GLOSSARY OF TERMS

The purpose of this glossary is to offer a common vocabulary of terms normally used in dam instrumentation terms for use within and among Central and State Government agencies. Included terms are general and apply to all dams, regardless of size, owner, or location.

Abutment – The part of the valley side against which the dam is constructed. The left and right abutments of a dam are defined with the observer looking downstream from the dam.

Appurtenant structures – Structures associated with the dam including the following:

a) Spillways, either in the dam or separate therefrom;

b) Reservoir and its rim;

c) Low-level outlet works and water conduits such as tunnels, pipelines or penstocks, either through the dam or its abutments or reservoir rim;

d) Hydro-mechanical equipment including gates, valves, hoists, and elevators;

e) Energy dissipation and river training works; and

Auxiliary spillway – Any secondary spillway that is designed to be infrequently operated, in anticipation of some degree of structural damage or erosion to the spillway that would occur during operation.

Barrage – While the term barrage is borrowed from the French word meaning "dam" in general, its usage in English refers to a type of low-head, dam that consists of many large gates that can be opened or closed to control the amount of water passing through the structure, and thus regulate and stabilize river water elevation upstream for diverting flow for irrigation and other purposes.

Berm–A flat part of the slope of embankment or cutting.

Bill of quantities – A means of listing and quantifying the volume and type of work in a piece of construction so that its cost or value can be determined.

Boil – A disruption of the soil surface caused by water discharging from below the surface. Eroded soil may be deposited in the form of a ring (miniature volcano) around the disruption.

Cavitation – A process that damages concrete or metal by the formation of bubbles in a water flow, created when offsets or irregularities exist on a flow surface exposed to high velocities.

Chimney drain – A vertical or inclined layer of permeable material in an embankment to control drainage of the embankment fill.

Cofferdam – A temporary structure that encloses all or part of the construction area so that work can proceed in dry conditions. A diversion cofferdam diverts a stream into a pipe, channel, tunnel, or another watercourse.

Compaction – Mechanical action that increases soil density by reducing voids.

Concrete lift – The vertical distance between successive horizontal construction joints.

Conduit – A closed channel to convey water through, around, or under a dam.

Construction joint – The interface between two successive placements or pours of concrete

where bond, and not permanent separation, is intended.

Construction – Building a proposed dam and appurtenant structures capable of storing water.

Contact grouting – Filling, with cement grout, any voids existing at the contact of two zones of dissimilar materials, i.e., between a concrete tunnel lining and the surrounding rock.

Core wall – A wall built of impervious material, usually of concrete or asphaltic concrete in the body of an embankment dam to prevent seepage.

Creep – A process of deformation that occurs in many materials where the load is applied over an extended period.

Cutoff trench – A foundation excavation later to be filled with impervious material to limit seepage beneath a dam.

Cutoff wall – A wall of impervious material usually of concrete, asphaltic concrete, or steel sheet piling constructed in the foundation and abutments to reduce seepage beneath and next to the dam.

Dam – Any artificial barrier including appurtenant works constructed across rivers or tributaries thereof with a view to impound or divert water; includes barrage, weir and similar water impounding structures but does not include water conveyance structures such as canal, aqueduct and navigation channel and flow regulation structures such as flood embankment, dike and guide bund.

Dam failure – Failures in the structures or operation of a dam which may lead to an uncontrolled release of impounded water resulting in downstream flooding affecting the life and property of the people.

Dam incident – All problems occurring at a dam that have not degraded into 'dam failure' and including the following:

a) Structural damage to the dam and appurtenant works;

b) Unusual readings of instruments in the dam;

c) Unusual seepage or leakage through the dam body;

d) Change in the seepage or leakage regime;

e) Boiling or artesian conditions noticed below an earth dam;

f) Stoppage or reduction in seepage or leakage from the foundation or body of the dam into any of the galleries, for dams with such galleries;

g) Malfunctioning or inappropriate operation of gates;

h) Occurrence of any flood, the peak of which exceeds the available flood discharge capacity or 70% of the approved design flood;

i) Occurrence of a flood, which resulted in encroachment on the available freeboard, or the adopted design freeboard;

j) Erosion in the near vicinity, up to five hundred meters, downstream of the spillway and waste weir; and

k) Any other event that prudence suggests would have a significant unfavorable impact on dam safety.

Dam inspection – On site examination of all components of dam and its appurtenances by one or more persons trained in this respect and includes inspection of non-overflow section, spillways, abutments, stilling basin, piers, bridge, downstream toe, drainage galleries, operation of mechanical systems (including gates and its components, drive units, cranes), interior of outlet conduits, instrumentation records and record- keeping arrangements of instruments.

Dam owner – The Central Government or a State Government or public sector undertaking or local authority or company and any or all such persons or organizations, who own, control, operate or maintain a specified dam.

Dam safety – The practice of ensuring the integrity and viability of dams such that they do not present unacceptable risks to the public, property, and the environment. It requires the collective application of engineering principles and experience, and a philosophy of risk management that recognizes that a dam is a structure whose safe function is not explicitly determined by its original design and construction. It also includes all actions taken to identify or predict deficiencies and consequences related to the failure and to document, publicize, and reduce, eliminate, or remediate to the extent reasonably possible, any unacceptable risks.

Densification – A means of improving the strength of soil by making it denser, usually by physical compaction.

Design and Construct – A form of con- tract in which the contractor undertakes both the design and the construction of the work.

Design water level – The highest water elevation, including the flood surcharge, that a dam is designed to withstand.

Design wind – The most severe wind that is possible at a reservoir for generating wind set-up and run-up. The determination will include the results of meteorological studies that combine wind velocity, duration, direction and seasonal distribution characteristics in a realistic manner.

Diaphragm wall – A cutoff wall of flexible concrete constructed in a trench cut through an embankment or the foundation.

Diversion dam – A dam built to divert water from a waterway or stream into a different watercourse.

Earthfill dam – An embankment dam in which more than 50% of the total volume is formed of compacted earth layers.

Effective crest of the dam – The elevation of the lowest point on the crest (top) of the dam, excluding spillways.

Embankment dam – Any dam constructed of excavated natural materials, such as both earth-fill and rock-fill dams, or of industrial waste materials, such as a tailings dam.

Embankment zone – An area or part of an embankment dam constructed using similar materials and similar construction and compaction methods throughout.

Emergency repairs – Any repairs that are temporary in nature and that are necessary to preserve the integrity of the dam and prevent a failure of the dam.

Emergency spillway – An auxiliary spill- way designed to pass a large, but infrequent, volume of flood flow, with a crest elevation higher than the principal spillway or normal operating level.

Extensometer – An instrument used to detect, usually small, movements of a structure or a mass of rock or soil.

Failure mode – A potential failure mode is a physically plausible process for dam failure

resulting from an existing inadequacy or defect related to a natural foundation condition, the dam or appurtenant structures design, the construction, the materials incorporated, the operations and maintenance, or aging process, which can lead to an uncontrolled release of the reservoir.

Fetch – The-straight-line distance across a body of water subject to wind forces. The fetch is one of the factors used in calculating wave heights in a reservoir.

Filter – One or more layers of granular material graded (either naturally or by selection) so as to allow seepage through or within the layers while preventing the migration of material from adjacent zones.

Flap gate – A gate hinged along one edge, usually either the top or bottom edge. Examples of bottom-hinged flap gates are tilting gates, and fish belly gates so called from their shape in cross section.

Flashboards – Structural members of timber, concrete, or steel placed in channels or on the crest of a spillway to raise the reservoir water level but intended to be quickly removed, tripped, or fail in case of a flood.

Flip bucket – An energy dissipater found at the downstream end of a spillway and shaped so that water flowing at a high velocity is deflected upwards in a trajectory away from the foundation of the spillway.

Flood hydrograph – A graph showing, for a given point on a stream, the discharge, height, or another characteristic of a flood with respect to time.

Freeboard – Vertical distance between a specified stillwater (or other) reservoir surface elevation and the top of the dam, without camber.

Gabion – Rectangular-shaped baskets or mattresses fabricated from wire mesh, filled with rock, and assembled to form overflow weirs, hydraulic drops, and overtopping protection for small embankment dams. Gabion baskets are stacked in a stair-stepped fashion, while mattresses are placed parallel to a slope. Gabions have advantages over loose riprap because of their modularity and rock confinement properties, thus giving erosion protection with less rock and with smaller rock sizes than loose riprap.

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

Gate – A movable water barrier for the control of water.

Geomembrane – An impermeable geo- synthetic composed of one or more synthetic sheets.

Geosynthetic – A planar product manufactured from a polymeric material used with soil, rock, earth, or other geotechnical engineering related material as an integral part of a project, structure, or system.

Geotextile – Any fabric or textile (natural or synthetic) when used as an engineering material in conjunction with soil, foundations, or rock. Geotextiles have the following purposes: drainage, filtration, separation of materials, reinforcement, moisture barriers, and erosion protection.

Gravity dam – A dam constructed of concrete or masonry that relies on its weight and internal strength for stability.

Grout – A fluidized material that is injected into soil, rock, concrete, or other construction material to seal openings and to lower the permeability and to provide additional structural strength. There are four major types of grouting materials: chemical; cement; clay; and bitumen.

Grout blanket – An area of the foundation systematically grouted to a uniform shallow depth.

Grout cap – A concrete filled trench or pad encompassing all grout lines constructed to impede surface leakage and to provide anchorage for grout connections.

Grout curtain – One or more zones, usually thin, in the foundation into which grout is injected to reduce seepage under or around a dam.

Height of dam – The difference in elevation between the natural bed of the watercourse or the lowest point on the downstream toe of the dam, whichever is lower, and the effective crest of the dam.

Hydraulic fracturing – Hydraulic fracturing in soils is a tensile parting that is created because of increased fluid pressure. Initiation or propagation cracks in the core sections of earthen dams because of hydraulic fracturing affect adversely the structural safety of the dams.

Hydraulic gradient – The change in total hydraulic pressure per unit distance of flow.

Hydrology – One of the earth sciences that encompasses the natural occurrence, distribution, movement, and properties of the waters of the earth and their environmental relationships.

Hydrometeorology – The study of the atmospheric and land-surface phases of the hydrologic cycle with emphasis on the interrelationships involved.

Hydrostatic pressure – The pressure exerted by water at rest.

Inclinometer – An instrument, usually consisting of a metal or plastic casing inserted in a drill hole and a sensitive monitor either lowered into the casing or fixed within the casing. The inclinometer measures the casing's inclination to the vertical at different points. The system may be used to measure settlement.

Instrumentation – An arrangement of devices installed into or near dams that enable measurements that can be used to evaluate the structural behavior and performance parameters of the structure.

Internal erosion – A general term used to describe all the various erosional processes where water moves internally through or adjacent to the soil zones of embankment dams and foundation, except for the specific process referred to as backward erosion piping. The term internal erosion is used in place of a variety of terms that have been used to describe various erosional processes, such as scour, suffusion, concentrated leak piping, and others.

Jet grouting – A system of grouting in which the existing foundation material is mixed in situ with cementations materials to stabilize the foundation, or it improve its water-tightness.

Karstic – An adjective to describe a limestone rock mass in which large openings have been caused over geological time by ground water dissolving the rock.

Large dam – A dam which is above 15 m in height, measured from the lowest part of the general foundation area to the top of dam; or a dam between 10 m to 15 m in height that satisfies at least one of the following, namely

- the length of the crest is not less than 500 m;
- the capacity of the reservoir formed by the dam is not less than one million cubic meters;
- the largest flood discharge dealt with by the dam is not less than 2000 m^3/s;
- the dam has particularly challenging foundation problems; or
- the dam is of unusual design.

Liquefaction – A condition whereby soil undergoes continued deformation at a constant low residual stress or with low residual resistance, because of the buildup and maintenance of

high pore-water pressures, which reduces the effective confining pressure to a very low value. Pore pressure buildup leading to liquefaction may be due either to static or cyclic stress applications, and the possibility of its occurrence will depend on the void ratio or relative density of a cohesionless soil and the confining pressure.

Low-level outlet (bottom outlet) – An opening at a low level from a reservoir used for emptying or for scouring sediment and sometimes for irrigation releases.

Maintenance – Those tasks that are generally recurring and are necessary to keep the dam and appurtenant structures in a sound condition and free from defect or damage that could hinder the dam's functions as designed, including adjacent areas that also could affect the function and operation of the dam.

Maintenance inspection – Visual inspection of the dam and appurtenant structures by the owner or owner's representative to detect apparent signs of deterioration, other deficiencies, or any other areas of concern.

Masonry dam – Any dam constructed mainly of stone, brick, or concrete blocks pointed with mortar. A dam having only a masonry facing should not be referred to as a masonry dam.

Maximum storage capacity – The volume, in millions of cubic meters (Mm^3), of the impoundment created by the dam at the effective crest of the dam; only water that can be stored above natural ground level or that could be released by failure of the dam is considered in assessing the storage volume; the maximum storage capacity may decrease over time because of sedimentation or increase if the reservoir is dredged.

Meteorology – The science that deals with the atmosphere and atmospheric phenomena, the study of weather, particularly storms and the rainfall they produce.

Normal storage capacity – The volume, in millions of cubic meters (Mm^3), of the impoundment created by the dam at the lowest uncontrolled spillway crest elevation, or at the maximum elevation of the reservoir at the normal (non-flooding) operating level.

Outlet – A conduit or pipe controlled by a gate or valve, or a siphon, that is used to release impounded water from the reservoir.

Outlet gate – A gate controlling the flow of water through a reservoir outlet.

Outlet works – A dam appurtenance that provides release of water (generally controlled) from a reservoir.

Parapet wall – A solid wall built along the top of a dam (upstream or downstream edge) used for ornamentation, for the safety of vehicles and pedestrians, or to prevent overtopping caused by wave run-up.

Peak flow – The maximum instantaneous discharge that occurs during a flood. It is coincident with the peak of a flood hydrograph.

Penstock – A pressurized pipeline or shaft between the reservoir and hydraulic machinery.

Phreatic surface – The free surface of water seeping at atmospheric pressure through soil or rock.

Piezometer – An instrument used to measure water levels or pore water pressures in embankments, foundations, abutments, soil, rock, or concrete.

Piping –The progressive development of internal erosion by seepage.

Plunge pool – A natural or artificially created pool that dissipates the energy of free falling water.

Post-tensioned anchors – A system of anchored stressed steel tendons or bars within or attached to a structure to provide structural support.

Pre-stressed structure – A structure containing elements that have been pre- loaded with stressed steel tendons, bars or jacks.

Pressure relief pipes – Pipes used to relieve uplift or pore water pressure in a dam foundation or in the dam structure.

Principal spillway – The primary or initial spillway engaged during a rainfall- runoff event that is designed to pass normal flows.

Radial gate – A gate with a curved upstream plate and radial arms hinged to piers or other supporting structure. Also known as a Tainter gate.

Rehabilitation – Work that aims to restore the service life of a structure, as opposed to maintenance, which seeks to restore the status quo, and upgrading whose purpose is to maximize the performance within the physical limits of the structure.

Repairs – Any work done on a dam that may affect the integrity, safety and operation of the dam

Reservoir – Any water spread that impounded water

Reservoir Storage – The retention of water or delay of runoff in a reservoir either by the planned operation, as in a reservoir, or by temporary filling in the progression of a flood wave. Certain types of storage in reservoirs are defined as follows:

a) **Active storage** – The volume of the reservoir that is available for some use such as power generation, irrigation, flood control, and water supply. The bottom elevation is the minimum operating level.

b) **Dead storage** – The storage that lies below the invert of the lowest outlet and that, therefore, cannot readily be withdrawn from the reservoir.

c) **Flood surcharge** – The storage volume between the top of the active storage and the design water level.

d) **Inactive storage** – The storage volume of a reservoir between the crest of the invert of the lowest outlet and the minimum operating level.

e) **Live storage** – The sum of the active and the inactive storage.

f) **Reservoir capacity** – The sum of the dead and live storage of the reservoir.

g) **Surcharge** – The volume or space in a reservoir between the controlled retention water level and the highest water level. Flood surcharge cannot be retained in the reservoir but will flow out of the reservoir until the controlled retention water level is reached.

Riprap – A layer of large rock, precast blocks, bags of cement, or other suitable material, placed on an embankment or along a watercourse as protection against wave action, erosion, or scour.

Rockfill dam – An embankment dam in which more than 50% of the total volume is made up of compacted or dumped cobbles, boulders, rock fragments, or quarried rock larger than 3-inch size.

Roller compacted concrete dam – A concrete gravity dam constructed using a dry mix concrete transported by conventional construction equipment and compacted by rolling, usually with vibratory rollers.

Rubble dam – A stone masonry dam in which the stones are not shaped or coursed.

Saddle dam (or dike) – A subsidiary dam of any type constructed across a saddle or low point on the perimeter of a reservoir.

Scour – The loss of material occurring at an erosional surface, where a strong flow is found, such as a crack in a dam or the dam/foundation contact. Continued flow causes the erosion to

progress, creating a larger and larger eroded area.

Seismometer – An instrument that measure the motion of the ground, including those of seismic waves generated by earthquakes, volcanic eruptions, and other seismic sources. Records of seismic waves allow seismologists to map the interior of the Earth, and locate and measure the size of these different sources.

Seepage – The internal movement of water that may take place through a dam, the foundation or the abutments, often emerging at the ground level lower down the slope.

Settlement – The vertical downward movement of a structure or its foundation.

Sinkhole – A depression in the ground showing subsurface settlement or particle movement, typically having clearly defined boundaries with a sharp offset.

Toe drain – A system of pipe or porous material along the downstream toe of a dam used to collect seepage from the foundation and embankment and convey it to a free outlet.

Toe of dam – The junction of the downstream slope or face of a dam with the ground surface, which is also referred to as the downstream toe. The intersection of the upstream slope with ground surface is called the heel or the upstream toe.

Top thickness (top width) – The thickness or width of a dam at the level of the top of the dam (excluding corbels or parapets). In general, the term thickness is used for gravity and arch dams, and width is used for other dams.

Uplift – The hydrostatic force of water exerted on or underneath a structure, tending to cause a displacement of the structure.

Weir, measuring – A device for measuring the rate of flow of water. It consists of a rectangular, trapezoidal, triangular, or other shaped notch cut into the top of a vertical, thin plate over which water flows. The rate of flow is calculated from the measured height of water above the weir crest

****