Mitman, Jeffrey

From: Mitman, Jeffrey
Sent: Thursday, January 07, 2010 4:32 PM
To: Ferrante, Fernando
Subject: RE: OFI Summary

Fernando, I received your email this morning (~5:30 AM) with three attachments. I haven't had a chance to look at it yet.

Thanks.

Jeff

-----Original Message-----
From: Ferrante, Fernando
Sent: Thursday, January 07, 2010 9:57 AM
To: Mitman, Jeffrey
Subject: OFI Summary

Jeff, did you receive the files on the OFI summary? One of the files was large, so let me know if it didn't arrive.

Thanks,
Fernando

B-74

Mitman, Jeffrey

From: Ferrante, Fernando MRR
Sent: Thursday, January 07, 2010 5:20 AM
To: Mitman, Jeffrey NRR
Subject: OFI SUMMARY
Attachments: OFI Summary Rev. 3.doc; OFI Timeline Individual.xls; OFI Summary Figures.doc

Jeff,

Please find attached:

1) The summary text. As we discussed, this is still in rough draft. The only portion I have not fleshed out is the Adequate protection input. I have included the notes from the meeting with G. Mizuno, which I was planning to use as a basis. It seems to me that it makes sense to have this discussion at the very end. For the most part the text is written is chronological order from the moment the SDP finding came to play. Formatting issues such as the reference list are still to be done, but I think the text is the main item at this point. It would be good to check for important missing input and inconsistencies (I suspect there are gaps here and there). There is more text than 2 pages, as expected, but it can be consolidated as it becomes complete.

2) The spreadsheet with the timeline, which may also be modified/updated

3) An additional file currently with figures relevant to OFI, but which I had planned to update as a repository of basic fundamental technical information about the site, the dams, etc...

Thanks,
Fernando

OCONEE FLOODING ISSUE SUMMARY DRAFT

On April 28, 2006, NRC staff identified a performance deficiency involving the Oconee Nuclear Station (ONS) maintenance activities associated with the Standby Shutdown Facility (SSF) to facilitate installation of temporary electrical power cables [1]. The importance of this finding is that ONS is located immediately downstream from two large dams in Seneca, South Carolina: Keowee Dam and Jocassee Dam. The SSF contains the only means to shut down all three existing units following a station blackout induced by a potential catastrophic flood, since the site does not have emergency diesel generators (on-site emergency ac power is provided by two hydro-electric generators at the Keowee Dam). A choice letter was submitted to the licensee (Duke Energy) on August 31, 2006 [2], identifying the issue as a preliminary White finding.

Duke Energy chose to not attend a regulatory conference on the issue, providing a written response to the preliminary finding on October 5, 2006. Subsequently, the NRC staff issued the licensee the Final Significance Determination Letter notifying the White finding on November 22, 2006. Duke Energy appealed this finding on December 20, 2006. After review of the appeal, NRC eventually confirmed the significance of the finding as White on March 1, 2007 [5] due to a lack of defense-in-depth and safety margin. On March 3, 2007, the licensee request NRC to reconsider the Final Significance Determination based on an updated fragility study of the Jocassee dam provided by the licensee on February 5, 2007 [6]. During a meeting between NRC and Duke Energy, it was stated that although the seismic contribution to the Jocassee dam failure frequency was considered to be negligible by both parties, NRC needed to consider all information that was pertinent to the determination of the Jocassee dam failure frequency.

ONS was issued operating licenses in 1973 (Units 1 and 2) and 1974 (Unit 3), prior to the publication of significant regulation [GDC-2] and guidance on external flooding hazards applicable to most of the industry [RG 1.59, ANSI/ANS-2.8, etc.]. However, NRC staff found that the licensing basis covering external hazard issues was in the construction permit for Oconee, which is licensed to a draft version of GDC-2 [DRAFT VERSION OF GDC 2]. However, the current ONS Updated Final Safety Analysis Report (UFSAR) [UFSAR] does not include the effects of a Jocassee Dam failure although 5-foot wall protection for the SSF is mentioned (references to Jocassee Dam failure and potential consequences to the site were removed from later revisions). This SSF flood protection is considered in the ONS UFSAR as a risk assessment enhancement obtained from insights from the ONS submittal of the Individual Plant Examination for External Events (IPEEE) in 1995 [IPEEE] based on a failure rate calculation. Furthermore, upstream dam failures were not considered in determining external flood threats to ONS based on the standards of the Jocassee Dam construction.

NRC staff performed an independent evaluation of the "sunny day" random dam (GAP NEEDS TO BE CLOSED HERE: WHAT TYPE OF FAILURES CAN BE CONSIDERED FOR DAMS) failure frequency contained in the IPEEE for ONS that indicated the listed licensee value of 1.4E-5/year was an order of magnitude lower than the NRC estimate (i.e., 1.8E-4/year [report]). This was discussed with the licensee during June, 2008, and added new information to the lack of safety margin already discussed during the White finding process. A more in-depth review [NSAC/60 review] of the discrepancy between the results discovered that the licensee had used a non-conservative result due to a methodological error in guidance published in a document supporting the IPEEE evaluation [NSAC/60]. The NRC estimate was eventually revised [whitepaper on 9/8/2009] and supported by additional internal research [RES Report].

Additionally, the licensee indicated that the basis for the 5-foot wall protection was a currently unavailable inundation study performed in 1983 which produced a maximum flood height of 4.7

feet at the SSF due to a 2-hour Jocassee Dam sunny day failures (no flooding or seismic-induced failures considered). However, a 1992 study produced for the Federal Energy Regulatory Commission (FERC) surfaced during discussions with the licensee (FERC has the licensing and inspection oversight over the Keowee and Jocassee Dam). The requested study shows results indicating a maximum flood height of 12.5 feet due to a sunny day failure and 16.8 feet due to a Probable Maximum Flooding (PMF) are possible, with a 5 hour prediction for the overtopping of the SSF [1992 FERC Study]. On the seismic failure considerations, an NRC evaluation of the licensee's submittal of the revised fragility evaluation for Jocassee Dam indicated that the seismic hazard curve information used was not up-to-date, that soil liquefaction and soil-structure interaction analysis had not been performed, among other technical issues [ADD REFERENCE].

Based on these facts, NRC staff submitted a 10 CFR 50.54(f) letter to Duke Energy on August 8, 2008 [ML], requesting additional information on (i) bounding external flood hazard (including basis for excluding scenarios such as the ones in the 1992 study), (ii) an assessment of a representative study for the expected flood height due to a Jocassee Dam failure, and (iii) the implications to safe operation of the site in the case of a catastrophic flood affecting the SSF.

On September 26, 2008, the licensee responded to the request. On the first issue, Duke Energy indicated that (a) there is adequate freeboard for Keowee and Jocassee to withstand a Probable Maximum Precipitation (PMP) event, (b) Jocassee Dam sunny day failures are not credible, and (c) the seismic design of Jocassee Dam considered the same input at the ONS seismic design. On the second issue, Duke Energy responded that the 1992 FERC study was not intended to assess flood heights at ONS and is not applicable. For the third issue, Duke Energy indicated that (a) the basis for survival of the SSF is a 5-feet flood height, (b) for floods greater than 5-ft, the SSF will be unavailable, and (c) core damage will occur in 8 to 9 hours, with containment failure in 59 to 68 hours resulting in significant dose to the public (assuming reactors are shutdown in 1 hour with floodwater reaching site in 5 hours). The licensee noted that this scenario does not consider that the postulated flood quickly recedes from ONS and that, after 5 hours from the onset of flooding, recovery actions can take place to mitigate the loss of power and extend the time to a potential containment breach. Additionally, Duke Energy divulged the commissioning of efforts to establish predominant failure modes and resulting credible flood levels at ONS, based on a Probabilistic Risk Assessment (PRA) of Jocassee Dam. Based on the consideration of available historical dam failure information, NRC staff has concluded that, although a PRA approach may be beneficial in identifying vulnerabilities, the limited failure data will lead to less defendable results.

During a subsequent face-to-face meeting on August 8, 2008, between Duke Energy and NRC staff, the licensee indicated that they could not reproduce the original inundation height calculation of 4.7 feet and that a potential solution could be to install watertight doors on the SSF. On November 11, 2008, the licensee submitted the ONS Emergency Action Plan (EAP) [REFER] for review in conjunction the external flooding hazard to the site. Posterior review by NRC staff indicates that the EAP does not demonstrate that its radiological emergency plan actions can be adequately implemented under the conditions resulting from a catastrophic flooding at ONS [NEED REFERENCE].

On December 4, 2008, Duke Energy made a presentation [ML] to NRC staff indicating that Jocassee is a well designed, well constructed, and well maintained dam, and that it does not consider its failure as part of the Construction Licensing Basis for ONS. The licensee confirmed that an updated ONS flooding inundation study and a risk assessment for Jocassee Dam were

being pursued and that it was committed to increasing the height of the current SSF walls to provide additional safety margin against external flooding via the evaluation of engineered solutions based on the realistic and reasonable design inputs. On a conference call between Duke Energy and NRC on January 27, 2009 [summary], NRC staff recognized that the Jocassee Dam is a well built and maintained dam. However, NRC staff conveyed the conclusion that parsing dam failure information to fit Jocassee's attributes would result in too few inputs and that a number below 1E-5/year could not be justified based solely on data. Additionally, NRC staff indicated that dam failures are well documented in literature. Duke Energy staff acknowledged that a Jocassee Dam failure does not appear to be an incredible event based on data, but that the results discussed with NRC staff are considered to be too conservative for Jocassee (and therefore justifying the need for a dam risk assessment to be performed).

The updated flooding inundation study by Duke Energy was presented on March 7, 2009 [Ref]. A 1-D flow model was used to simulate a Jocassee Dam failure. This model produced an overtopping of 15.7 feet at Keowee Dam and 4.5 feet at the ONS Intake Canal Dike, respectively, being reached approximately at 4.5 hours from initiation of the event. On April 30, 2009 [Ref], NRC submitted a letter to Duke Energy indicating that it had not demonstrated adequate protection for ONS, with a request for a sensitivity analysis and a plan completion by November 2009. This was based on NRC staff's position that Jocassee Dam failure is a credible event which needs to be addressed deterministically as, under NRC staff's conclusions, probabilistic approaches will not justify an assertion that dam failures do not need to be considered for ONS. The request for a sensitivity analysis was deemed by NRC staff to be beneficial based on the uncertainties involved in predicting dam failure and resultant flood levels at ONS, provided an adequate technical justification for the various input parameters and associated ranges of variability is included. Additionally, the NRC staff expressed the requirement to update the ONS UFSAR on its licensing basis for external flooding once adequate additional information was assessed by NRC, in accordance with 10 CFR 50.71(e)(2)(i).

Duke Energy provided preliminary inundation results along with a sensitivity analysis on May 11, 2009 [REFD]. The licensee confirmed the results from the March 2009 study with high confidence on the detailed inundation model developed. However, the licensee still sustained that the consideration of random failures of Jocassee Dam is outside of the licensing basis for ONS and that Jocassee Dam can withstand seismic events and a PMP/PMF event. Additionally Duke Energy stated that it views the Yankee Rowe Harriman Dam [REF] issue representative of a precedent applicable to the ONS external flooding issue. The intent to use a 2D flood modeling was also expressed by the licensee, without a timetable for preliminary results or completion. A request for an extension from 30 days to 60 days to respond to the NRC staff's April 30, 2009, letter was also discussed. A response was submitted on June 10, 2009 [RRR], with a tentative project schedule for completing the final inundation studies and sensitivity analyses and a closed management meeting between Duke Energy and NRC took place on June 11, 2009, in which November 2009 was presented [ML091620117] as a deadline, along with details of the sensitivity analysis. The NRC staff also questioned the licensee on the status of updating the ONS UFSAR, which the licensee indicated was not scheduled yet. On July 7, 2009, the licensee's official 60-day response letter [RLR] confirmed the November 2009 key milestone date.

On July 26, 2009, upon commission by NRC/NRR, the US Bureau of Reclamation (USBR) performed a review of Duke Energy's March 2009 flood inundation study, concluding that the PMF inflow condition should be examined as a potential dam failure scenario for Jocassee Dam, assuming inoperable and/or partially blockage spillway gates. Additionally, USBR

suggested that the effect of an updating effort on the PMP for the Carolinas region on the PMF in the future should be kept in mind, as well as sensitivity analysis considerations and the need for 2D modeling due to the complex terrain and constructed facilities involved in the flooding analysis at ONS.

NRC/NRR completed a Justification for Continued Operation (JCO) for ONS on August 12, 2009, that allows the operations at ONS to proceed for 2 years without corrective action 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. The JCO indicates that the risk to ONS 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 [JCO].

In a meeting on October 2009, Duke Energy supplies details of its 1D model sensitivity analysis and 2D modeling runs [?]... A letter submitted by the licensee on November 30, 2009, describes the deadline to complete the plan for the Corrective Action Requirements pending (November 2010), which includes the stated need for Duke Energy to consider the impact of design, review, and approval processes in its timeline and decision, as well as insights from the probabilistic dam failure studies under completion.

Additional topics to be considered for addition:

- summary of overtopping (Mitman to supply write-up)
- White Paper on Regulatory Guidance
- Licensing Basis (Basis for SSF) vs. Adequate Protection
- Breach Analysis by Ken See?
- PFMA?
- Research Papers?

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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.

Meeting Notes - Adequate Protection
Steven A. Laur

GSM Changes Redlined

Date: May 22, 2008

Attendees:

Jeff Circle	Steve Laur
Mark Cunningham	Geary Mizuno

Mike Franovich
Melanie Galloway
Mark Rubin
Bob Palla

Geary Mizuno, an attorney in the Rulemaking and Fuel Cycle Division of the Office of the General Counsel, discussed the concept of adequate protection in the Atomic Energy Act of 1954, as amended (AEA) and NRC regulations. The following points are a summary of the key points which he made, in his discussion and in response to questions which we posed.

- The AEA contains different sections establishing and constraining the agency's regulatory authority of nuclear power plants, including (but not limited to) Sections 103, 104, 109, 161, 182 and 184. These sections use various phrases to describe the agency's authority:
    1. "protect health and...minimize danger to life or property" (Section 103.b)
    2. "promote the common defense and security and...protect the health and safety of the public" (Section 103.b; Section 104.a and c)
    3. "[not] inimical to the common defense and security or to the health and safety of the public" (Section 103.d; Section 104.d)
    4. "[not] inimical to the common defense and security" (Section 109.b and c)
    5. "not...an unreasonable risk to the common defense and security (section 109.a)
    6. "necessary or desirable to promote the common defense and security or to protect health or to minimize danger to life or property" (Section 161.b)
    7. "protect health and to minimize danger to life or property" (Section 161.i)
    8. "protect public health and safety and promote the common defense and security" (Section 184)
    9. "provide adequate protection to the public health and safety and the environment during the period of temporary operation (Section 192b.(2))
    10. *C.f.* "national interest to assure the common defense and security and to protect the health and safety of the public" (Section 2.e); "a program to encourage widespread participation in the ...utilization of atomic energy...for peaceful purposes to the maximum extent consistent with the common defense and security and with the health and safety of the public" (Section 3.d); "'utilization facility' means (1) any equipment or device...capable of making use of special nuclear material...in such manner as to affect the health and safety of the public, or peculiarly adapted for making use of atomic energy ...as to be of significance to the common defense and security, or in such manner as to affect the health and safety of the public...." (Section 11.cc)
- The AEA gives the NRC unusually broad discretion in exercising the agency's authority in implementing the AEA's requirements.
- It is the Commission's long-held position that compliance with NRC regulations is presumptive of reasonable assurance of adequate protection to public health and safety and common defense and security. This presumption is rebuttable; *i.e.*, there may be (new) information indicating that there is inadequate protection even though all regulatory requirements are being complied with. (The converse is not true: Failure to comply with the regulations does not necessarily imply that adequate protection is not

assured; for example, exemptions may be granted - but adequate protection always must be assured.)

- Adequate protection can be considered a "floor" below which NRC would have to take action, consistent with the NRC's obligation to ensure compliance with the requirements of the AEA.
- There must be reasonable assurance of adequate protection continuously throughout the duration of the NRC-regulated activity. This does *not* require that the NRC reconsider and/or reconfirm in a formal manner its original finding of adequate protection which was made at the NRC's original approval of the regulated activity. However, if the NRC obtains new information or insight regarding the safety or security of the activity, then the NRC is obligated to assess whether its earlier finding continues to be valid or if there is an independent reason for concluding that there is reasonable assurance of adequate protection.
- Historically, although the NRC makes an overall (aggregate) finding of adequate protection, this finding has been supported by discrete findings of adequate protection in each technical area. Every discrete requirement must be at or above the adequate protection "floor." The Commission has not addressed overall PRA results for determining adequate protection; in fact, Commission positions seem to reject use of PRA results as the means for determining adequate protection.
- Adequate protection is a concept that does not consider the urgency or time-sensitive nature of the issue. (For example, adequate protection could be judged to not be met at some future point in a licensee's period of operation, but met at present.
- The urgency ("immediacy") of an issue (*e.g.*, a condition that presents an imminent danger to public safety) may allow the agency to take immediate action (similar to when a court issues an injunction or restraining order). The urgency of the issue constrains the time frame for taking responsive action. By contrast, the safety and security implications of the issue (*viz.*, whether the issue raises a matter of adequate protection) constrains the nature of the responsive action (e.g., publication of a RIS with recommended action, versus an order requiring shutdown)[1].
- Adequate protection is a concept that is independent of the determination as to whether an action constitutes "backfitting" under the Backfit Rule, 10 CFR 50.109. An NRC position could constitute backfitting, and be regarded as an "enhancement to safety" rather than one necessary for adequate protection (in which case a backfit analysis must be prepared). On the other hand, an NRC position may not constitute a change of position and therefore not constitute a backfit, but may be regarded as an adequate protection issue.
- The mention of "protection of property" allows the NRC to consider, as benefits (as opposed to averted costs), regulatory actions which go beyond protection of public health and safety or common defense and security. However, the Commission has interpreted the statutory authority to be limited to protection of the general public's property, not the licensee's property.

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[1] Thus, it is possible to conceive of a situation where the appropriate agency response is an issuance of an order directing the licensee to shutdown after 10 years of operation, or if a specified threshold is exceeded. The determination that an order directing shutdown was based upon the characterization of the issue as a matter of adequate protection, but that there was no imminent danger to public health and safety that would support making the order immediately effective.

- The AEA does not require or otherwise direct the agency to use deterministic, risk-informed, or risk-based regulatory approaches in implementing the statutory requirements (the words, "deterministic" and "risk-informed" are not used in the AEA). Historically, the NRC has used deterministic approaches, but the Commission has, over the last two decades, moved in an incremental fashion towards greater consideration of risk in regulatory decision making. The Commission has most recently endorsed the use of risk-informed decision making, where the decision is informed by the necessary compliance with deterministic requirements, supplemented by the insights provided by risk methodologies (often referred to as a "blended" approach for decision making). The AEA's use of the term, "no undue *risk*," supports the NRC's use of a more flexible regulatory framework that uses both deterministic and risk assessment tools. However, the Commission has also indicated that the NRC will not use risk-based decision making, where a regulatory decision is determined *solely* by quantitative risk results.
- Results from PRA studies and other risk information may inform the NRC decision maker's thinking, but no hard and fast risk thresholds have been established for determining whether reasonable assurance of adequate protection is provided.

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Reference List

[1] ML0611804510

[2] ML062480183

[3] ML0628902060

[4] ML0636200920

[5] March 1, 2007 confirming White Finding

[6] updated fragility study of the Jocassee dam

[GDC-2]

[RG 1.59, ANSI/ANS-2.8, etc.]

[DRAFT VERSION OF GDC 2] Federal Register (Volume 32, Number 132, 7/11/67)

[UFSAR]

[IPEEE]

[report] refer to 1.8E-4/year calculation

[NSAC/60 review]

[NSAC/60] NSAC/60, "Oconee PRA a Probabilistic Risk Assessment of Oconee Unit 3,"

[whitepaper on 9/8/2009]

[RES Report]

[1992 FERC Study]

[ADD REFERENCE] Seismic evaluations

[ML] 10 CFR 50.54(f) letter to Duke Power on August 8, 2008

[ML] September 26, 2008 Duke Response

[REFER] EAP Submittal

[NEED REFERENCE] Evaluation of EAP

[ML] On December 4, 2008, Duke Energy presentation to NRC

[summary] conference call between Duke Energy and NRC on January 27, 2009

[Ref] March 7, 2009 Dam Breach Study

[Ref] April, 30, 2009 Letter

[REFD] Duke Energy provided preliminary inundation results along with a sensitivity analysis on March 11, 2009

[REF] Yankee Rowe Harriman Dam

[RRR] June 10, 2009

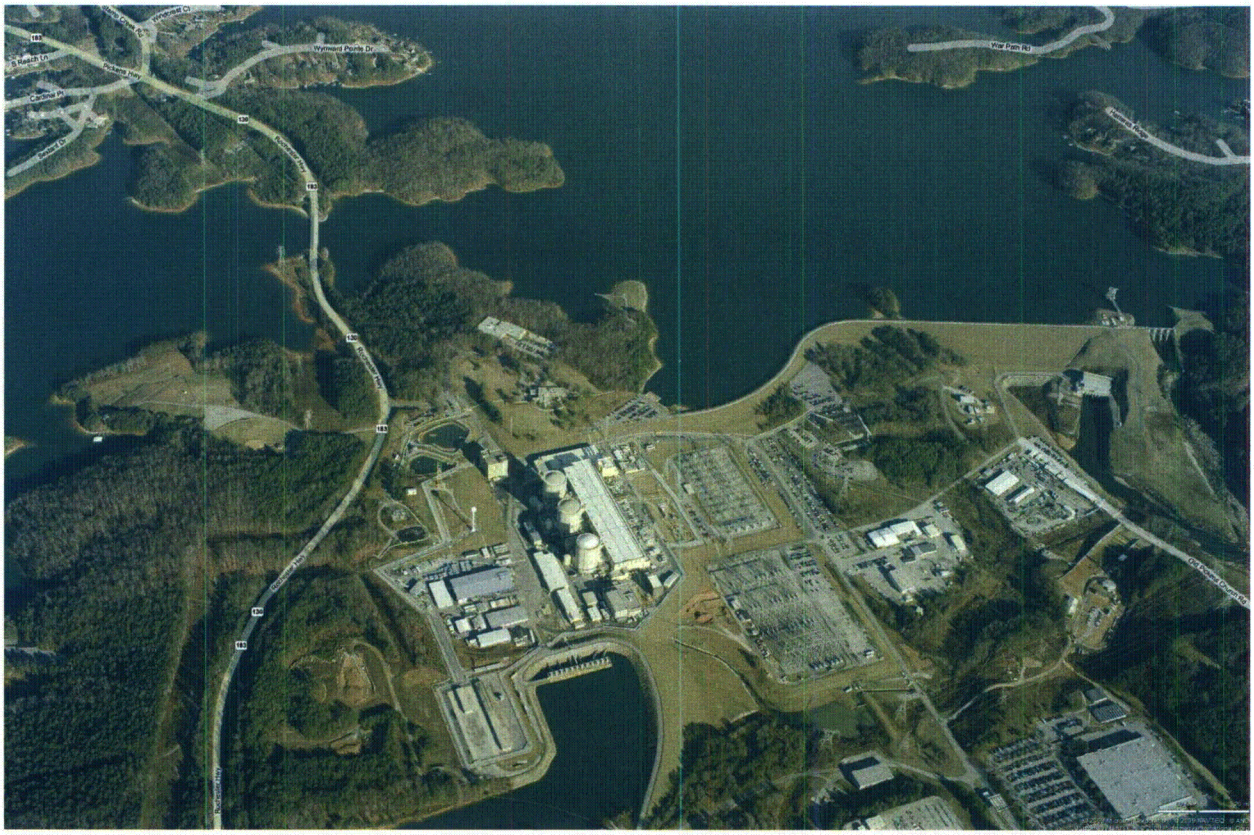
[ML091620117]

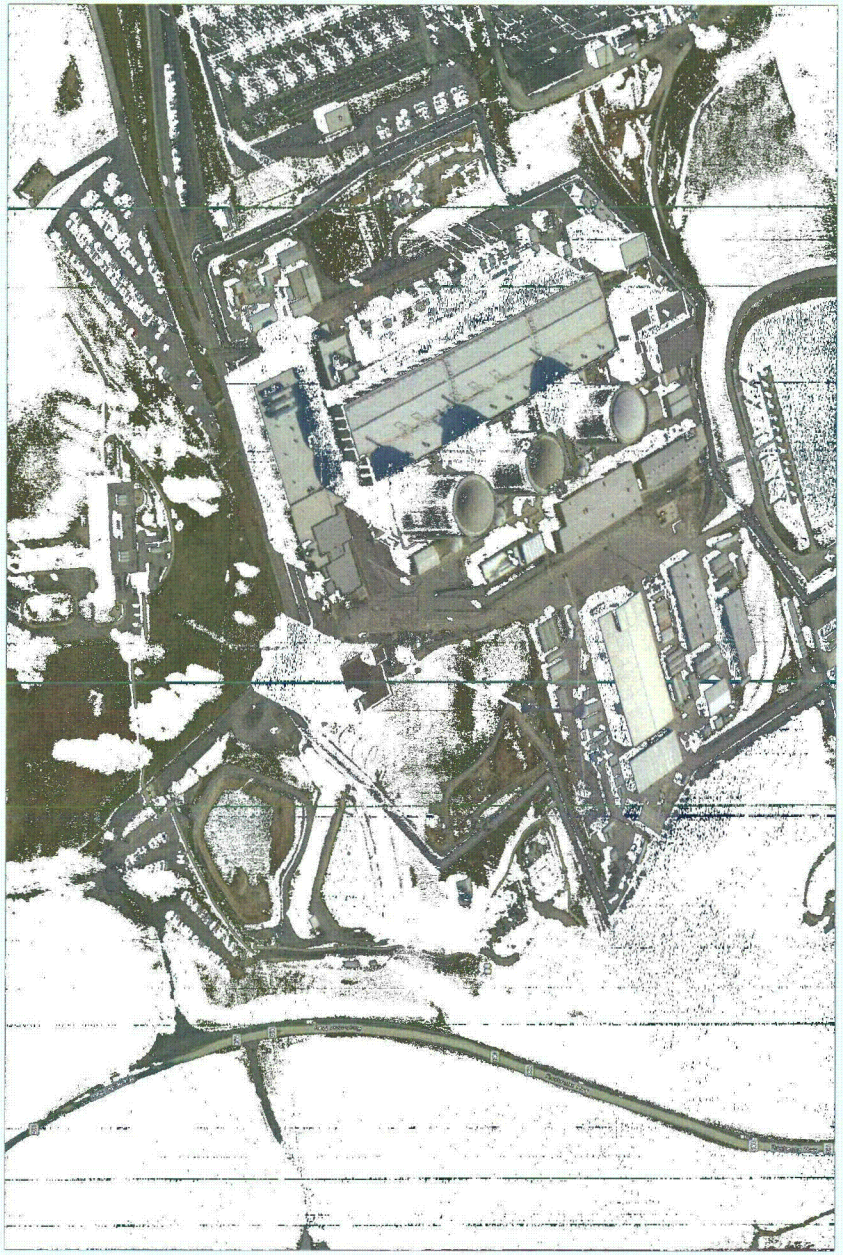
[RLR] 60-day response letter

[JCO]

OCONEE NUCLEAR STATION SITE (ONS)

[ADD RELEVANT DATA @ EACH SECTION]





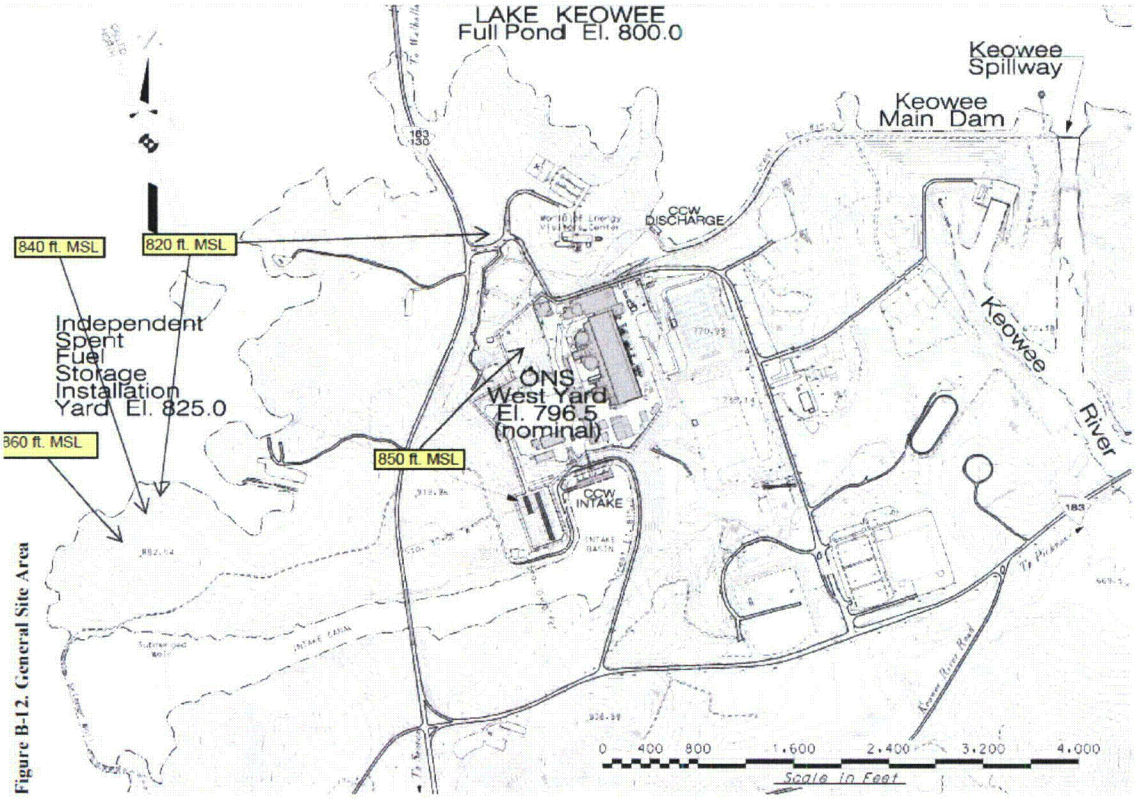
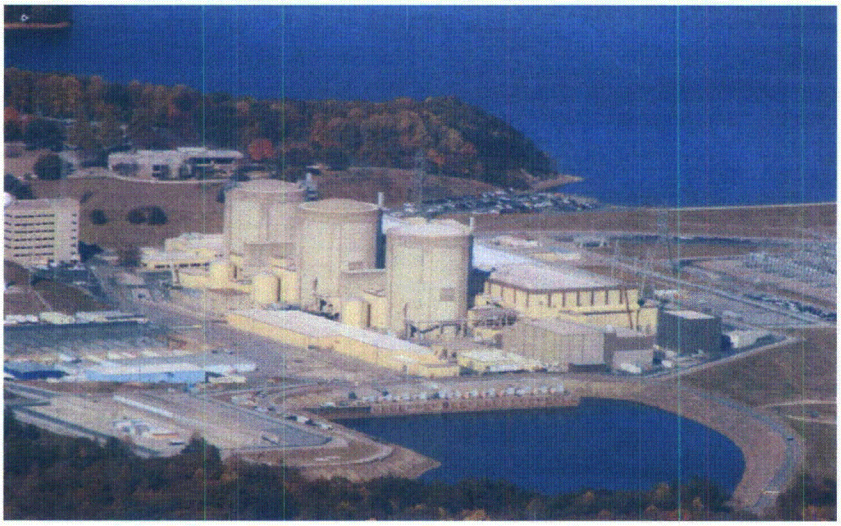
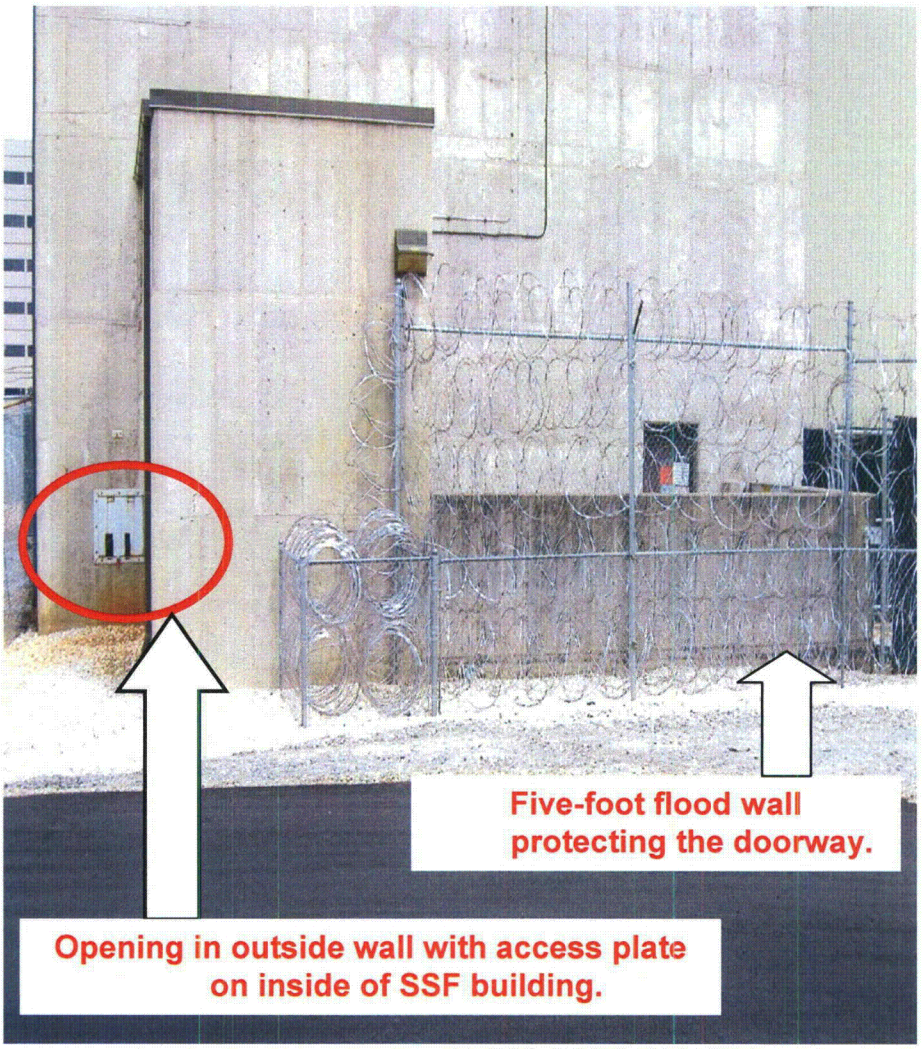


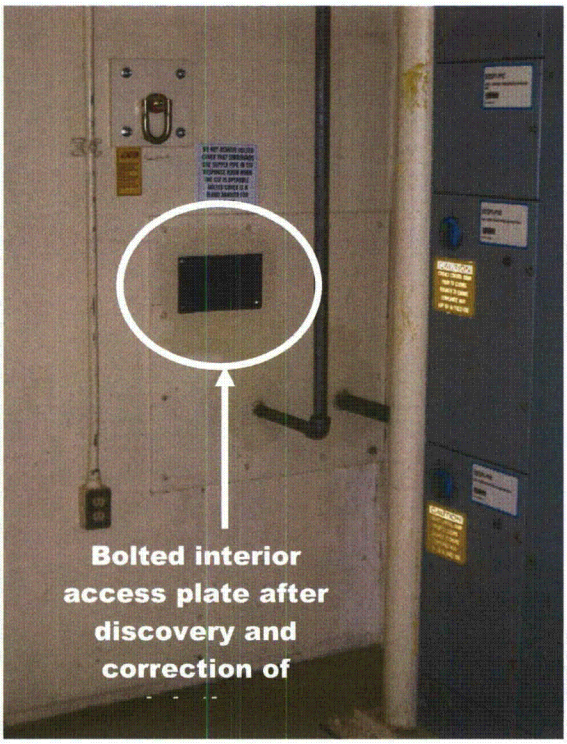
Figure B-12. General Site Area

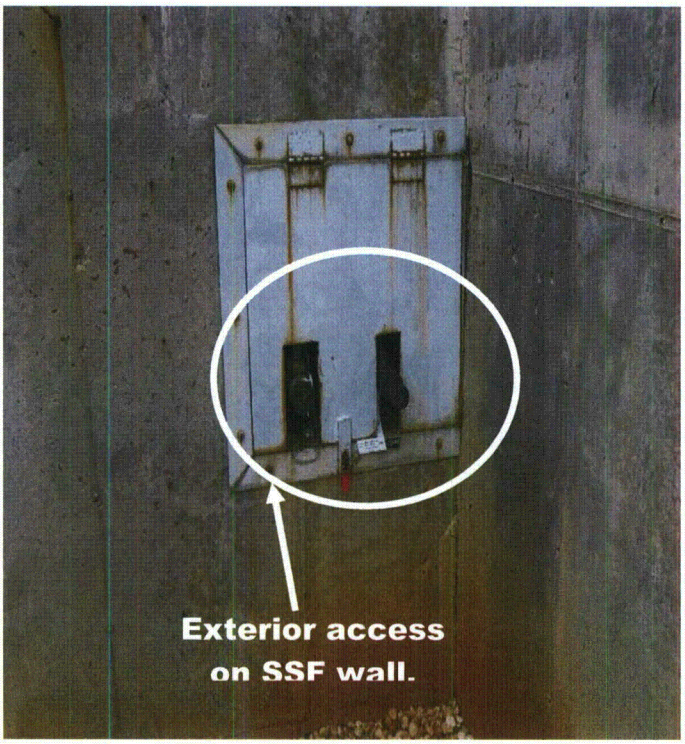
STANDBY SHUTDOWN FACILITY (SSF)

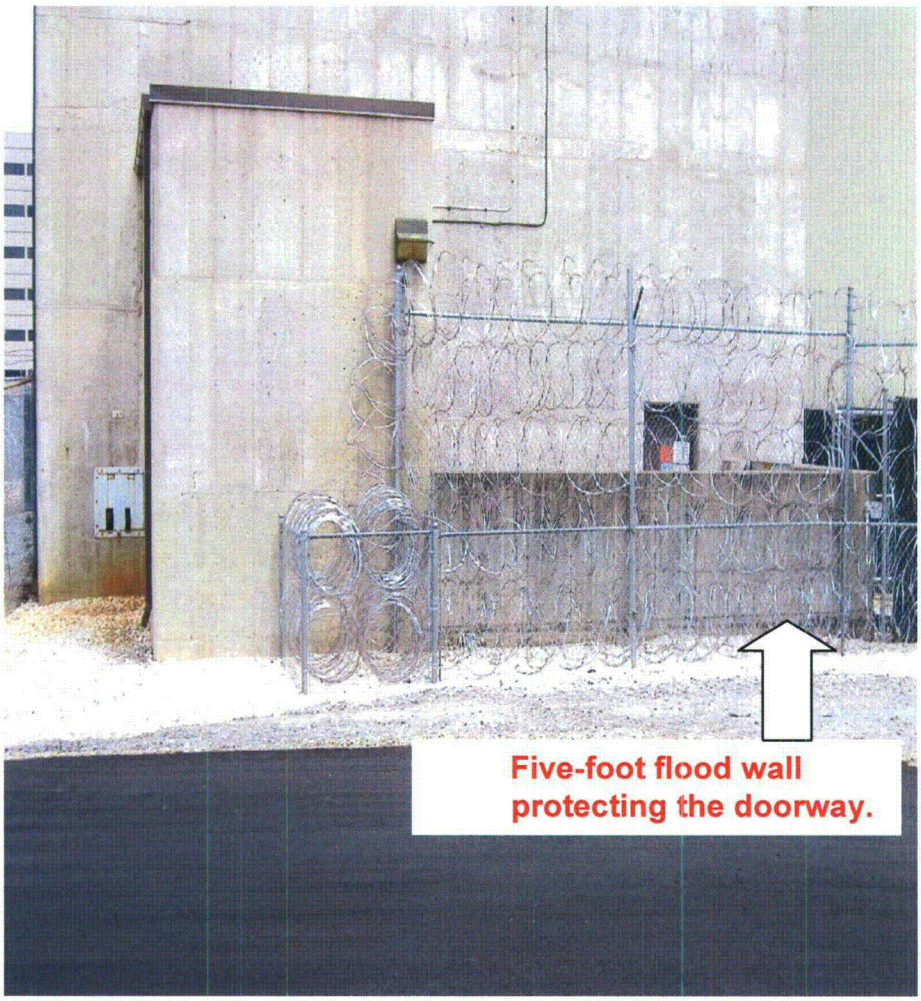
[ADD RELEVANT DATA]



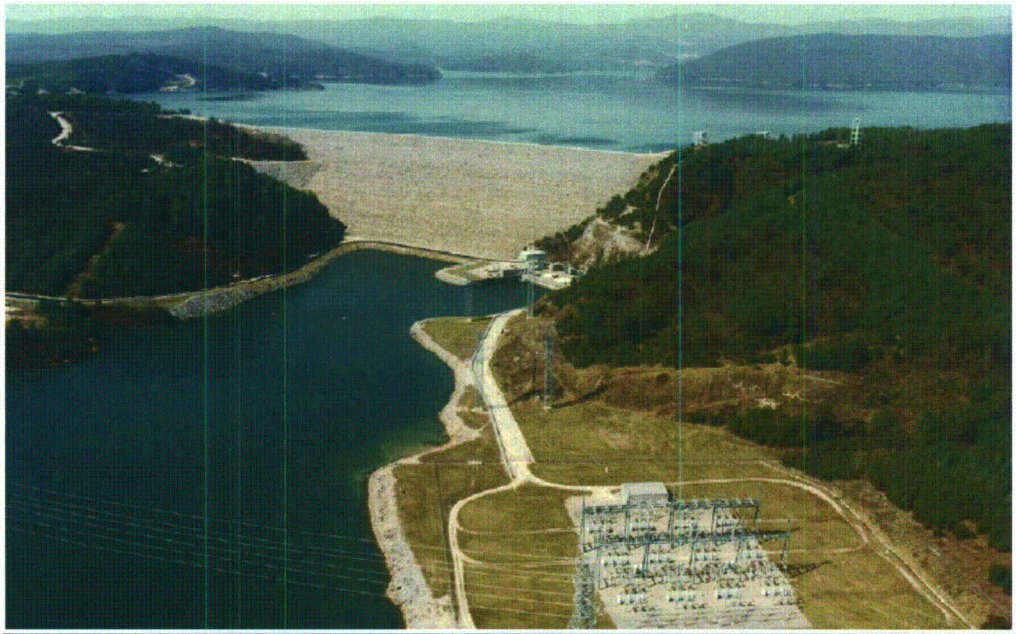

Five-foot flood wall
protecting the doorway.
Opening in outside wall with access plate
on inside of SSF building.

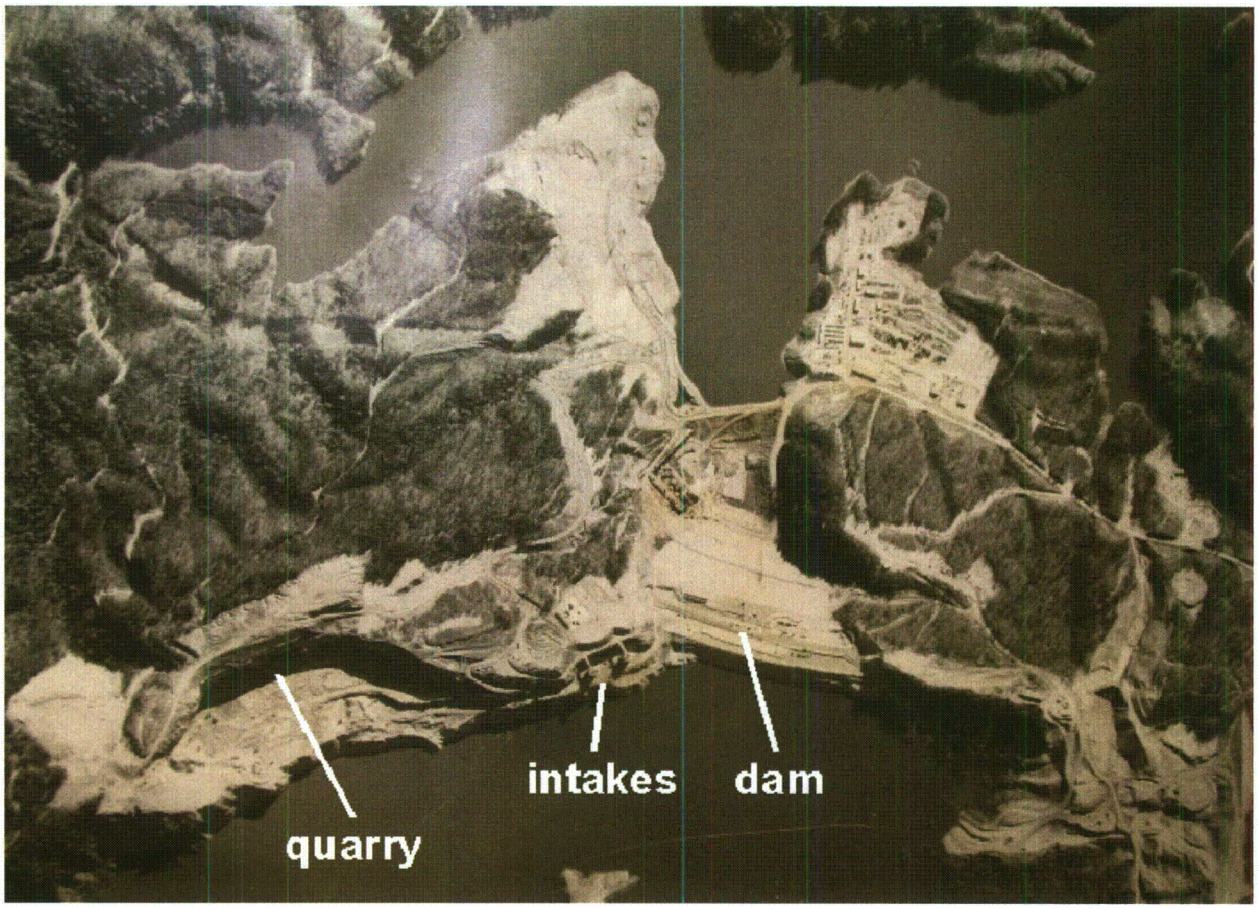

Bolted interior
access plate after
discovery and
correction of


Exterior access
on SSF wall.


Five-foot flood wall
protecting the doorway.

JOCASSEE DAM

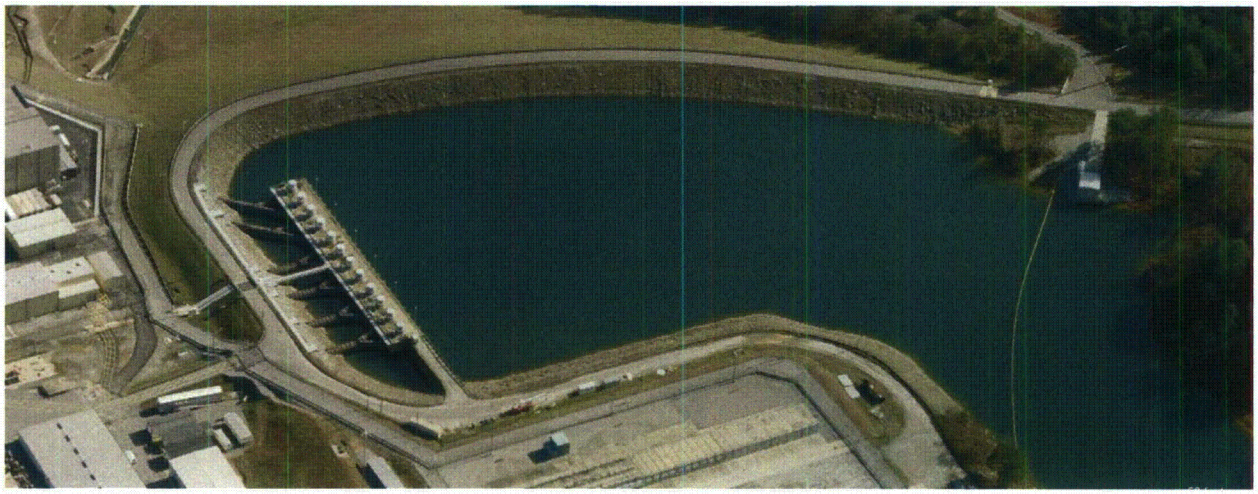



intakes
dam
quarry

JOCASSE SPILLWAY

KEOWEE

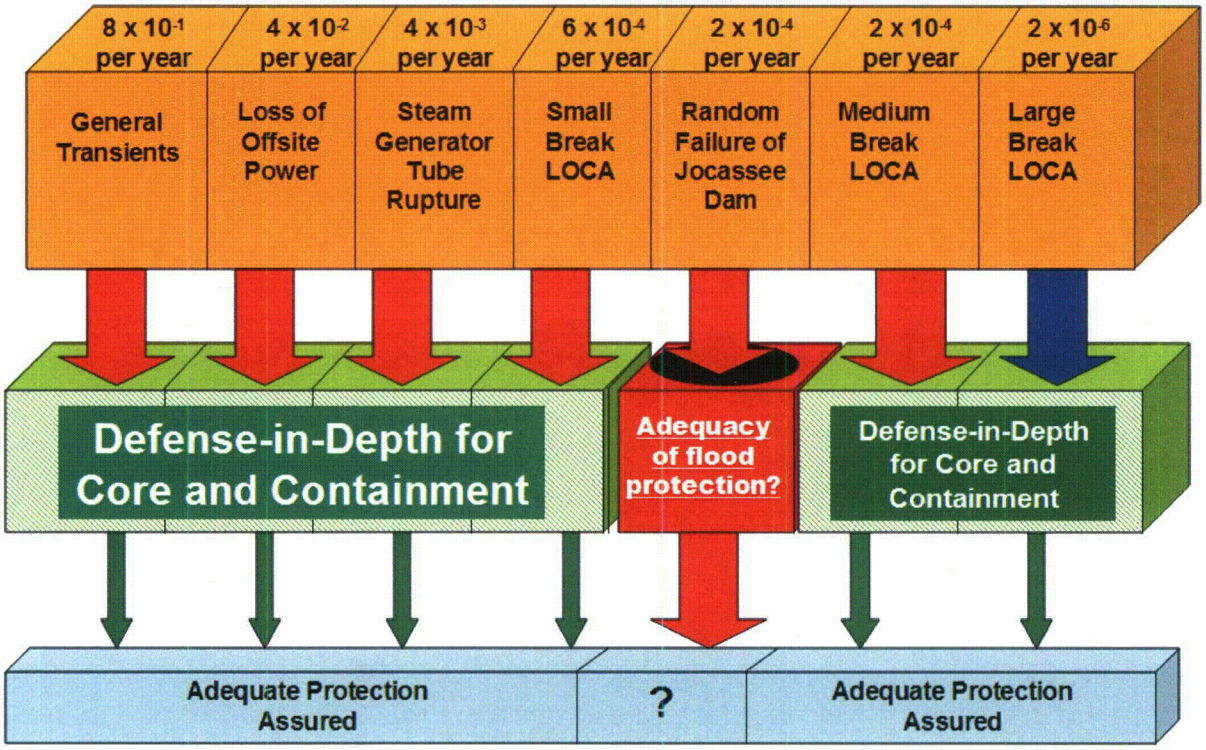
ONS INTAKE DIKE CANAL



SADDLE DIKES

Saddle dikes at Jocassee Lake are protected from wave action by rip rap on sides facing lake. Top: Saddle Dike #2. Middle: rip rap on lake side of Dike #1. Right: downstream side of Dike #1 has grass but no rip rap (french drain is visible along toe of dam).

MISCELLANEOUS



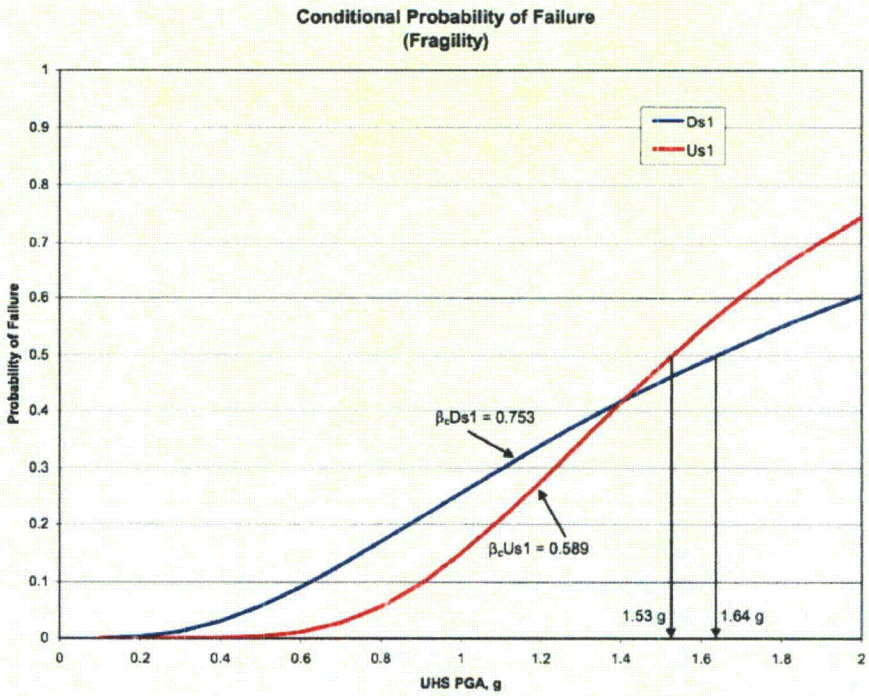
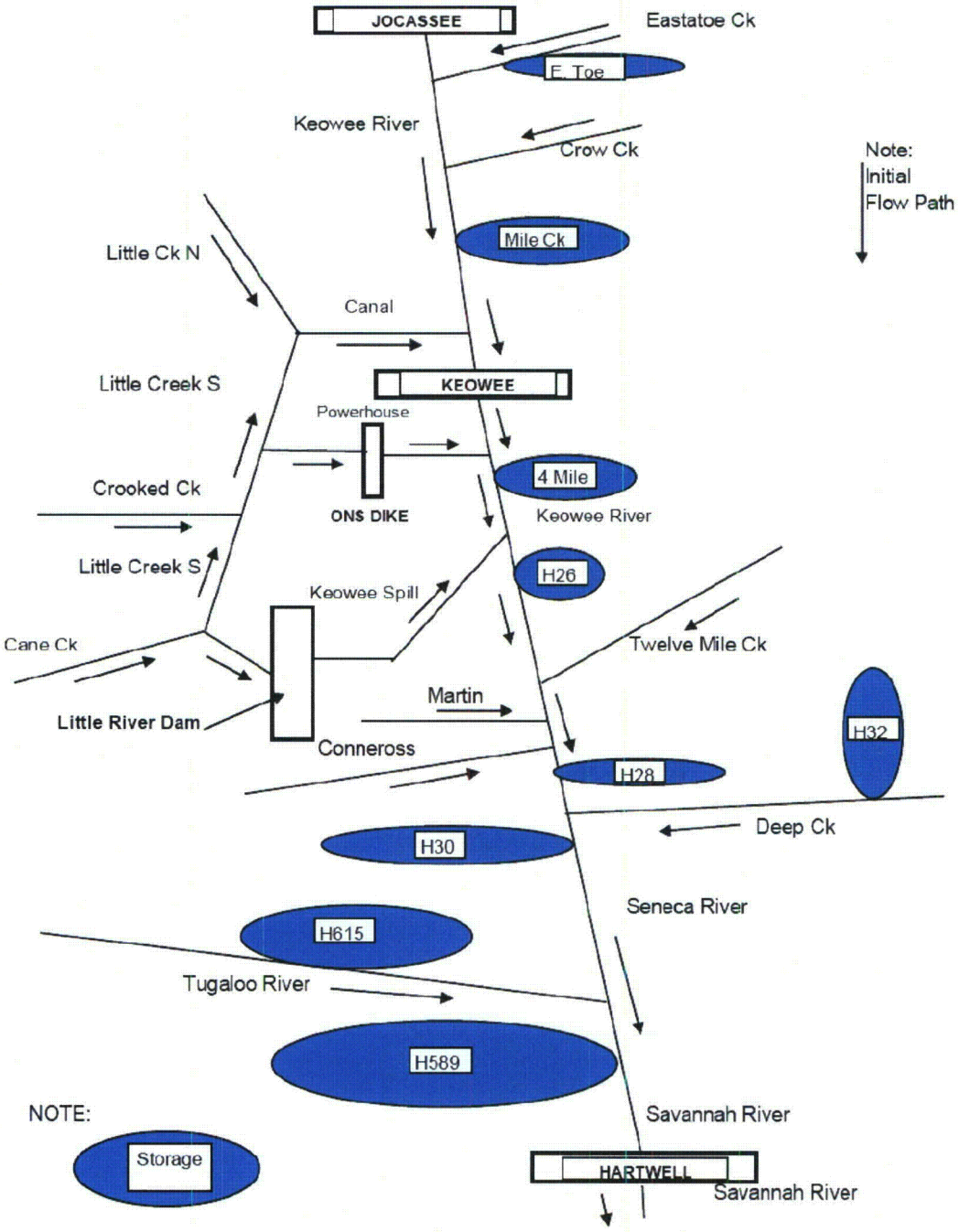


Figure H-1. Conditional Probability of Failure of Dam Slopes

FIGURE 2
MODEL SCHEMATIC

Jocassee-Keowee Dam Breach Study
Dam Breach Model Schematic



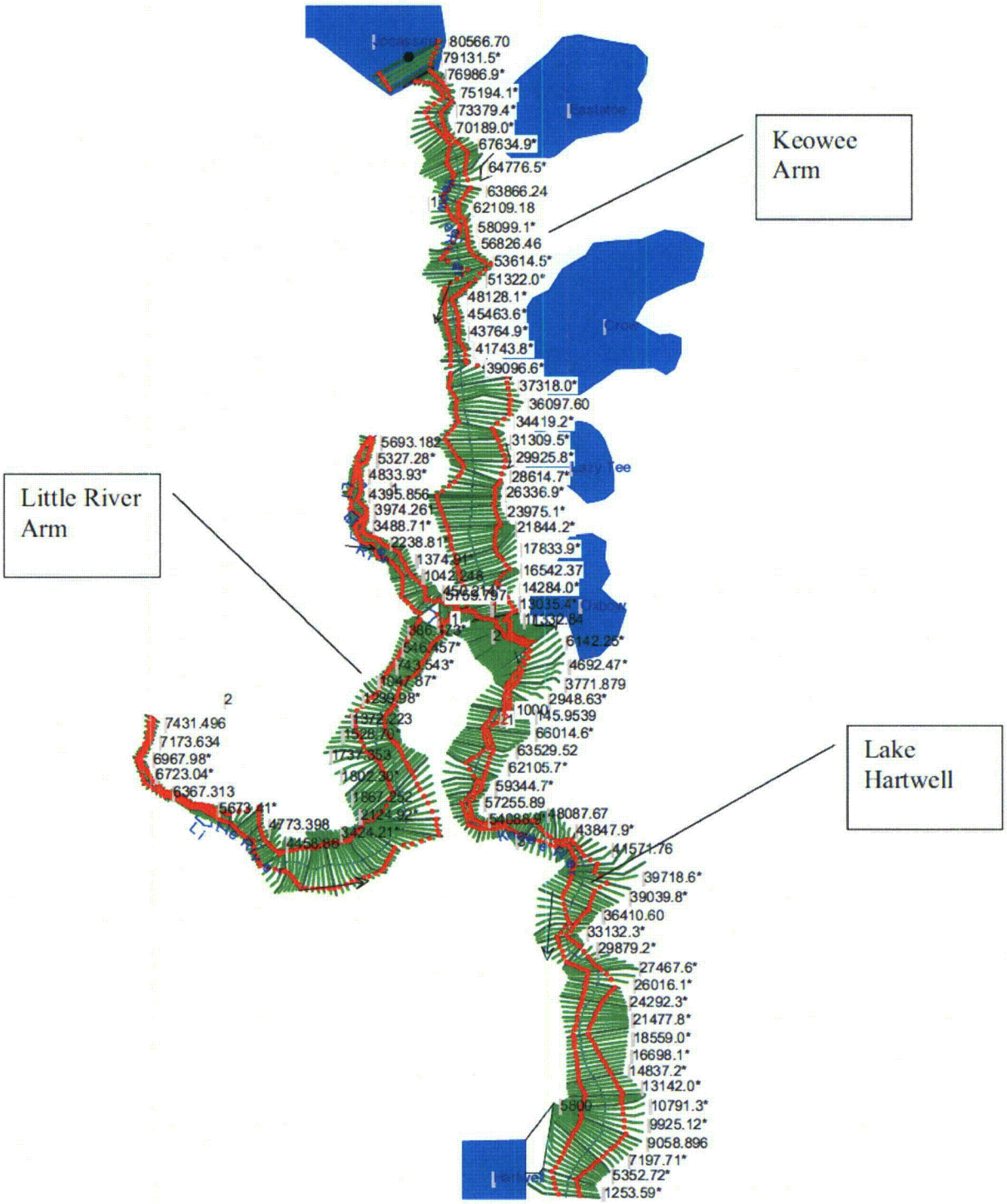
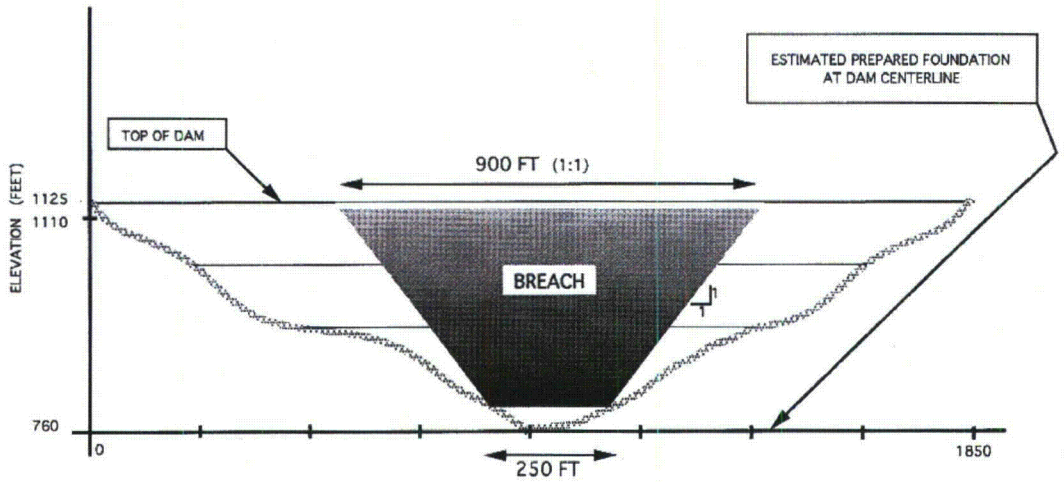
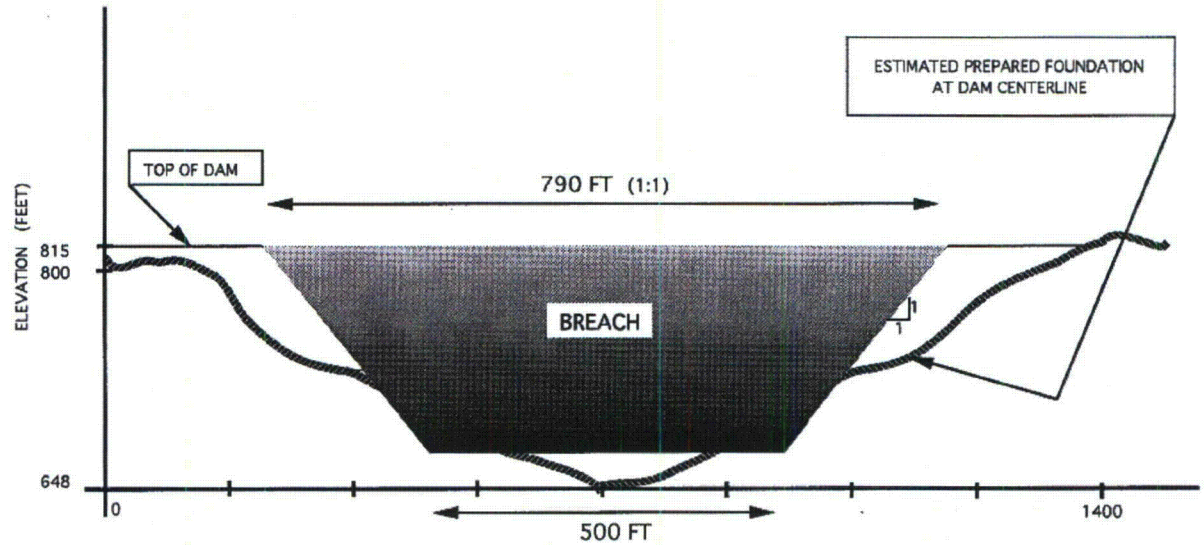


Figure 1 HEC_RAS Model Geometry File



DUKE POWER COMPANY
JOCASSEE PUMPED STORAGE PROJECT
JOCASSEE DAM
BREACH PROFILE

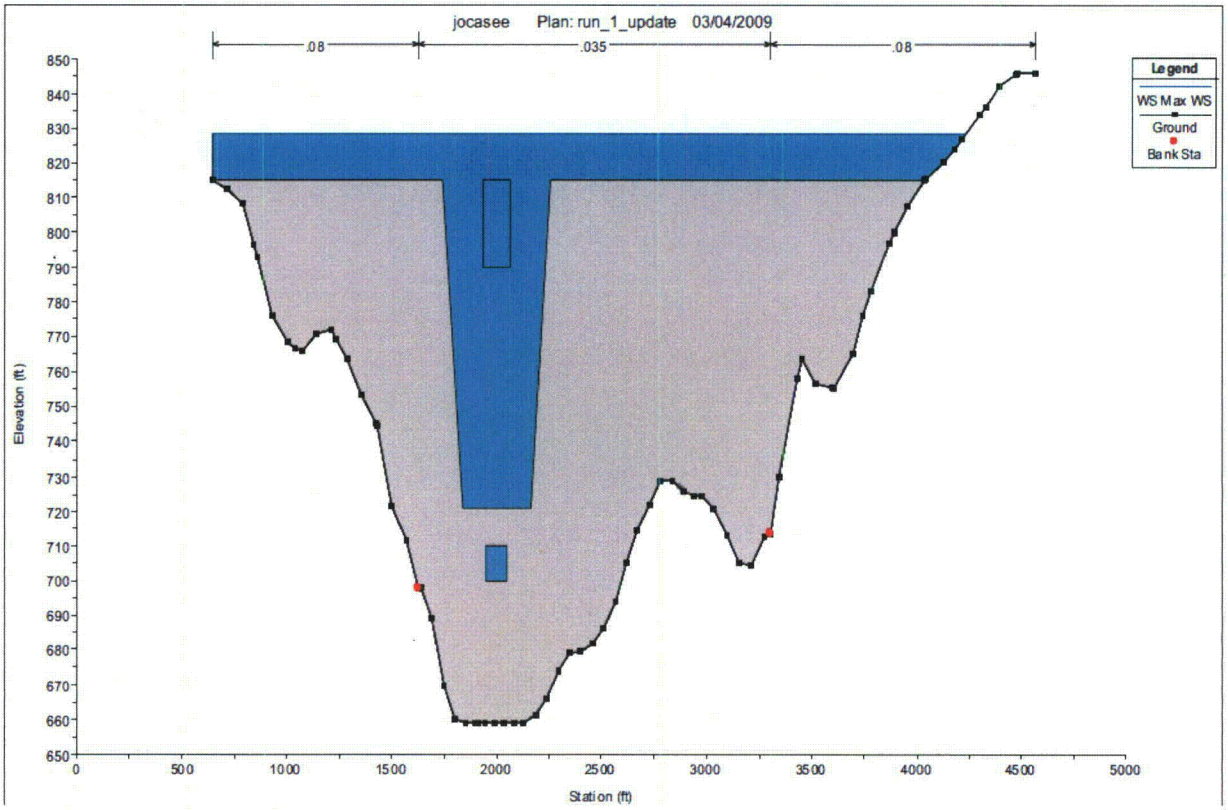
Figure 6.1



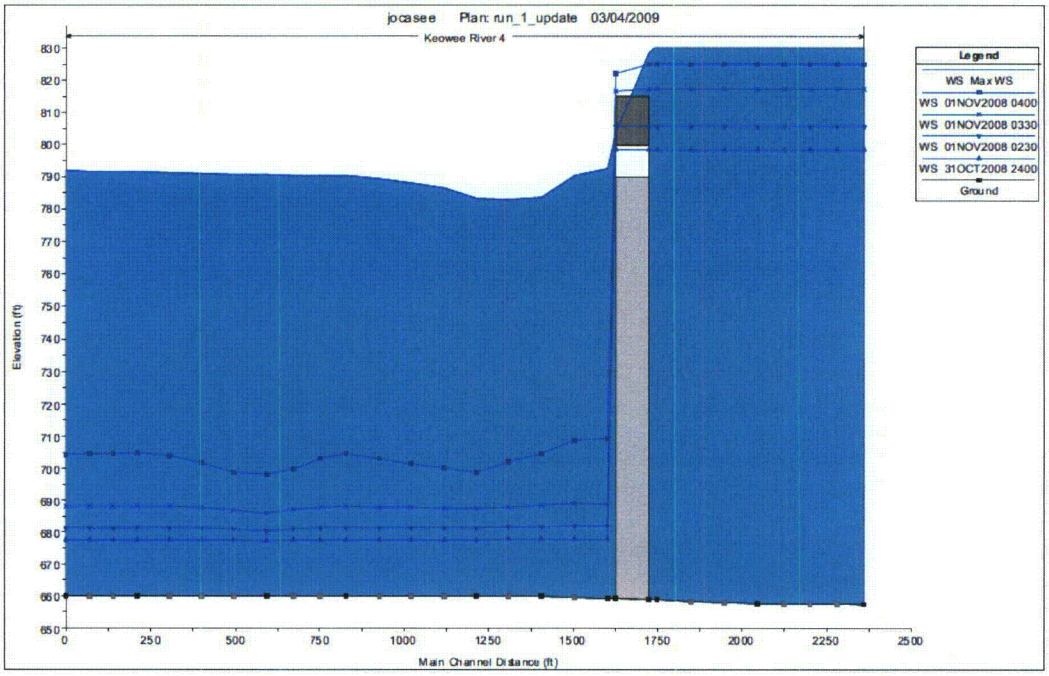
DUKE POWER COMPANY
KEOWEE HYDRO PROJECT
KEOWEE DAM
BREACH PROFILE

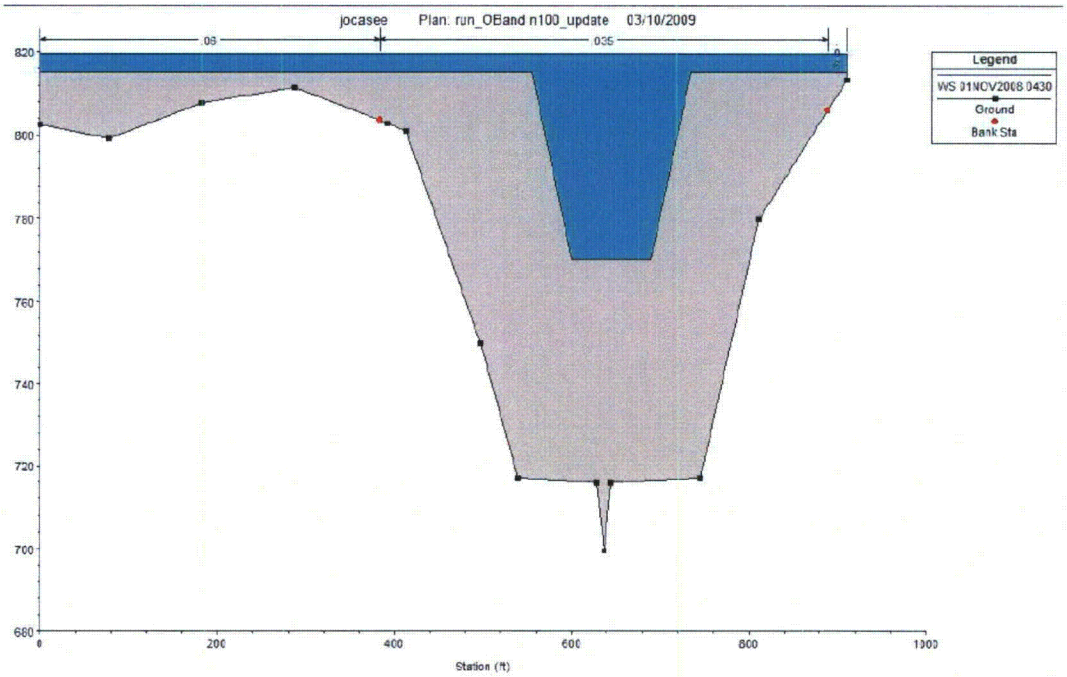
Figure 6.2

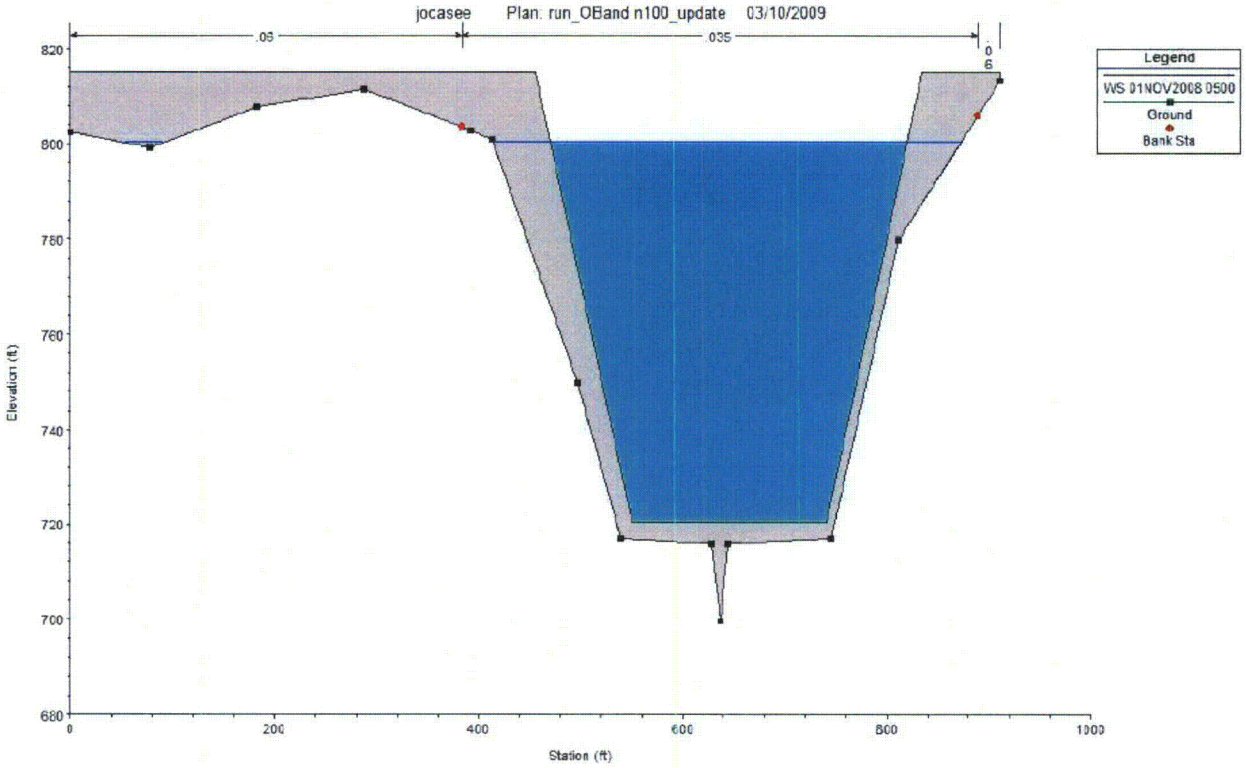
Keowee Dam Cross Section at Maximum Reservoir Elevation of 830.7 ft msl



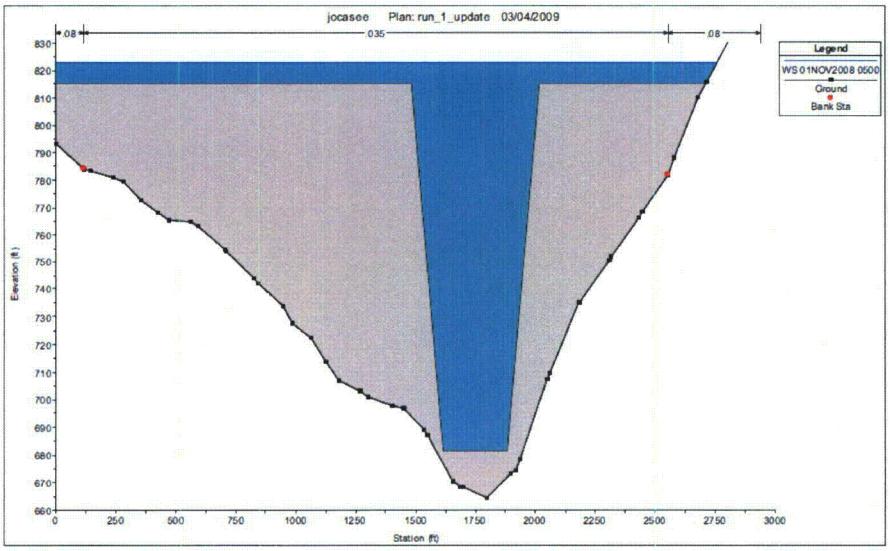
Keowee Dam - Variable Time Performance of Headwater and Tailrace




jocasee Plan: run_OBand n100_update 03/10/2009
.05
.035
Legend
WS 01NOV2008 0430
Ground
Bank Sta
820
800
780
760
740
720
700
680
0
200
400
600
800
1000
Station (ft)


jocasee Plan: run_OBand n100_update 03/10/2009
.05
.035
Legend
WS 01NOV2008 0500
Ground
Bank Sta
Elevation (ft)
820
800
780
760
740
720
700
680
0
200
400
600
800
1000
Station (ft)

Little River Dam Cross Section at Peak Elevation



Keowee-Seneca-Savannah River Profile: Main Stem of Reservoir System