ALABAMA POWER COMPANY

BIRMINGHAM, ALABAMA

MARTIN HYDROELECTRIC PROJECT

FERC NO. 349

STUDY PLAN 12 (A) – RULE CURVE CHANGE MODELING ANALYSIS

NOVEMBER 2008

Prepared by:

ALABAMA POWER
A SOUTHERN COMPANY

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MODELING ANALYSIS

TABLE OF CONTENTS

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1.0 GOALS AND OBJECTIVES OF STUDY

Many stakeholder groups have requested that Alabama Power Company (APC) investigate the feasibility of raising the winter rule curve at Martin. APC's goal of this study would be to determine the feasibility of revising the Martin rule curve and operating guidelines by modeling changes involving an increase in winter pool elevation in increments of 1 foot from el. 481 ft msl[1] to el. 486 ft msl (i.e., el. 482, 483, 484, 485, and 486 ft msl) as well as to examine the effects of maintaining the summer pool longer in the fall (October) and beginning the refilling of Lake Martin earlier (January 15 to reach full pool by April 1). APC will also conduct a review of the current drought contingency curve. This study will also evaluate impacts to flood control, navigation, minimum flows, and generation.

2.0 RELEVANT RESOURCE MANAGEMENT GOALS

The rule curve analysis will assist APC in making a proposal for the Pre-Application Document (PAD) and Preliminary Licensing Proposal for FERC's analysis in determining new license conditions for the Martin Project, including an appropriate winter pool level, considering the competing interests in the operation of the Martin project. APC will work with agencies and other stakeholders to ensure that resource management goals for individual resource areas are taken into account and any applicable environmental, cultural, or recreational relicensing studies take into account examining effects of any proposed rule curve change.

3.0 BACKGROUND AND EXISTING INFORMATION

APC has existing tools it is using to develop the appropriate flood control, routing and budget models for Martin to determine the feasibility of raising the winter rule curve. These tools include the Corps of Engineers HEC-RAS and Flood Frequency Analysis (FFA) models, HEC-ResSim, the ACT unimpaired flow data set developed by the Corps and others, APC's Project Routing model, APC's spreadsheet model to determine flow duration, and APC's HydroBudget model.

4.0 PROJECT NEXUS

The Project is licensed by FERC and all proposed operational changes (winter elevation and duration of summer pool) must be disclosed and affects addressed in the license application to FERC.

[1] Elevation 481 ft msl is equivalent to el. 480 Martin Datum (MD).

5.0 STUDY AREA AND STUDY SITES

The study area includes all of the waters located within the Martin Project boundary and the tailrace of the Project. It also includes looking at effects on inflows to APC's downstream Yates and Thurlow Project, and resulting cumulative effects of flows downstream of the Thurlow Project in the Tallapoosa River. The existing operations at the upstream Harris Project will also be included in the model to identify and quantify any potential impacts to Harris as a result of changes at Martin.

6.0 PROPOSED METHODOLOGY

The proposed methodology will address both the process and the tools to develop and implement the model(s) for the proposed rule curve change analysis. Specific methods and tools are outlined in Attachment A.

7.0 CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

1) Prior to developing and running the model, APC will present the proposed methodology to an independent expert for review and comment. The independent review may result in modifications to the proposed methodology.

2) Once APC has the model(s) completed according to the methods described in Attachment A, APC will obtain an independent expert to evaluate the model, assumptions and its ability to answer the study questions and perform according to the methods outlined in Attachment A. The independent review may result in modifications to the model(s).

3) The model(s) assumptions will be presented to the stakeholders following independent review.

4) A similar type of analysis was performed by APC in the 1999 Neely Henry study to raise the winter pool levels, and was accepted by the Corps of Engineers and FERC.

8.0 PRODUCTS

Data and documentation of the analyses will be presented in a single table, using a matrix format to facilitate review by the MIG 3. Final analyses will be presented in the Preliminary Licensing Proposal.

9.0 SCHEDULE

This schedule is draft and APC intends to develop a formal schedule with MIG 3 members upon Final FERC approval of the study.

Prepare Methodology and Conduct Independent expert review.October – November 2008
APC submits Final Study Plan for FERC Approval.....November 2008
Model Development and Independent Expert Review .....December 08 – April 2009
FERC Study Plan Approval..... May 2009
Conduct Model Analysis.....May 2009 – December 2009
Present Results.....December 2009
MIG 3 Consultation .....April 2009 – December 2010
Present proposal and analysis in PLP .....January 2010

10.0 LEVEL OF EFFORT AND COST

APC estimates that consultation with the MIG 3 and development of models and analysis on the potential rule curve change at Lake Martin will cost approximately $500,000.

11.0 REFERENCES

ATTACHMENT A
MODEL METHODOLOGY

PROPOSED HYDROLOGIC ANDN HYDRAULIC STUDY METHODOLOGY

Background

In addition to storage for low cost renewable energy, the Martin Project storage supports public water supply, releases for downstream water supply, navigation, and environmental needs, as well as significant recreational benefits to the Alabama community. Also, the Martin Project provides some seasonal flood control, especially when the reservoir is in a draw down condition. In the early years of the Project, storage in Lake Martin was strictly used to generate electrical energy. This operational procedure incorporated a significant seasonal drawdown or lowering of the pool. Through the years, economic development around the reservoir has grown significantly. The Federal Energy Regulatory Commission must give equal consideration to hydro generation and other project purposes such as environmental, recreation and land use, flood control, navigation, etc. when making licensing decisions.

Sometimes these various project purposes conflict. Some downstream interests focus on flood control benefits that could be achieved through lower lake levels in the reservoir that could allow the Martin Project to reduce the peak flows during major flood events. Other downstream interests, such as downstream water supply and industrial concerns, prefer higher lake levels to provide storage to support downstream flows. Lake recreational interests prefer higher lake levels for more of the year, and minimal support of downstream flow needs. Hydro generation requires maximum flexibility in the operation of the Project, both storing and releasing water to support this purpose. Lakeside interests focus on pool level fluctuations and the impacts on recreation and associated economic effects on the Lake area

The Federal Emergency Management Agency (FEMA) flood protection and insurance criteria are based on floods with a 1 percent return period (100 year); however, flood reduction benefits are also realized for higher frequency floods (such as 5, 10, 25 and 50 year return periods). Once FEMA defines the flood levels in a stream, developments and insurance coverage are directly associated to the flood levels.

Reservoir operational procedures are based on meeting the project purposes, maintaining a safe project and maximizing the benefits of the project. Lake Martin is currently operated to maintain a summer pool not exceeding elevation 491 ft msl[2] and a winter pool near 481 ft msl. The pool is lowered during the fall months of the year (September through December). This is generally accomplished through generation; thus, optimizing project benefits. During the high flow or wet season of the year, February through April, the reservoir captures flood waters and raises the reservoir level to the summer pool elevation. To the extent the project is below full pool elevation, some flood control is provided for the downstream portion of the Tallapoosa River.

[2] 491 msl equals 490 MD.

Concerns and Issues

The following issues or concerns will require evaluations of hydrologic and hydraulic impacts:

Concern #1*:* Lakeside stakeholders have expressed interest in maintaining a higher Martin winter pool. Current winter pool is elevation 481 ft msl.

Issues:

- This proposed change would reduce the useable storage in the Martin Reservoir, which could result in higher peak flow releases from Martin Dam during floods; thus, increasing flood levels downstream for certain high flow events.
- Any changes in maximum pool elevation in the Martin Reservoir must not induce damages upstream.

Concern #2: Lakeside stakeholders have expressed interest in maintaining the Martin summer pool level later into the fall season.

Issues:

- Maintaining a higher pool level during the dry season could reduce flow releases, which may result in increasing the frequency of not meeting downstream minimum flow targets, to the possible detriment of downstream municipal and industrial water supply, water quality, and navigation interests.
- Higher pool levels later into the fall season would reduce the period of time available to bring the Martin Reservoir level down to the winter pool, which could require unscheduled releases outside of the power generation needs, and would reduce the amount of storage available during tropical storm rainfall events.

Concern #3*:* Lakeside stakeholders have expressed interest in bringing the Martin pool level up to summer pool earlier in the year.

Issues:

- Currently, the Martin pool is allowed to rise to the summer pool of 491 ft. msl from mid-February through mid-April. Spring floods occur during this period and the Martin reservoir provides storage that helps reduce the peak flow releases during the flood events. A decrease in useable storage could result in higher releases during flood events, and no storage for large rainfall events after the reservoir is filled to full summer pool.
- The U. S. Army Corps of Engineers (USACE) has indicated that evaluation of proposed changes must be compared to existing conditions. They have implied that this means that evaluation of the downstream impacts to flooding must compare releases from a flood event with a higher winter pool to releases with the existing winter pool level. This effectively requires a seasonal comparison.

- Any changes in maximum pool elevation in the Martin Reservoir must not induce damages upstream.

Concern #4: Stakeholders associated with the Harris Project (Lake Wedowee), which is located upstream of Martin, have expressed concerns that changes to the operational procedures at Martin may impact their ability to request changes to operational procedures at Harris at some future time.

Technical Parameters, Processes and Tools

The evaluation process will employ the following parameter and tools.

- Downstream impacts to flooding will be evaluated by comparing current operating procedures to proposed alternatives for a 100 year flood at the Martin Dam. The USACE software package HEC-RAS will be used in the unsteady mode to simulate the movement of each hydrograph from Martin Dam combined with downstream intervening flows to the Jones Bluff Lock & Dam on the Alabama River. Existing topographic data will be used to code the model. This will include channel and floodplain cross-sections, LIDAR survey data and USGS topographic quadsheets.
- Standard hydrologic methods for deriving the 100 year flood apply to unregulated streams but the Tallapoosa River has been regulated during the entire period of hydrologic record. Normally, special hydrologic methods would be required to filter out the influence of the regulation; however, the Mobile District of USACE has developed a database for daily unregulated flows on the Tallapoosa River. This database will provide input to the USACE Flood Frequency Analysis (FFA) software package to determine the statistical frequency of historical flood events on the Tallapoosa River. The FFA program will only provide peak flow and volume information; therefore, representative hydrographs (such as the Feb. 1990 flood) will be scaled to represent the peak flow and volume from the FFA analysis. Scaling an historical event will also include realistic consideration of the peak timing and representative shape of the 100 year event.
- APC will analyze and present a probability analysis of the 100 year flood on a seasonal and monthly basis to FERC. The USACE FFA or updated version HEC-SSP will be used to develop this dataset.
- An unregulated 100 year inflow hydrograph to the Martin Reservoir can be derived by scaling a large flood to meet the FFA analysis but such a hydrograph will not reflect the regulation provided by the upstream structure, Harris Dam. To evaluate the influence of Harris regulation, a HEC-RAS model that represents the reach of river from the toe of the Harris Dam to the Martin Dam will be developed. To define the topographic data in the HEC-RAS model, APC intends to use:

    1. channel cross-sections from Harris Dam to Wadley;
    2. USGS quadsheets;
    3. a river channel thalweg survey from river gages Wadley to Horseshoe Bend; and

4. Martin Reservoir storage-elevation tables and sediment ranges in the Martin Reservoir.

- Outflow hydrographs or releases from the Harris Dam will be combined with intervening flows to generate an inflow hydrograph to Lake Martin that reflects regulation from the Harris Project.
- HEC-RAS models do not have the ability to incorporate detailed operational procedures at a Dam; therefore, APC has developed Project Routing Models in Microsoft Excel spreadsheets for Martin and Harris Dams to route floods through the dams and determine the resulting outflow hydrographs and reservoir elevation history for a flood event. These models incorporate the outflow capacity and reservoir storage with the rule curve and operational criteria. An iterative procedure with the respective HEC-RAS model(s) will be required to converge on the appropriate outflow hydrograph.
- In order to evaluate impacts of extending the summer pool into the fall on downstream navigation and environmental flows, flow duration relationships for selected sites will be generated using standard hydrologic methods. These relationships will only reflect current flood control operating procedures; however, some additional analysis or modeling with the HEC-RAS, HEC-ResSim and the APC Project Routing models may be required to identify the impacts of suggested flood control operational changes. The HEC-ResSim (Reservoir Simulation Model) will be employed to simulate the operation of the Martin Dam for a typical normal flow and low flow events. Simulations with the proposed rule curve changes will be compared to current operating rules.
- As noted before, any change in flood control operational procedures at Martin Dam has the potential to impact power generation and capacity values of the Martin Project. APC will utilize its in-house software economic package, *HydroBudget,* to evaluate net economic losses that would result from the proposed operational changes.

Coordination and Evaluation

Through consultation with the Martin relicensing stakeholders, APC has developed a list of rule curve changes to model including the following:

1. Model a rise in elevation of the winter rule curve in one foot increments from el. 481 ft msl up to and including el. 486 msl (el. 480 to 485 MD).
2. Analyze an extension of the summer pool level (491 msl) to remain in effect until October 1 or 15.
3. Analyze an earlier filling of Lake Martin in the winter to begin on January 15 to reach full summer pool level (491 msl) by April 1 of each calendar year.

- Downstream impacts, with respect to flooding, will be evaluated by comparing 100 year flood peak elevations generated by the downstream HEC-RAS model for each suggested change in operational criteria at Martin to the 100 year flood peak elevations for the existing procedures. A probability analysis (seasonal or monthly comparisons) may also be incorporated in the analysis. The Project Routing Model for Martin will be used to generate the outflow hydrographs for each suggested change in operational criteria at Martin. Actions to mitigate the impacts will be identified and evaluated for feasibility (operational, economic, etc).
- Effects of flood events upstream of Martin Dam for each alternative will be identified by comparing peak elevation profiles, generated by the Harris-Martin HEC-RAS model, to existing conditions.
- Flow duration tables, along with the Project Routing Model, will be used to analyze the summer pool extension alternative of the rule curve at Martin Dam. Historical low flow periods, such as the 2007 drought and a normal flow year, will be evaluated using HEC-ResSim and operational spreadsheets to determine if downstream low flow releases can be met with an extended summer pool. Additionally, the existing drought contingency curve for Lake Martin will be reviewed with special emphasis on the 2007 drought.
- Seasonal frequency relationships, the HEC-RAS model and the Project Routing Model will be used to evaluate the feasibility of the Lake Martin to rise to the summer elevation earlier than the existing rule curve schedule.
- Total cost associated with the proposed rule curve changes (including seasonal fill and lower schedule) will be documented and presented. The HydroBudget analysis will provide losses associated with power generation and power capacity with the respective operational procedural changes. Mitigation costs will be based on actions required to mitigate associated with proposed rule curve changes.
- Finally, all analyses, procedures, modeling and coordination will be properly documented and discussed with the Martin Issue Action Group (MIG) 3. MIG 3 members will be provided documentation of the analysis for review throughout the study process.