**Green Energy Benefits**

There is a more cost effective and more "Green" way to produce electrical power in a hydroelectric plant than to simply tune-up, adjust and select the generating machines that are already in-place and online to make them operate at peak efficiency.

**Type-1 Optimization** of a Kaplan turbine is the process of measuring operating efficiency at various blade and gate combinations across a range of heads and then redefining the optimum 3-dimensional blade to head and gate relationship to maximize its operating efficiency.

**Model Test Data** supplied with new Kaplan turbines is only a "best guess" as to the blade to head and gate relationship that will produce the best efficiency. Periodic field-testing of the full-sized prototype must be conducted to achieve and maintain peak efficiency operation.

**Green Energy** is created by index testing and optimizing Kaplan turbines. Increases of up to 10% are possible, creating more electricity while consuming no additional fuel (water flow).

**Minimized Environmental Harm** results from reducing turbulence and shear forces in the water that is flowing through the turbines. The energy that does not get converted to electrical power becomes turbulence in the water that both destroys the turbines and kills the fish.

*A Second Green Benefit of Index Testing is Reduced Environmental Harm*

**Type-2 Optimization** is the process of load-sharing in a multi-unit powerplant to achieve maximum aggregate efficiency by **Joint-Load Optimization**. Efficiency increases in excess of 5% in a powerplant’s "water-to-wire" conversion rate are achievable.

*A Third Green Benefit - more power with no additional fuel consumption*

Happens after Index test efficiency data is compounded in a Joint-Load Optimization scheme.

**These Green Benefits** are an immediate result from index testing and optimizing each Kaplan turbine in a powerplant and then applying a Joint Load Optimization Control scheme.

**Long-term benefits** of reduced vibration, noise and cavitation dramatically extend equipment working life. Index test data characterizes each turbine’s condition and operating envelope to provide working data so that a more informed unit allocation strategy to maximize ROI for the entire powerplant and helps to decide scheduling of refurbishment for individual machines.

Despite these well-proven and documented benefits, index testing, optimization and Joint-Load methodologies are seldom employed in powerplants where a number of hydroelectric units are operated in parallel. Rigorous application of these disciplines will increase electricity production by up to 15%, yet these technologies remain unutilized in many powerplants and unknown to many hydropower managers.

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**Kaplan Turbine Optimization**

**More Power and Revenue**

Up to 10% can be gained by realigning Kaplan Turbine blades that have never previously been index tested and optimized with payback within the first week of Optimization.

**Reduced Environmental Harm**

Downstream migrant aquatic life is saved from reducing the power wasted by misaligned Kaplan Turbine blades that create turbulence and shear force in the water passing through these turbines.

**Smother and Quieter Operation**

Kaplan Turbines Optimization reduces noise and vibration.

**Maximized Turbine Operating Life**

Reduces turbulence that erodes and pits runner blade surfaces.

**Energy Tax Credits**

2005 Energy Tax Law is available if efficiency increases exceed 5%.

**Carbon Tax Credits**

Will be earned by producing more electricity while releasing no carbon into the environment.

**Bottom Line ROI**

Pending your initial assessment payback can be weeks or months (see our website for details).
Index Testing and Optimization are the Only Way to Assure Maximum Efficiency, Power and Revenue from Kaplan Hydroelectric Turbines

Periodic Index Testing of Kaplan Turbines Will Achieve Peak Efficiency and Identify Small Problems Before They Become Big Problems!

**Type-1 Optimization - Kaplan Turbine with the Index Test Box**

**Index Test Box SteadyState Algorithm** reduces the time and expense of acquiring reliable steady state data for hydroelectric turbines by making this task automatic and economical.

**SteadyState Analysis** provides a powerful aid for conventional index tests utilizing industry accepted Constant Gate or Constant Blade methods by screening the data for steady-state, and automatically rejecting data that exceed pre-set limits for Slope and Standard Deviation.

**New Constant Power Testing** mode provides a less intrusive method for Kaplan Turbine index testing and optimization by exercising the blades to the required off-cam test points while maintaining the dispatched setpoint power levels. Constant power testing is especially beneficial for index testing solitary units in “run-of-the-river” powerplants where flow is dictated by Mother Nature.

**Random Data Capture Mode** is a completely “hands-off” data collection process where the turbines in the powerplant are operated normally while continuous performance data is streamed to a data logger for later analysis and optimization of the turbines.

In order to achieve any benefit from Type-1 Optimization, the newly optimized 3-D cam data must actually be installed in the Kaplan Turbine’s control system. This critical last-step is often neglected. Actuation Test Equipment has the technical expertise to address this situation for any manufacturer’s Kaplan blade control system, or supply new controls if necessary.

**Type-2 Optimization with Joint-Load Control**

All Kaplan Turbines don’t operate exactly the same. Under the same conditions of head and flow, efficiency performance differences of >7% have been noted between supposedly identical machines. In powerplants with a number of units, there is a single unit-allocation that will provide the highest aggregate efficiency level for the powerplant.

**Joint Load Optimization** is the means to determine this optimum unit allocation under any conditions of plant head, power and flow.

**Type-1 optimization of Every Kaplan turbine** must be conducted to maximize generating efficiency for every individual unit before they are combined into a Joint Load scheme to get the maximum overall power and revenue from the group.

**Model Test Data**

Is only the manufacturer’s “best guess” 3-D cam profile

**An Initial Index Test Box Optimization**

Will correct for differences between the tested model and the prototype

**Retesting at Five-Years**

Corrects runner strain relief and sitting in around approach and discharge canals that change flow patterns

**Subsequent Retests Every Five-Years**

Extend life of inevitable deterioration over time and provide critical data for timely scheduling of runner refurbishments.

**Post Surface Repairs**

Welding, grinding and even the most careful repairs can change or distort runner surface contours. Index Testing and Optimization of Kaplan 3-D cam surfaces will restore maximum operating efficiency after extensive repairs.

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