Unit operation optimization using combined method efficiency/vibration

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Abstract:

Dual-controlled turbines (Kaplan, Deriaz) require optimization of the relationship between the guide vanes and runner to achieve the best operating results. This means maximum efficiency, which yields maximum production, but quiet operation without high vibration is also very important. High vibration can cause damage or early wear to bearings and other mechanical parts.

Minimum vibration usually correlates with maximum efficiency. However, sometimes this correlation does not exist. In such cases, vibration minimization is usually preferred. These vibration originate in the hydraulic part of the turbine, so monitoring of pressure pulsations is also recommended during optimization.

Several results of optimization performed in the past by OSC Company will be presented in detail.

- Optimization of unit after unexpected damage on runner.
- Optimization of the unit during commissioning after refurbishment with a new hydraulic profile.

Conclusion:

Optimization for maximum efficiency only:

- The advantage of a small increase in efficiency in a small part of the operating range (about 1 ÷ 2%).
- This is almost negligible in the overall production.
- Expected increased number of unit failures due to increased vibration.
- Reduced operating time, hence lower annual production.
- Additional costs for fixing problems caused by increased vibrations.

Optimization with respect to vibration / pulsation

- Low loss of efficiency in a small part of the operating range (about 1 ÷ 2%).
- This is compensated by quiet operation and longer machine life.
- Vibrations in the A/B bands are usually acceptable (according to ISO 7919-5 or ISO 20816-5).
- Experience of HPP staff is important (especially after each change on the unit).
- It is recommended to check the cam curve after every change in the controller (sensors, hardware upgrade, etc.). Small shift of range can significantly increase pulsation / vibration.