Mitman, Jeffrey

From: Wong, See-Meng
Sent: Tuesday, November 16, 2010 8:27 AM
To: Ferrante, Fernando
Cc: Mitman, Jeffrey
Subject: RE: Draft Presentation (with Backup Slides) for Tomorrow's Meeting

Good. A minor typo in slide#4, "from, from."

-----Original Message-----
From: Ferrante, Fernando
Sent: Monday, November 15, 2010 8:48 PM
To: Wong, See-Meng
Cc: Mitman, Jeffrey
Subject: RE: Draft Presentation (with Backup Slides) for Tomorrow's Meeting

See-Meng,

Thanks. I added the changes and made some modifications. I also moved the backup slides forward. We can discuss tomorrow.

Fernando

-----Original Message-----
From: Wong, See-Meng
Sent: Monday, November 15, 2010 7:19 PM
To: Ferrante, Fernando
Subject: RE: Draft Presentation (with Backup Slides) for Tomorrow's Meeting

Fernando,

I have revised your slides to make it a more effective presentation. I have added slide #7 entitled: "Path Forward." For effective presentation, the thumb rule is no more than 3 bullets on each slide.
As for backup slides, I suggest moving slides 23-27 forward because DRA management is more interested in the issues you had addressed to make the new draft of IN a better product than the previous one. Please discuss with me before the meeting.

See Meng.

-----Original Message-----
From: Ferrante, Fernando
Sent: Monday, November 15, 2010 5:36 PM
To: Wong, See-Meng
Cc: Mitman, Jeffrey
Subject: Draft Presentation (with Backup Slides) for Tomorrow's Meeting

See-Meng,

See attached the draft presentation (with backup slides) for tomorrow's meeting with Mark and Sam. Note that the actual presentation is only 5 slides and the rest are backup slides used in a previous presentation.

I would appreciate if you could let me know of any comments you may have.

B-131

Thank you,
Fernando

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OUO - SENSITIVE INFORMATION

Purpose of Information Notice (IN)

- Information Notice (IN) was intended to inform industry of a potentially non-conservative dam failure frequency used in external flooding analysis
- Non-conservative dam failure frequency estimate may result in underestimation of external flooding hazard risks
- Dam failure frequency values used in referenced documents, e.g., NSAC/60 are an order of magnitude lower than those found in literature and in APOB's internal analysis (ML100760108)

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Background

- Earlier version of IN was drafted through the NRR Generic Communications Branch but process was not completed during discussions with NRR/DPR/PGCB

- APOB staff discussed the past efforts and best path forward with PGCB PM, who provided these suggestions:
  - Re-write of IN
  - Evaluate RES views for concurrence
  - Use less prescriptive language regarding failure rate

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Current Status

- Intended purpose of IN is still valid based on reevaluation of original analysis
- Issuance of IN will improve technical consistency on external events hazard analyses across other NRC Offices, e.g., NRO & RES
- Effort on IN draft supports parallel efforts: (i) Generic Issue submittal from from NRR/DE and NRR/DRA to RES/DRA, (ii) RTE tasks on external event initiators

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Current Status (continued)

- Based on feedback from PGCB and RES, APOB staff initiated these actions:
  - Developed a new draft of IN
  - Provided the new draft of IN to APOB subject matter experts for review and comment
  - Obtained verbal concurrence on new IN draft from RES/DRA subject matter expert on dams

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Main Message of Current Draft

- Alert addressees of a potentially non-conservative dam failure frequency estimate due to:
  - Approach used in NSAC/60
  - Site-specific characteristics
  - Data issues (i.e., sparseness and quality)

- Current draft only indicates that dam failure frequency values significantly lower than 1E-4/year are not supported by literature or NRC's internal assessments

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Path Forward

- Work with PGCB for concurrence and issuance

- Follow up with Generic Flood Risk Analysis efforts

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BACKUP SLIDES

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High Level Issues

Screening Criteria

↓

Flood Routing/Impact to the Site

↓

Mitigation Strategy

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Issues to Address (1)

- Parsing of failures in PMP/Seismic/Other
- Screening PMP as in NSAC/60
- Parsing of "Other" failure via engineering assumptions
- Widening of dam population when no failures are listed for a specific category (embankment vs. rockfill only)
- Defining a period range of 1940 – Present for a dam built in 1972

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Issues to Address (2)

- Assumption of the functional form in NSAC/60 for dam failure rates (no aging)?
- Screening of aging failures AND assumption of the functional form in NSAC/60
- Assumption of failure rate in a particular year for a certain dam (regardless of its age) = failure rate of new dam built in that same year.
- Use of NSAC/60 values for dam failures at other sites

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Path Forward

- Indicate non-conservatism in NSAC/60
  - Incorrect reference in NUREG/CR-5042
- No NRC position on actual value
  - Refer to expert literature
- Indicate alternatives (?)
- Indicate implications/need for awareness
- Additional analysis to be performed (?)

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Path Forward on Information Notice

- Applicability to 10 CFR Part 52, 72
- Official Use Only designation
- Concurrence with other offices
- Follow up with Generic Flooding Effort

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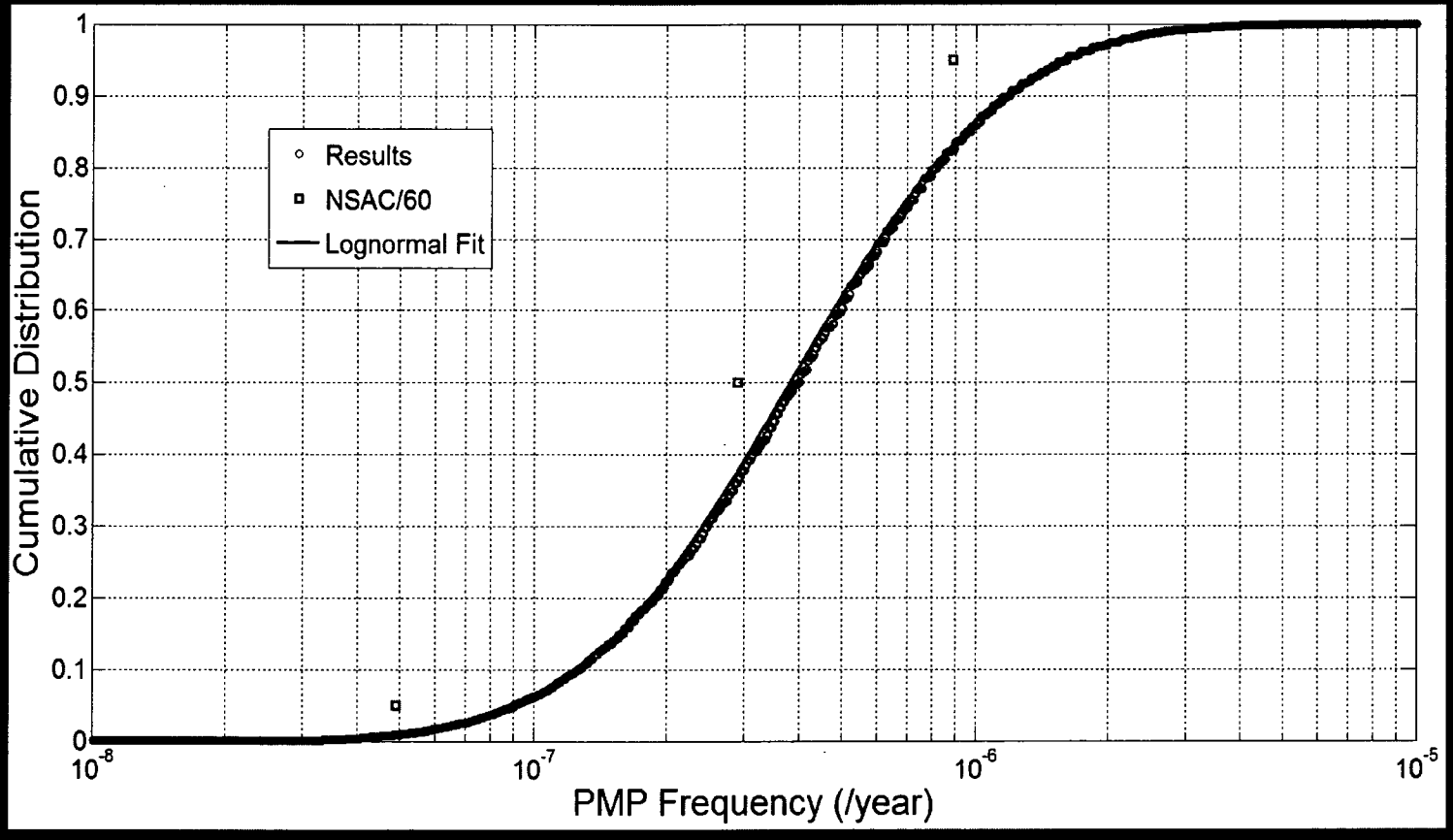
Comparison of Results (PMP)



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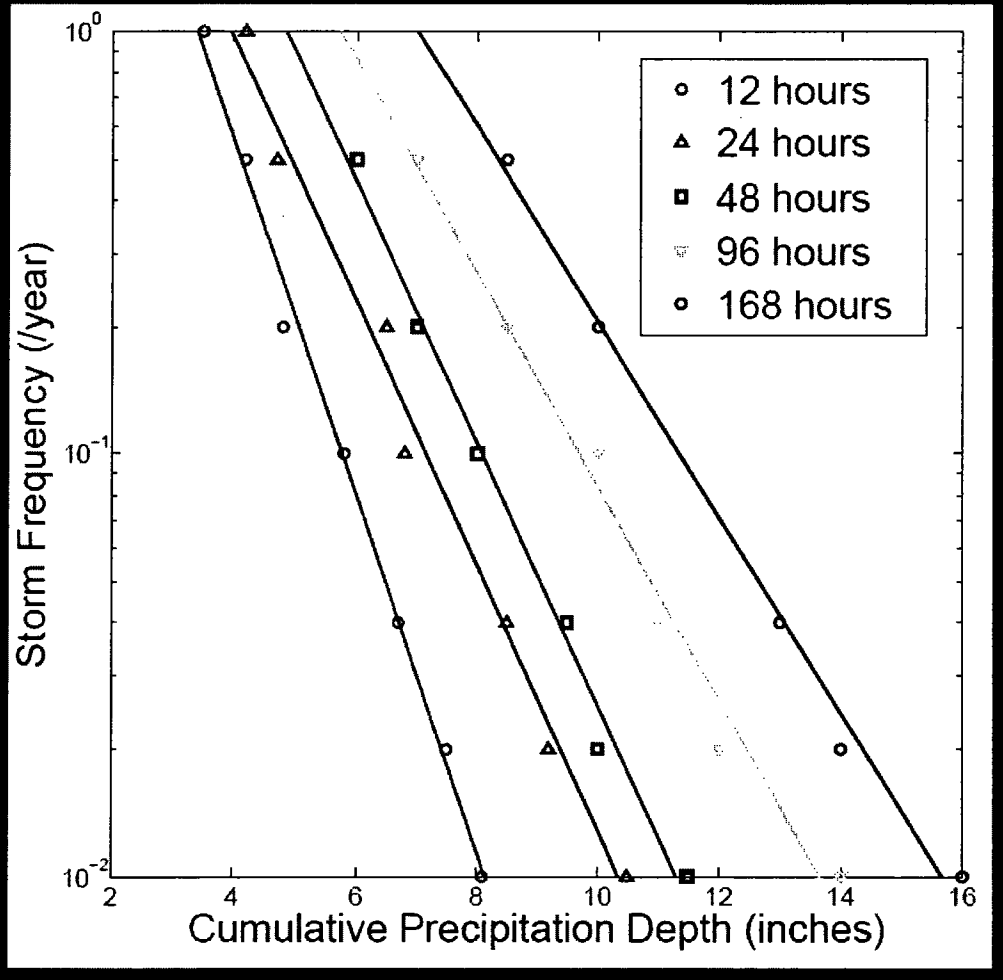
PMP Data in NSAC60

$$c_f = a \exp(b\, h/\tau^n)$$

i.e., f(*a*,*b*,*n*)

where, h = depth

c_f = frequency



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Dam Frequency Analysis in NSAC60

- Assumed Functional Form

$$L(t) = a\,t^{-b}$$ i.e., f(a,b)

where t = dam-years

- Large Earth, Earth-Rockfill, Rockfill (> 45 ft)
- Failure Modes
  - (1) Piping (except conduit and spillway)
  - (2) Seepage
  - (3) Embankment slides
  - (4) Structural failure foundation/abutment
- US catastrophic failures only (age > 5 years)
- (1900 – 1981), (1940 – 1981), (1960 – 1981)
  - set by construction year (dam-years)

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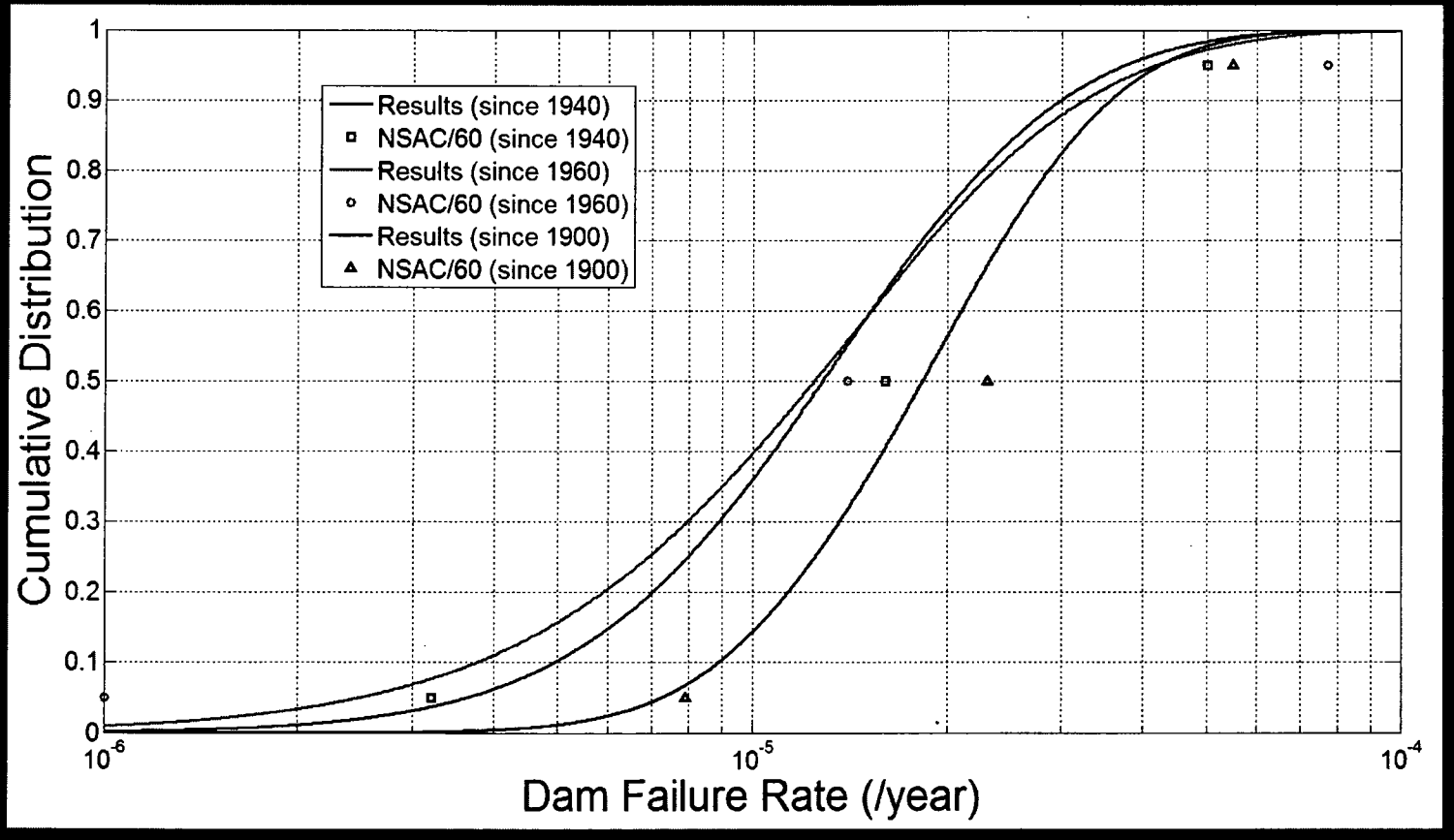
Comparison of Results (Dams)



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Specific Issues (1)

- Methodology
  - Bayesian updating
  - Functional form of Dam Failure Rate
- Assumptions
  - Parsing Failure Rates (PMP(!), Seismic, Others)
  - Parsing of Other Failures (Piping, Seepage, …)
  - Screening by Construction Period
  - Early Failures Cut-off
- Accuracy of the Analysis
  - in 1981
  - as of today

Specific Issues (2)

- Applicability to Other Sites
- NUREG/CR-5042

"Realistic calculations of the dam failure probability of a specific dam as a function of extreme conditions are difficult to find in the literature; bounding calculations are more common, and would be fully acceptable if based on defensibly conservative models and data.

On the other hand, some dam failures could easily be in the range of about $F_F = 10^{-3}$/year, since the mean value of the data base for F_F for all dams is in the range between 10^{-4}/year and 10^{-5}/year

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NSAC/60 Input Data (1900 – 1981)

Failures = 5 (4 Earthfill, 1 Mixed)

$$\frac{\text{ROCKFILL + EARTHFILL + MIXED}}{\text{ROCKFILL + EARTHFILL + MIXED}}$$

Dam-Years ≈ 100,000 (1981)

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NSAC/60 Input Data (1940 – 1981)

Failures = 2 (1 Earthfill, 1 Mixed)

$$\frac{\text{ROCKFILL + EARTHFILL + MIXED}}{\text{ROCKFILL + EARTHFILL + MIXED}}$$

Dam-Years ≈ 70,000 (1981)

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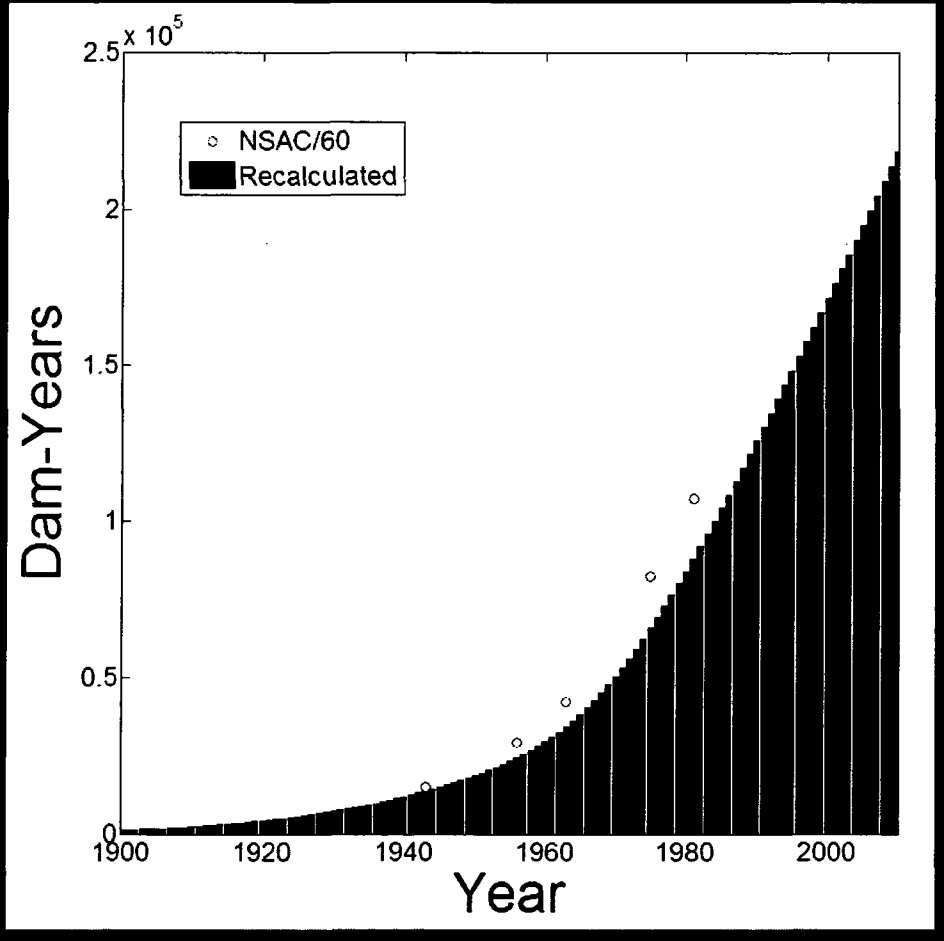
Dam-Years (1900 – 2010)



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Comparison using NSAC/60 Screening

- Screened out per NSAC/60
  - Failure Modes (no PMP, Seismic, Piping via conduit)
  - Dam Height and Type
  - Construction Year
  - Age (> 5 years)
  - End year (1981 & 2010)
- Sources
  - NRR/DRA Generic Rockfill Dam Failure Rate
    - National Performance of Dams Program (NPDP)
    - Other Sources
  - NSAC/60
  - Journal Paper "Critical appraisal of piping phenomena in earth dams" (2007)

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Failures (1900 – 1981)

	Dam Name	Built	Failed	Height	Type	Failure Description
	Pinkston, MO		1978	70	Earth (assumed)	Piping static liquefaction
4	Lambert, TN		1963	54	Earth	Piping-small leak increased leading to breach
	Pleasant Valley, UT		1928	63	Mixed	Piping through foundation and up an observation pipe, failure occurred within 24 h of first notice
	Scofield, UT		1928	78, 99	Earth	Piping through settlement cracks near abutment
2	Dresser No. 4 Dam, MO		1975	105	Mixed (REEROT)	Piping
	Kern Brothers Reservoir		1949	54	Mixed (REER)	Failure due to excessive settlement of fill.
	Baldwin Hills, CA	1951	1963	160	Earth	Piping into foundation from fault movement
	Lake Toxaway, NC	1902	1916	62	Earth	Piping into rock fissures
5	Goodrich	1900	1956	56	Earth	Limited piping due to seepage caused a void and abnormal weight of ice or ice pressure over void caused failure.
	Sinker Creek	1910	1943	92	Earth	Failed completely after many years of saturation of downstream slope + leakage through upper portion of dam.
	Walter Bouldin	1967	1975	170	Mixed (ERPG)	The dam may have failed due to piping in the downstream shell.

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Failures (1940 – 1981)

	Dam Name	Built	Failed	Height	Type	Failure Description
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	Baldwin Hills, CA	1951	1963	160	Earth	Piping into foundation from fault movement
2	Walter Bouldin	1967	1975	170	Mixed (ERPG)	The dam may have failed due to piping in the downstream shell.

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Failures (1900 – 2010)

	Dam Name	Built	Failed	Height	Type	Failure Description
	Big Bay Lake, MS		2004	57	Earth	Piping through French drains (failed within 24 h of observed seepage)
	Quail Creek, UT		1988	209	Earth	Piping through settlement cracks
	Cedar Lake, OK		1986	45	Earth	Piping in abutment, fissures in foundation
7	Pinkston, MO		1978	70	Earth (assumed)	Piping static liquefaction
	Lambert, TN		1963	54	Earth	Piping-small leak increased leading to breach
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	Taum Sauk, MO	1963	2005	164	Rock	Overpumping
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