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The SNL/NRC Fire Protection Research Programs

Presented to: GDF Suez Group

Presented by: Steve Nowlen

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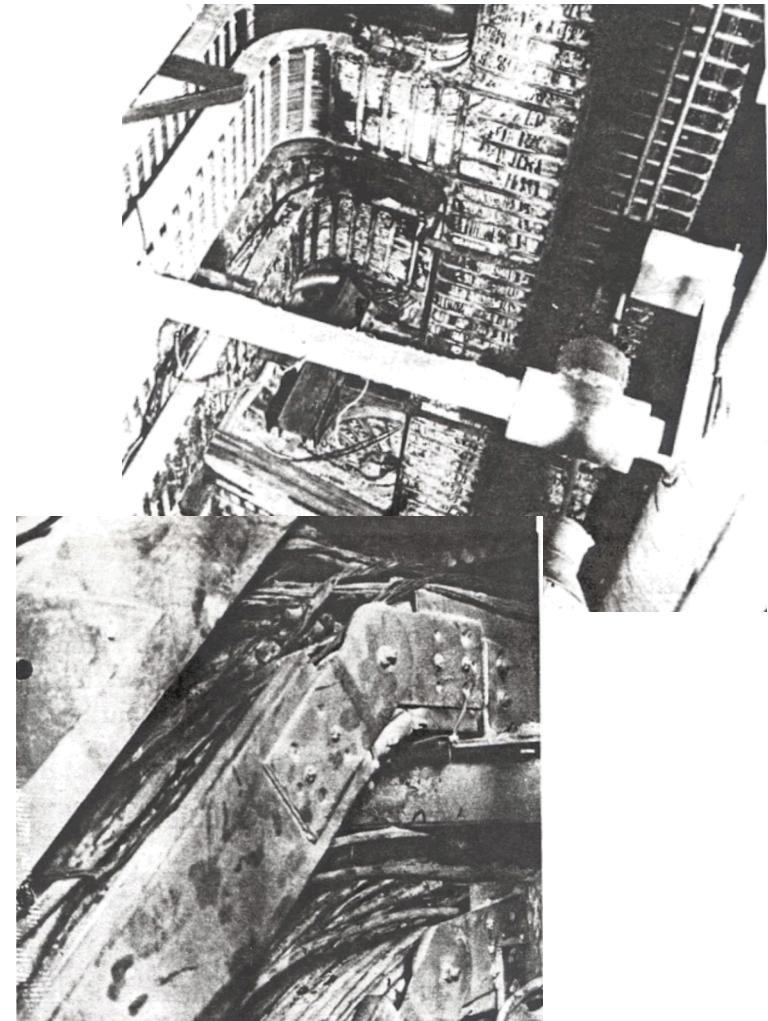
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Presentation Content

- Brief historical overview of Sandia's role in the U.S. Nuclear Regulatory Commissions fire protection research programs
- Overview of current activities
- Potential issues for the future

Fire Protection during the early years of nuclear power

- February 1975: AEC (later NRC) fire protection research program established at Sandia
- March 22, 1975: Browns Ferry cable spreading room fire
- Fire protection under the microscope for the next five years
 - NPP specific rules are needed and developed
 - 10CFR50.49 Appendix R issued late 1979



The 1980's

- NRC focus: implement the new fire protection rule
 - Roughly 3000 requests for exemptions to portions of the rule are submitted by licensees
- Research program continues, but shifts towards broader fire science and fire risk issues
 - Fire probabilistic risk assessment (PRA) methods
 - Early work mainly at UCLA
 - SNL role: fire science in support of PRA and other analysis methods
 - Characterization of fire sources
 - Reviews of operating experience
 - Fire suppression effectiveness
 - Fire modeling and model validation
 - More PRA work as decade progresses

The 1990's

- Risk analysis is king... PRA methods and applications drive the research programs
- 1990-96: Budgets in decline but support programs continue
 - The fire aging research program
 - The Fire Risk Scoping Study (NUREG/CR-5088)
 - GI-57 Resolution - spurious actuation of fire suppression systems
- 1996-2001: Resolution of Thermo-Lag fire barrier controversy
 - Brought compliance strategy into question for many plants
- 1995-2001: Individual Plant Examination External Events (IPEEE) studies conducted and reviewed
 - Fire is an important contributor for most plants

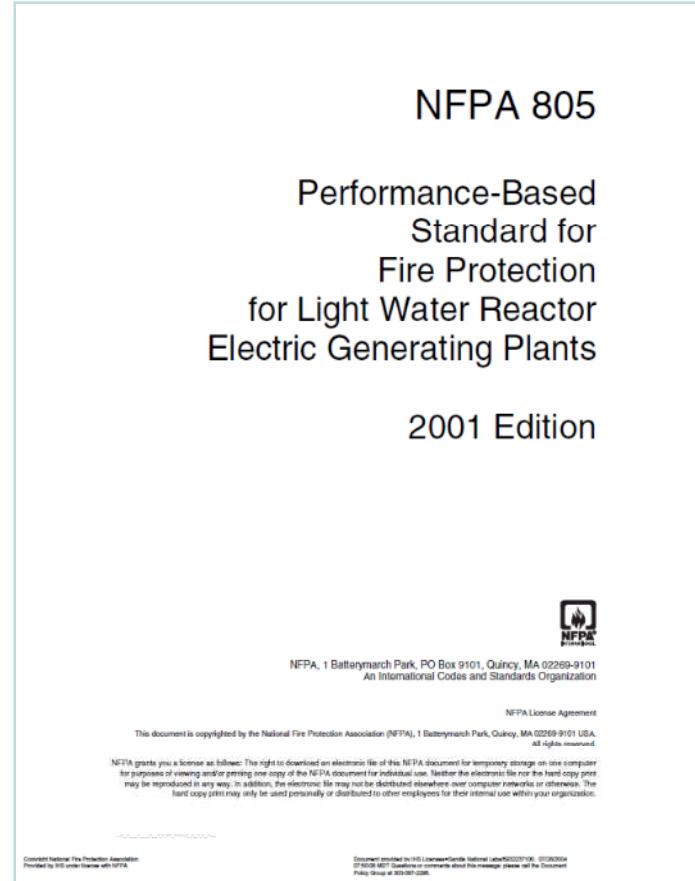
2000-present

- Going into 2000, interest in fire protection is resurgent
- Concept of risk-informed regulation takes firm hold at NRC
- Fire is first *major* area of regulation to successfully establish a risk-informed framework acceptable to both NRC and industry:
 - NFPA 805 10CFR50.48.C
- Transition process highlights need for:
 - Fire PRA methods improvements and consolidation
 - Implementation guidance
 - Verification and validation of fire modeling tools
 - Resolution of circuit analysis issues (spurious actuations)
 - Deal with operator manual actions as compliance strategy
- Sandia continues to be involved in all of the areas

Current programs and activities: Implementation of NFPA-805

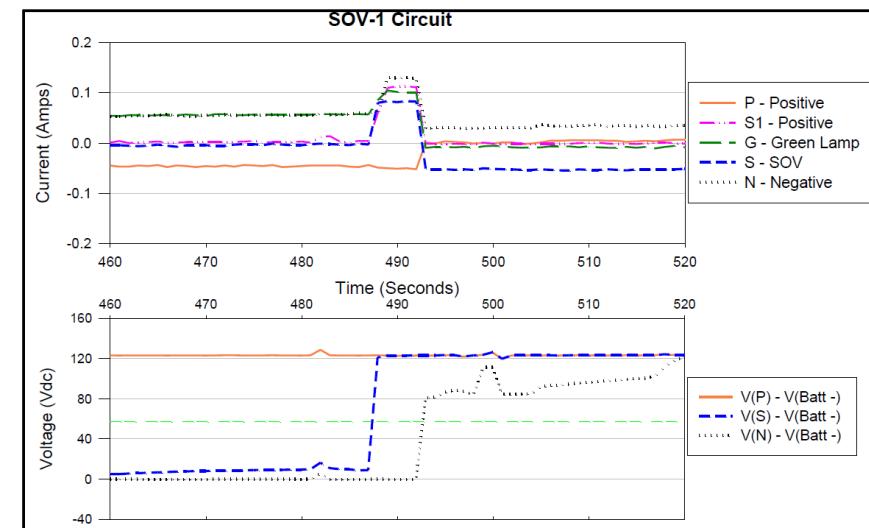
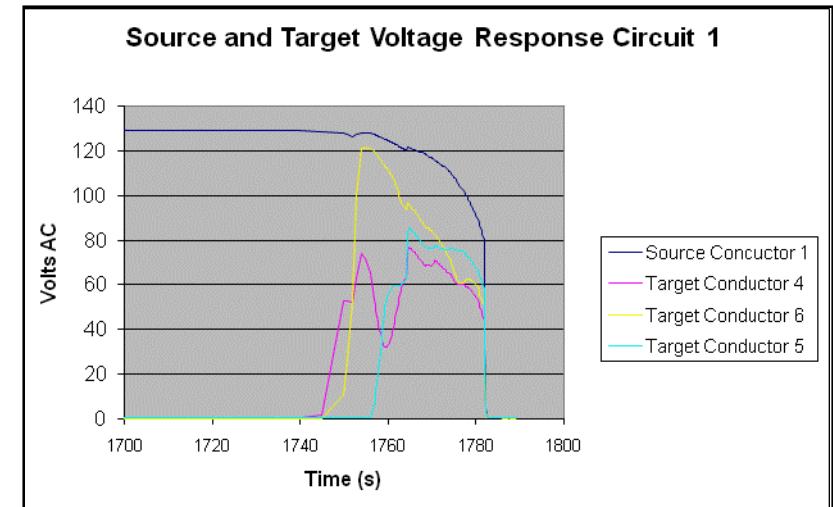


- Roughly ½ of US units are making transition
 - All are doing Fire PRAs and it is not easy
- Sandia is supporting:
 - Regulatory implementation
 - Inspection procedures
 - Inspector training
 - Inspection support
 - ASTM/ANS JCNRM PRA quality standard
- Risk methods development continues

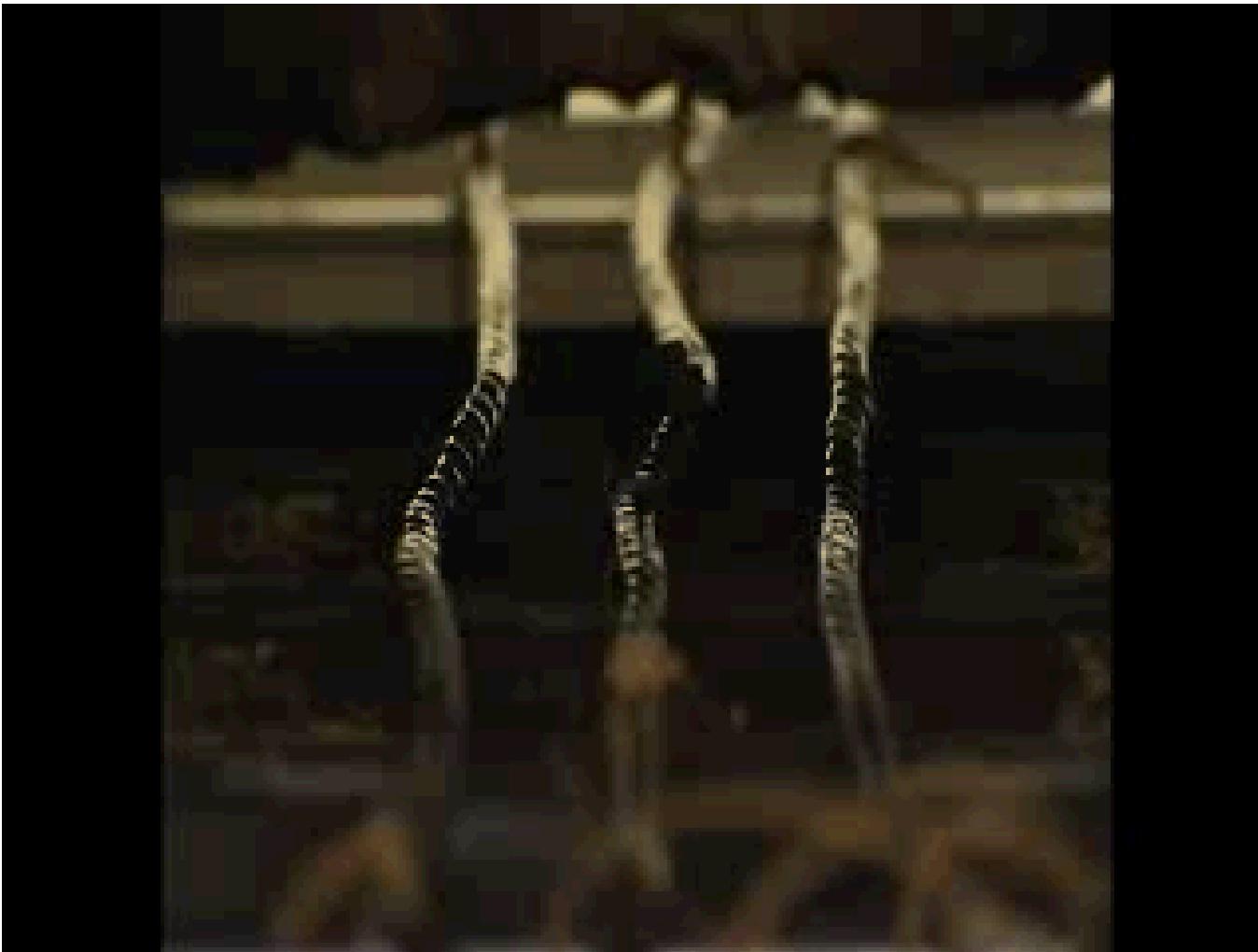


Cable Failures and Spurious Operation Analysis an Ongoing Challenge

- dc circuit testing is complete
- Phenomena Identification and Ranking Table (PIRT) exercise complete
 - All available ac & dc data have been re-analyzed
- Expert panel on circuit analysis for PRA underway
 - Will generate new spurious operation probability values
 - Also looking at duration question
- PRA methods and insights based on industry applications



Cable Fire Experimental Video



Other areas of Fire PRA methods development

- Fire event database update
 - Collaboration with EPRI
- Cabinet fire heat release rates and burnout
- Main control room fire analysis
- Oil fires
- Fire suppression
- Diesel generator fires
- Low power shutdown fire risk
- Fire PRA training
- NRC/EPRI panel to review new methods
- Human Reliability Analysis



Current testing programs: Cable fire retardant coatings

- Discovery experiments are complete
 - Simple tests to assess impact of coatings on heating rates and damage times
- Initial Test report being drafted now
 - Anticipate publication by end of September
- Future tests being planned to assessment of aging behaviors
 - Currently in early planning stages for aging tests
 - Challenging topic...



Current Testing Programs: High Energy Arc Faults

- Preliminary efforts completed in 2009
 - Literature and event reviews
- NRC/OECD and NRC/EPRI collaborations have been established
 - NRC is seeking equipment contributions for use in testing
- SNL has developed a preliminary test plan
 - Will be finalized when we know what equipment will be tested
- Exploring options for arc fault generation
- Anticipate start of testing by late 2012, continuing through FY2013

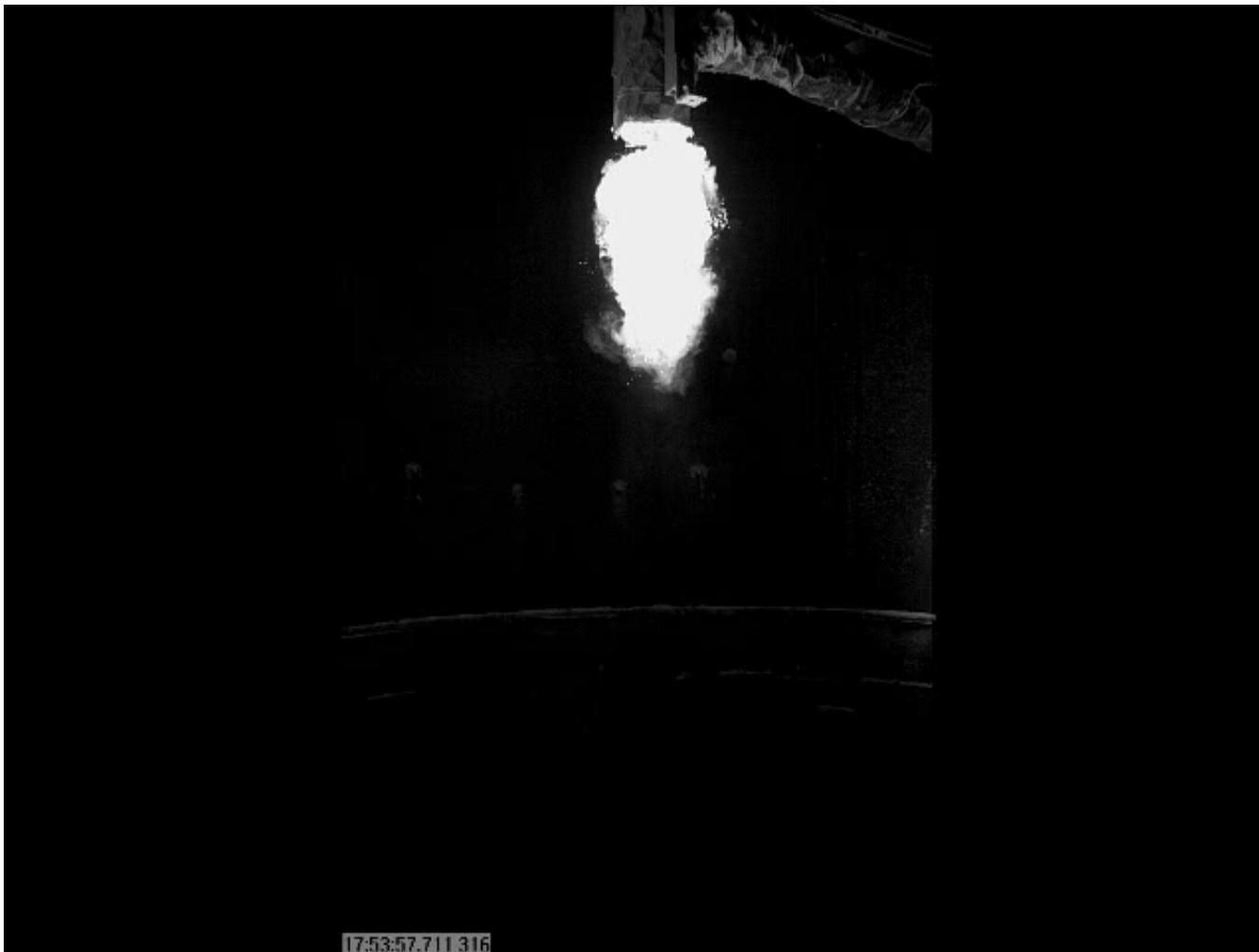


Issues looking forward: Sodium Fire Research for Advanced Reactors

- Significance of the fire hazard:
 - Highly reactive and energetic materials
 - Critical components vulnerable to thermal damage
 - Nuclear materials can be dispersed through vaporization, boiling of other components and through particle entrainment
- Sodium Fire Research Program(2007-2010)
 - Reactor design and safety assessments
 - Discovery experiments (sodium pool and spray fires)
 - Development of analytical tools
- To bring modern analysis methods (experimental and computational) to bear on metal fire problem for advanced fast reactor applications
- To develop the expertise and capability need to identify, investigate, and assess key metal fire issues



Sodium Spray Fire Video



Summary

- Sandia's involvement in NPP fire protection began in 1975 and the program continues today
- Currently enjoying strong NRC support for resolution of fire protection issues
- More and more areas of collaboration with EPRI and industry
- NFPA-805 risk-informed performance based fire protection is a major focus of attention
 - Highlights the need for strong PRA methods, tools and data
- Even units not transitioning to 805 are using risk-informed approaches in some areas
 - Circuits and Operator Manual Actions in particular
- The need for fire PRA expertise has never been greater