ALABAMA POWER COMPANY

BIRMINGHAM, ALABAMA

MARTIN HYDROELECTRIC PROJECT

FERC NO. 349

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

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

1.0 GOALS AND OBJECTIVES OF STUDY

Many stakeholder groups have requested that Alabama Power Company (APC) investigate the feasibility of modifying the 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). This study will also evaluate impacts to flood control, navigation, minimum flows, and generation.

This study plan establishes the methodologies that will be employed to development simulation models for the purpose of addressing the proposed changes to the rule curve. Simulation models will provide the tools to identify impacts and compare alternative rule curve operations with the existing rule curve operations. These models will focus on the impacts to the Martin pool and areas downstream of Martin Dam.

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, 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

Alabama Power has identified Martin Project operation-related effects downstream to the USGS river gauge at Montgomery Water Works located on the Tallapoosa River at RM 12.9. The proposed geographic scope for this study would include the Tallapoosa River from the Project to the Montgomery Water Works river gauge. Alabama Power has selected the Montgomery Water Works location for three primary reasons. Having a geographic scope that includes 30+ miles below the Project will account for the principal effects of Martin's operations downstream. Also, the Montgomery Water works location has 18+ years of gage data that would be available for use in depicting elevations and Martin Project related effects on that gage. Finally, keeping the geographic scope limited to the Montgomery Water Works, compared to expanding the scope to the confluence of the Coosa and Tallapoosa Rivers, would minimize the hydrologic complexity of the Coosa and Alabama Rivers operations and intervening flows. Keeping the geographic scope to the Montgomery Water Works would focus on the effects of the Martin Project operations, including low, normal and high flow operations.

The existing operations at the upstream Harris Project will also be included in the model to identify and quantify any potential impacts to the existing project operations at 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 the stakeholder group and appropriate State and Federal agencies for review and comment. The 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 present to the stakeholder group and appropriate State and Federal agencies the initial model results, models, assumptions and their ability to answer the study questions and perform according to the methods outlined in Attachment A. The review may result in additional simulations or refinement of the alternatives.

3) 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.

4) Initial screening of alternative's ability to manage significant flood events will be accomplished by subjecting each alternative to a representative flood with a 1% recurrence probability. These models will utilize small time steps, such as hourly,

Navigation, minimum flows and generation will be evaluated using long term models with daily time steps. Once an acceptable alternative has been identified, then some further simulation may be necessary to identify impacts for the full range of possible flood events.

5) Upon completing the model runs, Alabama Power will provide the results for MIG3 review and discussion.

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 corresponds to Alabama Power's Process Plan and Schedule filed with FERC on February 16, 2009. Actual consultation meeting dates will be determined with MIG 3 members upon FERC approval of the study plan.

Prepare Methodology	October – November 2008
Model Development	December 08 – April 2009
APC submits Final Study Plan for FERC Approval	March 2009
FERC Approval	April 2009
Conduct Model Analysis	May 2009 – December 2009
Initial Study Report	November 2009
Initial Study Report Meeting	December 2009
Present Results	December 2009
MIG 3 Consultation	February 2009 – December 2010
Draft Report	January 2010
Final Report	May 2010
FERC Updated Study Report	September 2010
Updated Study Report Meeting	September 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 AND HYDRAULIC STUDY

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 will reduce flow releases for power generation, thus resulting in lower flow durations downstream. However, minimum flow requirements at Thurlow will be met; and the ability to keep the pool elevation higher would depend on the inflow into the project during that extended period.
- 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 would 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.

Models and Datasets

APC plans to use the following data and models to conduct the analysis of the rule curve study at Martin:

1) ACT unimpaired flow database – this database was developed by the Army Corps of Engineers (COE) with input and data from other stakeholders in the ACT comprehensive study including both the states of Georgia, Alabama, Alabama Power Company and others. This dataset is average daily flows from 1939 – 2001 with regulation influences removed. It will be updated with flows thru 2006 during the spring of 2009. This dataset will be utilized in both the Flood Frequency Analysis as well as the evaluation of the extended summer pool.
2) Other data – Other data sources will include USGS, COE, and APC records.
3) HEC-Flood Frequency Analysis (HEC-FFA) – this model will be used to determine the statistical frequency of flooding on an annual basis. This study was completed in November 2005.
4) HEC-Statistical Software Package (HEC-SSP) – this model is the COE's newest version of the FFA. This model will be used to determine the statistical frequency of flooding on a monthly basis.
5) HEC-River Analysis System (HEC-RAS) – this model will be utilized in the flood study portion of evaluating the rule curve. It will route flows in the unsteady state along the river. There will be a model set up from Harris to Martin and one from Martin to Yates, Yates to Thurlow, and from Thurlow downstream to R.F. Henry Dam on the Alabama River.
6) HEC-Reservoir Simulation Model (HEC-ResSim) – this model will look at operational changes at Martin dam in conjunction with a rule curve change on a daily timestep. It will not be used to focus on the hourly flood study operations as it has not been converted to an hourly model at this time.
7) HEC-DSSVue – This is the COE's Data Storage System that is designed to efficiently store and retrieve scientific data that is typically sequential. Data in HEC-DSS database files can be graphed, tabulated, edited and manipulated with HEC-DSSVue. This program will be used to display some of the output of the other HEC models.
8) APC Project Routing Model – This model was developed by APC to determine the appropriate outflows from Martin dam given an inflow hydrograph. It is an excel spreadsheet that incorporates the physical properties of the dam to predict outflows during a flood event in an hourly time step.

9) APC Hydro Energy Model – This model is a proprietary model that will be used to evaluate the net economic gains or losses that could result from proposed rule curve changes at Martin dam.

Methodology

For the flood study portion of the analysis APC will utilize the COE's unimpaired flow data set in the HEC-FFA model to determine the statistical frequency of historical floods in the Tallapoosa basin. The historical storm closest to the 100 year frequency will then be increased or lowered to approximate the 100 year storm in peak flow and 1, 3 and 5 day volume. This storm will be routed using the Harris to Martin HEC-RAS unsteady state model. The inflow hydrograph will then be routed thru the Martin dam using the APC Project Routing model for both the baseline existing rule curve as well as each alternative. The resulting outflow hydrographs will then be routed downstream using the HEC-RAS model below Martin and impacts from resulting elevations will be evaluated. The attached flow chart entitled Martin Relicensing Flood Study Plan 12a describes this process.

For the analysis to study the extension of the summer pool rule curve elevation at Martin the COE's unimpaired flow data set will also be used. This dataset will be used in the HEC-ResSim model for both the current rule curve as well as the extended rule curve operation. The results that will be evaluated are the elevation of the Martin pool as well as the change to flow durations downstream. The minimum flow at Thurlow, as well as the navigation flow, will be incorporated. The attached flow chart entitled Martin Relicensing Summer Pool Extension Study Plan 12 a describes this process.

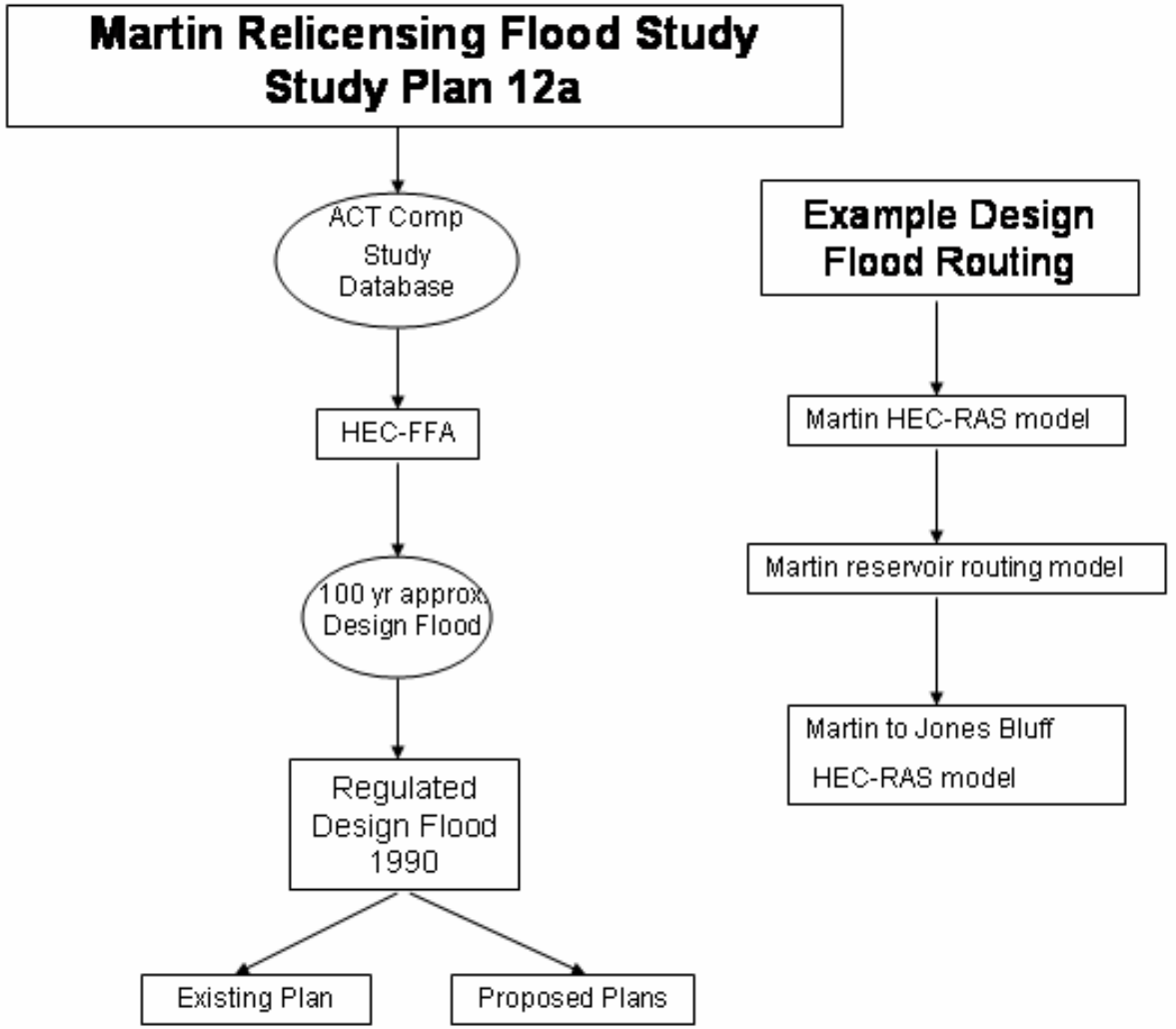
Coordination and Evaluation

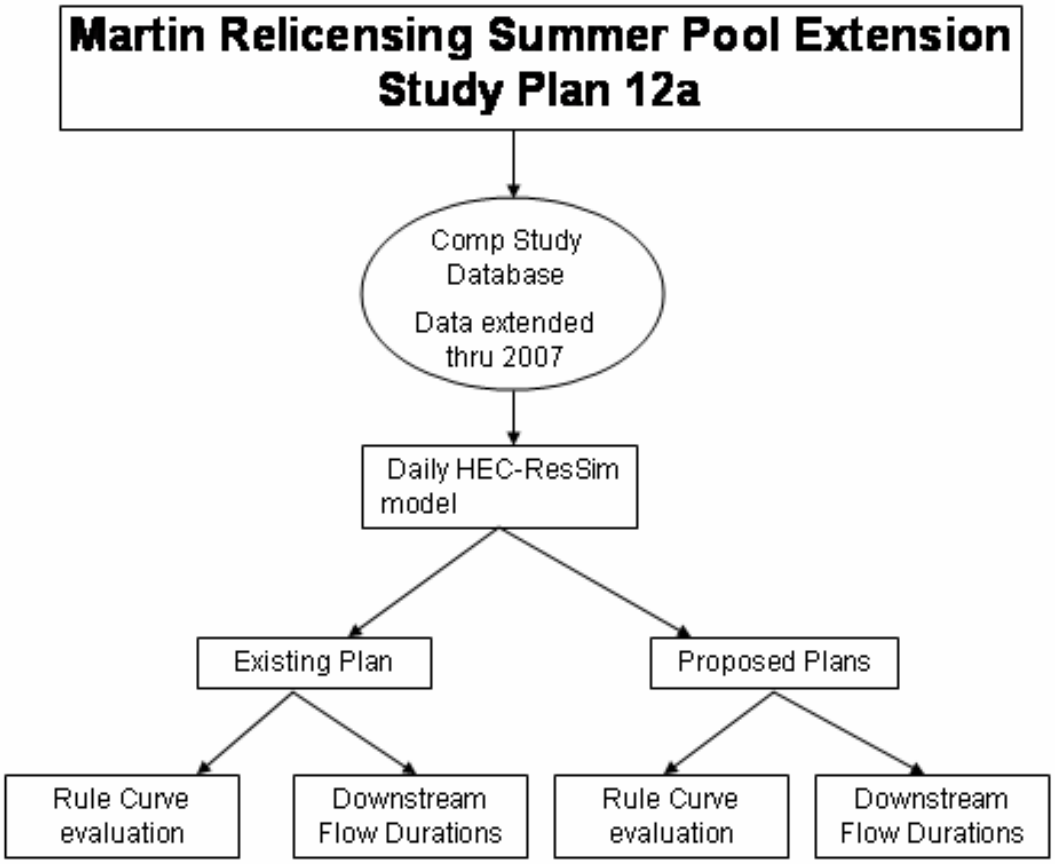
Through consultation with the Martin relicensing stakeholders, APC has developed a list of rule curve changes to model including the following:

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 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 developing an approximate 100 year Design Flood and comparing peak elevations generated by the downstream HEC-RAS model for each suggested change in rule curve at Martin to the peak elevations for the existing rule curve. A probability analysis (seasonal or monthly comparisons) will 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.
- A period of record analysis will be done using HEC-ResSim with special emphasis placed on low flow years to see how often the pool level can be maintained at a higher level under the summer pool extension alternative.
- 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 will be documented and presented. The Hydro Energy Model analysis will provide economic gains and/or losses associated with power generation with the respective operational procedural 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.


Martin Relicensing Flood Study
Study Plan 12a
ACT Comp Study Database
HEC-FFA
100 yr approx. Design Flood
Regulated Design Flood 1990
Existing Plan
Proposed Plans
Example Design Flood Routing
Martin HEC-RAS model
Martin reservoir routing model
Martin to Jones Bluff HEC-RAS model


Martin Relicensing Summer Pool Extension Study Plan 12a
Comp Study Database
Data extended thru 2007
Daily HEC-ResSim model
Existing Plan
Proposed Plans
Rule Curve evaluation
Downstream Flow Durations
Rule Curve evaluation
Downstream Flow Durations