MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
SALUDA HYDRO PROJECT RELICENSING
OPERATIONS TECHNICAL WORKING COMMITTEE

Saluda Hydro Training Center
August 23, 2006

Final brh 10-2-06

ATTENDEES:

Bob Olsen, NRE
Bret Hoffman, Kleinschmidt
Bud Badr, SCDNR
Jon Quebbeman, Kleinschmidt
Feleka Arega, SCDNR
Larry Turner, SC DHEC
Michael Waddell, TU
Mike Schimpff, Kleinschmidt
Ray Ammarell, SCE&G

ACTION ITEMS:

- Refine model inputs for inflows and evaporation; if necessary, consider longer period of input from Chappells gage.

Jon Quebbeman, Mike Schimpff

- Update members of improvements/changes to the model using hydrographs (via email).

Jon Quebbeman, Mike Schimpff

- Contact USGS for verification of data used in model during joint RCG meeting.

Ray Ammarell

- Check with SCE&G management about posting the model for downloading.

Ray Ammarell

DATE OF NEXT MEETING: **October 12, joint meeting with all RCG's**

MEETING NOTES:

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Mike S. opened the meeting and stated the objective was to review and finalize, or make recommendations to finalize, the base model structure. Using a projector, Jon and Mike displayed numerous screenshots from the HEC-ResSim program, explaining the various inputs and simulations of the model.

Input for Model

The watershed map was displayed, and gauged inputs for the model were pointed out. Jon and Mike then showed the un-gauged inputs and illustrated their respective basin areas on the map. These four un-gauged inputs were prorated from the Bush River gage. Mike noted that the rainfall directly onto the lake was part of one of these un-gauged inflows. Outflows are measured from a gage on the lower Saluda River near the tailrace; contributions from the Broad River are calculated by subtracting Saluda flows from those measured at the nearby Congaree River gage, which is just downstream of the confluence.

The reservoir stage – storage data was provided by SCE&G, and a reservoir guide curve was derived by averaging 16 years of observed lake level data (from 1990 to 2006). The hydrologic data for inflows corresponded with this 16-year period, chosen because it is the total combined period of record for all inflow gages used in the model. Reservoir evaporation was calculated using a formula incorporating average monthly temperatures. Bob mentioned the evaporation could be examined annually versus monthly. Ray explained that there are two possible calculation method for evaporation, pan and free-surface; he also presented the idea of using NOAA Atlas evaporation data. Mike and Jon agreed to revise evaporation from the reservoir.

The total 16-year period was used to check the accuracy of the model by two methods: 1) matching the outflow of the model to the observed outflows and comparing the calculated reservoir stage versus the actual recorded stage, and (2) matching the model's reservoir stage with the observed stage and comparing the calculated versus recorded outflows. Most years modeled extremely well for the stage matching, with the exception of two heavy inflow years. During those years, the reservoir elevation was calculated higher than actually occurred, even reaching El. 360'. This triggered the model to simulate flood control (opening spillway gates); in reality, the reservoir did not reach that elevation during those years; the spillway gates have not been operated since before Unit-5 was added (1971). Bob noted that the sudden increases during the heavy inflow years that triggered flood control did not readily return the reservoir to acceptable levels (below El. 360'). It

was realized that this is probably due to the flood control mode overriding the stage matching and switching the model to matching outflows. It was suggested that one of the more significant un-gauged inflows may need adjustment to account for direct lake precipitation, and Larry also proposed doing a volume comparison.

Discussion was held regarding the possibility of eliminating the Little River and Bush River gage contributions because they have a limiting period of available data for inflows. Using only the Chappells gage would allow inflow data dating back to 1965, when the gage was relocated. This would mean changing the Little River and Bush River watershed contributions to un-gauged inflows by following the Chappells rating. Mike and Jon will try to fine-tune the model with all current contributions (including Little River and Bush River gages) to better simulate the recorded stage conditions. If this does not work, the option of removing these two gages and just using the Chappells gage (capturing a longer period of inflow records) will be used. As they make adjustments and refine the model, Mike and Jon will email hydrographs showing comparative modifications to the TWC members. Bud suggested using a back-calculated method of known discharge and stage to determine the inflow hydrograph. This method is preferred as it eliminates uncertainty with respect to evaporation, local basin inflow, and inflow from direct precipitation onto the reservoir.

Lower Saluda River

For the lower Saluda River, 22 cross-sections were used to develop a 1D flow profile model using HEC-RAS. Jon showed graphs of several cross-sections, and noted that roughness coefficients are used for calibration of the model to several steady state calibration points. Cross-sections for the Congaree were also developed to route flows through and determine stages near the Congaree National Park. Flows were calibrated to the USGS curve at the gage near Columbia. The calculated flows from the model were very close to the recorded flows, with calculated flows being slightly higher at the upper end of the flow range and slightly below recorded flows at the lower end.

The question of flow contributions from tributaries on the lower Saluda River arose; the model does not individually address those flows because they are not related to operations. However, overall contributions from the watershed for the USGS gage near Columbia are included, and tributaries are part of that inflow. Since the model treats tributaries as part of the river's cross-section, the calculated velocities in reaches containing tributaries are drastically reduced; predictions in these reaches thus would not be representative of actual flow in the main river channel, and would affect calculated flow travel times. To eliminate these artificial velocity reductions, theoretical levees were placed across the mouths of tributaries entering the main river channel.

Constraints and Prioritization

Since the purpose of the model is to balance stakeholder interests with hydrologic and physical lake operation limitations, the question arose on how to prioritize constraints within the model. It was agreed that the TWC's purpose was to build an accurate model, and the stakeholders and RCG's would determine the prioritization of constraints. Ray noted that priorities will be alluded to in a low-flow protocol (drought contingency plan). In a typical (simple) low-flow situation, this protocol gives priority to municipal water supply, then environmental constraints (such as minimum flows), then other interests (generation, recreation, etc.). While Lake Murray provides some municipal water supply, this is not expected to be an issue because all supply intakes are below El. 345'. Ray reiterated SCE&G's interest is using Saluda for reserve capacity, then for reservoir management via a guide curve.

Another constraint discussed was the winter drawdown limitation; the purpose of the drawdown is to create reservoir storage for spring rains, and a higher winter reservoir elevation reduces this available storage. Inflows greater than the capacity of Saluda (~18,000 cfs) cause the reservoir to rise; once the lake reaches El. 360', spillway gates are opened in an attempt to match inflows and stabilize the reservoir level. Ray explained that SCE&G considers operating the spillway gates a failure to manage the reservoir as well as a waste of a resource. The Probable Maximum Flood (PMF) was also discussed, which Ray explained can be routed through Saluda without overtopping the dam; this requires that the reservoir is at or below the starting elevation for the PMF event. The FERC will require SCE&G to maintain the ability to route the PMF. The starting elevation for the PMF event, as well as the potential for reaching El. 360' (spillway operation threshold), will be determining factors in the model for the drawdown limitation.

Model Availability

The group held a discussion about whether or not the actual model would be available to stakeholders. The program is readily available for anyone to download from the Corps of Engineers website, and the watershed data can also be obtained online. Jon noted that the file size of the Saluda base model was thirty to forty megabytes, without the operating software. It was agreed that making the model available would not be of any harm, as it would likely only be used by the few people who understand the HEC software. Since SCE&G is paying for the services to develop the model, Ray will ask management for their approval prior to it being available for downloading. If the model data is made available, the one used for relicensing will not be open for changes other than RCG-submitted inputs; a statement to this affect will be posted on the website with the download link. The sole purpose of the TWC is to create the base model, which will not be open for change by outside interests.

Next Step

As the meeting closed, it was agreed that the base model structure was good, and Mike and Jon agreed to fine-tune inputs in attempts to more closely match calculated results with recorded conditions; their progress will be communicated to other TWC members via emails of hydrograph screenshots. The group agreed that the base model can be finalized without another TWC meeting, and considered it appropriate to present the model to all RCG's in a joint meeting.