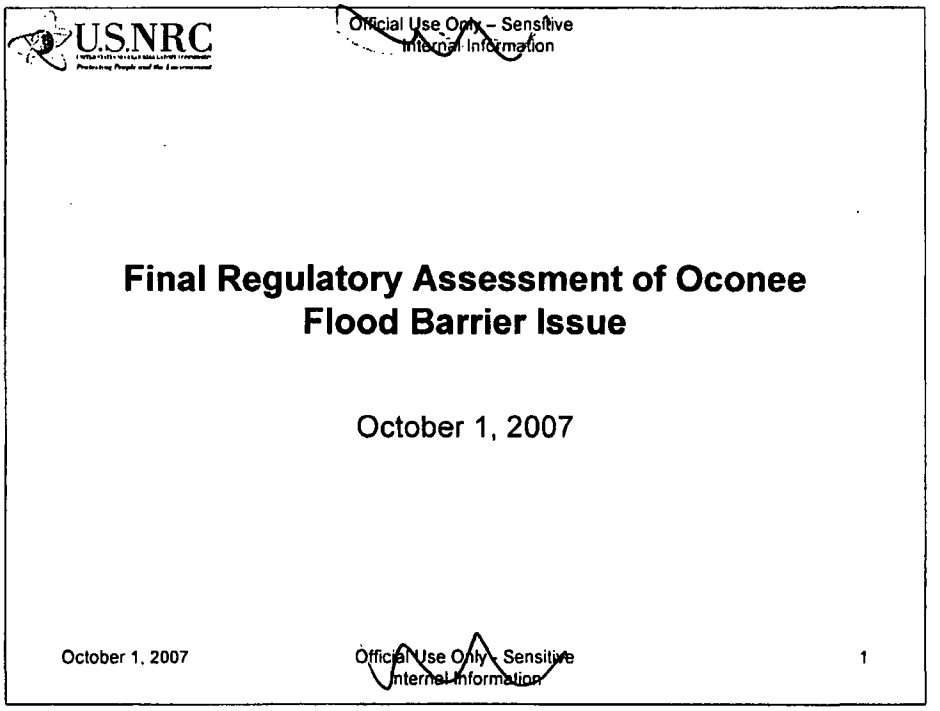
U.S.NRC
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Final Regulatory Assessment of Oconee Flood Barrier Issue
October 1, 2007
October 1, 2007
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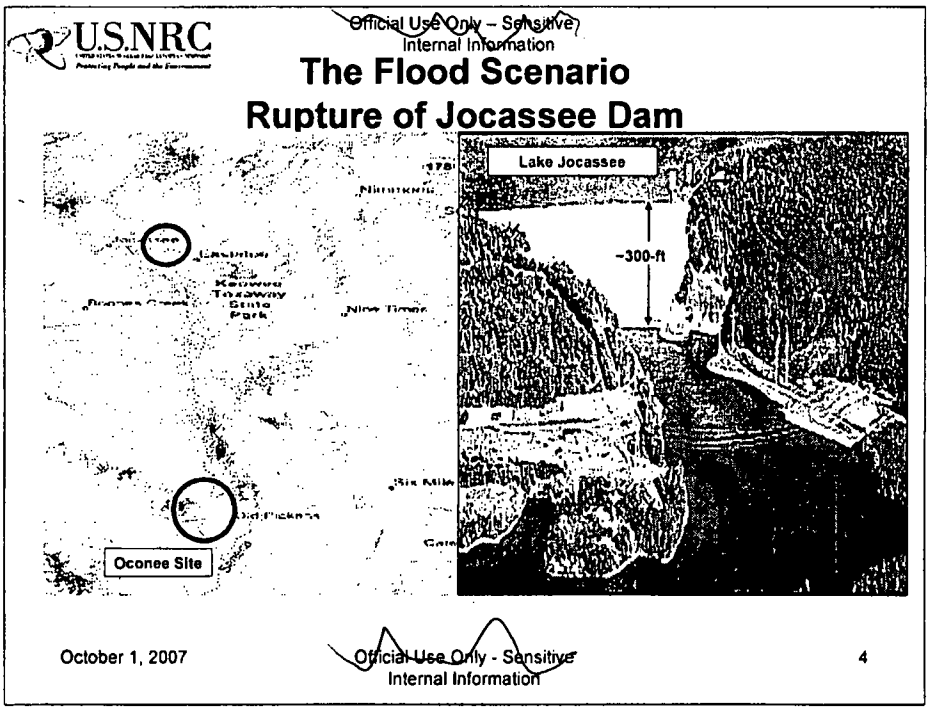
E6

Overview

- Objective
  - Reach agreement on path forward for Oconee flood barrier regulatory issues.
- Success
  - Understanding the flood barrier finding and related scenarios.
  - Understanding the associated regulatory issues.
  - Define and agree to path forward for resolution of each regulatory issue.

Timeline of SDP

- August 17, 2006 - SERP meeting assessed as preliminary WHITE based on a blended qualitative and quantitative risk-informed approach (pre-MC 0609 App M).
- August 31, 2006 - Choice letter sent to licensee.
- October 5, 2006 – Licensee provided written response to choice letter and waived regulatory conference.
- Nov. 22, 2006 - Final significance determination issued. WHITE based on qualitative erosion of defense-in-depth, but includes quantitative CDF based on apportioning flood frequency to flood height.
- December 20, 2006 - Licensee appeals the final significance determination. Requests NRC to accept incomplete, un-docketed new information.
- January 9, 2007 - Appeal panel convened
- March 1, 2007 – Appeal panel upholds WHITE finding.
- May 3, 2007 – Licensee requests reassessment of final significance determination.
- June, 2007 – Assembled a team to review new information. Flooding expert review of data on random dam failure.
- June 22, 2007 – Reassessment of final significance determination assigned to RII.
- June 28, 2007 - Follow up telecom with Licensee on dam failure questions and comments.
- July 17, 2007 - Licensee response to analysis questions by email.



River miles are approximately 14 miles.

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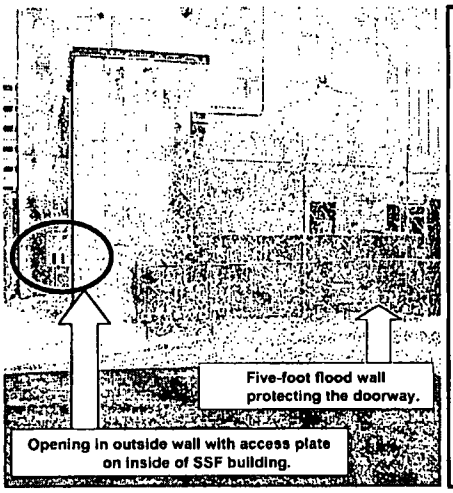
The Flood Barrier Finding



- Licensee opened an access cover uncovering a previously cut hole in the wall on August 13, 2003.
  - Should have done a 10CFR50.65 (a)(4) assessment immediately.
  - Should have done a 10CFR50.59 evaluation after 90 days.
- Licensee opportunities to identify issue
  - June 2, 2005 NRC inspectors notified the licensee of condition. Licensee issued PIP (condition report in their corrective action system). Corrective action not taken.
  - August 3, 2005 NRC inspectors questioned lack of corrective action and licensee issued a further PIP.
- Opening sealed on August 3, 2005.

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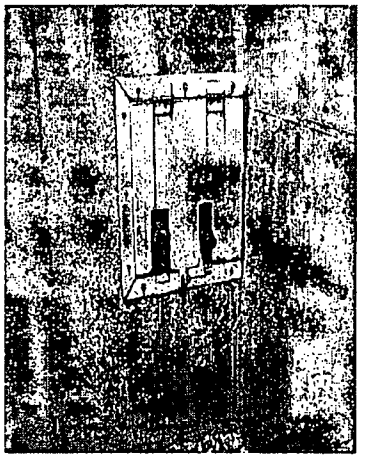
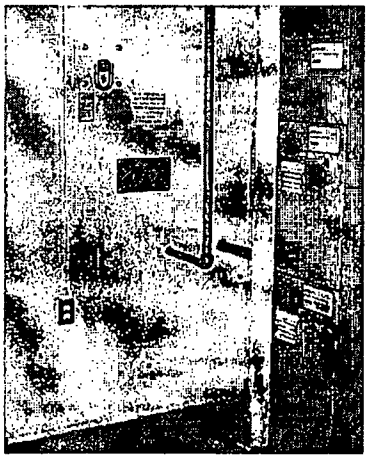
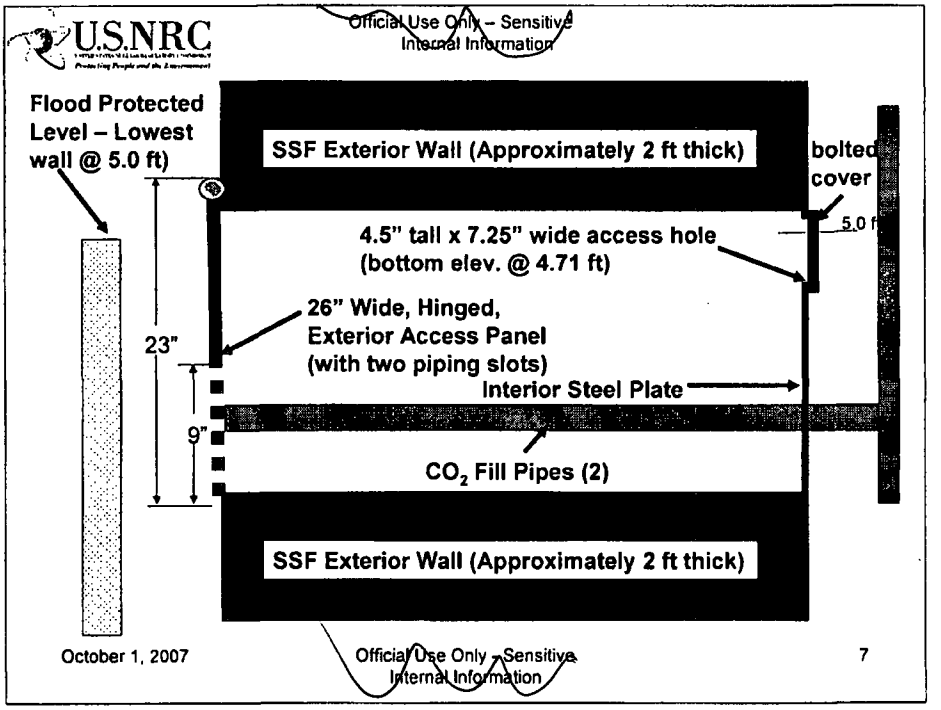


- Photo 3 (Flood Flowpath #1) Hinged, Exterior Access Panel for SSFCO-14 and SSF-CO-17

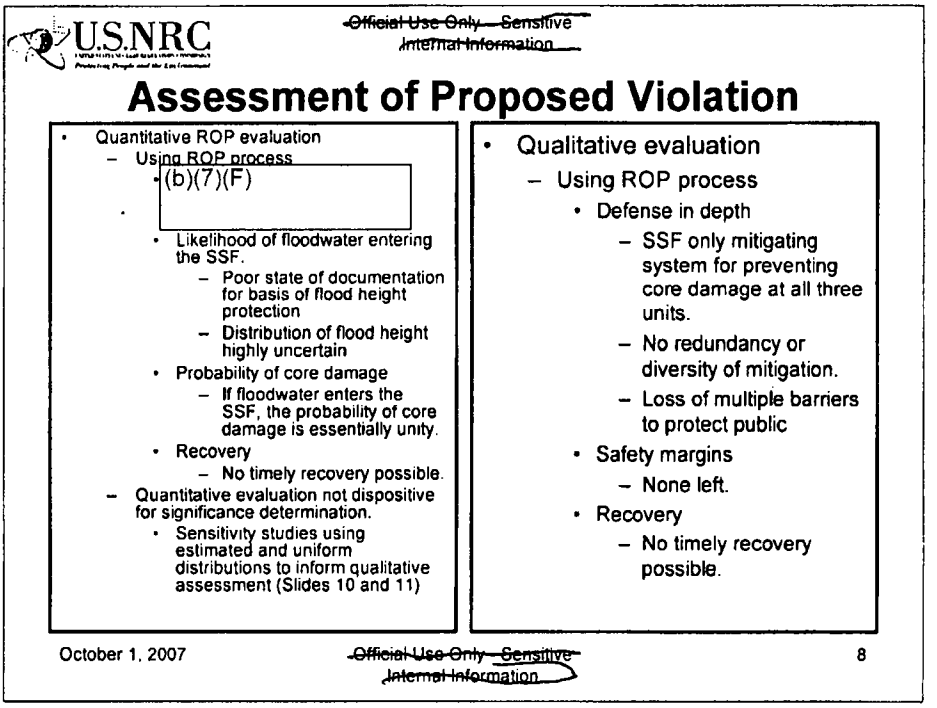


- Photo 4 (Flood Flowpath #1): View of 6" x 10" interior access panel (flood barrier), signage and 208V MCC 3XSF-1

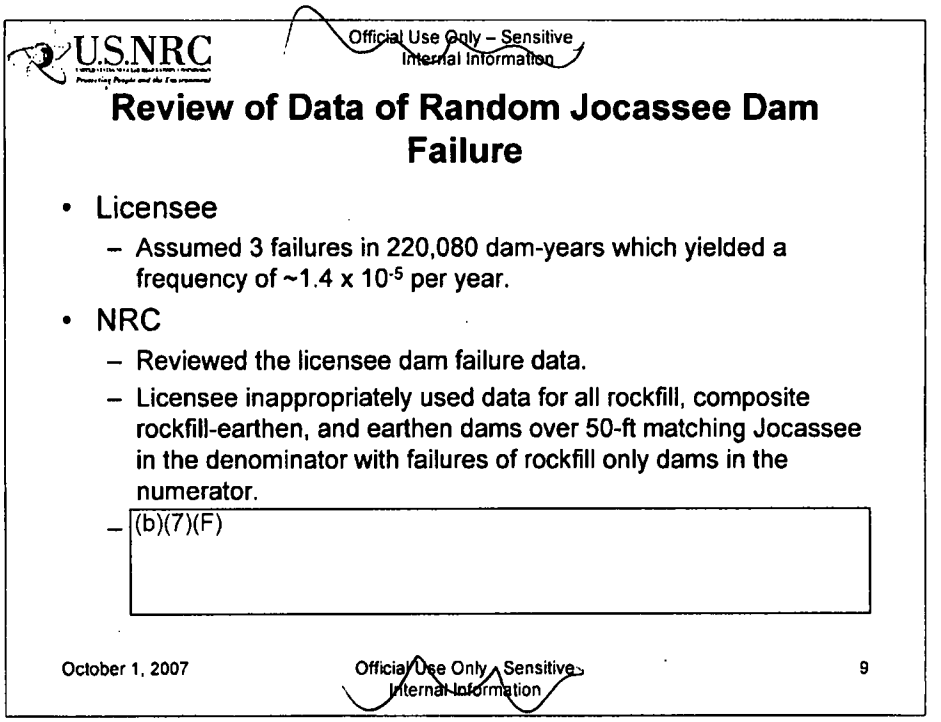


Note: The licensee surveyed the SSF and associated flood walls and provided an estimate that the lowest level of protection was at 801.0' msl. There was some initial discrepancies on the dimensions when NRC sent the preliminary white finding to the licensee in 2006. In order to resolve these differences, the licensee removed the interior bolted cover last October, and the resident inspectors verified the elevations and dimensions noted above.

Reference points	Elevation (feet msl)
Oconee Yard Grade	**796.00**
Ground floor of SSF	**797.00**
Bottom of breached flood barrier	**800.71**
Top of SSF North flood wall	**801.00**
Top of SSF South flood wall	**801.75**

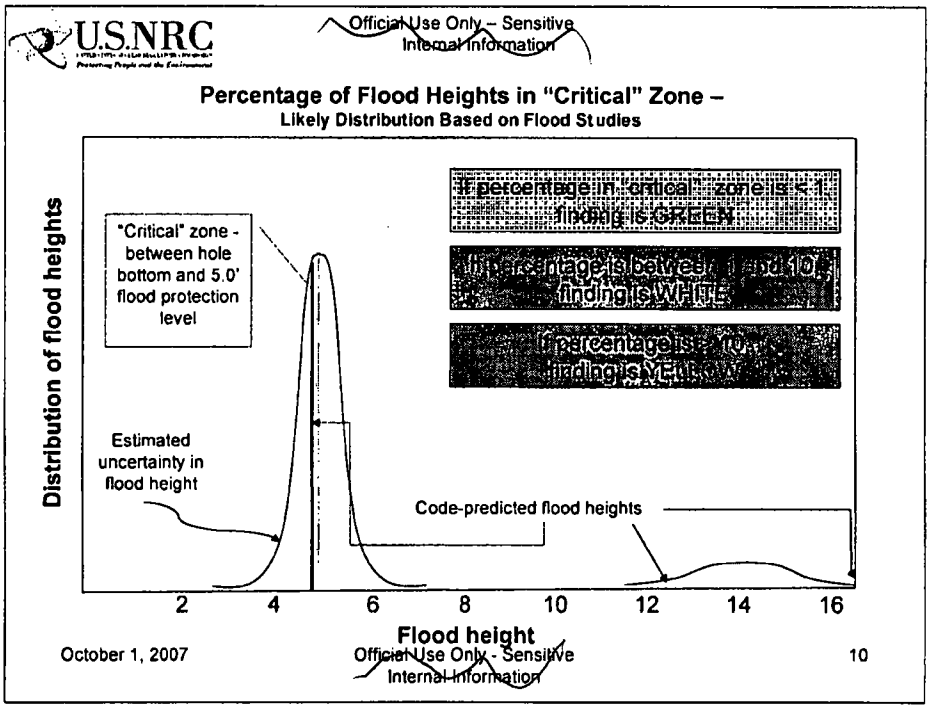


- Qualitative decision-making attributes are in accordance with numerous NRC guidance documents on risk-informed integrated decision-making (e.g., Regulatory Guide 1.174, SDP Appendix M, SDP IMC 308 (SDP basis document), LIC504, etc...).



- Correcting Duke's calculation results in a point-estimate of 1.92e-4/yr frequency when properly matching the numerator definition to what Duke used in the denominator of all Dams over 50 ft.

- The staff's best estimate is the Bayesian mean (state of the art approach). The 90 percent credible interval is the [5th, 95th] values. Assessment assumes rockfilled dams only.



Note: The 1983 study estimated flood level at 4.7 ft. Using the DAMBRK code, the Duke/FERC study in 1992 cited values for the sunny day dam break at 12.51 ft and for the probable maximum flood at 16.82 ft.

Total area under both curves = 1.0. Area under the curve for the 5' flood height approximately 0.8. Area under the curve for the 12' to 16' flood height approximately 0.2.

Change in CDF in terms of $Pr_{\text{flood critical zone}}$, probability of floods occurring in the "critical zone" using simplified risk calc:

$$\Delta CDF = CDF_{\text{non-conforming}} - CDF_{\text{baseline}}$$

$$= (IEF_{\text{Jocasee Break}} * Pr_{\text{flood critical zone}} * CCDP_{\text{SSF flood unprotected}}) - (IEF_{\text{Jocasee Break}} * Pr_{\text{flood critical zone}} * CCDP_{\text{SSF flood protected}})$$

$$= IEF_{\text{Jocasee Break}} * Pr_{\text{flood critical zone}} * (CCDP_{\text{SSF flood unprotected}} - CCDP\ SSF_{\text{flood protected}})$$

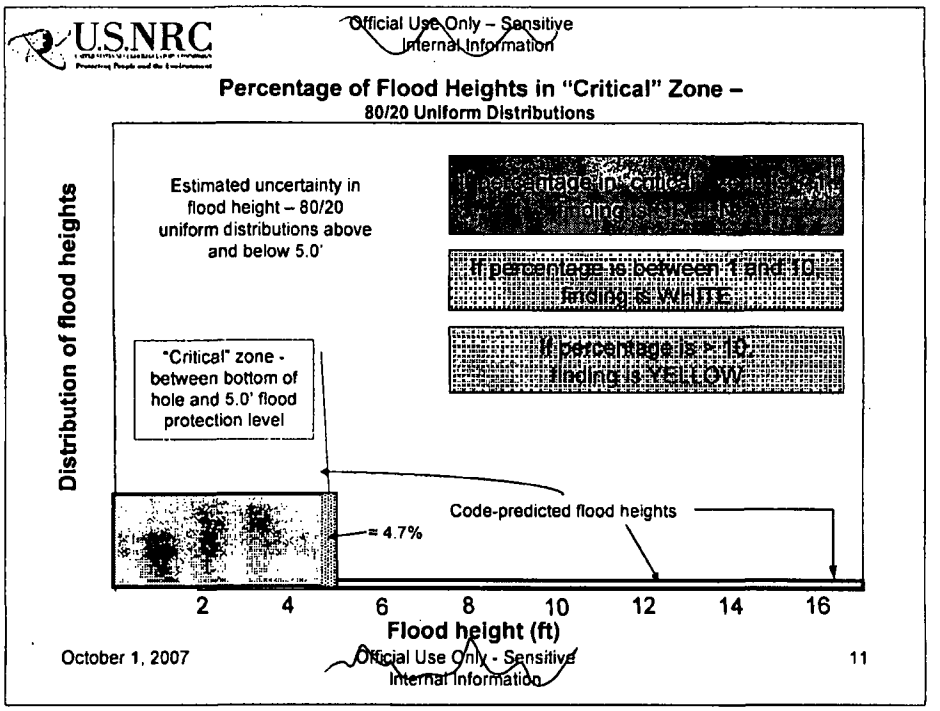
$$= 1.8E\text{-}4/yr * Pr_{\text{flood critical zone}} * (1.0 - 0.3)$$

$$\Delta CDF = 1.26E\text{-}4/yr * Pr_{\text{flood critical zone}}$$

SDP color thresholds in terms of $Pr_{\text{flood critical zone}}$:

White: 1e-6/1.26e-4 = 0.0079 or ≈ 1 percent

Yellow 1e-5/1.26e-4 = 0.079 or ≈ 10 percent



80 percent of flood distributed below 5.0' mark. The 80/20 split is based on the Duke PRA assessment (1990s). The assumption of uniform distributions is provided here only for a relative non-conservative perspective to the previous slide that has a bimodal distribution.

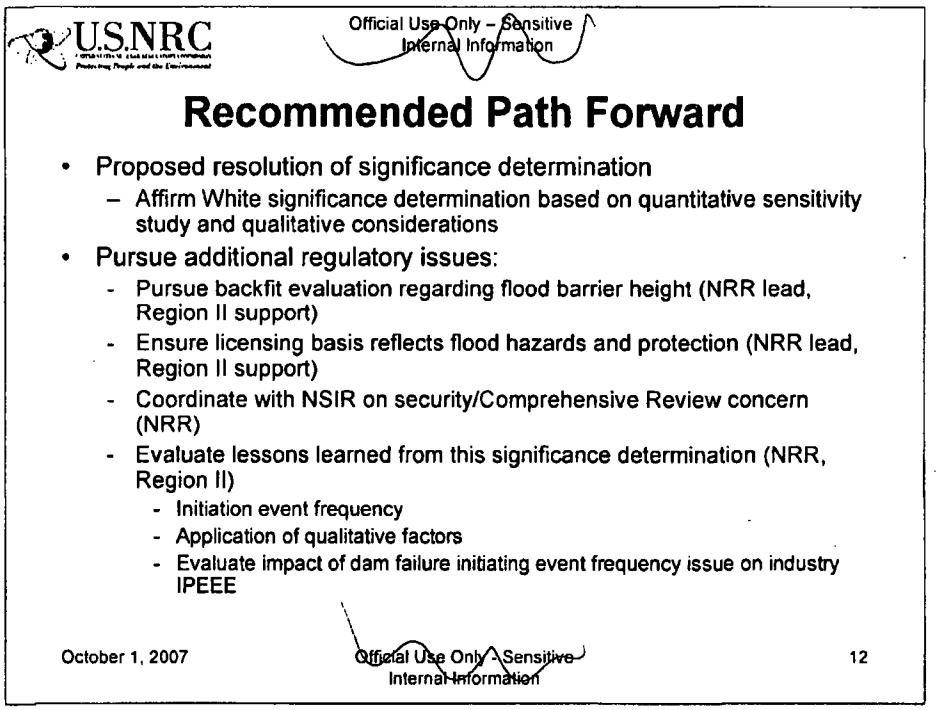
Likelihood of flood between 4.71' and 5.0' is:

0.8 * (3.5"/60") = 0.0466

Using 1.8e-4/yr for Jocassee Dam break frequency and a 0.047 probability of floods in the critical zone, and a nominal SSF unavailability of the SSF (test& maintenance, system unreliability, or human error) yields an estimated delta CDF (full calc not shown) of:

1.26e-4/yr * 0.047 = 5.9e-6/yr White finding

Likely distribution of flood height expected to be greater than 4.7% in the "critical zone."



NUREG-1742 identified only two IPEEEs that addressed dam failure floods quantitatively – Ft. Calhoun and Diablo Canyon. Everyone else only addressed probable maximum precipitation and screened out dam failure as low probability. Unfortunately, there were few dam failure data sources around back then, so many plants used the estimate published in NUREG/CR-5042. The data source for the estimate in NUREG/CR-5042 was the Oconee PRA - NSAC/60. The calculation in NSAC/60 was done in error and it propagated throughout the industry.

References:

NUREG/CR-5042, "Evaluation of External Hazards to Nuclear Power Plants in the United States.

NUREG-1742, "Perspectives Gained From the Individual Plant Examination of External Events (IPEEE) Program

NSAC/60, "Oconee PRA"