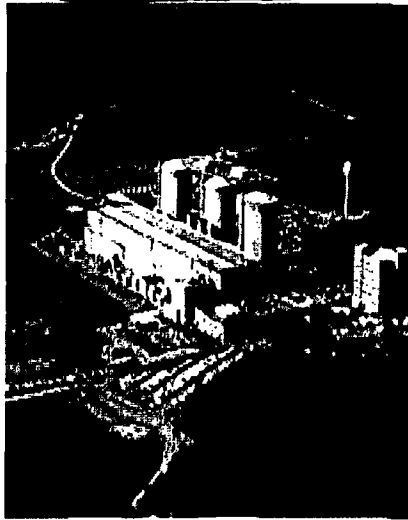




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# Oconee Flood Protection and the Jocassee Dam Hazard

DHS Briefing  
November 26, 2008

10/3/2012

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# Overview

- Objective
  - Provide background information for issue
  - Provide status and path forward
- Success
  - Understanding of the regulatory and safety issues
  - Understanding of NRC planned actions
  - Identify any NRC/DHS issues that need further action

10/3/2012

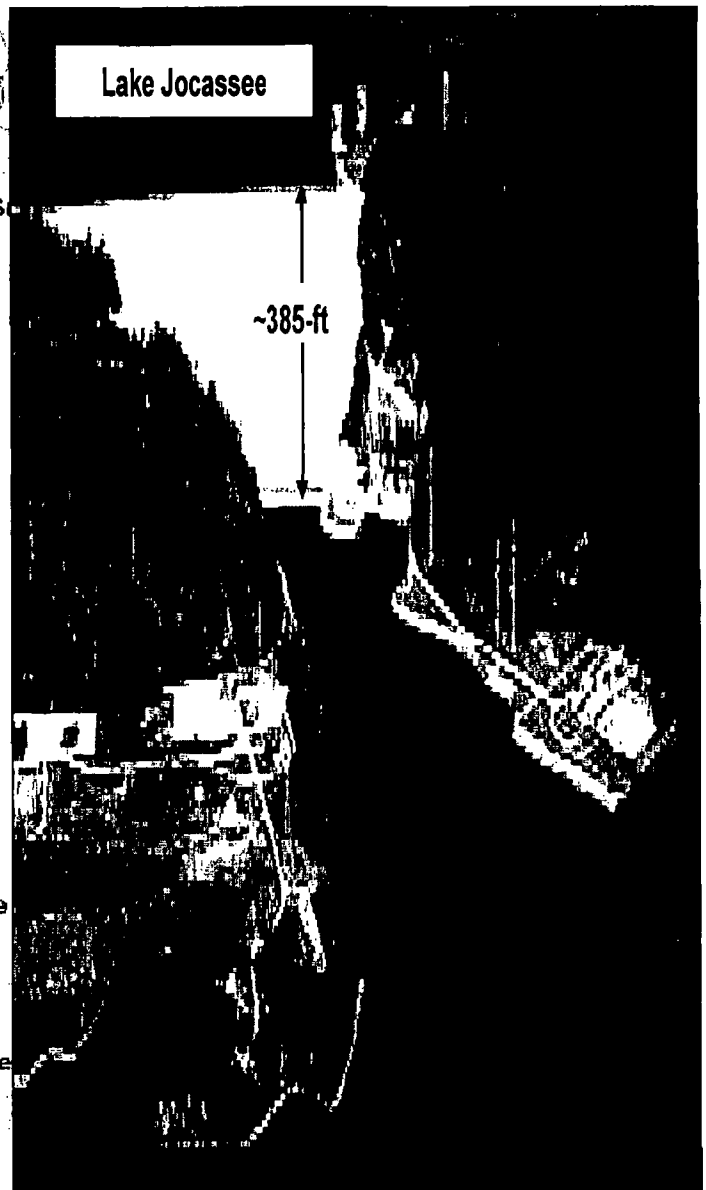
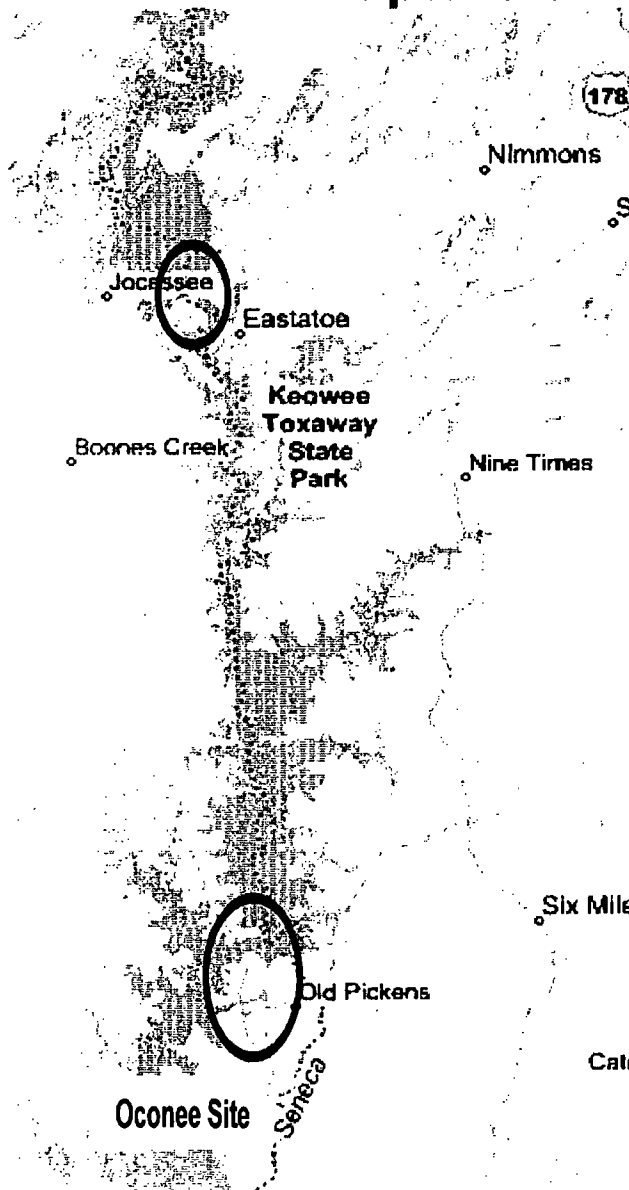
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# Oconee Nuclear Station

- Three pressurized water reactors located in Seneca, South Carolina
  - Owned and operated by Duke Energy Corporation
  - Operational in 1973-74
  - Located down river of lake Keowee (just north of site) and lake Jocassee (11 miles upriver)
- Only nuclear plant in the United States that relies on hyrdo-electric generators as emergency power source (Keowee Hydro Station)
- Plant relies on the Standby Shutdown Facility (SSF) to maintain reactor shutdown in case of fires, floods, or sabotage events.
  - SSF contains its own electric power source (diesel generators, batteries, etc..), control room.
  - SSF is a retrofit to the original plant design.

# The Flood Scenario

## Rupture of Jocassee Dam



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# Jocassee Dam Aerial



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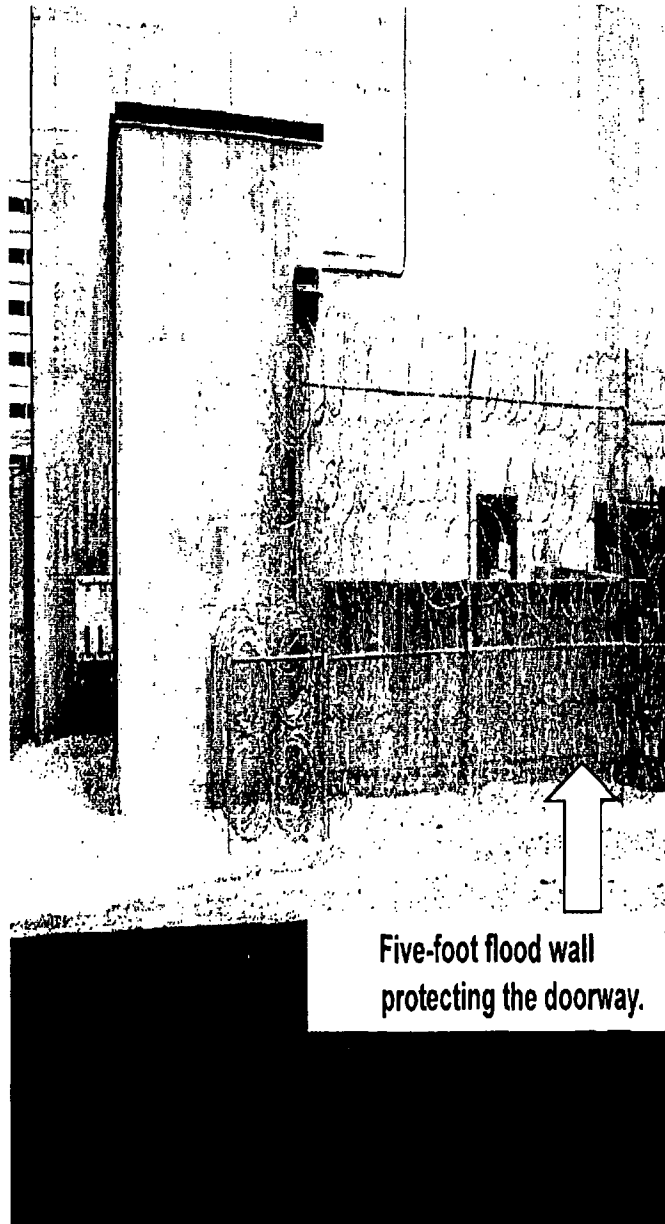
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# The SSF Flood Barriers

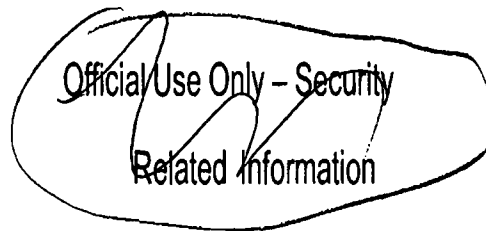


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## Key Insights from Reactor Oversight Process

- In 2007, NRC concluded that the Jocassee dam failure issue had not been adequately resolved.
- Duke Hydro/FERC Inundation Study completed in early 1990s. Estimated flood heights up to 16.8 ft above SSF grade level.
- Floods in excess of 5 ft lead to three-unit core damage event and ultimate failure of each containment building.
- Staff identified an under-estimate in licensee's dam failure frequency.

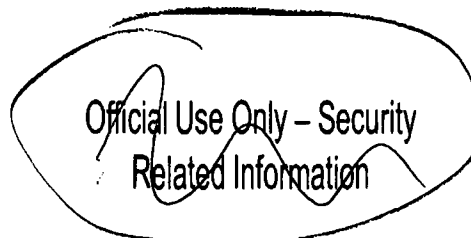




## Issuance 50.54(f) Letter

- On August 15, 2008, NRC issued letter to licensee requiring information to determine if NRC should modify, suspend, or revoke the license.
- Letter seeks information to assure protection of public and elevates NRC's regulatory and safety concerns.
- Letter states that Jocassee Dam Failure Inundation Study indicates flood heights up to 16.8 feet above SSF grade.
- Licensee responded to NRC on September 26, 2008.

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## **Actions Concurrent with 50.54(f) Letter**

- Backfit evaluation: external flooding within licensing basis. Licensee did not address Jocassee dam failure.
- “Adequate Protection” based backfit best approach.
  - No defense-in-depth: three unit core damage event with ultimate failure of each containment.
  - Regulatory expectations for external flood protection includes dam hazards.
- Cost-benefit estimate of \$3 million in modifications. Modifications on the order of \$13 million justified.

## **Actions Concurrent with 50.54(f) Letter**

(continued)

- In early September 2008, NRC staff notified Congressional staffers regarding the issue.
- NRC anticipates interaction with Congressional staffers on the issue and NRC resolution.
- Generic issue preliminary assessment completed.
  - Twenty five sites have a dependency on dam performance. Seven sites (including Oconee) are vulnerable to dams up river of the site.
  - Draft Information Notice has been written.

## NRC/DHS Interface

- NRC staff is providing this information to DHS should it affect the ranking of the Jocassee Dam from a security oversight standpoint.
- NRC has not determined how or if security issues may affect the NRC's regulatory actions.
- Are there any additional actions that DHS could take, if necessary, to further protect the dam?

## Other Vulnerable Sites

Of the 24 Nuclear plant sites located on rivers that contain upstream dams, 7 were identified that did not have obvious protective features.

Several sites had as many as 5 upstream dams with no provision for cascading failures.

Nuclear Plant	Location	River	Upstream Dams	Local Dams (Regulator)
<b>Arkansas Nuclear One 1 &amp; 2</b>	LAT 35 18'36" LONG 93 13'53"	Arkansas River	Ozark Dam	Dardarielle (N) (COE) 66' Concrete/Gravity
<b>Cooper Nuclear Station</b>	LAT 40 21'44" LONG 95 38'30.4"	Missouri River	Gavins Point, Fort Randall, Big Bend, Oahe, Garrison, Fort Peck	(COE)
<b>Ft. Calhoun Station</b>	LAT 41 31'14" LONG 96 4'39"	Missouri River	Gavins Point, Fort Randall, Big Bend, Oahe, Garrison, Fort Peck	(COE)
<b>McGuire Nuclear Station, Units 1 &amp; 2</b>	LAT 35 25'59" LONG 80 56'55"	Catawba River	Lookout Shoals Dam, Bridgewater, Rhodiss, Oxford	Cowans Ford (N) (FERC) 115' Gravity/Earth
<b>Oconee, Units 1, 2, and 3</b>	LAT 34 47'38.2" LONG 82 53'55.4"	Keowee River	Jocassee Dam, (Bad Creek Dam –not analyzed)	Jocassee 385' Rockfill Lake Keowee (N) 70' Gravity/Earth Little River (N) 155' Earthfill (FERC)
<b>Waterford Unit #3</b>	LAT 29 59'42" LONG 90 28'26"	Mississippi River	Many Dams on or feeding Mississippi River	(COE)
<b>Watts Bar Nuclear Plant</b>	LAT 35 36'7" LONG 85 47'21"	Tennessee River	Watts Bar Dam	Watts Bar, Chickamauga (N) (both TVA) 105' Gravity/Earth

Record ID	Dam name	Other dam name	NIDID	Longitude	Latitude	River	Owner name
1656	Ozark Lock & Dam	Ozark Lake	AR00164	-93.81	35.47333	Arkansas	CESWL
41465	Lookout Shoals		NC00394	-81.0908	35.7575	Catawba	DUKE POWER
41205	Rhodhiss		NC00104	-81.4381	35.77417	Catawba	DUKE POWER
41405	Oxford	Lake Hickory	NC00329	-81.1922	35.82139	Catawba	DUKE POWER
65679	Watts Bar	Watts Bar Lake	TN12102	-84.7833	35.62	Tennessee River	TVA
65754	Watts Bar Nuclear Holding Pond	Temporary Holding Pond	TN14306	-84.783	36	Tennessee River	TVA
65757	Watts Bar/Kingston Backwater Dike	Watts Bar Lake	TN14503	-84.517	35.875	Clinch River	TVA
65680	Watts Bar/Saddle Dam No. 1	Watts Bar Lake	TN12103	-84.783	35.62	Tennessee River	TVA
63599	Gavins Point Dam	Lewis And Clark Lake	SD01094	-97.4817	42.84833	Missouri River	CENWO
63598	Fort Randall Dam	Lake Francis Case	SD01093	-98.555	43.065	Missouri River	CENWO
37855	Fort Peck Dam	Fort Peck Lake	MT00025	-106.417	48	Missouri River	CENWO
63597	Big Bend Dam	Lake Sharpe	SD01092	-99.4467	44.03833	Missouri River	CENWO
63600	Oahe Dam	Lake Oahe	SD01095	-100.387	44.45	Missouri River	CENWO
43989	Garrison Dam	Lake Sakakawea	ND00145	-101.432	47.50167	Missouri River	CENWO

# Analysis Concerns with Jocassee Dam

- **NRC staff feels that Jocassee Dam is robust**
  - Discussions with licensee and FERC
  - FERC inspection reports
- **Licensee's analysis may lack necessary conservatism for nuclear licensing basis**
- **Areas where further analysis is required:**
  - **Inundation analysis**
    - Breach size parameters
    - Timing of breach
    - Probable Maximum Precipitation
    - Spillway gates
  - **Seismic Analysis**
    - Soil liquefaction
    - Settlement of foundation