Vogtle PEmails

From: Davis, James T. [JTDAVIS@southernco.com]
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The numbers in the tables that require correction were not used in the analysis. Please have your guys review. If you need a phone call, let me know.

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Table 2.4.4-3 J. Strom Thurmond Dam Input Variables

Input Variable	English Units	SI Units
h_w	151.1 ft	46.1 m
h_b	151.0 ft	46.0 m
h_d	151.0 ft	46.0 m
S	4360000 ac-ft	5378009947 m^3
S*		55162.75
W_c	40 ft	12.2 m
W_b	740 ft	225.6 m
W*		2.58 ~~8.47~~
V_{er}		15085176.57 m^3
K_o		1.4
K_c		0.6

Table 2.4.4-4 J. Strom Thurmond Dam Breach Parameters

Reference	B (m)	B (ft)	Z	tf (hrs)
Johnson and Illes	138.1	453		
Singh and Snorrason (1982, 1984)	230.1	755		0.25 to 1.0
MacDonald and Langridge-Monopolis (1984)				7.34
FERC (1987)	230.1	755	1 to 2	0.1 to 1.0
Froehlich (1987)	422.7 ~~365.6~~	1387 ~~1199~~	0.9 ~~2.1~~	
Bureau of Reclamation (1988)	138.2	453		1.52
Von Thun and Gillette	170.0	558		1.17
Froehlich (1995b)	679.0	2228		11.62

Table 2.4.4-5 Richard B. Russell Dam Input Variables

Input Variable	English Units	SI Units
Hw	150.1 ft	45.8 m
Hb	150.0 ft	45.7 m
Hd	150.0 ft	45.7 m
Storage	1700000 ac-ft	2096930484 m^3
S*		21941.45
W_c	20 ft	6.1 m
W_b	865 ft	263.7 m
W*		2.95 ~~0.60~~
V_{er}		7274160.639 m^3
K_o		1.4
K_c		0.6

Table 2.4.4-6 Richard B. Russell Dam Breach Parameters

Reference	B (m)	B (ft)	Z	tf(hrs)
Johnson and Illes	137.2	450		
Singh and Snorrason (1982, 1984)	228.6	750		0.25 to 1.0
MacDonald and Langridge-Monopolis (1984)				5.63
FERC (1987)	228.6	750	1 to 2	0.1 to 1.0
Froehlich (1987)	320.8 ~~258.3~~	1053 ~~847~~	1.0 ~~2.4~~	
Bureau of Reclamation (1988)	137.3	450		1.51
Von Thun and Gillette	169.3	555		1.17
Froehlich (1995b)	501.7	1646		7.10

invert depths for the widths calculated in the following discussion, native material will have to be eroded. However, for the purpose of this analysis, it will be assumed that the embankment and native material will erode to the upstream invert elevation.

The input variables along with the estimated breach parameters, by the various methodologies, for each dam are shown in Tables 2.4.4-3 through 2.4.4-6.

For the Thurmond Dam, the FERC (1987) equation from Table 2.4.4-2, as well as other sources in the literature, indicates that the breach width should be 2 to 5 times the height of the dam. This guidance is confirmed by the USBR report **(USBR 1998)**, which shows the 84 data points for observed breach widths used in their analysis of dam breach parameters. The Froehlich (1995b) relationships in the Table 2.4.4-2 were developed using a regression analysis of the data, which is biased by the fact that the majority of the data points are for breach widths less than 50 m (164 ft). In fact, the USBR report **(USBR 1998)** states that the Froehlich relationships are apparently the best fit for cases with observed breach widths less than 50 m (164 ft). Extrapolation of the Froehlich relations to the anticipated breach width on the order of 5 times the height of the dam (230 m [755 ft]) indicates that the Froehlich relations are not in agreement with the observed data for breach widths greater than 150 m (492 ft). Because all of the other methods shown in Table 2.4.4-4 are of the same order of magnitude, and are also within the range of accepted engineering practice for FERC-mandated dambreak analyses, a breach width of 755 ft was selected for this study. The value of 755 ft also is the maximum of the values obtained by all other methods, and is therefore conservative. The following considerations of the dam layout and river cross-section at the dam show that the use of a 755-ft breach width is also conservative in light of the physical layout of J. Strom Thurmond Dam and appurtenances:

- The HEC-RAS dam breach model and the equations used to determine discharges from the breach assume a "flat" bottom breach with a constant elevation. This means that bottom elevation of the entire 755-ft breach width is assumed to be at El. 200 ft msl, which is the minimum elevation of the original streambed on the upstream side of J. Strom Thurmond Dam.
- As shown on Figure 2.4.4-7, the total dam width at the top of the dam is about 5,700 ft **(USACE 1996)**. The width of the dam at the upstream invert elevation (El. 200 ft msl) is about 2,840 ft. Located within the portion of the dam that extends to El. 200 ft is a concrete embankment section 2,282 ft wide where the tainter gate spillways and powerhouse are located **(USACE 1996)**. The failure mode assumes that only the earth section of the dam will erode during the breach. Consequently, the 755-ft bottom width of the breach extends beyond the area in which the actual ground elevation is at the minimum ground elevation of El. 200 ft msl.
- Superposing the 755-ft bottom width at El. 200 ft msl on the cross-section of the valley on the upstream side of the dam shows that more than 200 ft of the breach would be above El. 200 ft msl. Therefore, the entire bottom of the breach was taken as El. 200 ft msl to be conservative.

The cross section shown in Figure 2.4.4-7 has been artificially widened at El. 200 ft msl to accommodate the 755-ft-wide breach.

Based on a review of data and analyses for 84 dam failure cases, and the physical layout of J. Strom Thurmond Dam, a breach width of 755 ft, with 2 to 1 side slopes was selected for this analysis. Additionally, most of the breach time predictions are close to 1.0 hour. Thus, a breach time of 1.0 hour was selected for this analysis.

The breach width for the Richard B. Russell dam is also much larger than 50 m and thus, the Froehlich equations predict values much greater than the observed data. Since all of the other methods shown in Table 2.4.4-6 are of the same order of magnitude, and are also within the range of accepted engineering practice for FERC-mandated dambreak analyses, a breach width of 750 ft was selected for this study. The value of 750 ft also is the maximum of the values obtained by all other methods, and is therefore conservative. The following considerations of the dam layout and river cross-section at the dam show that the use of a 750-ft breach width is also conservative in light of the physical layout of Richard B. Russell Dam and appurtenances:

- The HEC-RAS dam breach model and the equations used to determine discharges from the breach assume a "flat" bottom breach with a constant elevation. This means that the bottom elevation of the entire 750-ft breach width is assumed to be at El. 345 ft msl, which is the minimum elevation of the original streambed on the upstream side of Richard B. Russell Dam.
- As shown on Figure 2.4.4-8, the total dam width at the top of the dam is about 4,500 ft. **(USACE 1996)**. The width of the dam at the upstream invert elevation (El 345 ft msl) is about 2,200 ft. Located within the portion of the dam that extends to El. 345 ft msl is a concrete embankment section 2,180 ft wide where the tainter gate spillways and powerhouse are located **(USACE 1996)**. Only 1,000 ft of the concrete section extends to El. 345 ft msl, the remaining portion extends up the embankment. The failure mode assumes that only the earth section of the dam will erode during the breach. Consequently, the 750-ft bottom width of the breach extends beyond the area in which the actual ground elevation is at the minimum ground elevation of El. 345 ft msl.
- Superposing the 750-ft bottom width at El. 345 ft msl on the cross-section of the valley on the upstream side of the dam shows that more than 150 ft of the breach would be above El. 345 ft msl. Therefore, the entire bottom of the breach was taken as El. 345 ft msl to be conservative. The cross section shown in Figure 2.4.4-8 has been artificially widened at El. 345 ft mls to accommodate the 750-ft-wide breach.

Based on a review of data and analyses for 84 dam failure cases, and the physical layout of Richard B. Russell Dam, a breach width of 750 ft, with 2 to 1 side slopes was selected for this analysis. Additionally, most of the breach time predictions are close to 1.0 hour. Thus, a breach time of 1.0 hour was selected for this analysis.

Once the dam breach occurred, the HEC-RAS computer program determined the flood wave discharge from the dam based on the breach dimensions, water level in the reservoir behind the