Jun 26th, 1:30 PM - 1:50 PM

Concurrent Sessions A: Emerging Engineering Solutions for Downstream Fish Passage at Big Dams - A Portable Floating Fish Collector - New Approach to Flexible, Small-Scale Downstream Fish Passage

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*HDR Engineering, Inc.*

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A Portable Floating Fish Collector – New Approach to Flexible, Small-Scale Downstream Passage

Michael Garello, P.E. and Michael McGowan, P.E.
International Conference on Engineering and Ecohydrology for Fish Passage
Session A5 - June 26, 2013
USACE Team Members

- Project Manager- Chris Budai
- Project Biologist- Dave Griffiths
- Technical Lead- Kristy Fortuny, PE
- Hydraulics Lead- Liza Roy, PE
Design Development Team

- HDR Engineering Inc.
- Art Anderson and Associates
- iTen
- Allegiance Associates
- US Cost
Introduction and Background

- Focus on downstream passage effectiveness in the Pacific Northwest
  - Passing fish through hydropower turbines
  - Conveying fish through surface flow bypass outlets
  - Collecting fish in surface oriented collectors

- Existing projects (USACE, 2007)
  - Surface Spill (11)
  - High/Low Flow Sluiceways (6)
  - Forebay collectors (5)

- Effectiveness still inconclusive or inadequate on some facilities
- Data collection and facility evaluation ongoing
- There is a need for new, innovative, and economical means of improving downstream passage effectiveness
Overall Project Purpose

• Gather information on behavior and collection efficiency of tagged and run of river fish

• Proof of concept prior to installation of full-scale system

• Use at multiple reservoirs within the Willamette River basin
Target Performance and Design Criteria

- Intended design life 10 to 15 years
- Use of “off-the-shelf” components
- Accommodate large pool fluctuations and various reservoir depths
- Shore power with provisions for future stand-alone power source
- Deployable and portable
- Transportable to other reservoirs
- Economical
Cougar Reservoir

Max Pool 1,690 ft
Min Pool 1,516 ft
Fluctuation 160 ft
Collector Overview

- **Fish Work-Up Station**
- **Surface Decking**
- **Collector Inlet**
- **Flow Shroud**
- **Electrical and Instrumentation**
- **Anchorage**
- **Winches, Fairleads, and Moorage**
- **Modular Float System**
INLET SCREENS

FLUME

FISH GRADER AND HOLDING POOL

HOPPER

LEVELING PUMP

ATTRACTION FLOW PUMPS
Collector Operation
Collector Operation
Additional Challenges
Shore Power
Additional Challenges
Anchorage and Drift
Hydraulic Design Tool Development

• Spread sheet w/ visual basic
• Gradually varied-flow equations
• Simultaneously solves for two water surface profiles
• Provides depth, velocity, dewatering, over length of collector
• Flexibility for a number of collector dimensions and operating scenarios
Anticipated Performance

Run – D3

Water Surfaces

<table>
<thead>
<tr>
<th>Opening Size (in)</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Div 1: Station 31-36)</td>
<td>0.955</td>
</tr>
<tr>
<td>(Div 2: Station 36-41)</td>
<td>0.853</td>
</tr>
<tr>
<td>(Div 3: Station 41-46)</td>
<td>0.680</td>
</tr>
<tr>
<td>(Div 4: Station 46-51)</td>
<td>&lt;0.56</td>
</tr>
</tbody>
</table>

**GENERAL**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stern Pump Flow, Q_{STERN}</td>
<td>100.00</td>
<td>CFS</td>
</tr>
<tr>
<td>Leveling Pump Flow, Q_{LEV}</td>
<td>14.00</td>
<td>CFS</td>
</tr>
<tr>
<td>Constrictor Plate Opening Setting, h_{CP}</td>
<td>1.67</td>
<td>ft</td>
</tr>
</tbody>
</table>

**ANALYSIS CONTROL BOX**

| Initial WS EL. Guess | 8.25 | ft |

**POROSITY ADJUSTMENTS**

<table>
<thead>
<tr>
<th>K</th>
<th>Initial Value</th>
<th>Adjusted Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>K1</td>
<td>(Div 1: Station 31-36)</td>
<td>110</td>
</tr>
<tr>
<td>K2</td>
<td>(Div 2: Station 36-41)</td>
<td>150</td>
</tr>
<tr>
<td>K3</td>
<td>(Div 3: Station 41.0000)</td>
<td>215</td>
</tr>
<tr>
<td>K4</td>
<td>(Div 4: Station 46.0000)</td>
<td>313</td>
</tr>
</tbody>
</table>

**Control Point (CP) Location where Flows through Critical Selection**

<table>
<thead>
<tr>
<th>Analysis Types</th>
<th>Constriction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Constricted Throat Sections</td>
<td>1.150</td>
</tr>
<tr>
<td>Assigned depth upstream of CP</td>
<td>1.307</td>
</tr>
<tr>
<td>Assigned depth downstream of CP</td>
<td>1.100</td>
</tr>
</tbody>
</table>

**Notional Water Line (NWL)**

| Elev. (ft) | 9.44 |

**Diagram**

- NWL Elevation
- WS HC Section 4
- WS HC Section 3
- WS HC Section 2
- WSThroat
- WS HC Section 1
- WSCOL

Datum
Anticipated Performance

Run – D3

**GENERAL**
- Parameter: Stern Pump Flow, $Q_{STERN}$
  - Value: 100.00
  - Unit: CFS
- Parameter: Leveling Pump Flow, $Q_{LEV}$
  - Value: 24.00
  - Unit: CFS
- Parameter: Constrictor Plate Opening Setting
  - Value: 1.67
  - Unit: ft

**ANALYSIS CONTROL BOX**
- Initial WS El. Guess: 8.25 ft

**POROSITY ADJUSTMENTS**
- K1 (Div 1: Station 31-36)
  - Value: 110
  - Unit: non-dim
- K2 (Div 2: Station 36-41.00)
  - Value: 150
  - Unit: non-dim
- K3 (Div 3: Station 41.0000)
  - Value: 215
  - Unit: non-dim
- K4 (Div 4: Station 46.0000)
  - Value: 313
  - Unit: non-dim

- Flow Convergence: -0.0185
- WS Convergence: -0.008

**Control Point (CP) Location where Flows through Critical Selection**
- Analysis Types: Constriction
- Analysis Types: Throat Inlet

**Critical Depth**
- At end of the Constrictor Plates: 1.297
- Non-Constricted Throat Sections: 1.150
- Assigned depth upstream of CP: 1.307
- Assigned depth downstream of CP: 1.090

**Notional Water Line (NWL)**
- Elev. (ft): 9.44

**Graph Details**
- Average Velocity - Collector and HC (ft/s)
- Average HC Velocity (ft/s)
- Average Throat Velocity (ft/s)
- Screen Approach Vel
- Acceleration of Flow (ft/s²)
- Station (ft): 21.00 to 51.00
Project Timeline

• Design Completed October 2012
• Fabrication currently underway
• Commissioning last quarter in 2013
Conclusions

- Intended design life 10 to 15 years
- Use of “off-the-shelf” components
- Accommodate large pool fluctuations and various reservoir depths
- Shore power with provisions for future stand-alone power source
- Deployable and portable
- Transportable to other reservoirs
- Economical
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