Group J

FOIA/PA NO: 2012-0325

RECORDS BEING RELEASED IN THEIR ENTIRETY

Harold Chernoff Reviewed w/ on 7/11/06 · Me · Joe Shea · Mike E Bob · Lenr

TIA

Could you please provide answers to the following questions in relation to the licensing basis for flooding (GDC-2) for the standby shutdown facility (SSF) at Oconee Station?

I. *Details of Design Basis Issue Related to External Flooding*

On May 18, 1978, the NRC sent the licensee a RAI regarding the proposed SSF design. Question 6 asked, "Some equipment appears to be below grade. Provide the design features needed to prevent flooding. Provide the maximum limiting flood elevation at the structure location."

On **June 19, 1978**, the licensee responded to question 6 of the May 18, 1978, RAI as follows:

> "Normal groundwater infiltration of the Safe Shutdown Facilities Equipment Enclosure will be limited by standard waterproofing techniques. **Flood studies documented in the Oconee FSAR, Section 2.4.3 show that Lake Keowee and Jocassee are designed with adequate margins to contain and control floods so as to pose no risk to the Oconee Station site.** The Safe Shutdown Facility is within the site boundary, southwest of the Unit 2 Reactor Building, therefore, it is not subject to flooding from lake waters. The Safe Shutdown Facility will be waterproofed to an elevation slightly above yard grade to prevent inflow of yard surface waters."

A February 2, 1982 study, found in OSC-631 (SSF Design), concludes that a Jocassee Dam failure will overtop the Keowee Dam by 4 feet for 2.4 hours, resulting in 32.5 feet of flood water on site.

On **July 17, 1982**, the NRC sent the licensee a RAI regarding the SSF. Question 8 of the RAI asked "State the elevation of the grade level entrance to the SSF. If this elevation is below the maximum lake levels, provide a discussion of the means by which the equipment within the SSF is protected from the effects of flooding caused by an unisolable break of the non-seismic CCW system/piping located in the Turbine Building. The discussion should also state the maximum expected water level within the site boundary should such an event occur." (SRI comment. Since 1978, the licensee had convinced the NRC reviewers that the only flooding of concern would be from a turbine building circulating water pipe failure.)

Question 19 of the RAI asked "Describe those features of the design that assure that single failures within SSF components or that **design basis events do not result in consequential failures of the SSF** that would lead to conditions which exceed that for which safety systems have been designed."

On **September 20, 1982**, the licensee responded to question 8 and 19 of the July 17, 1982, RAI, as follows:

> Q8) "The elevation of the grade level entrance to the SSF is EL 797 + 0. This

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elevation is below Keowee full pond elevation of 800 as well as the maximum lake elevation of 808. (Ref. Oconee FSAR, Section 2.4.3). In the event of flooding due to a break of the non-seismic CCW system/piping located in the Turbine Building, the maximum expected water level within the site boundary is EL 796.5. Since the maximum expected water level is below the elevation of the grade level entrance to the SSF, the structure will not be flooded by such an incident."

> Q19) "Interconnections to essential plant systems have been inherently minimized by the SSF design objective (alternate means to achieve hot shutdown). The only ties to essential systems are the interconnection of the power and control "swap over" for selected valves and the piping tie to the Emergency Feedwater System and reactor coolant pump seals. SSF ties to the existing plant are such that no SSF failure will result in consequence more severe than those analyzed in the FSAR.".

A January 17, 1983, 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 memo also states that, "Similar dam failure studies were done for the Oconee PRA study as documented in the March 15, 1982 Memo to File and April 5, 1982 letter to K S Canady."

On April 28, 1983, the NRC sent the SSF SER to the licensee, which contained the following:

> Section 4.8 Flooding Review
>
> DPC has concluded that the most likely reason for flooding of the turbine building would be from a condenser circulating water pipe break resulting from a seismic event. The licensee therefore decided that the SSF would be a seismic Category 1 structure [which implies it is designed to withstand the effects of tornadoes]. The missile & spectrum upon which their analysis is based, is in conformance with the guidelines of the SRP Section 3.5.1.4, Revision 1, for a tornado Zone 1 site. The grade level entrance elevation of the SSF is 797.0 feet above mean sea level (msl). This elevation is below Keowee full pond elevation of 800 ft. as well as the maximum lake elevation of 808 ft. However, in the event of flooding due to a break in the non-seismic condenser circulating water (CCW) system piping located in the turbine building, the maximum expected water level within the site boundary' is 796.5 ft. Since the maximum expected water level below the elevation of the grade level entrance to the SSF, the structure will not be flooded by such an incident. In addition, the structure will be water proofed to prevent infiltration of normal ground water. **Thus, the structure meets the requirements of GDC 2, and the guidelines of Regulatory Guide 1.102 with respect to protection against flooding.**

OSC-631 (SSF Design), contains the initial design of the 5 foot flood barriers located at the North and South entrances of the SSF, and is dated **June 8, 1984.** (Comment from SRI. *The licensee considered the flood threat significant enough to install flood barriers* around the SSF, but not significant enough to inform the NRC prior to licensing of the SSF.)

Question 1. Should the licensee have provided the known information on flooding of the site for the Jocasse dam failure? 50.71e, yes

Question 2. If the licensee had submitted the information of flooding from Jocasse, would the licensing basis have included a Jocasse dam break with flooding up to 4.71 ft for 2.4 hours? ? would've been up to tech staff. • unknown at the time

Question 3. Does the failure to provide the information to the NRC prior to issuance of the SER constitute a 50.9 violation for failure to provide complete and accurate information? No, because it is before 50.9

when did 50.9 come into existance, Mel believes before 1986

II. ***Additional Details and 50.59 Issue*** ⇒ AE act

On **October 9, 1987**, IN 87-49, Deficiencies in Outside Containment Flooding Protection was issued.

what is the likely credible flooding scenario?

This IN was "...provided to alert recipients to a potentially significant problem pertaining to the flooding of safety-related equipment as a result of the inadequate design, installation, and maintenance of features intended to protect against flooding."

The IN discusses "... the potential for the loss of safe shutdown capability as a consequence of potential flooding of safety-related equipment outside containment."

TIA w/ licensee? - no

The IN goes on to state that, "Serious consequences may result if the design features of the plant are not adequate to direct the resulting flood water safely away from important equipment. Such design inadequacies may result from (1) the inadvertent use of non-conservative assumptions in the flooding design analysis, (2) the failure to recognize all possible flooding flow paths, (3) the failure to install flood protection features that have been determined to be necessary, or (4) the failure to properly maintain installed flood protection features."

A **March 20, 1990,** internal licensee letter and a April 16, 1990, followup internal licensee letter document the Duke sites attempt to use IN 87-49 and design studies to identify flooding deficiencies. Oconee's design study is identified as ONDS-268, Identification of Outside containment Flood Protection Barriers.

A **June 21, 1990,** internal licensee letter discusses the scope of Oconee's effort for ONDS-268 and that the results of the study will be used to create a DBD on flooding. The letter specifically states that, "A review of all applicable design documents (drawings, specifications, calculations, etc.) will be made in order to compile a list of flooding protection features. A review of the applicable Station Probabilistic Risk Assessment (PRA) will be made to determine flood sources or flood events associated with each flood protection feature. Features identified will have their function described and their relation to flooding states." The letter goes on to state areas of responsibility and a schedule for completion of the study with a final due date of December 31, 1991.

A **February 15, 1991,** internal licensee letter documents the completion of identifying the flood events for ONDS-268 (Identification of Outside containment Flood Protection

Barriers) and high risk areas derived from the Oconee PRA. With respect to the SSF, the letter states that, "**The SSF is equipped with 5 ft. flood barriers at its two entrances, and has otherwise been made impervious to site flooding. Therefore, the SSF would be available to mitigate all external flooding sequences.** Two sump pumps in the basement of the SSF building eliminate interior flooding of the SSF safety related equipment."

A **December 20, 1991,** internal licensee letter documents the discovery of an unsealed flood penetration surrounding the CO_2 piping entering SW corner of the SSF. The deficiency was discovered during the Oconee Design Study, ONDS-268, Identification of Outside containment Flood Protection Barriers. PIR (Problem Investigation Report) 4-092-0052 was generated for the deficiency, on March 30, 1992.

An attachment to the letter discusses "Features for Protection from External Floods" and states that, "The Oconee PRA identifies two potential events that could lead to external flooding of the Oconee site. The first is a general flooding of the rivers and reservoirs in the area due to a rainfall in excess of the Probable Maximum Precipitation (PMP). The FSAR addressees Oconee's location as on a ridge 100' above maximum known floods. Therefore, external flooding due to rainfall affecting rivers and reservoirs is not a problem. The second source of external flooding is a failure of the Jocassee Dam. Failure of the Jocassee Dam would result in a postulated wave height of 4.71 feet in the yard at the oconee site. The SSF provides Oconee's most secure method of safely shutting down the plant following an external flood due to a Jocassee Dam failure." With regards to the SSF, the attachment also discusses the 5 foot flood wall at the North and South entrances to the SSF, along with the SSF sump and its pumps and level control switches.

A December 10, 1992, Jocassee Dam Failure Inundation Study (FERC Project No. 2503) predicted that a Jocassee Dam failure could result in flood waters of approximately 12.5 to 16.8 feet deep at the Oconee Nuclear Site.

A December 14, 1993, memo to file documents the results of the Jocassee Dam Failure Inundation Study. The memo discusses the differences between the 1992 FERC and the 1983 PRA study (12.5 to 16.8 feet of water on site, compared with 4.71 feet of water). **The memo also states that the Oconee FSAR and PRA will be revised to reflect the potential loss of the SSF during a Jocassee Dam failure.**

On **March 31, 1994,** IN 94-27, Facility Operating Concerns Resulting From Local Area Flooding was issued. This IN was issued "... to alert addressees to emergency preparedness, equipment operability and radiological control problems that may result from local area flooding."

The IN discusses that, "This event demonstrates that flooding problems and degradation of equipment may be caused by water inleakage even though flood waters are not above grade elevations. Water leaking through underground walls may impinge on electrical equipment or may enter radiologically controlled areas and spread contamination to other areas. Underground cable and pipe tunnels may become flooded and serve as pathways for water to enter plant buildings. Management and plant personnel attention to these conditions is important to ensure that equipment is protected and unsafe facility conditions are not created."

On June 2, 1994, OSC-5781, USQ Evaluation for Change in FSAR Concerning SSF and Jocassee Flood, was approved. The calculation discusses the rationale behind using 50.59 to remove information in the SSF portion of the FSAR with regards to external flood protection of the site during a Jocassee Dam failure (using 1983 PRA study flood level of 4.71 feet on site). The calculation states that, "**FSAR Section 9.6 was revised in the 1992 Update of the FSAR to address external flood protection of the yard as a result of the rapid failure of the Jocassee Dam.** The information was determined to describe a PRA study and is not part of the design basis for Oconee. The FSAR statements are to be revised or removed to correct the information in the FSAR and reflect the existing licensing basis of Oconee."

On June 13, 1994, Flooding from External Sources DBD was issued. Section 2 discusses GDC 2 and that SSC important to safety shall not be effected by flooding and maximum precipitation. Section 3.2.6, Potential Dam Failure, states that, "Dam breaks have no bearing on the design basis flood."

Question 4. Should the Jocasse dam break and flooding response requested by the INs constitute an "analysis requested by the Commission" which would require the updated information be included in the next update to the UFSAR?

No, for IN

Question 5. The Jocasse dam break and flooding of the Oconee site was included in the 1992 update to the UFSAR. This update also included the use of the 5 ft walls at the SSF to preclude flooding. Was it appropriate to use the 50.59 process to remove the Jocasse flood from the UFSAR in 1994?

yes for IPEEE 88-20 analysis should've been included

need
- Old FSAR
- revised FSAR
- 50.59

Q4 should be reworded

See, Kenneth

From: Melanie Galloway
Sent: Monday, October 20, 2008 3:27 PM
To: Michael Case; Patrick Hiland; Frederick Brown; Brian Holian; Joseph Giitter; Michele Evans; William Ruland; John Lubinski; Sam Thomas; Robert Nelson; Samson Lee; Theodore Quay; David Skeen; Mark Cunningham; Tom Blount; Jared Wermiel; Michael Cheok; Mike Franovich; Melanie Wong; Jeff Circle; Jon Thompson; Leonard Olshan; Kamal Manoly; Goutam Bagchi; Kenneth See; James Vail; Raman Pichumani; DORLCAL Resource; Ebony Smith; Leonard Wert; Tim McGinty; Jon Thompson
Subject: Background for LT meeting tomorrow on Oconee External Flooding Issue
Attachments: Oconee Jocassee Flood - For LT 10-20-08-2.ppt; Oconee Jocassee Flood - For LT (Separated background) - 10-20-08.ppt; Oconee 50.54(f) Letter Sent to Duke ML0816402440.pdf

1st attachment is publicly available as ML14058A028.

Last attachment is publicly available as ML081640244.

LT and others:

In preparation for tomorrow's LT meeting, please find attached the presentation, a background package and the agency's 50.54(f) letter to Duke.

If you have a few moments before the meeting to review the presentation, you may find doing so helpful in terms of the discussion tomorrow.

Melanie

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Oconee Flood Protection and the 10 CFR 50.54(f) Response

Background Material

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Site Background

Oconee Nuclear Station

- Three nuclear units located in Seneca, SC
- Operational in 1973-74
- Plant located down river of Lake Keowee and Lake Jocassee
- Only nuclear plant in the United States that relies on hydro-electric generators located in one dam as emergency power source
- Plant relies on the Standby Shutdown Facility (SSF) to maintain reactor shutdown in case of fires, floods, or sabotage events.

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The Jocassee Dam

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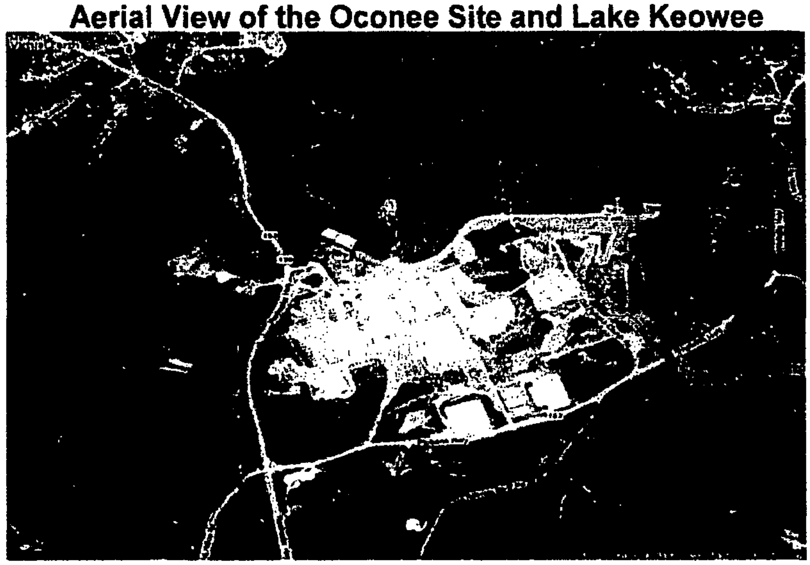
Aerial View of the Oconee Site and Lake Keowee



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Issue Background

- NRC inspection identified flood protection issue with Oconee Standby Shutdown Facility (SSF).
  - Potential lack of adequate flood protection and defense-in-depth upon loss of SSF
  - Five-foot walls constructed over SSF entrances to protect against Jocassee Dam failure based on unavailable inundation study
  - Duke Hydro/FERC Inundation Study completed in early 1990s. Estimated flood heights up to 16.8 ft above SSF grade level
  - Dam random failure frequency was significantly underestimated.
  - White finding on specific deficiency
- Staff response
  - Performed backfit analysis
  - Issued 10 CFR 50.54(f) letter for Duke to address external flooding concerns
  - Evaluation of current fleet for flood vulnerabilities underway
  - Security interface with NSIR and DHS

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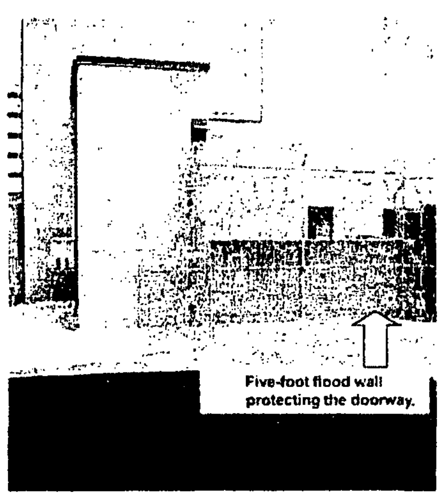
The SSF Flood Barriers



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Adequate Protection

- Adequate protection is perceived as a foundation to regulation. Nominally, it is expected to be provided through a licensee's compliance to regulation.
- At the lowest limit, the licensee should provide protection against natural phenomena including external flood hazards.
- The GDC does not specify the source of flooding. The site must have adequate protection from all flooding
  - Whether natural phenomena cause the direct catastrophic flood
  - One brought on by a failed dam upstream.

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10 CFR 50.109 Backfit Evaluation

- Backfit evaluation: external flooding is within Oconee's licensing basis. Licensee did not address Jocassee dam failure as a source of external flooding.
- Staff determined increased flood protection is a backfit.
- "Adequate Protection" based backfit is best approach.
  - No defense-in-depth: 3-unit core damage event with ultimate failure of each containment.
  - Regulatory expectations for external flood protection includes dam hazards.

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Team Members

SES - Management
- Melanie Galloway (DD/DRA)
- David Skeen (DD/DE)
- Sam Thomas (DD/DORL – acting)

DRA – Risk Assessment and Dam Failure Frequency
- Mike Franovich (BC/APOB)
- Jeff Circle (APOB)
- James Vail (APOB)

DE - Structural
- Kamal Manoly (BC/EMCB)
- Raman Pichumani (EMCB)

NRO – Seismic
- Goutam Bagchi (SL:NRO/DSER)

NRO - Hydrology
- Kenneth See (NRO/DSER/RHEB)

DORL – Project Management
- Melanie Wong (BC/LP)
- Leonard Olshan (LP)
- Jon Thompson (LP)

Contributing SES Members
- Mike Case (D/DPR)
- Timothy McGinty (DD/DORL)
- Sher Bahadur (DD/DE – acting)

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Principles of Risk-informed Decision Making Process Used

- Risk insights are integrated with considerations of defense in depth and safety margins.
- Traditional engineering analysis provides insight into available margins and defense in depth
- Topics considered in support of options
  - Likelihood of dam failure
  - Flood analysis (nominal and PMP lake levels)
  - Seismic analysis
  - Basis for continued operation
  - Security

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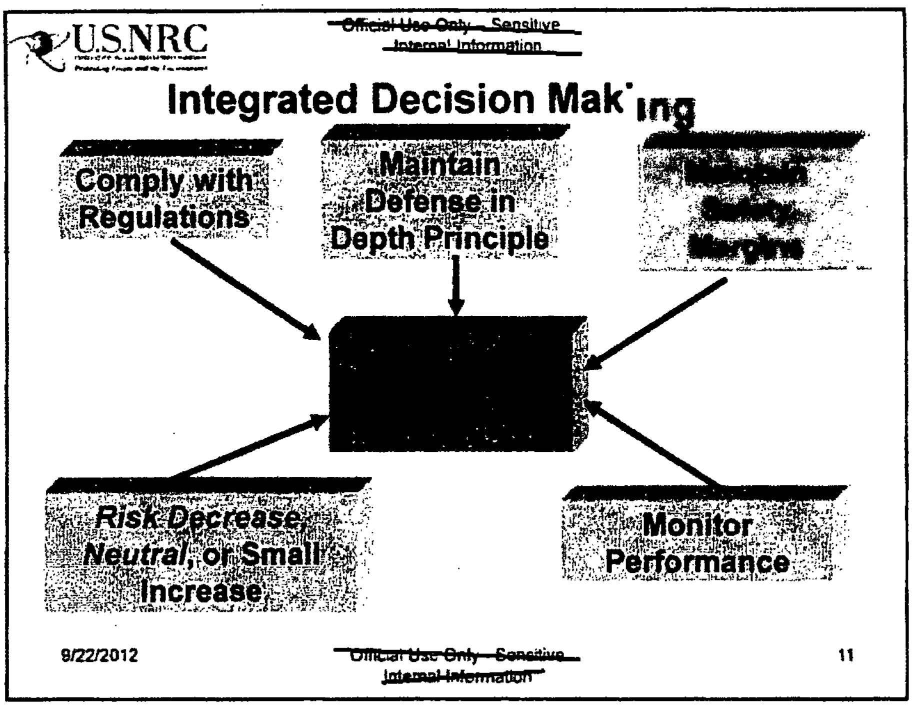
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Integrated Decision Making
Comply with Regulations
Maintain Defense in Depth Principle
[redacted]
Risk Decrease, Neutral, or Small Increase
Monitor Performance
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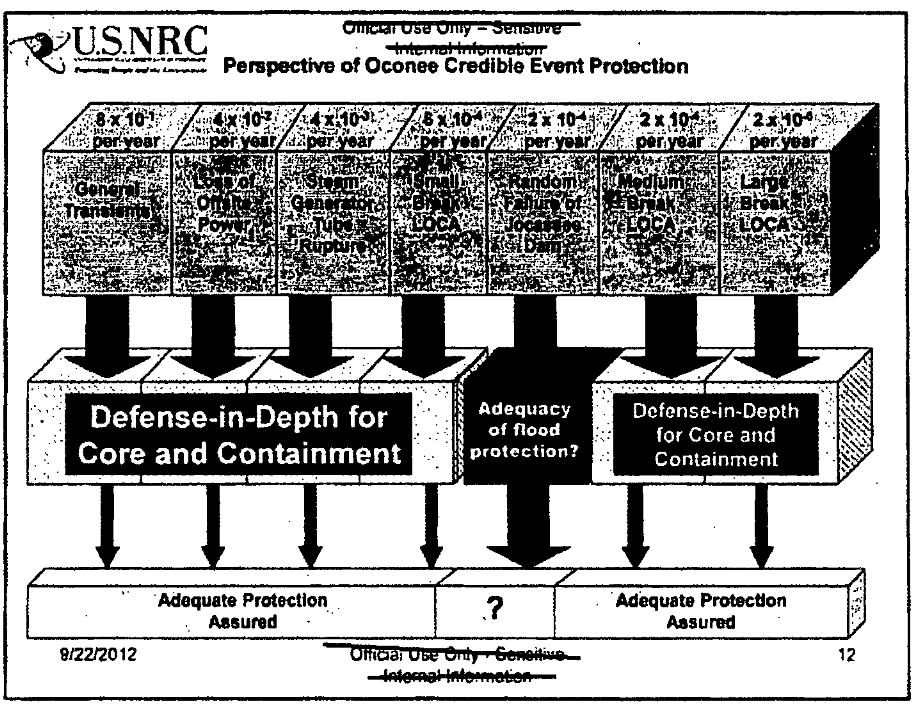
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Perspective of Oconee Credible Event Protection
8 x 10-1 per year
General Transients
4 x 10-2 per year
Loss of Offsite Power
4 x 10-3 per year
Steam Generator Tube Rupture
8 x 10-4 per year
Small Break LOCA
2 x 10-4 per year
Random Failure of Jocassee Dam
2 x 10-4 per year
Medium Break LOCA
2 x 10-6 per year
Large Break LOCA
Defense-in-Depth for Core and Containment
Adequacy of flood protection?
Defense-in-Depth for Core and Containment
Adequate Protection Assured
?
Adequate Protection Assured
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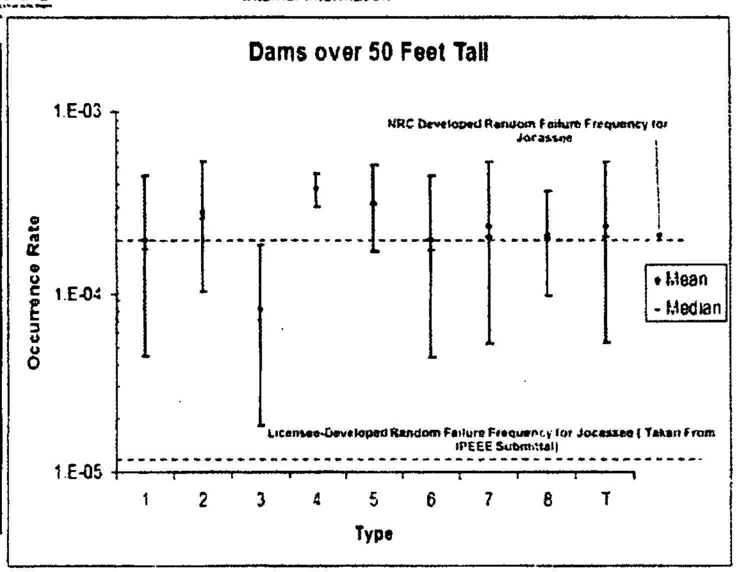
Summary of Failure Probability Frequency Issues of Licensee Response

1	Buttress Dams Over 50 Feet High
2	Arch Dams Over 50 Feet High
3	Concrete Dams Over 50 Feet High
4	Earth Dams Over 50 Feet High
5	Gravity Dams Over 50 Feet High
6	Masonry Dams Over 50 Feet High
7	Multi-Arch Dams Over 50 Feet High
8	Rockfill Dams Over 50 feet high
T	Total



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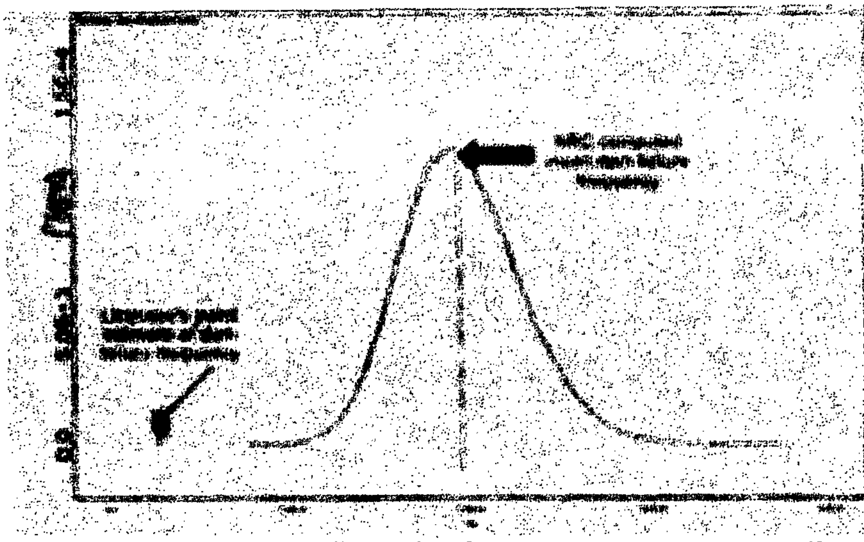
Probability Density of Jocassee Dam Failure Frequency



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Summary of Hydrology Issues of Licensee Response

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Flood Analysis for Oconee Nuclear Station

- The licensee proposed to use the Hydrologic Engineering Center River Analysis System (HEC-RAS) to model and estimate the flood depth at the ONS.
- HEC-RAS is a one-dimensional hydraulic model used to model networks of canals and reaches of rivers.
  - Typically, one-dimensional models are not appropriate near complex topography and submerged structures
  - Limitations of using a one dimensional model:
    - Flow path is parallel to stream path
    - Quantities such as velocity are uniform across the river.
    - Quantities such as velocity are uniform with depth.

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Flood Analysis for Oconee Nuclear Station.

Site Topography at Oconee Nuclear Station.

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Flood Analysis for Oconee Nuclear Station

- 1983 Study (Case 1) (Documented by KA Anthony in Memo)
  - Failure time of 2 hours
  - Median breach width of 575 ft
  - Maximum flood height of 4.7 ft (Sunny Day Failure)
  - PMF not considered
  - Licensee responded by building a 5 ft flood wall
- 1992 Study (Study Requested by FERC)
  - Failure time of 4 hours
  - Median breach width of 575 ft
  - Maximum flood height of 12.5 ft (Sunny Day Failure)
  - Maximum flood height of 16.8 ft (PMF with dam failure)
  - Predicted flood overtops SSF after 5 hours
  - Licensee took no action
- No explanation was given for adjusting failure time from the 1983 value (2 hours) to the 1992 value (4 hours).

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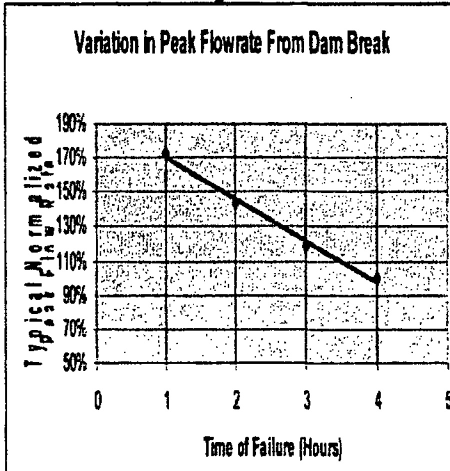
Sensitivity of Flood Analysis

- Any reduction in the failure time for Jocasseee dam will directly reduce the amount of response time. For example, a reduction in the failure time from 4 hours to 2 hours would mean the SSF would overtop in 3 hours not 5 hours, causing core damage to occur 2 hours earlier.
- Also any reduction in the time of failure for Jocassee dam would increase the maximum flow rate and flood height



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Summary of Seismic Issues of Licensee Response

Inadequacies of Jocassee Dam Seismic Fragility Based on Duke 2007 Submission

- Updated seismic hazard curves of ground motion are not up-to-date
  - Used a relatively low review level ground motion that did not reveal non-linear failure of critical slope surfaces
- Soil liquefaction and soil-structure interaction analysis was not done by Duke
  - Increased vertical settlement over time implies probability of soft material at base of dam which may have a liquefaction potential
  - SSE analysis using a suitable dynamic analysis or testing
- Assumed failure modes do not include catastrophic failure surface

See, Kenneth

From: Goutam Bagchi
Sent: Tuesday, October 21, 2008 1:35 PM
To: Richard Raione; Nilesh Chokshi
Cc: Scott Flanders; Kenneth See; Rebecca Karas; Clifford Munson; Melanie Galloway; Mike Franovich
Subject: NRR LT Meeting: Oconee 50.54f Response
Attachments: Oconee Jocassee Flood - For LT 10-20-08-2.ppt; Oconee Jocassee Flood - For LT (Separated background) - 10-20-08.ppt; Oconee 50.54(f) Letter Sent to Duke ML0816402440.pdf

Rich and Nilesh,
This is to keep you informed about the strategy meeting with the LT to elicit their recommendation for the path forward for future action on the Oconee Licensee. Ken See and I attended the meeting this morning and our technical input was incorporated in the background slides. The LT meeting was in preparation for the ET briefing. By the end of October there will be a high level management meeting to let Duke know about the path for resolution of the adequate protection issue on site flooding due to dam break.

Melanie Galloway and Mike Franovich made an excellent presentation. I believe that our participation was effective.

I have included the material that was provided to the LT. This entire issue and the associated presentation material is sensitive and not to be shared. Thank you.
Goutam
301-415-3305

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Oconee Flood Protection and the 10 CFR 50.54(f) Response

NRR ET Meeting

October 23, 2008

Objectives

- Purposes
  - Summarize the licensee's responses
  - Discuss the staff's evaluation
  - Receive ET feedback on the merits of proposed key messages to the licensee

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Background

- NRC inspections in 1994 and 2005
  -- issues regarding Oconee external flooding licensing basis
- FERC-required inundation study (1992)
  -- site flood height as high as 16.8 feet
- Unclear demonstration of flood height for adequate protection
- Underestimated Jocassee Dam failure frequency
- 10 CFR 50.54(f) letter to Duke to address flooding concerns

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Principal 10 CFR 50.54(f) Questions Regarding Oconee Flood

1. Explain the bounding external flood hazard at Oconee and the basis for excluding consideration of other external flood hazards, such as those described in the Inundation Study, as the bounding case.
2. Provide your assessment of the Inundation Study and why it does or does not represent the expected flood height following a Jocassee Dam failure.
3. Describe in detail the nuclear safety implications of floods that render unavailable the SSF and associated support equipment with a concurrent loss of all Alternating Current power.

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Licensee's Response

- Written response
  - Assessed inundation levels based on current drought conditions
  - Committed to increase current flood walls by 2.5 feet by February 2009
  - Proposed further analysis by February 2010
  - Relied heavily on test and inspection of dam to support low frequency assumptions
  - Asserted that seismic failure is "not credible"
  - Asserted that other dam failure modes (i.e., overtopping) "not credible"
- Oral response
  - Stated that watertight doors could be procured for the SSF
  - Stated that SSF walls can accommodate the impact of a 16.8 foot flood

Review of Licensee's Response

- Interim continued operation acceptable if:
  - Licensee commits to water management of Jocassee Lake levels
  - Licensee addresses SSF availability
- Insufficient basis for final resolution—current and future
  - Limited scope
    - Lack of adequate seismic analysis
    - Lack of a probable maximum precipitation (PMP) analysis
  - Inadequate dam failure modeling
    - Time of failure
    - Size of breach
    - Analysis model
  - Inadequate probabilistic argument

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Proposed Key Messages For November 5, 2008 Meeting with Licensee

- Interim continued operation acceptable if:
  - Licensee commits to water management of Jocassee Lake levels
  - Licensee addresses SSF availability
- Insufficient basis for final resolution—current and future
  - Limited scope
    - Lack of adequate seismic analysis
    - Lack of a probable maximum precipitation (PMP) analysis
  - Inadequate dam failure modeling
    - Time of failure
    - Size of breach
    - Analysis model
  - Inadequate probabilistic argument
- SSF improvements
  - Scope, timing, and commitment unclear
- Emphasis on timely resolution
- Letter conveying these concerns will be issued by November 21, 2008

See, Kenneth

From: Jeffrey Mitman
Sent: Tuesday, April 28, 2009 10:26 AM
To: Kenneth See
Subject: FW: Duke Jocassee/Keowee Breach (HEC-RAS) Report is Now on SharePoint

Ken, here is the general link to the Oconee SharePoint site. In the upper-left corner is a link to the "Shared Documents." On that page is a list of folders and the HEC-RAS report is in the "Duke Procedures and Calculations" folder.

Jeff

http://portal.nrc.gov/edo/nrr/ofi/default.aspx

From: Jeffrey Mitman
Sent: Monday, April 27, 2009 11:51 AM
To: Allen Howe; Andy Hutto; Anne Boland; Antonios Zoulis; Bradley Davis; David Skeen; Eric Riggs; Fernando J Ferrante; Goutam Bagchi; James Vail; Jeff Circle; Jeffrey Mitman; John Stang; John Vera; Jonathan Bartley; Joseph Giitter; Juan Uribe; Kamal Manoly; Kenneth See; Kimberly Sexton; Leonard Wert; Meena Khanna; Melanie Galloway; Melanie Wong; Raman Pichumani; Robert Carroll; Walt Rogers
Subject: Duke Jocassee/Keowee Breach (HEC-RAS) Report is Now on SharePoint

The subject 579 page report is now on the Oconee Flood Issue SharePoint site in the directory called "Duke Procedures and Calculations." It is available for download. A hard copy is in Melanie Wong's office.

Jeff Mitman

-V/4

Ferrante, Fernando

From: Melanie Galloway
Sent: Friday, May 08, 2009 11:56 AM
To: Christopher Cook; Kenneth See; James Vail; Fernando J Ferrante
Subject: FW: Duke Slide4s for the 05/11/09 Meeting
Attachments: 51109 NRC Meeting Presentation.pdf

Slides are ML091380424.

See attached for slides Duke plans to present at the meeting Monday.

Fernando, I am interested in knowing what you think of what they have presented on RGs and standards (largely slides 29 and 30).

For those of you attending the meeting Monday, I suggest that you review these slides in advance. If there is anything of note from your review, please forward.

Thanks.

From: John Stang
Sent: Friday, May 08, 2009 11:17 AM
To: Melanie Wong; Melanie Galloway; Mark Cunningham; Meena Khanna; Andy Hutto; Allen Howe; Robert Carroll; Bradley Davis; Joseph Glitter; Anne Boland; David Skeen; Kimberly Sexton; Catherine Marco; Raman Pichumani; George Wilson; Jeffrey Mitman; Jeff Circle
Subject: Duke Slide4s for the 05/11/09 Meeting

FYI

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Ferrante, Fernando

From: Galloway, Melanie
Sent: Monday, November 30, 2009 9:10 PM
To: Ferrante, Fernando; Mitman, Jeffrey; James, Lois
Cc: Cunningham, Mark
Subject: FW: USBR Jocassee Dam Inundation Study Review Summary
Attachments: SUMMARY OF THE US BUREAU OF RECLAMATION REVIEW OF THE JOCASSEE DAM INUNDATION STUDY PERFORMED BY HDR-DTA FOR DUKE ENERGY.doc

Fernando's brief but informative summary of USBR's review of the recent Jocassee assessment seems to echo in a highly parallel fashion concerns we in DRA have consistently voiced. I am curious as to how DE proposes to reconcile their expert's views with the direction they instead seem to be taking. Any word?

From: Ferrante, Fernando
Sent: Monday, November 30, 2009 9:03 AM
To: James, Lois
Cc: Galloway, Melanie; Mitman, Jeffrey
Subject: USBR Jocassee Dam Inundation Study Review Summary

Attachment is part of ML13063A508.

Lois,

I made a brief summary of the USBR review of the JD Inundation Study. I came out of the NRC Hydrology Workshop with a strong sense that there are items and efforts taking place (i.e., the USBR JD study itself and the updating of precitation records for the Carolinas) that have important insights into the past work we have done that may we may not be fully aware of. Additionally, there seems to be a need for a centralized document that describes the main technical items and the milestones that took place in the last few years on this issue (especially as we prepare to submit the generic issue to the GIP). A Q&A was being developed for this item, but it seems to me a stronger document is necessary, even if it's just internal to DRA.

Thank you,

Fernando Ferrante, Ph.D.
Office of Nuclear Reactor Regulation (NRR)
Division of Risk Assessment (DRA)
Operational Support and Maintenance Branch (APOB)
Mail Stop: 0-10C15
Phone: 301-415-8385
Fax: 301-415-3577

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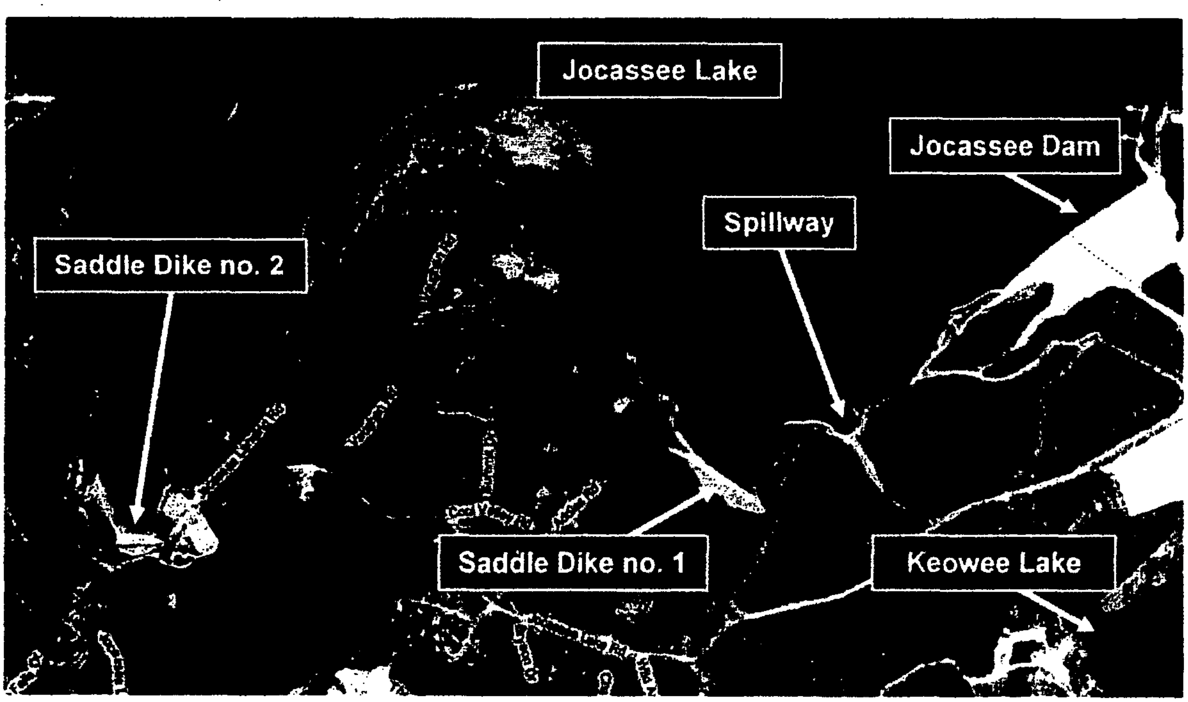
SUMMARY OF THE US BUREAU OF RECLAMATION REVIEW OF THE JOCASSEE DAM INUNDATION STUDY PERFORMED BY HDR/DTA FOR DUKE ENERGY

On July 6, 2009, the U.S. Bureau of Reclamation (USBR) completed a review of the March 2009 report titled "Oconee Nuclear Station, Jocassee-Keowee Dam Breach Model Report" prepared by HDR/DTA, Charlotte, NC, for Duke Energy Carolinas, LLC, Charlotte, NC. This review was requested by the Division of Engineering in U.S. Nuclear Regulatory Commission's (NRC) Office of Nuclear Reactor Regulation. The following major findings and recommendations are made in this review:

FAILURE MODES

USBR states that a piping failure is the most likely scenario for Jocassee Dam based on the December 2004 report titled "2004 Part 12 Inspection Report, Jocassee Pumped Storage Development Keowee-Toxaway Project" prepared by Findlay Engineering, Inc., for Duke Power, Charlotte, NC. In this report, a contractor performed a Potential Failure Mode Analysis (PFMA) to identify and develop an understanding of potential failure modes for Jocassee Dam as part of a Federal Energy Regulatory Commission (FERC) program.

However, USBR highlights that the current Probable Maximum Flood (PMF) that allows for 2.2 feet of freeboard at Jocassee Dam assumes successful operation of the spillway gates. USBR considers that overtopping could occur from a failure to operate the spillway gates under PMF conditions, depending on the performance of two saddle dikes located west of the main dam (see Figure below). If the saddle dikes breach first, the possibility of overtopping at Jocassee Dam could be reduced. Two recommendations are made: (1) assess the potential severity in the depth and duration of overtopping at Jocassee Dam to justify its inclusion or exclusion as a potential failure scenario, (2) evaluate any impact due to ongoing updates on the PMF that may result in larger volume and/or peak discharge values for Jocassee Dam.



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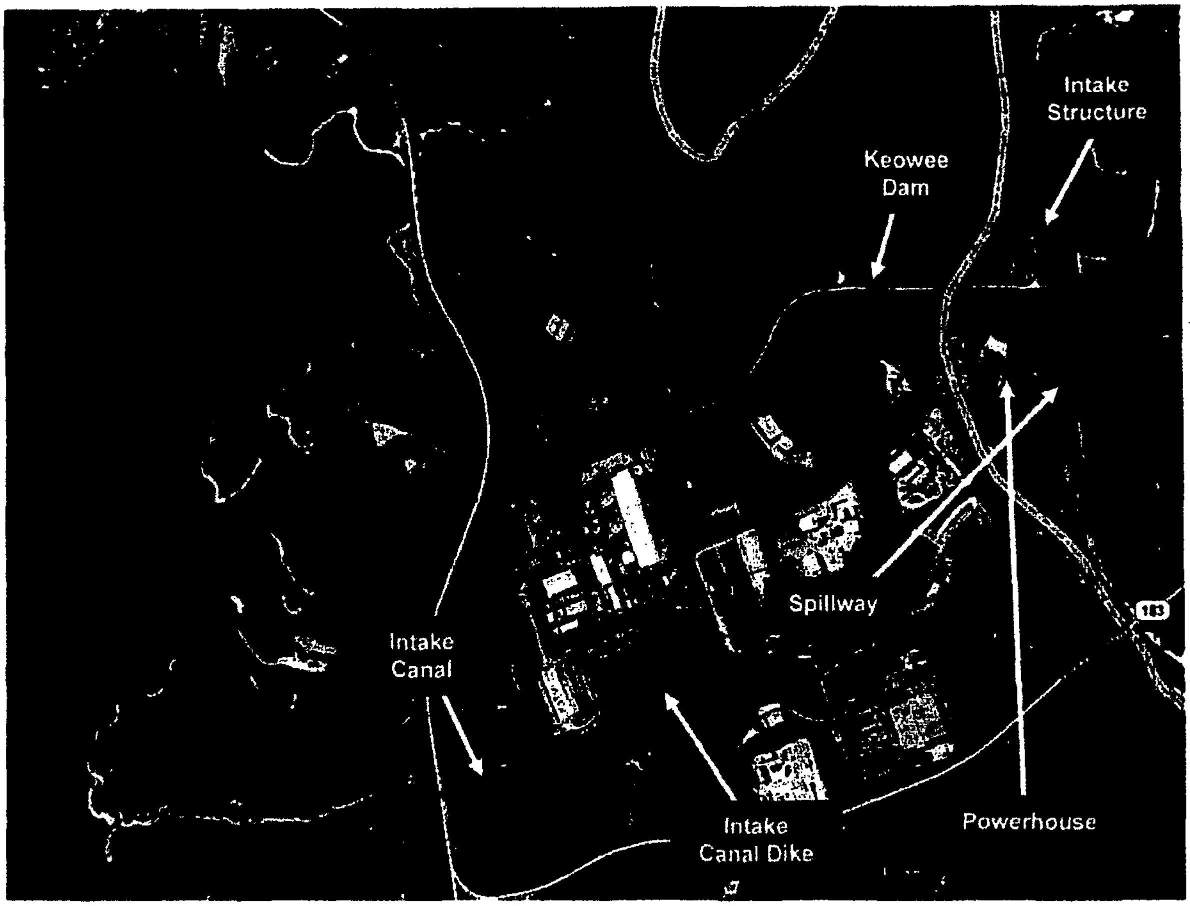
~~INTERNAL USE ONLY - SENSITIVE INFORMATION~~



Mitman, Jeffrey

From:	Galloway, Melanie
Sent:	Wednesday, December 09, 2009 11:49 AM
To:	Mitman, Jeffrey; James, Lois
Subject:	RE: JCO

I fully agree with Jeff's points outlined below.

I have two comments:
1. I'd reword the first bullet so it doesn't appear at the outset that we are agreeing with DE's approach. See suggestion below.

2. I would add a sentence (or two as needed) that notes the lack of current implementable procedures for saving the SSF.

And should we include a statement like "as the NRR organization responsible for assessing public risk, we are not currently in a position to agree with all of the bases of this proposed change."?

Strategy: Jeff should send to Meena and George and copy me and Lois. I will then forward to Dave and suggest we have another meeting (in addition to the one I have suggested for Dec. 14 on the analysis and "closure" plan) to discuss.

From: Mitman, Jeffrey
Sent: Wednesday, December 09, 2009 11:13 AM
To: Galloway, Melanie; James, Lois
Subject: FW: JCO
Importance: High

Melanie and Lois, in November George Wilson reviewed the JCO for continued operations of ONS from the perspective that Duke may exceed the original 2 years considered in it. Subsequent to his initial review, it is obvious that Duke will exceed the original 2 years addressed in the JCO. At the end of this email thread, he laid out his arguments on why it was OK for NRR to continue ONS operations. My comments with his arguments are given below.

When he originally sent out his email he requested that comments be expedited, however, this topic may have lost its urgency. One reason it may have lost this urgency is that NRR is considering asking Duke to write and submit a JCO. It is my understanding that this was discussed at the recent Duke/NRR meeting of December 2nd. (Lois, I forgot to bring up this last point in our discussions.)

Lois and I have discussed my response, however, before sending them on to DE, you may want to weight in. Please let me know if you want to discuss.

Jeff

From: Mitman, Jeffrey
Sent: Sunday, November 29, 2009 11:01 PM
To: James, Lois
Subject: RE: JCO
Importance: High

Lois, here are my comments on the re-evaluation of the JCO. We owe comments to DE, but I'm reluctant to send these on without first discussing them within DRA.

J/7

- The argument used in the original JCO regarding the condition of the dam and the probability of its failure are still applicable today. That is, the condition of the Jocassee Dam has not deteriorated and our basic understanding of the issues regarding the probability of a Jocassee Dam failure and its consequences have not changed substantially.
- However, the completeness of our knowledge is substantially improved. At the time of the JCO determination, Duke claimed that given a Jocassee failure the inundation height at the SSF would not threaten the SSF. The recent 2D analysis indicated that this is not the case: Given a catastrophic failure of Jocassee, the SSF will be inundated. Likewise, the inundation at the ONS will not only inundate the SSF but also flood the turbine building, and probably the auxiliary building(s) as well. In addition, Duke's 2D draft analysis indicates that once the flood waters pass the ONS the site will remain flooded to a depth of ~1 foot at the SSF (see the October 28th, 2009 presentation by Duke to the NRC slide 26), this is new information. These insights indicate that it is highly unlikely that equipment in the turbine, auxiliary or SSF buildings will be recoverable in the near term after the site is flooded.
- The current DE perspective gives some weight to the mitigation strategy completed at the beginning of 2009. This strategy was written before Duke completed their re-analysis of the Jocassee Dam failure using a more detailed 1D (HEC-RAS) model and before the detailed 2D analysis was performed. This strategy relies upon an assumption that plant personnel will have 5 hours to cool down the 3 Oconee units and prepare them for the forth coming inundation. The event timing from the new 2D analysis results appears to invalidate this key assumption and therefore, the validity of this mitigation strategy as currently written.
- Finally, the DE perspective indicates that the conditional core damage frequency from a Jocassee Dam failure at the time of the original JCO was ~1E-4 per year. Duke has operated the ONS for an additional 2 years without failure, therefore, the CDF remains the same at about 1E-4 While literally correct, this is an inappropriate regulatory perspective. For instance, the NRC does not accept this argument in deterministic Technical Specification space: If a licensee consumes an entire LCO/AOT without rectifying a problem and without an accident, we do not simply double the LCO/AOT and allow the licensee to continue operations. Likewise, in probabilistic space if a licensee had an issue with their plant and had a high CDF and the unit did not experience a core damage event during the subsequent year, we would not ignore the passage of a year and allow the unit to continue operating for another year with the issue uncorrected. With regard to public safety, the simply fact that event did not occur is not justification for continued exposure to the public of that risk.

Jeff

From: Khanna, Meena
Sent: Tuesday, November 24, 2009 10:33 PM
To: James, Lois; Mitman, Jeffrey
Cc: Wilson, George
Subject: FW: JCO

Hi Lois and Jeff,
Pls let me know if you plan to rovide any comments on the JCO that George sent out a few weeks back...we need to finalize this as it was an action item from Mallett...thanks!

Meena

From: Wilson, George
Sent: Tuesday, November 10, 2009 5:58 AM
To: James, Lois; Mitman, Jeffrey
Subject: JCO

Lois and or Jeff could you please provide feedback on the below document ASAP.

I need everybody to look at the internal NRC orginal document that allowed Oconee to continue to operate and see if the new information pertaining to the plant changed the evaluation. **(I.E. there will be approximately 18**

feet of water at SSF) I would like the review with associated comments sent to me by early next week. I greatly appreciate your help and support on this issue.

All, We have received additional information from Duke on the status of the site with the failure of the Jocassee Dam. I re-evaluted the document for allowing Oconee to still operate. The reasons for allowing Oconee to still operate have not changed with the exception of the 2009 FERC inspection showed that the Dam was still in good health. **(The original evaluation also assumed that the SSF would be lost)**

Below are listed the highlights and excerpts for the internal NRC document

As noted in the November 5 meeting, one of the NRC's bases for allowing continued operation of the Oconee units was the timelines until containment failure. Subsequent to the November 5 meeting, the licensee developed Technical Support Center (TSC) guideline, Engineering Manual E.M. 5.3, "Beyond Design Basis Mitigation Strategies," to utilize B.5.b and other equipment to take mitigating actions to provide core cooling and spent fuel pool cooling in the event of a loss of the SSF due to external flooding. The guidelines provide additional information and strategies on what measures the site may take to address such a scenario. The efficacy of these procedures has not yet been demonstrated.

Additional factors, in support of allowing operation through November 2010, are the current apparent health of the dam and the regular monitoring of its condition:

- Duke constantly surveils the performance of the dam by means of on-site cameras and performs offsite monitoring of the observed data from its headquarters office.

- Duke performs biweekly inspection and monitoring of the condition of the dam, as required by FERC.

- FERC personnel inspect the dam annually; the 2007 and the 2008 inspections did not identify any adverse trends in the condition of the dam. Further, the NRC regularly interacts with FERC and receives inspection information regarding the Jocassee dam. **(2009 inspections also showed no adverse trend, health of Dam is still good)**

- While the current health of the dam supported by condition monitoring is sufficient to support the staff's assessment to allow a slight increased risk through November 2010, the overall defense-in-depth and adequate safety margins for protecting ONS are deterministic pending completion of ongoing flood analysis work.

Overall, given the staff's understanding of the dam's health, inspection regime, condition monitoring activities as noted in the deterministic section, and the conservative risk assessment approach, the staff is confident that the estimated conditional CDF is no greater than low 10^{-4}/yr for the interim period till November 2010.

Overall

The staff has determined that continued operation of the Oconee units through November 2010 is acceptable because the Jocassee Dam is not likely to suffer a catastrophic failure, and accident sequence progression timelines to containment failure are on the order of days. Given the short duration to resolve this issue (November 2010), the staff has concluded, as noted at the November 5, meeting with the licensee, that the risk of Oconee continued operations is sufficiently low for this time period, as supported by the deterministic factors of continued condition monitoring and current health of the Jocassee dam and timelines until containment failure.

Further, the staff's conclusion that short-term continued operation of the Oconee units is acceptable was based principally on risk consideration. Specifically, the conditional CDF and conditional LERF for the external flooding of the Oconee units are substantially below the conditional CDF and conditional LERF guidelines of 10^{-3}/yr and 10^{-4}/year, respectively, that are noted in LIC-504. In evaluating the applicable LIC-504 criteria, the increased risk over the short term when balanced against the defense in depth and safety margin criteria of

LIC-504 over the same period was deemed acceptable. Therefore, continued operation during this time period is not inimical to the public health and safety.

George Wilson
USNRC
Electrical Engineering Branch Chief
Mail Stop O9E3
301-415-1711

Mitman, Jeffrey

From: Wilson, George
Sent: Tuesday, December 15, 2009 10:30 AM
To: Mitman, Jeffrey
Cc: Khanna, Meena
Subject: RE: JCO

Jeff, I did not write the original JCO document that was written. I was just evaluating this to see if the overall issue changed based on the new info. You stated that, the argument used in the original JCO regarding the condition of the dam and the probability of its failure are still applicable today. The process now is to have Duke justify the issue not us.

From: Mitman, Jeffrey
Sent: Monday, December 14, 2009 9:59 AM
To: Wilson, George
Cc: James, Lois; Khanna, Meena; Galloway, Melanie
Subject: RE: JCO

George, thanks for the opportunity to comment on the JCO. Here are my comments on the re-evaluation.

- The argument used in the original JCO regarding the condition of the dam and the probability of its failure are still applicable today. That is, the condition of the Jocassee Dam has not deteriorated and our basic understanding of the issues regarding the probability of a Jocassee Dam failure and its consequences have not changed substantially.
- However, the completeness of our knowledge is substantially improved. At the time of the JCO determination, Duke claimed that given a Jocassee failure the inundation height at the SSF would not threaten the SSF. The recent 2D analysis indicated that this is not the case: Given a catastrophic failure of Jocassee, the SSF will be inundated. Likewise, the inundation at the ONS will not only inundate the SSF but also flood the turbine building, and probably the auxiliary building(s) as well. In addition, Duke's 2D draft analysis indicates that once the flood waters pass the ONS the site will remain flooded to a depth of ~1 foot at the SSF (see the October 28th, 2009 presentation by Duke to the NRC slide 26), this is new information. These insights indicate that it is highly unlikely that equipment in the turbine, auxiliary or SSF buildings will be recoverable in the near term after the site is flooded.
- Your current perspective gives some weight to the mitigation strategy completed at the beginning of 2009. This strategy was written before Duke completed their re-analysis of the Jocassee Dam failure using a more detailed 1D (HEC-RAS) model and before the detailed 2D analysis was performed. This strategy relies upon an assumption that plant personnel will have 5 hours to cool down the 3 Oconee units and prepare them for the forth coming inundation. The event timing from the new 2D analysis results appears to invalidate this key assumption and therefore, the validity of this mitigation strategy as currently written. To my knowledge, the current mitigation strategy has not been revised since the beginning of the year, thus it does not take into account the new understanding from the 2D analysis.
- Finally, your write-up indicates that the conditional core damage frequency from a Jocassee Dam failure at the time of the original JCO was ~1E-4 per year, Duke has operated the ONS for an additional 2 years without failure, therefore, the CDF remains the same at about 1E-4. While literally correct, this is an inappropriate perspective. For instance, the NRC does not accept this argument in deterministic Technical Specification space: If a licensee consumes an entire LCO/AOT without rectifying a problem and without an accident, we do not simply double the LCO/AOT and allow the licensee to continue operations. Likewise, in probabilistic space if a licensee had an issue with their plant and had a high CDF and the unit did not experience a core damage event during the subsequent year, we would not ignore the passage of a year and allow the unit to continue operating for another year with the issue uncorrected. With regard to public safety, the simple fact that event did not occur is not justification for continued exposure to the public of that risk.

When you get to the point of revising the actual document, I be happy to take a look at it.

1/8

Jeff

From: Wilson, George
Sent: Tuesday, November 10, 2009 5:58 AM
To: James, Lois; Mitman, Jeffrey
Subject: JCO

Lois and or Jeff could you please provide feedback on the below document ASAP.

I need everybody to look at the internal NRC orginal document that allowed Oconee to continue to operate and see if the new information pertaining to the plant changed the evaluation. **(I.E. there will be approximately 18 feet of water at SSF) I would like the review with associated comments sent to me by early next week. I greatly appreciate your help and support on this issue.**

All, We have received additional information from Duke on the status of the site with the failure of the Jocassee Dam. I re-evaluted the document for allowing Oconee to still operate. The reasons for allowing Oconee to still operate have not changed with the exception of the 2009 FERC inspection showed that the Dam was still in good health. **(The original evaluation also assumed that the SSF would be lost)**

Below are listed the highlights and excerpts for the internal NRC document

As noted in the November 5 meeting, one of the NRC's bases for allowing continued operation of the Oconee units was the timelines until containment failure. Subsequent to the November 5 meeting, the licensee developed Technical Support Center (TSC) guideline, Engineering Manual E.M. 5.3, "Beyond Design Basis Mitigation Strategies," to utilize B.5.b and other equipment to take mitigating actions to provide core cooling and spent fuel pool cooling in the event of a loss of the SSF due to external flooding. The guidelines provide additional information and strategies on what measures the site may take to address such a scenario. The efficacy of these procedures has not yet been demonstrated.

Additional factors, in support of allowing operation through November 2010, are the current apparent health of the dam and the regular monitoring of its condition:

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- FERC personnel inspect the dam annually; the 2007 and the 2008 inspections did not identify any adverse trends in the condition of the dam. Further, the NRC regularly interacts with FERC and receives inspection information regarding the Jocassee dam. **(2009 inspections also showed no adverse trend, health of Dam is still good)**

- While the current health of the dam supported by condition monitoring is sufficient to support the staff's assessment to allow a slight increased risk through November 2010, the overall defense-in-depth and adequate safety margins for protecting ONS are deterministic pending completion of ongoing flood analysis work.

Overall, given the staff's understanding of the dam's health, inspection regime, condition monitoring activities as noted in the deterministic section, and the conservative risk assessment approach, the staff is confident that the estimated conditional CDF is no greater than low 10^{-4}/yr for the interim period till November 2010.

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Further, the staff's conclusion that short-term continued operation of the Oconee units is acceptable was based principally on risk consideration. Specifically, the conditional CDF and conditional LERF for the external flooding of the Oconee units are substantially below the conditional CDF and conditional LERF guidelines of 10^{-3}/yr and 10^{-4}/year, respectively, that are noted in LIC-504. In evaluating the applicable LIC-504 criteria, the increased risk over the short term when balanced against the defense in depth and safety margin criteria of LIC-504 over the same period was deemed acceptable. Therefore, continued operation during this time period is not inimical to the public health and safety.

George Wilson
USNRC
Electrical Engineering Branch Chief
Mail Stop O9E3
301-415-1711

Mitman, Jeffrey

From: Wilson, George
Sent: Wednesday, March 31, 2010 11:46 AM
To: James, Lois; Kulesa, Gloria; Mitman, Jeffrey
Subject: FW: Oconee ICM Inspection Matrix.doc
Attachments: Oconee ICM Inspection Matrix.doc ML14058A043

fyi

From: Bartley, Jonathan
Sent: Wednesday, March 31, 2010 7:52 AM
To: Wilson, George; Khanna, Meena
Cc: Stang, John; Rapp, Curtis; Sabisch, Andrew; Wert, Leonard; Munday, Joel; Rogers, Walt
Subject: Oconee ICM Inspection Matrix.doc

George, Meena,

Attached is a matrix Curt Rapp put together to lay out our inspection plan for the external flood inspection. It is based on the licensee's letter which laid out their compensatory measures. Looks like a one week inspection. Resources will be Curt (lead), SRA (Walt Rogers if available), and a human factors expert (supplied by NRR). Planning the inspection for the middle of May.

Thoughts?

Jonathan

.1/9

Pohida, Marie

From: Mitman, Jeffrey
Sent: Thursday, April 22, 2010 9:07 AM
To: Zoulis, Antonios; Pohida, Marie; Riggs, Eric; Khanna, Meena; Coleman, Neil; Wescott, Rex
Subject: FW: Generic Failure Rate Evaluation for the Jocassee Dam
Attachments: ADAMS Document.APK

Attached Generic Failure Rate Evaluation for Jocasssee Dam dated 03/15/2010 is already publicly available as ML13039A084.

fyi

From: Curran, Bridget
Sent: Thursday, April 22, 2010 7:01 AM
To: Cunningham, Mark
Cc: James, Lois; Mitman, Jeffrey; Ferrante, Fernando; Vail, James; Laur, Steven; Alexander, Cheryl; Moore, Mary
Subject: Generic Failure Rate Evaluation for the Jocassee Dam

Entire memorandum is public as ML100760109

Date: April 14, 2010

Memorandum To: Mark A. Cunningham, Director
Division of Risk Assessment
Office of Nuclear Reactor Regulation

Thru: Lois M. James, Chief
PRA Operational Support Branch
Division of Risk Assessment
Office of Nuclear Reactor Regulation

From: Jeffrey T. Mitman, Senior Reliability & Risk Analyst
PRA Operational Support Branch
Division of Risk Assessment
Office of Nuclear Reactor Regulation

Subject: Generic Failure Rate Evaluation for the Jocassee Dam

Package: ML100760108

Apostolakis, George

1:	Kotzalas, Margie
ᶜ:	Wednesday, May 12, 2010 4:02 PM
To:	Blake, Kathleen
Subject:	FW: ACTION: Jocasse Dam Brief

From: Leeds, Eric
Sent: Friday, May 07, 2010 1:08 PM
To: Skeen, David
Cc: Hiland, Patrick; Grobe, Jack; Boger, Bruce; Kotzalas, Margie
Subject: ACTION: Jocasse Dam Brief

Dave –

I had a periodic today with Commissioner Apostolakis and he requested a briefing on the Jocasse Dam. Please work with Margie to set up a brief – pictures, and even programs run on site inundation would be very helpful. Plan for it to be a joint briefing of both Comm A and Commission Ostendorff – they plant o travel together to Oconee in July. Thanks!

Eric J. Leeds, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
-415-1270

\/11

See, Kenneth

From: Khanna, Meena
Sent: Monday, May 02, 2011 5:51 PM
To: See, Kenneth
Subject: OUO/SRI - Oconee/Jocassee 2-D Analysis Results
Attachments: FW: Oconee/Jocassee 2-D Analysis Results

Ken, see if this provides the info that you need..thanks!

Meena

From: Khanna, Meena
Sent: Wednesday, February 02, 2011 3:36 PM
To: Mitman, Jeffrey
Cc: Wescott, Rex; Ferrante, Fernando; Rodriguez, Veronica
Subject: RE: Oconee/Jocassee 2-D Analysis Results

Jeff,
I just wanted to get back to you regarding your questions. I have confirmed that we do not have the 2-D analysis report. We had several questions regarding the 2-D model and the results of the 2-D analysis and received Duke's responses to those questions, as provided in the attachment. Upon review of Duke's information, we determined that Duke adequately provided us with the information that we requested to address our concerns. Pls. note that once Duke completes its assessment for final repair, they will provide us with their final 2-D runs.
Thanks,
Meena

From: Mitman, Jeffrey
Sent: Tuesday, February 01, 2011 12:48 PM
To: Khanna, Meena
Cc: Wescott, Rex; Ferrante, Fernando; Rodriguez, Veronica
Subject: RE: Oconee/Jocassee 2-D Analysis Results

Meena, back in October (see attached email) I asked about the Duke analysis entitled: "Oconee Nuclear Station, Jocassee 2-D Hydraulic Model Study, Hydraulic Modeling Report, Technical Report, April 2010." My recollection is the response to this inquiry was that we did not have the 2-D report. During our December 22nd meeting, I again asked whether we had this report or reviewed this report. I was assured that we did have it.

The attachment that was supplied yesterday is Duke's response to RAIs not the 2-D analysis report.

Do we have 2-D analysis report? If so I would like to have a copy. If we don't have this report, has anyone at the NRC reviewed a copy of the report, possibly via an audit at one of Duke's facilities?

Thanks.

Jeff Mitman

From: Khanna, Meena
Sent: Monday, January 31, 2011 9:39 AM
To: Mitman, Jeffrey
Subject: FW: Oconee/Jocassee 2-D Analysis Results

J/12

Pls let me know if this is what you need, Jeff...thanks

From: Wescott, Rex
Sent: Monday, January 31, 2011 9:10 AM
To: Khanna, Meena
Subject: RE: Oconee/Jocassee 2-D Analysis Results

I think this is what we were referring to.

Rex

From: Khanna, Meena
Sent: Friday, January 28, 2011 4:33 PM
To: Wescott, Rex
Subject: FW: Oconee/Jocassee 2-D Analysis Results

Hi Rex, hope all is well...do you happen to have this report?

From: Mitman, Jeffrey
Sent: Friday, January 28, 2011 4:09 PM
To: Khanna, Meena
Cc: Wescott, Rex; Rodriguez, Veronica
Subject: Oconee/Jocassee 2-D Analysis Results

Meena, in our meeting back in December, I asked about the availability of the subject report. Rex and/or Neil indicated that we have a copy. Could I please get a copy?

Thanks.

Jeff

Bensi, Michelle

From: Ferrante, Fernando
Sent: Tuesday, May 03, 2011 2:39 PM
To: Bensi, Michelle
Subject: Emailing: NSAC-60 Oconee PRA Section 9-4 Analysis of External Flood Events
Attachments: NSAC-60 Oconee PRA Section 9-4 Analysis of External Flood Events.pdf

Shelby,

Here is the first document.

Thanks,
Fernando

J/13

9.4 ANALYSIS OF EXTERNAL FLOOD EVENTS

This section presents results of analyses performed to evaluate the contribution of external floods to the core-melt frequency estimated for Oconee Unit 3. It also explains in detail the methods used in these analyses.

Two potential sources of external flooding of the Oconee plant were identified. The first is a general flooding of the rivers and reservoirs in the area due to rainfall in excess of the probable maximum precipitation (PMP). Since the Oconee site is inland, the effects of hurricanes were not considered. The second source is a random failure of the upstream Jocassee Dam. (Random failure includes all causes other than a rain-induced overtopping and an earthquake-induced failure, which were analyzed explicitly).

9.4.1 PRECIPITATION

The PMP postulated for the Oconee site would be 26.6 inches within 48 hours. The effects of this PMP on reservoirs and spillways were evaluated in a study performed by the Duke Power Company (1966). The results of this study demonstrated that the Keowee and Jocassee reservoirs are designed to contain and control the floods that could result from a PMP. Thus in order to flood the plant site, rainfall exceeding the PMP must occur. The frequency of exceeding the PMP was obtained from the analysis presented in this section and was used as a bounding estimate of the frequency of core melt caused by rain-induced external flooding.

9.4.1.1 Precipitation Data

The U.S. Weather Bureau (1961, 1964) has compiled a series of rainfall intensity-duration-frequency curves derived from meteorological data collected throughout the continental United States over a period of 50 years. The isopluvial maps published in these technical papers were interpolated for the Oconee site to obtain the amount of precipitation (inches) given the rainfall duration (hours) and its annual frequency of occurrence. The interpolated data for the Oconee site (see Table 9-18) are the basis for all the results derived in this section.

9.4.1.2 Method

The method used in deriving the probability distribution of the frequency for a PMP is an extension of the technique of Bayesian extrapolation first developed by S. Kaplan (personal communication, 1981). This method extrapolates the known trend to values outside those experienced to date. It is particularly suitable for probabilistic analyses because it establishes the degree of confidence in the extrapolation--providing that the trend continues. The validity of the assumption of a continuing trend is discussed in Section 9.4.1.5.

Table 9-18. Input Data for the Oconee External Flood Analysis[a]

Data point, m	Rainfall duration, τ_m (hours)	Precipitation depth, h_m (inches)	Observed storm frequency, f_m^o (yr^{-1})	Number of observed storms in 50 years $\nu_m = 50 f_m^o$
1	12	3.5	1.0	48
2	12	4.2	0.5	24
3	12	4.8	0.2	10
4	12	5.8	0.1	5
5	12	6.7	0.04	2
6	12	7.5	0.02	1
7	12	8.1	0.01	1
8	24	4.2	1.0	48
9	24	4.7	0.5	24
10	24	6.5	0.2	10
11	24	6.8	0.1	5
12	24	8.5	0.04	2
13	24	9.2	0.02	1
14	24	10.5	0.01	1
15	48	6.0	0.5	24
16	48	7.0	0.2	10
17	48	8.0	0.1	5
18	48	9.5	0.04	2
19	48	10.0	0.02	1
20	48	11.5	0.01	1
21	96	7.0	0.5	24
22	96	8.5	0.2	10
23	96	10.0	0.1	5
24	96	11.0	0.04	2
25	96	12.0	0.02	1
26	96	14.0	0.01	1
27	168	8.5	0.5	24
28	168	10.0	0.2	10
29	168	13.0	0.04	2
30	168	14.0	0.02	1
31	168	16.0	0.01	1

[a]Obtained by interpolation of U.S. Weather Bureau isopluvial maps.

A plot of the data presented in Table 9.18 is shown in Figure 9-56. This plot shows that there is a family of curves predicting the frequency of a rainstorm for the Oconee site in terms of the cumulative precipitation and the duration of the storm. The family of curves suggest that the frequency can be expressed as an exponential function of the form

$$c_{f(\tau,h)} = a \exp\{-[B(\tau)h]\} \qquad (9.4\text{-}1)$$

where

$c_{f(\tau,h)}$ ≡ calculated frequency of storm (yr^{-1})
h ≡ maximum cumulative precipitation (in)
τ ≡ duration of rainfall (hr)
a ≡ constant cumulative precipitation (in)
$B(\tau)$ ≡ a function of τ

Analysis of the $B(\tau)$ values obtained by fitting each individual curve of Figure 9-56 suggests that $B(\tau)$ can be expressed as

$$B(\tau) = b/\tau^n \qquad (9.4\text{-}2)$$

where n is a constant.

Substituting Equation 9.4-2 into Equation 9.4-1 gives

$$c_{f(\tau,h,a,b,n)} = a \exp\{-[h(h/\tau^n)]\} \qquad (9.4\text{-}3)$$

where for emphasis f is expressed as a function of a, b, and n.

Equation 9.4-3 expresses a mathematical model for the frequency of a complicated meteorological process involving many random variables. This model along with the data in Table 9-18 was used to derive probabilities for the various combinations of values for a, b, and n.

This set of probabilities permits the derivation through Equation 9.4-3 of the probability distribution for the frequency of PMP (τ_{PMP} = 48 hr; h_{PMP} = 26.6 in.).

Table 9-18 consists of 31 data entries. Each entry (m) represents the observed number of storms (ν_m^o) exhibiting particular values of cumulative precipitation (h_m) and duration (τ_m) over the 50-year observation period. The quantity ν_m is defined by

$$\nu_m = 50\ f_m^o \qquad (9.4\text{-}4)$$

where f_m^o is the observed frequency for entry (m).

For each of these entries, a doublet,

$$E_m = \langle \nu_m^o, 50 \rangle$$

can be formed to characterize the experience E_m.

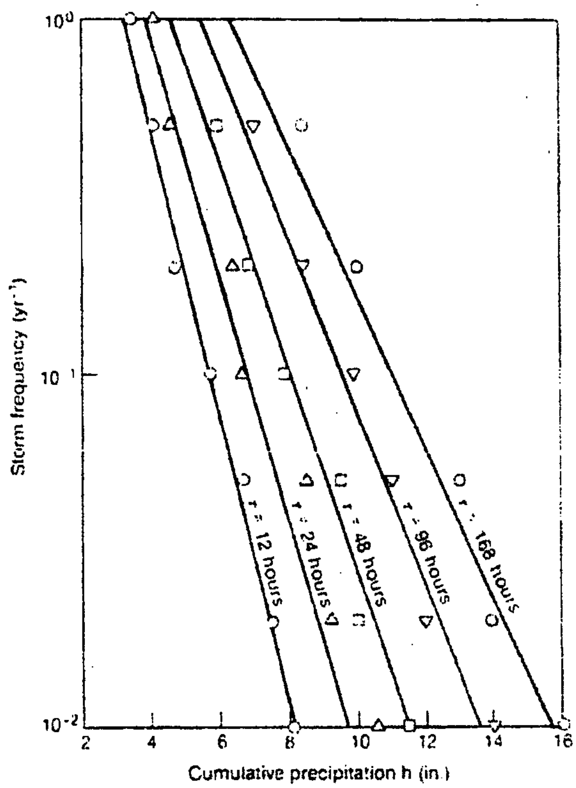

Figure 9-56. Plot of the data in Table 9-18. (Solid lines are a fit of data to Equation 3.)

The collective experience E of all 31 data points can be characterized by

$$E \equiv \{\langle \nu_m^o, 50 \rangle\} \text{ all } m \qquad (9.4\text{-}5)$$

In light of this evidence E and Equation 9.4-3 (which models the frequency f), a probability was assigned to the various combinations of different values for the three unknown parameters a, b, and n, using Bayes' theorem:

$$p(a,b,n|E) = p(a,b,n) \frac{p(E|a,b,n)}{\sum\limits_{\substack{\text{all} \\ a,b,n}} p(E|a,b,n)} \qquad (9.4\text{-}6)$$

where

$p(a,b,n) \equiv$ probability of a, b, and n prior to experience E
$p(E|a,b,n) \equiv$ likelihood of a, b, and n after the experience E
$p(a,b,n|E) \equiv$ probability of a, b, and n after the experience E

To obtain information on the probability of a, b, and n, several steps must be taken. The first is to define the calculated number of storms (c_ν) during the 50-year observation period:

$$c_{\nu(\tau,h,a,b,n)} = 50c_{f(\tau,h)} \qquad (9.4\text{-}7)$$

where $c_{f(\tau,h)}$ is given by Equation 9.4-3.

The likelihood of observing the doublet

$$E_m \equiv \langle \nu_m^o, 50 \rangle$$

given the values a, b, and n, can now be formulated. A process describing events that occur randomly in time is characterized by the Poisson distribution. This distribution predicts the likelihood of observing the doublet E_m given a, b, and n:

$$p(E_m|a,b,n) = \frac{\{c_{\nu(\tau_m,h_m,a,b,n)}\}^{\nu_m^o}}{\nu_m^o!} \exp\{-c_{\nu(\tau_m,h_m,a,b,n)}\} \qquad (9.4\text{-}8)$$

The likelihood of the total experience E is the product of the likelihoods of all the individual E_m terms--that is,

$$p(E|a,b,n) = \prod_{\substack{\text{all} \\ m}} p(E_m|a,b,n)$$

$$= \prod_{\substack{\text{all} \\ m}} \frac{\{c_{\nu(\tau_m,h_m,a,b,n)}\}^{\nu_m^o}}{\nu_m^o!} \exp\{-c_{\nu(\tau_m,h_m,a,b,n)}\} \qquad (9.4\text{-}9)$$

With the p(E|a,b,n) defined, the prior probability distribution p(a,b,n) is needed before applying Equation 9.4-6 to calculate p(a,b,n|E). Since there was no knowledge prior to experience E on the probability of the different

possible combinations of values for a, b, and n, a uniform prior was assumed, and Equation 9.4-6 is rewritten as

$$p(a,b,n|E) = \frac{p(E|a,b,n)}{\sum\limits_{\substack{\text{all}\\ a,b,n}} p(E|a,b,n)} \tag{9.4-10}$$

where $p(E|a,b,n)$ is given by Equation 9.4-9.

9.4.1.3 Numerical Analysis

Equation 9.4-3 expresses the frequency of a storm of duration (t_m) and cumulative precipitation depth (h_m) for any given combination of a, b, and n. Equation 9.4-10, on the other hand, establishes the probability of a specific combination of values a, b, and n in light of the available data. The objective of the numerical analysis was to obtain from these two equations the probability distribution for storm frequencies for a specific t and h (i.e., at the PMP conditions).

The numerical procedure requires establishing a grid of a_i, b_j, n_k values for a discrete evaluation of $p(E|a,b,n)$ and subsequently $p(a,b,n|E)$. A judicious choice of grid points is essential in obtaining accurate results without excessive computation. The following grid was used in evaluating the data of Table 9-18:

$$\{(a_i)\} = \{10,15,20,25,30,35,40,45,50,55,60\}$$

$$\{(b_j)\} = \{1.0,1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,2.0,2.1,2.2,2.3,2.4,2.5,2.6\}$$

$$\{(n_k)\} = \{0.10,0.12,0.14,0.16,0.18,0.20,0.22,0.24,0.26,0.28,0.30,0.32,0.34,0.36,0.38,0.40\}$$

For each specific combination of a_i, b_j, n_k values from this grid one can evaluate Equation 9.4-9, the likelihood function, which when expressed in its discrete form is given by

$$p(E|a_i,b_j,n_k) = \prod_{\text{all } m} \frac{[c\,v(t_m,h_m,a_i,b_j,n_k)]^{\omega_m}}{\omega_m!} \exp[-c\,v(t_m,h_m,a_i,b_j,n_m)] \tag{9.4-11}$$

The posterior probability for each a_i, b_j, n_k combination can now be obtained from a discrete form of Equation 9.4-8:

$$p(a_i,b_j,n_k|E) = \frac{p(E|a_i,b_j,n_k)}{\sum\limits_{\text{all } i}\sum\limits_{\text{all } j}\sum\limits_{\text{all } k} p(E|a_i,b_j,n_k)} \tag{9.4-12}$$

The last step of the analysis is the evaluation of the discrete version of Equation 9.4-3 at each one of the grid points

$$c_{f,ijk} = a_i \exp\left(- \frac{b_j h_{PMP}}{\tau_{PMP}^{n_k}}\right) \qquad (9.4\text{-}13)$$

where τ_{PMP} is the duration of a PMP rainfall (48 hours) and h_{PMP} is the maximum cumulative precipitation of a PMP rainfall (26.6 inches).

Note that for each $c_{f,ijk}$ there is a corresponding $p(a_i, b_j, n_k|E)$. In probabilistic language this correspondence is called a "doublet." The entire set of

$$\{\langle p(a_i, b_j, n_k|E),\ c_{fijk}\rangle\}$$

doublets forms the probability distribution for the frequency of the PMP storm at the Oconee site. The cumulative of this discrete probability distribution indicates the confidence when postulating a particular storm-frequency value.

9.4.1.4 Results

The numerical analysis described in Section 9.4.1.3 was carried out with the objective of calculating the probability distribution for the PMP frequency. A computer program specifically designed to carry out this analysis was written in the Basic language. The results of these calculations are given in Table 9-19: the PMP storm-frequency intervals, the discrete probability distribution (DPD) for each interval, and finally, the cumulative probability from zero to the end of each frequency interval.

Table 9-19. Probability Distribution for the Frequency of PMP Storms[a]

Storm-frequency range			
From	To	DPD	Cumulative probability
0	3.5-8[b]	0.0253	0.0253
3.5-8	6.0-8	0.0429	0.0682
6.0-8	1.0-7	0.1413	0.2096
1.0-7	1.7-7	0.2283	0.4380
1.7-7	3.0-7	0.2850	0.7230
3.0-7	5.0-7	0.1104	0.8334
5.0-7	8.0-7	0.0941	0.9276
8.0-7	1.3-6	0.0428	0.9704
1.3-6	2.2-6	0.0267	0.9972

[a]Duration τ = 48 hours; precipitation depth h = 26.6 inches.

[b]$3.5\text{-}8 = 3.5 \times 10^{-8}$.

A least-squares fit of the Table 9-19 storm frequency versus cumulative probability yields the frequencies of a PMP associated with the lower, median, and upper bounds of the probability distribution:

Cumulative probability	PMP frequency (year^{-1})
0.05	4.9-8
0.50	2.9-7
0.95	8.9-7

The cumulative probability for a particular frequency interval is to be interpreted as the degree of certainty that the PMP frequency observed over a long period of time will be less than or equal to the upper value of that frequency interval.

9.4.1.5 Discussion and Conclusions

Three questions concerning the validity of this analysis come to mind. First, since the data on which the analysis is based were collected during a relatively short period, 50 years, how can we be sure that the climatic conditions prevailing today will continue indefinitely?

For the purpose of this analysis there is no need to know that the prevailing climatic conditions will continue any longer than the plant life (about 40 years). The PMP frequency results are then based on the expectation that no dramatic change in climatic conditions will occur over the next 40 years. Historical data on climate show this assumption to be reasonable.

Second, we have formulated a mathematical model, Equation 9.4-3, which predicts the frequency of a storm given the duration of rainfall (hours) and the cumulative precipitation (inches). How can we be certain that this exponential model still applies at the precipitation level of a PMP storm?

We have no way of being certain that the exponential model continues to apply at the precipitation level of a PMP storm. The amount of precipitation during a period of time is dependent on a variety of random meteorological variables. The severity of the rainstorm is related to the probability of occurrence of increasingly adverse conditions (exponential model). There are, however, physical limits on these adverse conditions; at those limits the exponential model breaks down. If we continue to use the exponential model beyond those limits, we will overpredict the frequency of the storms. Since there is no information beyond the recorded data as to where the exponential model breaks down, the results of this analysis are an upper-bound, conservative estimate of the frequency of a PMP storm.

Third, there is an implicit assumption that the most severe condition that can affect the area around the Oconee site is the one where the storm lasts 48 hours with a cumulative precipitation of 26.6 inches. Is this truly the limiting storm, or could other storms of shorter or longer duration possibly cause flooding at the Oconee plant?

The duration, cumulative precipitation, and frequency resulting from this analysis have been reviewed by the plant designers and they share the belief of the Duke Power Company (communication from S. B. Hager, August 16, 1981), that the PMP storm is the most frequent storm that could exceed spillway capacities and result in flooding of the plant site.

Since the conservatively calculated mean frequency of flooding of the Oconee plant due to the PMP storm is more than an order of magnitude less than that due to a random failure of the Jocassee Dam, it was concluded that precipitation-induced external flooding is a negligible contributor to core-melt frequency and public risk.

9.4.2 DAM FAILURE

The Oconee site has a yard grade elevation a few feet below the full-pond level of Lake Keowee, which serves as the source of its condenser circulating water. Lake Jocassee has a full-pond elevation about 300 feet above Lake Keowee. If a sudden failure of the Jocassee Dam were to occur, and a rapid enough release of the impounded water from Lake Jocassee into Lake Keowee resulted, the flood wave generated in Lake Keowee would overtop the Keowee Dam and the Oconee intake dike, flooding the plant. This section presents the analysis performed to estimate the frequency of such a flood.

9.4.2.1 Frequency of Dam Failure

The Jocassee Dam is an earth-rockfill structure approximately 400 feet high. The dam was completed in 1972, and the reservoir was filled by April 1974. The spillway lies along one of the abutments, about one-quarter of a mile from the dam, and is a concrete structure founded on granite.

An analysis was performed to determine an annual frequency of failure for earth, earth-rockfill, and rockfill dams due to events other than overtopping and earthquake ground shaking, which were considered in separate analyses. Also, based on dam design information, structural failure of the spillway during discharge and failure associated with seepage along an outlet works have been eliminated as a possible failure mechanism. The following principal modes of failure were considered:

1. Piping.
2. Seepage.
3. Embankment slides.
4. Structural failure of the foundation or abutments.

These failure mechanisms are referred to collectively as random failures. Only failures resulting in the complete collapse of the structure and the uncontrolled release of the reservoir's contents were considered to have the potential for flooding the Oconee plant.

Previous investigations into the frequency of dam failure indicate that it decreases with later years of construction (Baecher et al., 1980). This is

generally attributed to improvements in the methods of design and construction. Therefore, another criterion considered in developing a data base and failure-frequency estimate was the period of construction.

The age of a dam is another factor that has been identified as having an effect on the rate of dam failure. Approximately half the dam failures occur during the first 5 years of operation (Baecher et al., 1980). Therefore, age was also considered in developing a data base.

Size, type of construction, realistic failure modes, period of construction, and age were the major considerations used to define a data base for use in estimating the failure frequency of the Jocassee Dam.

The data-base characteristics that were attributed to the Jocassee Dam are:

Characteristic	Jocassee Dam
Location (country)	United States
Year completed	1972
Age (years in operation)	7
Height (feet)	400
Type	Earth-rockfill

9.4.2.1.1 Data

Various catalogs were used to develop the data groups that were studied. Each group consisted of large earth, earth-rockfill, or rockfill dams (more than 45 feet high, USCOLD, 1975) in the United States that were in operation 6 or more years when they failed. Of the references used in this study (Middlebrooks, 1953; Gruner, 1964; Babb and Mermel, 1968; USCOLD, 1975), not one is a complete catalog, and therefore they were used collectively. At present, these references represent the best readily available information. From the various listings of failures, cross-checks were made when possible.

A data base uniquely suited in every major respect to the Jocassee Dam was unattainable because of a scarcity of the number of the earth-rockfill type.

The data base ultimately developed reflects discussions with Duke Power engineers familiar with the characteristics of the Jocassee Dam. It was decided that the data base should include only the failure modes that could occur at Jocassee. The two major failure types excluded from the data set were failures resulting from piping at a conduit passing through the dam and structural failures of the spillway during the flood discharge. Neither of these failures can occur because the necessary physical conditions do not exist at Jocassee. (Note, however, that dams in the data base do include those that can fail in either or both of these modes. This is proper because the experience from these dams represents realizations of nonfailure for other failure modes, such as embankment piping, foundation failure, and slope failure.)

Because of limitations in the historical record, it is possible only to develop a data set that takes into account a limited number of the specific

properties of the Jocassee Dam. Since Jocassee is a structure designed and constructed in recent times, it can be assumed that state-of-the-art technology was used in its design. In addition, because of its role as a critical facility of large size and importance, other aspects of the dam, such as seepage monitoring and inspection programs, are important factors that decrease the likelihood that the dam will fail. The following specific characteristics of Jocassee are identified as relevant factors that will affect the frequency of failure:

1. Quality maintenance and inspection programs.
2. Monitoring of the dam (i.e., seepage, settlement, etc.).
3. Presence of personnel at the site.
4. Responsiveness of the owner to potential problems (i.e., implementation of emergency plans).
5. Detailed geologic investigations conducted before site selection.
6. Experience of earth-rockfill dams in Jocassee's class (with respect to random failures).
7. Design techniques.

These factors notwithstanding, the data were examined, and the best available data base for application to Jocassee Dam was extracted (Benjamin and Associates, 1982) and used.

The data base was divided into three overlapping periods of dam construction: 1900 to 1975, 1940 to 1975, and 1960 to 1975. In each category, U.S. dams in operation 6 or more years at the time of failure and 45 feet or more in height were considered. The dams were of three types--earth, earth-rockfill, or rockfill--and only catastrophic failures were included. Table 9-20 lists the failures considered in the analysis.

The number of dam-years of operation was determined from data on the rate of construction provided in the USCOLD (1975) report. Table 9-21 lists chronologically for the three periods of construction the year a failure occurred, the interval between each failure in years, the cumulative number of dam-years to the year of failure, and the number of dam-years between failures.

The data in Table 9-21 show a historically upward trend in the dam-years between catastrophic failures. The reciprocal of these dam-year periods between failures represents the frequency of dam failures. Allowing for statistical variations, this number has been steadily declining since the beginning of this century. This change reflects a steady improvement in the state of the art for the design, construction, and maintenance of dams and dikes (i.e., a "learning curve").

In order to realistically represent the failure rate for a dam of modern design, construction, and operating practice, an analytical method was developed to use the data obtained, including the chronological order of dam failures. The method outlined below is adapted from one first developed by S. Kaplan (personal communication, 1981).

Table 9-20. Dam Failures Used in This Study

Dam	Year completed	Year failed
Goodrich[a]	1900	1956
Lake Toxaway[b]	1902	1916
Sinker Creek[c]	1910	1943
Baldwin Hills[a]	1951	1963
Walter Boudin[d]	1967	1975

[a]Data from Babb and Mermel (1968) and USCOLD (1975).

[b]Data from Babb and Mermel (1968), USCOLD (1975), and Middlebrooks (1953).

[c]Data from Babb and Mermel (1968), Middlebrooks (1953), and USCOLD (1975).

[d]Data from Jansen (1980).

Table 9-21. Chronological Order of Dam Failures

Year of failure	Years between failures	Cumulative dam-years	Dam-years between failures
	Period of Construction: 1900-1975		
1916	16[a]	1,560[a]	1,560[a]
1943	27	15,254	13,694
1956	13	29,236	13,982
1963	7	42,486	13,250
1975	12	82,709	40,223
1981	No failure	107,270	No failure
	Period of Construction: 1940-1975		
1963	23[b]	12,157[b]	12,157[b]
1975	12	43,308	31,151
1981	No failure	67,869	No failure
	Period of Construction: 1960-1975		
1975	15[c]	18,014[c]	18,014[c]
1981	No failure	42,575	No failure

[a]From 1900.

[b]From 1940.

[c]From 1960.

9.4.2.1.2 Method for Estimating Frequency

The data in Table 9-21 can be regarded as the random realization of a learning process in which the dam-failure frequency evolves with "time" t (measured in dam-years) according to the functional form described by

$$L(t) = at^{-b}$$

In this equation a and b are fitted probabilistically by means of Bayes' theorem. More specifically, a probability distribution on the space of <a,b> doublets, that is, the probability $\{p(a,b|V)\}$ (defined later) was derived. Using this probability distribution, the trend to the "time" (dam-years) accumulated by 1981 was extrapolated to obtain the present-day probability distribution for the frequency of random dam failures.

Method

The functional form chosen to describe the time-dependent (dam-years) failure rate was

$$L(t) = at^{-b} \qquad (9.4\text{-}14)$$

The probability of no failure between t_{k-1} and t_k, and subsequently a failure at $t_k + dt$ is

$$p(t_{k-1} \rightarrow t_k) = \exp\left[-\int_{t_{k-1}}^{t_k} L(t)\, dt\right] \left[L(t_k)\, dt\right]$$

$$= \exp\left[-\frac{a}{(1-b)}\left[t_k^{(1-b)} - t_{k-1}^{(1-b)}\right]\right]\left[at_k^{-b}\right] \qquad (9.4\text{-}15)$$

The probability of experiencing a sequence of K failures is given by the product of the K dam-failure probabilities, where t_o is the time from which the failure and success data have been counted.

$$p(t_o \rightarrow t_k) = \prod_{k=1}^{K} p(t_{k-1} \rightarrow t_k)$$

$$= \prod_{k=1}^{K} \exp\left[-\frac{a}{(1-b)}\left[t_k^{(1-b)} - t_{k-1}^{(1-b)}\right]\right]\left[at_k^{-b}\right]$$

$$= a^K \left[\prod_{k=1}^{K} t_k\right]^{-b} \exp\left[-\frac{a}{(1-b)}\left[t_K^{(1-b)} - t_o^{(1-b)}\right]\right] (dt)^K \qquad (9.4\text{-}16)$$

Furthermore, the probability of experiencing a sequence of K failure incidents and subsequently a period of time without failure between the K-th failure time (t_k) and the present time (t_p) is given by

$$p(B|a,b) = p(t_o \rightarrow t_k) \exp\left[-\int_{t_K}^{t_p} L(t)\, dt\right] \qquad (9.4\text{-}17)$$

$$= a^K \left[\prod_{k=1}^{K} t_k\right]^{-b} \exp\left[-\frac{a}{(1-b)}\left[t_p^{(1-b)} - t_o^{(1-b)}\right]\right] (dt)^K$$

Equation 9.4-17 represents in Bayesian language the likelihood function--that is, the probability of the evidence B (data) given a combination of values for a and b.

Bayes' theorem can be expressed as

$$p(a,b|B) = p(a,b) \frac{p(B|a,b)}{\sum_{\text{all } a} \sum_{\text{all } b} p(a,b)\, p(B|a,b)} \qquad (9.4\text{-}18)$$

where p(a,b) is the probability of a particular combination of a and b prior to having the evidence B and p(a,b|B) is the probability of a particular combination of a and b posterior to the evidence B (i.e., a measure of the confidence we have in the values of a and b).

Given that prior to evidence B there was no particular preference toward any particular values of a and b, Equation 9.4-18 is then

$$p(a,b|B) = \frac{p(B|a,b)}{\sum_{\text{all } a} \sum_{\text{all } b} p(B|a,b)} \qquad (9.4\text{-}19)$$

with p(B|a,b) given by Equation 9.4-17.

Numerical Analysis

The numerical procedure involves forming a grid of a_i and b_j values to be used in evaluating p(B|a,b). The process of selecting the grid is somewhat iterative. For the purpose of this analysis, the following grid was arrived at:

$$\{\{a_i\}\} \equiv \{0.0002, 0.0004, 0.00075, 0.0015, 0.003, 0.006, 0.012, 0.016, 0.02, 0.024, 0.03, 0.04, 0.05, 0.06, 0.075, 0.1\}$$

$$\{\{b_j\}\} \equiv \{0.1, 0.15, 0.2, 0.25, 0.3, 0.35, 0.4, 0.45, 0.5, 0.55, 0.6, 0.65, 0.7, 0.75, 0.8\}$$

For each combination a_i, b_j from one of these grids, a likelihood $p(B|a_i,b_j)$ can then be calculated from Equation 9.4-17, which we can now express in discrete form:

$$p(B|a_i,b_j) = a_i^K \left(\prod_{k=1}^{K} t_k\right)^{-b_j} \exp\left[-\frac{a_i}{(1-b_j)}\left[t_p^{(1-b_j)} - t_o^{(1-b_j)}\right]\right] \qquad (9.4\text{-}20)$$

Finally, a posterior probability for each a_i, b_j can be obtained through a discretely expressed Equation 9.4-19.

$$p(a_i,b_j|B) = \frac{p(B|a_i,b_j)}{\sum_{i=1}^{16} \sum_{j=1}^{15} p(B|a_i,b_j)} \qquad (9.4\text{-}21)$$

The last step required for completing the analysis is to evaluate Equation 9.4-14 at each one of the grid points (i,j) and time t_p--that is, the dam-years as of 1981 since the last failure in the data base. Again in discrete form Equation 9.4-14 can be written as

$$L_{ij}(t_p) = a_i t_p^{-b_j} \qquad (9.4\text{-}22)$$

Note that for each $L_{ij}(t_p)$ there is a corresponding $p(a_i,b_j|B)$. These corresponding ordered pairs are doublets. The set of

$$\{<p(a_i,b_j|B),L_{ij}(t_p)>\}$$

doublets form a discrete probability distribution that describes the probability of any individual value of dam-failure frequency.

9.4.2.1.3 Results

The numerical analysis outlined in the preceding section was carried out with the objective of estimating the frequency of occurrence and the associated probability for dam failure in 1981. A computer program specifically designed to perform this analysis was written in the Basic language. The results are shown in Table 9-22. The parameters shown are the dam-failure frequency intervals, the discrete probability distribution (DPD) for each frequency interval, and, finally, the cumulative probability from zero to the upper end of each frequency interval.

Table 9-22. Discrete Probability Distribution for Random Dam Failures

Frequency			
From	To	DPD	Cumulative probability
0	8.0-6[a]	0.0519	0.0519
8.0-6[a]	1.0-5	0.0473	0.0993
1.0-5	1.4-5	0.1259	0.2253
1.4-5	1.75-5	0.1199	0.3452
1.75-5	2.2-5	0.1476	0.4928
2.2-5	2.8-5	0.1645	0.6573
2.8-5	3.5-5	0.1188	0.7761
3.5-5	4.4-5	0.1248	0.9010
4.4-5	5.5-5	0.0527	0.9538

[a]8.0-6 = 8.0 x 10^{-6}.

A plot of the Table 9-22 dam-failure frequency versus cumulative probability yields the 1981 dam-failure frequencies associated with the lower, median, and upper bounds of the probability distribution:

Cumulative probability	1981 annual frequency
0.05	7.9×10^{-6}
0.50	2.3×10^{-5}
0.95	5.5×10^{-5}

The mean annual dam-failure frequency obtained from this distribution is 2.5×10^{-5}.

The analysis indicates that the 1981 mean failure frequency for the class of large U.S. built earthen dams included in the data base described in Section 9.4.2.1.1 is 2.5×10^{-5}. To the extent that this class is representative of the Jocassee Dam, these results can be interpreted as the predicted annual failure frequency of the Jocassee Dam from causes other than earthquakes or overtopping.

In using the data base of Table 9-22 to quantify the dam-failure frequency probability distribution, a fundamental assumption was made: the failure frequency in a particular year for a certain dam (regardless of its age) is identical with the failure frequency of a new dam built in that same year. In other words, the dams that survive up to a given year are just as "good" as the dams built in that year. As a check on the validity of this assumption, a complete learning-curve analysis was done on the subsets of the data base given in Table 9-22. These subsets are represented by the failures of dams built after 1940 and after 1960. The results of these analyses, showing the annual 1981 frequency, are as follows:

Cumulative probability	After-1940 dam	After-1960 dam
0.05	3.2×10^{-6}	1.0×10^{-6}
0.50	1.6×10^{-5}	1.4×10^{-5}
0.95	5.0×10^{-5}	7.7×10^{-5}
Mean	2.0×10^{-5}	2.2×10^{-5}

The median and the mean values of the 1981 dam-failure frequencies obtained by using different subsets of the failure data base compare closely. As expected, the bounds of the distribution are tighter as more data are included. These comparisons indicate that the above-mentioned assumption is reasonable.

9.4.2.2 Contribution to Core-Melt Frequency

In order to evaluate the contribution of random failure of Jocassee Dam to the frequency of core melt at Oconee Unit 3, three factors must be quanti-

fied. The first factor, the frequency of random dam failures, was estimated in the preceding section. The remaining two factors are the following:

1. The conditional probability of flooding of the Oconee site given a failure of the Jocassee Dam.

2. The conditional probability of core melt given flooding at the Oconee site.

The conditional probability of flooding at the Oconee site given a failure of the Jocassee Dam is a complex function of several variables. The level of the Jocassee Lake at the time of failure determines the amount of impounded water that will be released into Lake Keowee; the level of Lake Keowee determines how much flow can be received from Lake Jocassee before Keowee Dam and the Oconee intake dike are overtopped. The time available for warning of an impending dam failure will determine the likelihood that effective action can be taken to lower the levels of the Jocassee and Keowee Lakes and whether an action like notching the east side of the Keowee Dam, allowing the flood to bypass the Oconee site, could be conceived and implemented. The conditional probability of flooding given a dam failure also depends on the mode of failure, the rate of erosion (time to failure), the vertical depth to which the failure penetrates (fraction of the impounded water released), and whether either Keowee Dam or the east intake dike fails rapidly when overtopped (allowing the flood to bypass the Oconee site).

The data base includes only catastrophic failures by modes believed applicable to Jocassee. Most of the catastrophic failures reported in the literature for earth or earth-rockfill dams were total (i.e., the entire reservoir emptied), and most times to failure were in the range of 1 to 2 hours. However, the failures in the data base (Table 9-20) occurred only in earthen dams; thus, there is some question as to how applicable their rates of erosion and depths of failure are to the Jocassee Dam, an earth-rockfill structure.

The Hell Hole Dam, an earth-rockfill structure, failed during construction in 1964 when extreme precipitation caused overtopping. Since construction had not been completed and since the dam was overtopped, it did not satisfy the data-base characteristics and was not included in the failure set. However, its material of construction and size were very similar to those of Jocassee, and its failure behavior can therefore be used as one point of reference in judgments about the possible failure behavior of Jocassee. The overtopping of this partly constructed dam lasted for more than 40 hours before a catastrophic failure occurred. This suggests that a long warning time may be available, at least in some cases, before the failure of an earth-rockfill dam. Once the dam was breached, however, the breach propagated the full depth of the dam, down to the foundation, in about 2 hours. Thus, though more warning time may have been available, once failure began, the time and depth to complete breach were quite similar to those observed for earthen dams.

In addition to the uncertainty in the important parameters described above, a spectrum of calculated flood levels is not available. Thus it is not possible to determine where the sensitive range for the key parameters lies. Given this lack of information, a bounding value of 1 was used for the conditional probability of flooding of the Oconee site given a catastrophic failure of the Jocassee Dam.

The conditional probability of core melt given flooding at the Oconee site is also a complex function depending on the warning time, the action taken by the plant staff (e.g., hot shutdown vs. cold shutdown; whether the standby shutdown facility is manned), the depth of flooding, the survival time for various plant equipment (e.g., steam-driven emergency feedwater pump, standby shutdown facility), and other factors. A scoping of this problem indicates that all means of core cooling are likely to be lost for more than 24 hours, and a conditional probability of 1 was assigned to core melt given flooding.

Combining the three factors yields a bounding estimate of 2.5×10^{-5} for the mean annual frequency of core melt due to a random failure of the Jocassee Dam. It is possible that a more detailed analysis could provide estimated conditional probabilities of site flooding and core melt less than unity. However, core melt due to flooding in the turbine building from CCW failures clearly dominates the contribution from dam failure, and further analysis was judged to be not warranted.

A scoping analysis was performed to investigate whether or not an interfacing-system LOCA could be caused by a loss of decay-heat removal due to the flood, and subsequent RCS heatup and pressurization. Assuming core cooling is lost at about 8 hours after a reactor trip with the plant in a cooled-down condition and the PORV reset to lift at approximately 500 psig, decay heat could be matched with liquid relief at system pressure on the order of 100 psia. Several hours would be required to heat up the primary and secondary systems. In steady state at about 12 hours after a trip and after significant RCS inventory has been lost through liquid relief, saturated steam relief out of the RCS via the PORV at about 500 psia could match the decay heat, and the RCS would stabilize at a pressure below that estimated to cause a rupture in the 388-psig design RHR suction piping. Therefore it was concluded that a core melt caused by the flooding of the plant and a prolonged loss of core cooling would not directly breach the containment. Since this sequence would be a late core melt (on the order of 12 hours) with the RCS at moderate pressure (about 500 psig), it was assigned to core-melt bin II. Flood effects would cause a failure of the reactor-building sprays and cooling units (i.e., containment-safeguard state C). Thus these sequences were assigned to plant-damage bin IIC.

Bensi, Michelle

From: Kauffman, John
Sent: Thursday, June 30, 2011 2:56 PM
To: Perkins, Richard; Ibarra, Jose; Bensi, Michelle
Subject: FW: review request

From: Correia, Richard
Sent: Thursday, June 30, 2011 2:53 PM
To: Stapleton, Bernard; Holahan, Patricia; Westreich, Barry; Coe, Doug; Beasley, Benjamin; Kauffman, John
Cc: Norman, Robert
Subject: Re: review request

Thank you Bern for the requested information, advice and quick response. We will proceed as an uncontrolled document.
Regards
Rich
Richard Correia, Director
Division of Risk Analysis
RES

Sent from a Blackberry

From: Stapleton, Bernard
To: Holahan, Patricia; Correia, Richard; Westreich, Barry
Cc: Norman, Robert
Sent: Thu Jun 30 14:30:00 2011
Subject: RE: review request

Trish/Rich

Have spoken with RES on this issue several times (Beasley). All other times, it has been considered UNCONTROLLED unless the originating office wants it marked as OUO. Placed a call to FERC to ensure that information they have marked as CII on dam failures can be released as uncontrolled when documented by NRC officials. FERC has indicated over the phone that they do not have a problem with us issuing our own document and not calling it CII. The kicker would be if NRC copied FERC documents marked as CII and wanted to decontrol. I was waiting for an email to confirm same from last week but have not received it.

The position taken by RES in their document is sound and supports an uncontrolled, publicly available document. The SGI Designation Guide also supports this rationale since there is no mention of any security scenarios (document is a pure engineering and safety analysis that was not conducted as a result of a terrorist scenario – i.e., world trade center aircraft attack).

NOT Safeguards Information. If RES wants to release this as an UNCONTROLLED document, I have no objection and this has been confirmed with FERC as well (even though they mark such information as Critical Infrastructure Information).

Bern

From: Holahan, Patricia
Sent: Thursday, June 30, 2011 2:10 PM
To: Correia, Richard; Westreich, Barry; Stapleton, Bernard
Subject: Re: review request

Yes, I gave it to Bern. Bern - what's the status?

From: Correia, Richard
To: Holahan, Patricia; Westreich, Barry; Stapleton, Bernard
Sent: Thu Jun 30 09:44:18 2011
Subject: review request

Trish, Barry, Bern,

Greeting from Church St. Hope all is well in NSIR.

A couple of weeks ago we sent DSO a request for review of a possible generic issue on dam failure. We were looking for DSO's insights on whether the document(s) related to this effort should be considered OUO Security related information. Any idea when we might hear back on this request?

Thanks and happy Forth and happy Canada (Birthday) Day!

Richard Correia, PE
Director, Division of Risk Analysis
Office of Nuclear Regulatory Research
US NRC

richard.correia@nrc.gov

Beasley, Benjamin

From: Wilson, George
Sent: Wednesday, February 08, 2012 3:17 PM
To: Hiland, Patrick; Lund, Louise; Evans, Michele; Howe, Allen; Salgado, Nancy; Cheok, Michael; Skeen, David; Taylor, Robert; Correia, Richard; Beasley, Benjamin
Cc: Stang, John
Subject: RE: Oconee vs. GI-204

Summary of February 8, 2012, 10:30 a.m. Conference Call with Duke on GI-204 Screening Analysis

On the call from NRC were:
George Wilson, NRC Dam Safety Officer and NRR point for this issue
Nancy Salgado, NRR / DORL Branch Chief for Oconee
John Stang, Oconee PM
Jonathan Bartley, Region II Branch Chief
Ben Beasley, RES

On the call from DUKE
Terry Patterson led the call for Duke
Chris Nolan
Rich Freudenberger

George Wilson led the call for NRC. Terry Patterson led the call for Duke. Chris Nolan (Duke) expressed general concern about the sensitivity of the information in the Screening Analysis. He cited the guidance in criterion B of the Critical Infrastructure Information Act of 2002. He felt that the information presented in the Screening Analysis identified a vulnerability at Oconee and should be withheld under criterion B. Chris stated that discussion of gaps in the licensing basis, core damage frequencies and impacts to the Station were the source of his concern.

Jonathan Bartley pointed out that although much of the information used in the Analysis is available to the public, putting it all together into one place created the sensitivity. Chris Nolan (Duke) echoed that the Analysis does a good job painting the picture which causes the vulnerability. George Wilson responded that the review of the Analysis by the Department of Homeland Security did not reflect those concerns. DHS did not identify anything in the Oconee section of the Analysis as being sensitive.

Terry Patterson (Duke) stated that the Analysis did not use current data. He expressed concern that the utility will have to respond (to the media) based on what is in the Analysis. Ben Beasley pointed out that the Analysis is just a preliminary study using readily available information to determine only whether or not the issue should become a Generic Issue.

Rich Freudenberger (Duke) stated that a few items in the Analysis are not consistent with information in the NRC's January 2011 SER. Ben Beasley replied that, although we are just now issuing the Analysis, it was nearly complete by last January.

George Wilson asked Duke to give us specific input on the statements they felt were sensitive or needed updating. Duke and NRR agreed on a deadline of close of business Monday.

Additional information on the date that GI 204 is required to be signed out was discussed with the JLD – David Skeen, the drop dead date for getting GI -204 signed out by Feb 17, 2012, to ensure that the 50.54 f which mention Gi-204 are correct.

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From: Hiland, Patrick
Sent: Wednesday, February 08, 2012 12:51 PM
To: Wilson, George
Subject: Oconee vs. GI-204

George, can you send me a brief note regarding today's conference call w/Oconee. I'd like you to reference the participants so we can assure all parties are up to speed. Tim McGinty suggested we follow up to assure same.

Beasley, Benjamin

From: Beasley, Benjamin
Sent: Wednesday, February 08, 2012 3:00 PM
To: Wilson, George; Salgado, Nancy
Subject: Fw: Summary of Call with Duke on GI-204

I may be mistaken in that Andy Sabisch may not have been on the call.

Ben

Benjamin Beasley
Sent from an NRC Blackberry.

From: Beasley, Benjamin
To: Correia, Richard; Peters, Sean; Sheron, Brian; Holian, Brian
Cc: Perkins, Richard; Bensi, Michelle
Sent: Wed Feb 08 12:06:30 2012
Subject: Summary of Call with Duke on GI-204

All,

NRR included me on the conference call with Duke at 10:30 today. A summary of the call is provided below.

The bottom line is that Duke will provide specific concerns to NRR by close of business Monday. In a subsequent conversation with George Wilson and Nancy Salgado, I expressed concern that Monday does not support the schedule for the JLLD SECY on 50.54(f) letters. George and Nancy were going to talk with their management about the schedule.

Ben

Summary of February 8, 2012, 10:30 a.m. Conference Call with Duke On GI-204 Screening Analysis

On the call from the NRC were:

George Wilson, NRC Dam Safety Officer and NRR point for this issue
Nancy Salgado, NRR / DORL Branch Chief for Oconee
John Stang, Oconee PM
Jonathan Bartley, Region II Branch Chief
Andy Sabisch, Oconee Senior Resident
Ben Beasley, RES

George Wilson led the call for NRC. Terry Patterson led the call for Duke. Chris Nolan (Duke) expressed general concern about the sensitivity of the information in the Screening Analysis. He cited the guidance in criterion B of the Critical Infrastructure Information Act of 2002. He felt that the information presented in the Screening Analysis identified a vulnerability at Oconee and should be withheld under criterion B. Chris stated that discussion of gaps in the licensing basis, core damage frequencies and impacts to the Station were the source of his concern.

Jonathan Bartley pointed out that although much of the information used in the Analysis is available to the public, putting it all together into one place created the sensitivity. Chris Nolan (Duke) echoed that the Analysis does a good job painting the picture which causes the vulnerability. George Wilson responded that the review

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of the Analysis by the Department of Homeland Security did not reflect those concerns. DHS did not identify anything in the Oconee section of the Analysis as being sensitive.

Terry Patterson (Duke) stated that the Analysis did not use current data. He expressed concern that the utility will have to respond (to the media) based on what is in the Analysis. I pointed out that the Analysis is just a preliminary study using readily available information to determine only whether or not the issue should become a Generic Issue.

Rich Freudenberger (Duke) stated that a few items in the Analysis are not consistent with information in the NRC's January 2011 SER. I replied that, although we are just now issuing the Analysis, it was nearly complete by last January.

George Wilson asked Duke to give us specific input on the statements they felt were sensitive or needed updating. Duke agreed to provide that and asked for a week to prepare their input. George asked for my input on the schedule and I stated that we have a strong need to approve the Generic Issue this week. Duke and NRR agreed on a deadline of close of business Monday.

Beasley, Benjamin

From: Beasley, Benjamin
Sent: Friday, February 24, 2012 11:06 AM
To: Correia, Richard
Subject: RE: Notes from Conference Call with Duke

We explained our acceptance or non-acceptance of each of their comments. They asked us to reconsider our non-acceptance of four items. Of those four, we have decided to make changes for two and not make changes for the other two.

They had an attorney on the phone but he did not talk. They did not ask about the Homeland Security Act. We were agreed to redacting material from non-public sources so there was not much of an issue about the Act.

Ben

From: Correia, Richard
Sent: Friday, February 24, 2012 9:48 AM
To: Beasley, Benjamin
Subject: Re: Notes from Conference Call with Duke

Thx Ben. I assume this call was for us to tell/explain to Duke how we addressed their comments and not to debate our decisions(?). And that we are moving forward. Did they ask about the Homeland Security Act ? Rich
Richard Correia, Director
Division of Risk Analysis
RES

Sent from a Blackberry

From: Beasley, Benjamin
To: Wilson, George; Stang, John; Correia, Richard; Salgado, Nancy
Sent: Fri Feb 24 09:29:25 2012
Subject: Notes from Conference Call with Duke

All,

My notes are attached. Your comments are welcome.

Ben

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Summary of February 23, 2012, 12:30 p.m. Conference Call with Duke On GI-204 Screening Analysis

On the call from the NRC were:

George Wilson, NRC Dam Safety Officer and NRR point for this issue
Nancy Salgado, NRR / DORL Branch Chief for Oconee
John Stang, Oconee PM
Jonathan Bartley, Region II Branch Chief
Andy Sabisch, Oconee Senior Resident
Ben Beasley, RES

On the call from Duke were:

Dean Hubbard
Terry Patterson
Dave Cummings
Bob Michael
G. Martin
Rich Freudenberger

George Wilson led the call for the NRC. George provided NRC's preliminary response to Screening Analysis changes proposed by Duke via letter dated February 17, 2012. The letter contained numbered comments, to which George responded in order as noted below.

1. Not accepted – The proposed change was a minor wording change to be consistent with the UFSAR. George indicated that the NRC is interested in what text is sensitive and should be redacted rather than editorial comments.
2. Not accepted – Editorial comment
3. Accepted – The NRC will redact the Screening Analysis content.
4. Not accepted – Editorial comment
5. Not accepted – Editorial comment
6. Editorial comment, however the NRC agreed to consider changing "current licensing basis" to "original licensing basis" and "did not consider" to "did not include."
7. Accepted – Content will be redacted
8. Accepted – Content will be redacted
9. Not accepted – Non-public references are presented in the Screening Analysis in accordance with NRC style guidance and are not being changed.
10. Not accepted – Non-public references are not being changed.
11. Accepted – Content will be redacted
12. Not accepted – Editorial comment
13. This is an editorial comment about clarifying the use of emergency AC and alternate AC power sources. The NRC agreed to reconsider this comment.
14. Accepted – Content will be redacted
15. Accepted – Content will be redacted
16. Similar to comment 13, the reference to station blackout will be reconsidered.

17. Accepted – Content will be redacted
18. Not accepted – Editorial comment
19. Not accepted – Editorial comment
20. Not accepted – Editorial comment
21. Not accepted – Non-public references are not being changed. The comment did not propose redaction of content, but the content from the non-public reference will be redacted.
22. Not accepted – Editorial comment
23. The first part of comment 23 is not accepted since it is editorial. However, the second part of comment 23 is accepted and content will be redacted.
24. Not accepted – Non-public references are not being changed.
25. Not used. The draft of Duke's letter contained a comment 25. The paragraph referred to by the draft comment will be redacted.
26. There was discussion of the use of risk information regarding a possible Jocassee dam failure when the NRC has stated that it is to be treated deterministically. Failure of Jocassee due to earthquakes or overtopping was not included because it is not deem credible, a position the NRC has accepted. NRC will consider moving the risk discussion to another section. In addition, a sentence in the referenced paragraph will be redacted.
27. Not accepted – Editorial comment
28. Not accepted – Non-public references are treated in accordance with NRC style guidance.

Comments 29 through 38 of the February 17 Duke letter are part of a "recommended complete replacement for the Oconee Nuclear Station Section of NRC's Screening Analysis Report." This proposed complete replacement was not considered by the NRC and was not discussed in detail during the conference call.

Karwoski, Kenneth

From: Salgado, Nancy
Sent: Friday, February 17, 2012 7:15 PM
To: Wilson, George; Beasley, Benjamin
Cc: Howe, Allen; Stang, John; Bartley, Jonathan; Karwoski, Kenneth
Subject: Duke Engergy Response
Attachments: Duke Energy Response to Proposed GI-204.pdf

Publicly available as ML12053A016

George,

I will call you on Tuesday (I am working from home) to determine if we should have an internal call to discuss Duke's response. Have a nice weekend.

Nancy

From: Ellis, Kevin
Sent: Friday, February 17, 2012 4:17 PM
To: Salgado, Nancy
Cc: Stang, John; Bartley, Jonathan; Sabisch, Andrew
Subject:

Nancy-

Here is the Duke Energy response to the proposed GI-204. If there are any questions regarding the letter, please contact Bob Guy or Terry Patterson.

Have a good weekend.

Kevin

Beasley, Benjamin

From: Wilson, George
Sent: Wednesday, February 22, 2012 6:08 AM
To: Beasley, Benjamin
Subject: FW: Emailing: dukeenergy.pdf
Attachments: dukeenergy.pdf

From: Stang, John
Sent: Tuesday, February 21, 2012 10:48 AM
To: Wilson, George; Salgado, Nancy
Subject: Emailing: dukeenergy.pdf

FYI

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Statement from:

Sandra Magee
Communications Manager
Oconee Nuclear Station

Feb. 19, 2012

The Jocassee Dam was designed and constructed under the regulatory oversight of the FERC (formerly the Federal Power Commission) and an independent Board of Consultants (George F. Sowers, Carl Cullum and William Conn). Modern dam design and construction practices were used, and a comprehensive Quality Control program was in place throughout construction.

Jocassee Dam was designed with no penetrations through the dam. The spillway and the penstock (water path to the hydro generators) are both independent of the dam and located in the natural rock around the dam increasing the safety of the dam design.

The Jocassee Dam has been analyzed for an earthquake loading which equals or exceeds the magnitude of earthquake estimated for the area by the United Stated Geologic Survey (USGS) From a seismic perspective, a design criterion similar to Oconee Nuclear's was applied to Jocassee dams and dikes, as well. The design was based on the project's ability to withstand ground movement from an earthquake of greater magnitude than the region's worst-case earthquake, which was the Charleston earthquake of 1886.

Jocassee Dam is a zoned compacted rockfill dam which is inherently resistant to seismic events. Jocassee is located in an area with low seismic activity.

The Jocassee Dam fully meets established federal criteria for safe operation and performance in the event of an earthquake.

Duke Energy dams are safe. Our hydro fleet dams are routinely inspected by Duke Energy personnel. (This includes, at least every two weeks for earthen dams like Keowee and Jocassee) The dams are also inspected annually by our regulators and every five years by an independent engineering consultant.

Inspections are also done immediately following earthquakes or tremors. We receive instant alerts from the U.S. Geological Society and have our own seismic instrumentation at Jocassee's dam

Additional inspections are also done if the area receives more than two inches of rain within 24 hours.

There are instruments installed in, on, or around our dams based on rigorous federal standards that provide our dam safety staff information related to the general health of the dams. These instruments closely monitor parameters such as water level inside a dam, water pressure inside a dam, seepage rate through a dam, and settlement/deformation of a dam.

Based on our model that assumes an upstream dam failure, we've ensured we have mitigation strategies that would continue to provide cooling capabilities to the site's reactors and spent fuel pools.

While we have planned for the very unlikely event of a dam failure, and added prevention strategies to increase our margin of safety.

For example, we have improved monitoring capabilities that more quickly call attention to very small changes in the characteristics of our dams and allow us to take preventive actions early.

One of the most important safety features of any dam is a functional spillway. Spillways enable dams to safely pass large storm flows that exceed the discharge capacity of the hydroelectric units in our powerhouses. For gated spillways, like the Jocassee and Keowee spillways, FERC requires annual spillway gate testing to demonstrate operability. Each spillway gate is opened (to pass water) at least annually. A full open spillway gate test is performed every five years.

We're continuously making improvements and long-term investments to reduce the overall impact of external events. These improvements further add to the margin of safety of Oconee Nuclear and its ability to withstand external forces, such as fires, floods, tornadoes and earthquakes no matter how unlikely. We have heightened walls around key pieces of equipment at Oconee Nuclear Station.

Beasley, Benjamin

From: Wilson, George
Sent: Friday, February 24, 2012 5:51 AM
To: Beasley, Benjamin
Cc: Stang, John; Salgado, Nancy
Subject: RE: we neeed to writeup a summary of Duke call

Ben here is my preliminary writeup

Primary Duke Staff Terry Patterson and Rich Freudinberger
NRC Staff George Wilson, Ben Beasley, Nancy Salgado, John Stang, Andy Sabisch

The NRC and Oconee Nuclear Station had a call to discuss the redacted version of the Oconee section of GI 204 on Thursday, Feb 23, 2012. During the call the NRC staff went over the 29 comments that were made by Duke Staff on the Oconee section and the NRC staff informed the licensee on the status of each of the comments. The status included why the comment was accepted or not accepted. In addition the NRC staff also had action to reevaluate comments that they originally did not accept. The results of acceptance or non acceptance and those re-evaluations are listed below.

Comments 1, 2, 4, 5, 6, 9, 10, 12, 13, 18, 19, 20, 21, 22, 26, 27, 28, 29

Comments 3, 7, 8, 11, 14, 15, 16, 17, portions of 23,, portions of 24 (25) accepted

Based on the February 23rd conference call with Duke Energy, RES will make two changes to the screening analysis.

- Change the following sentence on page 7 as noted: "The current original licensing basis for Oconee Nuclear Station did not consider include the impact of failure..."
- Add "(not deemed credible)" to the discussion of Jocassee failure probability due to earthquakes or overtopping on page 9.

The following edits requested by Duke Energy will not be incorporated into the Screening Analysis.

- Clarify the distinction between emergency power source and alternate AC power source and change the use of "station blackout" to loss of all AC power.
- Move the discussion of risk estimates of rock filled dam failure to another section of the analysis

George Wilson
Branch Chief
USNRC
Office of Nuclear Reactor Regulation
Division of Operating Reactor Licensing
Plant Licensing Branch LPL1-1
301-415-1711
Mail Stop O8B1A
Office O8E18

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Beasley, Benjamin

From: Stang, John
Sent: Friday, February 24, 2012 2:49 PM
To: Beasley, Benjamin; Wilson, George
Cc: Wilson, George
Subject: Phone Summary 022312.docx
Attachments: Phone Summary 022312.docx

Changes have been made. If you concur please send me an E-mail. Thanks

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LICENSEE: DUKE ENERGY CAROLINAS, LLC

FACILITY: OCONEE NUCLEAR STATION UNITS 1, 2 AND 3

SUBJECT: SUMMARY OF A TELECONFERENCE ON FEBRUARY 23, 2012 BETWEEN THE NUCLEAR REGULATORY COMMISSION AND DUKE ENERGY CAROLINAS, LLC REGARDING COMMENTS MADE BY DUKE ENERGY CAROLINAS, LLC, CONCERNING THE ISSUANCE OF THE SCREENING ANAYLSIS REPORT FOR GENERIC ISSUE 204, "FLOODING OF NUCLEAR POWER PLANT SITES FOLLOWING UPSTREAM DAM FAILURES"

In preparation of the Nuclear Regulatory Commission (NRC) issuing the Screening Analysis Report for Generic Issue (GI) 204, "Flooding of Nuclear Power Plant Sites Following Upstream Dam Failures." the NRC requested Duke Energy Carolinas, LCC (the licensee) to provide comments concerning security related information in the portions of GI 204 which discussed the Oconee Nuclear Station. By letter dated February 17, 2012, the licensee provided a total of 39 comments on the draft GI 204 Screen Analysis Report.

The NRC staff reviewed the licensee's comments, and on February 23, 2012, held a teleconference with the licensee to discuss the NRC's disposition of the licensee's comments. During the call the NRC stated the reason for accepting or not accepting the licensee's comments, and how the Screening Analysis would be changed to reflect the licensee's comments. In the table below is a summary of the disposition by the NRC of each comment made by the licensee in the February 17, 2012.

COMMENT NUMBER	RESOLUTION
1	Not accepted – The proposed change was a minor wording change to be consistent with the UFSAR. George indicated that the NRC is interested in what text is sensitive and should be redacted rather than editorial comments.
2	Not accepted – Editorial comment
3	Accepted – The NRC will redact the Screening Analysis content
4	Not accepted – Editorial comment
5	Not accepted – Editorial comment
6	Editorial comment, however the NRC agreed to consider changing "current licensing basis" to "original licensing basis" and "did not consider" to "did not include."
7	Accepted – Content will be redacted
8	Accepted – Content will be redacted
9	Not accepted – Non-public references are presented in the Screening Analysis in accordance with NRC style guidance and are not being changed.
10	Not accepted – Non-public references are not being changed.
11	Accepted – Content will be redacted
12	Not accepted – Editorial comment
13	This is an editorial comment about clarifying the use of emergency AC and alternate AC power sources. The NRC agreed to reconsider this comment.
14	Accepted – Content will be redacted

COMMENT NUMBER	RESOLUTION
15	Accepted – Content will be redacted
16	Similar to comment 13, the reference to station blackout will be reconsidered.
17	Accepted – Content will be redacted
18	Not accepted – Editorial comment
19	Not accepted – Editorial comment
20	Not accepted – Editorial comment
21	Not accepted – Non-public references are not being changed. The comment did not propose redaction of content, but the content from the non-public reference will be redacted.
22	Not accepted – Editorial comment
23	The first part of comment 23 is not accepted since it is editorial. However, the second part of comment 23 is accepted and content will be redacted.
24	Not accepted – Non-public references are not being changed.
25	Not used. The draft of Duke's letter contained a comment 25. The paragraph referred to by the draft comment will be redacted.
26	There was discussion of the use of risk information regarding a possible Jocassee dam failure when the NRC has stated that it is to be treated deterministically. Failure of Jocassee due to earthquakes or overtopping was not included because it is not deem credible, a position the NRC has accepted. NRC will consider moving the risk discussion to another section. In addition, a sentence in the referenced paragraph will be redacted.
27	Not accepted – Editorial comment
28	Not accepted – Non-public references are treated in accordance with NRC style guidance.
29 - 39	Comments 29 through 38 of the February 17 2012, letter are part of a recommended complete replacement for the Oconee Nuclear Station Section of NRC's Screening Analysis Report. The NRC did accept these comments, because the comments did not pertain to the redaction to security related information.

As noted above in discussions with the licensee during the teleconference, the following were reconsidered by the NRC and will be modified in the Screening Analysis before it is issued.

- Comment 6 - Change the following sentence on page 7 of the Analysis as noted: "The original licensing basis for Oconee Nuclear Station did not include the impact of failure."

- Comment 26 - Add "(not deemed credible)" to the discussion of Jocassee failure probability due to earthquakes or overtopping on page 9 of the Analysis.

The follow actions requested by the licensee during the teleconference were reconsidered by the NRC, but will not be incorporated into the Screening Analysis.

- Comments 13 and 16 - Clarify the distinction between emergency power source and alternate AC power source and change the use of "station blackout" to loss of all AC power.

- Comment 26 - Move the discussion of risk estimates of rock filled dam failure to another section of the analysis.

If you have any questions, please call me at 301-415-1345.

Sincerely,

John Stang, Senior Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-269, 50-270, and 50-287

If you have any questions, please call me at 301-415-1345.

Sincerely,

John Stang, Senior Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-269, 50-270, and 50-287

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NAME	JStang	SFigueroa	GWilson	BBeasley	NSalgado	JStang
DATE						

OFFICIAL RECORD COPY

Beasley, Benjamin

From: Beasley, Benjamin
Sent: Friday, February 24, 2012 9:29 AM
To: Wilson, George; Stang, John; Correia, Richard; Salgado, Nancy
Subject: Notes from Conference Call with Duke
Attachments: Summary of February 23 conference call with Duke.docx

All,

My notes are attached. Your comments are welcome.

Ben

J/22

Summary of February 23, 2012, 12:30 p.m. Conference Call with Duke On GI-204 Screening Analysis

On the call from the NRC were:

George Wilson, NRC Dam Safety Officer and NRR point for this issue
Nancy Salgado, NRR / DORL Branch Chief for Oconee
John Stang, Oconee PM
Jonathan Bartley, Region II Branch Chief
Andy Sabisch, Oconee Senior Resident
Ben Beasley, RES

On the call from Duke were:

Dean Hubbard
Terry Patterson
Dave Cummings
Bob Michael
G. Martin
Rich Freudenberger

George Wilson led the call for the NRC. George provided NRC's preliminary response to Screening Analysis changes proposed by Duke via letter dated February 17, 2012. The letter contained numbered comments, to which George responded in order as noted below.

1. Not accepted – The proposed change was a minor wording change to be consistent with the UFSAR. George indicated that the NRC is interested in what text is sensitive and should be redacted rather than editorial comments.
2. Not accepted – Editorial comment
3. Accepted – The NRC will redact the Screening Analysis content.
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27. Not accepted – Editorial comment
28. Not accepted – Non-public references are treated in accordance with NRC style guidance.

Comments 29 through 38 of the February 17 Duke letter are part of a "recommended complete replacement for the Oconee Nuclear Station Section of NRC's Screening Analysis Report." This proposed complete replacement was not considered by the NRC and was not discussed in detail during the conference call.

Beasley, Benjamin

From: Wilson, George
Sent: Monday, February 27, 2012 7:41 AM
To: Stang, John; Beasley, Benjamin
Cc: Salgado, Nancy
Subject: RE: Phone Summary 022312.docx

John, I stated that we did not accept any of those comments since that were editorial and included in DUKE's rewrite of the section

-----Original Message-----
From: Stang, John
Sent: Friday, February 24, 2012 5:45 PM
To: Beasley, Benjamin; Wilson, George
Cc: Salgado, Nancy
Subject: RE: Phone Summary 022312.docx

George gave me the words for comment resolution for comment 29-39. I recommend that we talk on Monday. I will make the rest of the changes. Thanks for your help.

-----Original Message-----
From: Beasley, Benjamin
Sent: Friday, February 24, 2012 4:02 PM
To: Stang, John; Wilson, George
Cc: Salgado, Nancy
Subject: RE: Phone Summary 022312.docx

John,

I cannot concur on this version because of, what I assume is a typo, in the resolution of comments 29-39. You state that "the NRC did accept these comments..." We did not accept, or even consider, comments 29-39.

There are a couple other things that should be corrected. At the end of the very first sentence you refer to "portions of GI-204 which discussed the Oconee..." This should be "portions of GI-204 Screening Analysis which discussed..." You need to add "letter" as the last word of the second paragraph. It currently reads "...in the February 17, 2012." Under comment 26, you inherited a mistake from me. You need to add "ed" to deem in "...it is not deem credible..."

Lastly, the discussion of comment 6 at the end does not reflect what we are changing. It will be clear if we include "current" in strikeout and "original" in italics. Likewise, "consider" should be in strikeout and "include" should be in italics. If you do not want to use strikeout and italics, modify the sentence to be "Change the following sentence on page 7 of the Analysis to read:" rather than "as noted:"

I will be glad to look at a revised version Monday morning.

Ben

From: Stang, John
Sent: Friday, February 24, 2012 2:48 PM
To: Beasley, Benjamin; Wilson, George
Cc: Wilson, George
Subject: Phone Summary 022312.docx

J/23

Changes have been made. If you concur please send me an E-mail. Thanks

Beasley, Benjamin

From: Wilson, George
Sent: Monday, February 27, 2012 11:08 AM
To: Beasley, Benjamin; Stang, John
Cc: Salgado, Nancy
Subject: RE: Phone Summary 022312.docx

I agree

From: Beasley, Benjamin
Sent: Monday, February 27, 2012 9:58 AM
To: Stang, John; Wilson, George
Cc: Salgado, Nancy
Subject: RE: Phone Summary 022312.docx

John,

I just talked with George. He agreed with my comments from Friday. I have attached my comments in the attached Track Changes version. George can signify his endorsement by replying to you.

Thanks again for the opportunity to comment.

Ben

From: Stang, John
Sent: Friday, February 24, 2012 2:49 PM
To: Beasley, Benjamin; Wilson, George
Cc: Wilson, George
Subject: Phone Summary 022312.docx

Changes have been made. If you concur please send me an E-mail. Thanks

J124

Beasley, Benjamin

From: Beasley, Benjamin
Sent: Friday, March 02, 2012 1:32 PM
To: Stang, John
Cc: Salgado, Nancy
Subject: RE: Oconee GI-204

I concur.

Ben Beasley

From: Stang, John
Sent: Friday, March 02, 2012 1:18 PM
To: Beasley, Benjamin
Cc: Salgado, Nancy
Subject: Oconee GI-204

Ben please review the latest telephone summary ML12058A236

John Stang
301-415-1345

J/25

U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

RES Seminar

Geotechnical Response to Flooding: Foundations and Slopes

Jacob Philip

301-251-7471

Office of Nuclear Regulatory Research

1/26

U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

- Definitions
- Volume/Mass Relationships in Soils
- Soil Classification
- Soil Gradation
- Flooding /Inundation Effects:
    - ✓Footings/Mat Foundations
    - ✓Pile Foundations
    - ✓Slopes: Dams/Embankments/Levees/River Banks
    - ✓Underground Conduits/Tanks/Piping
    - ✓Bearing Capacity
- Summary

Unsaturated Soil

A soil layer is ***unsaturated*** if **some** of the pores between soil particles are filled with water.

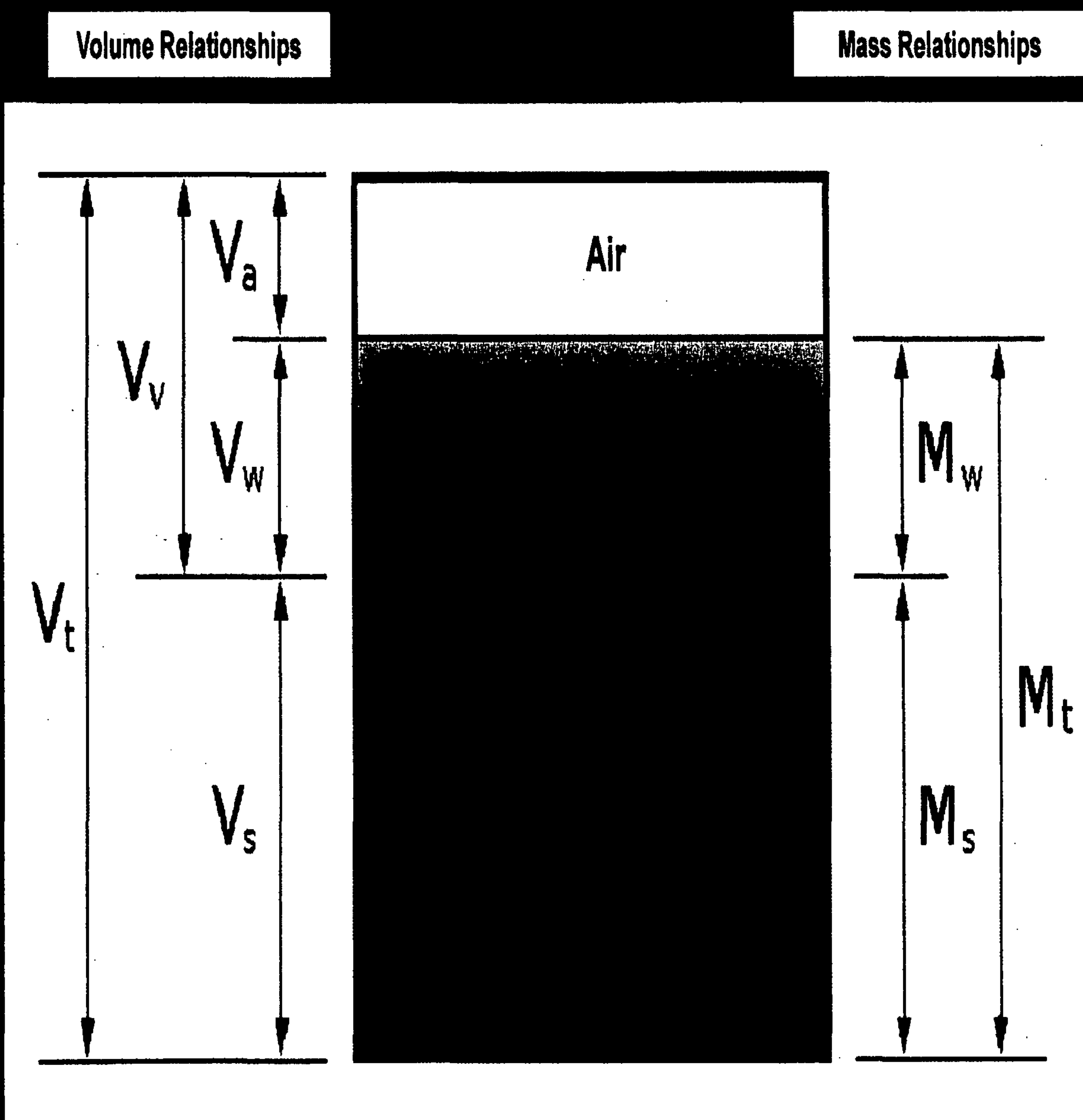
Saturated Soil

A soil layer is ***saturated*** if virtually ***all*** pores between soil particles are filled with water.

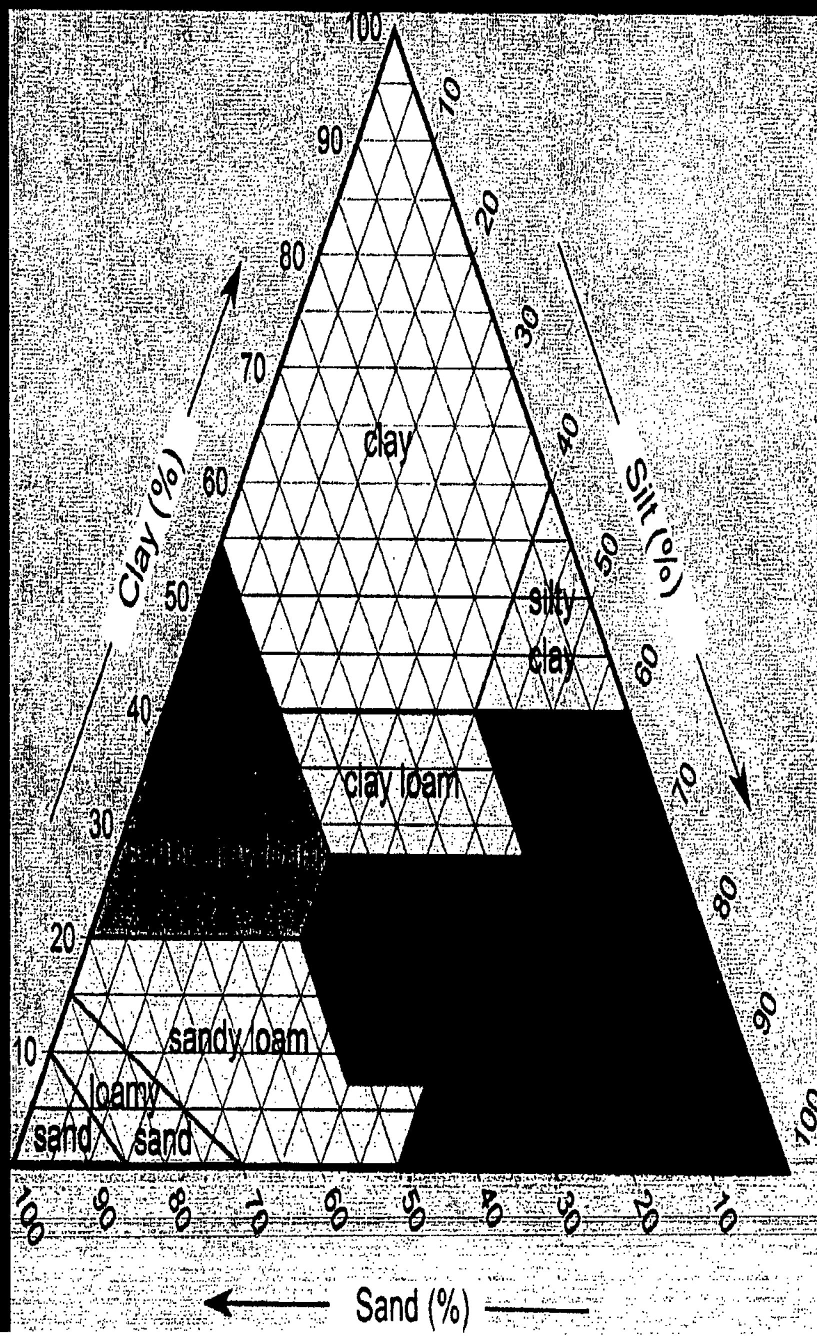
Inundation

A condition in which water from any source ***completely*** covers a land surface.

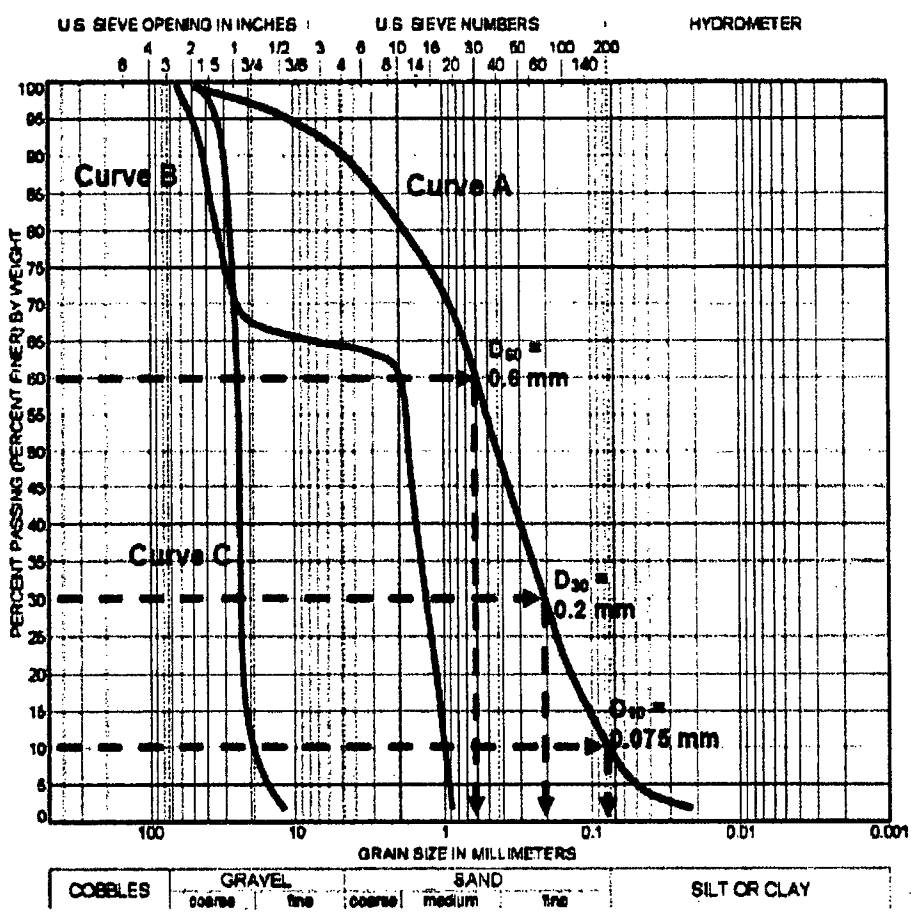
Volume and Mass Relationships in Soils



Soil Classification Chart



Soil Gradation Curves



Curve	D_{10} (mm)	D_{30} (mm)	D_{60} (mm)	C_u	C_c	Gradation
A	0.075	0.2	0.6	8.0	0.9	Well graded (1)
B	1	1.5	2	2.0	1.12	Poorly graded - Gap graded (2)
C	19	25	27	1.4	1.2	Poorly graded

(1) Soil does not meet C_u and C_c criteria for well-graded soil but GSD curve clearly indicates a well-graded soil

(2) The C_u and C_c parameters indicate a uniform (or poorly) graded material, but the GSD curve clearly indicates a gap-graded soil.

Note: For clarity only the D_{10}, D_{30}, and D_{60} sizes for Curve A are shown on the figure.

Consequences of Inundation

Volume of Soil Decreases Suddenly:

Soil Types: Loess

Weak Cemented Sands/Silts

Certain Residual Soils

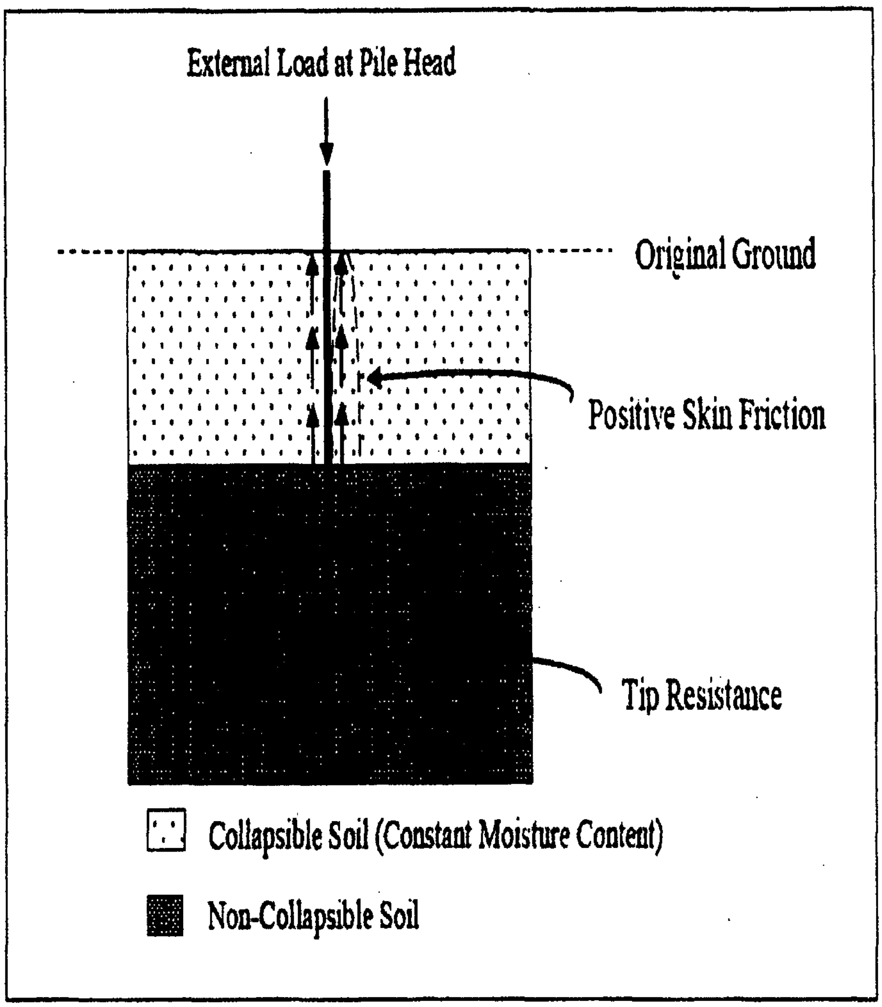
Compacted Soils/Fill

Granular Materials with Angular Particles

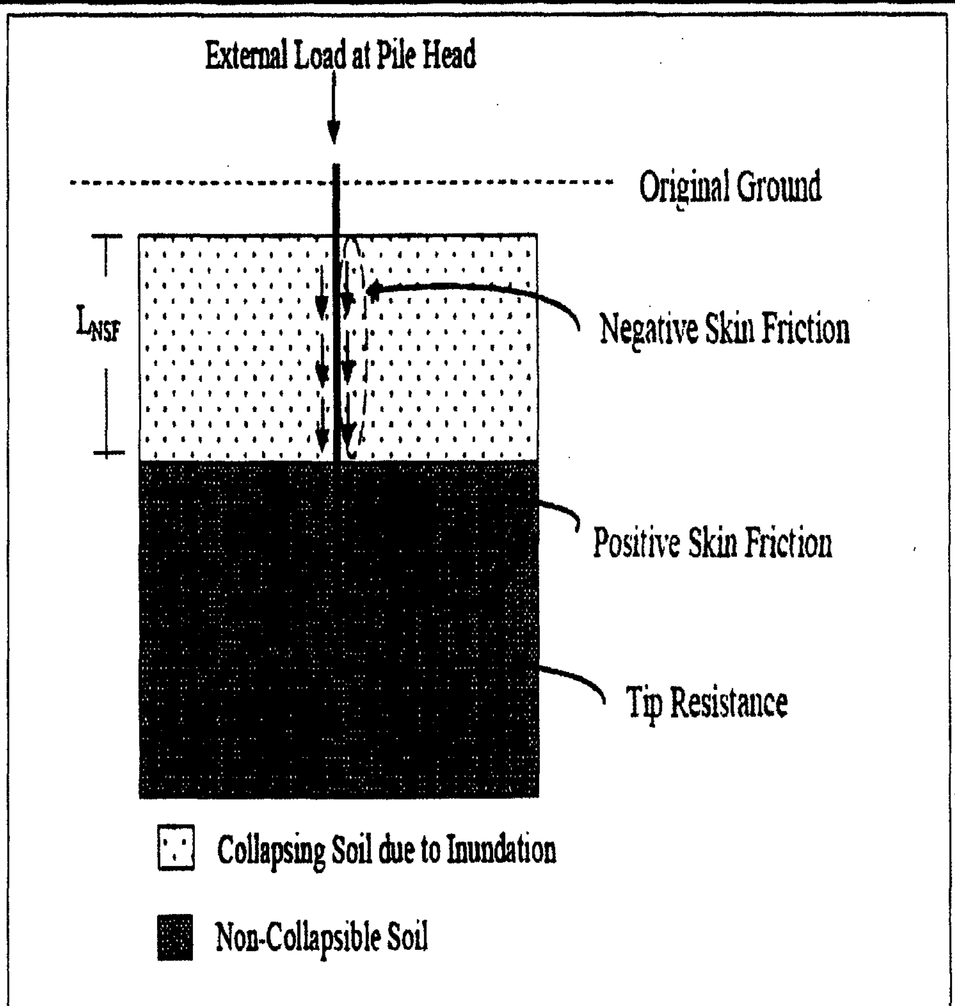
Soils Compacted Dry of Optimum Moisture Content

- Inundation, Cause: *Rainfall, Surface Runoff, Percolation of Rain Water, Poor Drainage, Flooding, Rise in Ground Water, Capillary Rise*

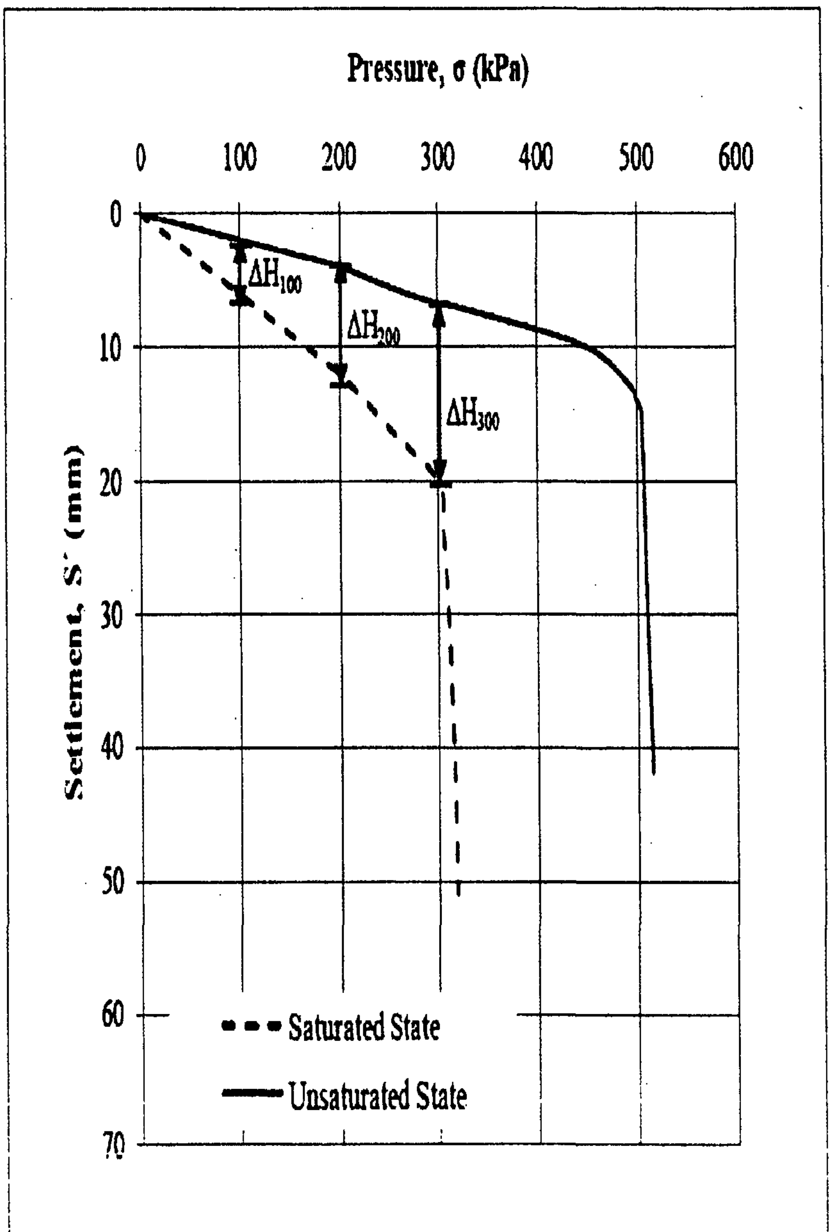
Load Transfer in Pile/Soil System-Constant Moisture Content



Load Transfer in Pile/Soil System: Inundation



Load Settlement Curve of Foundation: Effect of Inundation



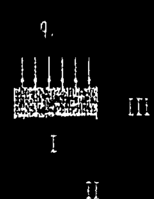
Bearing Capacity

BEARING CAPACITY

TYPES OF SHEAR FAILURE

When uniform load q is applied, soil settles. If $q=q_f$, bearing capacity failure occurs.

(1) **General Shear Failure** : Zone I is pushed downwards, then II and III are pushed sideways then upwards. Failure takes place by sliding, tilting of foundation is possible.



BEARING CAPACITY

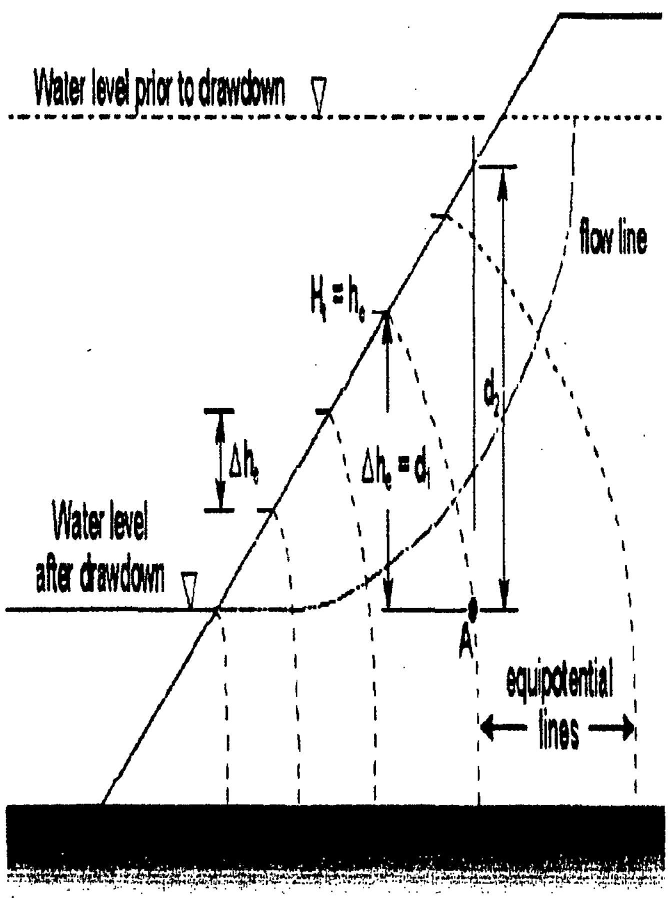
Safe Bearing Capacity is the value of gross pressure that can be applied without danger of shear failure.

Allowable Bearing Capacity (q_a) is the maximum (net) pressure which may be applied to the soil such that:

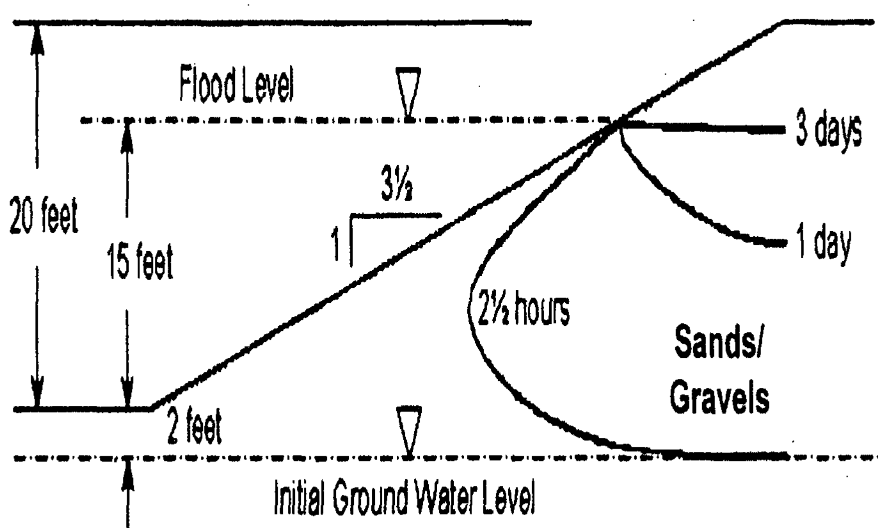
1. F.S. against shear failure of supporting soil is adequate (FS=2 or 3)
2. The total and differential settlements are within permissible limits.

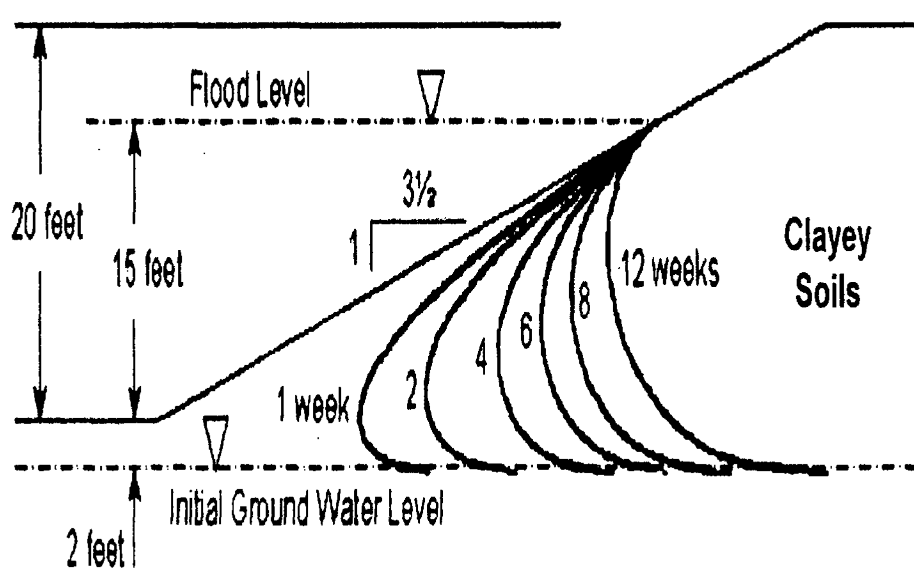
Effects of Inundation on Soil Slopes

Slope Instability due to Drawdown Conditions:

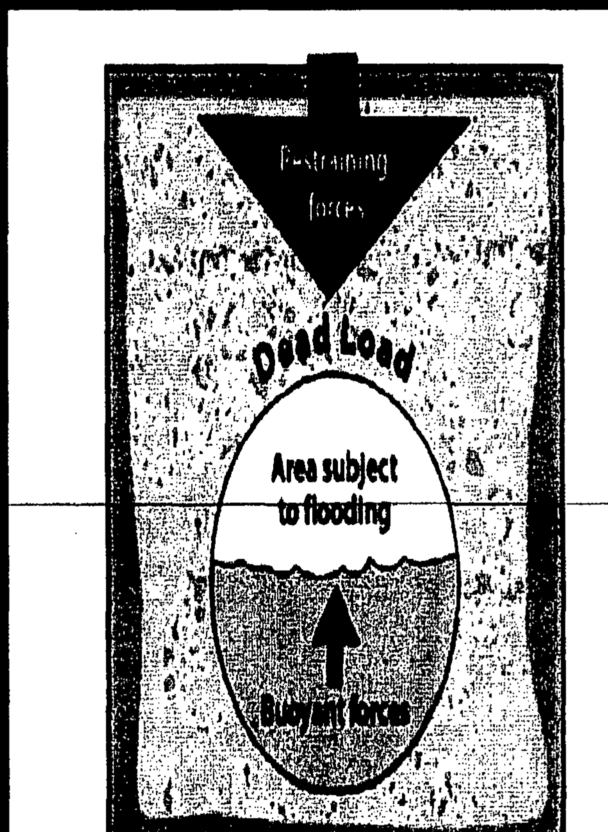


Effect of Inundation on Soil Slopes (cont'd)





Effects of Inundation on Underground Structures: Pipes/Tanks/Conduits



• Buried Structures float when its buoyancy exceeds it's weight. These structures are supposed to remain in place when flooded, and needs to be restrained. Flotation can put excess stress on weak sections of the underground structure causing severe damage or failure.

• Buried structures are also subject to the same volume reduction in supporting soil bedding/natural soils.

SUMMARY: Effects of Inundation

Change in Soil Properties (Affects Performance of Structures)

Reduction in Soil Volume

Volume Reduction Possible in a Wide Range of Soils

Negative Skin Friction in Pile Foundations

Additional Settlements in Spread Footings/Mat Foundations

Loss of Bearing Capacity

Degradation of Stability of Slopes

Flotation/Settlement of Underground Structures

QUESTIONS???

Bensi, Michelle

From:	Wilson, George
Sent:	Thursday, August 23, 2012 2:09 PM
To:	NTTF Rec 2.1 Flooding
Subject:	FW: NRC approval of Oconee inundation study
Attachments:	2011-01-28 NRC SE-CLB on flood ML110280153.pdf

publicly available as ML110280153

Here is the ml for the flooding study

From: Boska, John
Sent: Thursday, August 23, 2012 2:08 PM
To: Wilson, George
Subject: NRC approval of Oconee inundation study

See attached, ML number is in the file name.

John Boska
Oconee Project Manager, NRR/DORL
U.S. Nuclear Regulatory Commission
301-415-2901
email: john.boska@nrc.gov

Coe, Doug

From: Beasley, Benjamin
Sent: Monday, September 10, 2012 4:14 PM
To: Coe, Doug; Uhle, Jennifer
Cc: Correia, Richard
Subject: RE: NC State Symposium

Will do.

Ben

From: Coe, Doug
Sent: Monday, September 10, 2012 3:50 PM
To: Uhle, Jennifer; Beasley, Benjamin
Cc: Correia, Richard
Subject: RE: NC State Symposium

She won't be back until December time-frame, but we can get a title pretty quick I'm sure.

Ben- could you pulse Shelby for that please?

Thanks

From: Uhle, Jennifer
Sent: Monday, September 10, 2012 3:45 PM
To: Coe, Doug
Cc: Correia, Richard; Beasley, Benjamin
Subject: RE: NC State Symposium

Awesome. Can she finalize the title when she returns and send it to me? I need to get it in the announcements.
Thanks, J

From: Coe, Doug
Sent: Monday, September 10, 2012 3:45 PM
To: Uhle, Jennifer
Cc: Correia, Richard; Beasley, Benjamin
Subject: FW: NC State Symposium

Jennifer,

Thanks for the info.

Michelle (Shelby) Bensi from OEGIB (she is currently on rotation in NRO) will write the paper. She was very involved with GI-204.

From: Uhle, Jennifer
Sent: Monday, September 10, 2012 3:36 PM
To: Correia, Richard; Coe, Doug
Subject: NC State Symposium

Can you guys confirm whether someone from DRA is doing a paper on Dam Failure at the NC State Symposium in January. Additional information attached.

Coe, Doug

From: Decker, David
Sent: Tuesday, September 18, 2012 2:26 PM
To: Croteau, Rick; Bartley, Jonathan
Cc: Coe, Doug; Correia, Richard; Beasley, Benjamin
Subject: RE: GI-204 Congressional Interest

Thanks Rick. I just spoke with Ben Beasley in RES about this issue (who can cover GI-204 background and the redaction issue), and he also recommended John Boska be on the phone. Ben also mentioned that it would be good to have Chris Cook from NRO to talk about the work that's been done over the past 9 months on external flooding issue. I'll touch base with John and Chris to start organizing the logistics of setting up a call with the staffer.

David

From: Croteau, Rick
Sent: Tuesday, September 18, 2012 12:11 PM
To: Decker, David; Correia, Richard
Cc: Bartley, Jonathan
Subject: RE: GI-204 Congressional Interest

Jonathan Bartley is the BC here familiar with the Oconee issue. NRR needs to be in on the call as it involves licensing. John Boska is the NRR PM and Pat Hiland has been heavily involved from NRR DE. RII did not do the redacting, so we are not all that much help there.

From: Decker, David
Sent: Tuesday, September 18, 2012 11:49 AM
To: Correia, Richard; Croteau, Rick
Subject: GI-204 Congressional Interest

Rich and Rick,
One of our House oversight staffers, Annie Caputo, asked for a briefing on the status of GI-204, with a mini-focus on what Oconee has done following the issuance of the GI. Annie is definitely responding to the recent press articles about this issue. What she is interested in is discussing what the current status of GI-204 is, and what Oconee has done following the issuance of the GI. She is meeting with Duke Energy today to get their input on the Oconee aspect. Also, the issue of redacting the July, 2011 report will come up, but I think that may be an NSIR issue(?), and I can contact them separately.

Rich – would you, or one or your staff be the right person to brief the current status of the GI?

Rick – would you, or one of your staff, be the right person to talk about what Oconee has done?

I've gone through the Comm Plans on this, and you both would be the right starting points for this, but if you think there is a better POC just let me know. Thanks!

David

1/29

Coe, Doug

From: Cook, Christopher
Sent: Tuesday, September 18, 2012 4:41 PM
To: Decker, David; Boska, John; Bartley, Jonathan
Cc: Beasley, Benjamin; Croteau, Rick; Coe, Doug; Flanders, Scott; Chokshi, Nilesh; Miller, Ed
Subject: RE: Congressional Interest in GI-204 and Oconee
Attachments: NRC-MarkeyBrief_2Aug2012.pptx

David,
Yes, I can support discussion on NTTF Recommendation 2.1, which subsumed GI-204. For my potion of this brief, I'd like to borrow from a similar request (via Tim Riley, OCA). That request was to brief one of Rep Markey's staffers (Mackenzie Lystrup), which we did on Aug 2. Perhaps you can look thru that presentation (attached) and let me know if you want more/less on certain topics for my portion.

Chris

From: Decker, David
Sent: Tuesday, September 18, 2012 4:04 PM
To: Boska, John; Cook, Christopher; Bartley, Jonathan
Cc: Beasley, Benjamin; Croteau, Rick; Coe, Doug
Subject: RE: Congressional Interest in GI-204 and Oconee

John, Chris and Jonathan,
One of our congressional oversight staffers, Annie Caputo, has asked for a briefing that touches on a couple areas related to GI-204. She is interested in a briefing that present the background for GI-204, and what the NRC has done on the flooding issue recently, discuss what actions Oconee has taken in response to the flooding issue, and learn more about what was redacted from the July, 2001 GI-204 report. Annie has had many briefings from the NRC, and has training as a nuclear engineer. I expect the briefing (hopefully to be done over the phone) would take about 45 minutes, and would be 25% GI-204 background, 25% what we've done since the start of the year, 30%what Oconee has done in response to the flood issue, and 20% the report redaction issue. Annie told me that she is being briefed today by Duke Energy on the Oconee aspect of this issue.

After talking with Ben, it looks like he would be the right person to cover the GI-204 background and the redaction issue.

John and Jonathan – would you be available to support talking about what Oconee has done in response to GI-204 to prepare for a potential flood?

Chris – would you be available to discuss the actions the NRC has been working on over the past 9 months or so related to regulatory work associated with dealing with external flooding?

David
OCA/415-1693

From: David Decker
Sent: Tuesday, September 18, 2012 2:26 PM
To: Rick Croteau; Jonathan Bartley
Cc: Doug Coe; Richard Correia; Benjamin Beasley
Subject: RE: GI-204 Congressional Interest

1130

Thanks Rick. I just spoke with Ben Beasley in RES about this issue (who can cover GI-204 background and the redaction issue), and he also recommended John Boska be on the phone. Ben also mentioned that it would be good to have Chris Cook from NRO to talk about the work that's been done over the past 9 months on external flooding issue. I'll touch base with John and Chris to start organizing the logistics of setting up a call with the staffer.

David

From: Croteau, Rick
Sent: Tuesday, September 18, 2012 12:11 PM
To: Decker, David; Correia, Richard
Cc: Bartley, Jonathan
Subject: RE: GI-204 Congressional Interest

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From: Decker, David
Sent: Tuesday, September 18, 2012 11:49 AM
To: Correia, Richard; Croteau, Rick
Subject: GI-204 Congressional Interest

Rich and Rick,
One of our House oversight staffers, Annie Caputo, asked for a briefing on the status of GI-204, with a mini-focus on what Oconee has done following the issuance of the GI. Annie is definitely responding to the recent press articles about this issue. What she is interested in is discussing what the current status of GI-204 is, and what Oconee has done following the issuance of the GI. She is meeting with Duke Energy today to get their input on the Oconee aspect. Also, the issue of redacting the July, 2011 report will come up, but I think that may be an NSIR issue(?), and I can contact them separately.

Rich – would you, or one or your staff be the right person to brief the current status of the GI?

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David

U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

Reevaluation of Flooding of Nuclear Power Plant Sites Following Upstream Dam Failure:

Status and Outlook

August 2012

Christopher Cook, Scott Flanders
Division of Site Safety and Environmental Analysis
Office of New Reactors

G. Edward Miller
Japan Lessons-Learned Project Directorate
Office of Nuclear Reactor Regulation

U.S.NRC

Background

Generic Issue (GI)-204
- Office of Nuclear Reactor Regulation
  - Issue identified in 2010
  - Evaluation requested by Office of Research
- Office of Research (RES)
  - Followed NRC Management Directive 6.4, "Generic Issues Program" (MD 6.4) process
  - Screening analysis report developed
  - Screening report completed in July 2011
- Generic Issue Released
  - Approved by RES Office Director on Feb 29, 2012

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Background

Japan Near-Term Task Force (NTTF) Recommendations
- Issued July 2011
- R2.1 "...reevaluate the seismic and flooding hazards at their sites against current NRC requirements and guidance, and if necessary, update the design basis and SSCs important to safety to protect against the updated hazards."

SRM-SECY-11-0137
- Staff Requirement Memorandum from Commission
- Established R2.1 as Tier 1 activity
- Tier 1 activities are to "start without delay"

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Background (con't)

- SECY-12-0025
  - Enclosure 7 contains draft 50.54(f) letters
  - SRM-SECY-12-0025 issued on March 9, 2012
- Issuance details for the 50.54(f) letters
  - Letters sent on March 12, 2012
  - Addressees include all operating power reactor licensees
  - Flooding walkdowns are Letter Enclosure 4
  - Flooding reevaluations are Letter Enclosure 2
  - Walkdown results inform hazard reevaluation and follow-on assessments, if necessary

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Implementation Approach

- GI-204 transferred to NRR/JLD under "Regulatory Office Implementation" per MD 6.4 in March 2012
- NRC team formed of staff from across the agency
- NRC team activities
  - Extensive interactions with stakeholders (primarily NEI-lead industry group) in developing guidance
  - Review and issue guidance, as appropriate

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R2.1 Timeline

Deliverable	50.54(f) Required Response
Flooding - NRC Prioritizes Sites	60 days (May 11, 2012 Complete)
Interact on Integrated Assessment	180 days (Nov 30, 2012)
Flood Hazard Reevaluation Report Submittals	Within 3 years (March 2013, 2014 or 2015) depending on priority
Flooding - Integrated Assessment	2 years after the hazard (March 2015, 2016, or 2017)

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Flood Hazard Reevaluation

- Application of existing methodologies used for new reactor reviews (ESPs and COLs)
  - NUREG-0800 (SRP; March 2007)
  - NUREG/CR-6966 (Tsunami; March 2009)
  - NUREG/CR-7046 (Flood Eval; Nov 2011)
- Includes all flood causing mechanisms at site, including plausible combined events

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Flood Hazard Reevaluation Components

SRP Section	Topic
2.4.1	Hydrologic Description
2.4.2	Floods
2.4.3	Probable Maximum Flood on Streams and Rivers
2.4.4	Potential Dam Failure
2.4.5	Probable Maximum Surge and Seiche Flooding
2.4.6	Probable Maximum Tsunami Hazards
2.4.7	Ice Effects

SRP Section	Topic
2.4.8	Cooling Water Canals and Reservoirs
2.4.9	Channel Diversion
2.4.10	Flood Protection Requirements

SRP (2007). "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," NUREG-0800. U.S. Nuclear Regulatory Commission, March.

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Summary

- GI-204 was subsumed by Recommendation 2.1 activities in March 2012.
- R2.1 flood hazard reevaluations (including dam failure, as appropriate) are underway at all operating reactor sites.
- R2.1 reevaluations expected in March 2013, 2014, or 2015 based on issued prioritization list.
- Flood protection walkdowns are ongoing. Results from all sites due by end-Nov 2012.

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Coe, Doug

From: Decker, David
Sent: Wednesday, September 19, 2012 10:33 AM
To: Cook, Christopher; Boska, John; Bartley, Jonathan
Cc: Beasley, Benjamin; Croteau, Rick; Coe, Doug; Flanders, Scott; Chokshi, Nilesh; Miller, Ed
Subject: RE: Congressional Interest in GI-204 and Oconee

Chris,
From my perspective, slides 5-8 look like they would definitely cover the post-GI 204 phase. We don't need to provide slides for this, especially if we do it over the phone.

From: Cook, Christopher
Sent: Tuesday, September 18, 2012 4:41 PM
To: Decker, David; Boska, John; Bartley, Jonathan
Cc: Beasley, Benjamin; Croteau, Rick; Coe, Doug; Flanders, Scott; Chokshi, Nilesh; Miller, Ed
Subject: RE: Congressional Interest in GI-204 and Oconee

David,
Yes, I can support discussion on NTTF Recommendation 2.1, which subsumed GI-204. For my potion of this brief, I'd like to borrow from a similar request (via Tim Riley, OCA). That request was to brief one of Rep Markey's staffers (Mackenzie Lystrup), which we did on Aug 2. Perhaps you can look thru that presentation (attached) and let me know if you want more/less on certain topics for my portion.

Chris

From: Decker, David
Sent: Tuesday, September 18, 2012 4:04 PM
To: Boska, John; Cook, Christopher; Bartley, Jonathan
Cc: Beasley, Benjamin; Croteau, Rick; Coe, Doug
Subject: RE: Congressional Interest in GI-204 and Oconee

John, Chris and Jonathan,
One of our congressional oversight staffers, Annie Caputo, has asked for a briefing that touches on a couple areas related to GI-204. She is interested in a briefing that present the background for GI-204, and what the NRC has done on the flooding issue recently, discuss what actions Oconee has taken in response to the flooding issue, and learn more about what was redacted from the July, 2001 GI-204 report. Annie has had many briefings from the NRC, and has training as a nuclear engineer. I expect the briefing (hopefully to be done over the phone) would take about 45 minutes, and would be 25% GI-204 background, 25% what we've done since the start of the year, 30%what Oconee has done in response to the flood issue, and 20% the report redaction issue. Annie told me that she is being briefed today by Duke Energy on the Oconee aspect of this issue.

After talking with Ben, it looks like he would be the right person to cover the GI-204 background and the redaction issue.

John and Jonathan – would you be available to support talking about what Oconee has done in response to GI-204 to prepare for a potential flood?

Chris – would you be available to discuss the actions the NRC has been working on over the past 9 months or so related to regulatory work associated with dealing with external flooding?

David
OCA/415-1693

1/21

From: David Decker
Sent: Tuesday, September 18, 2012 2:26 PM
To: Rick Croteau; Jonathan Bartley
Cc: Doug Coe; Richard Correia; Benjamin Beasley
Subject: RE: GI-204 Congressional Interest

Thanks Rick. I just spoke with Ben Beasley in RES about this issue (who can cover GI-204 background and the redaction issue), and he also recommended John Boska be on the phone. Ben also mentioned that it would be good to have Chris Cook from NRO to talk about the work that's been done over the past 9 months on external flooding issue. I'll touch base with John and Chris to start organizing the logistics of setting up a call with the staffer.

David

From: Croteau, Rick
Sent: Tuesday, September 18, 2012 12:11 PM
To: Decker, David; Correia, Richard
Cc: Bartley, Jonathan
Subject: RE: GI-204 Congressional Interest

Jonathan Bartley is the BC here familiar with the Oconee issue. NRR needs to be in on the call as it involves licensing. John Boska is the NRR PM and Pat Hiland has been heavily involved from NRR DE. RII did not do the redacting, so we are not all that much help there.

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