MCNARY TURBINE REPLACEMENT

JAN 2026 FFDRWG DESIGN STATUS UPDATE

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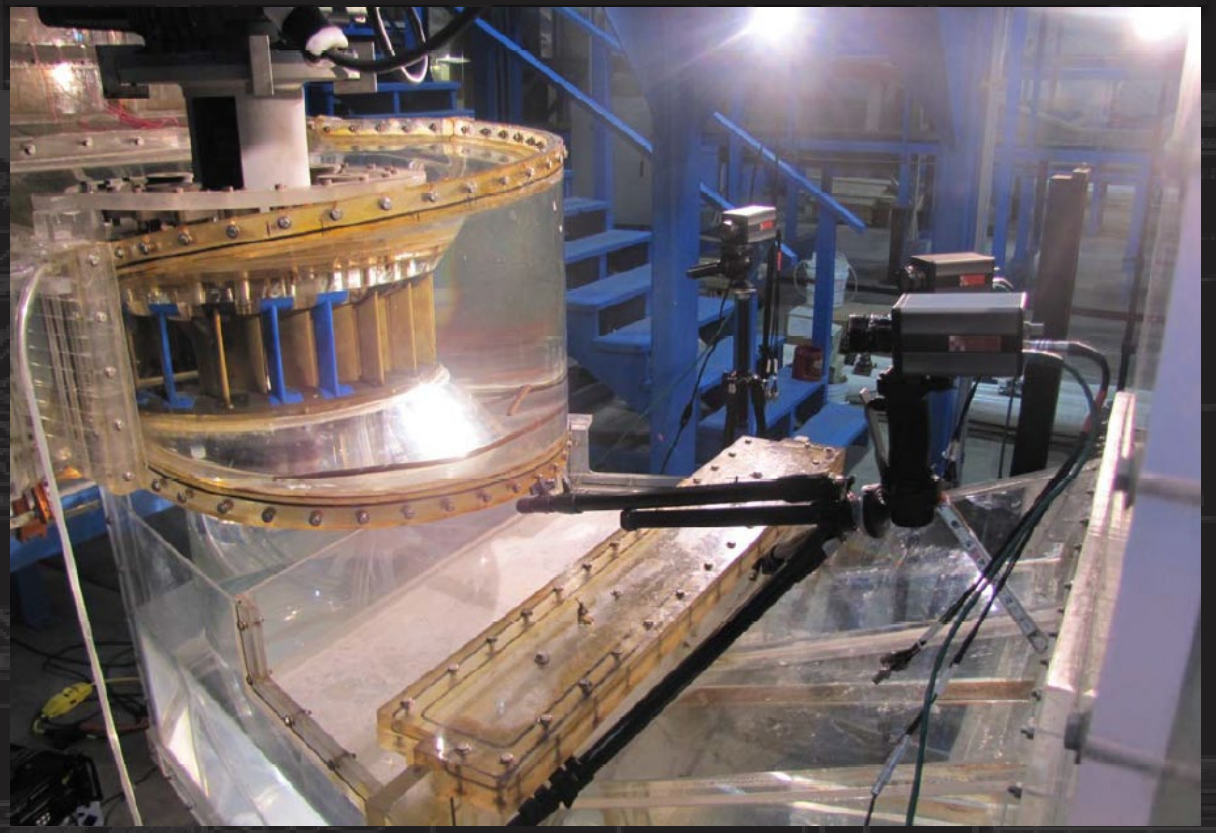

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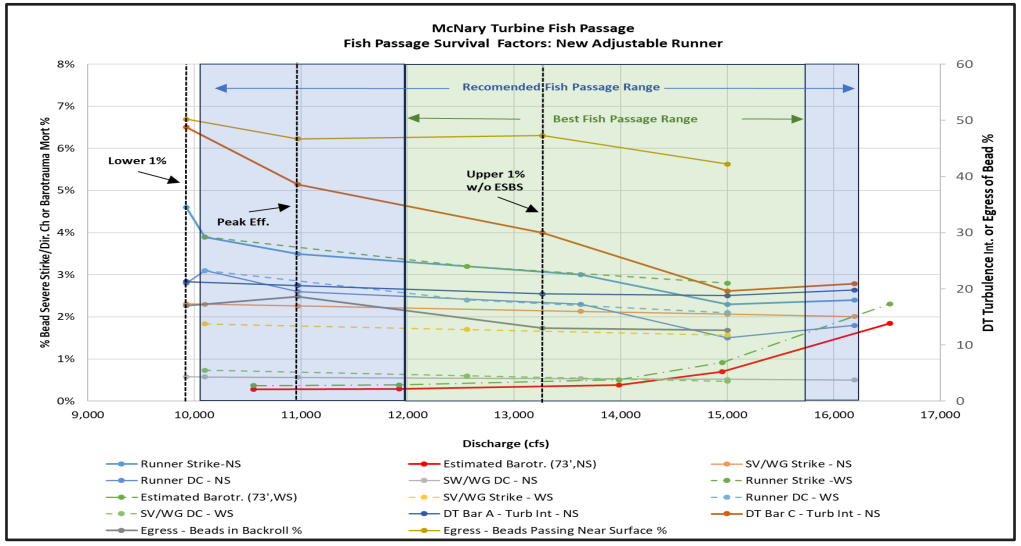
MCNARY TURBINE REPLACEMENT UPDATE

- Adjustable Runner
  - Fabrication nearing completion – several delays – largest to discharge ring
  - First Adj. Runner Installation ~ May 2026 to November 2027
  - FPP 2028 requires initial fish passage operating range
  - ERDC used inform release locations for future direct survival study
- Slot Filler
  - Award expected early CY26
  - Fabrication of first set 1 year after award



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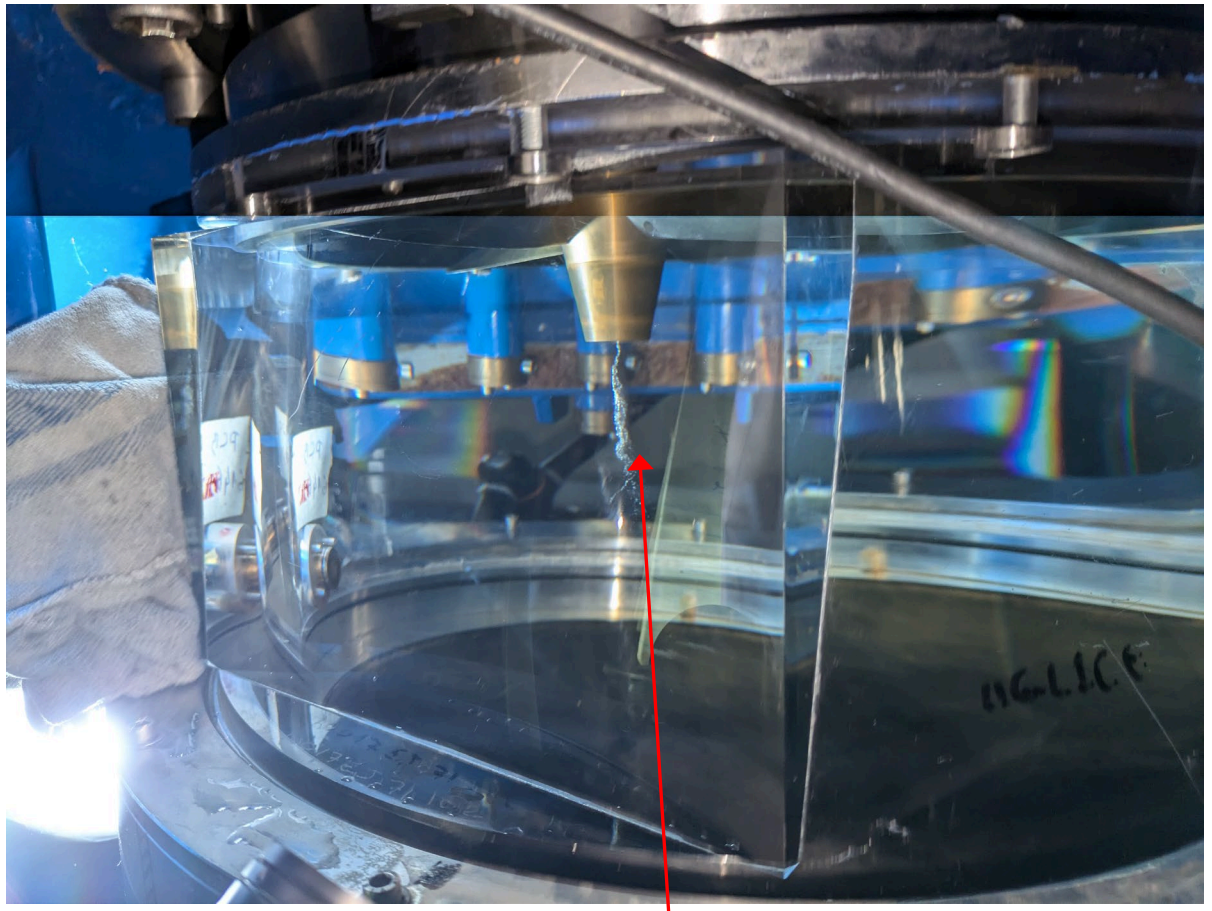
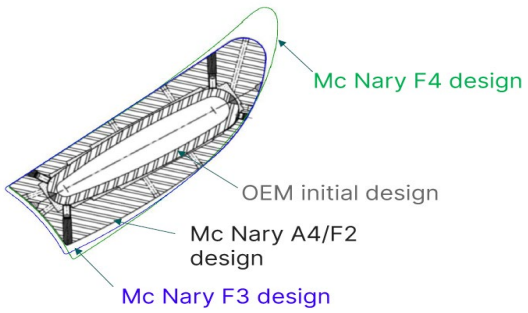
- Fixed Blade Design
  - F3 ERDC evaluation completed in August 2025
  - F4 hydraulic design completed in December 2025
  - Currently in performance testing. Complete in June 2026.
  - ERDC testing June – January 2027.
  - It is expected that F4 is the final iteration but option for F5.
- F3 Areas of Improvement for F4
  - Hub strikes past leading edge
  - Vortex rope below runner at upper 1%
  - SV/WG grazing strikes on SV TE or WG LE
  - Avoid regression of key improvements
    - No large drop in efficiency with 1% range
    - WG closing tendency up to maximum power
    - Maintain F3 minimum nadir pressures

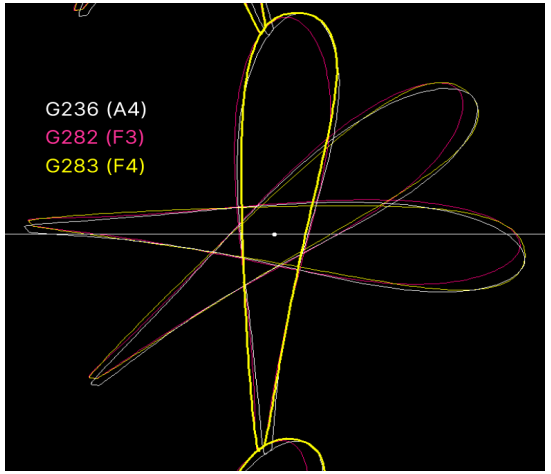


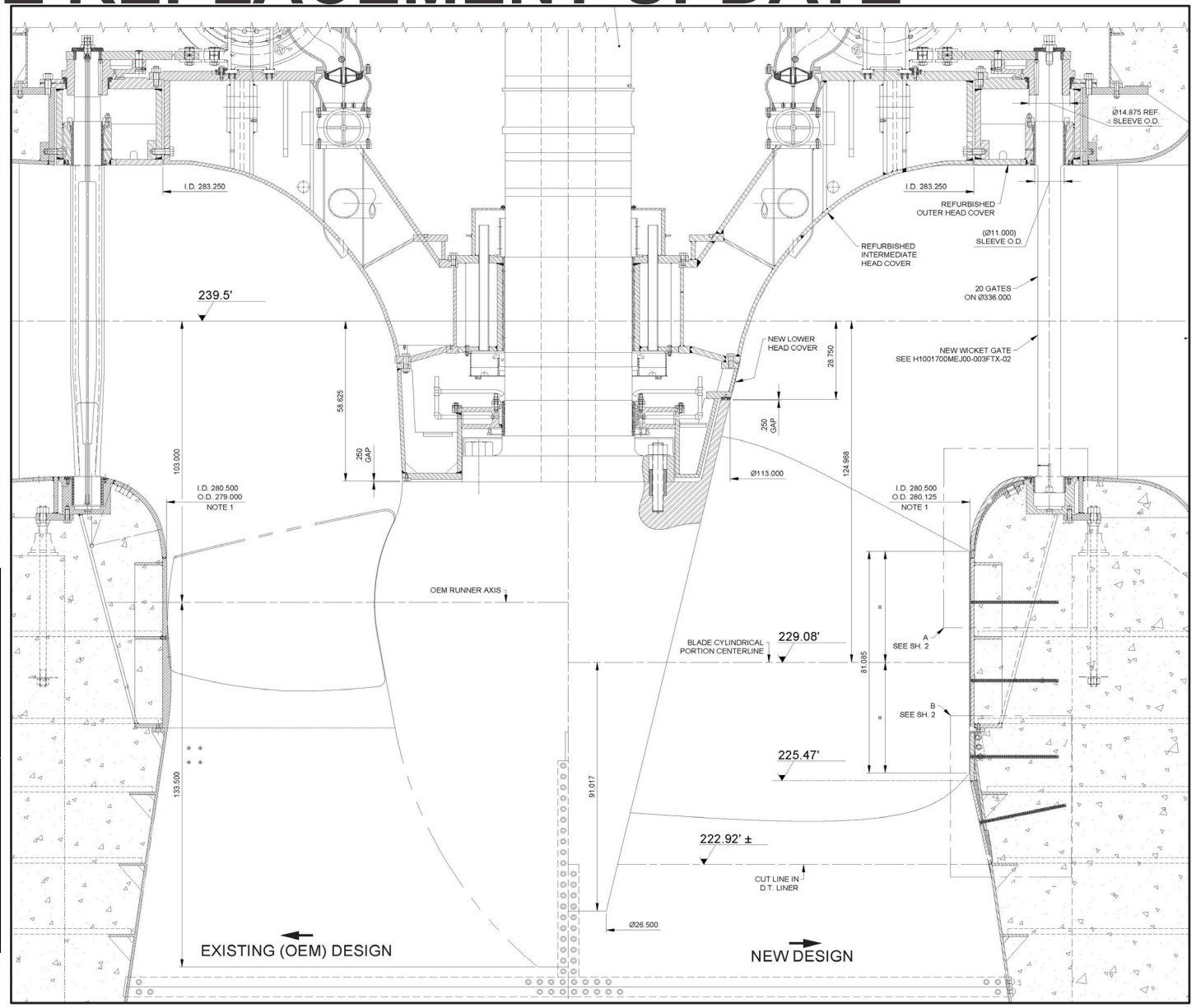
Small vortex rope in F3 performance model at true upper 1%

MCNARY TURBINE REPLACEMENT UPDATE

- F4 Geometry
  - 4 Bladed runner that uses a new lower headcover
  - Discharge ring machining & inserts to make 280” cylindrical
  - SV widened and WG straightened compared to A4 and more adjustments around the distributor

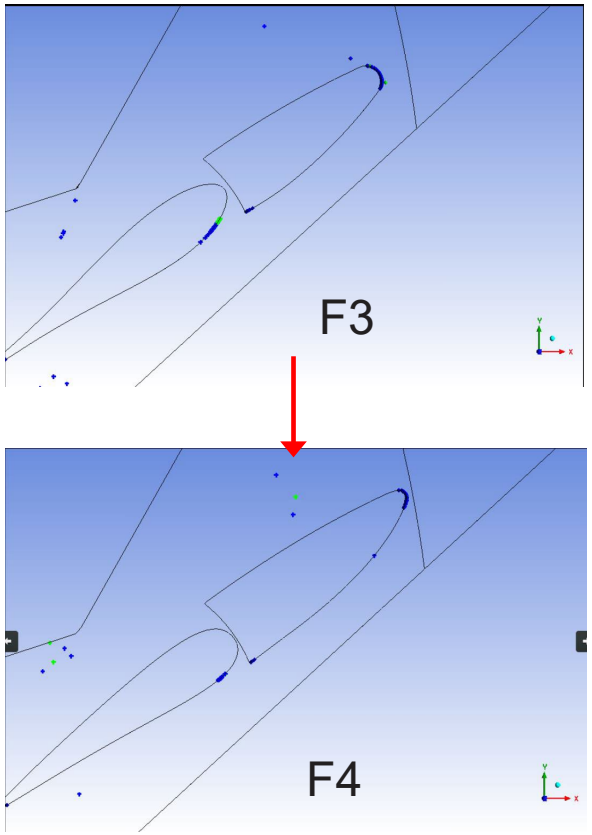


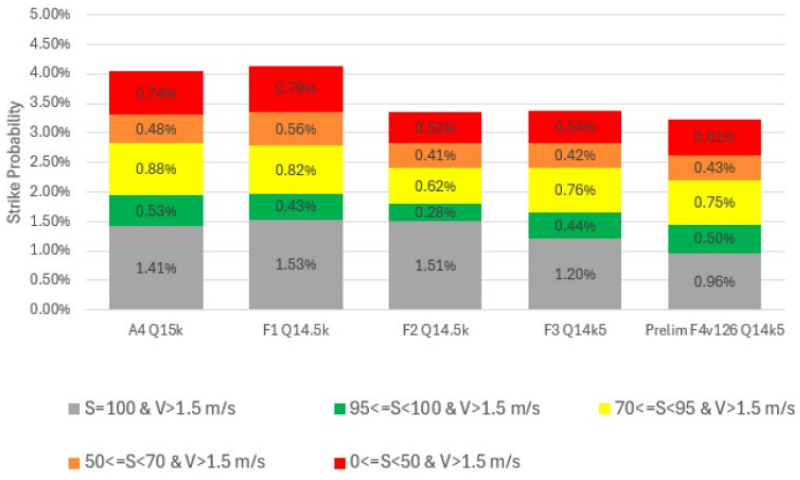


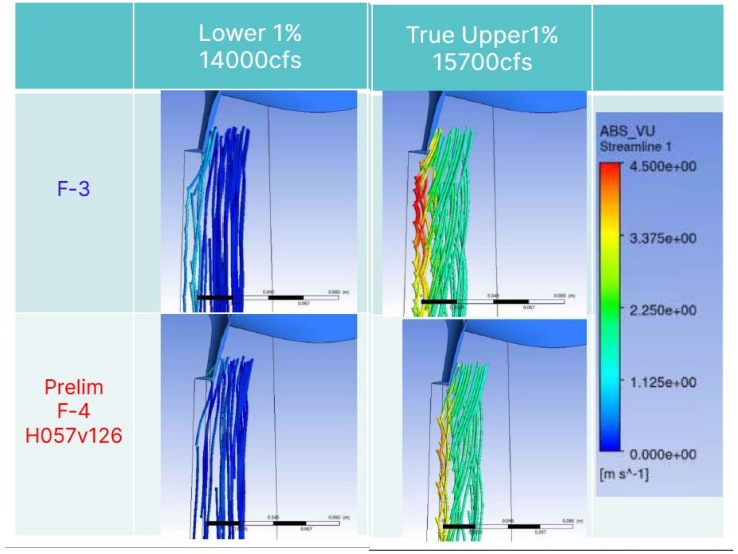


MCNARY TURBINE REPLACEMENT UPDATE

- F4 WG/SV CFD
  - Small reduction in strike frequency and intensity in CFD
  - WG hydraulic torque optimized – maximum torque lower but still with closing tendency
- F4 Runner CFD Results
  - F4 hub strikes decreased with more optimized leading edge. Slight reduction in overall strikes predicted by CFD.
  - Hub vortex moved to outside of 1% discharge range.







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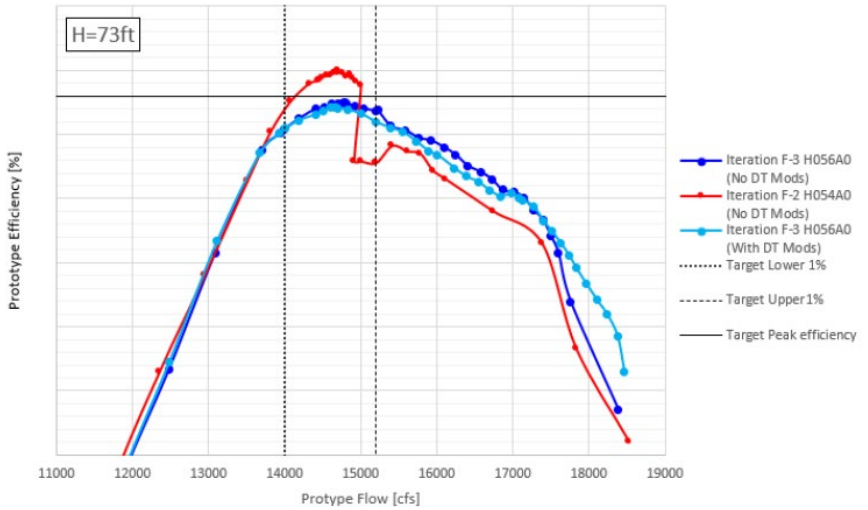
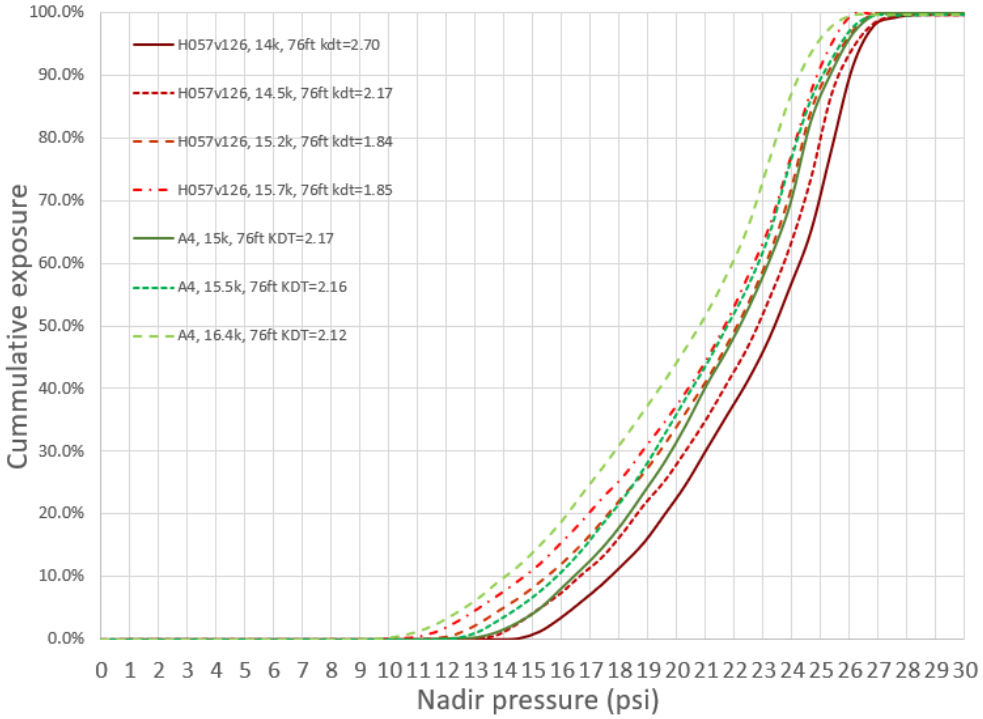
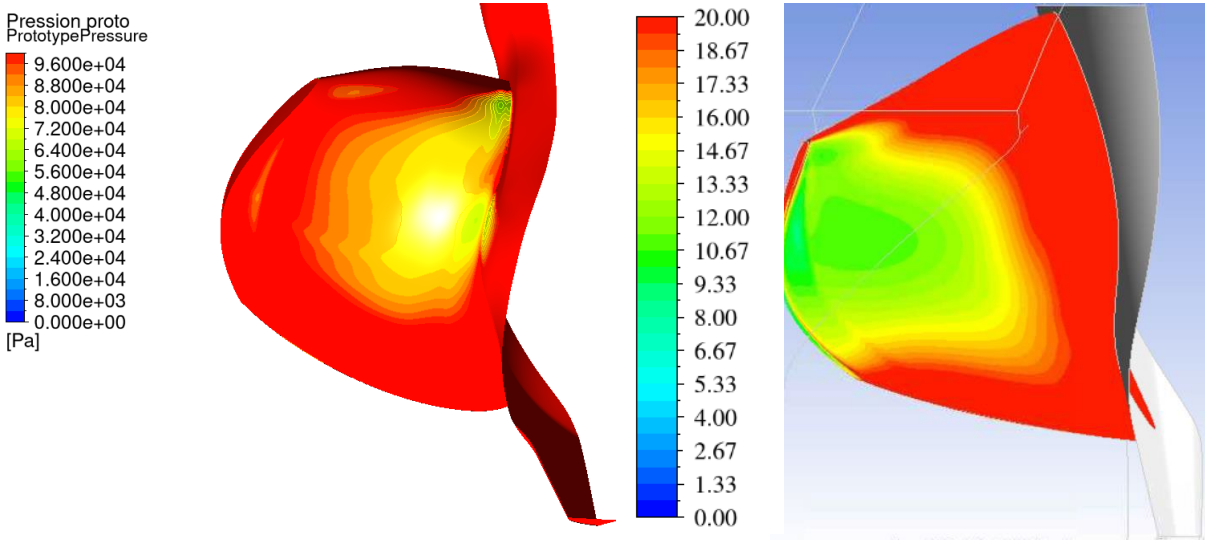
- F4 Power
  - F4 = F3 ~ 0.5% < F2 and 0.1% < target
  - F3 & F4 both avoid large drop in efficiency after peak
- F4 Runner CFD results
  - F3 & F4 very similar pressure.
  - F4 has similar nadir pressures as final adjustable (A4)





A4 at 16.4 kcfs at 76 ft

F4 at 15.7 kcfs at 76 ft



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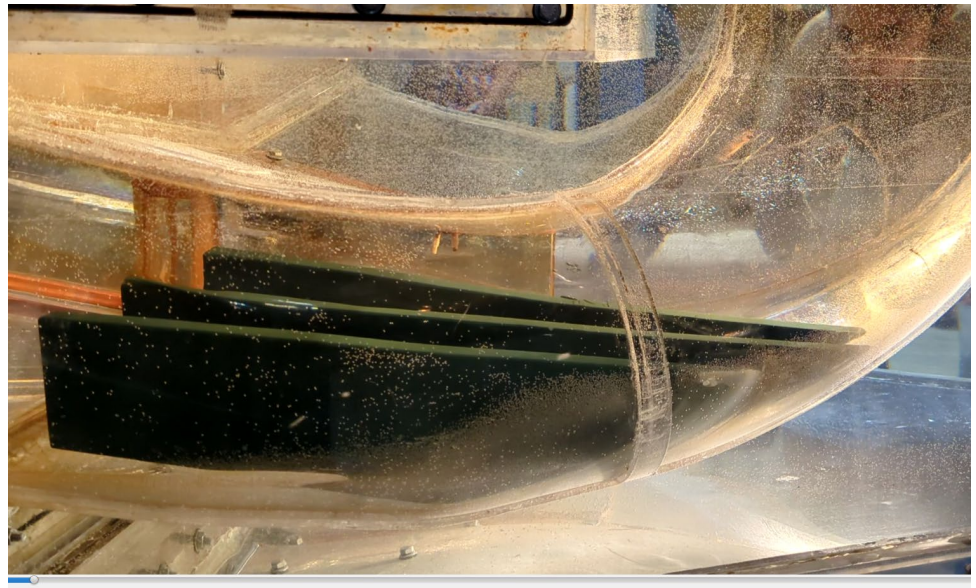
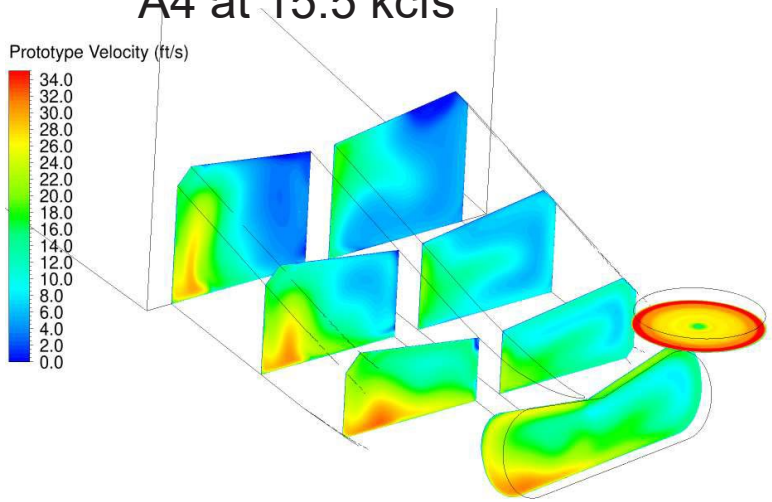
- F3 ERDC Draft Tube/Egress Results
  - Large flow separation at high flow eliminated and flow split near 50/50
  - Barrel A worse for uniformity but Barrel C improved
  - Egress mixed results
    - Worse for beads entrained in backroll
    - Reduced beads passing near surface at 200 ft
  - DT modification improved barrel A uniformity but caused too much strike and direction change
    - DT Modification not worth it



DT mod in A barrel during F3 ERDC testing

- F4 DT Hydraulic Design
  - Extensive hydraulic analysis determined that further efforts to improve barrel A would result in flow separation and worse conditions
  - Overall similar DT conditions to adjustable & existing runner

A4 at 15.5 kcfs



F4 at 15.2 kcfs