

Vattenfall R&D “Kungsgrännan”

SWECOLD 2018

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Laxeleratorn – full scale experiments with smolt and fish racks

Background:

- 3 EU directives (1992: Species and habitats, 2000: Framework water, 2009: Renewable energy sources).
- HaV and Energimyndigheten 2014: Strategy for actions – balance between environmental and energy aspects.
 - Each area is unique.
 - Aim for good ecological potential (or status).
 - Site specific solutions.
 - Connectivity is important for biodiversity.
- Implemented in the Swedish environmental law.
- No environmental permits older than 25 years.
- Reconsideration according to "Nationella prövningsplanen".



Background:

- Expected/proposed actions:
 - Environmental flow in dry reach.
 - MLQ (mean low flow).
 - Fish ladders and bypass channels.
 - α/β -racks with bypass/escape paths.
 - Hydromorphology (bottom structures).
- Estimated investment cost: θ billion SEK.
- Production losses: θ 10*investment cost.
- Large scale hydro fears an upscale of actions from small scale hydro.



Time line:

- 2016-10-20: Investment decision for building Laxeleratorn.
- 2017-11-06: Construction completed.
- 2017-11-20: Approved for testing with fish.
- 2018-06-04: Commissioning completed and ready for first test.



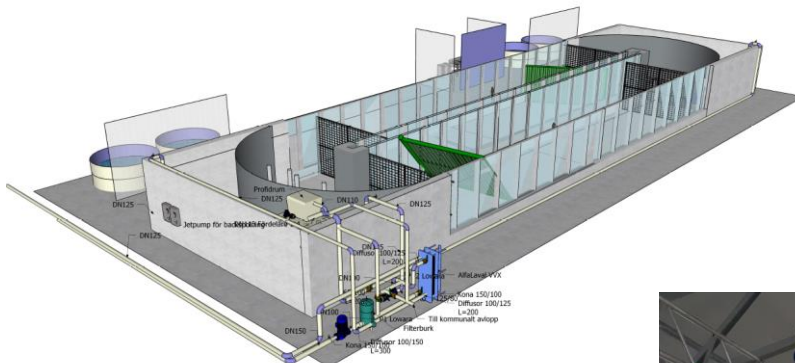
Laxeleratorn:

- Complete test facility with flowing water for ecohydraulic studies 20 x 40 m, 800 m².
- Flexibility.
- Tanks for holding fish between trials.
- Fish treatment facility.
- Easy access.
- Temperature controlled water and atmosphere.
- Adaptive light – maximum water surface illuminance 1000 lux.



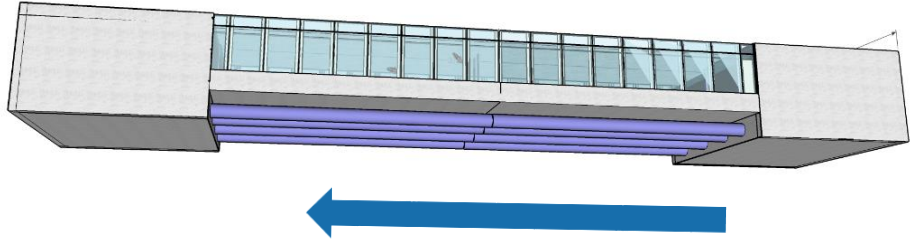
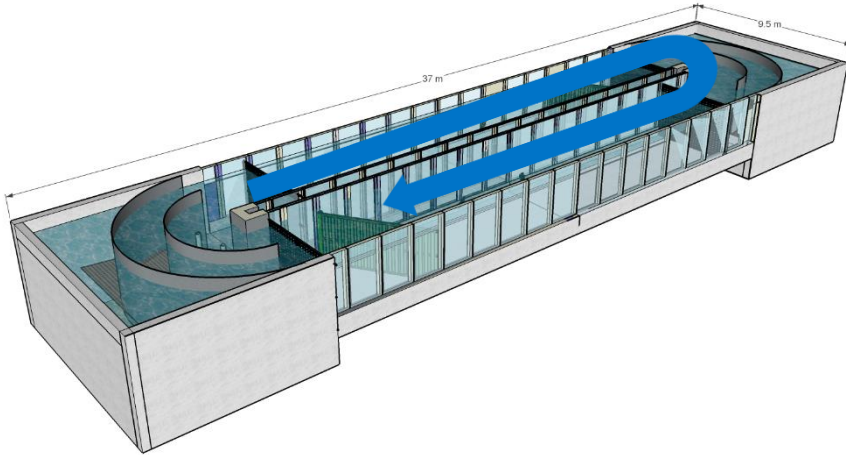
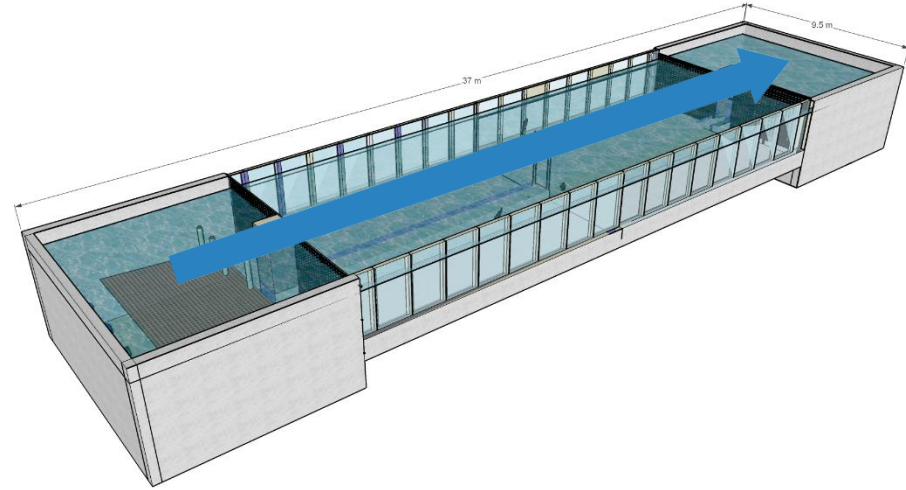
Performance:

- 2 // test sections.
- 24 m length.
- 4 m width.
- 2 m water depth.
- 4x40 kW pumps
- Flow velocity up to 2 m/s.
- Volumetric flow 16 m³/s.
- 10 cameras tracking fish.
- 4 PIT-tag antennas for positioning.
- From steady flow to violent white water flow.



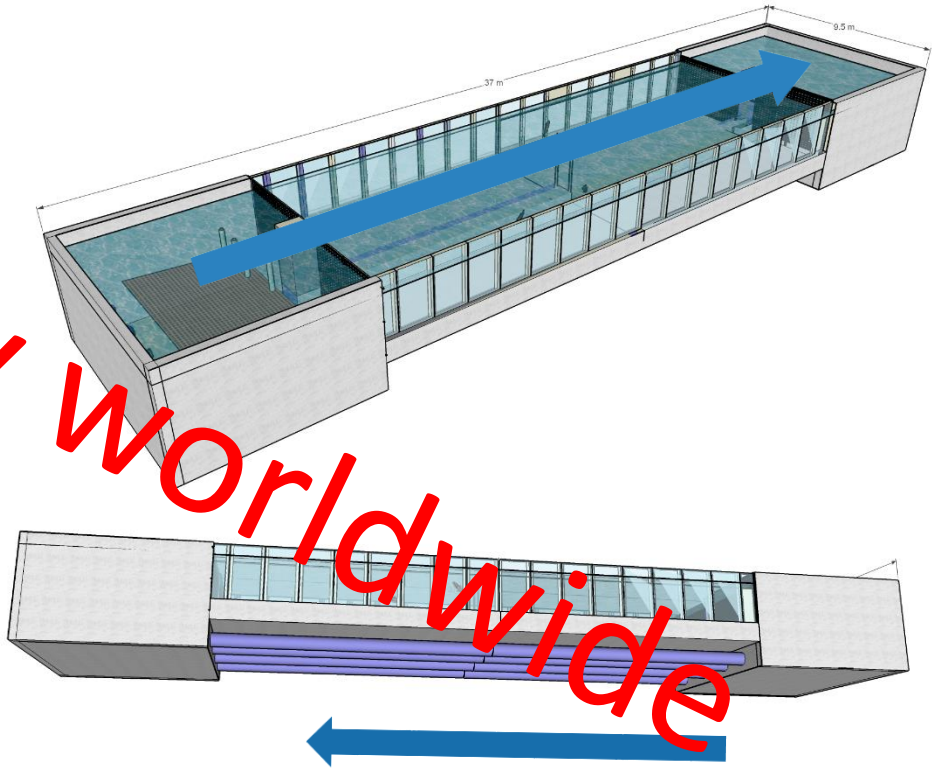
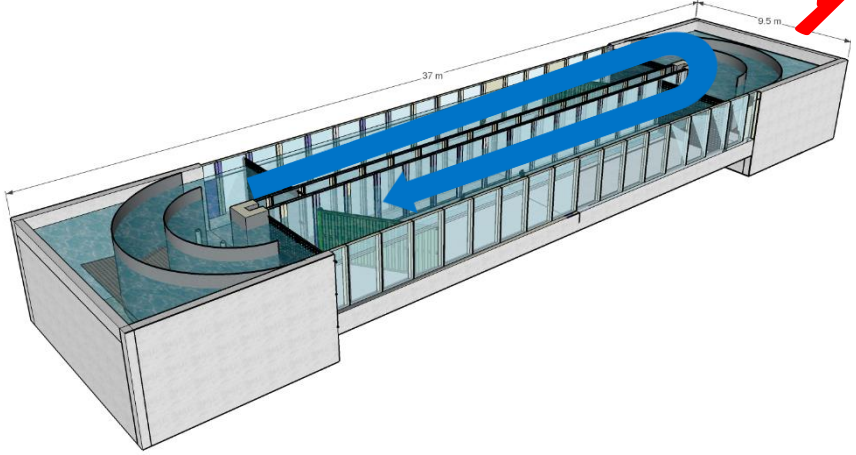
Performance:

- Flume up to 16 m³/s
- Wide basin (9 m) up to 2 m³/s
- Narrow basin (4 m) up to 2 m³/s



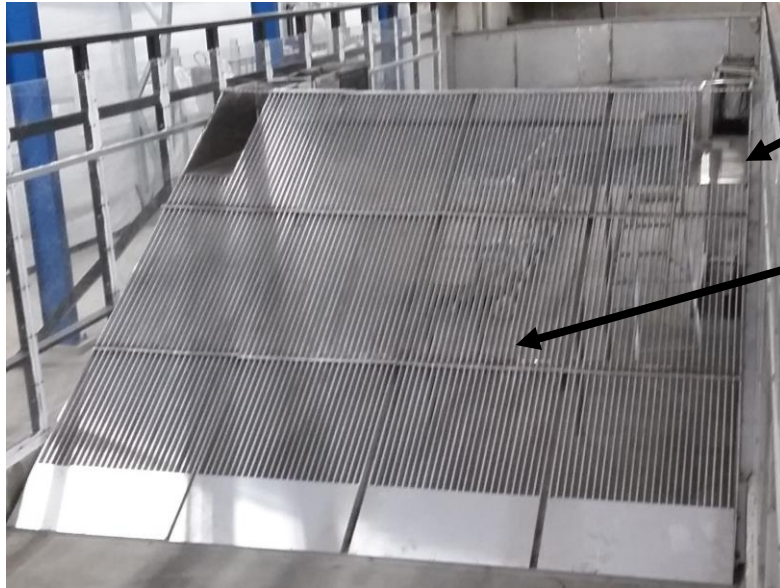
Performance:

- Flume up to 6 m³/s
- Wide basin (9 m) up to 2 m³/s
- Narrow basin (4 m) up to 2 m³/s



Unique facility worldwide

Full scale experiments with fish rack for improved fish migration:



Spacing: 15 mm, 18 mm, 30 mm, or 10 mm.

Bypass channel

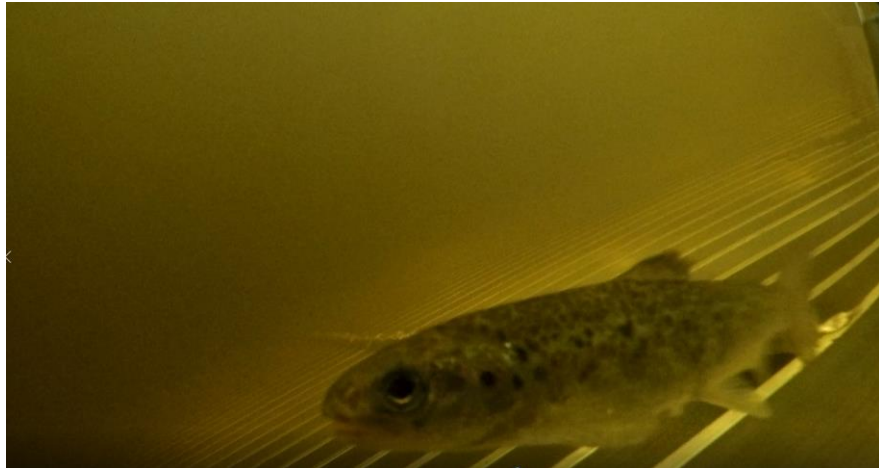
α -rack



Start box

Full scale experiments with fish rack for improved fish migration:

- The smaller spacing – the more head losses and more debris:
 - 30 mm → 15 mm: Δ 10 cm.
 - 1 MSEK/cm in capitalized value per unit.



Full scale experiments with fish rack for improved fish migration:

- Preliminary results:
 - Spacing 15 mm: 77% efficiency.
 - Spacing 30 mm: 77% efficiency.
- Very promising results that needs to be validated next year.
- Coming tests:
 - Eels in oct/nov.
 - Pre-fabricated, module based fish ladders in order to reduce cost.