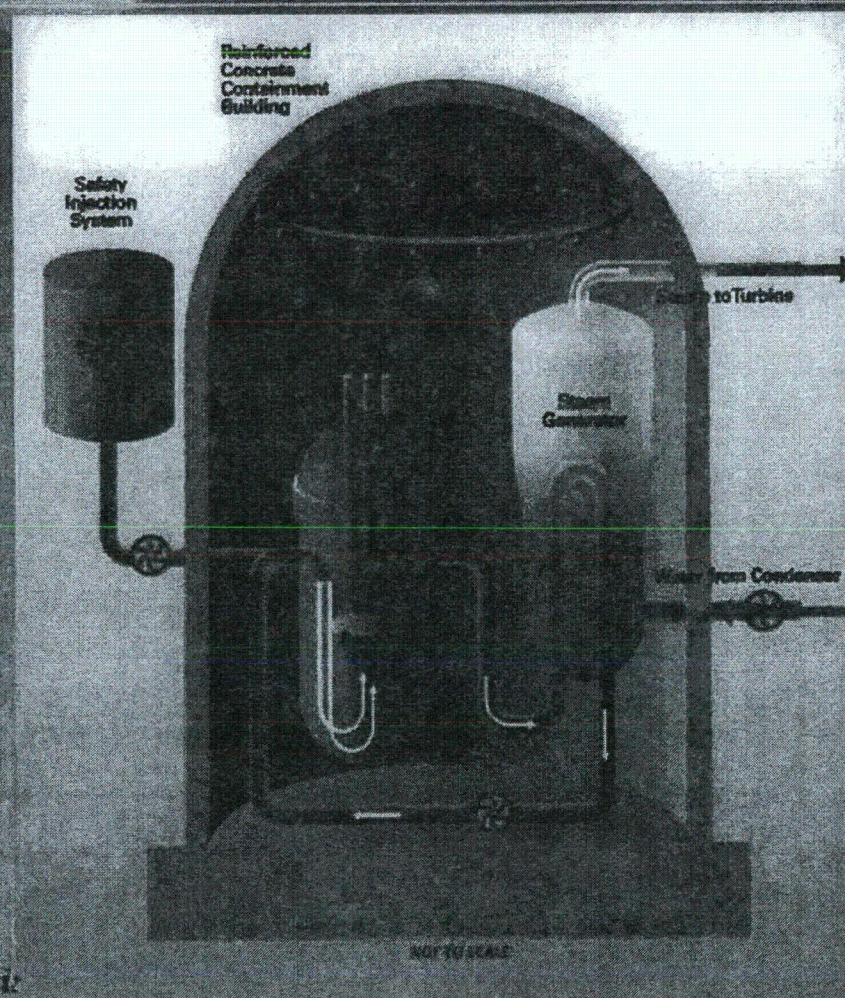




Scenarios Analyzed

Reactor Site	Accident Scenario	Description
Peach Bottom & Surry	Long-Term Station Blackout (LTSBO)	Seismic event; loss of ac power; batteries available initially
Peach Bottom & Surry	Short-Term Station Blackout (STSBO)	Seismic event; loss of ac power; batteries unavailable
Surry	STSBO with Thermally Induced Steam Generator Tube Rupture (TISGTR)	Variation of STSBO – a steam generator tube ruptures resulting in a pathway for radioactive material to potentially escape
Surry	Interfacing Systems Loss-of-Coolant Accident (ISLOCA)	Random failure of valves ruptures low-pressure system piping outside containment

Containment System Scenarios



U.S. Nuclear Regulatory Commi:



Accident Progression Modeling

- MELCOR's detailed, integrated computer model includes the reactor, plant systems, plant buildings
- MELCOR calculates accident scenario progression and release of radioactive material
 - Physics and chemistry models
 - Water boil-off in the reactor, core overheating and melting, reactor and containment failure, release of radioactive material
 - Operator actions
 - Installed and portable equipment for depressurizing reactor and injecting water





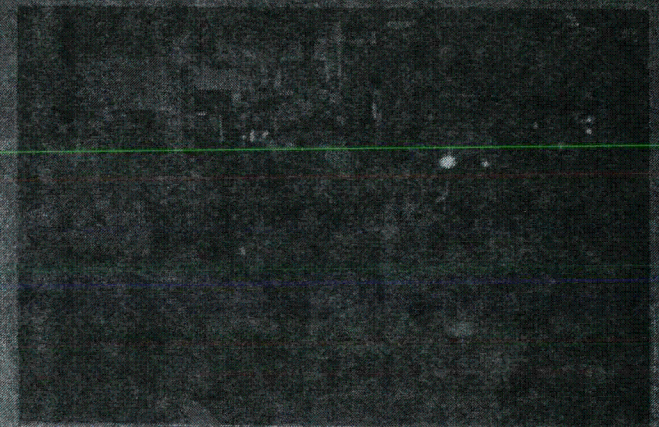
Analysis of Mitigation

- SOARCA evaluated the benefits of recent improvements by modeling two versions of each scenario
 - Mitigated—Operators successful in carrying out mitigating actions prescribed in EOPs, SAMGs, EDMGs, including 10 CFR 50.54(hh)
 - Unmitigated—Operators successful in carrying out mitigating actions prescribed in EOPs and SAMGs but unsuccessful in implementing post-9/11, 10 CFR 50.54(hh) equipment and procedures



Example of 10 CFR 20.22(a) (hh) Mitigation

- Procedures to manually (without electricity) operate steam-driven pumps
- Portable diesel-driven pumps
- Portable generators to power critical instrumentation and operate valves
- Portable air bottles to operate valves

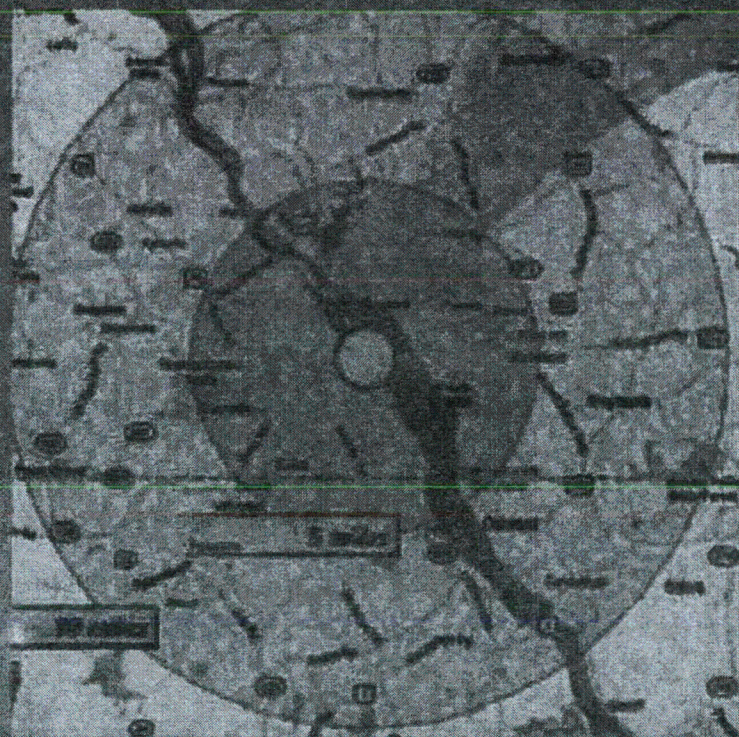


Emergency Response Modeling

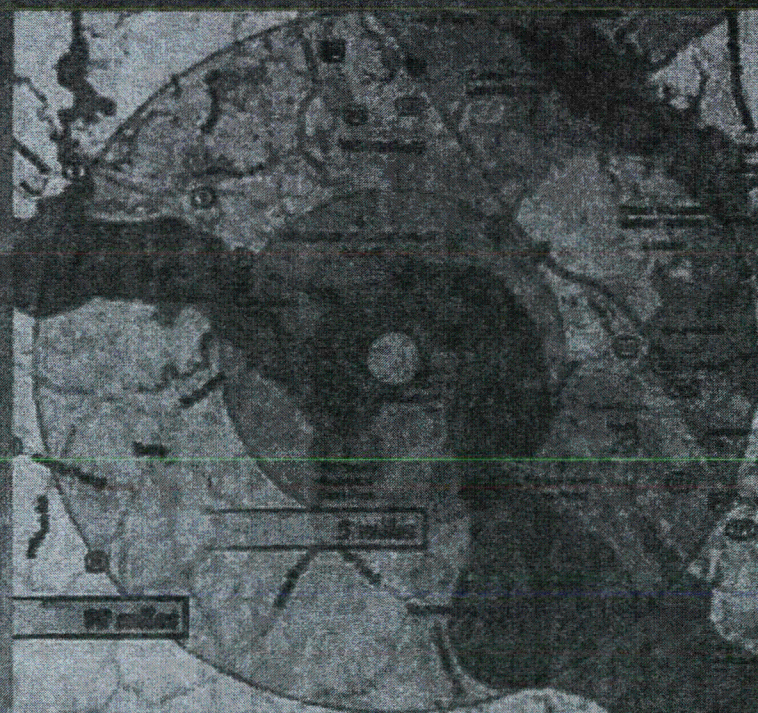
- Realistic modeling for emergency response (WFO 2002)
 - Site, State, and local emergency plans
 - Site's timeline for declaring an emergency
 - State/local protective action procedures
 - Precautionary protective actions modeled
 - Used Site Evacuation Time Estimate (ETE) data
 - Real-world examples help show:
 - The public will largely obey direction from officials
 - Emergency workers will implement plans



Peach Bottom and Surry Emergency Planning



Peach Bottom



Surry



Offsite Consequence

- More detailed modeling of plume release and azimuthal sectors
- Scenario specific Emergency Action Levels based on site procedures for Site Area Emergency and General Emergency
- Detailed evacuation and relocation modeling
 - Reflect ETEs and road networks at Surry and Peach Bottom
 - Treatment of multiple population groups
- Site-specific population and weather data



Offsite Consequences

- Range of truncation dose rates for latent cancer fatality prediction
 - SRM approved staff's recommendation to use LNT
 - Also performed sensitivities
 - Average background/medical exposure (620 mrem/year)
 - Value based on Health Physics Society position paper (5 rem/year with a 10 rem lifetime cap)
- Sensitivities
 - Potential evacuation impacts from earthquake
 - Loss of bridges, traffic signals, delay in notification
 - Potential evacuation of areas outside of EPZ



Consequence Analysis Reported in SCAG

- **Early Fatality Risk**—Individual risk of death shortly (usually within a few weeks or months) after exposure to large doses of radiation
- **Long-Term Cancer Fatality Risk**—Individual risk of cancer fatality years after exposure to radiation
 - Results compared to the NRC Safety Goal and the 1982 Siting Study



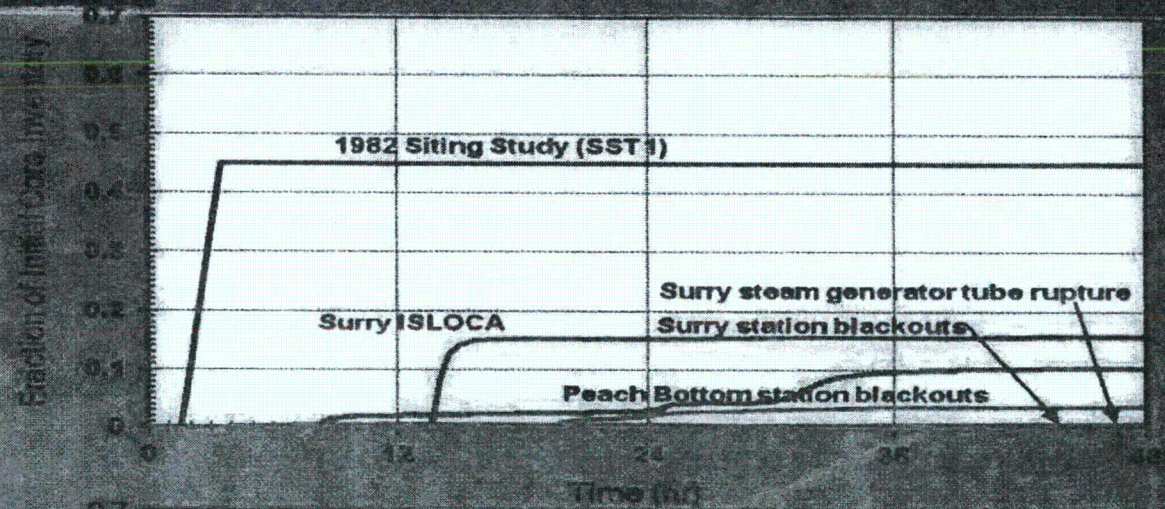
SOARCA Conclusions for Pilot Plants

- When operators are successful in using available onsite equipment during the accidents analyzed in SOARCA, they can prevent the reactor from melting, or delay or reduce releases of radioactive material to the environment.
- SOARCA analyses indicate that all modeled accident scenarios, even if operators are unsuccessful in stopping the accident, progress more slowly and release much smaller amounts of radioactive material than calculated in earlier studies.

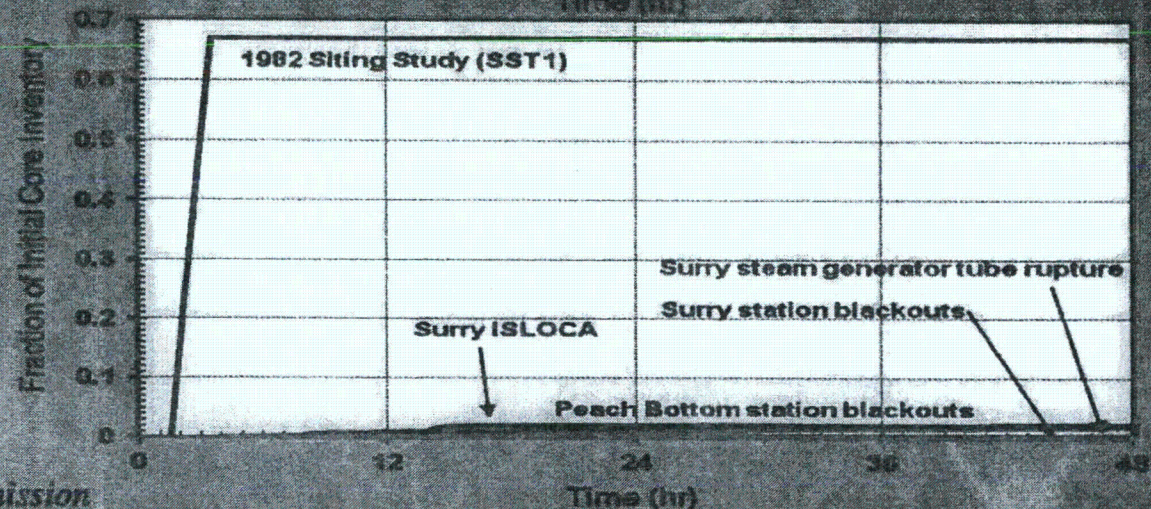


SCARCA Study Results for Pilot Plants

Iodine release
without 10 CFR
50.54(hh)



Cesium release
without 10 CFR
50.54(hh)



U.S. Nuclear Regulatory Commission



SOARCA Conclusions for Pilot Plants

- Public health consequences from severe nuclear accident scenarios are smaller than previously calculated
- Delayed releases calculated provide more time for emergency response actions such as evacuating or sheltering
- Modeled severe accident scenarios in SOARCA cause essentially no early fatality risk

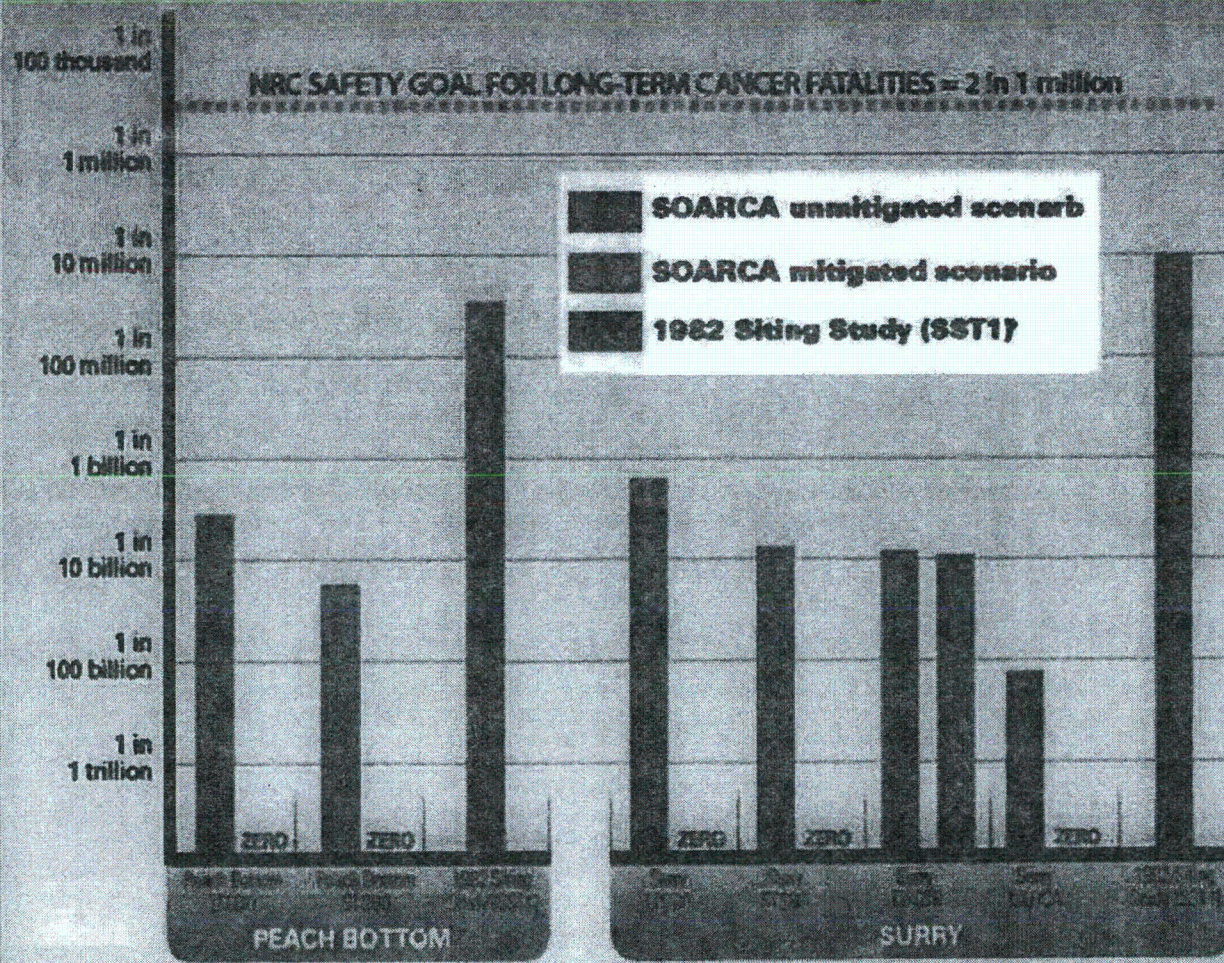


SOARCA Conclusions for Pilot Plants

- Calculated individual long-term cancer fatality risks for the accident scenarios analyzed are millions of times lower than the general U.S. cancer fatality risk



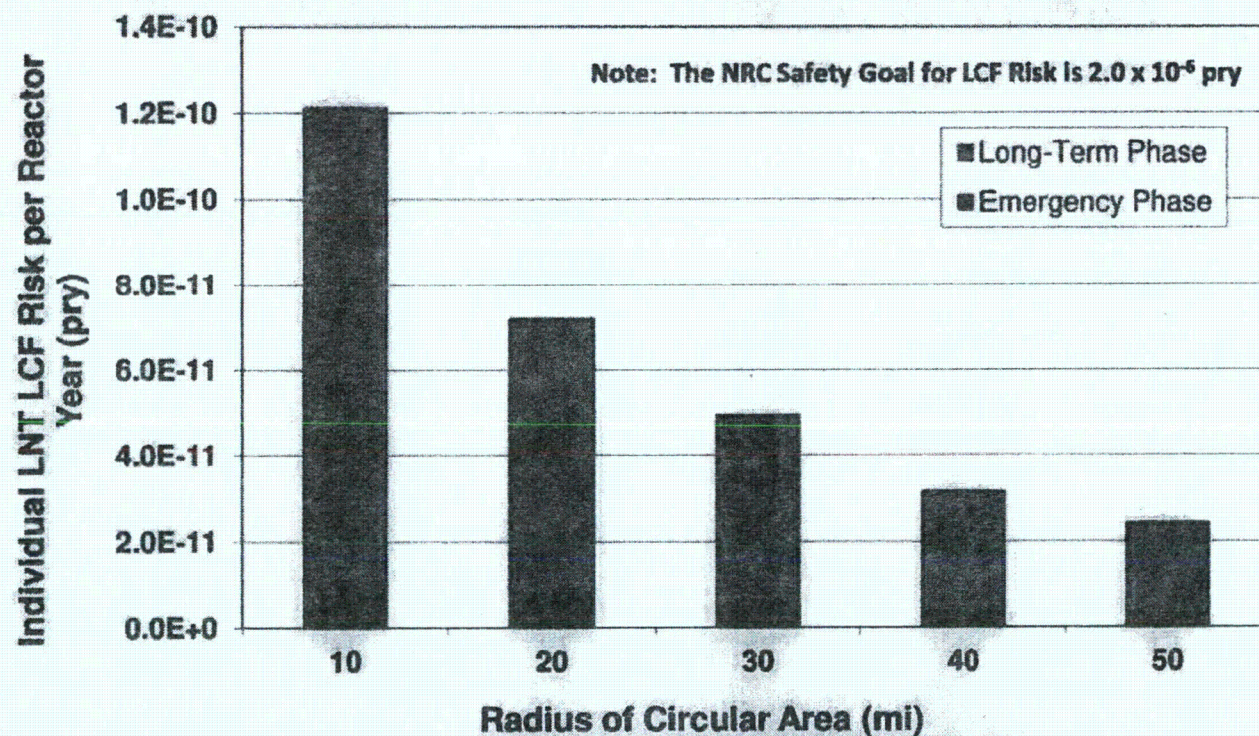
Scenario-Specific Cancer Death Rates within 10 miles of the site (per reactor-year)



The SOARCA model is a stochastic model that calculates the probability of a cancer death occurring within 10 miles of the reactor site. The model is based on the assumption that the cancer death rate is proportional to the dose rate. The SOARCA model is a conservative model, meaning that it tends to overestimate the cancer death rate. The SOARCA model is based on the assumption that the cancer death rate is proportional to the dose rate. The SOARCA model is a conservative model, meaning that it tends to overestimate the cancer death rate.

The 1982 Siting Study did not calculate the risk of long-term cancer deaths. Therefore, to compare the 1982 Siting Study SST1 results to SOARCA's results for risk of long-term cancer death, the SST1 results were put into the MACCS-2 code files for Peach Bottom and Surry unmitigated SST1 calculations.

Risk is Reduced After Returning Home After the Accident



Surry Unmitigated STSBO with TISGTR



SOARCA VS. FUKUSHIMA

- Operation of the FCIC system
 - 5 Hours for SOARCA unmitigated LTSSO, longer at Fukushima
- Hydrogen release and combustion
 - SOARCA calculates hydrogen release and combustion
- 48-hour truncation of releases in SOARCA
 - Reactor building flooding; additional offsite resources
- Multi-unit risk
 - Site Level 3 PRA project
- Spent fuel pool risk
 - Separate SFP Scoping Study/ Site Level 3 PRA project



SEARCA Tools and Methods

- Providing insights to improve SPAR models
- Supporting knowledge management for severe accident analysis
- Informing NSIR efforts to risk inform EP regulatory oversight
- Identified an emergency action level that is being added to classification scheme guidance
- Supporting NRC response to Fukushima event
- Coordinating with plans for Site Level 3 PRA



Status

- Staff believes SOARCA-type analysis for all 6 plant types at 10 operating reactors as originally described is not necessary
 - Provided body of knowledge updating understanding of severe accident progression, mitigation, and consequences
 - Site Level 3 PRA will continue to add to this body of knowledge
 - Provided flexible and updated models and methods
 - SOARCA models and methods being used for other programs (Fukushima-related plant improvements, Spent Fuel Pool Scoping Study, Site Level 3 PRA)
- Staff recommends limited follow-on research
- Deliverables to EDO in mid-June
 - Commission memo transmitting SOARCA reports to the Commission
 - Notation-vote paper recommending analysis of an ice condenser plant



From: Criscione, Lawrence
Sent: Wednesday, October 03, 2012 8:32 AM
To: 'McGee, Jim (HSGAC)'
Subject: FW: Mineral, VA earthquake Seminar - first ten slides
Attachments: NRC Virginia quake Leith Dec13 - slides 1-10.pptx

Slides 1 through 10 of 30.

From: Criscione, Lawrence
Sent: Wednesday, October 03, 2012 7:46 AM
To: 'McGee, Jim (HSGAC)'
Subject: Mineral, VA earthquake Seminar

Jim,

Attached is the poster from the RES Seminar on the Mineral Virginia earthquake. There is no DVD and the slide presentation is 31 MB in power point and 57 MB in Adobe. I'll try to break it up later today to send it to you.

I did not attend the seminar but heard it was pretty good. The presenter was William Leith from the USGS. His email is below. Also below is the email for Jon Ake at the NRC Office of Research. I don't know Jon, but most people in RES are willing to speak to anyone who calls with technical questions.

Larry

wleith@usgs.gov
Jon.Ake@nrc.gov

From: McGee, Jim (HSGAC) [mailto:Jim_McGee@hsgac.senate.gov]
Sent: Tuesday, October 02, 2012 3:35 PM
To: Criscione, Lawrence
Subject: RE: GI 199 and Mineral, VA earthquake

Thanks. I appreciate 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: Tuesday, October 02, 2012 3:34 PM
To: McGee, Jim (HSGAC)
Subject: RE: GI 199 and Mineral, VA earthquake

I've asked around but haven't heard back yet (it's only been a few hours). I may be able to get these presentations in the coming days.

Larry Criscione

From: McGee, Jim (HSGAC) [mailto:Jim_McGee@hsgac.senate.gov]
Sent: Tuesday, October 02, 2012 9:50 AM
To: Criscione, Lawrence
Subject: RE: GI 199 and Mineral, VA earthquake

Thanks. I couldn't get any of these links to work. I highlighted the topics that appear germane. Will try to track down those slides or DVD's, unless you have them.

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: Monday, October 01, 2012 8:00 PM
To: McGee, Jim (HSGAC)
Subject: FW: GI 199 and Mineral, VA earthquake

Jim,

I meant to send this to you a couple of weeks ago, but accidentally sent it to Jon Ake, Marty Stutzke and Ben Beasley (I had "temporarily" put their names in the "To" line to copy down their email addresses).

Anyways, at the very bottom of this email is a list of RES seminars. You might find #99, #102 and #112 interesting pertaining to dam failures, earthquakes and paleofloods.

Larry Criscione

From: Criscione, Lawrence
Sent: Friday, September 21, 2012 2:38 PM
To: Ake, Jon; Beasley, Benjamin; Stutzke, Martin
Subject: GI 199 and Mineral, VA earthquake

Jim,

Below is a list of Seminars given to the Office of Research.

One of them was on the Mineral, VA Earthquake of August 23, 2011. It was given by Dr. Leith of the USGS. The NRC contact was Jon.Ake@nrc.gov, 301-251-7626. He could probably send you the seminar material.

Marty Stutzke (martin.stutzke@nrc.gov, 301-251-7614) was one of the chief scientists on GI 199 (the earthquake Generic Issue) if you have any questions about what was looked at and what the conclusions were. Ben Beasley (Benjamin.Beasley@nrc.gov, 301-251-7676) should be able to either tell you what the status of it is or direct you to a contact in the office assigned to implement it.

Larry

From: Perkins, Richard
Sent: Friday, September 21, 2012 2:19 PM
To: Criscione, Lawrence
Subject: RE: Info

I found this, but there are no slides available. It was recorded.

12/14/10

Success and Failure: A Paradoxical Relationship

Prof. Henry Petroski










Duke University









Nathan Siu













DRA



Here's a copy of the RES Seminar Table through 2009 (if you can read this)

Seminar #114	09/19/12	Long-Term Research Program Overview	Robert Tregoning, Ph.D. Michael B. Rubin, LTRP PM David W. Stroup, P.E. Jacob Philip, P.E.	
Seminar #113	08/08/12	The NRC and Social Media – What We're Doing, Why We're Doing It, and How You Can Get Involved [View Poster]	Holly Harrington – Office of Public Affairs	No DVD available for this seminar
Seminar #112	07/10/12	Dam Failure, Nuclear Power Plant Flooding, and the Outlook for Generic Issue 204 [View Slide 1] [View Slide 2] [View Slide 3]	Richard Perkins & Jacob Philip RES/DRA	DVD
Seminar #111	06/19/12	Training Range Environmental Evaluation and Characterization System (TREECS) Applications - [View Slide]	Billy E. Johnson, U.S. Army Corps of Engineers; Mark S. Dortch, MSD Inc., and Boris Faybushenko, Lawrence Berkeley National Laboratory Sponsored by Tom Nicholson, DRA/RES	No DVD available for this seminar
Seminar #110	06/07/12	ASR Degradation of Concrete affecting Nuclear Power Plant Structures - [View Slide] [Presentation 1] [Presentation 2]	Jason Weiss, Purdue University; Kenneth Snyder, NIST; and Fahim Sadek, NIST. Sponsored by Jacob Philip, ETB/DRA/RES	No DVD available for this seminar
Seminar #109	06/06/12	Live webcast of Zirconium Fire Experiment on PWR Spent Fuel Pool Complete Loss of Coolant Accident	Ghani Zigh, RES/DSA	No DVD available for this seminar
Seminar #108	6/4/2012	State-of-the-Art Reactor Consequence Analyses (SOARCA) RES Seminar - [View Slides]	Richard Chang, Jonathan Barr & Jason Schaperow (SOARCA Team)	DVD
Seminar #107	5/21/2012	Health Physics Brown Bag 2012 Series: US Federal Agency Response to Fukushima Incident	Dr. Luis Benevides from NAVY, sponsored by Gladys Figueroa, RES/DSA/RPB	DVD
Seminar #106	4/17/2012	Multi-Scale Assessment of Prediction Uncertainty in Coupled Reactive Transport Models Curtis Flyer Announcement	Gary P. Curtis(USGS) Ming Ye(FSU) Philip D. Meyer(PNNL) Steve Yabusaki(PNNL)	No DVD available for this seminar

Seminar #105	3/27/2012	Development of the Extremely Low Probability of Rupture (xLPR) Assessment Tool View Slides	Dave Rudland, RES/DE	
Seminar #104	2/13/12	The NRC's Simulator-based Human Performance Testing Program - Advancing Model Validity with Data	Amy D'Agostino & James Chang, RES/DRA	
Seminar #103	1/25/12	Computational Fluid Dynamics for Nuclear Safety Analysis	Christopher Boyd, RES/DSA	
Seminar #102	12/13/11	The Mineral, VA Earthquake of August 23, 2011 View poster View presentation	Dr. William Leith, U.S. Geological Survey / Jon Ake, RES/DE/SGSEB	No DVD available for this seminar
Seminar #101	11/01/11	Lessons Learned from Investigations of Oil and Chemical Industry Events View Presentation	Mark Griffin Board Member U.S. Chemical Safety and Hazard Investigation Board	
Seminar #100	10/05/11	Investigations of Zirconium Fires during Spent Fuel Pool Loss of Coolant Accidents	Ghani Zigh, RES/DSA	
Seminar #99	08/23/11	The Value of Paleoflood Information when Estimating Flood Risk [Slides] [Background Info 1] [Background Info 2]	Dr. Timothy Cohn, U.S. Geological Survey Thomas Nicholson, DRA	
Seminar #98	07/11/11	Research Topics and Experiences on Safety Assessment Methods of Radioactive Materials (RAM) Containers German Federal Institute for Materials Research and Testing (BAM), Berlin, Germany	Dr. Frank Wille, "Requirements for Transport Packages after Interim Storage" Dr. Karsten Muller, "Recent Activities on Experimental Package and Component Testing at BAM" Mr. Gernar Eisenacher "Impact Limiter Modeling - An Approach for a Finite Element Material Model for Wood" Dr. Jose Pires, RES/DE/SGSEB	
Seminar #97	06/21/11	Assuring Durable Concrete: Chemical Degradation Processes and Modeling Service Life - View Slides	Dr. Kenneth A. Snyder, National Institute of Standards and Technology Jacob Philip, DRA/ETB	
Seminar #96	04/26/11	Chernobyl 25th Anniversary 1. Mike Weber's Introduction 2. Dr. Brian Sheron's Presentation 3. Dr. Frank Congel's Presentation 4. Dr. John Bolce's Presentation	Dr. Brian Sheron, RES Frank Congel, Former NRC Employee Dr. John Bolce, IEI	
Seminar #95	04/19/11	A Probabilistic Risk Assessment View of Consequential Steam Generator Tube Rupture View Slides	Selim Sancaktar, RES/DRA/PRAB	No DVD available for this seminar

Seminar #94	02/22/11	Radiation Epidemiology Past Studies and Future Opportunities [View Poster]	Dr. John Boice, Medicine at Vanderbilt University School of Medicine and Scientific Director of the International Epidemiology Institute (IEI) / Stephanie Bush- Goddard, RES/DSA/HEB	
Seminar #93	02/15/11	American Society of Mechanical Engineers [View Slides]	Rick Swayne, ASME Carol Moyer, RES/DE/CMB	
Seminar #92	01/20/11	Weather and Hydrologic Extremes in a Non-stationary Climate with Implications for Managing Critical Infrastructures and Key Resources Presentation Slides	Dr. Auroop Ganguly (ORNL) Joe Kanney (RES/DRA/ETB) Tom Nicholson (RES/DRA)	
Seminar #91	01/12/11	Field and Modeling Studies to Assess Radionuclide Transport in the Subsurface	Dr. Andy Ward, Senior Research Scientist, Pacific Northwest National Laboratory Tom Nicholson (RES/DRA)	
Seminar #90	12/14/10	Success and Failure: A Paradoxical Relationship	Prof. Henry Petroski Duke University Nathan Silu DRA	
Seminar #89	11/10/2010	Zirconium in the Nuclear Industry - [View Slides]	Patrick Reynaud DSA / FSTB	
Seminar #88	10/20/2010	ASME Codes and Standards: History, Content, Development, and Endorsement	Carol Moyer & Gary Stevens, RES/DE	No DVD available for this seminar
Seminar #87	09/23/2010	Seismic-related Generic Issue (GI-199) Safety/Risk Assessment Methods and Results - [Detail] [view Slides]	Marty Stutzke (RES/DRA) Jon Ake (RES/DE/SGSEB) Lauren Killian (RES/DRA/OEGIB)	
Seminar #86	07/23/2010	Risk and Uncertainty in Dam Safety [View Detail 1] [View Detail 2] [View Detail 3]	Professor Gregory B. Baecher University of Maryland, College Park/ Thomas Nicholson, RES/DRA	No DVD available for this seminar
Seminar #85	07/19/2010	The Evolution of Radiation Protection: From Erythema to Genetic Risks to Risks of Cancer [View Slides]	Charles Meinhold / Terry Brock, RES/DSA/HEB	
Seminar #84	07/12/2010	Advanced Control Room Human Factors [View Slides]	Jing Xing & Stephen Flegen RES/ DRA/HFRB	No DVD available for this seminar
Seminar #83	06/17/2010	Severe Accident Response for Steam Generator Tubing [View Slides]	Saurin Majumdar, ANL	No DVD available for this seminar
Seminar #82	06/17/2010	Lean Six Sigma on Internal Contracting	Mary Muesale, PMDA	No DVD available for this seminar

Seminar #81	05/13/2010	Overview of the Electric, Power Research Institute Organizational and Program Structure and its Relationship to the Industry's Materials Initiative	David Modsen / hosted by DE, David Rudland	
Seminar #80	04/29/2010	Lessons Learned in Detecting, Monitoring, Modeling, and Remediating Radioactive Groundwater Contamination at Brookhaven National Laboratory; [Handout]	Dr. William Gunther, Dr. Mike Hauptmann, and Dr. Terry Sullivan / hosted by DRA Thomas Nicholson	
Seminar #79	04/15/2010	Human-Rating of Space Systems - [View Slides]	Mr. Bryan O'Connor , Chief, Office of Safety and Mission Assurance, NASA	No DVD available for this seminar
Seminar #78	03/26/2010	Browns Ferry Seminar	Jack Lewis & Felix Gonzalez, DRA Dr.	
Seminar #77	03/25/2010	Fundamentals of Structural Dynamics - [View Slides]	Dr. Abhinav Gupta	No DVD available for this seminar
Seminar #76	02/23/2010	Recent United States Geological Survey (USGS) Research on Seismic Hazards and Ground Motions in the Eastern U.S.	Dr. Paul Spudich, USGS colleagues & Jon Ake, DE	
Seminar #75	01/21/2010	Improving the State-of-the-Art in Severe Accident Analysis [View Slides]	Richard Lee	No DVD available for this seminar
Seminar #74	01/05/2010	State of the Practice of Seismic Hazard Analysis: From the Good to the Bad	Dr. Norman Abrahamson	
Seminar #73	12/10/2009	Experimental Basis for Modification of Cladding Embrittlement Criteria	Michelle Flanagan	
Seminar #72	11/30/2009	Pressurized Thermal Shock	Mark Kirk	
Seminar #71	10/26/2009	Health Effects as a Function of Dose Rate Delivered [View Slides]	Dr. Jacquelyn Yanch, MIT	No DVD available for this seminar
Seminar #70	09/11/2009	THE COLLAPSE OF WORLD TRADE CENTER 7- THE FORGOTTEN BUILDING OF 9/11	Dr. Therese McAllister , National Institute of Standards and Technology (NIST)	
Seminar #69	09/08/2009	Geophysical Surveys Supporting Analysis of Contaminant Transport through Fractures [View Slides]	Dr. John Williams, USGS [View Bio]	
Seminar #68	08/24/2009	Safety and Regulatory Perspectives on Protective Coatings for Nuclear Facilities [View Slides]	Bruce Lin, RES/DE/MEEB	
Seminar #67	07/21/2009	Performance of Engineered Covers for Waste Disposal with Implications for PA [View Slides]	Professor Craig Benson, University of Wisconsin [View Bio]	
Seminar #66	05/11/2009	The Spent Nuclear Fuel Burnup Credit Research	John Wagner, ORNL	
Seminar #65	05/07/2009	2009 William B. Joyner Memorial Lecture, entitled "Earthquakes, Seismic Hazard, and Performance-Based Design"	Dr. Robin McGuire	
Seminar #64	04/24/2009	Modeling Uranium Behavior during In-Situ Bioremediation	Steven Yabusaki, Pacific Northwest National Laboratory	No DVD available for this seminar
Seminar #63	04/22/2009	Screening Methods for Estimating Storm-Surge Levels and Severity	Dr. Donald Resio, US Army Corps of Engineers	
Seminar #62	03/25/2009	The Accident at Three Mile Island - 30th Anniversary A Look Back: Preserving the Institutional Memory March 25, 2009 [Details] - [Poster] - [View Presentations]	Brian Sheron, Edward Frederick, Harold Denton, Gary Holahan	Please Contact Amy Bonaccorso

Seminar #61	02/10/2009	Perspectives on HTGR Safety and Design Considerations [View Slides]	Dr. Kenneth Stroh (VP, Sentech Inc. and Retired Guest Scientist, LANL)	
Seminar #60	01/21/2009	Modeling of the Dynamics of the Nucleation and Growth of Cracks Initiated due to Stress in Materials	Dr. Appajosula Rao, Material Engineer, DE/CMB	

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