



CORNELL PUMP COMPANY

HYDRO TURBINE



EFFICIENT BY DESIGN

HYDRO TURBINE

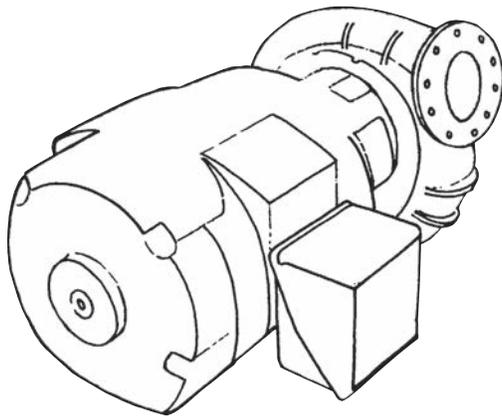


Industrial plants, municipalities, HVAC installations, and farms are tapping potential hydraulic energy sources to produce electric power as a revenue source, or as a means to reduce overall energy demands. The key to the system is the use of excess head to drive a turbine. The turbine may be used to drive a pump, a generator, or other power-requiring device. This technology makes it feasible for cities, farmers, resort managers, industrial plants and building managers to consider hydro turbines in their plant power needs. Studies show that a turbine, driven by water from a natural stream or process stream, can generate enough electric power to pay for itself in a short time.

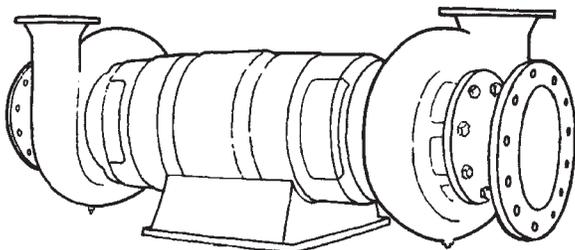
You don't need a raging river to take advantage of the energy savings a Cornell hydro turbine can provide. Heads as low as 50 feet, and flows as low as 90 gallons per minute can produce useable energy.

Cornell's high turbine efficiency is often found to be comparable with specially built imported turbines. They are less complex, easier to install and require less maintenance. Cornell turbines are available in a wide range of configurations and mounting styles.

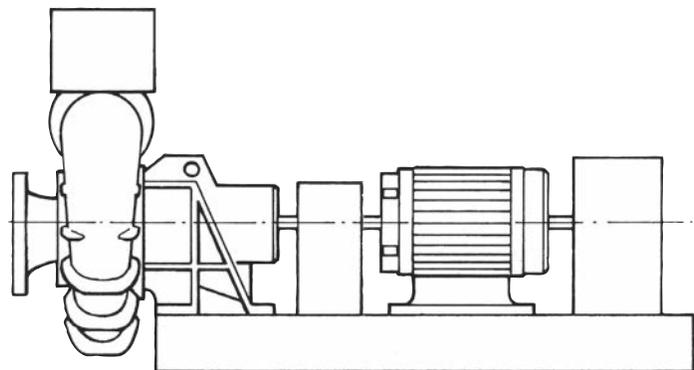
Cornell's approach to turbine applications has generated many new and innovative design features, resulting in unexpectedly high performance.



The simplest of assemblies – no couplings to align – economy of space – close coupled, induction generator/turbine assembly – many turbine and generator options available as required.



An assembly to allow the turbine to reduce a pumping load – common motor, turbine one end, pump other end. Both close coupled with all the features to suit a special installation. Specially suited to HVAC installations.



Frame turbine, coupled to an induction generator for applications connected to an existing power grid. Base assembled with optional speed control and safety shut down equipment.

HYDRO TURBINE

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HYDRAULIC TURBINE DATA WORKSHEET

(for Preliminary Evaluation)

Project Name _____

Name _____

Address _____

Phone _____

Email _____

SITE INFORMATION

STREAM or RESERVOIR (uses entire system head)

Gross head (static) _____

Net head (includes friction loss) _____

Available Flow _____

Penstock Diameter _____

Penstock Length _____

PRESSURIZED SYSTEM (pressure reduction)

Inlet Pressure _____

Outlet Pressure Required _____

Design Flow _____

ELECTRICAL CHARACTERISTICS

Induction (grid interface) or Synchronous (stand alone)

_____ Voltage _____

Cycles (Hertz) _____

Phase _____

ODP or TEFC _____

HYDRO TURBINE

Generator Types

Induction

Generator must be connected to an existing power grid. Speed is controlled by virtue of being connected to the grid, the same way motor speed is maintained. Requires an automatic disconnect from the grid when grid power fails.

Synchronous

Generator is stand alone. Can be used where there is no electrical grid nearby. Requires a load controller to maintain standard speed, voltage and phase.

Pressure Surge (Water Hammer) Protection

During grid power loss, a reaction turbine speeds up and the flow through it drops. The magnitude of the flow change depends on the turbine's design and the operating conditions. The flow change may occur very rapidly (in a few seconds) and can cause a pressure surge (water hammer) that is strong enough to damage or destroy the turbine and piping. The pressure surge can be reduced by:

- Adding mass in the form of a flywheel
- Installing a quick opening bypass valve in parallel with the turbine

Controls

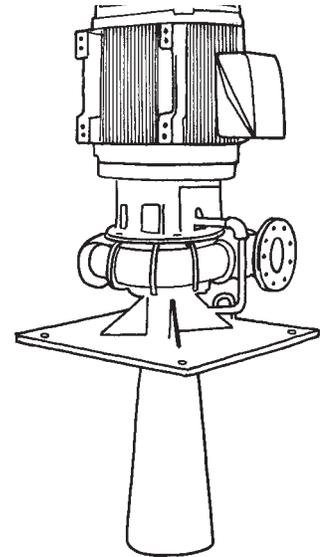
Hydraulic turbines need to be equipped with a control valve at the inlet of the turbine. This valve serves as an isolation device and can be used to control the head and flow through the turbine. The controls should include speed measuring devices. The control system should be designed so that during normal operation electrical contact is made or broken at or near the generator nominal (no load) speed. When power fails, the control system must break the electrical contact and close the inlet valve. It is advisable to contact your utility to determine if there are any special requirements.

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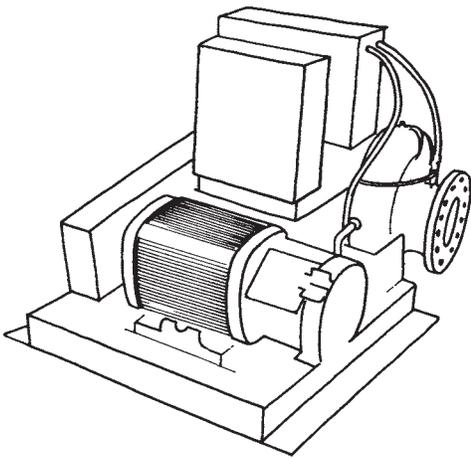
Standard Turbine Construction:

- Cast Iron, Bronze fittings - optional, Ductile Iron, Steel, Bronze, Stainless Steel.
- Mechanical shaft seal is standard, packing is optional.
- Standard ODP generator-optional TEFC.
- Hydro blue, double applied paint.

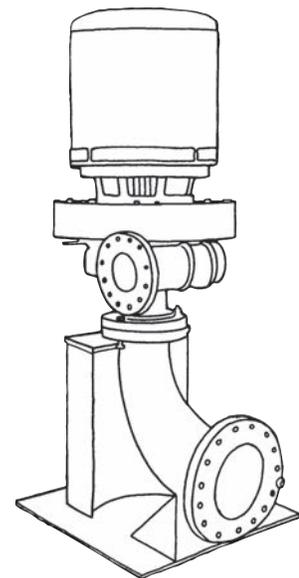
This high performance can be documented by certified model tests or actual performance tests on ordered units, conducted in Cornell's modern hydraulic labs under controlled conditions, by professional engineers. Let Cornell staff engineers and sales personnel provide specialty application and selections assistance. Whether your needs are demanding – requiring turbines in series or parallel, or utilize a single unit – Cornell will assist in your selection of a hydro turbine energy recovery system that is efficient over a wide range of operation.



For added space saving or simplicity of manifolding, close coupled, vertical mount with custom draft tub (available less draft tub for discharge manifold mounting).

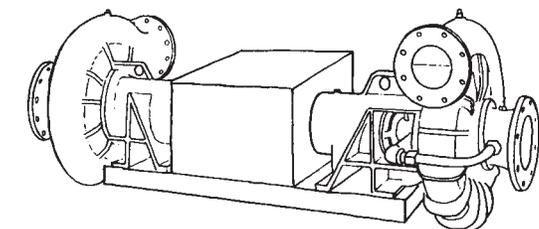


Synchronous generator for stand-alone applications with hydraulic-electric load controller, belt (or direct) drive to turbine, all base assembled.



Vertical mount, close coupled turbine with optional integral flywheel* and base elbow. (Also available without flywheel)

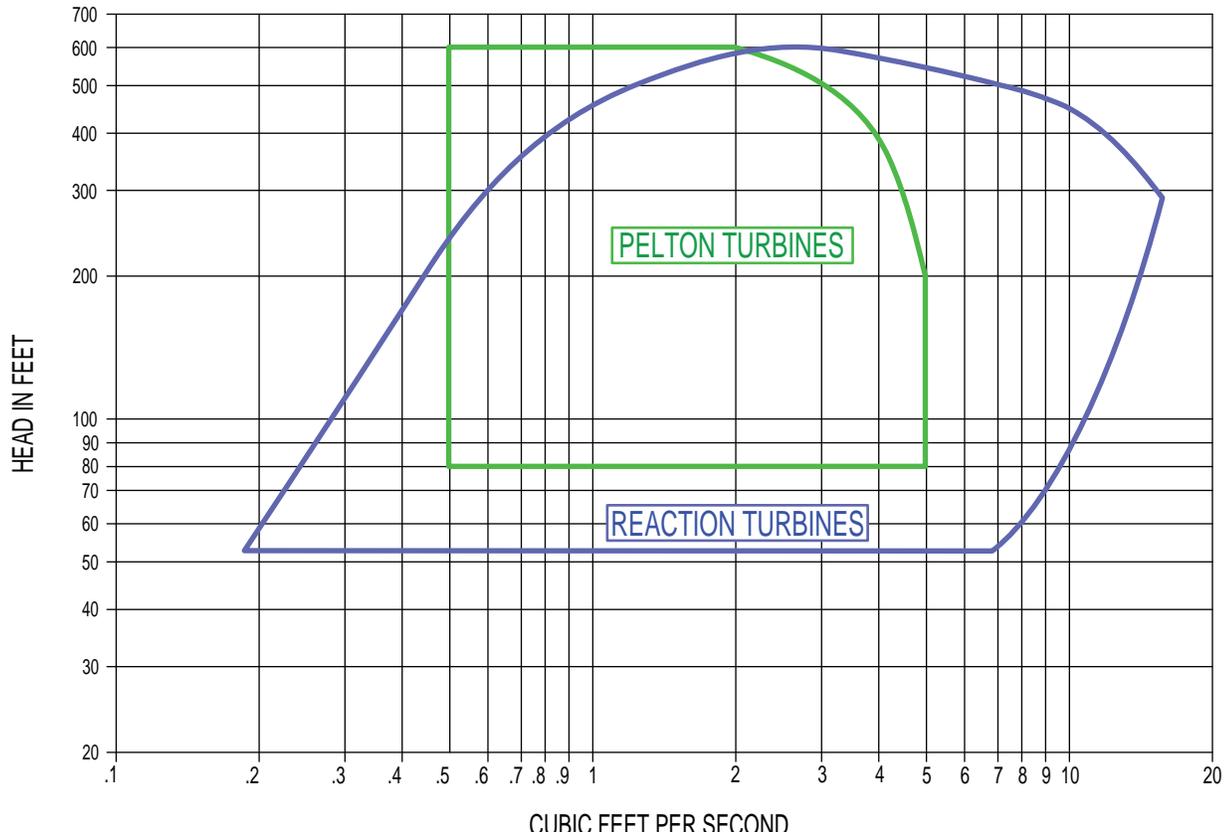
*Flywheels are used to prevent excessive surge pressures and to give more stable speed control



Horizontal frame mounted turbine, direct drive to an energy requiring device. (Turbine driving a pump is shown. A generator may be substituted for the pump.)

HYDRO TURBINE

APPROXIMATE PERFORMANCE RANGE

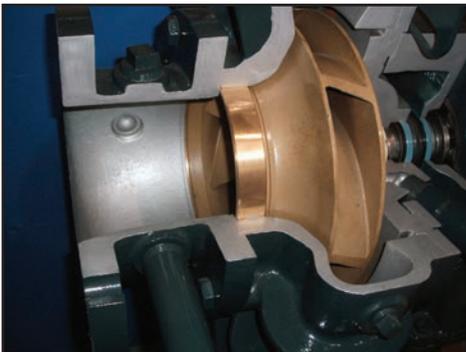


Reaction Turbine

- High efficiency compared to Pelton Turbines.
- Works when positive outlet pressure is required, good for force mains.
- Fixed geometry - best for fixed flow rates, does not handle variable flow well.
- May require flywheel or quick opening by-pass valve to prevent excessive pressure spikes in the event of grid loss.
- Costs less than Pelton Turbines.

Pelton Turbine

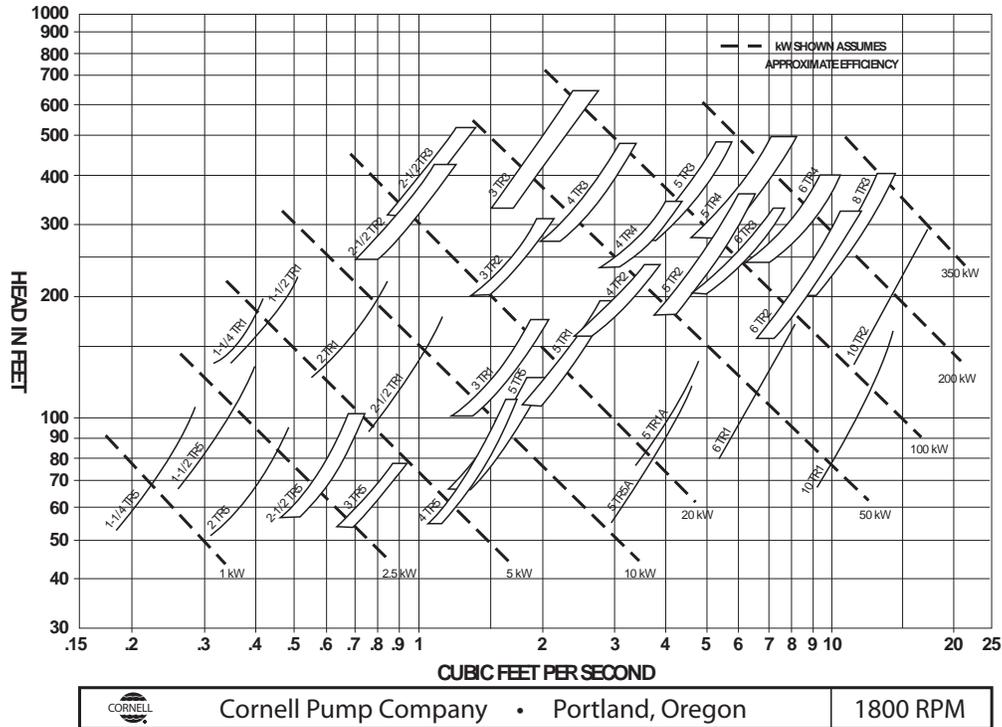
- Must exhaust to atmosphere - not appropriate for force mains, NPDH is not an issue.
- Adjustable nozzles allow for variable flow, efficiency remains fairly constant.
- No flywheel or quick opening by-pass valve is required in the event of grid loss because the flow is diverted away from the runner.
- Costs more than Reaction Turbine.



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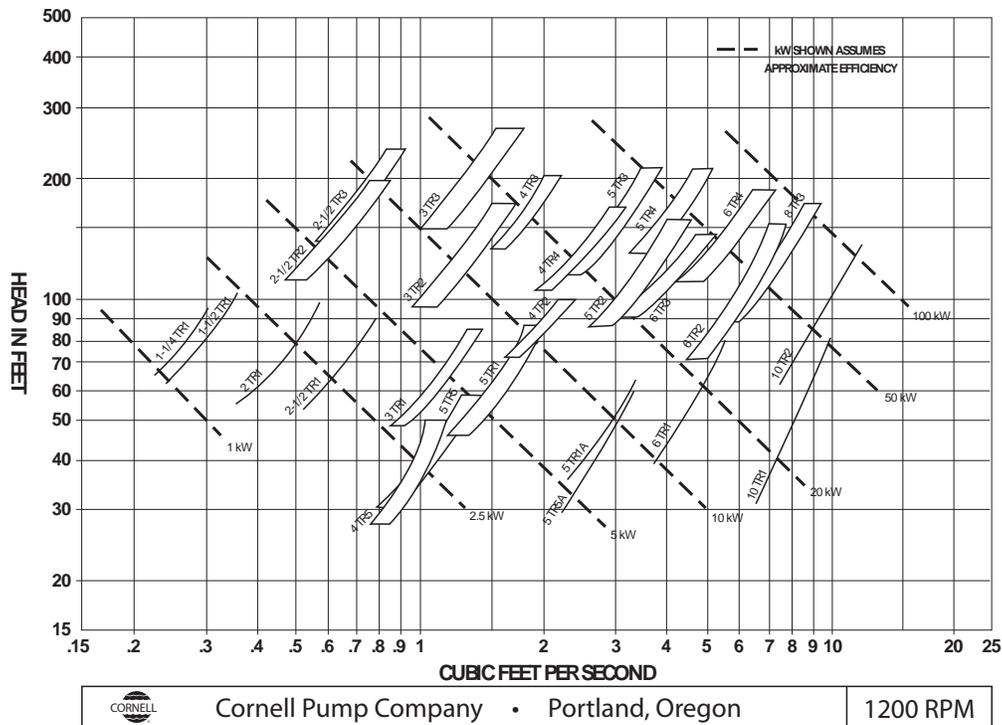
TURBINE SELECTION CHART

1800 RPM



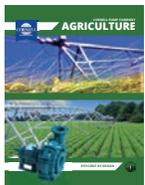
TURBINE SELECTION CHART

1200 RPM





MARKET AND PRODUCT LINE



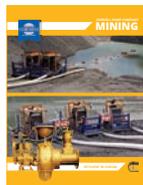
AGRICULTURAL



FOOD PROCESS



INDUSTRIAL



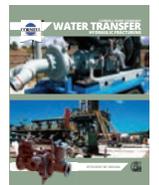
MINE DEWATERING



MUNICIPAL



REFRIGERATION



WATER TRANSFER



CHOPPER



CUTTER



EDGE™



HYDRAULIC SUBS



HYDRO TURBINE



IMMERSIBLE



MANURE



MP SERIES



MX SERIES



OIL & GAS



REDI-PRIME®



STX SERIES



SLURRY



SUBMERSIBLE

Cycloseal®, and Redi-Prime® are Registered Trademarks of Cornell Pump Company.

Cornell pumps and products are the subject of one or more of the following U.S. and Foreign patents: 3,207,485; 3,282,226; 3,295,456; 3,301,191; 3,630,637; 3,663,117; 3,743,437; 4,335,886; 4,523,900; 5,489,187; 5,591,001; 6,074,554; 6,036,434; 6,079,958; 6,309,169; 2,320,742; 96/8140; 319,837; 918,534; 1,224,969; 2,232,735; 701,979 and are the subject of pending U.S. and Foreign Patent Applications.



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