December 1, 2008

MEMORANDUM TO: Mark Salley, Branch Chief
Fire Research Branch
Division of Risk Analysis
Office of Nuclear Regulatory Research

FROM: Kendra Hill ***/RA/***
Fire Research Branch
Division of Risk Analysis
Office of Nuclear Regulatory Research

SUBJECT: SUBJECT: SUMMARY OF EPRI/NRC-RES FIRE PRA COURSE
SEPTEMBER 29 - OCTOBER 2 & NOVEMBER 17-20, 2008

The U.S. Nuclear Regulatory Commission (NRC) and the Electric Power Research Institute (EPRI) conducted a joint public meeting consisting of a fire PRA (Probabilistic Risk Assessment) course on September 29 - October 2 and November 17-20, 2008 at the Hyatt Regency in Bethesda, MD. The purpose of the course was to provide detailed, hands-on training on the fire PRA methodology described in the technical document, NUREG/CR-6850 (EPRI 1011989) entitled "EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities." The sessions conducted in September and November consisted of the same presentations and training materials. This fire PRA methodology document supports implementation of the risk-informed, performance-based rule 10CFR50.48(c) endorsing National Fire Protection Association (NFPA) Standard 805, as well as other applications such as exemptions or deviations to our current regulations and fire protection Significance Determination Process phase 3 applications.

RES and EPRI provided training in three subject areas: Fire Analysis, PRA/HRA (Human Reliability Assessment), and Electrical Analysis. Participants selected one of these subject areas and spent the duration of the course in the module that covered the subject area that they selected. This format allowed for in-depth presentations and practical examples directed toward the participant's area of interest. The approximately 170 participants in the two sessions included NRC employees from NRR, RES and the Regions, licensees and consultants, and representatives from outside the U.S.

Feedback from this year's course was positive with a high demand for future courses expressed. Future sessions of this workshop are currently being planned for 2009.

Enclosures:
1. Agenda
2. Attendance Lists
3. Course Slides

CONTACT: Kendra Hill, RES/DRA
301-251-3300

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Fire Research Branch
Division of Risk Analysis
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1. Agenda
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NAME	K.Hill	K.Hill	JS.Hyslop
DATE	12/01/08	12/01/08	12/01/08

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NRC-RES/EPRI FIRE PRA Course

NOVEMBER 17- 20, 2008
HYATT REGENCY BETHESDA
ONE BETHESDA METRO CENTER, BETHESDA, MD 20814

	INTRODUCTION		
Monday November 17th			
8:00 AM - 12:00 PM	Opening Remarks An Overview of the EPRI/NRC-RES Fire PRA Methodology and this Course Overview of Selected Other EPRI and NRC/RES Research Activities Related to Fire PRA		EPRI NRC-RES B. Najafi S. P. Nowlen
	MODULE 1: PRA/HRA **J. LaChance R. C. Anoba**	**MODULE 2: ELECTRICAL ANALYSIS** **D. L. Funk F. Wyant**	**MODULE 3: FIRE ANALYSIS** **F. Joglar M. Kazarians**
Monday November 17th			
1:00 PM - 5:00 PM	Building the fire-induced PRA model; Technical Tasks 2, 12a & interface with technical tasks 3/9. ✓ Technical presentation: Process & illustration ✓ Defining the sample problem	Cable Selection, Routing & Circuit Failure Mode Analysis; Technical Tasks 3, 9 & interface with technical task 2/5. ✓ Technical presentation: Process & illustration ✓ Defining the sample problem	Preliminary Fire Hazards Assessment; Technical Tasks 1, 6, 8 ✓ Technical presentation: Process & illustration ✓ Defining the sample problem ✓ Breakout/exercise ✓ Present/share results from sample problem and Q&A
Tuesday November 18th			
8:00 AM - 12:00 PM	CONTINUE FROM MONDAY PM		CONTINUE FROM MONDAY PM
1:00 PM - 5:00 PM	Building the fire-induced PRA model; Technical Task 5, and Screening, Tasks 4 & 7 ✓ Breakout/exercise ✓ Present/share results from sample problem and Q&A	Cable Selection, Routing & Circuit Failure Mode Analysis (Continue) ✓ Breakout/exercise ✓ Present/share results from example and Q&A	Fire Modeling, Single Compartment; Technical Task 11a ✓ Technical presentation: Process & illustration ✓ Defining the sample problem ✓ Breakout/exercise

Wednesday November 19th			
8:00 AM - 12:00 PM	CONTINUE FROM TUESDAY PM		CONTINUE FROM TUESDAY PM
1:00 PM - 5:00 PM	Fire Risk Quantification; Technical Tasks 12b, 14, 15, 16 ✓ Technical presentation: Process & illustration	Probabilistic Circuit Failure Mode Analysis; Technical Task 10 ✓ Technical presentation: Process & illustration	Fire Modeling, MCR and MCA; Technical Tasks 11b, 11c ✓ Breakout/exercise ✓ Present/share results from sample problem and Q&A Seismic Fire; Technical Task 13 ✓ Technical presentation: Process & illustration
Thursday November 20th			
8:00 AM - 12:00 PM	CONTINUE FROM WEDNESDAY PM	CONTINUE FROM WEDNESDAY PM	CONTINUE FROM WEDNESDAY PM
	CLOSURE		
1:00 PM - 4:00 PM	Integration & Lessons Learned		S. P. Nowlen B. Najafi
	Perspective / Closing Remarks		EPRI NRC-RES

R. P. Kassawara

Education: BSCE Polytechnic Institute of Brooklyn,
Ph.D. Civil Engineering, University of Illinois
Institution/Position: EPRI, Fire Protection Program Manager
Contact Information: 650-855-2775, rkassawa@epri.com

Summary: Dr. Kassawara is the Manager of Fire Protection Engineering at EPRI responsible for the technical, financial and administrative planning and management of EPRI's R&D for fire protection. He is responsible for EPRI's efforts in Risk Informed/ Performance Based Fire Protection, Fire Modeling, Fire Induced Circuit Failures, Fire Risk Re-quantification, and EPRI Fire Events Data Base. He was instrumental in the development of the Memorandum of Understanding on Fire Protection between EPRI and NRC Research that has enabled the two organizations to work jointly on a range of projects from circuit failure tests to fire risk re-quantification.

B. Najafi

Education: BS Electrical Engineering, (76), MS Nuclear Engineering University of Washington (79)
Institution/Position: SAIC / Manager, Fire Protection Section
Contact Information: 650-960-5944, bijan.najafi@saic.com

Summary: Mr. Najafi is the Manager of the EPRI Fire Technology Program at SAIC. He has been instrumental in development of methods, data and guidance for nuclear fire protection

community for nearly 15 years that has produced "Fire PRA Implementation Guide", "Fire Modeling Guide", and "Fire Barrier Penetration Seal Handbook." Mr. Najafi is the EPRI Technical Project Manager for the development of the EPRI/NRC Fire PRA Methodology (EPRI 10119189, NUREG/CR-6850) that forms the basis of this course and the joint EPRI and NRC-RES project, *Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications*, NUREG-1824, EPRI 1011999, May 2007. He is a member of the NFPA Technical Committee for Nuclear Facilities, SFPE Performance-Based Fire Protection Design and Risk Task Groups and ANS writing committee for the Fire PRA Standard.

F. Joglar-Billoch

Education: BS Industrial Eng., Univ. of Puerto Rico (97), MS Fire Protection Engineering (98) & Ph.D. Reliability Engineering (00), University of Md.
Institution, Position: SAIC, Fire & Risk Analyst
Contact Information: 703-318-4695, francisco.j.joglar-billoch@saic.com

Summary: Since joining SAIC, Dr. Joglar research has been focused on the use of fire modeling tools in nuclear power plant applications, including fire risk analysis. In the area of fire modeling, Dr. Joglar is the principal author of EPRI's, Fire Modeling Guide for Nuclear Power Plant Applications, and is an instructor of EPRI's seminars on fire modeling. In the area of fire risk, Dr. Joglar is member of the writing committees for both the EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities, and the ANS Fire PRA Standard. Dr. Joglar is also a consultant to commercial nuclear utilities in the area of fire modeling and fire risk analysis. He is the co-author of the Reliability Chapter of the SFPE Handbook. Dr. Joglar is a Licensed Professional Engineer.

D. Funk

Education: BS Electrical Engineering, (81)
Institution/Position: Edan Engineering, Principal Engineer
Contact Information: 360-750-4842, dfunk@edanengineering.com

Summary: Mr. Funk is a co-founder and principal engineer of Edan Engineering Corporation. He has 23 years of engineering, testing, and management experience. Mr. Funk has held positions as engineering manager, principal engineer, engineering supervisor, and project manager. He has extensive experience with fire protection requirements for electrical systems at nuclear power and industrial facilities. He has participated in development of numerous industry documents and guides relating to fire-induced circuit failures. Mr. Funk participated in all facets of the recent nuclear industry fire tests and is currently the electrical lead for an EPRI/NRC-RES collaborative project to develop state-of-the-art fire risk technology for risk-informed applications. Mr. Funk is a registered professional engineer in electrical and control systems.

R.C. Anoba

Education: BS Nuclear Engineering, UCSB (73), MS Nuclear Engineering, MIT (75)
Institution/Position: Anoba Consulting, LLC
Contact Information:

Summary: *Mr. Anoba is the EPRI Technical Area Lead for the PRA/Risk Analysis in the EPRI/US NRC Fire Risk Re-quantification Project.* Mr. Anoba is currently the President of Anoba Consulting Services. He has thirty years of experience in areas of engineering analysis, system reliability analysis, safety analysis, Probabilistic Risk Assessment (PRA), project management, design engineering, and power plant operation. He is a registered professional engineer in the states of California and North Carolina and a member of the American Society of Mechanical

Engineers (ASME). He has been employed by The Atomic Energy Commission, the Energy Research and Development Administration, the Department of Energy, Westinghouse Hanford Company, Pacific Gas and Electric Company, Martin Marietta Corporation, Brown and Root Incorporated, Bovay Engineers, Carolina Power & Light Company, Science Applications International Corporation, and Data Systems and Solutions. He is currently the president of Anoba Consulting Services and is an independent consultant providing PRA support services including model updates, model reviews against the ASME PRA Standard, and external event model development.

J.S. Hyslop

Education: Ph.D. Physics, Virginia Tech (90), M.S. Physics, Virginia Tech (82), B.S Physics, Washington and Lee University (79)
Institution/Position: U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research (RES) / Senior Reliability and Risk Engineer
Contact Information: 301-415-6354, jsh2@nrc.gov
Summary: For the last 3 years, Dr. Hyslop has been the lead for fire PRA under RES's fire research program. He plans the fire PRA regulatory program from both a financial and technical perspective, leads its implementation, and participates in the development and review of its products. Examples of recent accomplishments in which RES has participated are the revision of the fire protection Significance Determination Process, and the development of the technical basis for RIS 2004-03 on safe-shutdown circuit inspection items. Dr. Hyslop is currently the RES project manager for the Fire Risk Requantification Study, under which this methodology was developed, and a reviewer of the ANS fire PRA Standard. Prior to coming to RES, he was the fire PRA lead in NRR for the analysis of the significance of fire protection inspection findings. He also participated in several of the comprehensive Fire Protection Functional Inspections carried out by NRC.

S.P. Nowlen

Education: BS Mechanical Engineering (81); MS Mechanical Engineering (84), Michigan State University
Institution/Position: Sandia National Laboratories, Distinguished Member of Technical Staff, Risk and Reliability Analysis Dept.
Contact Information: 505-845-9850, spnowle@sandia.gov
Summary: Mr. Nowlen joined SNL in 1983. His early career focused on fire testing including, in particular, studies of the fire damageability of cables and other electrical components.
Mr. Nowlen became the technical and programmatic lead for the NRC-sponsored fire protection studies at SNL in 1987. His more recent work focuses on the fire risk analysis methods and applications. He was a member of the NRC Senior Review Board for IPEEE fire analyses; led efforts to develop the new Fire Protection SDP process; is a member of the core writing team for the ANS Fire PRA Standard; and is the NRC Technical Program Manager for the Fire Risk Requantification Study. He has also played a prominent role in recent efforts to resolve the cable failure modes and effects circuit analysis issues, and has published extensively in the field of NPP fire protection.

M. Kazarians

Education: Ph.D. Nuclear Engineering, UCLA
Institution/Position: Kazarians & Associates, Inc. / Principal
Contact Information: (818) 242-0401; Mardy.Kazarians@Kazarians.com
Summary: Dr. Mardy Kazarians was one of the first few PRA practitioners and methodology developers for internal fires and floods risk analysis for nuclear power plants. He has extensive experience in applying those methods and has participated in several major projects for the

Nuclear Regulatory Commission where he has reviewed IPEEEs, assessed risk significance of Appendix R (10CFR50) exemptions, studied risk related lessons of a number of major fire events at nuclear power plants, participated in phase 3 SDP evaluation projects. In addition to nuclear power plants, Dr. Kazarians has developed process safety and risk management plans for facilities handling highly hazardous chemicals and has managed several security vulnerability assessment projects for the water utilities and chemicals manufacturing facilities.

J.L. LaChance

Education: BS General Engineering, Idaho State University (75)
Institution/Position: Sandia National Laboratories, Principal Member of Technical Staff, Risk and Reliability Analysis Dept.
Contact Information: 505-844-9173, jllacha@sandia.gov
Summary: Mr. LaChance has 28 years of experience in performing PRA on a variety of facilities including nuclear reactors and fuel cycle facilities, weapons storage facilities, and chemical plants. In addition to performing PRAs (including fire assessments), he has developed innovative PRA methods, helped write an ASME standard on PRA, and supports the Nuclear Regulatory Commission (NRC) on developing PRA quality requirements. He has been involved in the development of risk-informed, performance-based regulations for nuclear reactors since the initiative began at the NRC in 1995. His fire PRA experience includes the Fire Risk Scoping Study, lead author on an NRC circuit analysis methodology report, and the IPEEE fire insights report. He also supported the NRC in the initiation of the tri-annual, risk-informed fire inspection program. He is currently working on expanding the NUREG/CR-6850 methodology to analyze fires during LPSD conditions.

F. Wyant

Education: BS Engineering Science (79), MS Nuclear Engineering (80), Iowa State University
Institution/Position: Sandia National Laboratories, SMTS, Risk & Reliability Analysis Dept.
Contact Information: 505-844-5682, fjwyant@sandia.gov
Summary: Mr. Wyant is an active participant in the US NRC Fire Risk Research Programs. He is the principal investigator for the Hemyc and M.T. Fire Barrier Performance Test Program. Mr. Wyant is also a key member of the Significance Determination Process, Phase-3 Analysis Team for the NRC Office of Reactor Regulation. In recent years, he has participated in a number of triennial fire-protection inspections along with NRC Region inspection staff.
Mr. Wyant is the co-technical area lead for circuit analysis tasks in the EPRI/NRC-RES Fire Risk Re-quantification Project.

EPRI/NRC-RES Fire PRA Workshop 2008

November 17-20, 2008

Attendees

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NRC-RES/EPRI Fire PRA Workshop 2008

September 29 - Oct 2

Attendees

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