Session:

Sediment management
What are the mitigation options?

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For more information: www.hydropower.org/congress
Hydro-abrasive Erosion in HPP Equipments

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Locations vulnerable to sand erosion:
- where small gap exists: 2, 3, 4, 5
- where particles hit surfaces directly: 1, 6
- where swirling flow takes place: 7, 9
- where cavitation takes place: 8
- other locations
Consequences

Sediment Erosion

- Increased gap size
- Damaged surface
  - higher leakage
  - Lower efficiency
  - Less energy production
- Cavitation
  - Cracks
  - Less availability
  - Less safety margin
• Head: 400~487 m, maximum sand load: >10 kg/m$^3$, after one monsoon season of operation

K. Winkler, Understanding hydro-abrasive erosion for sustainable solutions, Hydro Vision India 2011
Examples: Francis Turbine

- Head: 159.3 m, 90 MW. Water was clean when the HPP was constructed. 2008 after the Wenchuan earthquake, debris flow entered the head water. Then, after~100 hours of operation this is the consequence… …
Examples: Kaplan Turbine

- Head: 18~21.5 m, Diameter: 5.5 m, maximum sand load: 20 kg/m³
- 700~1300 kg material lost after 11 Mio. Tons of sand have passed
Examples: Pelton Turbine

- Head: 690 m, Discharge: 13.9 m$^3$/s, Diameter: 2.1 m, maximum sand load: 1.8 kg/m$^3$

K. Winkler, Understanding hydro-abrasive erosion for sustainable solutions, Hydro Vision India 2011
Influential Parameters

**Particle Parameters**
- Concentration
- Grain size distribution
- Mineralogical composition
- Grain shape
- etc.

**Turbine Design Parameters**
- Turbine type
- Turbine size
- Components geometry
- Speed
- Flow patterns
- etc.

**Protection Measure**
- Material
- Coating quality
- etc.
Counter Measures

• Optimize the design
  – Choice of machine type and dimension
  – Suppress flow patterns causing erosion
  – Consider availability in addition to efficiency
  – Consider easiness of maintenance
  – Consider feasibility of applying coating

• Apply anti-erosion coating
  – Quality of powder material: hardness, strength, resistance, composition, grain size, production route, etc.
  – Spray and coating process
- Uncoated (left) and coated guide vane after one monsoon cycle of operation

Andritz Hydro, SXH7X Coating
Results of Coating

- Uncoated (left) and coated (right) Pleton bucket after ~100000 tons of sand

Andritz Hydro, SXH7X Coating