Action name: Hydrologic Simulation Model**Prerequisite Actions:** None

Action Description:

Develop a record of simulated daily flows for the Tuckasegee and Nantahala Rivers at several selected drainage areas under a variety of operating scenarios.

Applicable Hydro Projects/Developments:

West Fork Project No. 2686 (Tuckasegee and Thorpe developments), East Fork Project No. 2698 (Cedar Cliff, Bear Creek, and Tennessee Creek/Wolf Creek developments), and Nantahala Project No. 2692

I. Objective

The objective of this study is to produce records of daily stream flows at drainage areas corresponding to those locations where instream flow studies of aquatic habitat and recreation will be conducted for bypassed and peaking reaches affected by projects in the Tuckasegee and Nantahala watersheds. For reaches that are affected by upstream hydropeaking operation, minimum and maximum discharges for each day will also be determined. The approach used to generate these flow records will be able to incorporate the following:

- Various releases for aquatic habitat and recreation.
- Lake level drawdown restrictions.
- Drought indices that adjust releases, generation, and lake drawdown in response to reduced inflows.
- Tributary inflow between the diversion dam(s) and site of interest.
- Modified peaking regime, for example: ramping rates, limits on maximum release, limits on consecutive days of peaking flows, and limits on number of peaking days per week, month or season.
- Interrelationships between the operation of multiple impoundments and generating facilities.

The simulation approach will be able to integrate various requirements for multiple locations into the overall water budget for the storage impoundments so that alternative operating scenarios can be evaluated for their effects on aquatic habitat, reservoir level and storage, power generation and revenues, and water available for recreational releases.

II. Basis

Since the East Fork and West Fork projects contain several developments that are hydraulically and operationally linked, it is very difficult to analyze the operational and economic impact of various operational alternatives. In addition, the Nantahala project contains several features (bypass, penstocks/tunnels, etc.) that make the operations of the powerhouse very complex. A dynamic reservoir operations model that takes into account complex and/or multi-development constraints such as drawdown limits, minimum flows, and turbine unit variable efficiency curves would accurately account for these variables simultaneously in a way that hand calculations and spreadsheets would not be able to.

III. Geographic and Temporal Scope

The study area will be the East Fork, West Fork multi-development projects on the Tuckasegee River and the Nantahala project on the Nantahala River. There will be one model for the East Fork and the West Fork projects together and one model for the Nantahala project. The period of analysis needs to be assessed as part of the model development and will be based on the period of historical generation data available.

IV. Approach and Analysis

This study will utilize the CHEOPS™ multi-development dynamic reservoir/hydropower operations model. The model for the East Fork/West Fork complex will have two inter-dependent branches, one for the East Fork and one for the West Fork and will operate to optimize operations for both forks simultaneously. The model input will include reservoir size and storage, generating characteristics such as efficiency verses head curves, travel times and channel routing where appropriate, operating constraints, and scenario options, such as minimum flows, bypass flows, and lake level restrictions. An additional feature for both the East Fork/West Fork and Nantahala models will be the addition of a model node located some distance downstream of the powerhouses. The purpose of the model node at this location will be to input various downstream constraints (minimum flows, variable flows, etc.) at a downstream point of interest that will dictate the reservoir responses to the constraint at that location. The powerhouse discharges will be channel routed to the model input node location using one of the channel routing models available.

The model, when completed, will be made available to all model participants via a CD. Duke Power will conduct any training required. Historical relative pricing information (non-proprietary) will be made available to all model participants so that all participants can see similar data input.

V. Schedules and Required Conditions

Data collection and model input will begin in spring, 2001 and model development targeted to be completed by January 31, 2002. The following is a more detailed tentative schedule that is subject to revisions as the modeling process progresses.

Process	Tentative Completion Date
Data Collection	May 11, 2001
Hydrology Input Data	June 30, 2001
Operations Description Manual	July 15, 2001
Channel Routing Modeling Input Completion (prelinimary)	August 31, 2001
Non-operating Model For Review (via CD)	October 31, 2001
Model Completion	January 31, 2002

There will be no specific operational or other preparatory conditions required for this study.

VI. Results

The results of this study will be the development and deployment of a simulation model that will be used to evaluate the effects of alternative reservoir operating scenarios on aquatic habitat, reservoir level and storage, power generation and revenues, and water available for recreational releases. The model can be used to quantify the impact of potential alternative operating scenarios on reservoir levels, power generation output, and downstream flows.

VII. Participants

	Organization	Name	Phone #	E-Mail
Duke Power Lead	Duke Power	Ed Bruce	704-382-5239	edbruce@ duke-energy.com
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Duke Power Supporting Consultant	DE&S	Ed Luttrell	704-382-4262	Ecluttre@ dukeengineering.com
Other Participants				

VIII. Expected Benefits

The models developed by this study will be a key component in the relicensing effort. They will be the analytical tools that tie the results of multiple studies together. Their output will allow alternative operating scenarios to be evaluated for their effects on multiple resource uses. The use of these models will be critical in evaluating impacts and trade-offs, and in negotiating license conditions.

IX. List of Attachments

N/A

X. List of References

N/A