Levelling inspection plan for a hydro turbine stay-ring flange

turbine-flange-level

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Application template; not a claim of a completed customer project.

Scope

For installation level and face flatness of a hydro turbine stay-ring flange (Ø6000 mm, example/teaching data). The autocollimator measures multiple radial lines on the large-diameter face, tied to a common datum at the centre; an electronic level cross-checks overall tilt on two orthogonal diameters. After adjustment, re-measure the full ring and keep both versions.

Equipment and configuration guidance

• Long-focus photoelectric autocollimator (0.1″ class) with 250 mm reflector base (example)

• Calibrated electronic level

• Centre datum fixture and station markers

• Multi-point temperature logging

Principle and calculation

$\Delta h = L \cdot \tan\theta$; with L=250 mm, 1″≈1.212 μm (example/teaching data). Tilt follows from the least-squares plane normal, $\alpha \approx \arctan(\Delta h / D)$; the tilt azimuth is the fitted-plane gradient direction.

On-site checklist

• Grouting and support state recorded

• Centre-node closure checked

• Tilt results of both instruments consistent

Suggested records

• Ring face height distribution map

• Tilt magnitude and azimuth

• Before/after adjustment comparison and conclusion

Limitations

Does not cover long-term settlement monitoring of the concrete foundation or flange sealing tests; deformation under unit operating conditions is outside this plan.

Detailed teaching example

Hydraulic Turbine Stay Ring Flange Level Inspection · Tutorial Case

Scenario and task

Teaching demonstration, not a real customer project: segmented level survey of a hydraulic turbine stay ring flange; data are instructional settings.

Workflow overview

Flange layout → Place bridge → Read per step → Convert heights → Level evaluation

Preparation and measurement steps

01. Clean the flange face and mark the division points

02. Place an electronic level on a 250 mm bridge

03. Step radially, reading the tilt per segment

04. Take two readings per segment and average

05. Cumulate and convert for flange level results

Teaching example readings

• Bridge span L=250 mm; segment 1 electronic level reading θ□=-0.5″

• Segment 2 electronic level reading θ□=+1″

• Segment 3 electronic level reading θ□=-0.5″

Calculation procedure

Height conversion: Δh = L·tan(θ·π/648000)×1000 (μm). Segment 1: 250×tan(-0.5″)=-0.61 μm; Segment 2: 250×tan(+1″)=+1.21 μm; Segment 3: 250×tan(-0.5″)=-0.61 μm. Cumulative heights: 0→-0.61→+0.60→-0.01 μm; peak-to-valley PV=+0.60−(-0.61)=+1.21 μm.

Example result and interpretation

Tutorial result PV≈1.21 μm, demonstrating micrometre-level level measurement of the stay ring flange.

Example verification checklist

• Bridge centred radially on the flange face

• Level thermally settled before reading

• Forward and reverse passes averaged

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