Generation equipment does not last forever. Market changes that favor cyclical modes of operation, increased starts and stops, and frequent torque fluctuations reduce life expectancy. End-of-life can first appear as cracks in the rotating parts, stator or foundation; partial discharge and shorts in the stator winding; or perhaps decreased performance and reliability. Rapidly aging equipment results in a difficult decision point with questions such as: “Which cracks or deviations are concerning?” “Which ones require immediate action?” “Which symptoms are benign?”

To help owners make the best decisions, Black & Veatch has assembled a staff with decades of experience and expertise in the fundamental design and care of hydroelectric generators. Our team executes sound assessments and analyses to deliver clear, focused and actionable results to restore reliable, efficient operation.
B&V HELPS YOU IDENTIFY AND EVALUATE RISKS

- In-person condition assessments.
- Direction of non-destructive examination technicians for thorough assessment.
- Oversee full range of electrical tests.
- Assistance with HydroAmp checklists.
- Interpretation of existing vibration or air gap data.
- FEA and fatigue assessment to evaluate threats posed by existing cracks and other defects.
- Rotordynamics analysis to evaluate risks of changing hydraulic overspeeds or changing bearing characteristics.

B&V HELPS TO PRIORITIZE PROJECTS

- Risk-adjusted cost-benefit analysis or Monte Carlo Net Present Value Analysis to prioritize improvement projects.
- Modeling of resource leveling over capital improvement planning horizon.
- Dashboards for live updating of CAPEX/OPEX project priorities.

DISCOVERING OPPORTUNITIES FOR INCREASED REVENUE

Black & Veatch offers a full-suite or a la carte uprate study: hydrological and hydraulic, electromagnetic, thermal, mechanical/fatigue, rotordynamics, and cost-benefit of uprate.

USACE: FOSTER

- U.S. Army Corps of Engineers found cracks in rotor spider at Foster.
- B&V invited to understand risks and help make repair-vs.-replace decision.
- FEA study and weld inspections clearly differentiated between original manufacture vs. cracks from a specific fault condition and allowed for a limited repair program.

WEC ENERGY: JOHNSON FALLS

- WEC Energy maintenance staff sought a new bearing at Johnson Falls.
- B&V was asked to determine safety of new bearing arrangement given high magnetic pull and imbalance force.
- Lean approach and sensitivity analysis allowed for quick and certain “green light” for crew to make desired improvements.

YUBA: NARROWS 2 POWERHOUSE

- Yuba Water Agency acquired Narrows 2 Powerhouse from Pacific Gas & Electric and needed to understand how to prioritize competing needs on new and existing assets.
- B&V facilitated workshops to quantify competing needs.
- Yuba able to prioritize capital for two years and implement asset management with full-time resources.

Recent Projects

<table>
<thead>
<tr>
<th>Tennessee Valley Authority</th>
<th>Douglas Dam</th>
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<tbody>
<tr>
<td>Lewis County PUD</td>
<td>Cowlitz Falls</td>
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<tr>
<td>Prioritized -140 projects based on risk and level spending</td>
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<tr>
<td>Southern Company</td>
<td>Tarella and Tugalo</td>
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<tr>
<td>Verified tolerability of existing cracks in spiders</td>
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<tr>
<td>Tarrant Regional Water District</td>
<td>Arlington Outlet</td>
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<tr>
<td>Established feasibility, designed and installed new hydro facility to replace existing pressure reducing valves</td>
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Black & Veatch

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