Mitman, Jeffrey

From: Mitman, Jeffrey | NRR
Sent: Monday, December 20, 2010 2:41 PM
To: Ferrante, Fernando | NRR
Subject: FW: Spillway Curve
Attachments: Hydralogy - N values and Spillway Curves.pdf

Fernando, I'm not sure where I got the attached document. It appears to be an early evaluation by hydrologist in regard to the inundation analysis. My reason for sending it to you is the information on the JD spillways.

Jeff

-----Original Message-----
From: JEFFREY.MITMAN@NRC.GOV [mailto:JEffrey.mitman@nrc.gov]
Sent: Monday, December 20, 2010 2:34 PM
To: Mitman, Jeffrey
Subject: Spillway Curve

B-146

The infiltration in the LAW model was originally modeled using an SCS Curve number (CN) of 55. In response to further questions from FERC, the PMF was recomputed using a Curve number of 60 for all sub-basins. This curve number was justified by the licensee on the basis of constant infiltration rates used by the Corps of Engineers for Hartwell Dam and North Georgia Dams. This computation resulted in peak inflow of 536,667 cfs, an outflow of 86,652 and water level elevation of 1122.79.

Evaluation of Curve Number

The licensee's original curve number of 55 is considered to reflect average moisture conditions in the watershed. According to Chapter 10 (Estimation of Direct runoff from storm rainfall) of Part 630 (Hydrology) of the SCS National Engineering Handbook, an Antecedent Runoff Condition III (ARC III) when applied to a curve number of 55 results in a CN of 74. The ARC III represents the type of condition normally assumed for a PMF. A CN of 74 would result in a runoff of 32.11 in from the 72 hour PMP of 36 in. which is approximately the same runoff that would result if the constant infiltration rate of .05 in/hr was assumed. Without other basin specific information, the use of a CN of 74 would be more consistent with the assumptions used in the original storm accepted by the AEC staff. The use of CN 60 was accepted by FERC as representative of the basin. Without the FERC justification available for review, the curve number of 60 was questioned by NRC hydrologists.

The significance of using a higher curve number

The most direct way to evaluate the effect of an increased runoff condition on the basin above Jocassee Dam is to run the HEC-1 model with the revised CN as an input. Do to the size of the input and lack of an electronic copy, re-running the model was considered to be a prohibitively labor intensive task. To approximate the effect of increased runoff, the inflow hydrograph to Jocassee Reservoir from the 111 miles upstream was taken from the outputs of the LAW Engineering computations for curve numbers of 55 and 60. A comparison with NRR calculated runoff amounts was then made as follows:

Runoff over 111 sq. mi (in)

Curve number	Max 6 hour	Max 24 hour	Max 72 hour
55	19.1	25.6	28.4
60	19.7	26.6	29.7
74	20.9	28.6	32.7

Ratios were then computed from the above runoffs for comparison with the computed flood flows:

Ratios

CN ratio	Max 6 hour	Max 24 hour	Max 72 hour
CN 60/CN 55	1.03	1.04	1.05
CN74/CN60	1.06	1.08	1.10

The peak flood flows from the LAW engineering model were then compared for the 111 sq mi area:

	Inflow, cfs		
Curve number	Peak Discharge	Max 6 hour	Max 24 hour[1]
55	378,000	207,000	72,000
60	389,000	214,000	76,000

These flows resulted in ratios of the CN 55 to the CN 60 amounts of 1.03, 1.03, and 1.05 respectively. Based on these comparisons it was decided that an increase in the CN 60 inflow hydrograph ordinates of 10% would be reasonable and conservative.

The ordinates of this hydrograph were multiplied by a factor of 1.1 representing the ratio of the 72 hr runoff for a CN of 60 to a CN of 74. In addition the local runoff around the reservoir was modeled the same as in the LAW study but with a CN 0f 74. This resulted in a greatly simplified HEC-1 input file which could also route the resulting flood through the spillway.

The result was an increase in water level of about 1.2 ft or an elevation of 1124.0 ft msl.

Spillway Discharge Curve

The spillway discharge curve as used in the LAW Engineering analysis could not be confirmed in this evaluation. The staff did calculate a spillway rating curve using information developed by the U.S Army Waterways Experiment Station and presented in Section 14.7 of Open Channel Hydraulics (Chow, 1959). In this method, piers in gated spillways are adjusted for using the relationship $L = L_0 - K N H_e$ where:

L is the effective length of each bay of the gated spillway,
L_0 is the clear span between piers (38 ft for Jocassee Dam)
K is a coefficient of pier contraction dependent on pier shape, design head, and total head (determined to be 0.04)
N is the number of side contractions (4 for 2 gate bays)
He is the total head on the crest of the spillway including the velocity head (maximum is 48 ft for Jocassee dam)

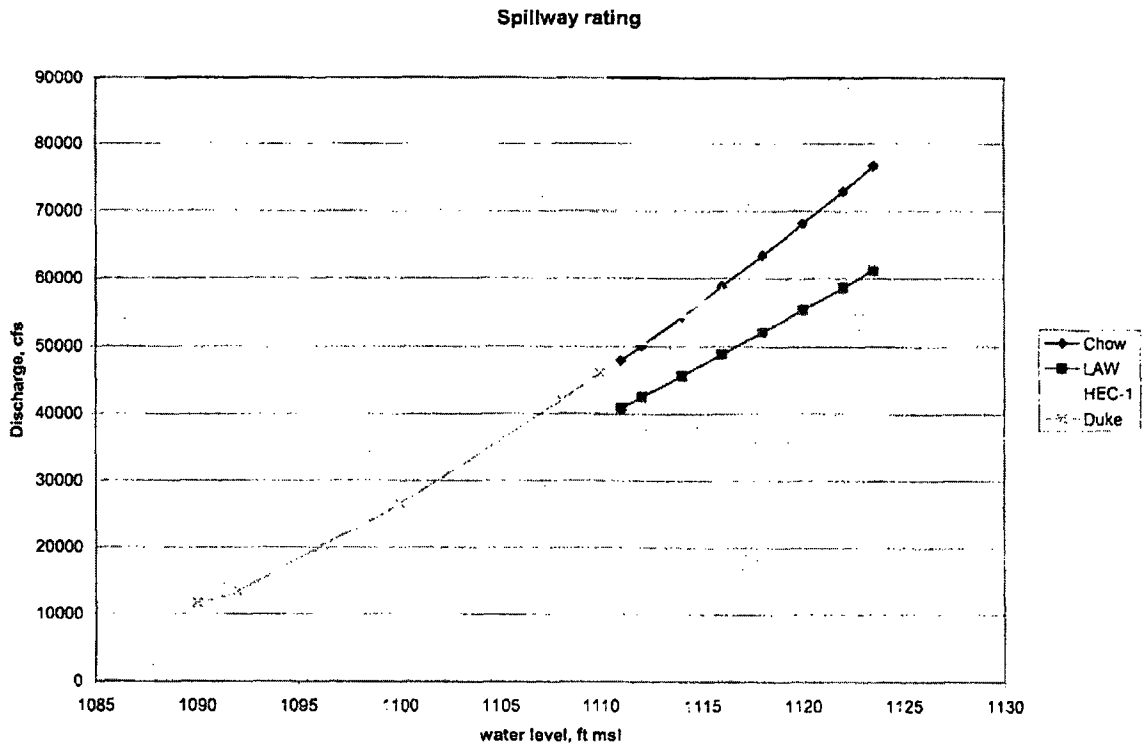
This relationship results in an effective length, L of approximately 30 ft,

With the spillway coefficient of discharge equal to 4.0, $Q = 120 H_e^{1.5}$ for each bay of the spillway. This relationship corresponds approximately to the discharge curve by Duke used by FEI in the FERC report (2004) presented in this report. The discharge determined in the original study evaluated by AEC approximates the value that would be determined from this relationship (72,000 cfs as compared to 73,660 cfs).

The staff also considered the methodology presented in the HEC-1 program manual. Using this methodology, a different shaped curve was determined. Also, the original rating curve ended at

[1] The computation of the hydrographs from the LAW HEC runs ended prior to 72 hours.

el 1123.5 because the low chord of the bridge is at this elevation and flow out of the reservoir changes to orifice flow at this level. Because of the higher water levels to be evaluated, the rating curve was adjusted for orifice flow and added to the program. All three rating curves are shown in Figure ___.



The LAW study included turbine flow, which the original study submitted to the AEC did not. The effect of not including turbine flow was evaluated by performing a reservoir routing where the the outflow rating curve was decreased by flow through two turbines (13,300 cfs). The analysis resulted in a maximum elevation of 1124.0 ft