Use of FERC Inundation Calculation Parameters

Issue:
Are the inundation study parameters that Duke presented in its 50.54(f) letter response appropriate for any future inundation study? Are the current parameters sufficient to compute the flood height that the Oconee units need to be protected against?

Concern:
The parameters developed were used for the licensing of Jocassee Dam with FERC as required by 18 CFR 12D. Although these parameters are appropriate for licensing the dam, they might lack the necessary margins required to satisfy the licensing criteria for external flood protection for the Oconee Nuclear Site.

Agency Mission Statements:
The Federal Energy Regulatory Commission (FERC) mission statement is:
"Regulate and oversee energy industries in the economic, environmental, and safety interests of the American public."

The NRC mission statement is:
"The mission of the NRC is to license and regulate the Nation's civilian use of byproduct, source, and special nuclear materials to ensure adequate protection of public health and safety, promote the common defense and security, and protect the environment."

Oconee Nuclear Site Requirements:
The licensing basis for external flooding for Oconee follows a draft version of GDC-2 presented in the Federal Register Notice of July 11, 1967:

"*Those systems and components of reactor facilities which are essential to the prevention of accidents which could affect the public health and safety or to mitigation of their consequences shall be designed, fabricated, and erected to performance standards that will enable the facility to withstand, without loss of the capability to protect the public, the additional forces that might be imposed by natural phenomena such as earthquakes, tornadoes, flooding conditions, winds, ice, and other local site effects. The design bases so established shall reflect: (a) appropriate consideration for the most severe of these natural phenomena that have been recorded for the site and the surrounding areas and (b) an appropriate margin for withstanding forces greater than those recorded to reflect uncertainties about the historical data and their suitability as a basis for design.*"

Regulatory Guide 1.59, "Design Basis Floods for Nuclear Power Plants", states that, "In addition to floods produced by severe hydrometerological conditions, the most severe seismically induced floods reasonably possible should be considered for each site. Along streams and estuaries, seismically induced floods may be produced by dam failures or landslides. " .. "Flood conditions that could be caused by dam failures from earthquakes should also be considered in establishing the design basis flood." The most severe impact must be considered for dam failure with an appropriate margin to withstand higher forces.

FERC Guidance on Dams:
In conducting dam break studies, FERC suggests[1] for rockfill dams that an average breach width of between one and five times the height of the dam should be used. The time-to-failure should be within 0.1 hrs (6-minutes) to 1 hour. The guidance goes on to state, "For a worst-case scenario, the average breach width should be in the upper portion of the recommended range, the time to failure should be in the lower portion of the range, and the Manning's "n" value[2] should be in the upper portion of the recommended range. In order to fully evaluate the impacts of a failure on downstream areas, a sensitivity analysis is required to estimate the confidence and relative differences resulting from varying assumptions." To account for high degree of uncertainty, FERC recommends that the upper breach width along with shorter times be adopted assuming that the dam fails catastrophically.

Conclusion:
In its response to the 10 CFR 50.54(f) letter, Duke argued that the parameters that were used in the FERC inundation study were conservative. However, NRC review of the FERC regulations and guidance shows that the parameters are not conservative. The 575-ft breach width chosen by Duke is at the lower end of the guidance range, or less than twice the height of the dam. The time-to-failure chosen by Duke of 4-hours is four times higher at the less conservative end of the maximum time of one hour. To account for the high degree of uncertainty, FERC recommends a higher breach width and lower time-to-failure.

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[1] Federal Energy Regulatory Commission, FERC Engineering Guidelines, Appendix II-A, "Dambreak Studies", October 1993.

[2] Manning's equation is an empirical formula which measures flow velocity across the open channel created by the dam breach. The "n" factor is an empirical factor which represents roughness of the channel which is inversely proportional to the velocity.