Mitman, Jeffrey

From: Galloway, Melanie
Sent: Thursday, December 10, 2009 3:45 PM
To: James, Lois; Mitman, Jeffrey
Subject: Planning for Oconee meeting on Dec. 14 at 1 pm
Attachments: Oconee High level summary 120709.doc

Follow Up Flag: Follow up
Flag Status: Completed

Lois and Jeff,

I pulled together several documents which together provide a high-level summary of some of the key issues I see on Oconee flooding. (Note that for some reason there is a blank page that I can't seem to get rid of.) This is intended to help organize our thoughts for the meeting with DE on Monday.

I have also summarized the key issues that I see with the flooding issue that need to be addressed. See list below. Note that I believe we should focus the meeting Monday on items 1 and 2. We may touch on item 3, but I don't want to dwell there--just make the point that I am waiting for the meeting that Dave and I have discussed on at least 2 occasions in which we will get all the parties including OGC to answer the questions: (a) if flooding occurs from overtopping, would we have a similar concern about safety of the site as we do from random dam failure, and (b) if so, then do we have sufficient "new" information that would cause us to need to address overtopping as an adequate protection issue? I don't want this meeting to be consumed by the above discussion.

<u>List of issues associated with resolving flooding issue</u>

1. Lack of sensitivity details provided by licensee and apparent non-conservatisms in analysis without justification

2. Disposition of issues raised by agency's expert consultants, USBR

3. Failure for agency to assess whether overtopping is an adequate protection question and follow appropriate procedure

4. Low probability of success of SSF operation (0.27)

5. Lack of procedures for protection of SSF and for operation of spillgates in advance of impending PMP

In addition, there is also the issue associated with the JCO. Jeff, have you sent your e-mail yet? I want to bring your concerns to Dave's attention as soon as possible.

Please consider how we should present our analysis issues (related to items 1 and 2 above) on Monday and then let's discuss Monday morning in preparation for our meeting with DE. I will ask Mary to schedule.

Thanks.

Melanie

B-49

High-Level Summary of Duke's November 30, 2009, Submittal of Oconee External Flooding Analyses and Associated Corrective Action Plan

- Our letter of April 30, 2009 states in part, "As discussed in our November 5, 2008, meeting, the NRC staff expects that the analyses discussed above which would establish an adequate licensing basis for external flooding and the technical basis for proposed closure, to be completed by November 2009. Should Duke find that additional modifications are necessary that schedule should also be provided by November 2009." Attachment 3 indicates that Duke will not know what modifications it will make nor what the implementation schedule is until 11/15/2010. Duke has not complied with the required November 2009 due date.

- Attachment 2 describes the sensitivity analysis that Duke performed. In some cases they varied important parameters from their base value to other values in the non-conservative direction only.

  For example when they varied the overtopping trigger for the Keowee Dam they started with their best estimate of 817 ft. above Mean Sea Level (MSL) and incremented it down to 815.5 ft. MSL. The top of the Keowee Dam is at 815 ft. MSL. They did not perform sensitivity cases above 817 ft. MSL. A higher trigger would hold up water behind the Keowee Dam for a longer period of time and potentially increase the inundation level at the SSF. [Note that this point correlates to the USBR recommendation c., highlighted in that summary.]

  The requirement to perform sensitivity analysis was intended to explore the responsiveness of the inundation depth to the individual parameters such as trigger elevation. This goal was not always accomplished.

- Two parameters that Duke acknowledges are important are the water volume impounded by the two dams, Jocassee and Keowee. The water volume impounded is controlled by the reservoir level at the time of failure. All of the analysis were conducted with the Keowee Reservoir at 800 ft. MSL. All but one of the cases were conducted with Jocassee Reservoir at a level of 1110 ft. MSL. (One case was performed with level at 1108 ft. MSL for comparison to the original 1992 analysis.) These are the full pond elevations and therefore, volumes. No sensitivity analysis was performed around these parameters. Of most interest would be cases with reservoir levels above 800 and 1110.

- The most important sensitivity analysis deficiency is that no results of the sensitivity analysis were supplied. In addition, no evaluation of the results were supplied. Thus the NRC does not know which parameters impacted the result of interest (i.e., SSF inundation depth) the most nor by how much. It is not clear that Duke has evaluated the sensitivity analysis results.

- Attachment 1 to the letter address which parameter values were chosen for the Duke suggested case. An attempt to justify these parameter values was made. No mention of adequate protection was made nor any justification of why the chosen parameters meet the adequate protection requirement. No mention of worst case and/or most severe case was made nor any attempt to justify that the parameter values chosen are worst case and/or most severe. No mention that a reasonable assurance of adequate protection is the appropriate standard for regulatory action was made as Duke had claimed in previous presentations or why this fulfills the adequate protection requirement.

- Some Attachment 1 critical parameters (e.g. Jocassee Dam breach width and time to fail, and Keowee Dam time to fail) appear to be optimistic. This should be reviewed by an experienced hydrologist.

In summary, this is not a corrective action plan. This analysis documents inundation parameter values that Duke believes are appropriate and attempts to justify use of these suggested values. It describes sensitivity analysis that Duke performed on these parameter values but does not supply any insights or conclusions from this sensitivity analysis. Finally, it does not describe what corrective actions Duke intends to take nor give any indication when the actions will be completed. For a hazard which the NRC believes to have a core damage frequency at least an order of magnitude greater than all other hazards combined this proposed analysis appears inadequate.

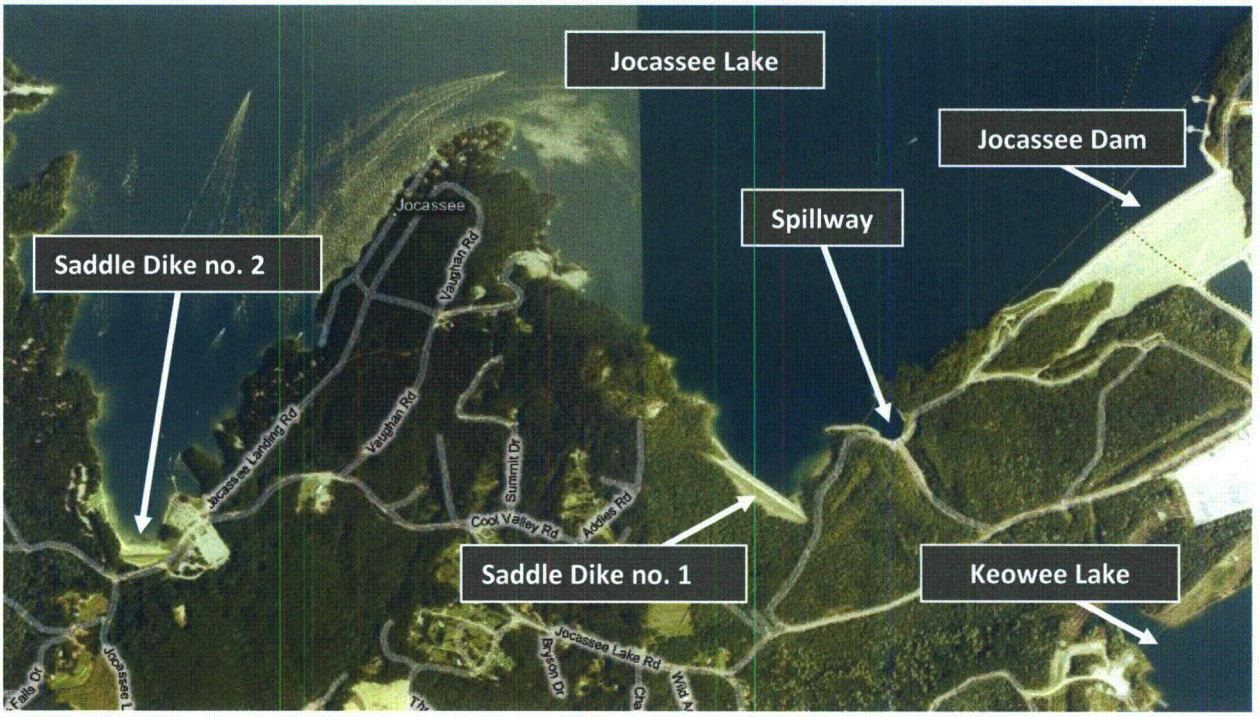
SUMMARY OF THE US BUREAU OF RECLAMATION REVIEW OF THE JOCASSEE DAM INUNDATION STUDY PERFORMED BY HDR/DTA FOR DUKE ENERGY

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.



BREACH PARAMETERS

USBR evaluated a range of values for breach widths for Jocassee Dam based on FERC breach parameter guidelines and empirical relations in published literature. The conclusions by USBR are that (i) the values used in the HDR/DTA report are on the lower range of potential breach widths, (ii) the large storage volume of Jocassee Dam could result in breach widths closer to the upper range, and (iii) there is a precedent for potentially wider breach widths than the upper bound recommended by FERC (i.e., Orós Dam failure, 1960).

Time to breach formation values of 2 to 4 hours (as reported in the HDR/DTA report) are considered reasonable but should be extended to consider a more severe combination for sensitivity purposes.

The reservoir operational level at Jocassee is identified as varying between 1,099 and 1,110 ft in the HDR/DTA study. However, a value of 1,108 ft is used as an initial level. USBR lists two past analysis reports (including the December 2004 study) to emphasize that full reservoir level has been stated to be 1,110 ft.

Based on these considerations, USBR recommends additional sensitivity studies to be performed, specifically:

(a) A scenario with a 250 ft wide base width breach extending to elevation 800 ft with 1:1 side slopes and a 2 hour time to formation

(b) A scenario with the entire dam breached to the original ground surface line and multiple breach formation times of 2, 4, and 6 hours

(c) Consideration of longer breach time values for Keowee Dam, which are expected to cause higher flood levels at the Oconee Nuclear Station (ONS)

(d) If the Jocassee Reservoir is operated at 1,110 feet on a regular basis or if the normal maximum operating level is considered to be 1,110 feet, then this value is the one that should be used in breach analyses since a difference of a few feet can translate into a large storage volume difference

SUPPORT FOR 2D MODELING

USBR states that the complexity of the Keowee Lake hydromorphology and its large surface area require 2D modeling in order to produce results with a high level of confidence. While the 1D model used by HDR/DTA attempts to account for 2D effects using potentially conservative assumptions, USBR believes that there isn't sufficient consensus that the approach used can indeed achieve this. In particular, it is stated that flooding levels at the Keowee Dam could be underestimated if 2D effects are not properly considered. Additionally, flood routing at the ONS intake canal (leading up to the intake dike) would require 2D considerations due to the multiple bends that flooding waters would perform to reach the site (see the figure in next page for site locations and schematic diagram of flooding direction).

USBR also recommends that NRC should consider augmenting current guidance documents with criteria that takes into account issues related to hydrologic modeling refinement (e.g., 1D versus 2D models, use of approximations).


Rochester Hwy
PICKENS
OCONEE
183
Pickens Hwy
Pickens Hwy
Old Pickens

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Comparison of various Jocassee Dam Failure Cases

	1992 - Case	"Case 1"	"Case 2"	"Case 3"	"Worst Case" 1D	Overtopping Case
INPUT						
Jocassee						
Pond Elevation (ft. above MSL)	1108	1110	1110	1110	1110	1125
Storage Capacity (acre-feet)		1,160,000 [8]				1,273,000 [9, 10]
Bottom Breach Width (ft.)	250	250	425	600	600	?
Average Breach Width (ft.)	575	575	790	965	?	?
Time to Breach (hr.)	4	2.6	2.8	3	1	?
OUTPUT						
1D Results						
Max. 1D Keowee Head Water El. (ft. above MSL)	823 [5]	831 [1]	835 [1]	839 [1]	850 [3]	?
Max. 1D Keowee Tailrace Water El. (ft. above MSL)	813 [6]	821 [7]	822 [7]	823 [7]	n/a	?
2D Results						
Max. Keowee Head Water El. (ft. above MSL) [2]	n/a	835	838	842	n/a	?
Max. El. at SSF (ft. above MSL) [2]	n/a	813.5	814.5	815.5	n/a	?
Max. El. at SSF (ft. above SSF Yard El.) [4]	n/a	17.5	18.5	19.5	n/a	?
Intake Dike Headwater (ft. above MSL) [4]	n/a	822	823	823	n/a	?

Notes:
1 Based on Duke 10/28/09 presentation, slide 28 rounded to nearest 1 foot
2 Based on Duke 10/28/09 presentation, slide 28 rounded to nearest 1 foot
3 Based on Duke 10/28/09 presentation, slide 5 rounded to nearest 1 foot
4 Based on Duke 10/28/09 presentation, slide 26
5 Based on Jocassee Hydro Project Dam Failure Inundation Study December 10, 1992, page 18
6 Based on Jocassee Hydro Project Dam Failure Inundation Study December 10, 1992, Table 5.1 page 2 of 7
7 Based on Duke 10/28/09 presentation, slide 20
8 Jocassee dam Hydrologic Analysis, Law Environmental January 1991, page 76 of125
9 This is approximately 110% of full pond. It was calculated by multiplying the area of Jocassee Reservoir 7565 acres) by 15 feet from full pond el. (1110 ft.) to dam top (1125 ft.) and adding it to volume at full pond (1,160,000 acre ft.). This calculation will somewhat underestimate actual storage volume. [1,273,000 = 1,160,000 + 7565 * (1125 – 1110)]
10 The overtopping analysis has not been performed, but if the Jocassee Dam is overtopped it is clear that the inundation height at the SSF is significantly higher then "Case 2"

- "Case 2" appears to be the case we are moving to as the regulatory case.
- "Case 2" is not the worst case/most severe that Duke has analyzed.
- Overtopping – if it can occur – would be expected to cause inundation depths at the SSF significantly in excess of the currently calculated "Case 2" or regulatory case due to expected increased storage in Jocassee Reservoir which would be released with a dam failure.