

Power Recovery Turbines

***Fixed and Variable
Geometry***

Vertical

Horizontal

**Pump Supplier
To The World**

Flowserve is the driving force in the global industrial pump marketplace. No other pump company in the world has the depth or breadth of expertise in the successful application of pre-engineered, engineered and special purpose pumps and systems.

Pumping Solutions

Flowserve is providing pumping solutions which permit customers to continuously improve productivity, profitability and pumping system reliability.

**Market Focused
Customer Support**

Product and industry specialists develop effective proposals and solutions directed toward market and customer preferences. They offer technical advice and assistance throughout each stage of the product life cycle, beginning with the inquiry.



Dynamic Technologies

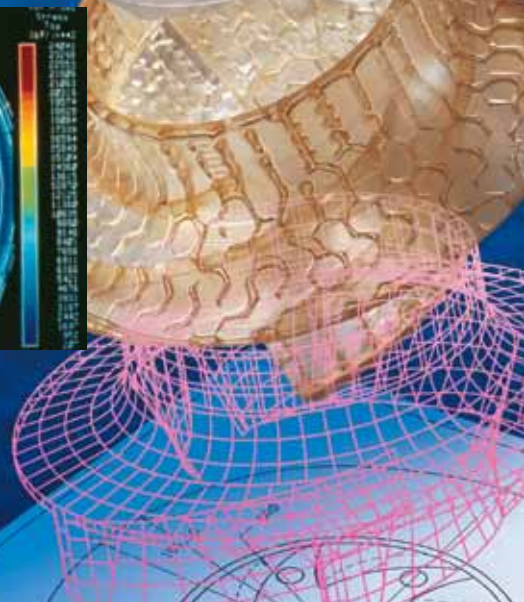
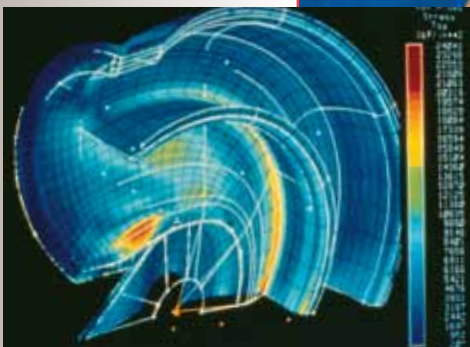
Flowserve is without peer in the development and application of pump technology, including:

- Hydraulic engineering
- Mechanical design
- Materials science
- Intelligent pumping
- Manufacturing technology

Broad Product Lines

Flowserve offers a wide range of complementary pump types, from pre-engineered process pumps, to highly engineered and special purpose pumps and systems. Pumps are built to recognized global standards and customer specifications. Pump designs include:

- Single stage process
- Between bearing single stage
- Between bearing multistage
- Vertical
- Submersible motor
- Rotary
- Reciprocating
- Nuclear
- Specialty



Power Generation Turbines

**Vertical
Horizontal**

Capturing Water's Energy Potential

Ever increasing energy costs have stimulated renewed interest in using available water resources to drive hydraulic turbines. These applications range from mammoth projects harnessing the flow of major rivers and elevated lakes to small installations operated by entrepreneurs.



Flowserve offers purpose engineered single and multistage hydraulic power recovery turbines (HPRTs) for projects ranging from 50 kW (67 hp) per site to 4000 kW (5600 hp). HPRTs are available in a variety of configurations to suit both site and budget factors, and they range from small manually controlled single stage units to elaborate assemblies provided for state and federal projects of every description.

The choice of HPRT is dependent upon many factors, which Flowserve application engineers take into account in collaboration with the purchaser's civil, electrical and mechanical engineers. These parameters include:

- Materials required for liquid conditions
- Installation constraints
- Noise control
- Configuration for optimum installation
- Viability of investment
- Determination of fixed or variable geometry
- Scope of supply
- Environmental considerations

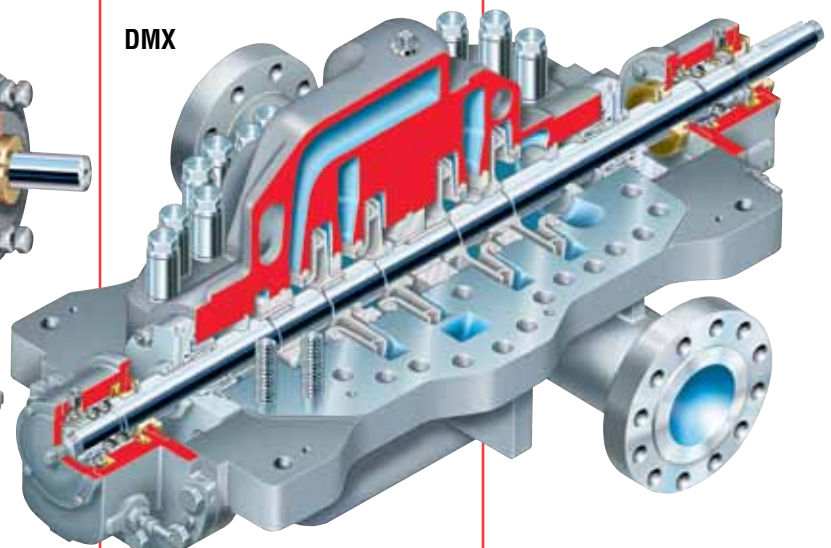
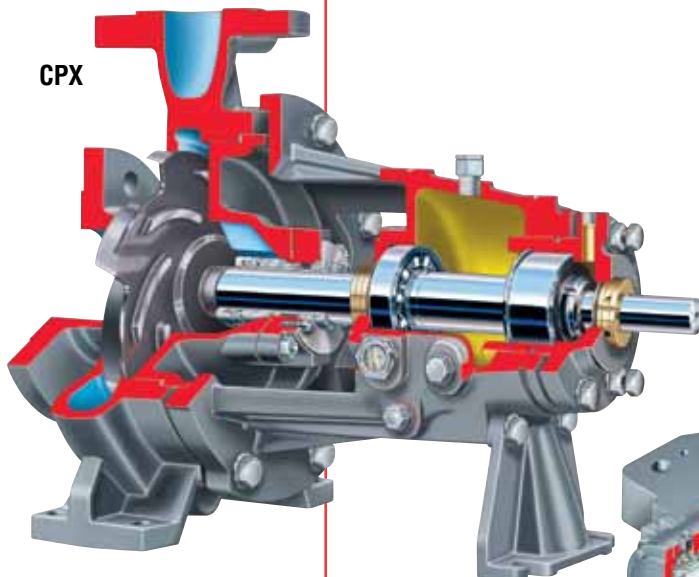
Broad applications in converting energy from fluid flows:

- River flows
- Capitalizing on elevated lakes energy potential
- Powering pumps and compressors
- Bypassing pressure reducing valves to recover energy
- Reverse osmosis
- Pipeline pressure reduction
- Powering auxiliary equipment
- Cryogenic dense fluid expanders

Complementary Pump Designs

Power generation turbines may be used with other Flowserve models. These include:

- Multistage between bearing pumps
- Single stage overhung pumps
- Single stage, double suction, double volute pumps



Variable Geometry Hydroturbine

The TKW is a variable geometry, semi-axial flow hydraulic turbine specifically designed for small hydroelectric sites. Vertical mounting has the advantage of reduced site preparation and civil engineering costs.

Bearing Construction

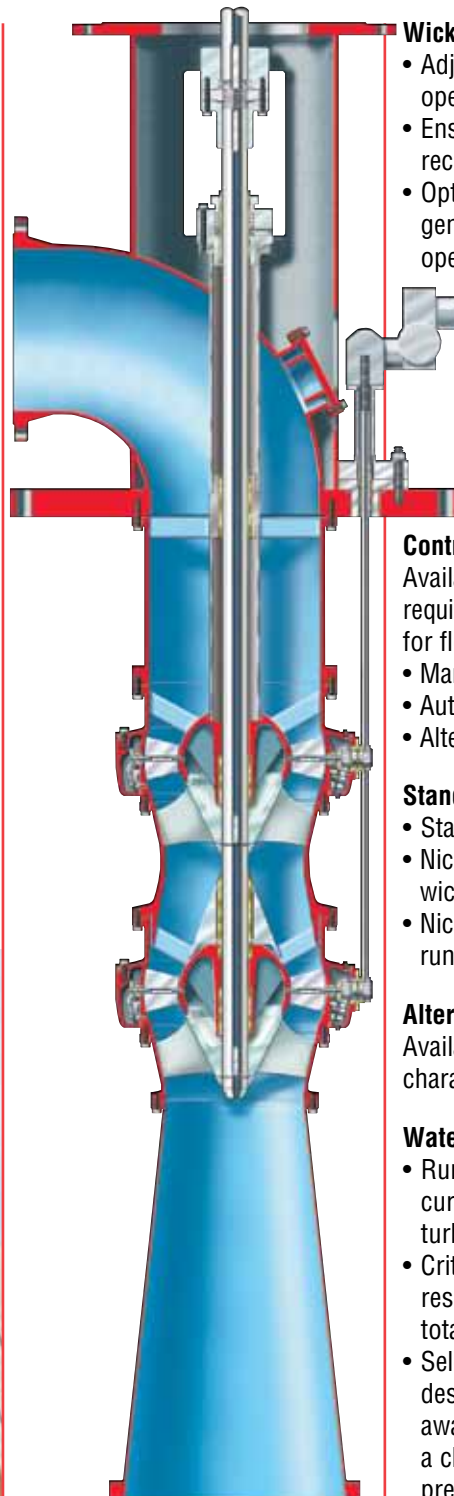
Options to meet site conditions and prolong bearing life:

- Self-lube – Open shaft
- Oil-lube – Enclosed shaft

Adjustable Rotor Clearance

- Restores efficiency
- Maintains optimum output

Accomplished without disassembly by adjustment of coupling connecting turbine to generator



Wicket Gates

- Adjustable during operation
- Ensure maximum power recovery
- Optimize power generation over a wide operating range

Control Options

Available to suit site requirements and user needs for flow management:

- Manual
- Automatic
- Alternative mechanisms

Standard Materials

- Stainless steel shaft
- Nickel aluminum bronze wicket gates
- Nickel aluminum bronze runner and runner case

Alternate Materials

Available to suit liquid characteristics

Water Hammer Eliminated

- Runaway speed-flow curve approximates the turbine design flow
- Criticality of valve response time to stop total flow reduced
- Selected specific speed designs to minimize runaway speed and provide a choke flow that precludes water hammer

Draft Tube Design

- Results in maximum energy recovery of velocity head
- Supplied in fabricated steel
- Flanged for connection to the runner casing
- Alternate designs to suit site conditions

Operating Parameters

- For sites of 50 kW to 3000 kW
- 50 kW to 1000 kW per unit
- 12 m (40 ft) to 45 m (150 ft) of head per stage

**Fixed Geometry
Hydroturbine and
Reverse Running
Pumps**

Flowserve fixed geometry turbines are offered in a variety of designs for economical power generation applications.

Model LNT and MNT

- Reverse running pump
- Optimized turbine design

Horizontal

- Side-side inlet and outlet
- Side inlet and bottom outlet

Vertical

- Side inlet and bottom outlet
 - Dry pit
 - Wet pit



**Reverse Running Pump
Design Features**

- Special casing volute for optimum efficiency
- Special impeller configurations for optimum outlet geometry
- Heavy casing to accommodate pressure surges
- Mechanical design for transmission of high horsepower



**Optimized Turbine
Design Features**

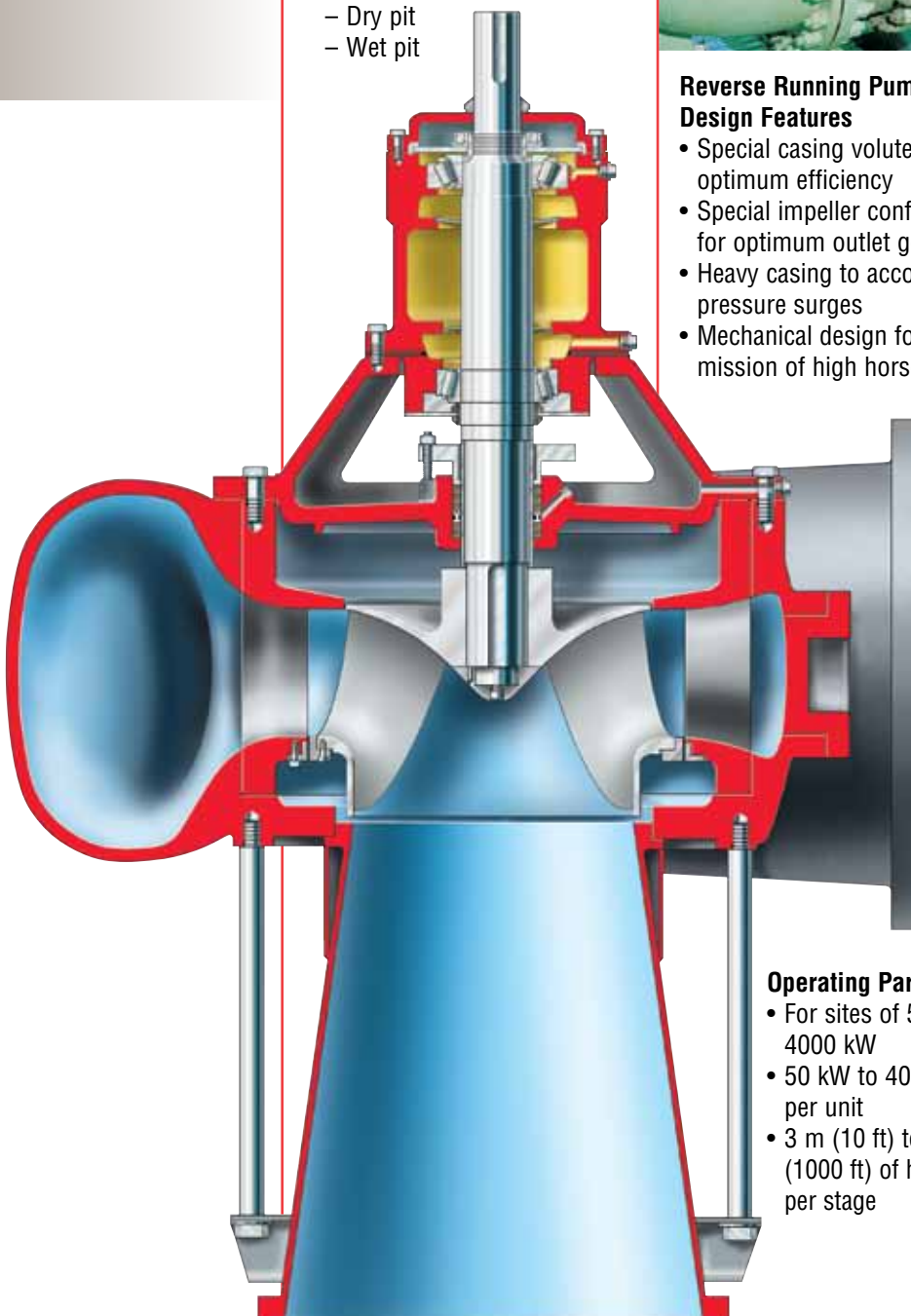
- Fixed guide vanes to suit site conditions
- Francis runner for optimum efficiency
- Draft tube for velocity recovery on turbine outlet

**Engineered Power
Generation System
to suit site and
control needs**

- Driven machine
 - Induction generator
 - Pump
 - Compressor
- Mounting options
 - Continuous baseplate
 - Sole plates
 - Integral to inlet case
- Control systems
 - Automatic synchronization
 - Overspeed trip
 - Remote start/stop
 - Proportional

Operating Parameters

- For sites of 50 kW to 4000 kW
- 50 kW to 4000 kW per unit
- 3 m (10 ft) to 300 m (1000 ft) of head per stage



Options and Technical Data

Options

- Materials to suit operating fluid
- Draft tubes
- Multistage
- Mechanical seals
- Continuous baseplates under turbine and driven machine
- Control systems
- Factory performance testing
- Exhaust tanks
- Manual or electric actuators
- Alternate designs for special applications

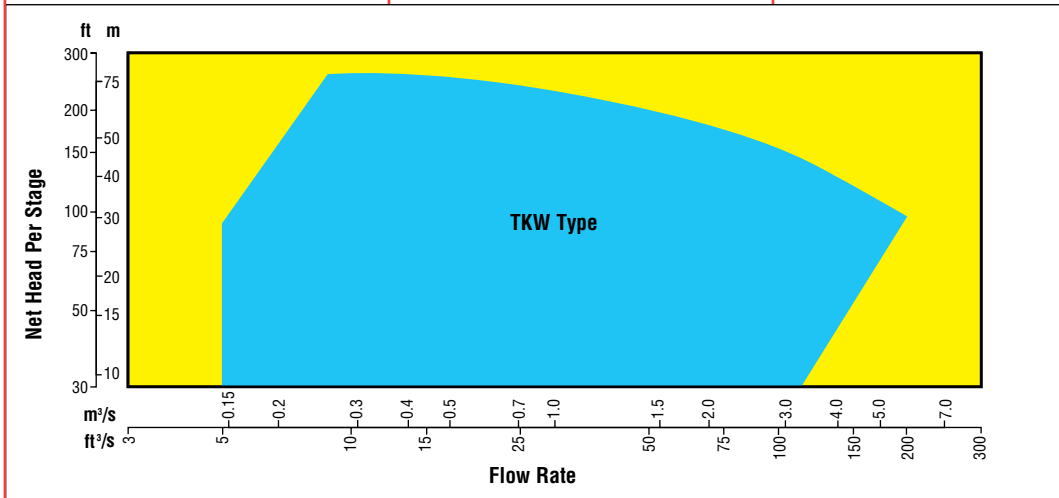
Optimized Turbine Runner



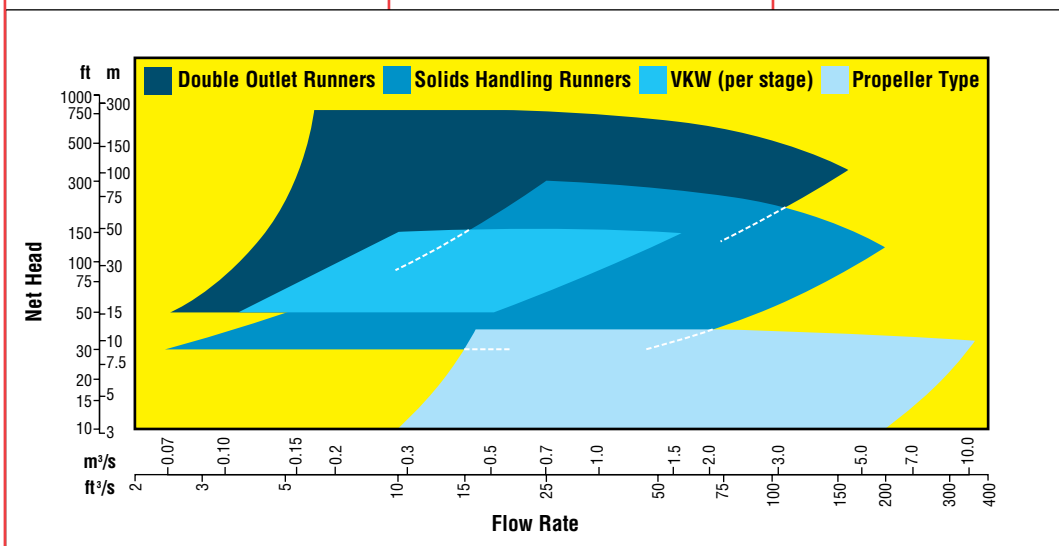
Conventional Impeller



Variable Geometry Range Chart



Fixed Geometry Range Chart

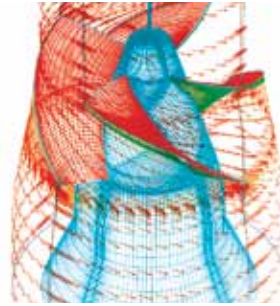


Global Service and Technical Support

Advanced Technologies

Few if any pump companies can match Flowserve's capabilities in hydraulic and mechanical design or in materials engineering. These capabilities include:

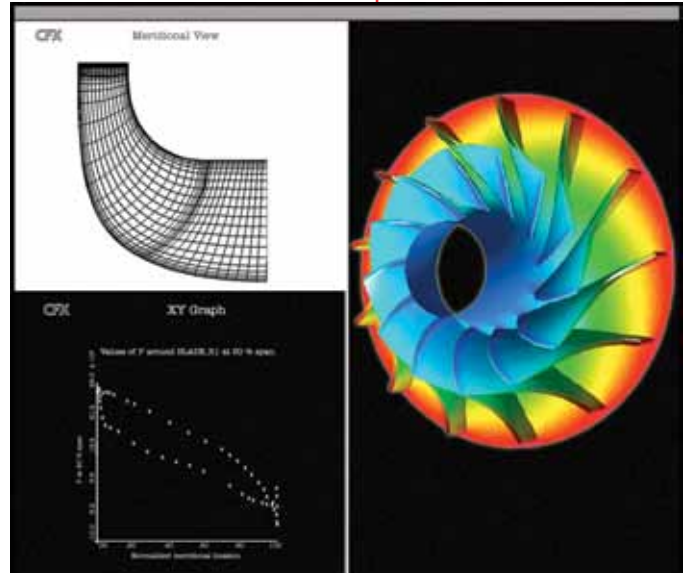
- Computational fluid dynamics
- Flow visualization
- Cavitation studies
- Efficiency optimization
- Finite element analysis
- Rapid prototyping
- Captive high nickel alloy and light reactive alloy foundries
- Non-metallic materials processing and manufacturing



Service and Repair Group

Flowserve's Service and Repair Group is dedicated to maximizing equipment performance and reliability-centered maintenance programs. Pump related services include:

- Startup and commissioning
- Diagnostics and prognostics
- Routine and repair maintenance
- ANSI and ISO power end exchange program
- Re-rates, upgrades and retrofits
- Spare parts inventory and management programs
- Training



Pump Improvement Engineering Services

Flowserve is committed to helping customers obtain the best possible return on their pump equipment investment. Engineering assistance and technological solutions for pumping problems are readily available.

These services include:

- Field performance testing
- Vibration analysis
- Design analysis and root-cause problem solving
- Material improvements
- Pump and system audit
- Advanced technology solutions
- PumpTrac™ remote pump monitoring and diagnostic services
- Instruction manual updates
- Training courses

**Flowserve... Supporting Our Customers
With The World's Leading
Pump Brands**



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