Tennessee Valley Authority, Post Office Box 2000, Soddy-Daisy, Tennessee 37384-2000

January 26, 2007

TVA-SQN-TS-06-03 10 CFR 50.90

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555-0001

Gentlemen:

In the Matter of	)	Docket Nos. 50-327
Tennessee Valley Authority	)	50-328

SEQUOYAH NUCLEAR PLANT (SQN) - UNITS 1 AND 2 - RESPONSE TO REQUEST FOR ADDITIONAL INFORAMTION (RAI) FOR TECHNICAL SPECIFICATIONS (TS) CHANGE 06-03 (TAC NOS. MD2621 AND MD2622)

References:

1. TVA Letter to NRC dated, July, 12, 2006, "Sequoyah Nuclear Plant (SQN) - Units 1 and 2 - Technical Specifications (TS) Change 06-03 'Ultimate Heat Sink (UHS) Temperature Increase and Elevation Changes'"

2. TVA Letter to NRC dated, December 7, 2006, "Sequoyah Nuclear Plant (SQN) - Units 1 and 2 - Technical Specifications (TS) Change 06-03 'Ultimate Heat Sink (UHS) Temperature Increase and Elevation Changes Supplemental Information' (TAC Nos. MD2621 and MD2622)"

3. NRC letter to TVA dated November 22, 2006, "Sequoyah Nuclear Plant, Units 1 and 2 - Request for Additional Information Regarding Technical Specification Change Request for Ultimate Heat Sink Temperature (TAC Nos. MD2621 and MD 2622)"

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TVA submitted a request to change the UHS requirements for SQN's Unit 1 and 2 TSs by Reference 1. TVA supplemented this request with additional information in Reference 2. The purpose of this letter is to provide TVA's response to NRC's RAI letter provided in Reference 3. TVA's response to the RAI supports NRC's review of SQN TS Change 06-03.

The enclosure provides the TVA responses. In addition to the enclosure, information is being submitted on a compact disk with the following files:

File Name	**File Size (kb)**
chickamaugaseasonalplots.xls	352
cknkgt86.geo(geometry for Chickamauga-Nickajack-Guntersville)	95
Q14kHW675L400Z0.dat(SOCH dataset including B.C.s)	4
Q14kHW675L400Z0.out(SOCH output)	891
Q14kHW675L400Z0.prt(SOCH summary output)	12
SOCH1969 Technical Reference.pdf	614
Soch.for	232
SOCHDATA.DOC	41

TVA has discovered an error in the supplemental information provided in Reference 2. On page E1-2 in the paragraph at the top of the page, the sentence starting on the 10th line reads, "Significant changes in the policy as they impact SQN included extending summer reservoir levels on Chickamauga Reservoir until November 1 and adopting a tiered minimum flow regime from June through Labor Day at the Chickamauga Dam." Labor Day should be inserted in place of November 1 in this sentence and it should read, "Significant changes in the policy as they impact SQN included extending summer reservoir levels on Chickamauga Reservoir until Labor Day and adopting a tiered minimum flow regime from June through Labor Day at the Chickamauga Dam."

There are no commitments contained in this submittal.

If you have any questions about this change, please contact me at 843-7170.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 26th day of January, 2007.

Sincerely,

Glenn W. Morris

Glenn W. Morris
Manager, Site Licensing and
Industry Affairs

Enclosure:
Response to Request for Additional Information

Enclosure
cc (Enclosure w/o CD):

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ENCLOSURE

TENNESSEE VALLEY AUTHORITY (TVA)
SEQUOYAH NUCLEAR PLANT (SQN)
UNITS 1 AND 2

Response to Request for Additional Information

RAI Question 1:

"While the applicant assumed a Chickamauga earth dam breach width of 400 feet which is about 5 times dam height as suggested by the U.S. Bureau of Reclamation (1998), a recent study by Wahl (2004; 'Uncertainty of Predictions of Embankment Dam Breach Parameters,' ASCE J. of Hydraulic Engr. V.130, No. 5) argued that the uncertainties in breach width estimates are widely recognized to be large. For large storage dams, breach width is a function of both breach height and reservoir storage volume. Therefore, the applicant should consider both breach width and storage volume in estimating breach width. It is expected that the licensee's estimate of breach width will consider reasonable assurance for protection of ultimate heat sink (UHS) volume and intake head."

TVA Response:

TVA had looked at four different empirical relationships for estimation of breach width as presented in "Prediction of Embankment Dam Breach Parameters," Report DSO-98-004, U. S. Department of Interior, July 1998. The chart below summarizes the predicted breach size for each of the methods for initial Chickamauga pool elevations of 674 and 681 feet.

Method	Initial Pool	Predicted Breach (ft)
Von Thun and Gillette	674	290
	681	308
Federal Energy Regulatory Commission (FERC)	674	380
	681	380
Reclamation	674	132
	681	153
Froelich	674	570
	681	675

Neither the FERC nor Reclamation methods take into account the volume of the reservoir. However, the most conservative FERC coefficient of 5 x dam height was used in the above table. The Reclamation coefficient is described in the aforementioned reference as "intended to produce conservative, upper bound values . . ." (page 14). Von Thun and Gillette do account for reservoir volume, and also suggest that the database of large-dam failures tends to indicate 500 feet as a possible upper bound for breach width (page 15, aforementioned reference). The Froelich relationship does suggest larger breach sizes than the 400 feet adopted by TVA. Wahl's 2004 paper elaborates on these relationships further and suggests a risk assessment may be appropriate when considering failure impacts. TVA has incorporated this on less formal basis by performing sensitivity analyses on key parameters. TVA's sensitivity analyses did include breach widths of 300 feet to 1000 feet, which significantly brackets the uncertainty of breach width. Other TVA assumptions are extremely conservative, most notably an assumed instantaneous failure. The most likely failure mechanism for the Chickamauga south embankment is internal erosion, as opposed to overtopping or seismic induced failure. As such, it is probable that the failure would occur gradually, with some indication of problems before failure. However, for simplification and a major degree of conservatism, TVA elected to assume an instantaneous breach. Another conservative assumption is that the rock retaining weir at SQN will not retard the flow of water downstream during a loss of downstream dam (LODD) event. Another major conservative assumption is the initial pool elevation and the determination of only counting water available from elevation 674 feet down to 670 feet for UHS response. Records over the last 20 years show that Chickamauga is seldom drawn below elevation 675 (Attachment A). Pre-flood drawdowns below 675 feet are not conducted as they were in the past, partly in response to increased navigation with heavier loading of barges, increased development along the shoreline, and continued uncertainty in accuracy of flood-producing rain forecast with adequate lead time. With elevation 675 feet met or exceeded 99.9 percent of the time (Attachment B), and elevation 681 being the approximate median elevation, using the elevation range of 674 feet to 670 feet is conservative. TVA concludes that the hydraulic analyses as a whole does provide an adequate degree of conservatism, particularly in light of two major questions being addressed: Adequacy of cooling water available at SQN immediately following LODD; and ultimate long-term availability of cooling following LODD for an extended period.

RAI Question 2:

"Please clarify that there is enough margin to ensure the provision of "at least 4 hours of river level above 670 feet following a loss of downstream dam" considering the uncertainty in the reservoir recession (drawdown) curves (Graph on Page E1-15) caused by the uncertainty in estimating breach width."

TVA Response:

As discussed in response to Question 1, sensitivity analyses already performed by TVA provide a basis for answering this question. The following table summarizes pertinent results of some of these runs:

Breach (Ft)	Initial HW (Ft)	Time elapsed Init HW-670 (Hrs)	Time elapsed 674-670 (Hrs)	Scenario
400	681	13.26	5.34	Run A
300	681	13.45	5.41	Run B
400	675	5.62	4.18	Run C
1000	681	11.20	4.55	Run D

For a starting elevation of 681 (a representative median pool level for the previous 20 years), just counting the time of recession from 674 to 670, the time varies from 4.55 hours to 5.41 hours. Even with a breach width of 1000 feet and instantaneous failure, and only counting the hours from 674 to 670, 4 hours is comfortably exceeded. With a conservative initial elevation of 675 (this elevation is exceeded 99.9 percent of the time), a most likely breach length of 400 feet still provides 4.18 hours between elevation 674 and 670. As runs A, B, and D indicate, the time elapsed is not linearly dependent of breach width (largely due to tailwater submergence and the reservoir dynamics due to SQN being located 14 miles upstream of Chickamauga Dam).

RAI Question 3:

"Please revise the recession curves in Page E1-15 by taking into account the backwater effect at the Sequoyah Nuclear Plant emergency raw cooling water intake site, which is located about 14 miles upstream of Chickamauga Dam."

TVA Response:

The river water elevations shown in the recession curves are those seen at the SQN intake pumping structure as indicated on the legend of the vertical axis, Tennessee River Mile 484.7, and thus already include the backwater effect at the SQN essential raw water cooling intake site. These recession curves use the same reference point and are consistent with those utilized in the 1988 licensing basis. The Chickamauga Dam headwater elevation is utilized as the initiation point. Backwater effects during the initial hours of the failure (generally about 60 hours) are dependent on river channel geometry, Chickamauga headwater recession, and the Chickamauga breach parameters. Watts Bar Nuclear Plant discharges do not have a significant impact on SQN intake elevations during this time. After about 60 hours the system reaches a steady state, and the recession curves indicate that the backwater effect is primarily dependent on the river channel geometry and Watts Bar discharges. Breach width has less and less effect, becoming insignificant under steady flow conditions at the completion of the recession.

RAI Question 4:

"For the staff to perform its confirmatory analysis, please provide input, output, and source code of the simulated open channel hydraulics model used to construct the tailwater rating curve at the Chickamauga Dam site."

TVA Response:

Development of the Chickamauga tailwater rating curve is an iterative process due to the configuration of the downstream dam (Nickajack). Nickajack Dam impounds the Tennessee River back up to Chickamauga Dam, and thus introduces tailwater submergence effects into the dam failure analyses. The computations proceed as follows:

1) Prepare breach rating curve as function of Chickamauga headwater pool elevation using assumed Chickamauga tailwater rating curve and submerged weir flow equation. This is an iterative process to arrive at a converged Q associated with a given headwater, which satisfies both the assumed tailwater rating and the submerged weir equation, and is conducted external to the Simulated Open Channel Hydraulics (SOCH) model
2) Run simultaneous SOCH unsteady flow models for both Chickamauga and Nickajack Reservoirs (Nickajack model simulates the Chickamauga tailwater).
3) At conclusion of run, check the modeled Chickamauga tailwater discharge curve verses assumed tailwater discharge curve used in Step 1. If not within acceptable bounds, modify headwater breach rating curve and re-simulate until assumptions converge. This usually happens within two iterations.

Included for this response is a CD containing the boundary condition files, reservoir geometry files, and SOCH model source codes for only the initial elevation of 675 at Chickamauga, breach width of 400 feet, vertical side slopes, and 14,000 cubic feet per second (cfs) Watts Bar inflow. Data is provided for the downstream reservoir, Nickajack. Output files are supplied for this configuration.

RAI Question 5:

"While the initial pool level of the Chickamauga reservoir is very sensitive to the rate of reservoir recession, the applicant should justify the use of an initial pool level of 680 feet in simulating reservoir recession curves. Or, please explain why one of driest/wettest water levels should not be used as an initial condition to be conservative."

TVA Response:

As discussed and presented in response to Question 2, some sensitivities were performed using different hardwater elevations. Elevation 681 is a representative median elevation for the previous 20 years.

Conservatism for this submittal was built in by only counting the hours during the recession from elevation 674 to 670. Run C, as shown in response to Question 2, does address the issue of starting at an extreme elevation, in this case elevation 675. This pool elevation is exceeded 99.9 percent of the time in actual operations (see Attachment B). For this case, with a 400-foot breach width, instantaneous failure, and only counting hours from 674 to 670 feet, the results indicate an elapsed time of 4.18 hours. The total elapsed time from failure (675 - 670) is 5.62 hours.

RAI Question 6:

"Page 4 in reference #8 of Enclosure 1 states that 'the reservoir levels are lower at other times of the year, but the ultimate heat sink limit is not approached during this time,' which is from December to March. The applicant should verify this statement based on historical water temperatures, water levels, and recorded UHS shutdowns."

TVA Response:

Attachment C provides the requested information. An excel spreadsheet containing the data is also included on the CD. TVA anticipates operating Chickamauga Reservoir on the same seasonal pattern for the foreseeable future, and also anticipates that the future seasonal temperatures will follow the same general pattern as shown on the plots. No UHS shutdowns have been experienced at the SQN plant.

RAI Question 7:

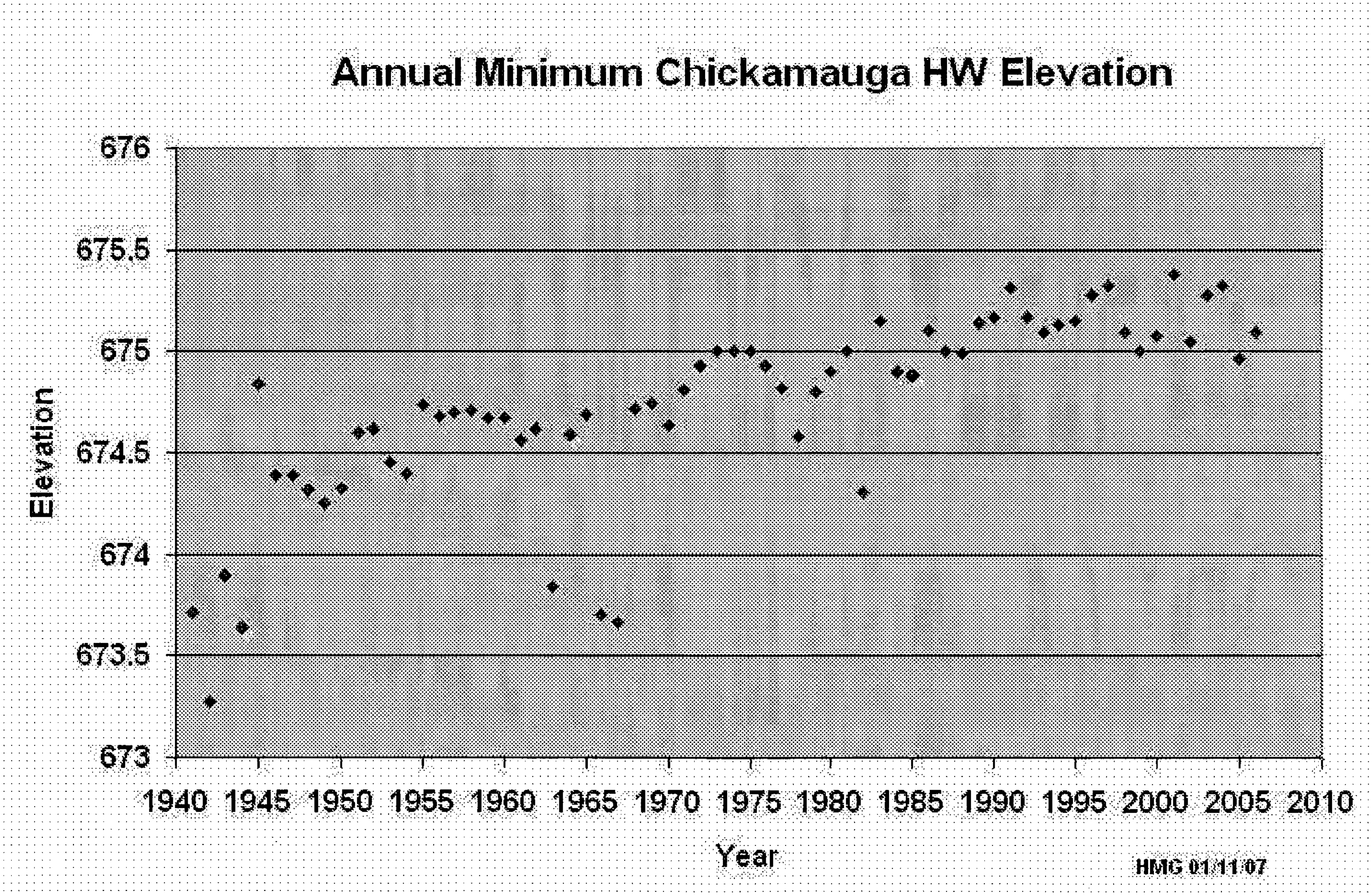
"Please clarify the condition of simulation for the recession curve in Page 18 of Reference #8."

TVA Response:

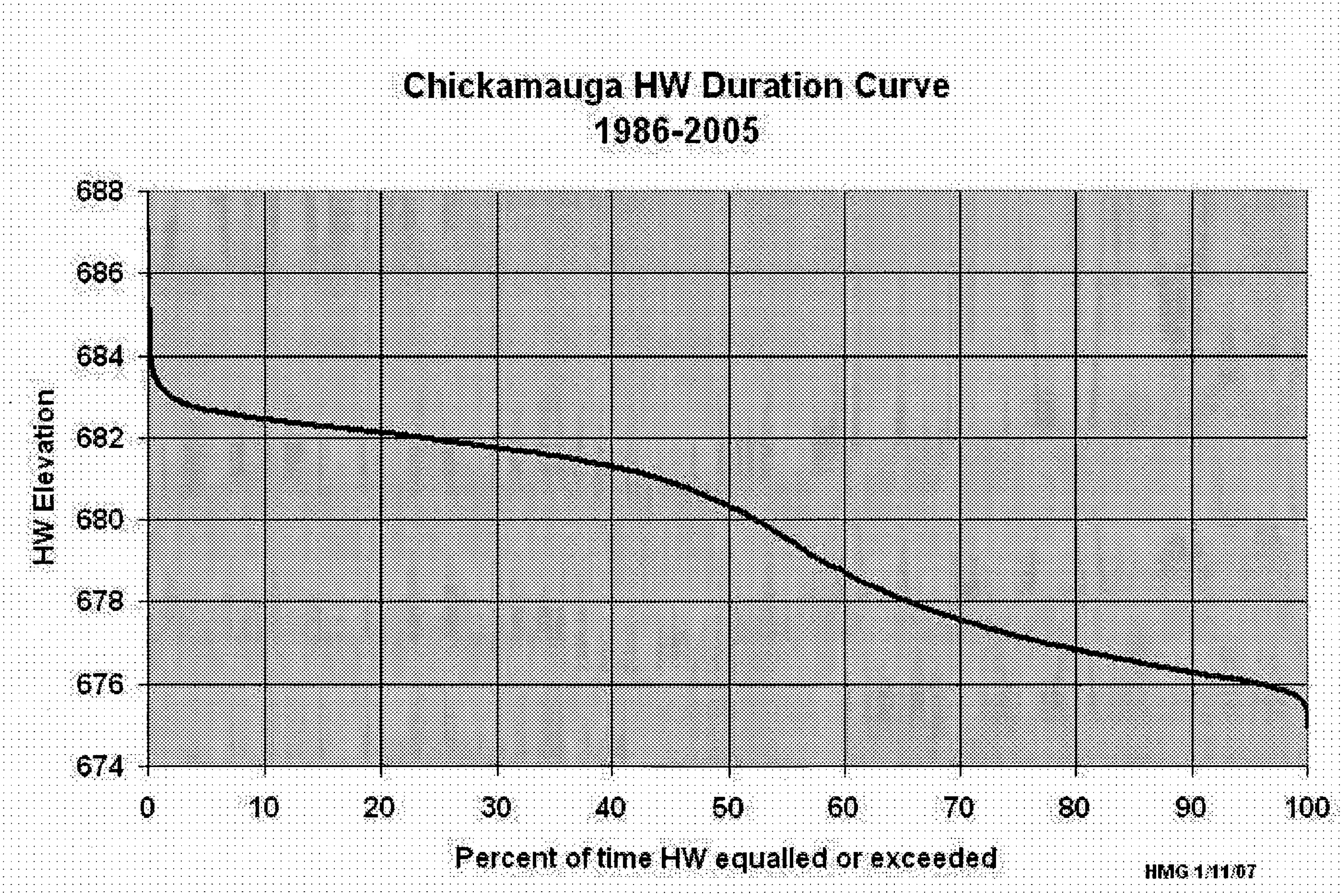
The physical configurations of the runs are described at the top of the page and in the legend. However, there are two axes. The red curves are for Chickamauga discharges, as shown on the right y axis. The blue curves are for SQN river elevations as shown on the left y axis. Data are plotted at one hour intervals.

As expected, the water level recession at SQN is more rapid for the 1000-foot breach width as compared to the 300-foot breach width. Both reach essentially the same steady state elevation approximately 60 hours after dam failure. The Chickamauga discharge peaks at about 466,000 cfs for the 300-foot breach, and at about 941,000 cfs for the 1000-foot width within the first hour (peaks are not shown because they occur before the end of the first hour). This relationship of peak discharges is not linear as a function of breach width due to submergence effects from the downstream reservoir, Nickajack.

Attachment A



Attachment B



Attachment C