

Fish Entrainment and Impingement

August 23, 2006

1:00 pm

Participants:

Tim Banta – DTA

Matt McKinney – DTA

Bill Kittrell – Virginia Department of Game and Inland Fisheries

John Copeland – Virginia Dept. of Game and Inland Fisheries

Matthew Chan – Normandeau Associates

Frank Simms – American Electric Power

John Smith – FERC (conference call)

Teresa Rogers – American Electric Power

Study plan objectives were reviewed from the July 19th Stakeholder Meeting.

Proposed fish species of interest were reviewed:

Largemouth bass, spotted bass, smallmouth bass, striped bass, white bass, hybrid striped bass, walleye, gizzard shad, alewife.

Trends in the SE: Study by Steve Laymen

Small and/or young of year fish comprise majority

YOY more susceptible than larger fish to being transported downstream and less capable of escaping intake velocity

Fish sizes of <6 and <4 inches represented over 75% of estimates at 33 and 24 hydro sites, respectively

Intake screen – 4 inch spacing. Debris accumulation at intake is minimal.

Prominent species for entrained: sunfish, perch, catfish, minnows, and shad. Shad entrainment abundance over 80% at five hydro sites. Temperate bass reported to have low entrainment potential, from 0.33% to 3.9% at 3 sites.

Comment: Some fish passage has occurred through the dam. Not sure if through spillway gates or units.

Possible reasons for entrainment were reviewed.

As an example of possible database availability you have the Catawba – Wateree River Basin and the Yadkin Pee Dee River Basin in North Carolina where there are 19 hydroelectric plants in various stages of Relicensing. These projects are less than 2.5 hours from Claytor Hydro. They may not offer similarity and are only referenced to indicate potential database.

Reviewed physical hydro plant factors influencing entrainment.

A cross section and front view of the typical Claytor Hydro intake was shown. There are two intake bays per unit. The centerline of the intake is about 45' deep below the water surface elevation of 1846'. The bottom of the intake is approximately 68 feet below the water surface. The trash racks are located behind the face of the intake.

Mechanisms that contribute to fish injury / mortality: turbine components strikes, water column pressure changes, turbine cavitation, water column turbulence, water induced shear stress.

Factors influencing survival during turbine passage:

Turbine type, inlet clearance and speed, operating head, number of runner blades, turbine discharge, and turbine velocity.

The Claytor Hydro units are typically operated at their most efficient point (MEP). The unit discharge is approximately 2000 cfs (80% of maximum unit discharge). This corresponds to approximately 17 – 18 MW's.

The general layout of intake velocity transects were presented: two upstream transverse (parallel to face) transects and two longitudinal transects per unit. The longitudinal transects would be centered on the respective intake bays. Full surface to bottom velocity profiles using Acoustic Doppler would be required. The water depth at the intake section is approximately 124 feet.

The Acoustic Doppler device will pick up interference from the intake face. The distance from the intake face for the two transverse transects are roughly 35-50 feet for the first transect, while the second transect will be located approximately 50' – 100' from the face of the intake.

New velocity transect additions to study: Two transects through stratified portion of reservoir. Location to be determined.

Two recommended plant operations: maximum four unit hydraulic capacity (10,000 cfs) and auto cycle with one unit at MEP (2,000 cfs).

Opportunities for velocity measurements will be dependent on conditions in the field (project inflow). Can't absolutely guarantee that maximum four unit operations will be available.

Proposed schedule:

Kickoff meeting in January 2007. Studies – literature review, 1st – 2nd quarter, Velocity measurements: late 1st, early 2nd or late 3rd, 4th to accommodate four unit flow.

Question: Would velocity measurements differ throughout year?

Response: It shouldn't matter when the measurements are taken.

Comment: Seen heavy rains coming in and it seems there is a density current building up and being pulled through.

Response: From a hydraulic perspective there are two things that affect the velocity vector: the configuration of the reservoir (cross sectional area) and whatever the unit discharge (cfs - pull) is.

Comment: There may be two different scenarios going on in a stratified reservoir.

Response: Current flow information will be provided by sedimentation study.

Comment: In the appendices of John Kilpatrick's thesis, there is information on temperature data as it changes.

Response: Entrainment probability likely won't change by season because it is based primarily on intake velocity.

Comment: Losing striped bass from Claytor – not sure how they are getting through. Striped bass (from Claytor) have been caught in the Bluestone Reservoir downstream of the Claytor dam.

Response: Claytor has vertical spillway gates, drawing water from 28 feet below water surface at full pond. The hydro unit intake centerline is approximately 45 below the water surface.

Comment: Thermal range that fish key in on – in Kilpatrick’s thesis.

Question: Where is the key temperature area as it relates to the different velocities?

Response: The intake and reservoir velocities are independent of temperature. The velocity profiles will show lines of common velocities (isohyets) within the reservoir cross section.

Question: Does spilling and quick drawdowns in preparation of a hurricane in the summer have an impact?

Comment: Look at 2001 period around July to see if there is a correlation with plant operation / drawdown / spillway operations with the observed striped bass fish kill.

Comment: Bluegill and black crappie would be in the habitat – add Bluegill and black crappie to species of interest list. Look at adult and juvenile.

Comment: Don’t know much about larval abundance.

Comment: How do you subtract out the natural current from the velocity data?

Response: Time stamp the data collection and plant operations to discern between natural inflow current and unit operations. Plant operation is most likely the predominant factor over project inflow. Except after fall drawdowns when refilling the lake is a priority. The plant would only pass minimum flow, which historically would be less than the project inflow.

Comment: VDGIF has a literature review utilized for developing water supply intakes.

Velocity measurements will be independent of when the water quality data is collected. However, the locations of the reservoir velocity measurements and the water quality samples (DO, pH, temperature, conductivity, chlorophyll A) will be the same in the lower portion of the reservoir. Two possible reservoir locations will be immediately downstream of mouth at Dublin Hollow and at the boat barrier upstream of the plant intake – the exact locations may change based on discussions at the January 2007 meeting. The Entrainment/Impingement group will need to

GPS these transect locations so they can be replicated during the Water Quality study.

In summary we are proposing four inflow velocity transverse transect locations – velocity measurements will be taken for both operation scenarios (full plant load and one unit MEP auto cycle). Field work will likely take place in the late winter / early spring to take advantage of historical river flows.

Question: How are we going to get at the % entrainment in this reservoir? How do you make the leap from literature review to reservoir application?

Response: FERC staff has been looking at assessment of existing fish population.

Comment: Don't know what is going on with larval fish. Know some of the fish are showing up downstream.

Question: On netting studies – do they try to quantitatively try to assess how many fish are passed? Response: EPRI has data with ballpark estimates.

Comment: Larval fish are dependent on the flow – no swimming speed.

The literature and project similarity assessment provide information to determine probability as high, moderate and low entrainment based on characteristics of hydro plant and fish species. Survivability probability is based on turbine characteristics of the Claytor plant based on similarities with other project turbines.

Comment: Spillway gates (vertical gates) with spillway crest at 28 feet down. Hybrid striped bass may be at that water depth.

Meeting adjourned.