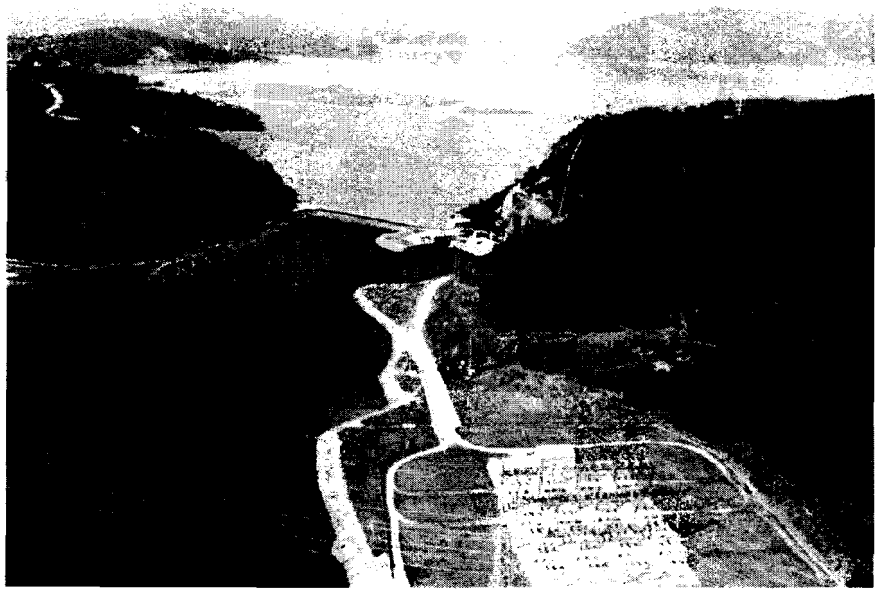
Duke Energy®



Oconee Nuclear Station

External Flood Technical Meeting

Rockville, MD

August 27, 2009

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Duke Attendees

- Jeff Thomas, Corporate Regulatory Compliance Manager
- Tim Brown, ONS Project Manager
- Ray Mc Coy, ONS Principal Engineer
- Chris Ey, Principal Engineer HDR
- Tim Banta, Senior Engineer HDR

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Agenda

- Opening Remarks
- Key Input Parameters
  - Identification of Parameters Varied
  - Identification of Parameters Not Varied
  - Variation of Identified Parameters
  - Justification for Identified Parameters and their Variation
- Overview of 1D & 2D models
- Technical Question / Answer Session

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Key Parameters

- Jocassee Breach Parameters
  - Bottom Elevation
  - Bottom Width
  - Side Slopes
  - Piping Elevation
  - Time to Failure
  - Failure Progression
- Channel Flow Parameters
  - Manning's n

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Key Parameters

- Keowee Breach Parameters
  - Location
  - Size
  - Side Slopes
  - Overtopping Failure Trigger
  - Time to Failure:
    - Main Dam
    - ONS Intake Canal Dike
    - Little River Dam

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Parameters Not Varied

- Jocassee Breach Parameters
  - Reservoir Elevation
    - Base case – 1108 ft. MSL (1992 EAP)
    - All other cases – 1110 ft. MSL
  - No concurrent PMF
- Keowee Breach Parameters
  - Reservoir Elevation – 800 ft. MSL
  - No concurrent PMF
  - West Saddle Dike Breach Size
    - Bottom Breach Elevation – 795 ft. MSL
    - Top Breach Length – 1680 ft.
    - Overtopping Trigger Elevation – 817 ft. MSL
    - Time to Failure - .5 hrs.

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Parameters Not Varied

- Oconee Intake Canal Dike
  - Bottom Breach Elevation – 715.5 ft. MSL
  - Bottom Width – 200 ft.
  - Side Slopes – 1:1
  - Overtopping Trigger Elevation – 817 ft. MSL
  - Failure Progression – Sine Wave
- Little River Dam
  - Bottom Breach Elevation – 670 ft. MSL
  - Bottom Width – 290 ft.
  - Side Slopes – 1:1
  - Overtopping Trigger Elevation – 817 ft. MSL
  - Failure Progression – Sine Wave

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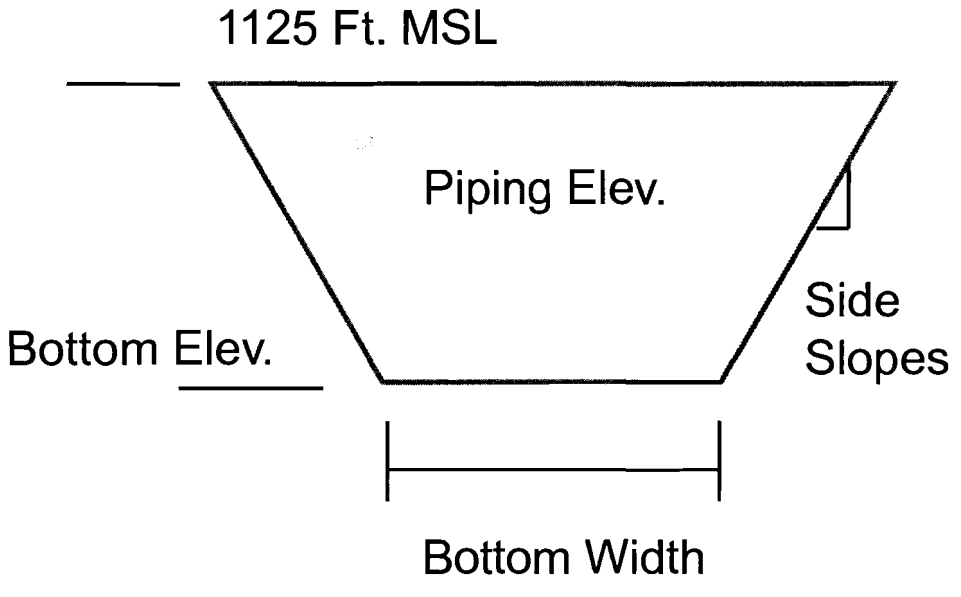
Variation in Jocassee Breach Parameters

- Bottom Elevation
  - 750 ft. MSL
  - 800 ft. MSL
  - 825 ft. MSL
  - 850 ft. MSL
- Bottom Width
  - 250 ft.
  - 500 ft.
  - 600 ft.
  - 625 ft.
  - 650 ft.



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Variation in Jocassee Breach Parameters / cont.

- Side Slopes
  - .9:1 (both)
  - 1:1 (both)
  - 1.5:1 (both)
  - 1.55:1 (West Side), .7:1 (East Side)
  - 1.55:1 (West Side), 1:1 (East Side)
- Piping Elevation
  - 940 ft. MSL
  - 1020 ft. MSL

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Variation

- Jocassee Breach Parameters / cont.
  - Time to Failure
    - 1 hr.
    - 2 hr.
    - 3 hr.
    - 4 hr.
    - 5 hr
  - Failure Progression
    - Linear
    - Sine Wave

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Computed Jocassee Parameters

Jocassee Breach Parameters: Average Breach Width

- 575 ft. (1992 EAP)
- 625 ft.
- 770 ft.
- 792.5 ft.
- 800 ft.
- 825 ft.
- 875 ft.
- 865.6 ft.
- 882.5 ft.
- 900 ft.
- 914.4 ft.
- 925 ft.
- 950 ft.
- 965.6 ft.
- 987.5 ft.
- 1014 .4 ft.
- 1087.5

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Computed Jocassee Parameters

Jocassee Breach Parameters: Top Breach Width

- 900 ft. (1992 EAP)
- 1000 ft.
- 1040 ft.
- 1085 ft.
- 1100 ft.
- 1150 ft.
- 1200 ft.
- 1231 ft.
- 1265 ft.
- 1329 ft.
- 1331 ft.
- 1400 ft.
- 1429 ft.
- 1475 ft.
- 1575 ft.

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Variation in Keowee Breach Parameters

- Location
  - Main Dam (Small Breach)
    - Bottom Elevation 670 & 700 ft. MSL
    - Bottom Width 500 & 650 ft.
    - Side slopes 1:1 (both)
  - Main Dam (Large Breach)
    - Bottom Elevation 670 ft. MSL
    - Bottom Width 500 ft.
    - Side Slopes 3.45:1 (West), 2.03:1 (East)
  - W. Saddle Dike Breach Size:
    - Bottom Elevation 795 ft. MSL
    - Length 1680 ft.

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Variation in Keowee Breach Parameters / cont.

- Overtopping Failure Trigger (Keowee Main Dam)
  - .5 ft.
  - 2 ft.
- Time to Failure
  - Main Dam
    - 2 hrs.
    - 2.4 hrs.
    - 4 hrs.
  - Little River Dam
    - 1 hr.
    - 2.4 hrs.
    - 4 hrs
  - Oconee Intake Dike
    - 1 hr.
    - 1.2 hrs.
    - 2 hrs.

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Computed Keowee Parameters

- Average Breach Width
  - 615 ft.
  - 645 ft.
  - 765 ft.
  - 897.3 ft.
- Top Breach Width
  - 790 ft.
  - 880 ft.
  - 1295 ft.

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Variation in Channel Flow

- Channel Flow Parameters
  - Manning's 'n'
    - Main Channel (Upstream of Keowee)
      - .02
      - .025
      - .035
    - Keowee Tailrace
      - .035
      - .07, followed by transition from .07 to .02

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Variation Justification

- Jocassee
  - Froehlich
    - Bottom Breach Width: 725 ft. (maximum site constraint 600 ft.)
    - Side Slopes: 0.7:1
    - Average Breach Width: 918 ft.
    - Top Breach Width: 1110 ft.
    - Time to Failure (Mean) 2.6 hrs.
    - Time to Failure (95% Confidence Interval): 1.7 – 7.1 hrs.
    - Breach Discharge (Mean) 2.7 mcfs
    - Breach Discharge (95% Confidence Interval): .94 – 7.4 mcfs

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Variation Justification

- Jocassee
  - Walder & O'Connor
    - Time to Failure (Mean) 3.04 hrs.
    - Breach Discharge (95% Confidence Interval): 7.12 mcfs
  - MacDonald-Langridge Monopolis
    - Time to Failure (Mean): 5.92 hrs.
    - Breach Discharge (Mean): 1.52 mcfs
    - Breach Discharge (95% Confidence Interval): 5.26 mcfs

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Variation Justification

- Keowee
  - Froehlich
    - Bottom Breach Width: 1028 ft. (maximum site constraint 500 ft.)
    - Side Slopes: 1:1
    - Average Breach Width: 1173 ft.
    - Top Breach Width: 1318 ft.
    - Time to Failure (95% Confidence Interval): 2.4 – 2.8 hrs.
    - Breach Discharge (Mean) 1.2 mcfs
    - Breach Discharge (95% Confidence Interval): .44 – 3.4 mcfs

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Variation Justification

- Keowee
  - Walder & O'Connor
    - Time to Failure (Mean): 1.3 hrs.
    - Time to Failure (95% Confidence Interval): 1.5 – 6.2 hrs.
    - Breach Discharge (Mean) 2.3 mcfs
  - MacDonald-Langridge Monopolis
    - Time to Failure (Mean): 4.6 hrs.
    - Time to Failure (95% Confidence Interval): 1.7 – 7.3 hrs.
    - Breach Discharge (Mean): 1.1 mcfs

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Variation Justification

- Oconee Intake Dike
  - Froehlich
    - Bottom Breach Width: 1036 ft.
    - Side Slopes: 1:1
    - Average Breach Width: 1161 ft.
    - Top Breach Width: 1286 ft.
    - Time to Failure (95% Confidence Interval): 1.1 – 1.5 hrs.
    - Breach Discharge (Mean) 1.1 mcfs
    - Breach Discharge (95% Confidence Interval): .36 – 2.8 mcfs

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Variation Justification

- Oconee Intake Dike
  - Walder & O'Connor
    - Time to Failure (Mean): 1.3 hrs.
    - Time to Failure (95% Confidence Interval): .7 – 2.8 hrs.
    - Breach Discharge (Mean) 1.9 mcfs
  - MacDonald-Langridge Monopolis
    - Time to Failure (Mean): 4.5 hrs.
    - Time to Failure (95% Confidence Interval): .9 – 3.8 hrs.
    - Breach Discharge (Mean): 3.6 mcfs

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