

History of Oconee Flood Concerns

Updated 9/20/12 by Jonathan Bartley and John Boska

Agency Actions

- **April 1983** – Based on RAI responses, NRC issues Standby Shutdown Facility (SSF SER) SE, which recognized turbine building flood as the only credible SSF flooding concern....not Jocassee Dam failure. (ML103370444)
- **February 1994** - NRC issued a Notice of Violation and Notice of Deviation (Report number 50-269,270,287 / 93-25) which included the identification of the inability of the SSF to mitigate the worst case Jocassee Dam failure per the recently completed FERC study; and the inaccurate IPE submittal, which stated that the SSF flood walls were 8 feet in height (they were actually 5 feet).
- **April 2006** – NRC inspectors, in documenting a breach of the SSF wall as a performance deficiency, also note the 1992 Jocassee Dam Inundation Study. Inspectors also identified a new flood flow path via the building's sanitary system. Both issues are documented as URIs in Oconee report 2006002 (ML061180451).
- **November 2006** - Final significance determination of WHITE was issued for breached SSF Flood Barrier (Oconee report 2006017, ML063260282).
- **March 2007** – Appeal panel upheld the WHITE finding based on random dam failure alone.
- **July 2007** – Oconee report 2007003 (ML072120140) issued which closes Sanitary System URI with no enforcement action.
- **September 2007** – Final SERP concluded a WHITE finding for the breached SSF Flood barrier.
- **October 2007** – Associated IP95002 Supplemental Inspection (conducted in late August 2007) report issued.
- **November 2007** – November 20 letter to licensee regarding the Final Significance Determination of the SSF barrier white finding and communication of the NRC's analysis of the Jocassee Dam failure frequency error (ML073241045)
- **December 2007** – NRC Region II communicated the NRC Jocassee Dam failure frequency computation to the licensee.
- **August 15, 2008** – Oconee 50.54(f) letter issued to address external flooding due to failure of Jocassee Dam (ML081640244)
- **June 10, 2010** – Region II completed inspection of interim compensatory measures (ICMs)
- **June 22, 2010** – Region II issued CAL. (ML101730329) CAL directed licensee to:
 - Implement ICMs as documented in the June 3, 2010 letter
 - Submit to the NRC by August 2, 2010, all documentation necessary to demonstrate to the NRC that the inundation of the Oconee site resulting from the failure of the Jocassee Dam has been bounded
 - Submit by November 30, 2010, a list of all modifications necessary to adequately mitigate the inundation
 - Make all necessary modifications by November 30, 2011
- **July 7, 2010** – NRC Inspection Report for CAL ICMs, (ML101880768 non-public, ML101880769-public)
- **January 28, 2011** – Staff issues safety evaluation of inundation study. Safety evaluation determined that Case 2 provided adequate bounding parameters to model the dam failure and subsequent flooding (Reservoir 1110 full pond, bottom breach el 800 ft, width 425 ft, time-to-failure 2.8 hours) (ML110280153)
- **September 20, 2012** – Staff issues letter answering Duke's June 14, 2012, letter, accepts FERC standards for flood walls, and establishes start date and end date for modification timeline (ML12219A163).

Interactions Timeline

~~OFFICIAL USE ONLY - SECURITY RELATED INFORMATION~~

- **May 1980** – Licensee memo to file documents the initiation of the NSAC-60 study (Oconee Level 3 PRA with internal and external events)
- **February 1982** – Oconee calculation OSC-631 contains a simplified licensee flood study which predicts that a Jocassee failure would overtop the Keowee Dam by 4 feet for 2.4 hours, resulting in 32.5 feet of flood water on site.
- **May 1982** – draft Oconee PRA assigned Jocassee Dam failure frequency of $2.5E-5$ /yr with conditional probability of site flooding and core melt to be 1.0.
- **January 1983** - Licensee memo to file, documents that a Jocassee Dam failure would overtop the Keowee Dam by 2.45 feet resulting in 4.71 feet of water on site. The flood study was completed as part of the Oconee PRA study, NSAC-60, by Duke Power and the EPRI Nuclear Safety Analysis Center.
- **April 1983** – Based on RAI responses, NRC issues SSF SER, which recognized turbine building flood as only credible SSF flooding concern...not Jocassee Dam failure.
- **June 1984** - NSAC-60 study was completed. (This addressed both random failures of Jocassee Dam....no split fractions and no credit for SSF.)
- **June 1984 to June 1986** – Licensee design and construction of the North and South SSF 5-ft exterior flood walls.
- **December 1992** - Jocassee Dam Failure Inundation Study (FERC Project No. 2503) was completed and predicted a flood depth of 12.5 ft to 16.8 ft above site grade level.
- **December 1992** - Licensee implemented an UFSAR update which added the Jocassee Dam failure, SSF flood wall, and watertight door references to the UFSAR
- **December 1993** – In an internal memo, licensee attempted to reconcile differences between the FERC study and their internal one due to updated software and analysis conservatism. Licensee admits that they can not recreate the 4.71-ft flood height. Proposed corrective action to re-analyze as part of the Individual Plant Examination of External Events (IPEEE) for December 1995.
- **February 1994** - NRC issued a Notice of Violation and Notice of Deviation (Report number 50-269,270,287 / 93-25) which included the identification of the inability of the SSF to mitigate the worst case Jocassee Dam failure per the recently completed FERC study; and the inaccurate IPE submittal, which stated that the SSF flood walls were 8 feet in height (they were 5 feet in height).
- **March 1994** – Service Water inspection and violations. Licensee discussed a commitment to the NRC "...to complete a reanalysis of a postulated Jocassee flood with the available information on flood frequency, SSF availability, and SSF serviceability, as part of the IPEEE effort."
- **March 1994** - Licensee letter discussed a commitment to the NRC "...to complete a reanalysis of a postulated Jocassee flood with the available information on flood frequency, SSF availability, and SSF serviceability, as part of the IPEEE effort."
- **June 1994** – Licensee removed all references to Jocassee Dam failure and the SSF flood walls in the UFSAR. The 10 CFR 50.59 evaluation stated that these references were originally added based on results of a PRA study which was not part of design basis.
- **September 1994** – (Internal NRC meeting between RII and NRR as documented in memo dated October 6, 1994)...The status of NRC review of a hypothetical Jocassee Dam failure was discussed. NRR indicated that the external events review would not be done for months, and research had not been contacted about the error in the licensee's IPE submittal. The ramifications of a high E-5 event was discussed, NRR considered it of minimal importance, and a revision submittal of 1995 was acceptable.
- **December 1995** – Licensee issued the IPEEE. Random dam failure frequency was computed to be 1.3×10^{-5} per year. In addition, split fractions for flood heights that exceeded the 5-ft level were included. Subsequent supplements issued in December 1996 and December 1997 also carried over these split fractions. In response to January 1999 RAI, the licensee reconfirms that a flooding event (resulting from the seismically-induced failure of the Jocassee Dam) which exceeds the 5 foot SSF flood wall is the dominant cutset. The core damage frequency was calculated to be low enough that no further action was required. Subsequently in March 2000 (ML003694349), the NRC closes the IPEEE generic letter.

~~OFFICIAL USE ONLY - SECURITY RELATED INFORMATION~~

- **July 1998** – Licensee applied for renewal of operating license for all three units. In the value impact results for potentially cost-beneficial Severe Accident Mitigation Alternatives (SAMA), the licensee considered increasing the height of the 5-ft flood walls. However, it was not deemed cost-effective based on the now known underestimated IPEEE results. It came up during the NRC's efforts as part of the SSF hole-in-the wall appeal process.
- **August 2003** – Licensee removed an access cover on the south side of the SSF outer wall exposing it to floods below the 5-foot level. Licensee failed to perform any 10 CFR 50.65 (a)(4) or 10 CFR 50.59 evaluation (ref. RIS-2001-009) for a breached barrier.
- **September 2004** – During SSF sump modifications, the licensee's SSF Risk Reduction Team identified the need to consider increasing the height of the flood walls. This recommendation was identified in PIP O-04-6365, corrective action #8. However, actual corrective action #8 stated that, "Based on discussions with the Severe Accident Analysis Group, modifications to increase the height of the flood wall around the SSF will not be pursued at this time. Therefore, the proposed replacement SSF Sump pump should be based on operating with flood levels up to the height of the existing flood wall surrounding the SSF."
- **June 2005** – NRC inspectors notified licensee of the wall breach in the SSF. The licensee entered the deficiency into their corrective action program.
- **August 2005** – After a second corrective action, the licensee corrected the condition by sealing the breach in the SSF wall.
- **April 2006** – NRC inspectors, in documenting a breach of the SSF wall as a performance deficiency, also note the 1992 Jocassee Dam Inundation Study. Inspectors also identified a new flood flow path via the building's sanitary system. Both issues are documented as URIs in Oconee report 2006002 (ML061180451).
- **August 2006** – SERP meeting for the breached SSF flood barrier was assessed as preliminary WHITE with the choice letter sent to the licensee. This issue would have been YELLOW if the appropriate initiating event frequency had been utilized (this was discovered in June 2007). SSF Sanitary System issue pre-decisional YELLOW.
- **October 2006** – Licensee provided written response to the NRC choice letter to waive a regulatory conference.
- **November 2006** – During caucus, it was recommended by NRR that Sanitary System issue be processed as a Finding. Oconee's position in the action matrix was then noted.
- **November 2006** – Final significance determination of WHITE was issued for breached SSF Flood Barrier (Oconee report 2006017, ML063260282).
- **December 2006** – Licensee appeals the determination. Requested NRC to accept an incomplete, undocketed, Jocassee seismic fragility study. (ML063620092)
- **January 2007** – Appeal panel was convened with Region II, Region IV and Headquarters personnel.
- **February 2007** – Licensee sent completed seismic fragility analysis of Jocassee to NRC one month late.
- **March 2007** – Appeal panel upheld the WHITE finding based on random dam failure alone. (ML070610458)
- **May 2007** – Licensee requested reassessment of the final determination of the appeal panel. (ML072970510)
- **June 2007** – Team assembled to evaluate seismic analysis. Flooding expert reviewed the random failure frequency for Jocassee Dam. NRC staff determined that the failure probability of Jocassee Dam was on the order of 2×10^{-4} events/yr for a sunny day failure. This was a factor of 10 greater than the licensee's probability of dam failure (1.5×10^{-5}). The NRC calculation included the failure of two earthen dams. The licensee's calculation did not include the earthen dam failures calculation because they determined they were not applicable because Jocassee was a rock filled dam. With the NRC's frequency of 2×10^{-4} and a CDP of 1, the CDF of 2×10^{-4} was above the threshold for an adequate protection issue. Follow up telecom with licensee after seismic fragility analysis was evaluated. Discrepancy in dam failure frequency was communicated to the licensee.

~~OFFICIAL USE ONLY - SECURITY RELATED INFORMATION~~

- **July 2007** - Licensee response to analysis questions by email.
- **July 2007** – Oconee report 2007003 issued which closes Sanitary System URI with no enforcement action. (ML072120140)
- **September 2007** – Final SERP concluded a WHITE finding for the breached SSF Flood barrier.
- **October 2007** – Associated IP95002 Supplemental Inspection (conducted in late August 2007) report issued. (ML072850850)
- **November 2007** – November 20 letter to licensee regarding the Final Significance Determination of the SSF barrier white finding and communication of the Jocassee Dam failure frequency error. (ML073241045)
- **December 2007** – NRC Region II communicated the NRC Jocassee Dam failure frequency computation to the licensee.
- **December 2007 - August 2008** – The NRC staff developed/implemented an internal backfit assessment/flood action plan. This included pursuance of concern as an “inadequate protection” issue.
- **August 2008** – NRC Deputy Executive Director (DEDR) telecon to licensee Chief Nuclear Officer on concerns over Jocassee Dam failure and Oconee site flood height. 50.54(f) letter issued August 15, 2008 (ML081640244).
- **August 2008** – NRC Declines PRA Walkdown Invitation
- **September 26, 2008** – Duke response to 50.54(f) letter (ML082750106)
- **November 5, 2008** - Meeting with Duke (see June 18, 2009)
- **December 4, 2008** - NRC Meeting Summary of 11-5-08, (ML091420319)
- **February 2009** – Oconee increased SSF flood wall height to 7.5 feet
- **March 13, 2009** – NRC Closed Meeting with Duke to discuss 50.54f
- **April 30, 2009** – NRC RAIs (ML090570779)
- **May 11, 2009** – NRC closed meeting with Duke
- **May 20, 2009** – Duke request to extend 60 day response
- **June 1, 2009** – Meeting summary of 12-4-08 (ML091420319)
- **June 6, 2009** – Duke request to withhold sensitive materials
- **June 10, 2009** – Duke reply to NRC's 4-30-09 (ML091680195)
- **June 18, 2009** – NRC meeting summary of 11-5-08 meeting (ML091060761)
- **July 9, 2009** – Duke 60 day reply (ML092020480)
- **July 9, 2009** – Summary of 6-11-09 meeting on flooding (ML091620675)
- **August 12, 2009** – NRC memo justifies continued operation to Nov2010 (ML090570117)
- **October 28, 2009** – NRC closed meeting with Duke to discuss flood analyses
- **November 10, 2009** – NRC Summary of 5-11-09 Closed Meeting (ML092940769)
- **November 30, 2009** – Duke provides external flood analysis and corrective action plan (ML093380701)
- **December 2, 2009** – NRC Closed Meeting
- **January 15, 2010** – Duke provides external flood interim actions (ML100210199)
- **January 29, 2010** – NRC Evaluation of Duke 50.54f Response w/ RAI's (ML100271591)
- **February 8, 2010** – Duke External Flood RAI Response (ML100470053)
- **February 26, 2010** – Duke External Flood Revised Commitments (ML100610674)
- **March 5, 2010** – Duke RAI Response Letter (ML103430047)
- **March 5, 2010** – NRC memo justifies to 11-30-11 for flood protection modifications (ML103410042)
- **March 15, 2010** – NRR memo calculates failure frequency for Jocassee Dam as 2.8E-4 per year. (ML100780084)

~~OFFICIAL USE ONLY – SECURITY RELATED INFORMATION~~

- **May 27, 2010** – Duke modifies external flood interim actions provided in January 15, 2010, letter (ML101600468)
- **June 3, 2010** – Duke correspondence providing list of commitments for external flood (ML101610083)
- **June 10, 2010** – Region II completed inspection of interim compensatory measures (ICMs)
- **June 22, 2010** – Region II issued CAL on Oconee external flood. (ML101730329) CAL directed licensee to:
 - Implement ICMs as documented in the June 3, 2010 letter
 - Submit to the NRC by August 2, 2010, all documentation necessary to demonstrate to the NRC that the inundation of the Oconee site resulting from the failure of the Jocassee Dam has been bounded
 - Submit by November 30, 2010, a list of all modifications necessary to adequately mitigate the inundation
 - Make all necessary modifications by November 30, 2011
- **June 24, 2010** – Duke RAI response date change, (ML101830007), 3 pages
- **July 7, 2010** – NRC Inspection Report for CAL ICMs, (ML101880768 non-public, ML101880769-public)
- **August 2, 2010** – Duke provides inundation study (CAL item) (ML102170006)
- **October 26, 2010** – DE memo to DORL on bounding of flood (ML102990064)
- **November 29, 2010** – Oconee provides high level, conceptual list of possible modifications (CAL requirement). This was not the detail staff desired. Letter stated they needed to know what Case to use so they knew what flood height to protect against and stated they would provide a final list by April 30, 2011. (ML103490330)
- **January 28, 2011** – Staff issues safety evaluation of inundation study. Letter informed Duke that the staff considered Case 2 to be adequate to bound (Reservoir 1110 full pond, bottom breach el 800 ft, width 425 ft, time-to-failure 2.8 hours) (ML110280153)
- **April 29, 2011** – Oconee provides list of modifications (intake dike diversion wall, dedicated flood protected offsite power, power block diversion wall, turbine building and yard drain isolation, SFP makeup via re-routed SSF ASW miniflow line). Completion times determined by FERC and NRC (LAR) approvals plus 30 months. (ML111460063)
 - Licensee made clear in this letter that they still considered this external flood to be a beyond “DBE” as described in their licensing basis which clearly states that DBE’s are only those events in Ch 15 of the FSAR.
 - Licensee will not build and treat flood protection features as QA1/safety related
- **August 18, 2011** – NRC sends Oconee RAI concerning April 29 2011, letter focused on more details on the flood is a beyond DBE, that natural phenomena are not DBEs, justification for assumptions used to develop mitigation strategies, actions for mitigation strategies, justification for not installing the modifications IAW 50 Appendix B. (ML11174A138)
- **October 17, 2011** – Duke responds to August 18 RAIs (ML11294A341)
- **April 29, 2011 to present** – NRC transmitted and Duke responded to multiple rounds of communications to resolve/establish: 1) construction/quality standards to be applied to flood protection features, 2) the timeline for completing modifications, and 3) a better understanding of the planned modifications, including implications of the results of the flooding hazard re-evaluations required by the Fukushima 50.54(f) letter recommendation 2.3 on flooding.
- **March 12, 2012** – NRC Fukushima 50.54(f) letter (ML12053A340)
- **May 15, 2012** – NRC CAL RAIs (2 RAIs on flood wall design) (ML12129A186)
- **June 14, 2012** – Duke’s response to NRC RAIs. Duke requests clarification on acceptable standards for flood walls and posed 2 questions (does the flood SE cover Fukushima 50.54(f) evaluation and, if not, will the CAL be closed to the Fukushima 50.54(f) letter). (ML12167A372)

~~OFFICIAL USE ONLY - SECURITY RELATED INFORMATION~~

- **September 4, 2012** – Staff briefed JLD steering committee on Oconee flooding. JLD steering committee agrees with staff's recommendation on endorsing use of FERC standards for building flood protection features.
- **September 20, 2012** – Staff issues letter answering Duke's June 14, 2012, letter, accepts FERC standards for flood walls, and establishes start date and end date for modification timeline (ML12219A163).