OPTIMIZING BEARING CLEARANCE

Too tight, power is wasted and bearings wear faster. Too loose, increased vibrations overload components and run the risk of a Kaplan blade rub. These were the considerations for the eight cascade power station hydro units that have recently been subjected to increased bearing wear due to peaking operation. Brüel & Kjær Vibro’s Compass 6000™ played a critical role in monitoring the clearance and facilitating maintenance planning.

**MACHINE/INDUSTRY/PROCESS**

<table>
<thead>
<tr>
<th>Machine</th>
<th>22 hydroelectric generating units with Kaplan turbines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company/Process</td>
<td>DEM (Dravske Elektrane Maribor) hydropower, Slovenia</td>
</tr>
<tr>
<td>Monitoring System</td>
<td>Brüel &amp; Kjær Vibro Compass 6000™</td>
</tr>
<tr>
<td>Monitoring Strategy</td>
<td>Protection and comprehensive condition monitoring with specialized generator monitoring for some units (air gap and magnetic flux).</td>
</tr>
</tbody>
</table>

**OBSERVATION/DIAGNOSIS**

Since peaking operation has been implemented on the hydro units, the $S_{\text{max}}$ trend value was observed to be increasing over time; up to 130 $\mu$m at maximum load on the guide bearings of several units. Although this is still considered satisfactory according to ISO 7919-5, the bearings were disassembled anyway to determine the radial bearing clearance. This was measured to be 0.20 mm. Above 0.20 mm, $S_{\text{max}}$ increases significantly during starting and stopping of the unit, while below 0.15 mm, $S_{\text{max}}$ decreased to 60 $\mu$m (at full load), but the bearing temperature increases significantly.

**BENEFITS**

By monitoring $S_{\text{max}}$ to the limits 90-100 $\mu$m, it is possible to identify the initiation of excessive clearance during the summer months, which then gives sufficient lead time to stop the machine and adjust the bearings during the winter months. This would save 3 days lost production per unit if the re-adjustment had to be done during the production months. Since Compass 6000™ was commissioned on all the hydro units in the cascade power stations, a major contribution was made to converting maintenance work that was interval based to predictive based. This has significantly reduced the maintenance expenses and increased uptime. Moreover, the interval between inspection shutdowns for the hydrogenating units has also increased from 25,000 to 30,000 hours for the Zlatoličje hydropower plant. Plans are already underway to implement this turnaround time for the other power stations.

**CONTACT**

Michael Hastings
Brüel & Kjær Vibro GmbH
Leydheckerstrasse 10
64293 Darmstadt
Germany
Phone: +49 6151 428 0
Fax: +49 6151 428 1000
hydro@bkvibro.com
www.bkvibro.com