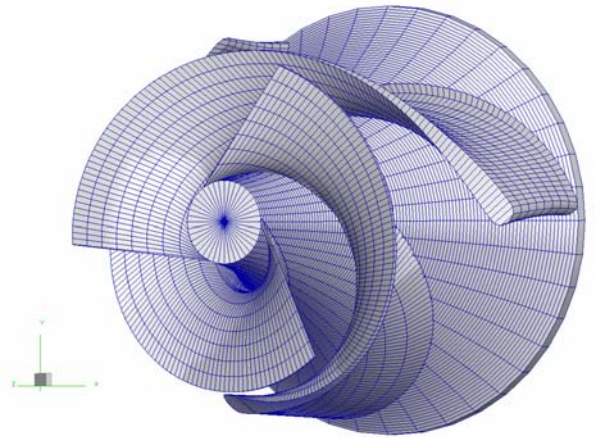

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Developments in Waterpower Fish Passage & Protection

Doug Dixon
Program Manager
Waterpower Research

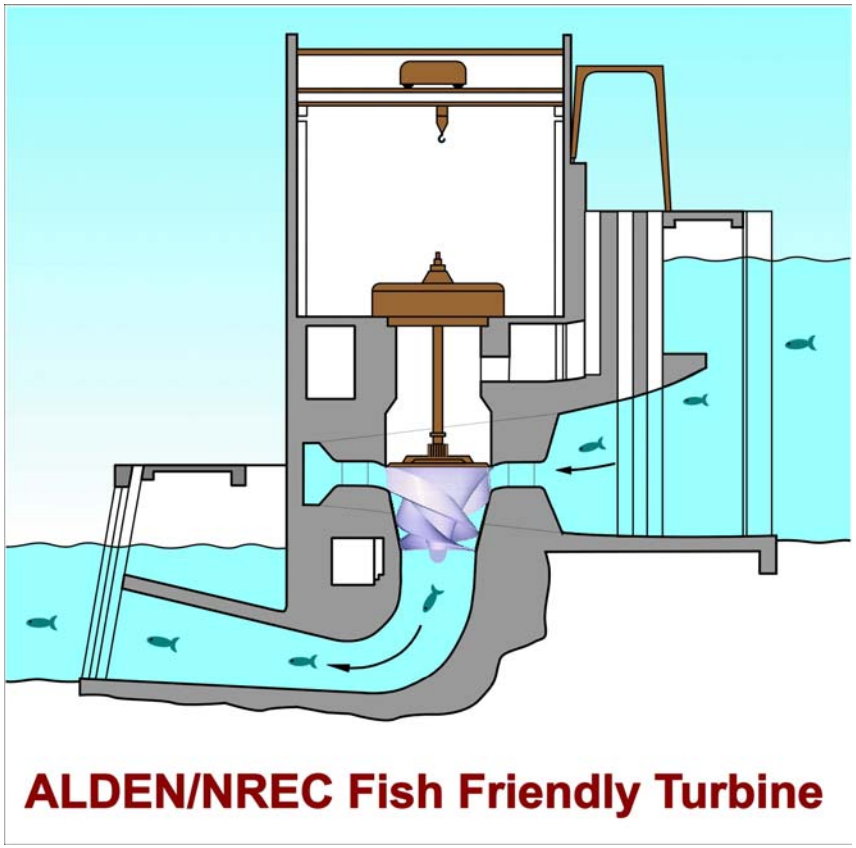
NHA Conference 2009

ACT now

What EPRI is Doing & What I Will Briefly Discuss

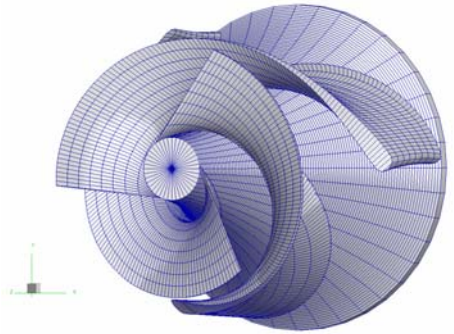
- R&D:
  - Fish-friendly turbine development (Alden/Concepts NREC turbine)
  - New: hydrokinetic turbine impacts on fish
- Information Management:
  - Fish passage & protection information
  - American eel issues
- Collaboration:
  - American Fisheries Society - Continuing Education & Symposia

Fish-Friendly Turbine Development Next Steps: Conceptual to Design Engineering



U.S. DEPARTMENT OF ENERGY

ALDEN
Solving flow problems since 1894



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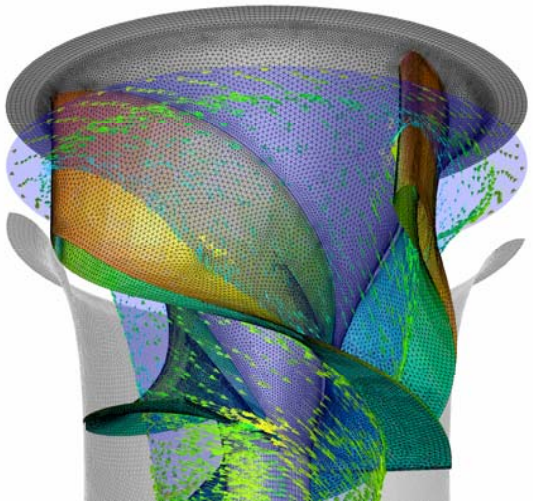
EPRI Advanced Turbine Research

- 2009 - Year 1 of EPRI-DOE-Industry Program: **design engineering**
- 2010 – Year 2 of EPRI-DOE-Industry Program: **model testing and "final" design engineering**
- 2012-13 – **Deploy**
- 2013-14 – **TEST**



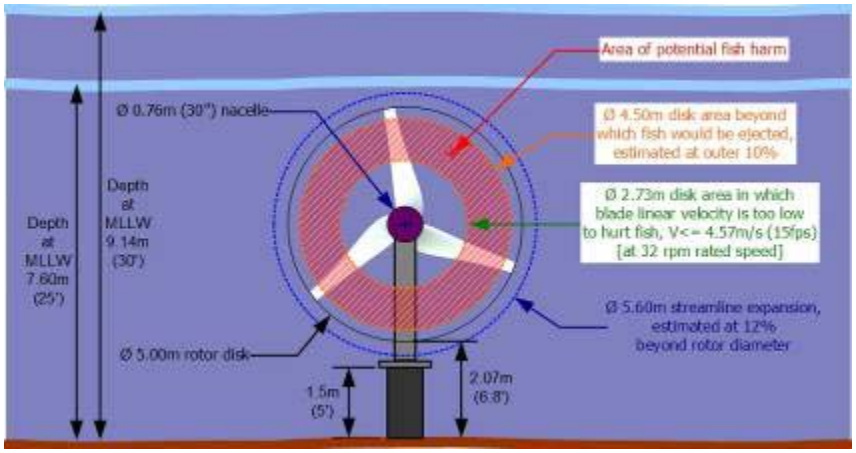
Why Advanced Turbines?
#1 R&D Need of the Industry (2007 & 2008)

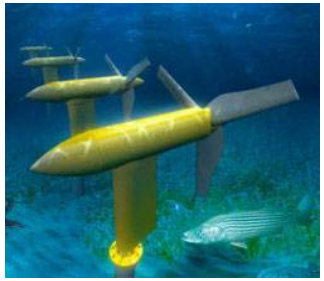
Puget Sound Energy's $53 million "gulper" for protecting downstream migrating salmon

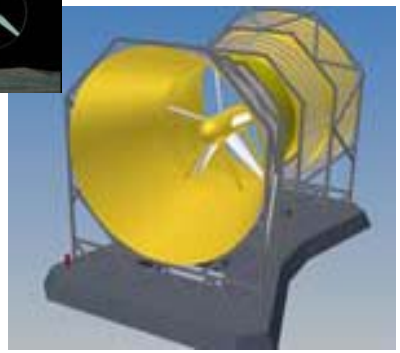
Millions/billions spent/lost protecting downstream migrants with screens, spills, barges and other devices

- **Why not pass them safely through turbines?**
- Reduce mortality to migrating & moving fish (≤2%)
- Improve generating capacity (reduce diversion/spill for fish passage)
- Expand hydro generation (new development) with avoided CO_2 emissions

Hydrokinetic Research: Need to Resolve Fish Issues







- Blade injury & mortality
- Behavioral changes

- Need:
  - Field studies
  - Laboratory observations
  - Cumulative impact analysis techniques

Does It Make Sense to Pass Eels Upstream?

Resource agency policy - pass them for restoration:

- "Salmonid" model (but eels spawn in ocean!)
- Eels not obligate catadromous
- Passage exposes them to:
  - Downstream turbine mortality
  - Upstream predation
  - Chemical contaminants
  - Reduced growth & egg production(?)
  - Swim bladder parasite (*Anquillicola*) stage spread
  - Longer migration distance (with parasite & chemical burden)
- Full presentation at AFS Annual meeting

EPRI American Eel Interest Group

Stakeholder forum for participants to exchange information related to protection of this species at hydro plants:

- Population trends
- Reproductive biology
- Growth (freshwater & estuarine) and maturation
- Migration information (timing, swimming patterns)
- Contaminant effects
- Parasite infestation and related issues
- Upstream and downstream passage technology design & performance
- Aquaculture

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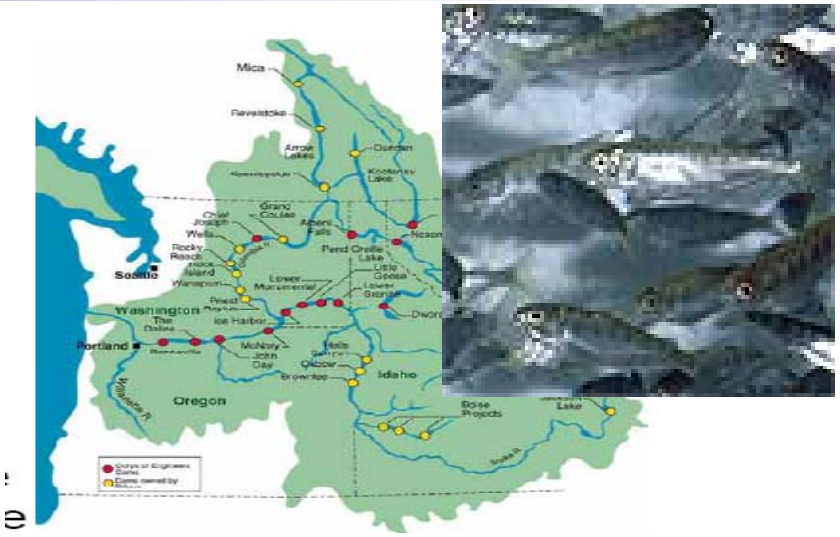
Tracking Fish Passage & Protection Developments (*punctuated equilibrium*)

EPRI Quarterly Science Review & Web Site – KEY PAPER

Survival of migrating salmon smolts in large rivers with and without dams. D. W. Welch et al. 2008. PLOS Biology (open access) 6(10):

- Fraser River (no dams) smolt survival to sea ~ = Columbia smolt survival
- Smolt survival upper Columbia > lower Columbia below Bonneville



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AFS Continuing Education: August 30, 2009, Nashville, TN (2 CEUs)

Upstream Passage Course: *Science, Tools and Information Resources on Upstream Fish Passage*:

- Why upstream passage
- Physics & biology of passage
- Fishway design
- Agency (U.S. & Canada) processes & criteria
- Fishway evaluation
- Vertical slot, weirs, Denil, fish lifts, trap & transport, eel ladders
- Case studies
- Fish passage at road crossings

AFS Symposium: *Innovation in Fish Passage & Protection* (September 1-2, 2009)

Fish passage and protection 100 years after Denil – *where have we been, what's wrong, and what can be improved*:

- **Upstream Fish Passage**
- **Downstream Fish Passage**
- **Screening Technologies and Criteria**
- **Biological Basis of Bioengineering**

AFS Bioengineering Section

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QUESTIONS?

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