



Benefits

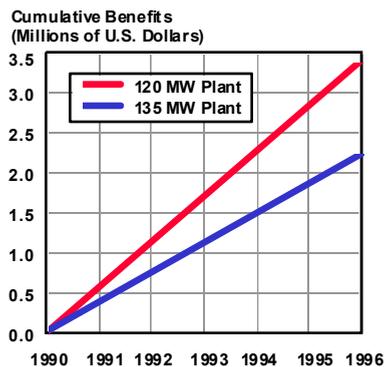
In today's competitive business environment, demands on water resources are increasing, operating budgets are shrinking, and customer needs are expanding. Hydro utilities must optimize hydraulic performance, while meeting environmental objectives in a cost-effective manner. WaterView, a proprietary system for real-time hydro optimization and monitoring, is your best solution for balancing energy, economics, and the environment.

WaterView's unique concept delivers on-line data and optimized graphics that compare your plant's current performance with its optimum potential.

It identifies resources wasted, calculates dollars lost, and monitors environmental variables.

Using WaterView, hydro operators can increase hydro generation (typically, 1% or more for main river plants and 2% to 5% for tributary plants), minimize vibration and related maintenance, and reduce cavitation damage, while meeting environmental goals.

Representative Benefits Achieved From Improved Performance for Tributary Hydro Plants
(Based on \$25/MWH Incremental Electric Rates)





General

WaterView was jointly developed by two companies that understand hydro power. Voith Siemens Hydro Power Generation, Inc., is experienced in designing, manufacturing, and commissioning turbines, generators, and automation systems for the hydroelectric industry. The Tennessee Valley Authority, the nation's largest wholesale producer of electricity, operates 30 hydroelectric plants, including five pump-turbines. TVA's Resource Management business is experienced in instrumentation systems, software development, performance testing, monitoring, and optimization of hydro facilities.

Modules

WaterView is a proprietary, modular, PC-based, hardware/software system, consisting of the Core (Efficiency) Module, the multi-unit Optimization Module, the Trash Rack Module, and additional modules for environmental performance, maintenance-cost estimation, Safe Passage[™] of fish, and optimization-based performance indicators. WaterView's unique modules are the subject of a variety of U.S. patents and patents-pending.



The **Core (Efficiency) Module** collects real-time data using network-based data acquisition equipment and transducers located throughout the plant, or using the existing SCADA equipment. The Summary screen presents plant and unit operating data, including unit efficiencies and cavitation levels, in an easily understandable format.

Plant Elevations		Plant Totals		Cumulative Plant Totals Since 0:00:02	
HeadWater (ft)	681.57	Power (MW)	142.6	Curr Hr Gen (MWh)	135.6
Aux HeadWater (ft)	681.57	Flowrate (cfs)	45,674.8	Prev Hr Gen (MWh)	111.0
TailWater (ft)	637.53	Plant Efficiency (%)	84.20	Curr Day Gen (MWh)	305.3
Gross Head (ft)	44.04	Station Service (MW)	0.4	Prev Day Gen (MWh)	1,488.0
				Curr Hr Flow (cfs)	43,159
				Prev Hr Flow (cfs)	33,342
				Curr Day Flow (cfs)	89,418
				Prev Day Flow (cfs)	465,390

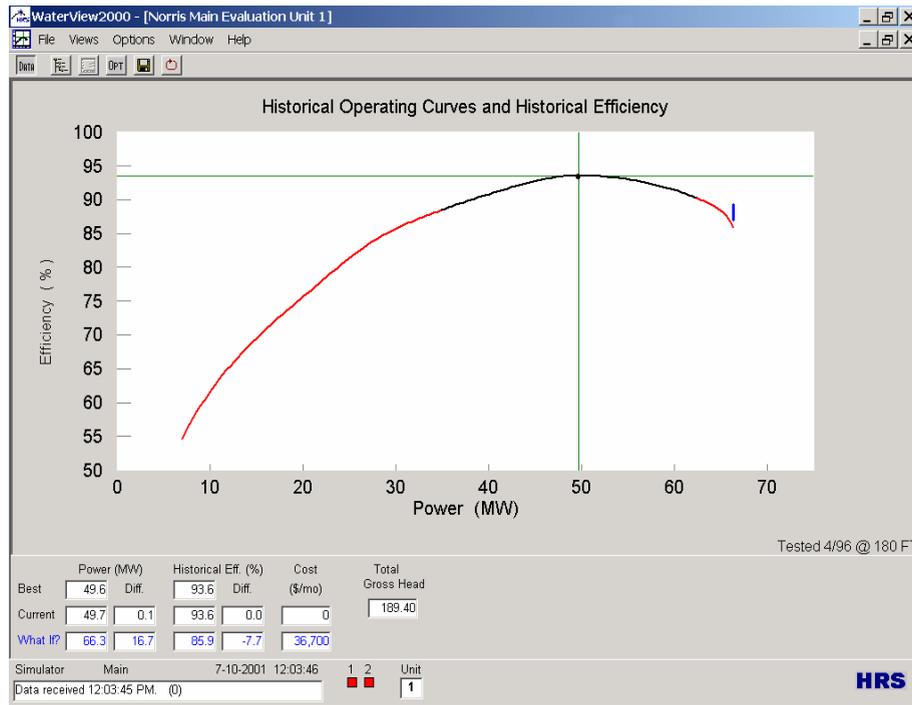
	Unit 1	Unit 2	Unit 3	Unit 4
Gate Opening (%)	89.2	91.9	80.3	77.2
Blade Angle (%)	38.0	37.9	34.9	37.2
Flowrate (cfs)	11,293	11,725	11,507	11,350
Power (MW)	35.5	36.1	35.4	35.5
Reactive Power (MVAR)	0.5	0.6	0.3	0.6
Gross Efficiency (%)	84.7	82.8	82.9	84.3
Hist Efficiency (%)				
Peak Efficiency Power (MW)	21.5	22.1	19.2	20.6
Off-Peak Eff Cost (\$/mo)	22,100	24,400	31,200	22,400
Water Temperature (C)	31.2	30.9	32.8	30.7
Total Forebay-Scrollcase Head Loss (ft)	1.39	0.94	0.96	0.98
Trash Loss (ft)	0.29	0.00	0.00	0.00
Total Trash Rack Head Loss (ft)	0.67	0.41	0.34	0.34
Fouling Cost (\$/mo)	0	0	0	0
WG Servo Press (psi)	-111.3	-30.6	26.0	-40.2

Datagram	Main	6-25-2002 10:55:16	1	2	3	4	Unit
Data received 10:55:16 AM. Waiting for data...			■	■	■	■	A

HRS



The Evaluation screen graphically displays the overall efficiency of each unit. The tabulated data shows the wasted resource (efficiency loss) and unrealized revenue (cost) for less efficient operation. A “What If” cursor allows the user to compare other operating points to the peak efficiency point. The on-line data provides immediate feedback to the operator on the value of potential operating improvements.





The multi-unit **Optimization Module** can be used “manually” by an operator, or integrated into an automated control system or SCADA system. The module determines the optimized combination of units and operating characteristics, consistent with the plant’s operating constraints. The module considers the unit operating status and the various operating constraints, including loading and unloading priorities, cavitation, tailwater levels, vibration avoidance zones, and generator power or thermal constraints.

Parameter	Value
Power (MW)	111.6
AGC Base (MW)	0.0
AGC Participation (MW)	0.0
Flow (cfs)	33,912.7
Reactive Power (MVAR)	0.0
Capability (MW)	138.9
Efficiency (%)	88.52
Computed Tailwater (ft)	637.53
Computed Head (ft)	44.05

Unit	Unit Capability (MW)		Efficiency (%)	Flow (cfs)	Power (MW)	Participation (MW)	Reactive (MVAR)
	Min	Max					
1	16.0	34.7	88.07	8,872.4	29.0		0.0
2	16.0	34.7	88.62	9,114.9	30.0		0.0
3	16.0	34.7	89.40	7,413.7	24.6		0.0
4	17.6	34.7	88.13	8,511.6	27.9		0.0



Optional Modules

The **Maintenance-Cost Module** uses cumulative damage theory and measured parameters, such as bearing vibration, to assess and quantify the effects of varying operating conditions on the maintenance costs. Controlling these costs will be an increasingly important concern as market forces push hydro owner/operators into non-traditional modes of operation.

The screenshot displays the WaterView2000 software interface. The main window shows a summary of maintenance costs for two units, Unit 1 and Unit 2. A dialog box titled 'Maintenance Cost Component Properties' is open, showing detailed settings for a 'Turbine Guide Bearing' component.

	Unit 1	Unit 2
Cavitation		
Stressor Level (mV)	190.52	906.92
Reference Stressor (mV)	190.00	190.00
Cost (\$/yr)	18	34238
Unit Startups	1	1
Total Cost (\$)	0	2
Totals Since	6-14-00	6-14-00
Turbine Guide Bearing		
Stressor Level (mils)	1.16	8.46
Reference Stressor (mils)	1.00	1.00
Cost (\$/yr)	804	37312
Unit Startups	1	1
Total Cost (\$)	0	2
Totals Since	6-14-00	6-14-00

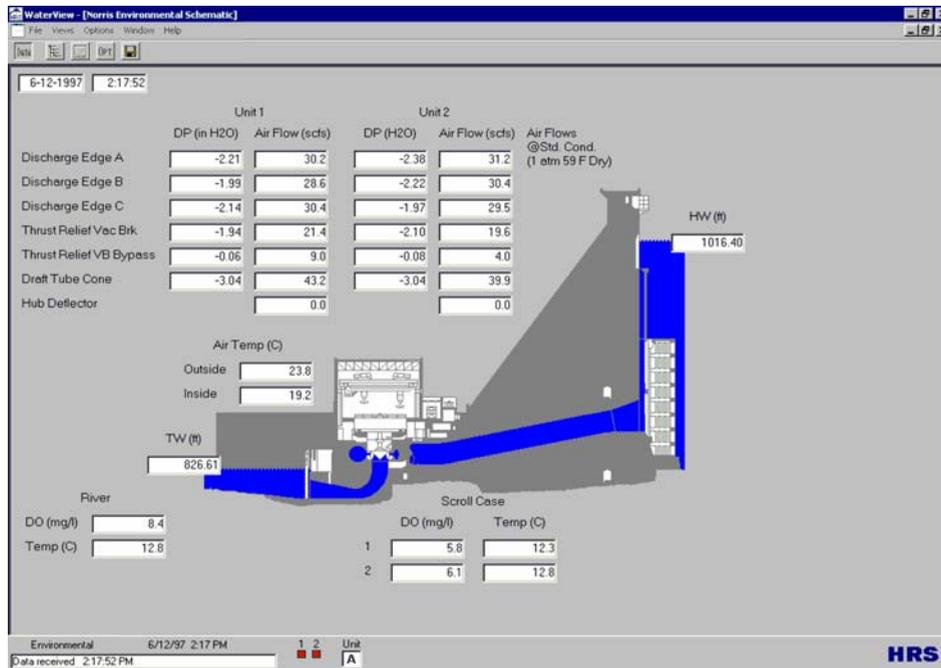
Maintenance Cost Component Properties	
Select Component:	Unit: 2 Component: Turbine Guide Bearing
Component Properties:	
Reset Date	06/14/2000 12:08:09 PM
Replacement Cost	100000
Minimum Stressor Value	1
Maximum Stressor Value	10
Minimum Component Life	2
Maximum Component Life	20
Life Used per Unit Startup	0
Life Used per Unit Shutdown	0
Buttons: Reset, O.K., Cancel, Apply	

Simulator Maintenance Cost 6/14/2000 20:24:56 1 2 Unit
Data received 8:24:56 PM. (0) A

HRS

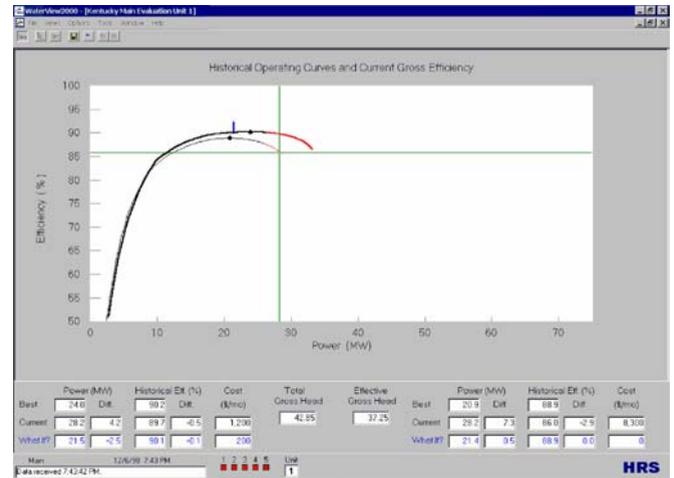
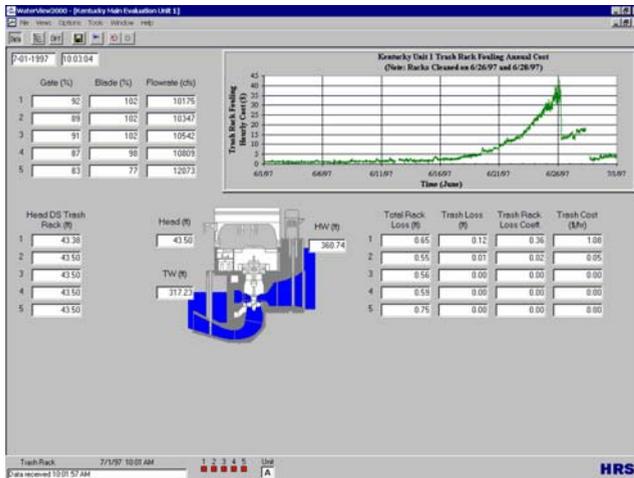


Measurements used by the **Environmental Module** typically include dissolved oxygen levels, total dissolved gas levels, water temperatures, oxygen or air flow rates, and the status of auxiliary equipment. The **Safe Passage Module** optimizes total plant energy production, consistent with high levels of fish survival. By using data from these modules, the operator can evaluate the environmental performance of the hydro units and take appropriate actions to achieve environmental objectives, while minimizing the impact on operating efficiency.





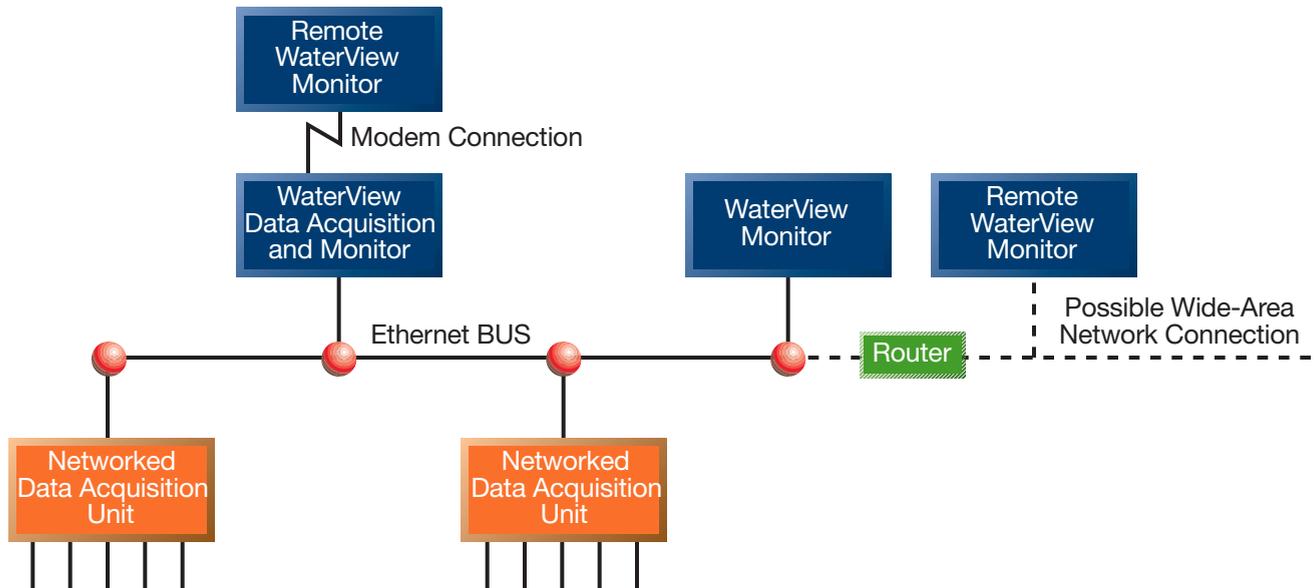
The **Trash Rack Module** indicates the total head loss across the trash rack, the portion of the total head loss due to trash, and a trash rack loss coefficient for evaluating the rate at which trash is accumulating. Trash rack losses are also expressed in economic terms. For a typical 5-unit, 175-MW, main river hydro plant, trash rack losses of one foot represent an annual revenue loss of \$500,000 (assuming an energy value of \$25/MWh). The Trash Rack Module displays the expected performance and the trash-affected performance. This allows the multi-unit Optimization Module to use the actual, trash-affected performance for each unit in optimizing the plant's operation.





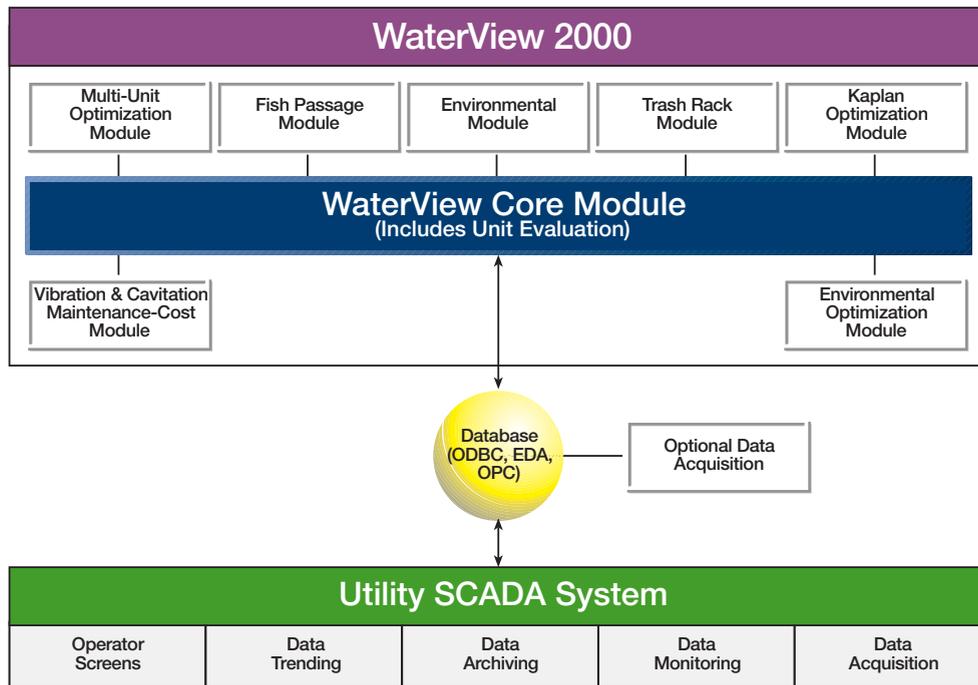
Configurations

This schematic shows a typical WaterView installation for a plant with little or no previously existing data acquisition. This “stand-alone” version of WaterView uses one or more IBM-compatible PCs running on a Windows NT[®] (or higher) local area network. Network hardware and software are included with the basic package.





The WaterView[®]2000 system integrates with a variety of SCADA systems, such as Intellution FIX[®], WonderWare[®], WinCC[®], and RSView[®]. WaterView 2000 receives its data and schedule requests from the SCADA system through a shared database. WaterView 2000 computes, for example, the optimized combination of units to satisfy the schedule request and returns the recommended unit loadings to the database for retrieval and execution by the control system.





Recommended Hardware

CPU:	2 GHz Dual Processor or faster (minimum 1 GHz Pentium 4)
RAM:	1 GB (minimum 256 MB)
Hard Drive:	40 GB (minimum 20 GB)
OS:	Windows NT [®] or higher
Network:	Ethernet Adapter
Video RAM:	64 MB (minimum 32 MB)
Monitor:	19-inch
Modem:	56,000 baud (for remote support)



Hydro Resource Solutions LLC
Superior Technology, Demonstrated Results
Web site: www.waterview2000.com

Voith Siemens Hydro
Power Generation, Inc.
P.O. Box 712
760 East Berlin Road
York, Pennsylvania 17405
717.792.7848
Richard K. Fisher, Jr.
richard.fisher@vs-hydro.com

Tennessee Valley Authority
Resource Management
P.O. Box 1649
129 Pine Road
Norris, Tennessee 37828-1649
865.494.7625
Patrick A. March
pamarch_hrs@bellsouth.net

Copyright © 2004 by HRS LLC. All rights reserved.