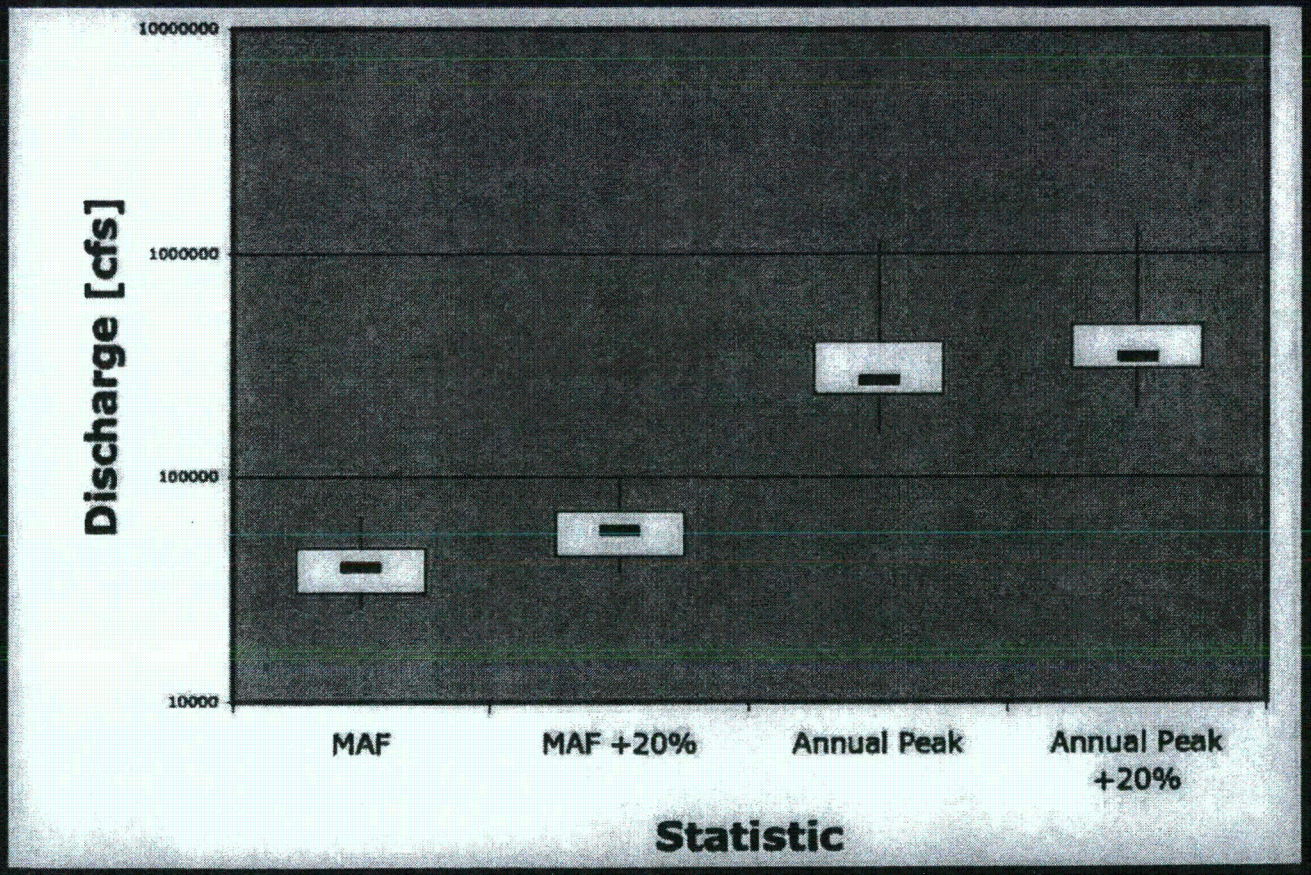
Earthquakes ★ Floods ★ Hurricanes ★ Landslides ★ Tsunamis ★ Volcanoes ★ Wildfires

Paradox: Why are there so few significant trends in floods?

USGS

Earthquakes ★ Floods ★ Hurricanes ★ Landslides ★ Tsunamis ★ Volcanoes ★ Wildfires

Explanation (?) (a)...



USGS

Explanation (?) (b)...

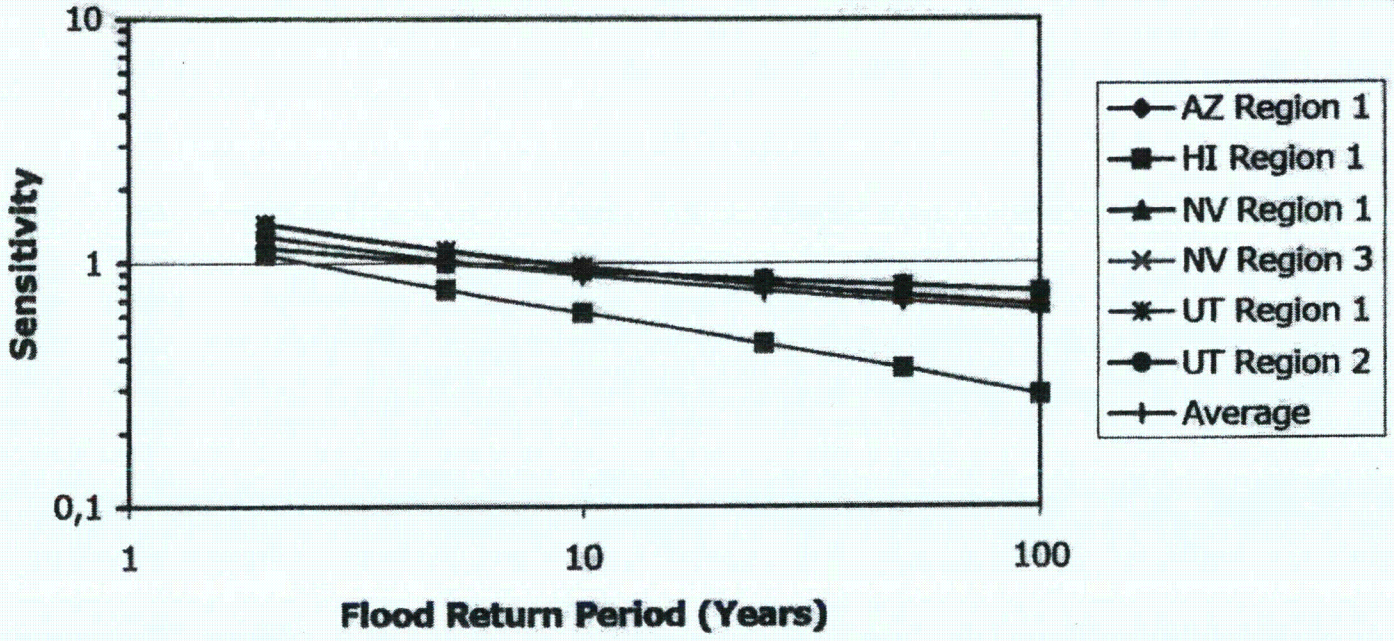


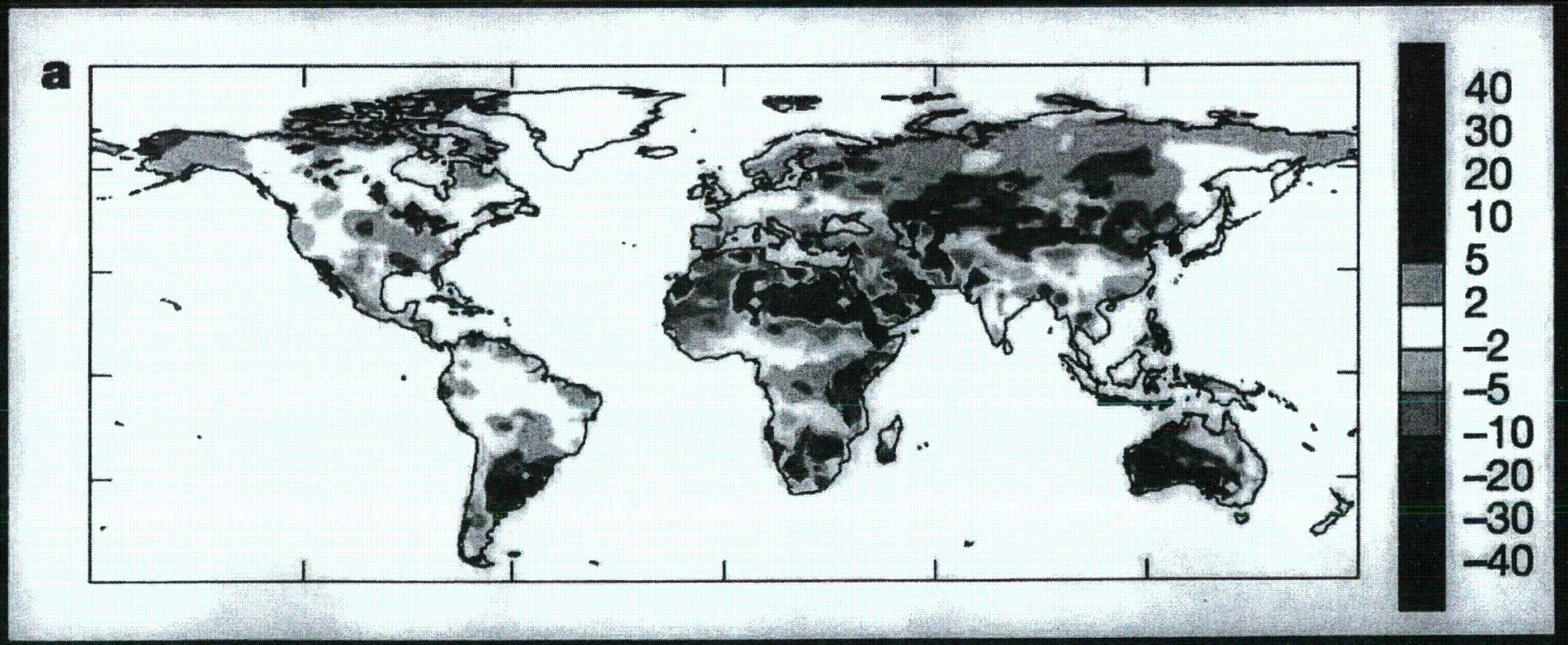
Figure 1. Sensitivity (elasticity) of flood flows at various return periods to mean annual precipitation.

USGS

Earthquakes ★ Floods ★ Hurricanes ★ Landslides ★ Tsunamis ★ Volcanoes ★ Wildfires

Changes in 20th Century Runoff

100*(mean[1971-1998]-mean[1900-1970])/mean[1900-1970]

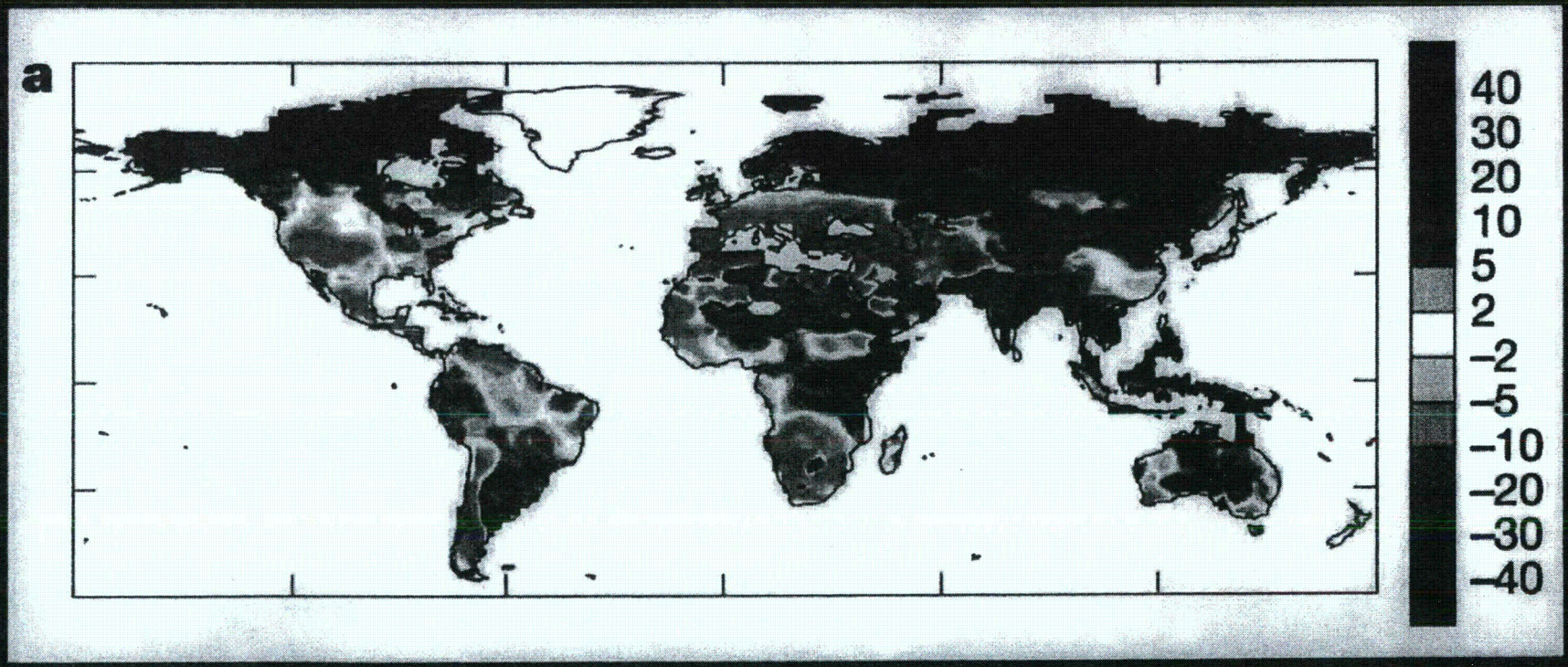


USGS

Earthquakes ★ Floods ★ Hurricanes ★ Landslides ★ Tsunamis ★ Volcanoes ★ Wildfires

Projected Changes in 21st Century Runoff

100*(projected[2041-2060]-mean[1900-1970])/mean[1900-1970]



USGS

Conclusions

- Paleoflood data have a lot to offer in practice:
  - Given efficient statistical methods, greatly reduced uncertainty in flood quantile estimates

Conclusions

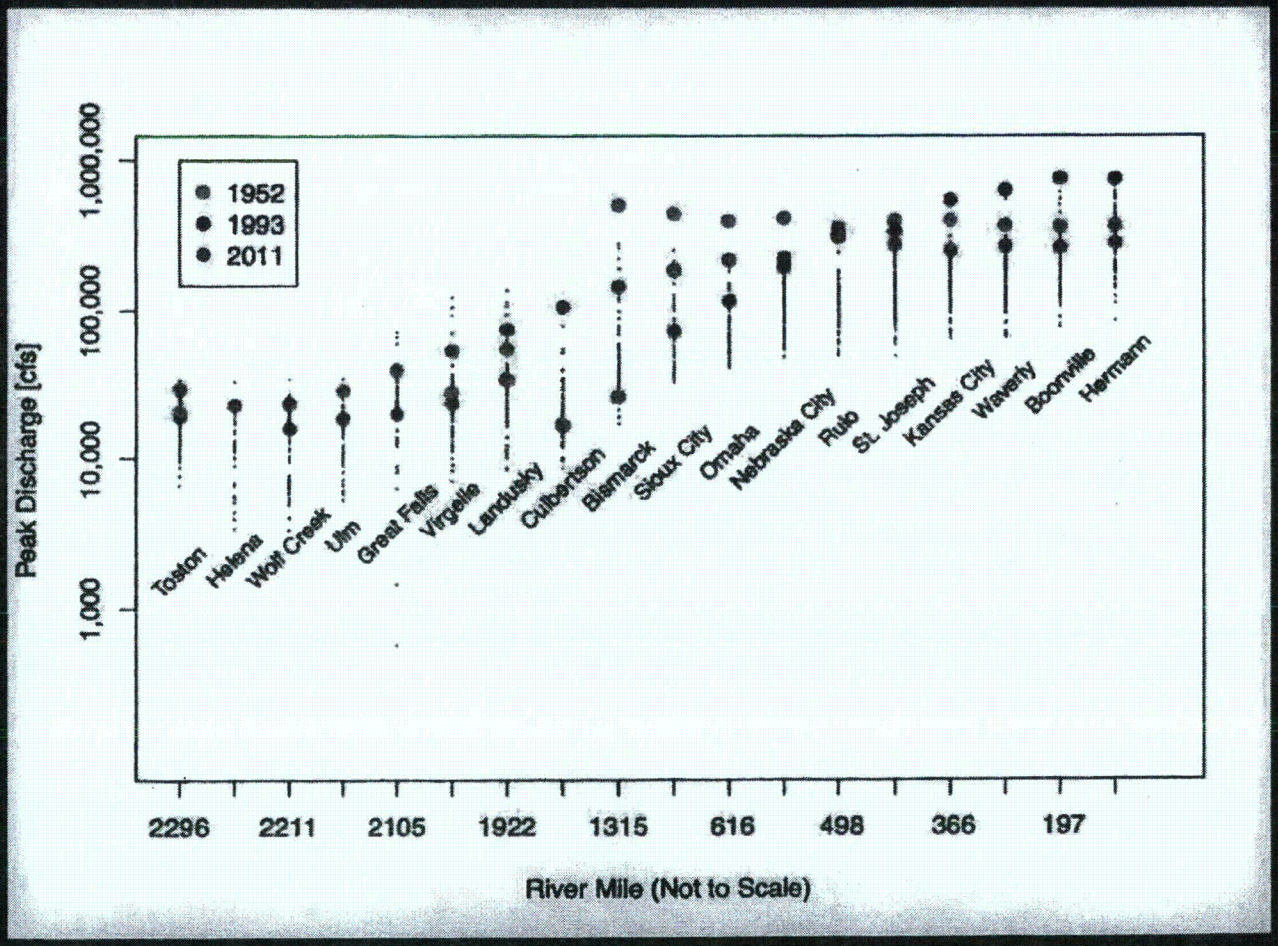
- Paleoflood data have a lot to offer in practice:
  - Given efficient statistical methods, greatly reduced uncertainty in flood quantile estimates
- ...but we need to be careful

Some Additional Thoughts

- Estimating risk associated with really extreme/rare events will continue to be a challenge
- Annual Peak Flow may not always be the most relevant statistic

Earthquakes ★ Floods ★ Hurricanes ★ Landslides ★ Tsunamis ★ Volcanoes ★ Wildfires

2011 Missouri River Floods

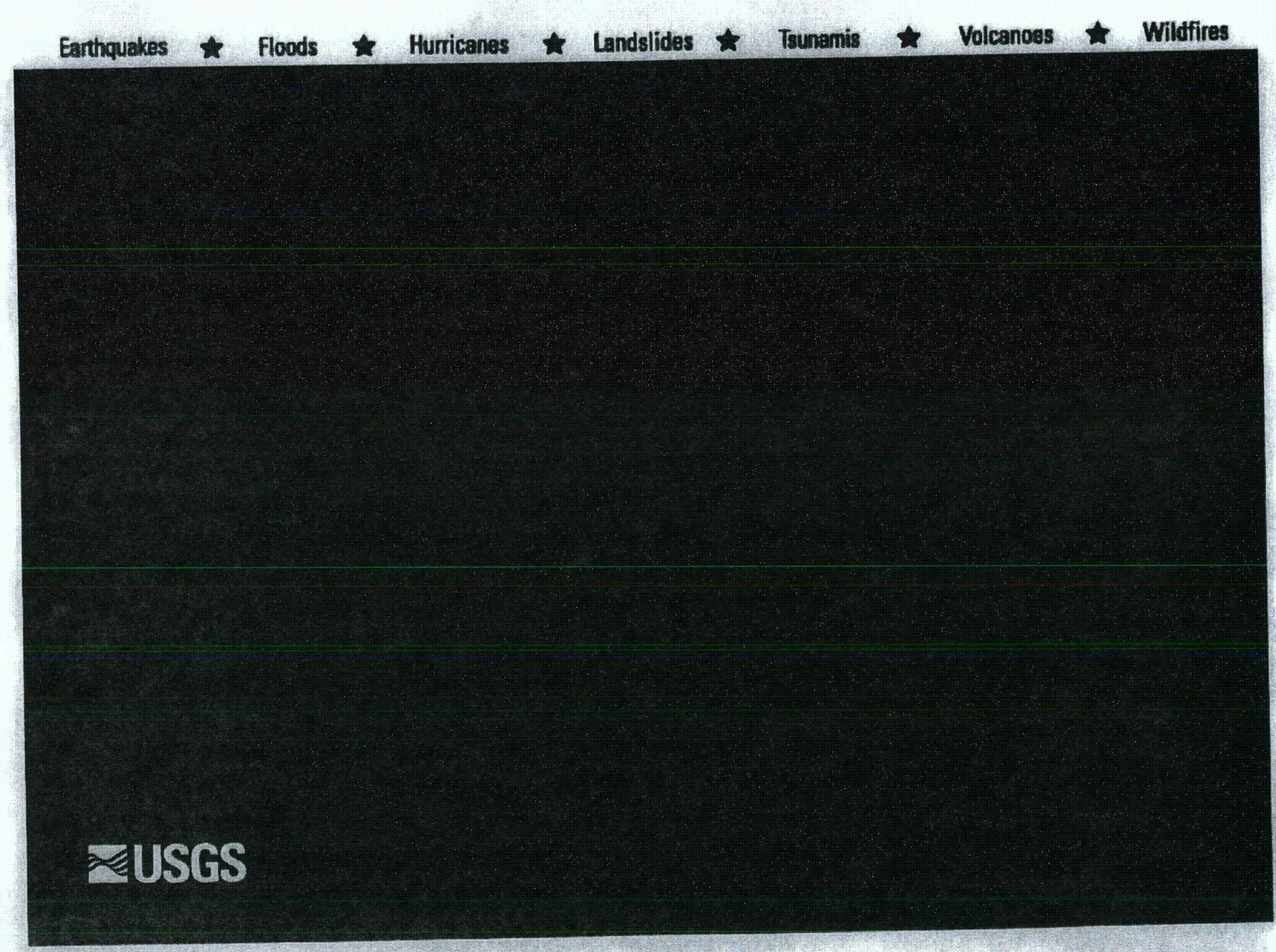


USGS

Earthquakes ★ Floods ★ Hurricanes ★ Landslides ★ Tsunamis ★ Volcanoes ★ Wildfires

Fort Calhoun Nuclear Power Plant

USGS


Earthquakes
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Landslides
Tsunamis
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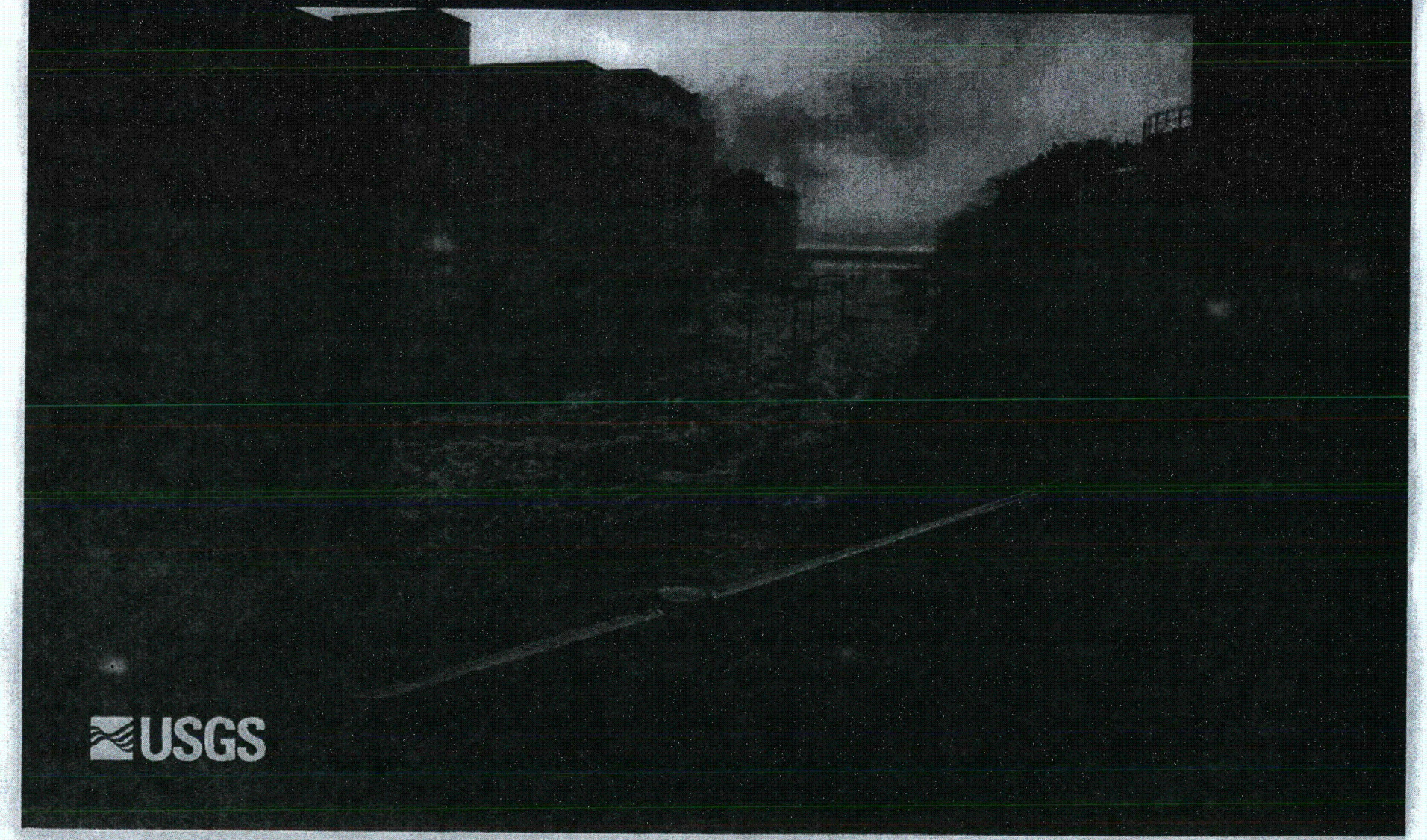
USGS

Earthquakes ★ Floods ★ Hurricanes ★ Landslides ★ Tsunamis ★ Volcanoes ★ Wildfires

Fukushima Nuclear Plant After Tsunami



USGS

From: Perkins, Richard
Sent: Friday, September 21, 2012 3:20 PM
To: Criscione, Lawrence
Subject: RE: Info

Other offices do seminars that would not be on the list I just sent.

From: Criscione, Lawrence
Sent: Friday, September 21, 2012 3:09 PM
To: Perkins, Richard
Subject: RE: Info

It was really about how engineering lessons learned are forgotten over time, but the guy giving it used bridge design as his basis. It was in 2010 or 2011. I'm not certain it was a RES seminar. It was in the same auditorium as our seminars and I know I went to it with Kauffman so I assume it was a seminar. Do other offices do seminars?

From: Perkins, Richard
Sent: Friday, September 21, 2012 1:53 PM
To: Criscione, Lawrence
Subject: Info

Energy Daily did a front page story today on FERC standing up a new office. You should take a look at that if you haven't.

I just sent the info on paleofloods (previous e-mail). Let me know if you don't get it.

I don't recall the brief about bridge failure. Anything to help me find it? Didn't see it in the RES seminar list (or I didn't recognize it as bridge failure related).

Richard H. Perkins, P.E.
Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
Division of Risk Analysis
Operating Experience and Generic Issues Branch
Phone - 301/251-7479

E|19

From: Criscione, Lawrence
Sent: Friday, September 21, 2012 7:05 PM
To: 'McGee, Jim (HSGAC)'
Subject: Documents - Email 2 - Letters and Memos between NRC and Duke
Attachments: 2009-04-30 - NRC letter to Duke which was the cause for Galloway's 2009-04-06 non concurrence.pdf; 2006-04-28 - Oconee Inspection Report which began it all - issue starts on page 5 of Enclosure.pdf; 2010-07-19 Memo from NRR to RES which formally began GI 204 - informal memo from George Wilson started the process in Feb 2010.pdf; 2010-03-05 Duke Energy response to request for additional information.pdf; 2008-09-26 Duke Energy response containing 8 hr core damage prediction.pdf; 2010-03-15 - formal write up of 2007 calculations showing 2.8E-4 annual failure rate.pdf

Attachments that are publicly available: ML090570779; ML061180451; ML101900305; ML103430047; ML13039A084.

From: McGee, Jim (HSGAC) [mailto:Jim_McGee@hsgac.senate.gov]
Sent: Thursday, September 20, 2012 5:16 PM
To: Criscione, Lawrence
Subject: RE: Update on Jocassee Dam contacts

Also would appreciate your guidance on which of the documents on this list may be worth obtaining. I've highlighted those that look useful, or that strike me as worth seeing. Any thoughts you have along this line would be appreciated.

Thanks.

Jim McGee
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Senate Committee on Homeland Security and Governmental Affairs
202-224-2627

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B/20

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Why didn't estimates of risk include earthquakes or seismic risks? See page 9 of screening study

Did NRC expand this GI study to include the other plants? See page 21 of screening study

Thanks for your help

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Sent: Thursday, September 20, 2012 1:31 PM
To: McGee, Jim (HSGAC)
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redactions if I knew that DHS and FERC had been specifically contacted and asked to state which parts of section 2.2 cannot be released to the public.

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Larry

From: Criscione, Lawrence
Sent: Friday, September 21, 2012 7:05 PM
To: 'McGee, Jim (HSGAC)'
Subject: Documents - Email 1 - Duke's slide show
Attachments: 2009-10-28 Duke Energy presentation to USNRC.pdf

Publicly available as ML093080034

Jim,

Here are some of the documents. Because of the size of some of them, I'll be needing to send these via several emails.

Larry

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From: Criscione, Lawrence
Sent: Friday, September 21, 2012 7:06 PM
To: 'McGee, Jim (HSGAC)'
Subject: Documents - Email 4 - RIC presentation and IAEA document
Attachments: 2010-03-11 Rajiv Prasad - Hierarchical Flood Hazard Assessment - RIC 2010 presentation.pdf; 2003-03 IAEA-TECHDOC-1341 Extreme external events in the design and assessment of nuclear power plants.pdf

This 114-page report is publicly available at http://www-pub.iaea.org/MTCD/publications/PDF/te1341_web.pdf.

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Larry

RIC 2010
Hierarchical Flood Hazard Assessment

Rajiv Prasad
Pacific Northwest National Laboratory
March 11, 2010

Pacific Northwest
NATIONAL LABORATORY

Background

- 10 CFR 52.79(a)(1)(iii) for Combined License applications
  - The seismic, meteorological, **hydrologic**, and geologic characteristics of the proposed site with appropriate consideration of the **most severe of the natural phenomena** that have been historically reported for the site and surrounding area and **with sufficient margin** for the limited accuracy, quantity, and time in which the historical data have been accumulated.
- 10 CFR 52.17(a)(1)(vi) for Early Site Permit applications
- 10 CFR Part 50, Appendix A, General Design Criterion 2
- 10 CFR Part 100

Pacific Northwest
NATIONAL LABORATORY

Hierarchical Hazard Assessment Approach

- Objective of Flood Hazard Assessment
  - provide reasonable assurance that plant SSCs would be safe
  - account for worst historical flood hazard
  - account for limited datasets
  - demonstrate sufficient margin
- How do we meet these objectives?
  - analysis of historical data and observations
  - consideration of all plausible flood causing phenomena
  - floods generated by probable maximum events
  - use conservative assumptions

Pacific Northwest
NATIONAL LABORATORY

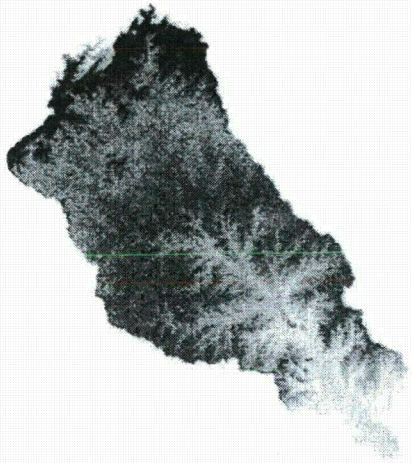
Hierarchical Hazard Assessment Approach

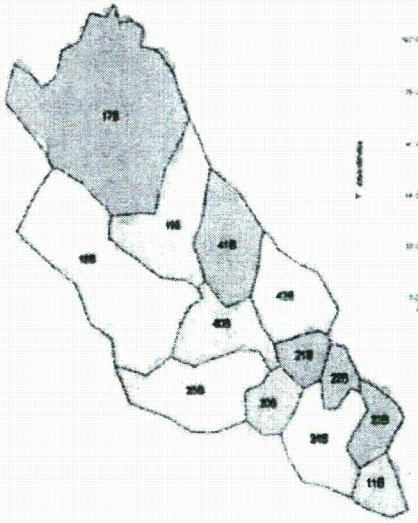
- What is HHA?
  - a set of iterative, progressively refined flood estimation steps
    - **Step 1**: identify flood causing phenomena by inspection of historical data and an assessment of all plausible hydrological, geoseismic, and structural failure processes in the vicinity of the site; document implausibility
    - **Step 2**: for each flood causing phenomenon, perform a conservative estimation of the flood hazards using ANSI/ANS-2.8-1992 combinations
    - **Step 3**: if any safety-related SSC is exposed to adverse effects of flood hazards, perform a more site-specific flood analysis ensuring that the flood-producing conditions are at least as conservative as and are consistent with what Federal agencies use in similar design considerations and repeat Step 2; else perform Step 4
    - **Step 4**: specify site characteristics for flood hazards

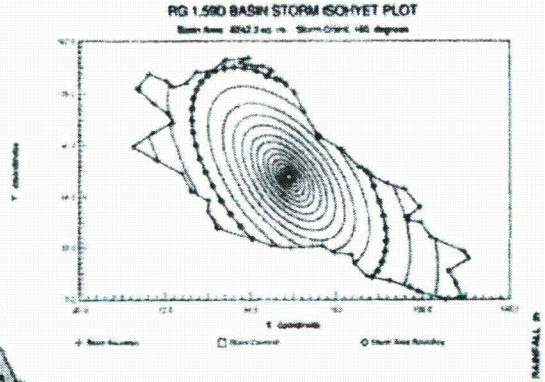
Pacific Northwest
NATIONAL LABORATORY

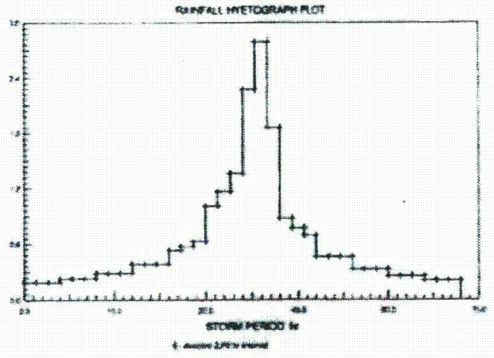
An Example of HHA

- Probable Maximum Flood (PMF) at a site
  - PMF is caused by a Probable Maximum Precipitation (PMP) event
  - Step 1:
    - estimate PMP hyetographs for subbasins of upstream drainage area









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NATIONAL LABORATORY

An Example of HHA (cont.)

- PMF at a site
  - Step 1:
    - flood causing phenomemon: PMF in the drainage area above the site
  - Step 2:
    - estimate PMF using conservative assumptions: no precipitation loss, instantaneous translation of surface runoff to the site, no attenuation as flood peak passes through storage reservoirs; estimate coincident wind-wave effects consistent with ANSI/ANS-2.8-1992
    - let us say this conservative estimation resulted in inundation of site grade
  - Step 3:
    - use site specific data: route surface runoff using peaked unit hydrographs
    - flood level drops, but still presents hazards to some SSCs
    - use site specific data: precipitation loss rate consistent with US Army Corps
    - flood level drops more, only SSC still inundated is safety-related intake
    - no more site-specific data to use

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An Example of HHA (cont.)

- PMF at a site
  - Step 4:
    - estimate flood hazards for the safety-related intake: hydrostatic forces (water levels), hydrodynamic forces (velocities), scouring potential, duration of inundation, and lead time for action
- HHA should be applied to all plausible flood causing phenomena
  - site flooding under local intense precipitation
  - flooding in rivers and streams; flooding from dam breaches and failures
  - storm surges, seiches, tsunamis, ice-induced events, channel diversions

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Recently Encountered Unique Issues

- Sequential combination of PMSS and Dam Breach
  - ANSI/ANS-2.8-1992 recommends that two extreme events should not be postulated to occur concurrently if they are independently caused
  - however, sequential combination is possible:
    - normal water surface elevation in cooling lake higher than site grade
    - under PMH-induced storm surge, site is wet
    - unreinforced outer face of cooling lake embankment subject to wave action and erosion
    - breach of embankment leads to a flood at site coincident with PMSS
- Small margin between site grade and PMF water levels
  - how small a margin is acceptable?
  - better approaches for estimation of unit hydrographs

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Observations and Conclusion

- HHA provides a consistent framework for assessment of flood hazards
- HHA provides assurance that all plausible flood causing phenomena have been investigated
  - analysis of historical data and observations
  - documentation of implausible flood causing phenomena
- HHA documents the level of conservatism built into the flood hazard analyses
  - clear documentation of site specific data used in flood hazard analyses
- HHA documents the conditions under which safety margins are estimated

From: Criscione, Lawrence
Sent: Friday, September 21, 2012 7:06 PM
To: 'McGee, Jim (HSGAC)'
Subject: Documents - Email 3 - NUREG/CR-704
Attachments: 2010-12 completed - 2011-11 published - NUREG-CR-7046 - Design-Basis Flood Estimation.pdf

This 185-page document is publicly available at http://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr7046/cr7046.pdf.

This is NUREG/CR-7046, Design-Basis Flood Estimation for Site Characterization at Nuclear Power Plants in the United States. It was completed in December 2010 but not published until November 2011.

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The DHS analysis of the Screening Study, or its assessment
Duck Action Plan to address issues
Was there earlier GI re: Oconee in 2006, reference a power cable?

And had these couple questions:

B/23

Is there a general weakness with the FSAR's and IPEEE documents for these plants? Or is result of the fact that most of these were developed several decades ago?

Why didn't estimates of risk include earthquakes or seismic risks? See page 9 of screening study

Did NRC expand this GI study to include the other plants? See page 21 of screening study

Thanks for your help

Jim McGee
Professional Staff/Investigations
Senate Committee on Homeland Security and Governmental Affairs
202-224-2627

From: Criscione, Lawrence [mailto:Lawrence.Criscione@nrc.gov]
Sent: Thursday, September 20, 2012 1:31 PM
To: McGee, Jim (HSGAC)
Subject: Update on Jocassee Dam contacts

Jim,

Yesterday I told you the NRC's Dam Safety Officer was George Wilson. Earlier this year he turned over to Kenneth Karwoski (301-415-2752, Kenneth.Karwoski@nrc.gov).

I spoke with George Wilson this morning (I had never met him until today). He informed me that in addition to the Department of Homeland Security, the NRC also sent the GI 204 Screening report to the Federal Energy Regulatory Commission. He said that it is possible that FERC was the source of the redactions and not DHS.

This has become an issue which I cannot resolve without the assistance of a congressional staffer since it involves one federal agency (the NRC) saying it is redacting documents due to the concerns of two other federal agencies (FERC and DHS).

I was told by George Wilson (the old Dam Safety Officer) that he does not have records of DHS's review from earlier in the year, but his contact at DHS was Craig Conklin. I don't know Craig's phone number, but his email is Craig.Conklin@dhs.gov.

I don't have a contact at FERC, but attached is a page out of their phone directory. I would think an appropriate contact would be William Allerton in Washington or Wayne King in Atlanta.

What I desire to know is whether or not there is anything in Section 2.2 (pp. 5-9) of the attached screening report which (1) DHS believes needs to be withheld from the public and (2) FERC believes needs to be withheld from the public.

There are at least two other entities (the TVA and the Army Corp of Engineers) which the NRC sent to review the report, but neither of these entities would have requested redactions to section 2.2 on Jocassee Dam because this dam falls under FERC. The Corp was concerned with dams along the Missouri River and the TVA with dams in the Tennessee Valley.

I don't know exactly what was told to Michal, but I'm under the impression that the NRC claimed the redactions to section 2.2 were at the request of either FERC or DHS. This may be true, but I would feel more comfortable about the redactions if I knew that DHS and FERC had been specifically contacted and asked to state which parts of section 2.2 cannot be released to the public.

Although there are certainly some merit into not broadcasting our infrastructure vulnerabilities, if you were a resident of Oconee County, South Carolina I assume you would want to know both the security and the purely safety liabilities which the Oconee Nuclear Station poses to you. The same is true for the residents of Nebraska and other affected sites. Withholding a detailed drawing showing the weak areas of Jocassee Dam is one thing, withholding merely the failure probability of that dam due to natural phenomena is something entirely different.

Larry

From: Criscione, Lawrence
Sent: Friday, September 21, 2012 7:06 PM
To: 'McGee, Jim (HSGAC)'
Subject: Documents - Email 5 - IPEEE for Oconee
Attachments: 1995-12-21 IPEEE Oconee - Individual Plant Examination of External Events.pdf

Attachment has been excluded from scope of request.

From: McGee, Jim (HSGAC) [mailto:Jim_McGee@hsgac.senate.gov]
Sent: Thursday, September 20, 2012 5:16 PM
To: Criscione, Lawrence
Subject: RE: Update on Jocassee Dam contacts

Also would appreciate your guidance on which of the documents on this list may be worth obtaining. I've highlighted those that look useful, or that strike me as worth seeing. Any thoughts you have along this line would be appreciated.

Thanks.

Jim McGee
Professional Staff/Investigations
Senate Committee on Homeland Security and Governmental Affairs
202-224-2627

From: McGee, Jim (HSGAC)
Sent: Thursday, September 20, 2012 6:01 PM
To: 'Criscione, Lawrence'
Subject: RE: Update on Jocassee Dam contacts

Larry,

Working my way through this material. I'd be interested in your thoughts on the attached, which includes a summary of findings from a post-Fukushima inspection, and NRC orders or requests for information. Would these have generated any information on Oconee that is relevant to the GI or issues you've raised?

Wondered if the following documents are available:

The 1992 FERC inundation study on Oconee
The 2008 and 2010 Duke studies
The DHS analysis of the Screening Study, or its assessment
Duck Action Plan to address issues
Was there earlier GI re: Oconee in 2006, reference a power cable?

And had these couple questions:

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B/24

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Jim McGee
Professional Staff/Investigations
Senate Committee on Homeland Security and Governmental Affairs
202-224-2627

From: Criscione, Lawrence [mailto:Lawrence.Criscione@nrc.gov]
Sent: Thursday, September 20, 2012 1:31 PM
To: McGee, Jim (HSGAC)
Subject: Update on Jocassee Dam contacts

Jim,

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sites. Withholding a detailed drawing showing the weak areas of Jocassee Dam is one thing, withholding merely the failure probability of that dam due to natural phenomena is something entirely different.

Larry

Criscione, Lawrence

From: Criscione, Lawrence
Sent: Friday, September 21, 2012 7:06 PM
To: 'McGee, Jim (HSGAC)'
Subject: Documents - Email 7 - Final
Attachments: Ch 2 - Site Characteristics - ONS FSAR.pdf; Source_Documents_Screening Report ML1107404821.pdf

Ch. 2 has been excluded from scope of request

Jim,

I think you'll find the attached document interesting. It has information about the demographics around ONS (which appears to be highly populated due to the popularity of Lake Keowee).

The attached document is a chapter from the Interim Fuel Storage Facility at Oconee (basically the concrete bunker where 25-year old used fuel is stored in the Yucca Mountain shipping containers).

I could find the IFSF FSAR in Adams, but not the FSARs for any of the ONS reactors. I did find letters announcing FSAR revisions and they usually refer to an attached CD-ROM. There is a share-point drive outside of ADAMS which might contain the FSARs. I'll see if I can't find my way there. However, I might find that the documents are way too big to email.

The project manager for Oconee is John.Boska@nrc.gov 301-415-2901. I don't know him, but he'd probably send you a copy of the Oconee FSAR (he might ask you to go through the NRC's Congressional Liaison, but I doubt it). However, it's probably too big to email so he'd need to send it via a CD ROM. DON'T ASK FOR A HARD COPY – it's thousands of pages long.

The project manager for Fort Calhoun is Lynnea.Wilkins@nrc.gov 301-415-1377. The Ft. Calhoun FSAR is also thousands of pages long.

I don't know much about the NRC's Office of Congressional Affairs. My guess is that for most things you'll get them a lot quicker if you just go right to the source. However, since these FSARs will likely need to be physically delivered (either by some type of inter office mail or US mail) you might get them quicker through the NRC's OCA (they might have some type of inter-office delivery service to get documents to the Hill). The OCA contacts for Region II (Oconee) and Region IV (Fort Calhoun) are David.Decker@nrc.gov and Jenny.Weil@nrc.gov.

I could not locate the presentation "An Assessment of Large Dam Failure Frequencies based on US Historical Data" that was given at the PSA 2011 International Topical Meeting on Probabilistic Safety Assessment and Analysis. I would recommend asking one of the study's authors to send it to you. Here are the authors in the order I think most likely to just email you the document without burdening you with going through the Office of Congressional Affairs This is a publicly available paper which they should be passing on to any member of the public who requests it so you might want to just ask for an electronic copy of the paper without telling them you are from a senatorial committee:

- Jeff Mitman 301-251-2834 Jeffrey.Mitman@nrc.gov
- Fernando Ferrante 301-251-8385 Fernando.Ferrante@nrc.gov
- Selim Sancaktar 301-251-7572 Selim.Sancaktar@nrc.gov
- Jeff Wood 301-251-7588 Jeffrey.Wood@nrc.gov

Larry

From: McGee, Jim (HSGAC) [mailto:Jim McGee@hsgac.senate.gov]
Sent: Thursday, September 20, 2012 5:16 PM
To: Criscione, Lawrence
Subject: RE: Update on Jocassee Dam contacts

5. References

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nail 2 Duke. "Letter from Duke Energy to USNRC: Oconee External Flood, Response to Request for Additional Information (March 5, 2010)." ADAMS Accession No. ML103430047 (Not publically available), 2010.

nail 2 Duke. "Letter from Duke Energy to USNRC: Response to NRC Letter from Joseph G. Guitter to Dave Baxter, "Information request pursuant to 10 CFR 50.54(f) related to external flooding,including failure of the Jocassee Dam, at Oconee Nuclear Station (Sept. 26, 2008)." ADAMS Accession No. ML082750106 (Not publically available), 2008.

rnando.Ferrante@nrc.gov 301-415-8385, Jeffrey.Mitman -2843, Jeffrey.Wood -7588, Selim.Sancaktar -7572

F. Ferrante, S. Sancaktar, J. Mitman, J. Wood. "An Assessment of Large Dam Failure Frequencies based on US Historical Data." *Proceedings of ANS PSA 2011 International Topical Meeting on Probablisitic Safety Assessment and Analysis.* Wilmington, NC: American Nuclear Society, 2011.

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ıail 2 USNRC. "Letter from USNRC to Duke Energy: Evaluation of Duke Energy Carolinas, LLC (Duke) September 28, 2008, Respnse to NRC Letter Dated August 15, 2008, Related to External Flooding at

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From: Mitman, Jeffrey
Sent: Tuesday, September 25, 2012 2:56 PM
To: Criscione, Lawrence
Subject: RE: PSA 2011 Paper

Fenando went and presented, I did not go. I don't know if Shelby went.

Jeff Mitman

From: Criscione, Lawrence
Sent: Tuesday, September 25, 2012 1:09 PM
To: Mitman, Jeffrey
Subject: RE: PSA 2011 Paper

Thanks Jeff. I was looking for the PSA 2011 paper.

Did you or Fernando or Shelby get to go to Finland to present your PSAM paper?

From: Mitman, Jeffrey
Sent: Tuesday, September 25, 2012 11:28 AM
To: Criscione, Lawrence
Subject: RE: PSA 2011 Paper

Larry, attached is the PSA 2011 paper. I don't recall whether it's in ADAMS. Also attached is a second paper on dam failures which I'm also a co-author on. It was presented at PSAM earlier this year. There are many papers on dam failures, these are the only two that I've been involved with that were published outside of the NRC. I'm not sure what you're looking for so if you're interested let me know and I can send more.

Jeff Mitman

From: Criscione, Lawrence
Sent: Thursday, September 20, 2012 3:17 PM
To: Mitman, Jeffrey
Subject: PSA 2011 Paper

Jeff,

Is your PSA 2011 paper in ADAMS? If not, can you point me to it on the web or send me a copy?

Thanks,
Larry

B127