Emergency Pumping Plant Fish Protection Screens at California's Red Bluff Diversion Dam

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Outline

- Background of RBDD
- Emergency Pumping Plant and Fish Screen Design
- Construction Challenges
- Performance Testing
- RBDD Removal in 2014
- Lessons Learned
Original Red Bluff Diversion Dam’s Purpose:

- Gravity divert water into the Tehama-Colusa and Corning Canals (140 miles total length);
- Irrigate 150,000 acres (producing $250 million of crops annually)
- Provide adult fish passage around facility while gates are in place;
- Prevent fish entrainment of downstream migrating juvenile fish with canal fish screen
History of RBDD Operations

- 1964 Red Bluff Diversion Dam built; gates in year-round
- 1986: Annual period of dam operations reduced
- 1994: Annual operations limited to May 15 to Sept. 15; Sacramento River winter-run Chinook salmon listed as endangered
- 1995: U.S. Bureau of Reclamation builds research pumping plant to test fish-protecting technology
- 1998: Sacramento River winter-run steelhead listed as threatened
- 2002: Draft environmental documents on pumping-plant alternative to dam released
- 2006: Green sturgeon listed as threatened in Sacramento River; bureau releases revised environmental documents improving fish passage and irrigation water supply
- 2008: Dam operations come under jurisdiction of federal court; final environmental documents released; pumping plant alternative selected;
- 2009: Red Bluff lawsuit settled; dam operations shortened to June 15 to Aug. 31; first construction contract awarded for New Intake and Emergency Pumping Plant
- 2012: Gates out on June 1 for good!
- 2014: All original RBDD Facilities removed or decommissioned
RBDD Passage Issues

- **Adult Fish**
  - Poor fish ladder performance - poor attraction flows, delays, etc.
  - Ladders not designed for sturgeon or other native fish species

- **Juvenile Fish**
  - Delayed passage through lake and under gates
  - Pedation and injury below gate area
  - Fish screen bypass issues – concentration of fish
Red Bluff Diversion Dam Facilities

- New On-River Flat Plate Screen and PP (2500 cfs)
- Canal Drum Screens (2500 cfs)
- Original Louver Screen Facility (2500 cfs)
- Emergency PP (500 cfs Cone Screens)
- Temporary Fish Ladder PP (135 cfs Flat Plate Screen)
- Research PP (385 cfs Hidrostal, Archimedes and screen bypass)
- Gravity Canal Intake Area
Emergency Pumping Plant and Fish Screen Challenges

- Aggressive schedule required to meet TCCA deliveries
  - Design, Fabricate, and Construct from Jan-Mar 2009
- 500 cfs capacity needed to supplement RPP and IPP
- 1500 square feet of screen area needed for fish protection
  - Only 3 feet water depth available
  - Less than 150 feet of waterfront available
  - Backwater area (mostly)
- Pumps must operate with 15+ ft. of river fluctuation
- Design must not undermine existing facilities or operations
- Facility must be removed at end of operations
Screen and Pump here...

Release into TC canal here...
Ten 50 cfs Pumps; Ten 14-ft Cone Screens
Tehema-Colusa Canal Authority’s 500 cfs Emergency Pumping Plant
ISI Cone Screen Design Features

- Large Screen Area for Small Footprint
- Can Operate in Very Shallow Water
- Self-Cleaning Brush System
- Strong and Durable Wedgewire and Frame
- Generally used in Tidal or Backwater Intakes
Typical Application Examples
Hydraulic Power Unit and Controls

(NOTE: HPU uses Environmental Friendly Fluids)
Construction Begins – March 2009
Pile driving sound pressure level monitoring conducted to assess impacts
Facility Operational April 1, 2009
(3 months after NTP)
Operational Conditions and Challenges
Sweeping Velocity up to 10 fps at Upstream Screen...
...and near Zero fps at Downstream Screens...

Gravel accumulation after 2 years at base of downstream screens due to poor sweeping flows
Brush arms were additionally weighted and prevented from lifting from velocity and gravel buildup...
Velocity Measurements and Video Monitoring Study by NMFS, USFWS, and DFG
Poor Velocity Distribution in Upstream Screen Units
Approach Velocity Detail of Upstream Two Units
Lesson - Alternative Baffle Testing
Conducted by USBR in 2010

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ISI Cone Screen Performance in a Riverine Environment

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Internal Screen Flow Baffle and Divider Plates
Separate Flow and Prevent Flow-Through
Internal “Pie” baffle prevented flow through and improved velocity distribution
New Facility Operational June 2012 – Emergency PP no longer needed
Questions?

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