

## **Saluda Hydroelectric Project (FERC No. 516)**

### **Study Plan: Fish Entrainment Desktop Study Plan**

Fish Entrainment Technical Working Committee  
May 9, 2006

#### **I. Study Objective**

The study objective is to characterize and provide an order-of-magnitude estimate of entrainment using existing literature and site-specific information for the Saluda Hydro Dam.

#### **II. Introduction**

The Saluda Hydro project is a 202.6 MW licensed hydroelectric facility located in Lexington, Newberry, Richland, and Saluda Counties of South Carolina and is owned and operated by South Carolina Electric & Gas (Licensee). The project consists of Lake Murray, the Saluda Dam, the new back-up Saluda Berm, Spillway, powerhouse, intakes, and penstocks. The project is currently licensed by the Federal Energy Regulatory Commission (FERC No. 516) and the present license is due to expire in the year 2010.

The Licensee prepared and issued the Initial Consultation Document (ICD) on April 29, 2005, in order to initiate the relicensing process for the Project. The Licensee submitted the document to a number of state and federal resource agencies for their review and comment. As a result, the United States Fish and Wildlife Service (USFWS) and the South Carolina Department of Natural Resources (SCDNR) requested studies to determine the potential impact of Project operation on the fishery resource. The resource agencies recommended the Licensee assess potential fish entrainment effects on the fishery resource due to project operation.

In response to resource agency requests for studies in support of relicensing, SCE&G proposed to develop entrainment estimates from the extensive entrainment database that currently exists from recent project relicensing. Resource agencies concurred with SCE&G's proposal to determine potential fish entrainment effects through a desktop analysis (see Fish and Wildlife RCG meeting notes dated February 22, 2006).

#### **III. Methodology**

Fish entrainment at the Saluda Hydro project will be assessed through a desktop study. The goal of this study is to characterize and provide an order-of-magnitude estimate of entrainment using existing literature and site-specific information. The primary inputs for this analysis will be:

- 1) Develop an entrainment database that can be applied to the Saluda Hydro Project
- 2) Calculate and estimate fish entrainment rate(s) (seasonal if possible)
- 3) Characterize the species composition of fish entrainment
- 4) Apply any physical or biological filters that may affect entrainment
- 5) Estimate total annual entrainment for the Saluda Hydro Project

These inputs will be developed as described in the following sections.

### *Development of Entrainment Database*

Over seventy site-specific studies of resident fish entrainment at hydroelectric sites in the United States have been reported to date which provide order-of-magnitude estimates of annual fish entrainment (FERC, 1995). Descriptive information will be gathered from each entrainment study and will include:

- 1) Location: geographical proximity (preference given to same river basin)
- 2) Project size: discharge capacity and power production
- 3) Mode of operation - e.g., peaking, run-of-river etc.
- 4) Biological factors: fish species composition
- 5) Impoundment characteristics: general water quality, impoundment size, flow regime
- 6) Physical project characteristics: trash rack spacing, intake velocity, etc.

This information will be assembled into a “matrix” of data to be used as a database for the Saluda Hydro Project entrainment desktop study. After review, specific studies from this “matrix” that are most applicable to the Saluda Hydro Project will be selected for use of the entrainment database. Several key criteria to be used in acceptance of candidate studies will be:

- 1) Similar geographical location, with preference given to projects located on the same river basin
- 2) Similar station hydraulic capacity
- 3) Similar station operation (peaking, pulsing, run-of-river, etc.)
- 4) Biological similarities: fish species, assemblage and water quality
- 5) Availability of entrainment netting data

### *Fish Entrainment Rate*

The entrainment rate information from the accepted studies will be consolidated to show fish entrainment rates on a monthly basis (when available). Preference will be given to netting entrainment rates over hydroacoustic entrainment rates. The entrainment rates will be presented in fish entrained per hour of operation and fish per volume of water passed through project turbines (fish/million cubic feet). The data will be grouped by season, where appropriate, to determine an entrainment density for each season of the

year. The seasonal data from each entrainment study will be averaged to develop a seasonal mean entrainment estimate at the Saluda Hydro Project.

### Species Composition Analysis

Species composition data from the accepted entrainment studies will be analyzed and compiled to determine the general species and sizes of fish typically entrained at other hydroelectric projects. This information will be grouped to yield predicted seasonal estimates of species-specific data for entrained fish to determine:

1. A list of potentially entrained fish species
2. Expected relative abundance of each species identified as potentially entrained
3. Prediction of seasonality of potentially entrained fish species.

### Estimation of Annual Fish Entrainment

Total fish entrainment for the Saluda Hydro Project will be estimated on an annual basis to provide an order-of-magnitude entrainment estimate. The total fish entrainment estimate will be produced for a typical water and operating year.

### Turbine Mortality

As fish move through hydroelectric turbines, a percentage are killed due to turbine mortality (i.e. blade strikes, shear forces, and pressure changes, etc.). Turbine passage survival studies have been performed at numerous hydroelectric projects throughout the country. Characteristics of these projects will be compared to the characteristics of the Saluda Hydro Project and suitable studies will be selected for the transfer of turbine mortality data for each development. Selected turbine survival rate data will be obtained from the literature and used to estimate the number of fish killed due to turbine mortality. The following turbine characteristics are recommended as general criteria in accepting turbine mortality studies for use in this analysis:

- 1) design type
- 2) operating head
- 3) runner speed
- 4) diameter, and peripheral runner velocity

These characteristics are commonly attributed to turbine passage mortality (Cramer and Oligher, 1963; Bell, 1991; Eicher, 1987; EPRI, 1992).

To the extent possible, turbine mortality rate data available from source studies will be related to the species-family group of fish estimated to be entrained at the Lake Murray Project. Where multiple tests are available for a given species-family group class, a mean survival rate will be computed. For species-family group where no applicable data can be found or accepted, the survival rate reported for a similar group will be substituted.

Once turbine mortality rates are developed from the study database, the rates will be applied to the entrainment estimates for the Saluda Hydro Project. This will be accomplished by multiplying fish entrainment estimates by the composite mortality rates for each family/genus group (where applicable).

#### Entrainment Filters

Due to certain site-specific characteristics of Lake Murray, it may be necessary to adjust entrainment estimates. Factors affecting entrainment rates that may warrant investigation for adjustment of estimates include:

- 1) stratification at the intakes (dissolved oxygen);
- 2) intake velocities;
- 3) fish habitat available at the intakes, and/or
- 4) other site specific factors.

#### **IV. Schedule and Required Conditions**

In an attempt to reach consensus during the entrainment desktop study, each step of the process will be discussed with TWC members. Comments from the TWC will be addressed during each phase of the analysis. Upon completion of the study, a draft report will be prepared and distributed to state and federal resource agencies for review and comment. The Draft report will summarize the results obtained in the study; will contain appropriate tables and figures depicting estimated fish entrainment; and will contain all supporting correspondence among the TWC members. After receipt of all comments, the draft report will be revised to address final comments by all TWC members and will be resubmitted as the Final Report.

#### **V. Use of Study Results**

Study results will be used as an information resource during discussion of relicensing issues with the SCDNR, USFWS, Fish Entrainment TWC, and other relicensing stakeholders.

## VI. Study Participants

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