attach objects or structures to concrete, wood, or steel. Anchor bolts can be cast in place when the concrete is placed around a pre-positioned bolt, or installed after concrete is placed by drilling holes into set concrete and then hammering the bolt into the hole.

Ancillary Services: Secondary or supporting services that can be performed by the equipment and people that generate, control, and transmit electricity. These services – which include load following, frequency regulation, spinning reserve, and non-spinning reserve – support the basic services of generating capacity, energy supply, and power delivery by ensuring system stability.

Appurtenant Structure or Facility: Ancillary feature of a hydroelectric facility or dam, such as an outlet, spillway, tunnel, switchyard, access road, valve, gate, crane, navigation lock, or any major feature that enables the structure or facility to function.

Armature: The power-producing winding in a generator, or main power-

consuming winding in a motor; it may be rotating or stationary.

Assembly Bay: The part of a powerhouse that provides laydown space for turbine and generator assembly. It is used during construction and for major maintenance operations. Sometimes called the erection or service bay.

Availability: The percent of time a plant is available to produce power.

Avoided Cost: The estimated sum of money that would have been spent on the lowest cost alternative generating plant that would be used if a hydro project did not exist; used in setting power prices.

Backup Power: Reserve generating capacity of a power system.

Base Load Capacity: Capacity available from the generating units used to meet around-the-clock demand for electricity.

Bearing, Guide: A bearing on a generating unit's rotating shaft designed to provide radial support to the unit's shafting system and to meet mechanical design requirements, such as shaft stress, deflection, and critical speed.

Bearing, Thrust: A bearing that provides axial support parallel to the shaft of the turbine and generator components.

Bifurcation: The area where a pipeline, tunnel, or conduit divides into two branches. Bifurcated penstocks are fairly common.

Black Start: The start up of a power plant without an external electrical supply.

Block Loading: Increasing or decreasing output of a generating plant in definite steps without regard to following a particular load shape. A generating plant carries a block load when its output is maintained at a fixed level for an extended period of time.

Do you see hydro industry terms that are not defined in this glossary? Please send terms you would like to see included, along with their definitions if available, to Editor, Hydro Review, 410 Archibald Street, Kansas City, MO 64111; E-mail: mbarnes@hcupub.com.



Boom: A floating structure spanning the surface, or part of the surface, of a reservoir upstream of a dam, generally

used to intercept debris and exclude it from the power intakes or spillway gates. Such structures also can preclude boat access and enhance public safety, and are usually marked with visible warning signs.

Breach: An opening through a dam that allows an uncontrolled release of water from a reservoir. A controlled breach is a constructed opening. An uncontrolled breach is an unintentional opening. A

breach is generally associated with the partial or complete failure of the water-retaining structure (e.g. dam, canal, and/or levee).

Brushgear: The assembly of slip rings/commutator, brush holders, and brushes used to generate and/or transport direct current onto the rotor of a synchronous machine.

Bucket, Runner: The convex portion of a turbine blade against which water impinges.

Bulkhead Gate: A temporary gate installed at the entrance of a fluid passage and used to dewater the passage for inspection and maintenance, or in emergency situations. Almost always opened or closed under balanced pressure.

Busbar, Bus: An electrical conductor in the form of rigid bars that serves as a common connection for two or more electric circuits or devices.

Bushing (Electrical): Insulator to permit passage of a high-voltage lead through a frame or housing.

Bushing (Mechanical): A replaceable cylindrical lining designed to reduce friction and wear or to constrict and restrain the motion of mechanical parts.

Capacitor: A device used to temporarily store an electrical charge; consists of two conducting plates separated by an insulating material.

Capacity (Load) Factor: The ratio of the energy a power-generating system produces to the energy it would produce if it operated at full capacity throughout a given period, usually one year.

Cathodic Protection: A system that uses a sacrificial anode or applied current flow to prevent electrolytic corrosion of metal surfaces that are in contact with water or soil (i.e. gates, bulkheads, etc.).

Cavitation: The formation of voids within a body of moving liquid (or around a body moving in a liquid) when the local pressure is lower than the vapor pressure, and the particles of liquid fail to adhere to the boundaries of the passage-way. These voids fill with vapor and then collapse, resulting in a high-pressure jet.

Cavitation Damage: Removal pitting of metal on turbine blades due to cavitation.

Channel: Any natural or artificial facility that conveys water. The deepest part of a river channel that conveys the bulk of a river's discharge.

Circuit Breaker: A switching device that automatically interrupts the flow of an electric current under load or short-circuit conditions.

Circuit Breaker, Air Blast: High-voltage circuit breaker in which the arc is extinguished by a powerful blast of air directed through an orifice across the arc and into an arc chute.

Circuit Breaker, Oil-Filled: High-voltage circuit breaker in which the contacts open under oil. The arc is extinguished via the gas bubble pressure created by the current arc.

Circuit Breaker, SF₆: High-voltage circuit breaker in which the contacts open in sulphur hexafluoride gas as the insulating and extinguishing medium.

Civil Works: All heavy construction work associated with dams, tunnels, canals, conduits, penstocks, powerhouse structures, access roads, bridges, and site improvements.

Cofferdam: A temporary structure or embankment built to control water, for the purpose of creating or maintaining a dry work environment.

Commutator: An electrical switch that periodically reverses the current in an electric motor or generator. Commutators enable motors to run on, and generators to produce, direct current instead of alternating current.

Computational Fluid Dynamics

(CFD): A calculation technique used to analyze the flow of fluids relative to complex geometries such as hydraulic turbines. CFD analysis is performed by using a computer to solve the three-dimensional turbulence modeled equations of motion on a fine grid filling the water passages of the conduit or flow passage being analyzed.

Conduit: A pipeline or tunnel used to convey water or a tube or pipe for enclosing electric wires or cables.

Conventional Hydroelectric Plant:

A hydroelectric power plant using falling water only once as it passes downstream, as contrasted to either a pump-back or pumped-storage plant, which recirculates all or a portion of the streamflow during the production of electric power.

Core (Civil): A zone of material with low permeability in an embankment dam. Sometimes referred to as the impervious zone.

Core (Electrical): An element made of magnetic material, services as a path for magnetic flux (e.g., generator core, transformer core).

Corrosion: The gradual deterioration of a metal due to chemical or electrical activity.

Crane: A machine used to lift and lower equipment and may move it horizontally. Cranes commonly used in hydro powerhouses include gantry and overhead cranes.

Critical Speed: The angular speed at which a rotating shaft becomes dynamically unstable with large lateral amplitudes, due to resonance with natural frequencies of lateral vibration of the shaft.

Cumulative Impacts: The sum of the environmental impacts of two or more hydro projects on the same river system.

Current (Electric): The rate of flow of electric charge through a conductor or circuit, measured in amperes.

Cutoff Trench: A foundation excavation later to be filled with impervious material so as to limit seepage beneath a dam.



Cutoff Wall: A wall of impervious material – usually concrete, asphaltic concrete, or steel sheet piling – constructed in a dam's foundation and abutments to reduce seepage beneath and adjacent to the dam.

Cycling: Power plant operation to meet the variable portion of the load (nine to 14 hours per day).

Dam: A structure for impounding water.

Dam, Arch: A thin, curved dam usually made of steel-reinforced concrete that depends upon the arch for its strength.

Dam, Buttress: A dam where the face is held up by a series of supports. The dam face may be curved or flat.

Dam, Concrete-Faced Rockfill (CFRD): An embankment dam made of rockfill with an upstream facing of concrete to serve as the water barrier.

Dam, Diversion: Used to divert water through long tunnels, canals, or pipelines to a powerhouse located some distance from the dam. Also, a dam used to divert water around something, such as during construction of a new dam.

Dam, Embankment: A massive dam made of earth or rock that relies on its weight to resist the flow of water.

Dam, Gravity: A concrete dam that has sufficient mass to be inherently stable under all externally applied loads.

Dam, Roller-Compacted-Concrete (RCC): Dam built with a concrete of no-slump consistency that is compacted with vibratory rollers.

Dam, Timber Crib: A dam constructed of timber crib cells filled with rock ballast and covered with sheathing on the water side to minimize leakage.

Demand: The rate at which electric energy is delivered to or by a system or to a piece of equipment.

Dependable Capacity: The expected load-carrying ability of a hydropower plant under specified conditions.

Design Flood: The flood, either observed or synthetic, that is chosen as the basis for the design of a hydraulic structure.

Dewatering: Removing or draining water from an enclosure or a structure.

Diffuser: A duct, chamber, or section in which a high-velocity, low-pressure stream of fluid is converted into a low-velocity, high-pressure flow.

Digital Controls: The use of digital or discrete signal processing technology to maintain conditions in operating systems as close as possible to desired values.

Dike: A walled structure, usually earthen, constructed to fill low areas around higher natural or man-made contours for the purpose of retaining water at a higher elevation.

Discharge: The rate of water flow through, over, or around water control facilities. The flow rate is measured by a stream gage or calculated from predetermined rating tables. The term may be applied to the rate of flow from each individual source (such as a particular turbine) or to the algebraic summation from all individual sources (which would be the total rate of flow). Total discharge is synonymous with outflow.

Discharge Ring: The structural member of a Francis turbine that surrounds the runner band. On a Kaplan or propeller unit, the discharge ring surrounds the blades and forms a guide for the water.

Dispatching: Operating control of generating units, transmission lines, and other facilities, including assigning of generator outputs as needed, controlling/ scheduling switching operations, and scheduling energy transactions with other utilities.

Dissolved Oxygen: Amount of oxygen gas dissolved in water by diffusion from the surrounding air, by aeration, and as a waste product of photosynthesis. Typically expressed in parts per million (ppm).

Distributor: Components (wicket gates, bottom ring, head cover, and stay ring) of a turbine whose purpose is to guide the flow into the runner.

Diversion Channel or Tunnel: A constructed channel or tunnel used to temporarily divert water from its natural course, such as when bypassing water around a dam site during construction.

Draft Tube: A conduit that carries water from a reaction turbine runner or crossflow turbine runner to the tailrace. Designed to maximize head use by the turbine.

Drainage Area: The area of land draining to a stream or power plant. Sometimes called the catchment area.

Drawdown: The distance that the water surface elevation of a storage reservoir is lowered as a result of the withdrawal of water to meet some project purpose (i.e., power generation, flood control, irrigation demand, etc.).

Eddy: A miniature whirlpool resulting when a current of water moves against the main current. Occurs when the fluid flows near a wall or other shear region with a high velocity gradient.

Efficiency: The ratio of energy developed by a machine to the energy supplied to it.

Efficiency, Absolute: Ratio of useful energy output to total energy input to calculate the performance of a turbine or pump. For a hydroelectric plant, the ratio of gross energy production to water flow potential given by flow rate and head, expressed as a percent.

Efficiency, Mechanical: Ratio of the power available at the shaft to that exerted on the runner for a turbine (vice versa for a pump). It accounts for bearing and disc friction and the drag on the runner in the clearance spaces.

Efficiency, Overall: Accounts for all the system efficiencies, hydraulic, turbine, generator, and transformer.

Efficiency, Relative: The efficiency of a turbine or pump determined by directly measuring the head and power while using relative flow measurement techniques to determine flow, expressed as a percent in relation to another or absolute efficiency. This method ignores common or fixed losses. Also known as index test performance.

Efficiency, Turbine: Accounts for hydraulic friction and eddy losses through the spiral case, stay ring, wicket gates, runner, and draft tube of a turbine, as well as the kinetic energy of the water at the draft tube exit that has not been converted into useful work by the turbine.



Emergency Action Plan (EAP): A written document that identifies potential or impending flood emergency conditions at a dam. Agencies such as the Federal Energy Regulatory Commission have stylized regulations defining specified pre-planned and sequential communications and actions to be followed to minimize property damage and to avoid loss of life. EAPs are often practiced in simulation as a readiness or training tool.

Energy: That which does or is capable of doing work. It is measured in terms of the work that it is capable of doing; electric energy is usually measured in kilowatt-hours.

Erosion: Surface destruction of a material by the abrasive action of a moving fluid. Often accelerated by solid particles in suspension.

Exciter: An electrical device that supplies direct current to the generator field during start up and running of the unit. It may be a rotating shaft-mounted type or a static rectifier type.

Exemption: Special rules that permit the Federal Energy Regulatory Commission to waive the requirement that a project be licensed under the Federal Power Act if it meets certain capacity, project type, land ownership, and environmental criteria.

Feasibility Study: An investigation performed to formulate a hydropower project and definitely assess its desirability for implementation.

Federal Energy Regulatory Commission (FERC): The agency of the U.S. Department of Energy that licenses non-federal hydropower projects and regulates interstate transfer of electric energy. Formerly the Federal Power Commission (FPC).

Federal Register: A daily U.S. federal government publication containing all new federal regulations, proposed regulations, administrative notices, and other documents. Available by subscription from the General Services Administration.

Feedback Signal: A sample taken of an already processed signal (an output of a system) that is returned to a point ahead of where the signal was processed for comparison to a desired outcome.

Field Pole: A structure of magnetic material located on the rotor to which the field coil or winding is mounted. Direct current in a field winding creates a magnetic pole.

Finite Element Method: A method for determining the behavior of a structure from a knowledge of the behavior, under load, of its components. A structural system is considered an assembly of a finite number of finite-size elements. These are assumed to be connected only at discrete points called nodes. The characteristics of the whole system can be derived from the characteristics of the elements, such as their stiffness or flexibility. Thus, the internal stresses and strains throughout can be computed, and both static and dynamic behavior can be predicted.

Fish Bypass: A structure in a dam that provides a route for fish to move through or around the dam without going through the turbine units. The bypass channel is the part of a system that includes a conduit built into the dam to pass fish.

Fish Guidance Efficiency (FGE): The percent of fish moving toward a dam's turbine units that are diverted away by a fish guidance device, such as a submersible traveling screen.

Fish Ladder: An artificial waterway composed of a series of stepped pools allowing fish to ascend a vertical gradient from the downstream to the upstream portion of the dam; usually built at one end of a dam.

Fish Screen: Barrier installed to divert downstream migrating fish into a safe bypass.

Flashboards: Temporary structures installed at the top of dams, gates, or spillways to temporarily raise the pool elevation, and hence the gross head of a hydroelectric generating plant, thus increasing power output and water storage capacity. Normally, flashboards are removed at the end of the water storage season or during periods of high streamflow.

Flow: The amount of water passing a point in a given amount of time.

Flow Duration Curve: A curve of flow values plotted in descending order of magnitude against time intervals,

usually in percentages. For example, the curve might show that a river flows at 500 cubic feet per second (cfs) or more 10 percent of the time, and at 100 cfs or more 80 percent of the time.

Flow Line: Usually an inclined pipe but sometimes an open channel that uses gravity to carry water to a hydro plant. Such conduits usually flow partially full and are not under pressure. Segments of conduits that lead to turbine-generators and that are under pressure are called penstocks and are confined in steel pipes to withstand high pressure.

Forebay: The water intake area for a canal, penstock, or turbine designed to reduce water velocity and turbulence in order to settle suspended material and keep it from entering the system.

Frazil Ice: A collection of loose, usually adhesive, randomly oriented needle-shaped ice crystals in water. As it coalesces, it resembles slush and forms on

structures such as penstocks or natural channel bottoms and banks in turbulent, super-cooled water (water that is less than 32 degrees Fahrenheit but in a liquid state, including water flowing through trackracks. Frazil ice can be problematic at hydroelectric plants and diversion facilities by blocking the flow of water or causing flooding outside the normal channel. It can also scour a river channel, damaging natural biota.

Freeboard: The vertical distance between the normal reservoir surface elevation and the top of the dam. This is usually a component in assessing the safety of a dam to withstand flood events.

Full-Gate Operation: Discharge through a turbine when the turbine wicket gates are wide open.

Fuse Plug: A collapsible sacrificial structure installed to increase the discharge capacity of a dam under flooding or very high flow conditions. Before the reservoir elevation can reach the point of overtopping the crest of the main dam, the lower crested fuse plug is intended to overtop and wash away, thus relieving pressure and protecting the main dam from a possible uncontrolled breach.



Gallery: A passageway in the body of a dam used for inspection, foundation grouting, and/or drainage.

Gantry Crane: A crane or hoisting machine mounted on a frame or structure spanning an open space which often travels on rails. Commonly used to lift equipment in a powerhouse, or gates on a spillway.

Gate: A closure device in which a plate is moved across the fluid from an external actuator to control the flow of water.

Gate, Radial: A gate with a curved upstream plate and radial arms hinged to piers or other supporting structure. The gate usually sits atop an ogee-type spillway and lifts vertically, allowing water to flow underneath the gate. Radial gates are typically operated hydraulically and remotely and allow fine-tuned control of reservoir elevation on a daily operating basis as well as major flood control operations. Also commonly referred to as a tainter gate.

Gate, Sluice: A gate that is opened or closed by sliding in supporting guides, grooves, or on a framework. These gates are commonly used to control water levels and flow rates in rivers and canals, or to sluice surface water at a dam to remove ice and trash and are associated with appropriate structures to divert discharge safely away from the dam. They are also used to sluice debris which has settled or collected in front of a hydraulic control structure. Also called slide gate.

Gate, Spillway: A gate on a spillway structure to control the flow of water. These can include radial, vertical lift, flap (Bascule), and crest gates. Also called flood gate. In addition to using steel structures, gates can be made of wood logs or panels or inflatable spillways.

Gate, Tainter: A type of radial arm flood gate named after structural engineer Jeremiah Tainter, used to control water flow at a dam. When the gate is closed, water bears on the convex upstream side. The gate is rotated open with the help of hydrostatic pressure on its trunnions and will close under its own weight.

Gatewell: The slot on the upstream face of a concrete dam where hydraulic gates are stored when not used to close the turbine intakes. The gatewell may house the fish screening device.

Gaging Station: A particular site on a stream, canal, lake, or reservoir where systematic observations of streamflow or other hydrologic data are obtained.

Generating Capability: The maximum load that a system can supply without exceeding approved limits of temperature and/or various stresses. Often referred to as generating capacity.

Generating Unit: A single power-producing unit consisting of a turbine, generator, and related equipment.

Generation, Gross: The total amount of electric energy produced by a generating station or stations, measured at the generator terminals.

Generation, Net: Gross generation, less plant use (station service).

Generator, Electrical: A machine that converts mechanical energy into electrical energy.

Generator, Induction: A nonsynchronous alternating-current generator that is driven above synchronous speed by external sources of mechanical power, normally best-suited to small hydroelectric plants and requires external capacitive reactive compensation.

Generator, Synchronous: An alternating current (AC) generator whose operating speed is fixed by the frequency of the electrical system to which it is interconnected.

Governor: A device that measures and regulates turbine speed by controlling wicket gate angle to adjust water flow to the turbine.

Grid: The transmission network interconnecting electric power systems or bulk power components of a single system.

Habitat, Riparian: Habitat on or near stream or river banks.

Head Cover: Turbine structural member that spans the top of the distributor and provides the separation between the watered runner passage and the dry

turbine pit. It also supports other turbine components.

Head Gate: A closure device built in an intake to control inflow to the penstock, canal, or turbine inlet.

Head (Hydraulic) Loss: The various energy losses per unit mass (giving units of head) sustained as water flows from

the headwater to the tailwater. Head losses through the turbine are normally accounted for in the turbine efficiency.

Head, Critical: The hydraulic head at which the full-gate output of the turbine equals the generator rated capacity. Below critical head, the full-gate turbine capability will be less than the generator rated capacity. Above critical head, generator rated capacity can be obtained at a discharge less than full-gate discharge.

Head, Design: The head at which the turbine will operate to give the best overall efficiency under various operating conditions.

Head, Gross: The difference in elevation between the water surfaces of the forebay and tailrace under specified conditions; also called static head.

Head, Hydraulic: A measure of energy or pressure, expressed in terms of the height of a column of water.

Head, Net: Actual head available to a turbine. It is equal to the gross head minus hydraulic losses in the waterways, except those chargeable to the turbine, as the water passes from headwater to tailwater.

Head, Operating: Difference in elevation between the water surface forebay and tailrace with allowances for velocity heads.

Head, Rated: Net head at which the full-gate output of a turbine produces the generator rated output.

Head, Static: The height of the water column under no-flow conditions.

Head, Weighted Average: The net head determined from reservoir operation calculations that will produce the same amount of energy in kilowatt-hours between that head and maximum head as is developed between that same head and minimum head.



Headrace: The portion of the power canal which extends from the intake works to the powerhouse.

Headwater: Water upstream of a dam or powerhouse.

Headwater Benefits: The benefits brought about by the storage and release of water by a reservoir project upstream. Application of the term is usually in reference to benefits realized at a downstream hydroelectric power plant.

Headwater Elevation: Elevation of the water upstream of a dam or powerhouse.

Hipot Test: High-potential, or dielectric, test, is used to ensure that the insulation being tested should be capable of enduring temporary over voltages. The hi-pot test, normally associated with the testing of stator windings and performed with the generator off line, involves stressing the insulation by applying a pre-defined higher-than-normal voltage to the stator winding conductors.. If the winding insulation does not fail (i.e., puncture) during this test, this can provide some reassurance that the stator winding is not as likely to fail when there is a greater risk of significant collateral damage. Hipot tests can be performed using alternating current or direct current.

Hydrograph: A graphical representation of the variations of the flow of a stream at a given station plotted in chronological order, usually with time as the abscissa and flow as the ordinate.

Impeller: Rotating member of a pump-turbine, blower, fan, axial or centrifugal pump, or mixing apparatus.

Inflow: The rate of volume of water that flows into a reservoir or forebay during a specified period.

Inflow Design Flood (IDF): The flood flow above which the incremental increase in water surface elevation due to failure of a dam or other water-impounding structure is no longer considered to present an unacceptable threat to downstream life or property. During design of a dam, the IDF is used to size the spillway and outlet works and to determine maximum height of the dam, freeboard, and temporary storage requirements.

Instream Flow: The minimum flow that must be released from a project in order to meet environmental or other non-power water requirements. May also be referred to as Environmental Flow or Minimum Discharge.

Intake: A structure to divert water into a conduit leading to the power plant.

Interconnection: A transmission line joining two or more power systems, allowing power produced by one system to be used by another. Also referred to as an intertie.

Interruptible Load: Electric power load that may be curtailed at the supplier's discretion, or in accordance with a contractual agreement.

Labyrinth Seal: A minimum leakage seal that offers resistance to fluid flow while providing radial or axial clearance.

Laminar Flow: Fluid flow without turbulence or eddys in which all fluid particles move in distinct and separate lines.

License: Approval from a permitting body such as the Federal Energy Regulatory Commission to develop and operate a hydroelectric project for a specified period of time.

Load: The amount of electric power delivered for consumption at a given point.

Load Duration Curve: A curve showing the total time, within a specified period, during which the load equaled or exceeded the given power values.

Load Factor: Also called Capacity Factor. The ratio of kilowatt-hours produced over a designated period to the theoretical peak kilowatt-hours based on installed capacity during that period.

Load Rejection: A sudden cessation of electrical load on a generating unit, resulting in a rapid acceleration and overspeed of the rotating mass, and requiring the subsequent rapid closure of the wicket gates.

Log Boom: A device used to prevent large objects floating on the water surface from entering an area. Normally used upstream of an intake or spillway.

Mainstem: The main channel of the river in a river basin, as opposed to the streams and smaller rivers that feed into it.

Mitigation Measure: Any type of feature (structural, operational, etc.) incorporated into the design of a hydro project to offset or compensate for environmental effects.

Motor-Generator: A machine that converts mechanical energy into electrical energy as a generator and converts electrical energy into mechanical energy as a motor. Motor-generators may be reversible (i.e., generate in one direction and motor in the other) if they are connected to a reversible pump-turbine. Otherwise, they may be unidirectional if connected to separate pump impeller and turbine runner assemblies. Typically used in a pumped-storage plant to generate electricity or drive the pump.

Municipal Preference: Federal Energy Regulatory Commission (FERC) law for deciding between competing applications for project licenses that gives municipal developers priority over non-municipal developers, all other criteria being equal.

Net Energy for System: The electric energy requirements of a system, including losses, defined as: (a) net generation of the system, plus (b) energy received from others, less (c) energy delivered to other systems for resale.

Nozzle: A control valve that directs flow onto the runner of a Pelton or Turgo impulse turbine.

Outage, Forced: The shutting down of a generating unit, transmission line, or other facility for emergency reasons.

Outage, Planned: Removal of a generating unit from operation for required maintenance.

Outlet: An opening through which water can be freely discharged from a reservoir to the river. Outlet works on non-generating dams are the primary means to control river discharge for downstream water use. On dams with generating facilities, outlet works serve



unusual or infrequent non-generating purposes including draining the forebay or reservoir for maintenance or for additional flood control release capacity.

Overspeed: A condition in which the rotational speed of the runner and turbine exceeds nominal operating speed. This usually occurs following a load rejection. The overspeed condition results from energy being diverted from the power system load (electrical) to accelerating the generator rotor and runner (mechanical) It takes time to close the turbine wicket gates and thereby reduce the energy being produced by the turbine.

Parapet Wall: A solid wall built along the top of a dam (upstream or downstream edge).

Peak Load: The maximum load in a stated period of time.

Peaking Capacity: That part of a system's capacity that is operated during the hours of highest power demand.

Penstock: A high-pressure conduit extending from the first upstream water surface to the turbine.

Piping: The progressive development of internal erosion inside an earthfill-type dam by seepage. This is a potentially dangerous condition that can lead to the failure of earthen dams. When observed, piping is closely monitored and usually repaired to avoid risk of dam failure.

Plant Factor: The ratio of the energy that a plant produces to the energy that would be produced if it were operated at full capacity throughout a given period, usually a year.

Pondage: Water stored behind a dam used for daily or weekly regulation of the flow of a river.

Post Tension Anchors: Used to stabilize dams using long cables under tension anchored to bedrock and the top of a dam.

Power: The time rate of transferring energy. Electrical power is measured in kilowatts.

Power Factor: The ratio of real power to apparent power. Low power factor reduces the efficiency of power transmission.

Power Pool: Two or more interconnected electric systems that coordinate the planning or operation of their bulk power facilities to achieve greater reliability and economy in accordance with contractual agreements that establish each member's responsibilities.

Power, Firm: Power or power-producing capacity intended to be available at all times during the period covered by a guaranteed commitment to deliver, even under adverse conditions.

Power, Reactive: The cyclic energy absorbed and released from an inductive or capacitive element in a power system. It is expressed as reactive volt-amperes, or vars. Inductive reactance is considered a var source (positive), and capacitive reactance is considered a var sink (negative).

Powerhouse: A structure that houses the turbines, generators, and associated control equipment.

Preliminary Permit: A permit granted by the Federal Energy Regulatory Commission for a particular project site, giving the holder priority status for filing an application for a license or exemption. A preliminary permit may be granted for a term of up to 36 months and is not renewable. Obtaining such a permit is an optional step in the licensing process.

Pressure Shaft: A vertical or inclined conduit excavated in rock and capable of carrying water under pressure. In underground hydroelectric projects, it replaces the penstock.

Prime Mover: The engine, turbine, waterwheel, or similar machine that converts a natural source of energy into mechanical energy.

Probable Maximum Flood (PMF): The flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are theoretically possible in a particular drainage basin. The PMF is estimated by a variety of historic hydrologic and precipitation data and modeling factors (see also PMP).

Probable Maximum Precipitation (PMP): The greatest volume of precipitation for a given duration that is theoretically possible for a given size

storm area at a particular geographical location at a certain time of year. The PMF is partly generated using the PMP but also includes potential for saturated soils and existing snow cover on the ground.

Pumped Storage: A method of energy storage in which electrical energy produced during low demand periods is used to pump water into an elevated reservoir, from which water is released during high demand periods to supply high-value electrical energy.

Pump-Turbine: A hydraulic machine that can be used alternatively as a pump and turbine.

Ramp Rate (Maximum): The maximum allowable rate of change in output from a power plant. The ramp rate is established to prevent undesirable effects due to rapid changes in loading or, in the case of hydroelectric plants, discharge.

Rehabilitation: The restoration of a disabled unit to maximum productivity commensurate with its limitations.

Relay, Protective: The incorporation of sensing devices in electric power systems to monitor and identify abnormalities in system characteristics, such as voltage, current, and frequency, and to actuate other pieces of equipment to correct or isolate detected abnormal operating conditions.

Relicense: Approval from the Federal Energy Regulatory Commission to continue operating a hydroelectric project for a specified period of time after expiration of the original license (see License).

Reregulating Reservoir: A reservoir located downstream from a hydroelectric peaking plant that has sufficient capacity to store the fluctuating discharges from the plant and release them in a relatively uniform manner downstream.

Reserve: The additional capacity of a power system that is used to cover contingencies, including maintenance, forced outages, and abnormal loads.

Reserve, Ready: Reserve capacity that can be placed on line in a matter of minutes. Can be referred to as standby reserve.



Reserve, System: The capacity, in equipment and conductors, installed on the system in excess of that required to carry the peak load.

Reservoir: An impoundment into which water flows and can be stored for future use.

Rewind: Replacement of a generator stator or rotor winding. The winding capacity may be increased incidental to the rewind; therefore, the nameplate capacity of the unit may or may not be changed.

Riprap: Large stones or concrete placed for the purpose of protecting a slope from water erosion.

Rock Anchor: A steel rod or cable, usually more than 4 meters long, placed in a hole drilled in rock, held in position by grout, mechanical means, or both.

Rotor: The rotating inner portion of a generator consisting of windings surrounding the field poles, which are dovetailed to the periphery of a laminated core.

Rule Curve: A curve or family of curves indicating how a reservoir is to be operated under specific conditions to obtain best or pre-determined results.

Runaway Speed: The maximum rotational speed a turbine-generator unit will eventually reach when subjected to a sudden loss of electrical load on the generator, when operating under maximum net head, and with the wicket gates in the most adverse position.

Runner: The rotating element of a turbine that transforms the pressure and kinetic energy of the water into mechanical energy for the generator to use in making electric energy.

Runoff: The portion of precipitation that runs over the land surface and forms streamflow.

Runout: Often used to refer to the vibrational motion of the shaft measured with displacement proximity probes. Runout may also be used to mean the deviation of the outer periphery of a shaft from a true circle as the shaft is rotated.

Run-of-River: A type of hydro project that releases water at the same rate as the natural flow of the river (outflow equals inflow).

SCADA (Supervisory Control and Data Acquisition): A system used to remotely collect and archive data while monitoring conditions and operating mechanical features associated with a utility power or industrial process facility.

Seasonal Diversity: Diversity between two or more power systems when their annual peak loads occur during different seasons of the year.

Seepage: Internal movement of water that may take place through the dam, foundation, or abutments.

Semi-Spiral (Scroll) Case: A concrete intake for lower-head projects having direct flow to the upstream portion of the turbine and a spiral case surrounding the downstream portion of the turbine to provide uniform water distribution.

Service Area: Territory in which a utility system is required to (or has the right to) supply or make available electric service to ultimate consumers.

Servomotor: The electric, hydraulic, or other type of motor that serves as the final control element in a servomechanism; it receives power from the amplifier element and drives the load with a linear or rotary motion.

Settling Basin: A chamber designed to remove sediment from water by providing quiescent conditions that allow sediment to fall to the floor of the chamber.

Shear Pin: A pin or wire designed to hold parts in a fixed relationship until forces are exerted on one or more of the parts that cause shearing of the pin or wire.

Slip Ring: A method of making an electrical connection through a rotating assembly, commonly found in electrical generators for alternating current systems and alternators. Also called rotary electrical interfaces, collectors, swivels, or electrical rotary joints.

Sluice: A water channel controlled at its head by a gate.

Sluiceway: A channel designed to collect ice and trash in the river (e.g., logs) and pass it downstream of the power station away from the turbine intakes where the debris may cause headloss and possibly damage to the units. Sluiceways may be operated automatically or manually, but usually require that the turbines be shut down.

Specific Speed: The speed in revolutions per minute at which a hydraulic turbine would rotate, if reduced homologously in size, so that it would develop 1 horsepower under 1 foot of head at full gate. Specific speed is the basic parameter to which other performance and dimensional turbine characteristics are related for design and performance purposes.

Speed Increaser: A mechanical device installed between the generator and the turbine that permits the generator to operate at a higher speed.

Speed Rise: The increase in unit rotational speed above synchronous speed that occurs immediately after electrical load is suddenly removed from the generator and before the governor regains speed control. Normally measured in percent of rated speed.

Spherical Valve: A cylindrical closing body, encased in a spherical housing, and rotating around a shaft perpendicular to the penstock axis.

Spill: The discharge of water through gates, spillways, or conduits that bypasses the turbines of a hydro plant.

Spillway: An outlet from a reservoir or section of a dam designed to release surplus water that is not discharged through a turbine or other outlet works.

Spillway Apron: concrete bed designed to dissipate energy and prevent undermining of a dam from erosion and turbulence generated by spill.

Spinning Reserve: Available unused generating capacity for a transmission system from turbine-generator units that are connected to the power system (spinning) but not producing electricity.



Spiral (Scroll) Case: A spiral-shaped water passage that completely surrounds the turbine, providing a uniform distribution of water flow. The upstream end of the case connects to the pressure conduit or penstock.

Station Service: The power source for operating lights, building systems, unit controls, and all other demands associated with a power station. May be provided by one of the main generating units, a smaller “house” unit, or the main grid via a station service transformer.

Stator: The stationary outer portion of a generator consisting of a frame, laminated magnetic core, and armature windings that carry heavy currents and high voltages.

Stator Coil: A single or multi-turn coil of insulated wire mounted to the stator core. A series of coils is referred to as a stator winding. The stator coil of a generator creates alternating current voltage due to the changing magnetic flux produced by the rotating field poles.

Stator Rewind: Typically refers to the replacement of a generator stator winding while reusing the existing stator core and frame. The winding capacity may be increased incidental to the rewind, but the nameplate capacity of the unit may or may not be changed.

Stator Winding: The electrical coils on the stationary element of a generator.

Stay Ring: The structural member surrounding the wicket gates having two annular rings connected by a number of fixed stay vanes in the water passages. Its function is to provide support and structural continuity between the upper and lower portions of the turbine distributor, while guiding the water as it enters or leaves the spiral case.

Stay Vanes: Curved, airfoil-shaped, stationary surfaces located between the spiral case and wicket gates in a hydraulic turbine whose purpose is to induce a pre-rotation or pre-whirl to the fluid to reduce the relative velocity to the runner. They sometimes serve as columns that aid in supporting the generator weight and the loads associated with the internally pressurized machine.

Stilling Basin: A basin constructed to dissipate the energy of rapidly flowing water, e.g., from a spillway or outlet, and to protect the riverbed from erosion.

Stoplog: A gate installed at the entrance of a fluid passage and used to dewater the passage for inspection and maintenance. Almost always opened or closed under balanced pressure. Also known as a bulkhead gate.

Submergence: The elevation of the runner or impeller relative to the tailwater elevation.

Surge Tank: A hydraulic structure designed to control pressure and flow fluctuations in a penstock or tunnel. It functions as a reservoir that temporarily stores or releases water to the turbine.

Switchgear: The switches, breakers, and other devices used for opening or closing electrical circuits and connecting or disconnecting generators, transformers, and other equipment.

Switchyard: A concentration of electrical equipment that connects two or more electric circuits through switches, selectively arranged to permit a circuit to be disconnected or to change the electric connection between the circuits. In a hydroelectric project, the switchyard is the point at which the energy generated at the project is connected to the transmission system.

Synchronous Condenser: A synchronous motor running without mechanical load and drawing a large leading current, like a capacitor, used to improve the power factor and voltage regulation of an alternating current (AC) power system.

Synchronous Speed: The speed of rotation of a synchronous machine, in revolutions per second. It is equal to twice the frequency of the alternating current in Hertz divided by the number of poles in the machines.

Tailrace: A channel for conducting water away from a power plant after it has passed through it. Sometimes called an afterbay.

Tailwater: Water surface downstream of the powerhouse.

Tailwater Elevation: The elevation of the water surface downstream from a dam or hydroelectric plant.

Transducer: Device that converts physical quantities into equivalent signals, commonly electrical, for measurement and recording purposes.

Transformer: An electromagnetic device used to change the voltage of alternating current (AC) electricity.

Transmission Line: The wires used to transport or convey electric energy in bulk to a convenient point, where it is subdivided for delivery to the distribution system.

Trashrack: A rack or screen of parallel bars installed to prevent debris from entering the turbine.

Trashrake: Cleaning device for removing debris and ice from trashracks and associated structures.

Trunnion: A cylindrical protrusion used as a mounting point. The trunnion is the hinge upon which a tainter gate rotates.

Turbidity: Measure of the extent to which water has become clouded as a result of suspended sediments.

Turbine: A machine that, in the case of a hydroelectric plant, converts the energy of falling water to mechanical energy.

Turbine, Banki: Impulse turbine in which the flow passes through the blade row twice, first at the upper portion of the wheel and again at the lower portion, exiting in the opposite direction from the first pass.

Turbine, Bulb: An axial flow turbine situated in a straight-through water passage. The generator is enclosed in a streamlined watertight bulb located in the water passageway on either the upstream or the downstream side of the runner.

Turbine, Crossflow: Impulse turbine with partial air admission. The runner is drum-shaped with the blades fixed radially along the outer edge. Well suited to low-head application. Also known as an Ossberger turbine.



Turbine, Deriaz: A diagonal-flow turbine with a propeller runner whose blades are adjustable and the axis of the blades is at an angle with the axis of the shaft.

Turbine, Francis: A reaction turbine having a runner with a large number of fixed buckets, usually nine or more, to which the water is supplied in a whirling radial direction. It can be designed for operating heads ranging from 50 to 2,000 feet.

Turbine, Impulse: Uses the kinetic energy of one or more high-velocity water jets to produce power by impinging on the buckets of the runner.

Turbine, Kaplan: The most common type of propeller turbine, in which the angle of the blades to the flow can be adjusted. Most frequently used in the low- to moderate-head range.

Turbine, Pelton: The energy of water is converted through nozzles into high-velocity jets of water that drive a turbine by virtue of the forces of the water jets on buckets attached to the turbine wheel. Generally used for high-head applications.

Turbine, Propeller: Has a runner with four, five, or six fixed or moveable blades through which water passes. The water passes in an axial direction with respect to the shaft. Kaplan is the most common type of propeller turbine. It is most frequently

used in the low- to moderate-head range.

Turbine, Reaction: A turbine that uses both kinetic energy and the pressure of the water column to produce power. Features a water supply case, a mechanism for controlling the quantity of water and for distributing it equally over the entire runner intake, and a draft tube.

Turbine, Tubular: Turbine that has propeller runners and may be mounted in horizontal, vertical, or slant positions. The runners may be fixed or variable in pitch.

Turbine, Turgo: An impulse turbine used at the lower end of the high hydraulic head range. The turbine works on the impact between high-velocity water jets and the runner blades. The jets are directed onto the surface of the turbine runner at an angle to the runner shaft.

Turbine-Generator: The primary component of a hydro unit. A machine that, in the case of a hydroelectric plant, converts the energy of water to mechanical energy, and then the mechanical energy into electrical energy.

Upgrading: Increasing the generating capacity of a plant by either replacing existing equipment with new equipment or improving the existing equipment.

Valve: A device for controlling the flow of fluids, such as water.

Vane: A flat or curved surface exposed to a flow of fluid so as to be forced to move or to rotate about an axis, to re-channel the flow, or to act as the impeller.

Vortex: A mass of fluid with a whirling or circular motion that tends to form a cavity or vacuum in the center of the rotation.

Waterhammer: Pressure changes in a pressure conduit or penstock that are caused by the flow variation with time.

Watershed: The drainage area of a stream or river.

Waterwheel: A vertical wheel on a horizontal shaft that is made to revolve by the action or weight of water on or in containers attached to the rim.

Wearing Rings: Replaceable rotating rings fastened to the runner/impeller or adjacent stationary rings fastened to the head cover and bottom ring/discharge ring, forming removable seals with small clearances to reduce water leakages past the runner/impeller and thus increase turbine efficiency.

Wheeling: The transfer of power and energy from one utility over the transmission system of a second utility for delivery to a third utility, or to a load of the first utility.

Wicket Gates: Angularly adjustable streamlined elements (vanes) that control the flow of water to a turbine or discharge from a pump.

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