NRC Perspectives on NUREG/CR-6850 and RG 1.200

NEI Fire Protection Forum

Donnie Harrison
Chief, PRA Licensing Branch
Division of Risk Assessment
Office of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission

Fire PRA Initial History

WASH-1400

- Study started in 1972
- Purpose/Objective:
  - Realistic estimate of the public risks from potential accidents in commercial nuclear power plants
  - Compare nuclear plant risks to other non-nuclear risks
- Results showed risk to public are comparatively small
- Revealed actual risk significant areas and interactions that were very different from the design basis events
- Treated fires qualitatively – fires not considered a significant risk contributor

New Perspectives

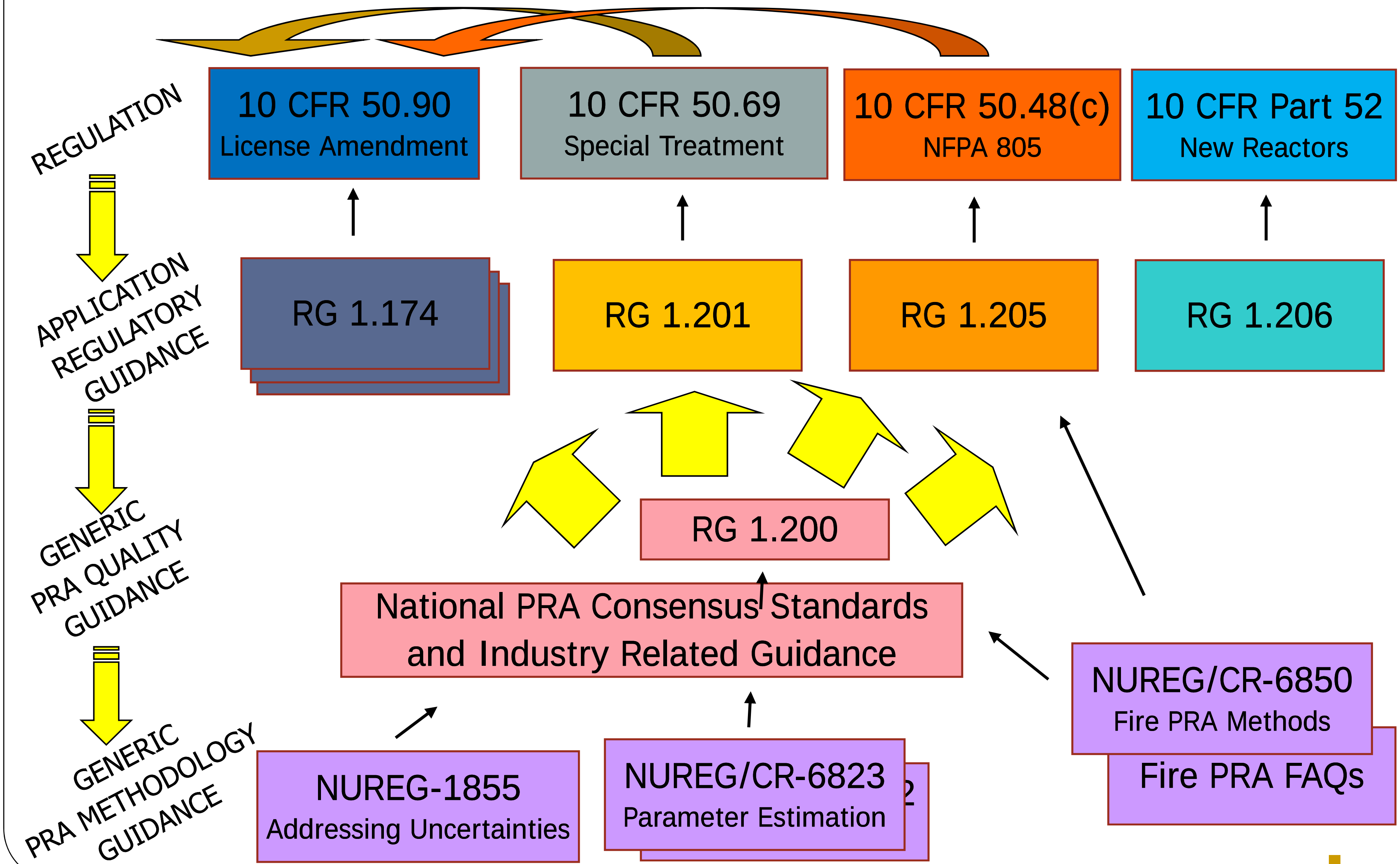
Then came

- Browns Ferry Fire
- Three Mile Island, Unit 2

PRA Methodology Guidance versus PRA Standards

- PRA Methodology Guidance describe **how** to develop or perform the elements of a PRA
  - Data Handbook
  - HRA Good Practices
  - Fire PRA Methods (e.g., NUREG/CR-6850/EPRI TR 1011989)
  - Uncertainty Guidance
- PRA Standard addresses the **technical adequacy** of the elements of a PRA
  - Regulatory Guide (RG) 1.200 endorses, with exceptions and clarifications, the ASME/ANS PRA Standards and associated industry peer review guidance

PRA Infrastructure



Fire PRA Methodology Guidance History

- PRA Procedures Guide (Chapter 10 and Section 11.2)
  - Published January 1983
- EPRI FIVE Methodology
  - Published 1992
  - Vulnerability evaluation methodology developed in response to IPEEE program
- EPRI Fire PRA Implementation Guide
  - Published 1995
  - Developed as a complement to FIVE for detailed evaluation of unscreened fire areas/compartments
  - More robust methods (compared to FIVE) for:
    - Development and evaluation of fire risk model, including human actions
    - Assessment of fire growth and damage, detection, and suppression
    - Control room and multi-compartment fire risk

Current Fire PRA Methodology Guidance

- Fire PRA Methodology for Nuclear Power Facilities (NUREG/CR-6850/EPRI TR 1011989)
  - Published September 2005
- Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications (NUREG-1824/EPRI TR 1011999)
  - Published May 2007
- Fire Human Reliability Analysis Guidelines (NUREG-1921/EPRI TR 1019196)
  - Draft Report for Public Comment
  - September 2009
- Nuclear Power Plant Fire Modeling Application Guide (NUREG-1934)
  - Draft Report for Public Comment
  - January 2010
- Numerous Fire PRA Frequently Asked Questions (FAQs)

NUREG/CR-6850 / EPRI TR 1011989

- Methodology presented in the form of technical task procedures within an overall process
- Process intended as a guide and should fit most cases
- User may adjust process based on plant-specific information, efficiency, economy, and applications

PRA Standards - Objective

- Establishes the technical requirements of a base PRA
- Establishes a process for determining the needed scope, level of detail, plant specificity, and realism of base PRA for a specific application
- Establishes the requirements for a PRA configuration control process to ensure that the base PRA represents the as-built/as-operated plant
- Establishes the requirements for a peer review

Regulatory Guide 1.200, Revision 2 Implementation

March 2009

- Staff issued Revision 2 of RG 1.200, *An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities*
  - Provides NRC endorsement, with qualifications and modifications, of ASME/ANS RA-Sa-2009, *Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications*.
  - Licensees can use RG to demonstrate the technical adequacy of a PRA used in a risk-informed licensing action

- Regulatory Guide 1.200, Revision 2
  - Issued March 2009
  - Effective implementation date April 2010

Plenary 4, Session 1
Fire Protection Staff Overview

2010 NEI Fire Protection Information Forum

Alexander Klein, P.E. Chief,
Fire Protection Branch
Division of Risk Assessment
Office of Nuclear Reactor Regulation

Topics

- Past
- Present
- Future

Past

- Remember the lessons learned
  - WHY
  - WHAT
  - HOW

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Present

- Remember the lessons learned but forward focus on safety, compliance and what is important
- Two regulatory pathways
  - Deterministic [10 CFR 50.48(b) or licensing basis]
  - Risk-informed, performance-based [10 CFR 50.48(c)]

Present

- Established guidance for each of the two regulatory pathways:
  – Regulatory Guide 1.189 (Rev. 2)
  – Regulatory Guide 1.205 (Rev. 1)
  – Other (e.g., NUREGs; SRP; templates, etc)

- Licensees can implement the guidance today

Present

- Major topics
  - Post-fire operator manual actions
  - Fire-induced circuit failures
  - Risk-informed, performance-based tools
- There will always be opportunities for continuous improvement
  - Data
  - Methods
  - Model

Present to the Future

- Is there a paradigm shift today or did it already happen?
  - 1970's: fire protection guidance
  - 1980's: Appendix R
  - 1990's: IPEEE
  - 2000's: risk-informed ROP
  - 2010's: risk-informed decision making

Future

- All important fire protection issues have been dispositioned

- Normal, routine process have been established for maintaining and inspecting fire protection programs

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Plenary 4, Session 6
Fire Protection Closure Plan

2010 NEI Fire Protection Information Forum

Daniel Frumkin, Fire Protection Team Leader US NRC

Purpose

- To provide background on the NRC Fire Protection Steering Committee and status of closure plan items

Topics

1. Fire Protection Steering Committee
2. Completed Closure Plan Items
3. Active Closure Plan Items
   - Task 1 - NFPA 805
   - Tasks 3 and 4 - Circuits and Operator Manual Actions
   - Task 6 - Fire Protection Lessons Learned Report
4. Conclusion

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

1. Fire Protection Steering Committee

- The Charter of the FPSC
  - ADAMS ML072640666
- Staffed by NRC executives, meets periodically with industry stakeholders
- The FPSC meets and discusses the status of the fire protection closure plan
- The current fire protection closure plan or fire protection stabilization plan is in Commission paper SECY 10-0060, dated May 14, 2010

2. Completed Closure Plan items (1)

- Task 2 – Closeout of Hemyc and MT Fire Barrier Issues
  - In addition to closing out this item, the NRC Office of Nuclear Regulatory Research has published a NUREG series document on fire barriers – NUREG-1924
- Task 5 – Assess Regulatory Effectiveness
  - The NRC/RES has taken over this activity. Staff plans to continue to track the three metrics: fires, findings and long-term compensatory measures
  - The latest report is in ADAMS as ML092580647
  - RES is working with EPRI regarding long-term compensatory measure information under their memorandum of understanding

2. Completed Closure Plan items (2)

- Task 7 - Exemption Database
  - A database of exemptions for pre-1979 licensees has been developed – ADAMS ML100200007
  - All documents in the database are available in the main ADAMS library
- Task 8 – Reasonable Assurance that Fire Protection Instabilities Have Been Identified
  - A report is in ADAMS with the current status - ADAMS ML101530627

3. Open Closure Plan items (1)

- Task 1 - NFPA 805
  - Harris safety evaluation issued June 28, 2010
  - Oconee safety evaluation is the last remaining item for this Task 1

3. Open Closure Plan Items (2)

- Tasks 3 and 4 – Circuits and Operator manual actions
  - Completed inspection portion of Temporary Instruction 2515-0181, at Vogtle and Millstone
  - Preliminary results, guidance is sufficient to conclude that the regulatory infrastructure is stabilized
  - Although more work will continue on these topics, Tasks 3 and 4 will likely be closed based on the results of the temporary instructions

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

3. Open Closure Plan Items (3)

- Task 6 - Fire Protection Lessons Learned Report
  - The report is under development

United States Nuclear Regulatory Commission
Protecting People and the Environment

4. Conclusion

- The closure plan has focused the staff on stabilizing fire protection issues. The plan has been successful
- The NRC staff will soon recommend ending the NRC Fire Protection Steering Committee
- Questions

Plenary 5, Session 8
MSO - Regulatory Insight and Perspectives

2010 NEI Fire Protection Information Forum

Harold Barrett, P.E., Senior Fire Protection Engineer
Daniel Frumkin, Fire Protection Team Leader
US NRC

Purpose

- To provide background on the status of agency activities in the area of multiple spurious operations

Topics

1. RG 1.189 and NEI 00-01
2. Enforcement Discretion
3. Temporary Instruction 2515-0181
4. Path Forward

1. Revision 2 of RG 1.189 and NEI 00-01 (1)

- NEI released Revision 2 of NEI 00-01, “Guidance for Post-Fire Safe Shutdown Circuit Analysis,” in June 5, 2009
- NRC issued Revision 2 of Regulatory Guide 1.189, “Fire Protection for Nuclear Power Plants,” see Federal Register Notice dated November 2, 2009
  - RG 1.189, Revision 2, endorsed portions of Revision 2 of NEI 00-01

1. Revision 2 of RG 1.189 and NEI 00-01 (2)

- NEI has reported that Revision 3 to NEI 00-01 will include clarifications
  - NRC staff is interested if those clarifications are needed for licensee analysis of multiple spurious actuation scenarios
  - NEI staff has said they will get back to NRC staff

2. Enforcement Discretion (1)

- Enforcement Guidance Memorandum (EGM) 98-002, “Disposition of Violations of Appendix R, Sections III.G and III.L Regarding Circuit Failures,” has been superseded
- EGM 07-004, “Enforcement Discretion For Post-Fire Manual Actions Used as Compensatory Measures for Fire Induced Circuit Failures,” superseded EGM 98-002 for operator manual actions and single spurious actuations
  - Expired March 6, 2009
  - Licensing actions were submitted for manual actions relating to single spurious actuations

2. Enforcement Discretion (2)

- EGM 09-002, "Enforcement Discretion for Fire Induced Circuit Faults," superseded EGM 98-002 for multiple spurious actuations
  - Licensees had until May 2, 2010 to identify noncompliances, implement compensatory measures and enter those noncompliances into their corrective action program
- During recent public meetings licensees described the use of "enhanced operator rounds," as compensatory measures for multiple spurious actuation circuit faults
  - NEI staff indicated they will provide NRC staff more information on "enhanced operator rounds"

3. Temporary Instruction 2515-0181

- Temporary Instruction (TI) 2515-0181, “Validate the Effectiveness of the Regulatory Infrastructure Related to Fire-Induced Circuit Failures and Operator Manual Actions”
- Performed at Vogtle and Millstone
- Preliminary results indicate that the infrastructure is stable for licensee to find and fix circuit related noncompliances
- Results will be published in Vogtle and Millstone triennial reports

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

4. Path Forward

- NRC is waiting to see NEI 00-01, Revision 3
- NRC is interested if changes to NEI 00-01, Revision 3 involve:
  - Clarifications for consistency or
  - Document changes that will require NRC endorsement
- This document was discussed at the August 23, 2010, NRC Fire Protection Steering Committee meeting, NEI took an action to resolve the question above

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

NEI Fire Protection Information Forum – Plenary Six: Fire Protection Research and Development

Moderator: Mark Henry Salley P.E., NRC

September 12 - 16, 2010

Laguna Cliffs Marriott

Dana Point California

Office of Nuclear Regulatory Research

Fire Research Branch

Overview of Today's Presentations

- Provide High-Level Overview of Plenary 6 "Fire Protection Research & Development"
- NRC's Research Partners
  - Electric Power Research Institute (EPRI)
    - Memorandum of Understanding (MOU)
  - National Institute of Standards and Technology (NIST)
  - Sandia National Laboratories (SNL)
  - Brookhaven National Laboratories (BNL)
- Public Involvement
  - Stakeholders Review & Comments

Overview of Today's Presentations (2)

- Session 1: NRC – RES and EPRI Programs
  - Mark Henry Salley, NRC/RES
  - Ken Canavan, EPRI
- Session 2: DC Circuit Testing (DESIREE-FIRE)
  - Gabriel Taylor, NRC/RES
  - Harold Barrett, NRC/NRR
  - Dan Funk, Edan Engineering (EPRI)
- Session 3: Fire Modeling Activities
  - David Stroup, NRC/RES
  - Francisco Jouglar , SAIC (EPRI)
- Session 4: Cable Tray Fire Testing (CHRISTI-FIRE)
  - David Stroup, NRC/RES
  - Kevin McGrattan, NIST (NRC)

Overview of Today's Presentations (3)

- Session 5: NRC – RES and EPRI Training Programs
  - Mark Henry Salley, NRC/RES
  - Ken Canavan, EPRI
- Session 6: Fire Events Data Base Project
  - Ken Canavan, EPRI
- Session 7: Revising NUREG/CR-6850 (ERRI 1011989) Fire PRA Methodology
  - Mark Henry Salley, NRC/RES
- Session 8: Fire Research Forum Feedback and Discussion
  - Thomas Gorman , PPL

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

NRC Fire Research Overview: Current and Future Research Projects

Mark Henry Salley P.E., Branch Chief

September 12 - 16, 2010

Laguna Cliffs Marriott

Dana Point California

Office of Nuclear Regulatory Research

Fire Research Branch

Overview of RES Activities

- Provide a High-Level Overview of NRC RES Fire Research Activities
- Separate Presentations on NRC's Major Projects
  - DC Circuit Testing and Follow-up Activities
  - Fire Modeling
  - Cable Tray Fire Testing
  - Training Programs
  - Revising Fire PRA Methodology

Goals of NRC RES Activities

- Respond to NRC's User Office Needs
- Continue to Advance the Science and Understanding
  - Improve the State-of-the-Art
  - Expand the Knowledge Base
- Reduce Uncertainty
  - Continue to refine/improve
    - Methods
    - Data

Fire Research Knowledge Management

– NUREG/BR-0361 Browns Ferry Fire
  - Issued February 2009
  - Plan Revision in 2011
– NUREG/BR-0364 NRC History of Fire Research Activities
  - Issued June 2009
– NUREG/BR-0465 Fire Protection and Research Knowledge Management Digest
  - Issued January 2010

Other Planned Near-Term NRC Fire Research 2011-2012

- Updating Fire Events Data Base
  - EPRI currently collecting the data
- Incipient Detection Systems
- Low Power Shutdown Fire PRA
- Electrical Cabinet HRR
- Smoke Damage to Electrical Circuits/Components
  - Digital Instrument and Control
- Effectiveness of Gaseous Fire Extinguishing Agents
- Compensatory Measures
- High Energy Arcing Faults
  - International Proposal
  - Request Industry participation through EPRI

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

NRC and EPRI Fire Protection Training Programs

Mark Henry Salley P.E., NRC

Ken Canavan EPRI

September 12 - 16, 2010

Laguna Cliffs Marriott

Dana Point, California

Office of Nuclear Regulatory Research

Fire Research Branch

Overview of NRC RES & EPRI Training Activities

- Providing Specialized Training is essential to successful implementation of the methodologies
- Two Major Areas of Focus
  - Fire PRA NUREG/CR-6850 (EPRI 1011989)
  - Fire Modeling

Fire PRA Methodology Training

- NUREG/CR-6850 EPRI 1011989
- Joint Training between NRC-RES & EPRI
- NRC hosting this year in Rockville MD.
  - Week 1 September 27 to October 1
  - Week 2 October 25 to 29
- Information/Registration
  - http://www.nrc.gov/public-involve/conference-symposia/epri-fire-pra-course/epri-fire-pra-course-info.html
- Next year EPRI will host

Fire PRA Methodology Training (2)

- Four Separate Modules
  - Fire PRA
  - Electrical Analysis
  - Fire Analysis
  - Fire HRA (NEW)
- Includes Latest FAQs
- First day Introduction
  - Last time we will be doing Introduction

Fire PRA Methodology Training (3)

New "Self Study" tool:

– Methods for Applying Risk Analysis to Fire Scenarios (MARIAFIRES-2008)

NUREG/CP-0194 (EPRI 1020621)

Published July 2010

Based upon the 2008 Training Sessions

Planning to do MARIAFIRES-2010

Fire Modeling

- NUREG-1805 “Fire Dynamic Tools”
  - Initial Issue: December 2004
- EPRI Annual Fire Model Training
  - Program ran 10+ years
- How do we move forward and provide the needed Fire Modeling Training?
  - Licensee
  - Regulator

Fire Modeling (2)

- Fire Modeling has Advanced
  - NUREG-1824 (EPRI-1011999) Verification and Validation (V&V)
    - Initial Issue: May 2007
    - Future Expansion
  - NUREG/CR-6978 Fire Modeling PIRT
    - Initial Issue: November 2008
    - Guide Future Fire Modeling Improvements
- NUREG-1934 EPRI-1019195 Fire Modeling Application Guide
  - Next Draft for Comment December 2010
  - Serve as the "Text Book" for NPP applications

Fire Modeling (3)

- NRC & EPRI would like Stakeholder Feedback
  - What type of Training do you need?
  - How often should it be held?
  - Not meant to replace Introductory College Level Classes or Professional Society (e.g. SFPE) Introductory Fire Modeling classes

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Revising NUREG/CR-6850 (EPRI 1011989) Fire PRA Methodology

Mark Henry Salley P.E., Branch Chief

September 12 - 16, 2010

Laguna Cliffs Marriott

Dana Point California

Office of Nuclear Regulatory Research

Fire Research Branch

Current Fire PRA Methodology

- NUREG/CR-6850 EPRI 1011989
- State-of-the-Art Fire PRA
  - Initial Issue: September 2005
- Supports:
  - Fire Re-quantification (SDP)
  - NFPA 805 Transition
- Supported with Joint NRC/EPRI Annual Training
- Frequently Asked Questions (FAQ)
- Experience gained through Use of the Methodology

Examine Fire PRA Methodology

- 18 Specific Chapters (Tasks) + Glossary
- 23 Appendix (A – W)
  - State-of-the-Art does not advance uniformly
- The State-of-the-Art is > 5 years old
- NRC worked closely with EPRI under MOU and stakeholders to write Supplement 1

The Big Question:

- What is the best way to revise/update the Methodology?
- Option 1: Complete Document Revision
  - Pros:
    - It would be nice and clean when done
  - Cons:
    - Size and Scope of the Methodology
    - Non-Uniform advancement of State-of-the Art
    - Time (in Years) and Resources (in Millions $) to do the work
      - When has the "average" State-of-the-Art advanced enough to start the project?
      - Parts would be outdated when publication is complete

The Big Question Option 2

- Option 2: NRC Proposal "Modular Update"
  - Revise and Issue Chapters/Appendix as the Research advances State-of-the-Art
- Pros:
  - Project is manageable
    - Ancient Proverb, "How do you eat an Elephant?"
  - Make State-of-the-Art Information available as soon as practical
  - Focus on most needed information
- Cons:
  - Not as clean as a Full Revision
    - However, it will be easy to do the Full Revision once the individual parts have been updated

NRC Modular Update Examples

- Two Examples:
  - Chapter 9 “Circuit Failure Analysis”
    - NRC DESIREE-FIRE Program
      - Electrical PIRT
      - PRA Failure Probabilities
  - Appendix R “ Cable Fires”
    - NRC CHRISTI-FIRE Program

The Big Question Option 3

- Option 3: The "Do Nothing Option"

- Pros:
  - Easiest workload for RES and EPRI
- Cons:
  - State-of-the-Art becomes Fixed and Maturity of the Methodology slows/stops
  - Standardization, Uniformity, Predictability become hindered if people "go their own way"

The Big Question Option 4

- Option 4: Other Suggestions
- NRC and EPRI are open to suggestions:
  - What will work best for:
    - Industry
    - Regulator (NRR + Regions)
  - Must Satisfy Both
- Please contact RES and EPRI if you have a better suggestion

Keep in Mind the Goal of Fire PRA Activities

- Continue to work together to Advance the Science and Understanding
  - Improve the State-of-the-Art
  - Expand the Knowledge Base
- Continue to Reduce Uncertainty
  - Close to Reality as possible
  - Continue to refine/improve
    - Methods
    - Data
- Integrated with other Research Programs
  - Examples:
    - DESIREE-FIRE
    - CHRISTI-FIRE

Cable Heat Release, Ignition, and Spread in Tray Installations during Fire (CHRISTIFIRE) Phase I

Kevin McGrattan, Andrew Lock, Nathan Marsh, Marc Nyden
National Institute of Standards and Technology
Gaithersburg, Maryland, USA

David Stroup and Jason Dreisbach
U.S. Nuclear Regulatory Commission
Washington, D.C., USA

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

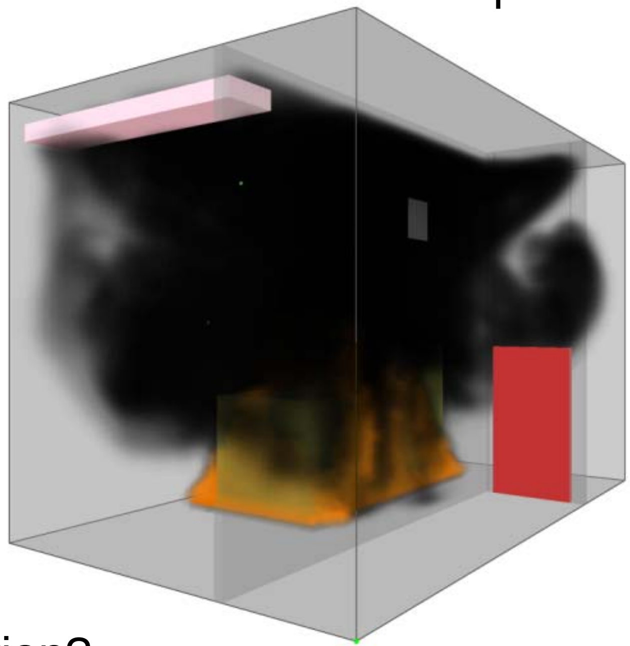
NIST
National Institute of Standards and Technology
U.S. Department of Commerce

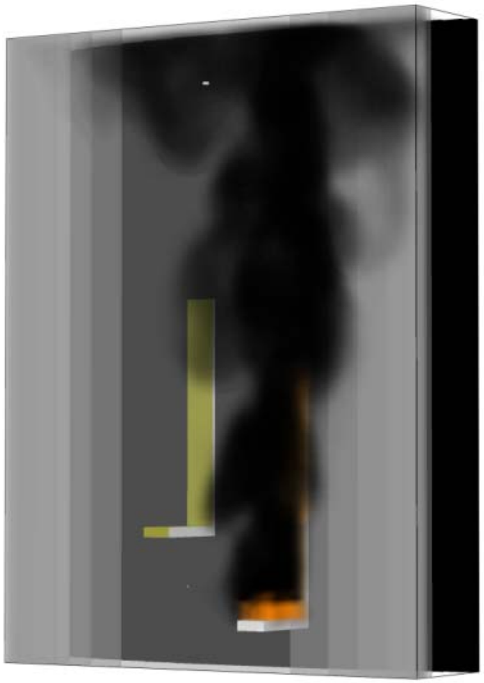
What’s the Problem?

Answer: Very little useful information on cables for fire modeling

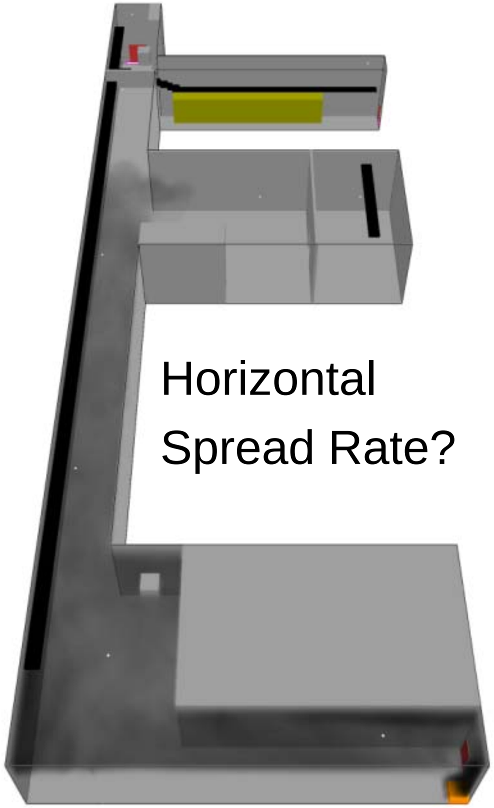
Tray to Tray Spread?

Effectiveness of Wraps?



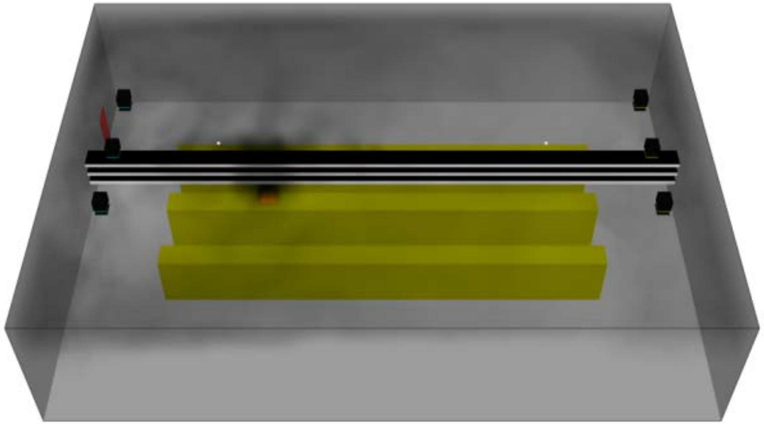


Vertical Spread Rate?



Horizontal Spread Rate?

Ignition?



Current Guidance for Modeling Cables

EPRI 1011989

NUREG/CR-6850
Final Report

EPRI/NRC-RES
Fire PRA Methodology for Nuclear Power Facilities
Volume 2: Detailed Methodology

Electric Power Research Institute
3420 Hillview Avenue
Palo Alto, CA 94303

U.S. Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
Washington, DC 20555-0001

EPRI ELECTRIC POWER RESEARCH INSTITUTE

UNITED STATES NUCLEAR REGULATORY COMMISSION

Problems going from "bench" to full-scale

Table R-1
Bench Scale HRR Values Under a Heat Flux of 60 kW/m^2, q_{bs} [R-4]

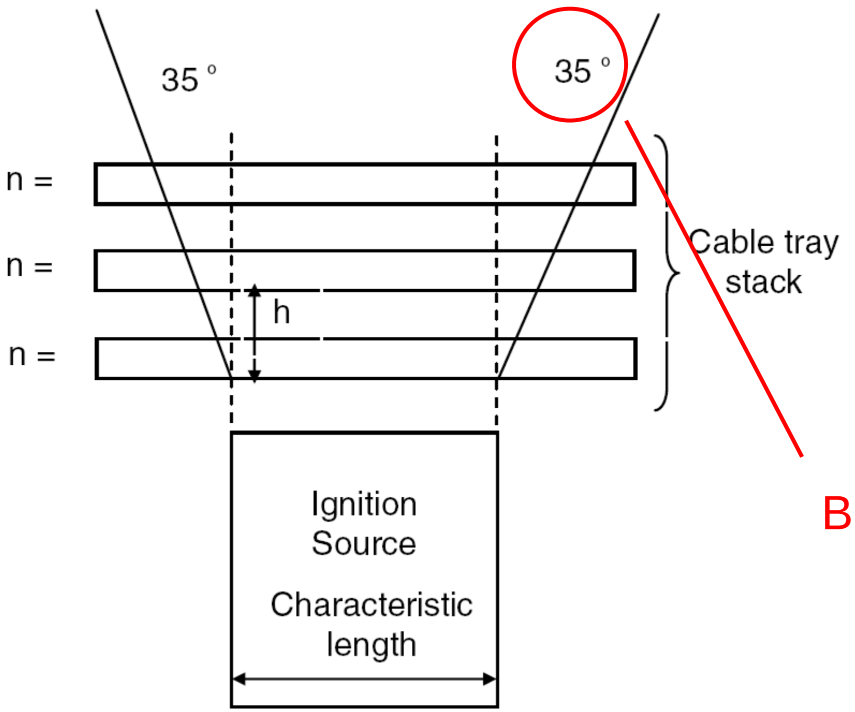
Material	Bench Scale HRR [kW/m^2]
XPE/FRXPE	475
XPE/Neoprene	354
XPE/Neoprene	302
XPE/XPE	178
PE/PVC	395
PE/PVC	359
PE/PVC	312
PE/PVC	589
PE, Nylon/PVC, Nylon	231
PE, Nylon/PVC, Nylon	218

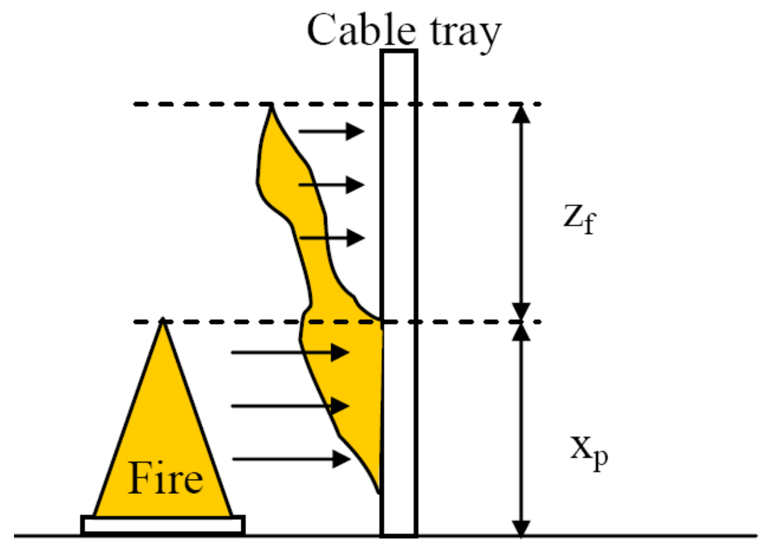
Which HRR to Use?

Current Guidance on Flame Spread

$$v = \frac{4\left(\dot{q}''_f\right)^2 \delta_f}{\pi (k\rho c)\left(T_{ig} - T_{amb}\right)^2}$$

Vague or ill-defined parameters





Based on only one experiment

Cables used in CHRISTIFIRE

Micro-Calorimeter

5 mg sample

Standard Test Method for Measuring Flammability Properties of Plastics and Other Solid Materials Using Microscale Combustion Calorimetry
ASTM D 7309

Cone Calorimeter

10 cm x 10 cm sample

Standard Test Method for Using a Cone Calorimeter to Determine Fire-Test-Response Characteristics of Insulating Materials Contained in Electrical or Optical Fiber Cables
ASTM D 7309

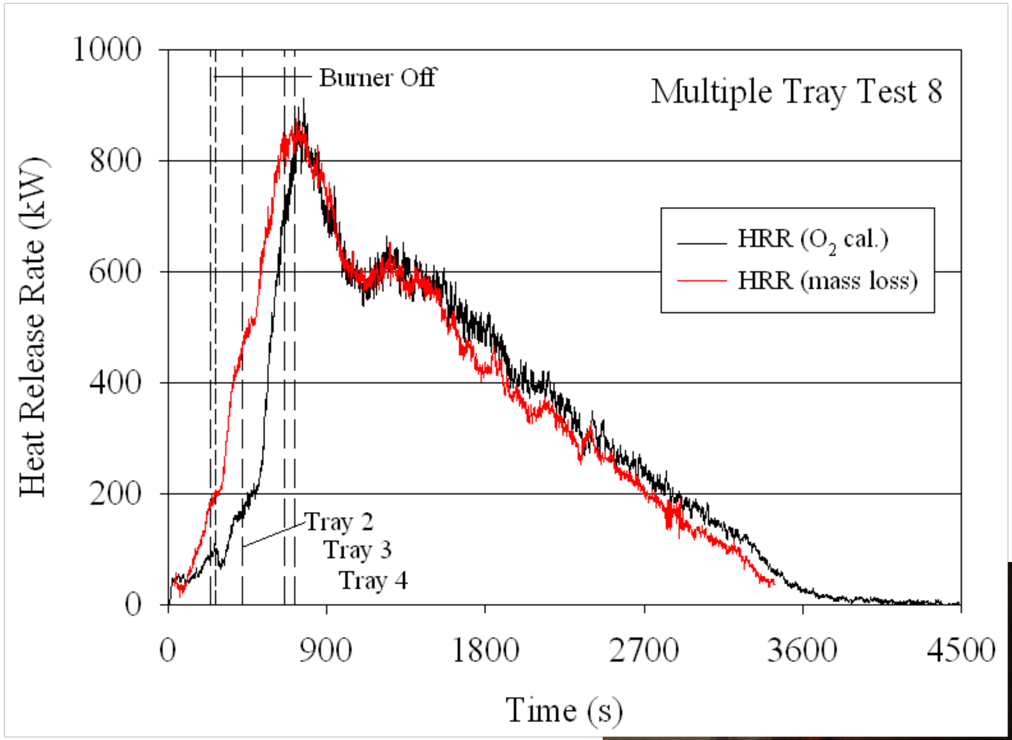
Panel Calorimeter

120 cm x 45 cm sample

No Applicable Standard

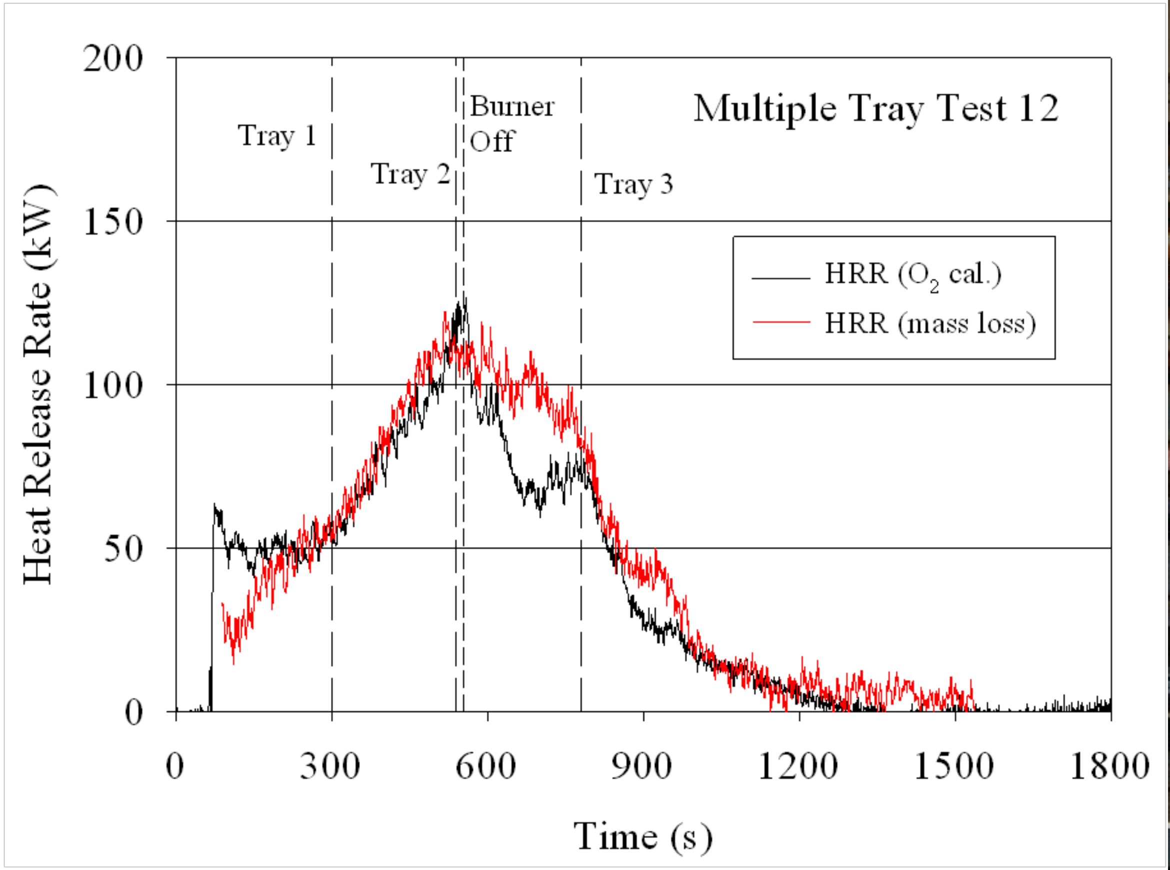
Thermoplastic cables tend to melt and drip; Electrical failure ~200 °C

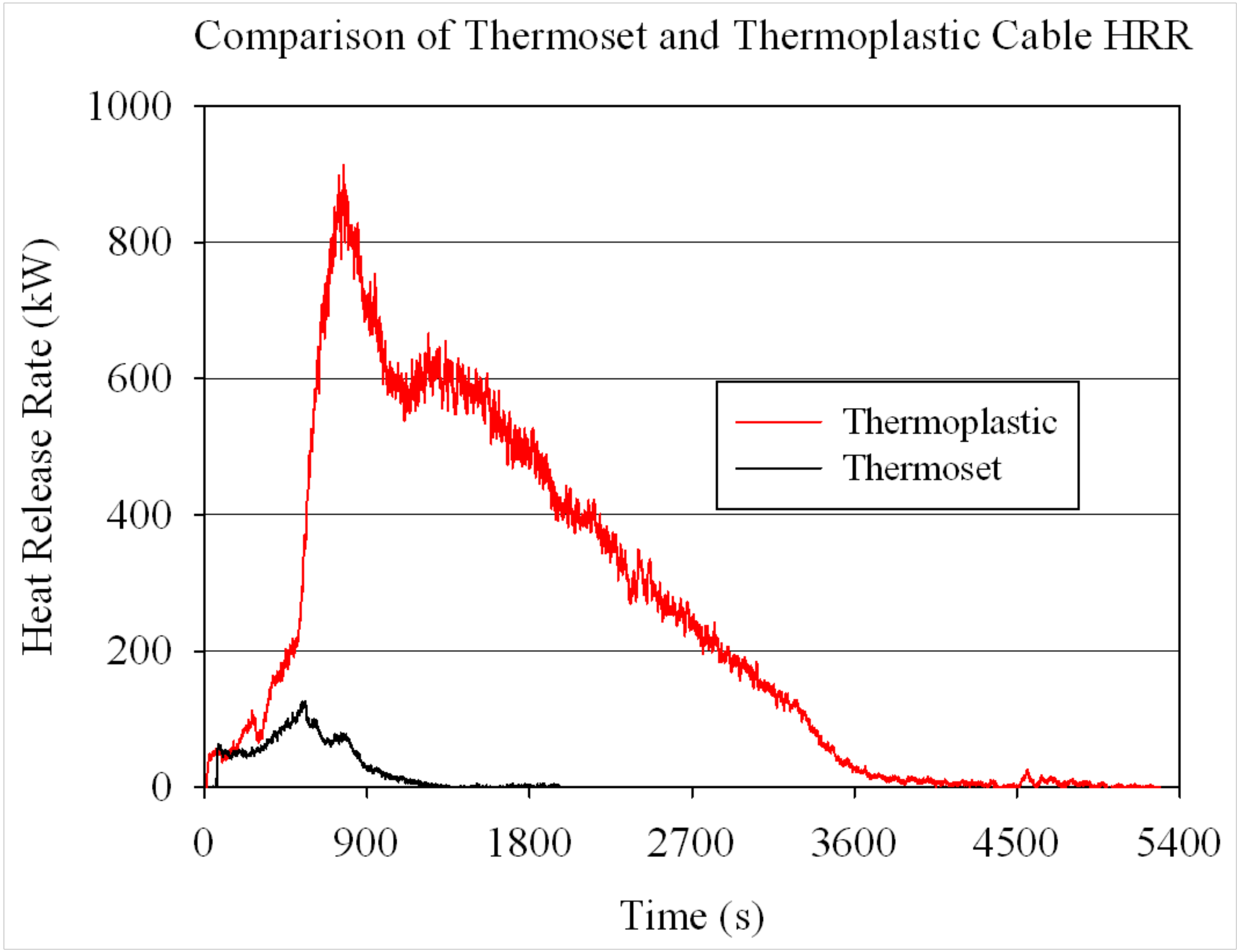
Thermoset cables tend to char and smolder; Electrical failure ~400 °C



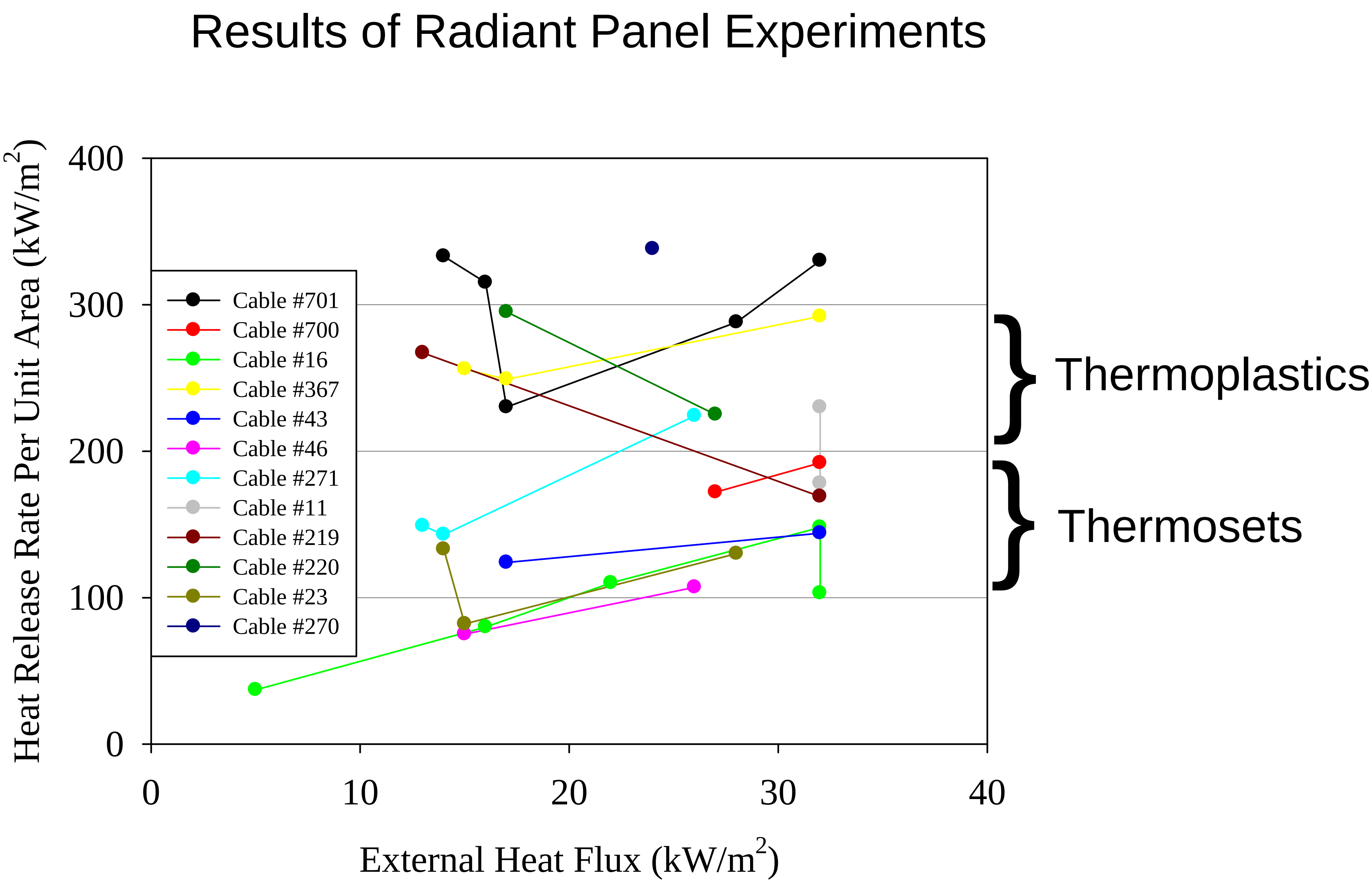
Thermoplastic Cable

Thermoset Cable



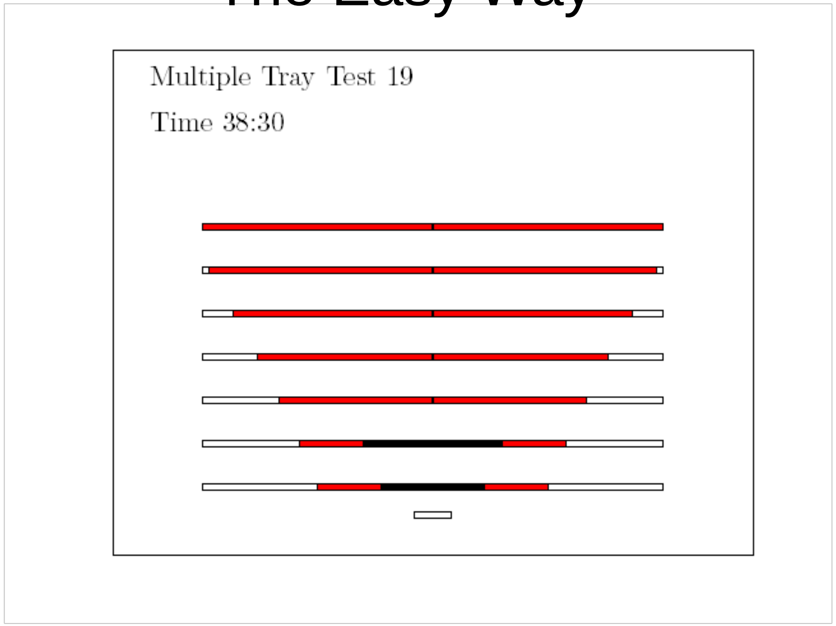


Comparison of Thermoset and Thermoplastic Cable HRR
Heat Release Rate (kW)
0
200
400
600
800
1000
Time (s)
0
900
1800
2700
3600
4500
5400
Thermoplastic
Thermoset

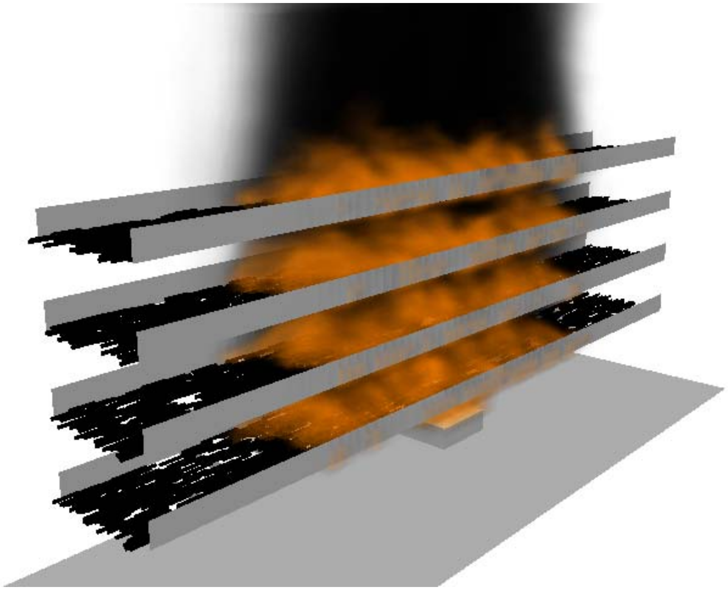

Results of Radiant Panel Experiments
Heat Release Rate Per Unit Area (kW/m2)
400
300
200
100
0
0
10
20
30
40
External Heat Flux (kW/m2)
Cable #701
Cable #700
Cable #16
Cable #367
Cable #43
Cable #46
Cable #271
Cable #11
Cable #219
Cable #220
Cable #23
Cable #270
Thermoplastics
Thermosets

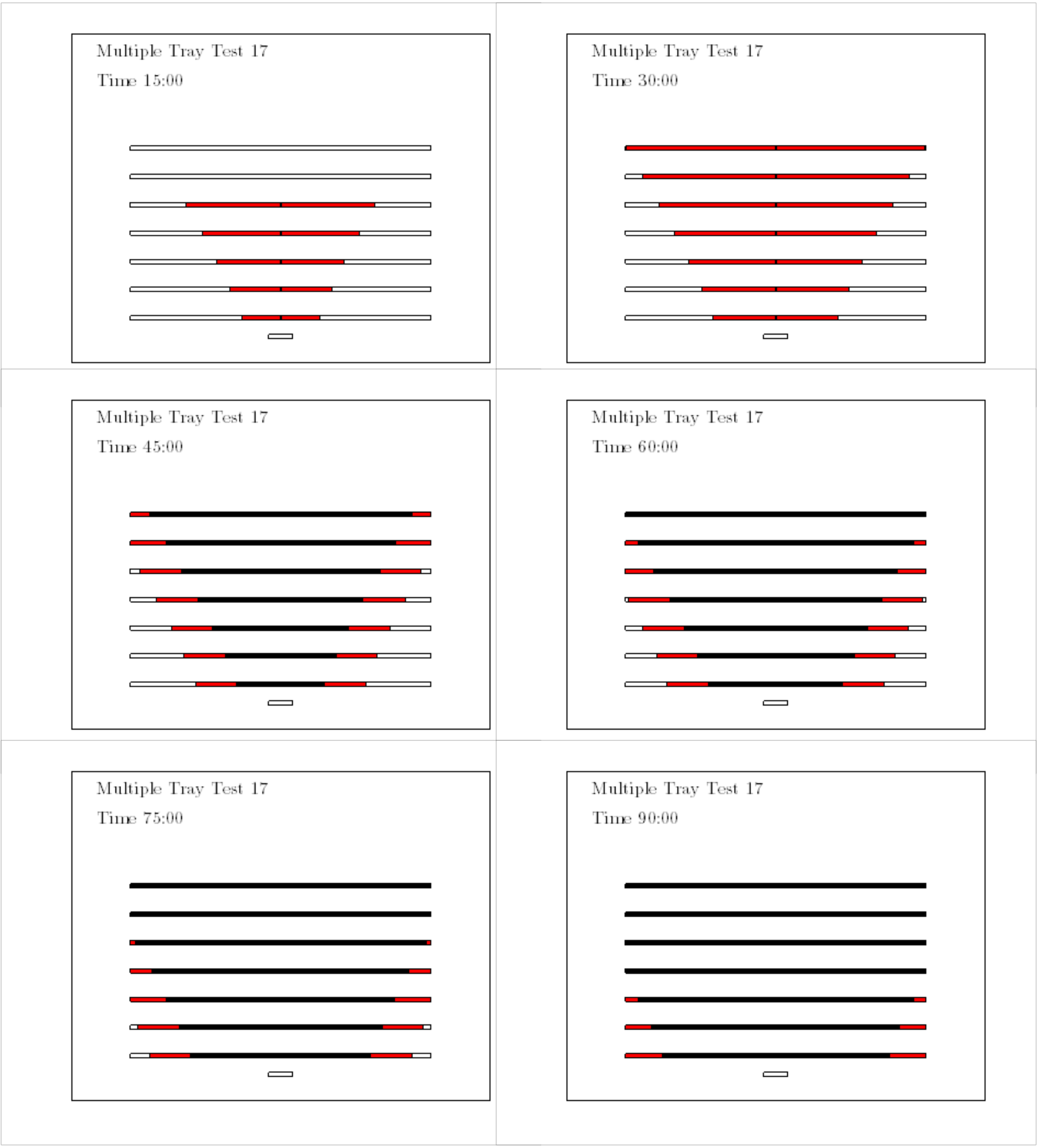
Modeling

The Easy Way



The Hard Way





FLASH-CAT

Flame Spread over Horizontal Cable Trays

Required Data
- Cable mass/length
- Non-metal mass fraction

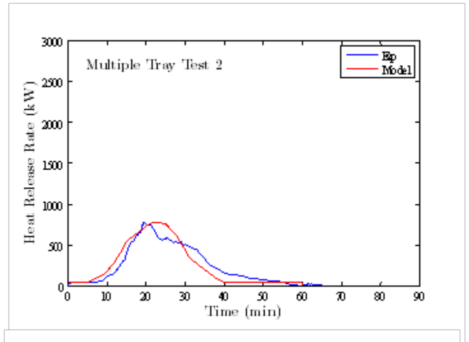
Ignition
- 5-4-3-2-1 minute rule

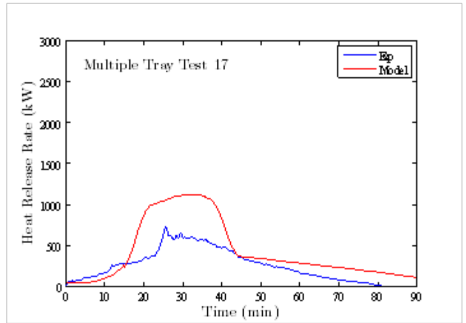
Upward Spread
- 35° spread angle

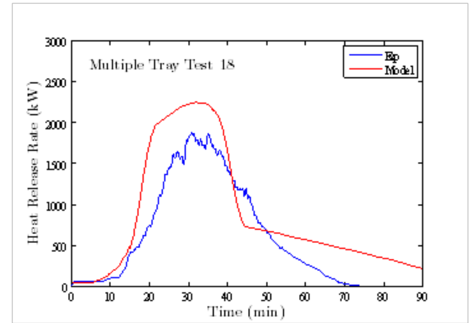
Burning Rate
- 250 kW/m² thermoplastics
- 150 kW/m² thermosets

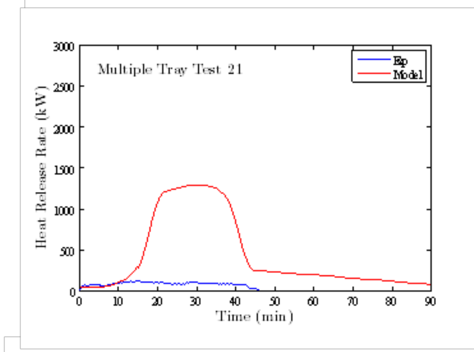
Lateral Spread
- 3.2 m/h thermoplastics
- 1.1 m/h thermosets

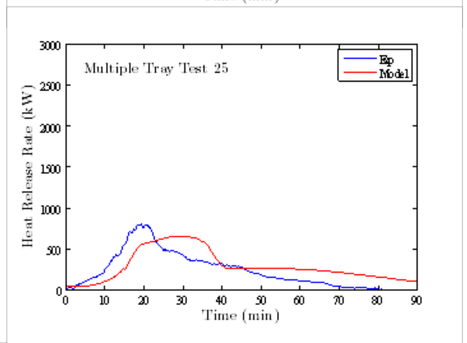
Heat of Combustion
- 16 MJ/kg for all

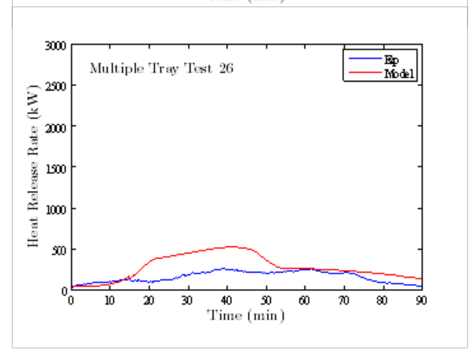

Multiple Tray Test 2
Exp
Model
Heat Release Rate (kW)
Time (min)

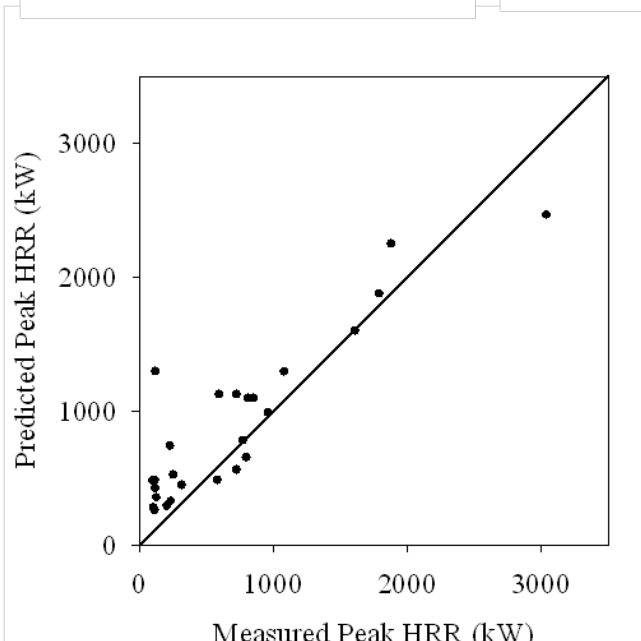

Multiple Tray Test 17
Exp
Model
Heat Release Rate (kW)
Time (min)

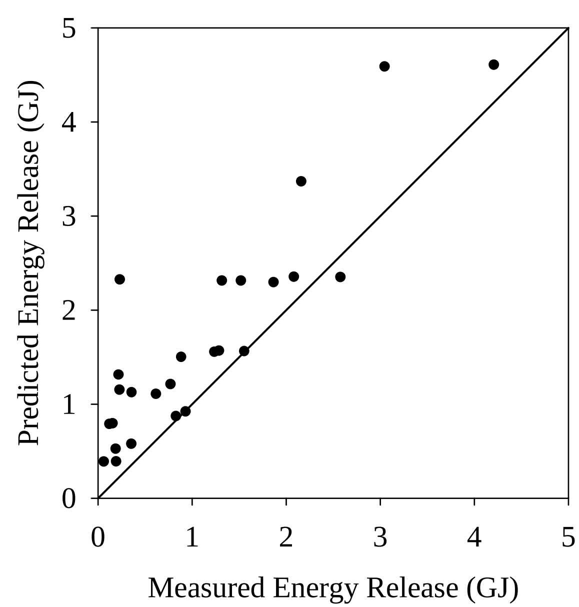

Multiple Tray Test 18
Exp
Model
Heat Release Rate (kW)
Time (min)


Multiple Tray Test 21
Exp
Model
Heat Release Rate (kW)
Time (min)

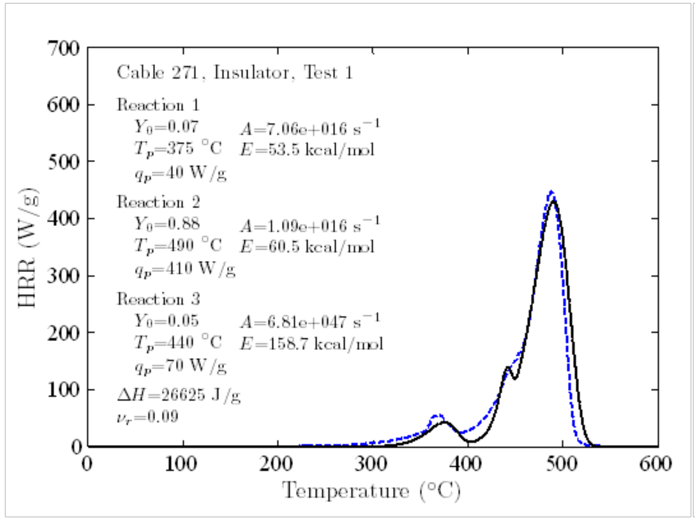

Multiple Tray Test 25
Exp
Model
Heat Release Rate (kW)
Time (min)

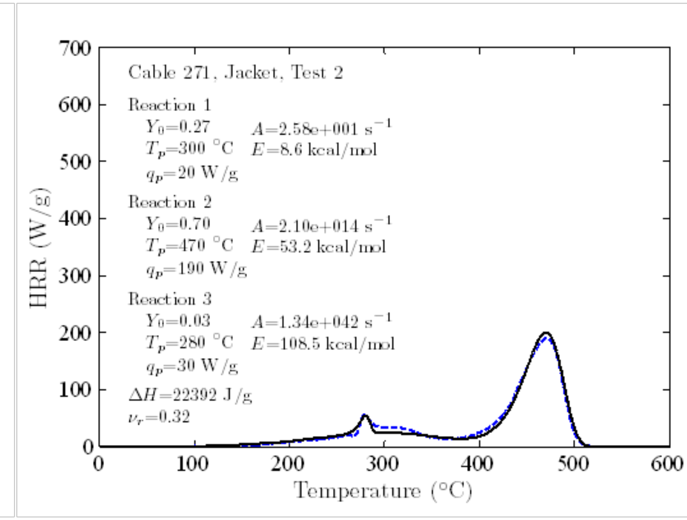

Multiple Tray Test 26
Exp
Model
Heat Release Rate (kW)
Time (min)

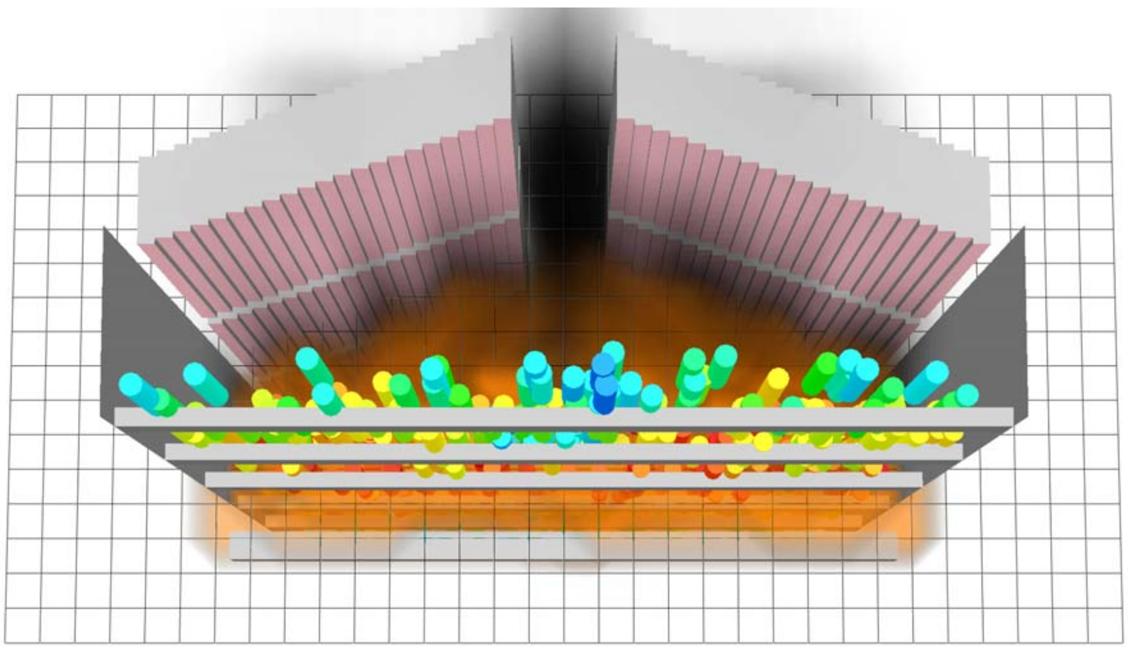

Predicted Peak HRR (kW)
Measured Peak HRR (kW)
0
1000
2000
3000


Predicted Energy Release (GJ)
Measured Energy Release (GJ)
0
1
2
3
4
5

Fire Dynamics Simulator (FDS)







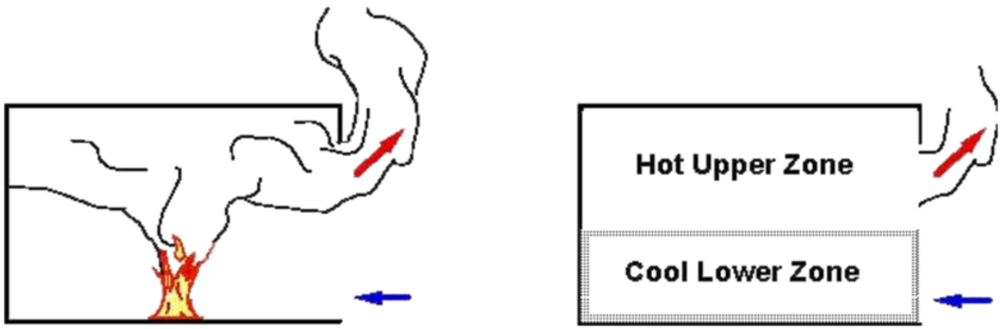
CHRISTIFIRE Report, NUREG/CR-7010, Public Comment, September 2010

kevin.mcgrattan@nist.gov

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Fire Modeling Activities



David W. Stroup, NRC
Francisco Joglar, SAIC/EPRI

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Primary Fire Models

- NRC – NUREG-1805 (FDTs)
- NIST (www.bfrl.nist.gov)
  - CFAST
  - Fire Dynamics Simulator & SMOKEVIEW
- EPRI
  - FIVE
  - MAGIC

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Fire Dynamic Tools (FDTs)

- SFPE Fire Protection Engineering Hand Calculations
- Microsoft Excel® Spreadsheets
- Training Tool
- Risk Insights
- Fire Hazard Analysis

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

EPRI ELECTRIC POWER RESEARCH INSTITUTE

List of FDT^{s} Spreadsheets

- 02.1_Temperature_NV.xls
- 02.2_Temperature_FV.xls
- 02.3_Temperature_CC.xls
- 03_HRR_Flame_Height_Burning_Duration_Calculation.xls
- 04_Flame_Height_Calculations.xls
- 05.1_Heat_Flux_Calculations_Wind_Free.xls
- 05.2_Heat_Flux_Calculations_Wind.xls
- 05.3_Thermal_Radiation_From_Hydrocarbon_Fireballs.xls
- 06_Ignition_Time_Calculations.xls
- 07_Cable_HRR_Calculations.xls
- 08_Burning_Duration_Soild.xls
- 09_Plume_Temperature_Calculations.xls
- 10_Detector_Activation_Time.xls
- 13_Compartment_Flashover_Calculations.xls
- 14_Compartment_Over_Pressure_Calculations.xls
- 15_Explosion_Claculations.xls
- 16_Battery_Room_Flammable_Gas_Conc.xls
- 17.1_FR_Beams_Columns_Substitution_Correlation.xls
- 17.2_FR_Beams_Columns_Quasi_Steady_State_Spray_Insulated.xls
- 17.3_FR_Beams_Columns_Quasi_Steady_State_Board_Insulated.xls
- 17.4_FR_Beams_Columns_Quasi_Steady_State_Uninsulated.xls
- 18_Visibility_Through_Smoke.xls

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

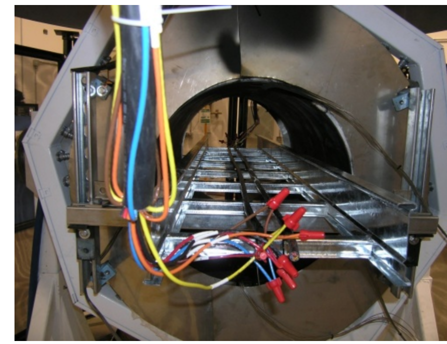
EPRI | ELECTRIC POWER RESEARCH INSTITUTE

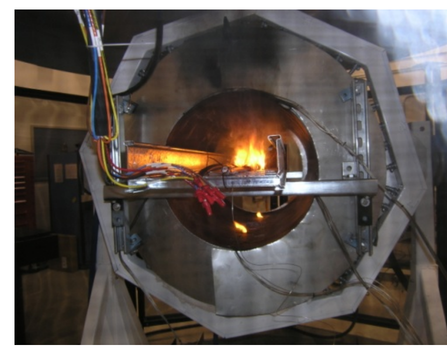
Revisions to NUREG-1805

- George Hausman – Region 3
- Document THIEF Spreadsheet
- Fix Errors
- Improve Usability and Printing
  - Inputs on One Page
  - Output on One Page
- Supplement 1 To Be Issued – Nov. 2010

THIEF Model to be Added to NUREG-1805 Supplement 1

- CAROLFIRE Project Results
- 1-D Heat Conduction
- Constant Cable Properties (k, c_p, ρ)
- Fire Model Results
  - Convective Flux
  - Radiative Flux





U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Plume (Chap. 9) – Old Format

CHAPTER 9. ESTIMATING CENTERLINE TEMPERATURE OF A BUOYANT FIRE PLUME

Version 1805.0 (SI Units)

The following calculations estimate the centerline plume temperature in a compartment fire.

Parameters should be specified ONLY IN THE YELLOW INPUT PARAMETER BOXES.

All subsequent output values are calculated by the spreadsheet and based on values specified in the input parameters. This spreadsheet is protected and secure to avoid errors due to a wrong entry in a cell(s).

The chapter in the NUREG should be read before an analysis is made.

INPUT PARAMETERS — SI UNITS

Heat Release Rate of the Fire (Q)	218.00	kW		
Elevation Above the Fire Source (z)	0.50	m	1.64	ft
Area of Combustible Fuel (A_c)	1.00	m^2	10.76	ft^2
Ambient Air Temperature (T_a)	25.00	°C	77.00	°F
	Calculate		298.00	K

AMBIENT CONDITIONS

Specific Heat of Air (c_p)	1.00	kJ/kg-K
Ambient Air Density (ρ_a)	1.18	kg/m^3
Acceleration of Gravity (g)	9.81	m/sec^2
Convective Heat Release Fraction (χ_c)	0.70	

Note: Air density will automatically correct with Ambient Air Temperature (T_a) Input

ESTIMATING PLUME CENTERLINE TEMPERATURE

Reference: SFPE Handbook of Fire Protection Engineering, 3rd Edition, 2002, Page 2-6.

$$T_{p(centerline)} - T_a = 9.1\ (T_a/g\ c_p^2\ \rho_a^2)^{1/3}\ Q_c^{2/3}\ (z - z_0)^{-5/3}$$

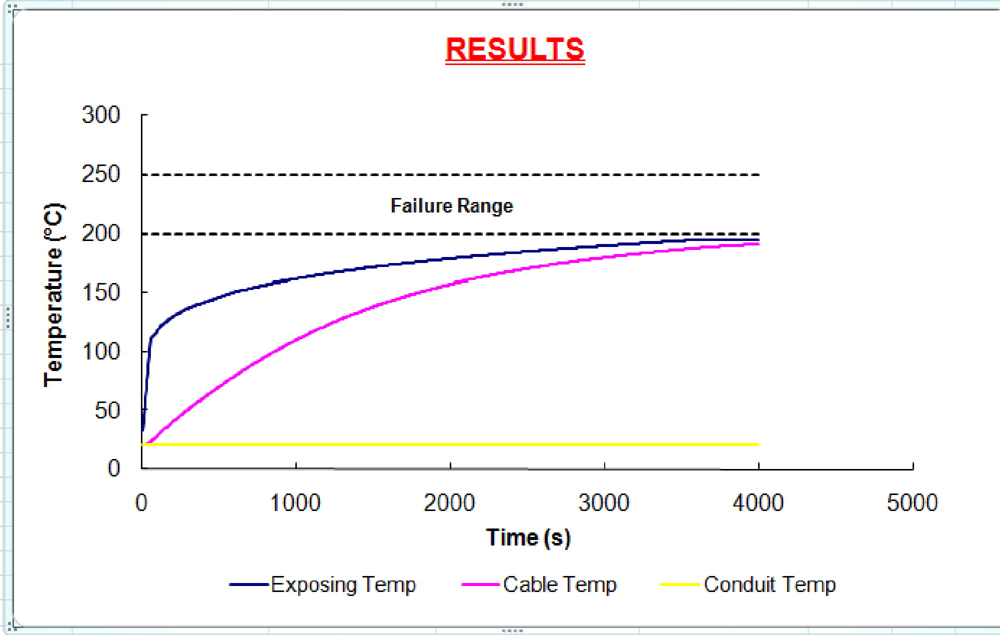
Where $T_{p(centerline)}$ = plume centerline temperature (°C)

Q_c = convective portion of the heat release rate (kW)

Results – Old Format

EXPOSURE GAS TEMPERATURE PROFILE

Time (s)	Gas Temperature (°C)	Gas Temperature (K)
0	25.00	298.15
60	110.95	384.10
120	121.48	394.63
180	128.23	401.38
240	133.30	406.45
300	137.40	410.55
600	151.16	424.31
900	159.99	433.14
1200	166.62	439.77
1500	171.98	445.13
1800	176.52	449.67
2100	180.46	453.61
2400	183.96	457.11
2700	187.11	460.26
3000	189.98	463.13
3300	192.62	465.77
3600	195.07	468.22



Click Calculate Button when finished entering data!

Calculate

Answer: Cable does not reach failure temperature in 4000.4 seconds

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Input - New Format

CHAPTER 5
ESTIMATING THERMAL RADIATION FROM HYDROCARBON FIREBALLS

Version 1805.1
(English Units)

The following calculations estimate the thermal heat flux from hydrocarbon fuel vapors received by an object.
Parameters in YELLOW CELLS are Entered by the User.
Parameters in GREEN CELLS are Automatically Selected from the DROP DOWN MENU for the Fuel Type Selected.
All subsequent output values are calculated by the spreadsheet and based on values specified in the input parameters. This spreadsheet is protected and secure to avoid errors due to a wrong entry in a cell(s). The chapter in the NUREG should be read before an analysis is made.

Project / Inspection Title:

INPUT PARAMETERS

Mass of Fuel Vapor (m_F)	10.00	lb
Distance at Ground Level from the Origin (L)	300	ft
Fuel Vapor Density (ρ_F)	0.10	kg/m^3

Calculate

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Output – New Format

Maximum Heat Flux on Target

$q''_r = 828 (m_F)^{0.771} / R^2$

Answer	q''_r =	0.25 kW/m^2	0.02 Btu/ft^2-sec

Diameter of the Fireball

$D = 5.25 (m_F)^{0.314}$

Where,
D = maximum fireball diameter (m)
m_F = mass of fuel vapor (kg)

Answer	D =	8.44 m	27.69 ft

Duration of the Fireball

$t_p = 2.8 (V_F)^{1/6}$

Where,
t_p = time of the fireball (sec)
V_F = volume of fuel vapor (m^3)

Answer	t_p =	5.29 sec	0.09 min

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

EPRI ELECTRIC POWER RESEARCH INSTITUTE

FIVE – Rev1

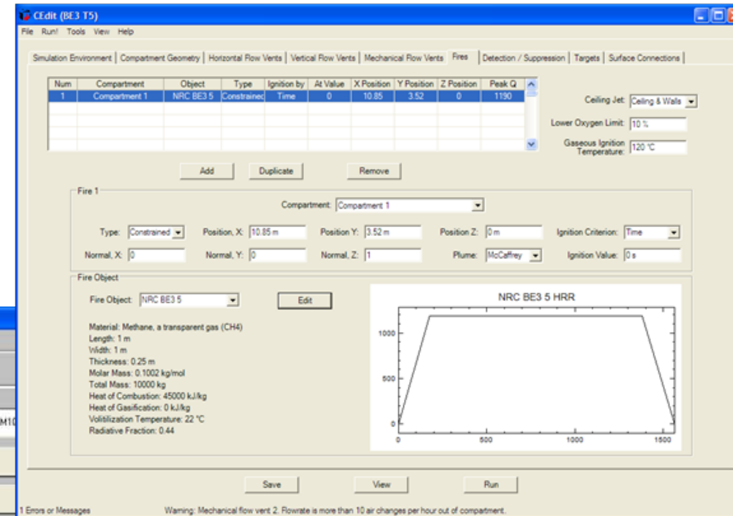
- Fire-Induced Vulnerability Evaluation
- EPRI TR-100443 “Methods of Quantitative Fire Hazards Analysis”
- Collection of Hand Calculations
- Menu Driven
- Excel Spreadsheets

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

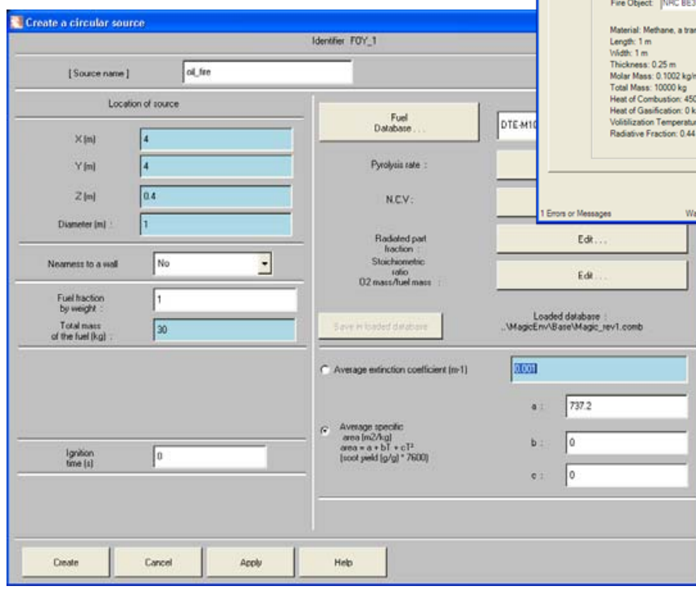
EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Zone Model Examples

- CFAST



- MAGIC

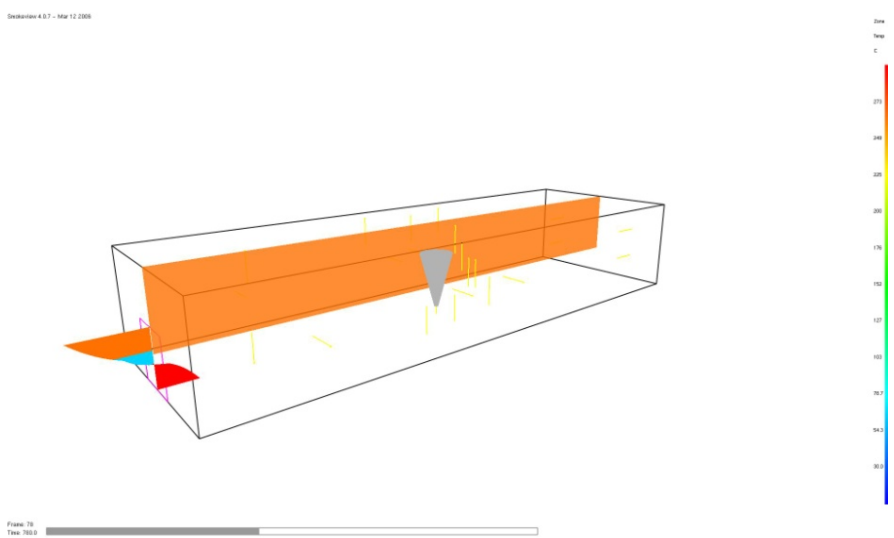


U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

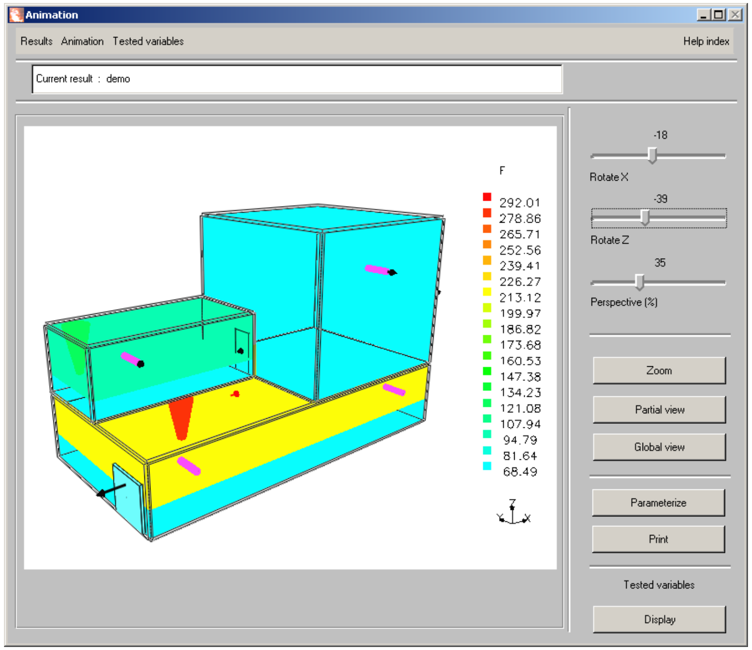
EPRI ELECTRIC POWER RESEARCH INSTITUTE

Zone Model Results

CFAST



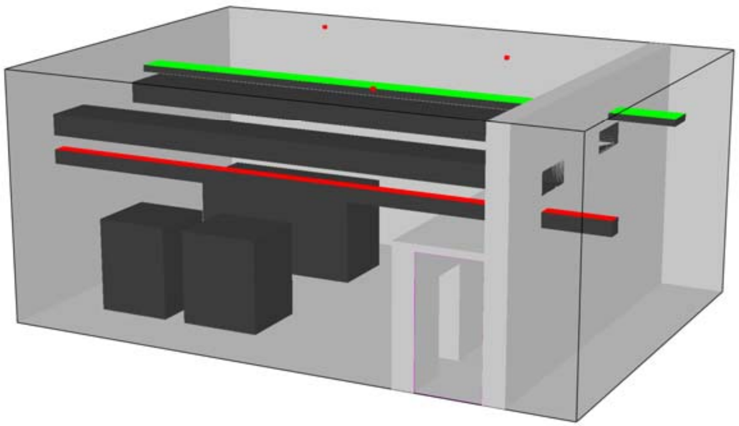
MAGIC

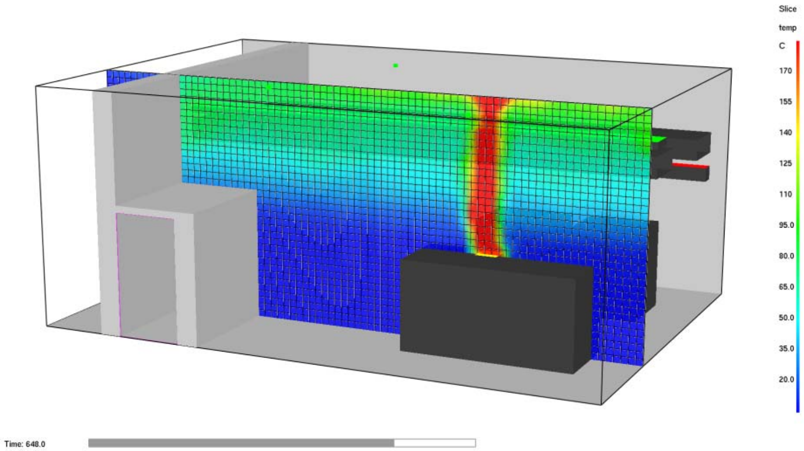


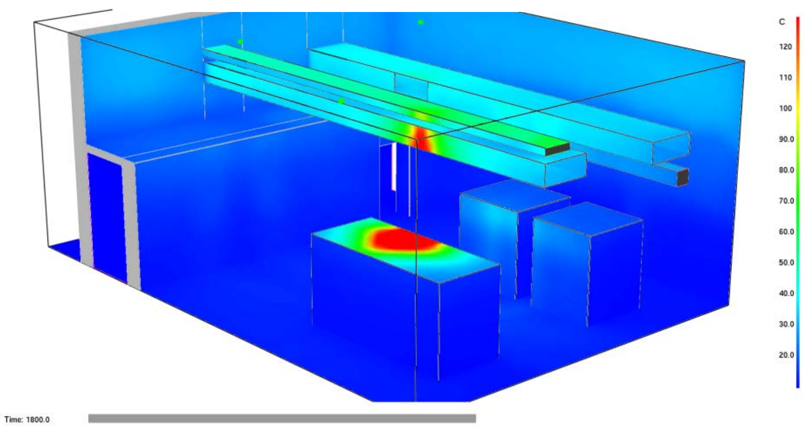
Field Models

- Computational Fluid Dynamics (CFD)
- Conservation of Mass, Momentum, and Energy
- Sub-process Models
- Fire Dynamics Simulator (FDS)
  - NIST
  - V & V

Fire Dynamics Simulator



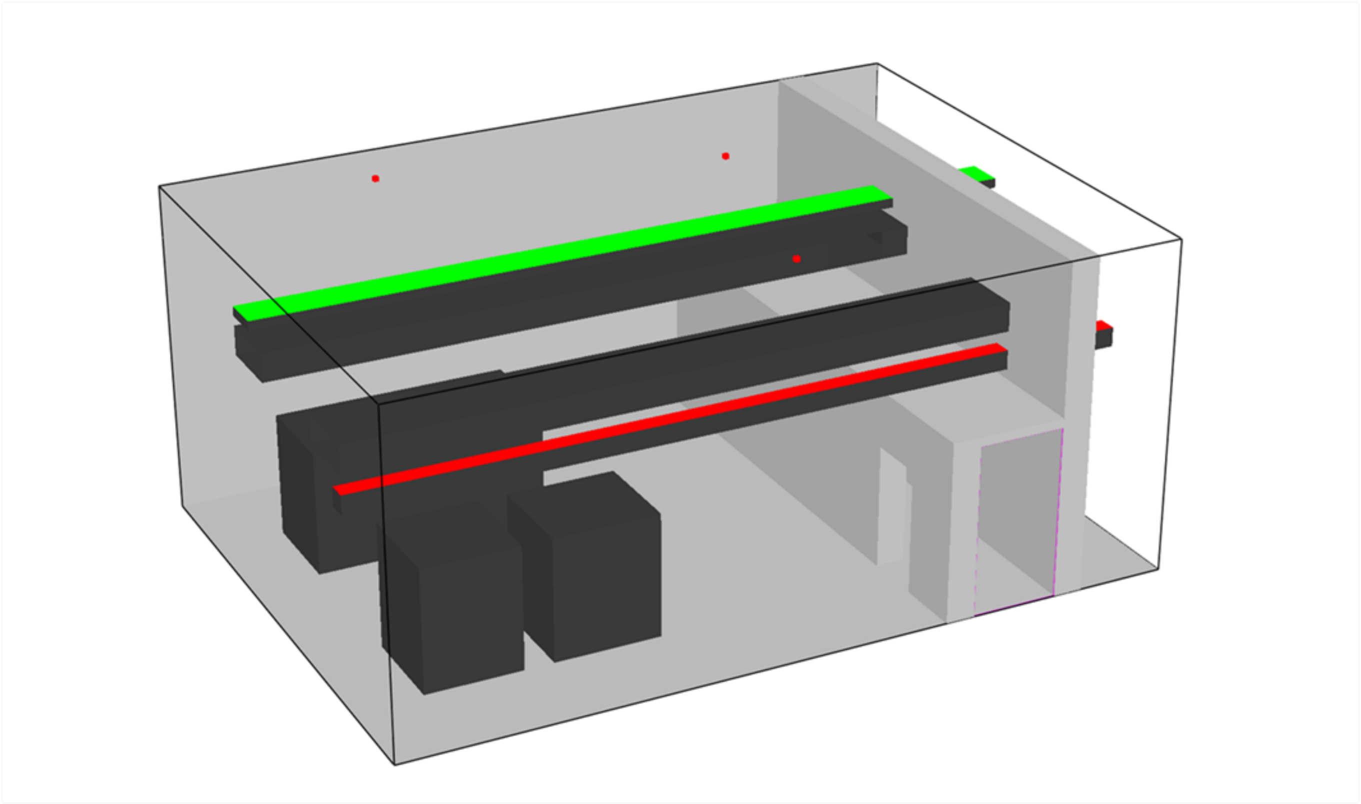




U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

EPRI
ELECTRIC POWER
RESEARCH INSTITUTE

FDS Example



U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Current Activities

- NUREG-1824 (V&V) – May 2007
- NUREG/CR-6978 (PIRT) – November 2008
- Fire Model Applications Guide

Fire Model Applications Guide

- Joint Activity (NRC, EPRI, NIST)
- Supplement NUREG-1824
- Fire Modeling Process
- Uncertainty Analysis
- Solved Problems

Writing Team

- David Stroup, NRC
- Francisco Joglar, SAIC
- Kevin McGrattan, NIST
- Rick Peacock, NIST
- Sean Hunt, HAI, Inc.
- Clarence Worrell, Westinghouse
- Kiang Zee, ERIN
- Jim Milke, UMd
- Mark Henry Salley, NRC
- Ken Canavan, EPRI
- Robert Kassawara, EPRI
- Rick Wachowiak, EPRI
- Dave Birk, SAIC

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Background

- EPRI 1002981, *Fire Modeling Guide for Nuclear Power Plant Applications*
- NUREG-1934 Draft For Comment
- Original Draft – Summer 2009
- Peer Review
- Revised Draft – Late 2009
- 60 Day Public Comment – 4/30/2010

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Status

- 206 Comments from 8 Sources
- Currently Resolving Public Comments
- 2nd Draft for Comment – 12/30/2010
- 30 Day Public Comment
- Final Report – Summer 2011

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Questions???

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

Sandia National Laboratories

EPRI

DESIREE-FIRE

Direct Current Electrical Shorting In Response to Exposure-FIRE

NEI Fire Protection Information Forum

September 14, 2010

Laguna Cliffs Marriott
Dana Point, California

Office of Nuclear Regulatory Research

Fire Research Branch

Project Overview

Gabriel Taylor
NRC - RES
Fire Research Branch

DESIREE-FIRE

- Experimental testing program to evaluate direct current (dc) circuit response to fire exposure.
- Cooperative research project with EPRI
- Sandia National Laboratories conducted the testing

Need for Testing

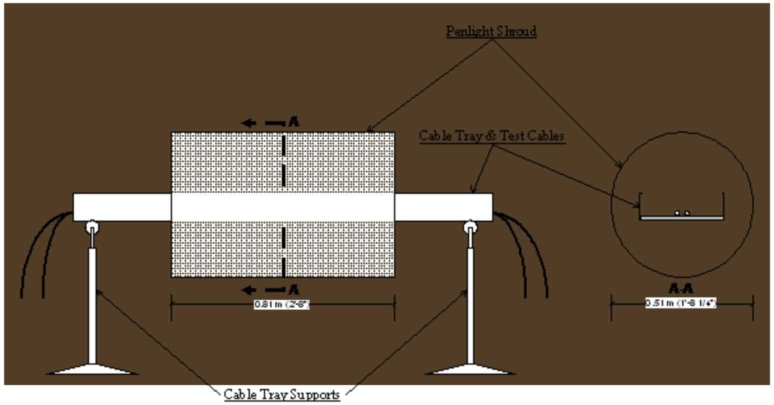
- Lack of data and uncertainties extrapolating alternating current (ac) results to dc circuits
- Numerous safety related systems commonly powered with dc
- Duke testing in 2006 indicated that dc circuits may react differently than ac circuits to fire-induced failures

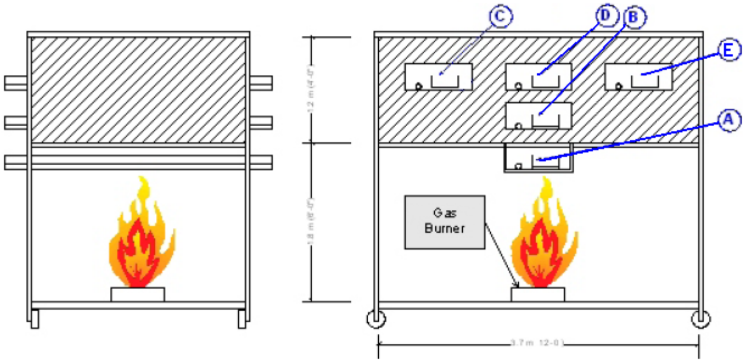
Approach

- **Similar to CAROLFIRE**
  - Small-scale radiant exposure
  - Intermediate-scale live fire tests
- **Numerous dc circuit types evaluated**
  - dc motor starter - motor operated valve (MOV)
  - Small pilot dc solenoid operated valve (SOV) (ASCO red-hat)
  - Medium voltage circuit breaker (complete breaker assembly)
  - 1” SOV
  - Large coil - similar to power operated relief valve (PORV)
  - Inter-cable circuits configuration

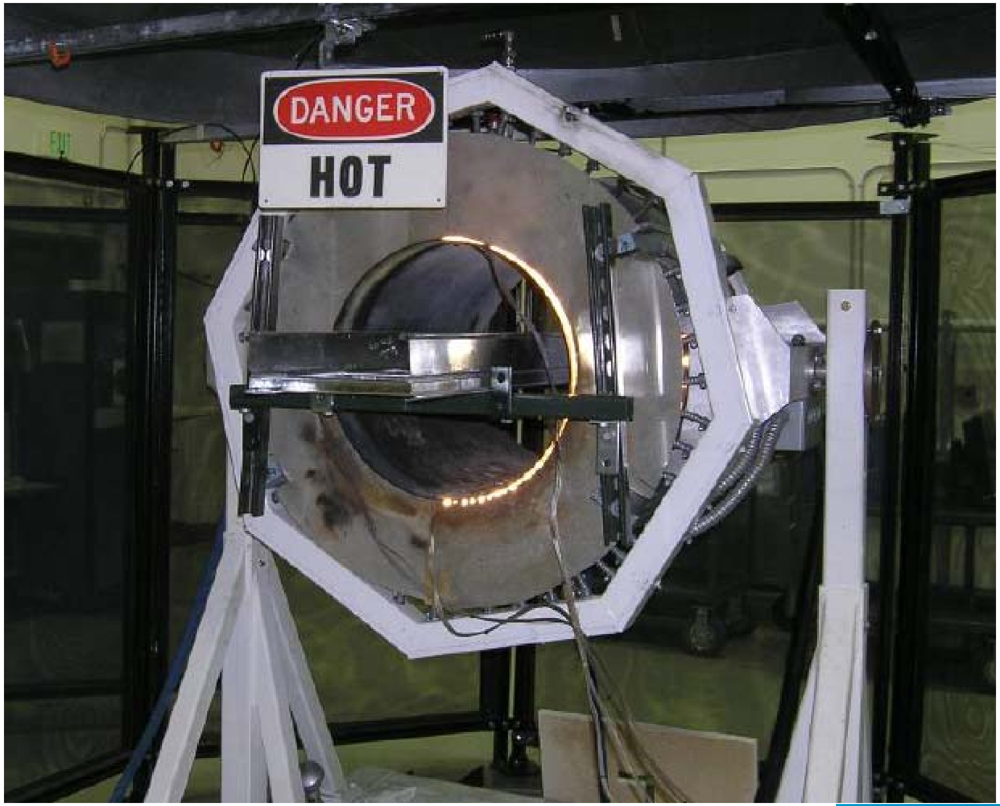
Testing Schedule

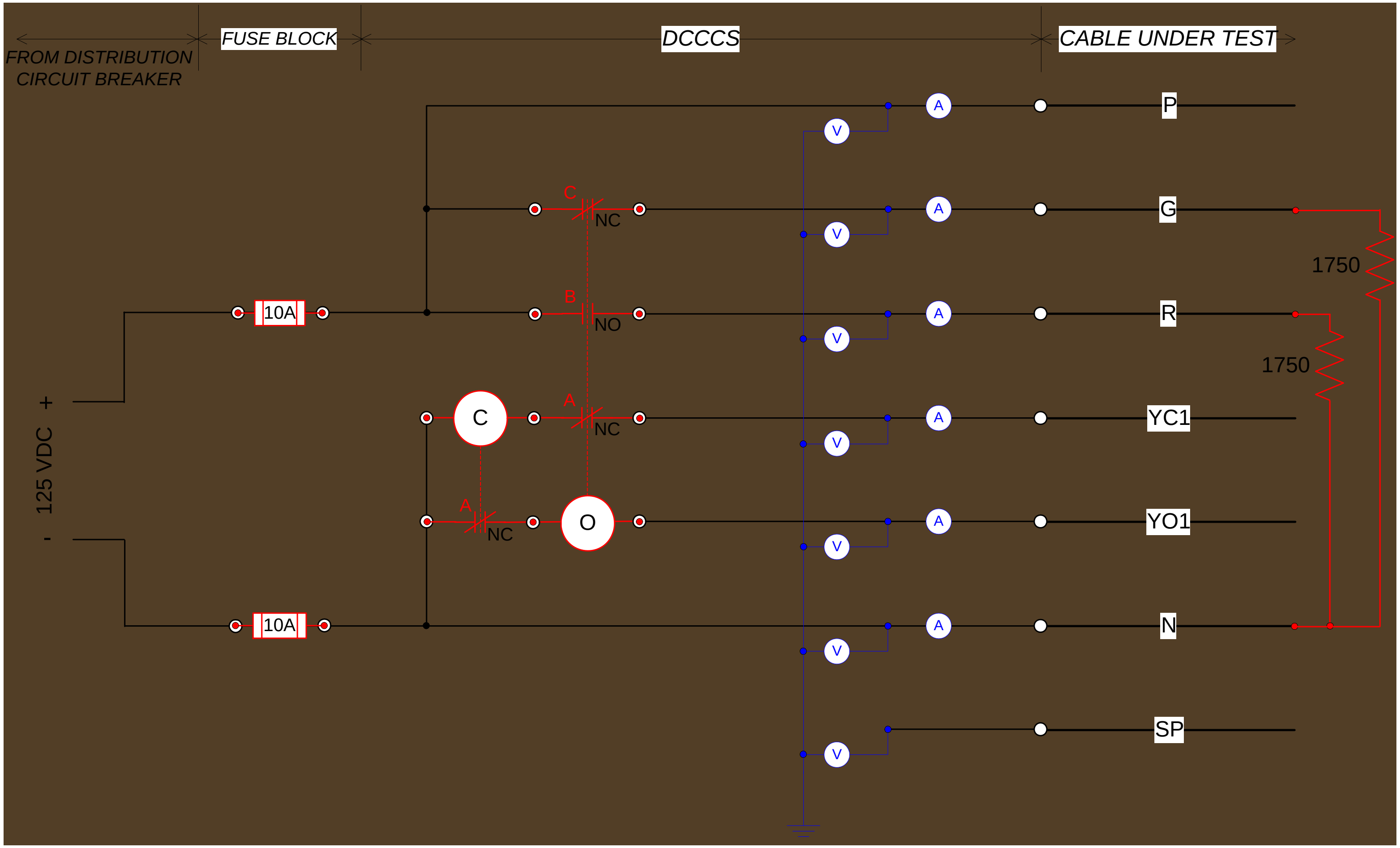
- Small-Scale
  - July to October 2009
- Intermediate-Scale
  - September 2009 to February 2010
- Final Report
  - October 2010



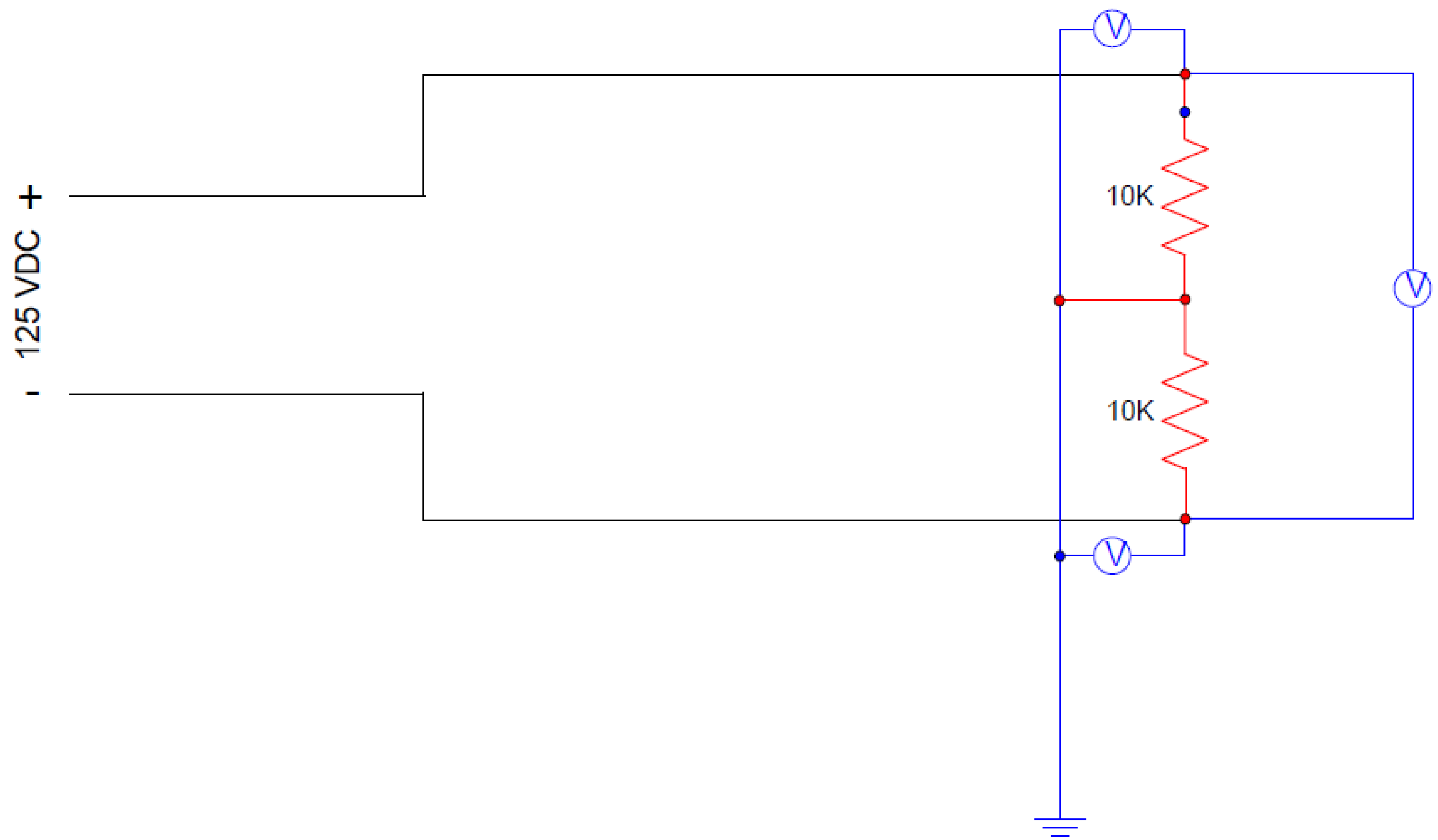


Penlight




FROM DISTRIBUTION CIRCUIT BREAKER
FUSE BLOCK
DCCCS
CABLE UNDER TEST
125 VDC
+
-
10A
10A
C
NC
B
NO
A
NC
C
A
NC
O
A
V
P
G
R
YC1
YO1
N
SP
1750
1750

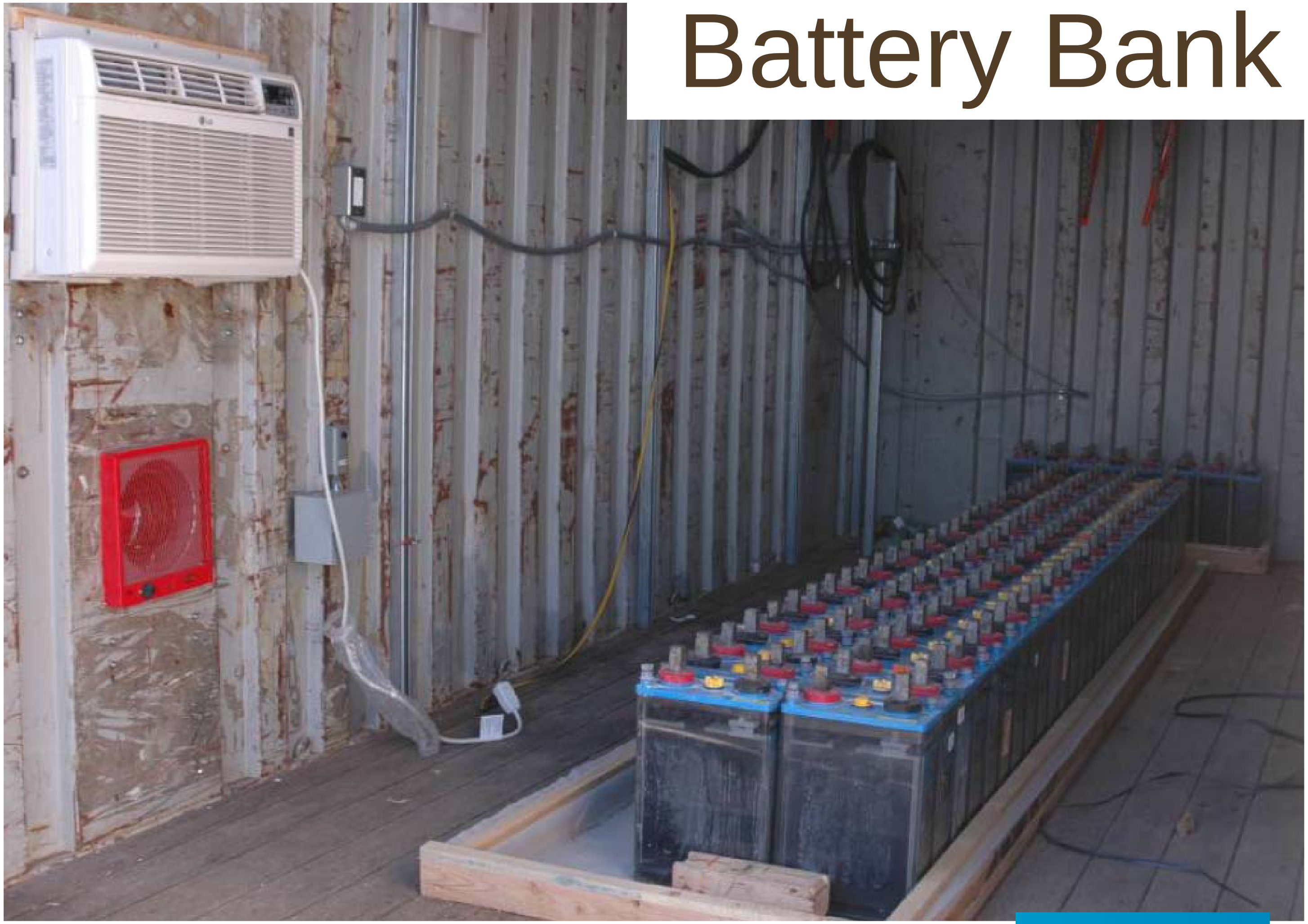
Ground Monitoring Circuit



1" &
Large
Coil

Voltage & Current Transducers

Battery Bank



Industry Perspectives

Dan Funk

Edan Engineering

Test Results

Harry Barrett
NRC - NRR
Fire Protection Branch

Results

- Open Circuits
  - Failure mode not observed in ac testing

Open Circuit

Copper Slag

Results (2)

- Arcing & Cable Ignition
  - dc electrical failures are typically more energetic than ac failures
  - In most cases arcing appears to act as the pilot for cable ignition

Results (3)

- Fuse sizing
  - Generally, larger fuses (15-35A) take significantly longer to clear than small fuses (5-10A)
  - In several tests, fuses did not clear due to open circuiting of test cable
  - Arcing and hot short durations are linked to fuse sizing

Results (4)

- Hot short duration is also linked to heat release rate
  – During several small scale tests, heat flux was maintained at lower levels, resulting in longer duration hot shorts

Results (5)

- Grounding
  - dc battery bank was intentionally left ungrounded, however a high-resistance ground connection was implemented for instrumentation purposes
  - A single short to ground (e.g., to cable raceway) won't clear a fuse for an ungrounded dc circuit
  - Presents an opportunity for inter-cable interactions
    - shorts occurred through cable raceway or spare conductors

Results (6)

- Kerite
  - 3 types of Kerite were tested
    - 2 – FR, 1 – HTK
  - Kerite FR fails somewhere between Thermoplastic (205ºC) and Thermoset (330ºC) thresholds
  - Kerite HTK fails above the Thermoset threshold (330ºC)
  - Additional Kerite cable types donated for future testing.

dc MOV Results

- dc MOV
  - Penlight 22 spurious actuations per 30 test circuits
  - Intermediate 13 spurious actuations (SA) per 26 test circuits
  - Maximum SA duration 57 minutes

dc SOV Results

- dc SOV
  - Penlight 11 spurious actuations per 20 test circuits
  - Intermediate 14 SA per 26 test circuits
  - Maximum SA duration 21.9 minutes

Large Coil & 1” Valve Results

- Large Coil
  - Penlight 3 SA per 5 test circuits
  - Intermediate 5 SA per 13 per test circuits
  - Maximum SA duration 2 minutes
- 1” Valve
  - Penlight 4 SA per 5 test circuits
  - Intermediate 7 SA per 13 test circuits
  - Maximum SA duration 1.5 minutes

Follow-on Projects

Gabriel Taylor
NRC - RES
Fire Research Branch

PIRT & Expert Elicitation

- Phenomena Identification and Ranking Table (PIRT)
  - PIRT will rank the importance and state of knowledge of various aspects related to fire-induced cable damage
- Expert Elicitation
  - Expert Elicitation will provide best estimate probabilities of SA given cable damage for use in Fire PRA

Follow-on Work

- Panels will be made up of experts
  - NRC will select 50% of panel & EPRI will select 50% of panel
  - PIRT panel will focus on electrical aspects of fire-induced circuit failures
  - Expert elicitation panel will focus on developing best estimate probabilities based on configurations developed by PIRT panel

PIRT Panel Objectives

- Identify phenomena of interest and associated key parameters
- Rank the importance and state of knowledge of each phenomena
- Rank importance and state of knowledge for any key parameters

Expert Elicitation Objectives

- Estimate conditional probabilities of fire-induced cable and circuit failure phenomena
  - Update original EPRI estimates
    - (EPRI TR 1006961)
  - Provide estimates for dc circuits
  - Provide estimates for other circuits of interest

Use of results

- PIRT
  - Provide insights on areas of fire-induced circuit failure where additional research is needed.
- Expert Elicitation
  - Provide improved and new best-estimate probabilities for use in fire PRA applications.

Questions

Harold Barrett, PE
Senior Fire Protection Engineer
Fire Protection Branch
Division of Risk Assessment
Office of Nuclear Reactor Regulation

Lessons Learned/SE Template/ NFPA 805 Transition

September 15, 2010

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Discussion Topics

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- Shearon Harris NFPA 805 Pilot Safety Evaluation
  - Background
  - Statistics
  - Level of Detail
- NFPA 805 Safety Evaluation Template
- NFPA 805 Transition Lessons Learned
- Summary

Background

- Shearon Harris NFPA 805 Licensing Timeline:
  - June 10, 2005, Progress Energy submitted LOI
    - Letter stated that transition would take 3 years
  - February 4 – 8, 2008, NRC staff reviewed the Fire PRA
  - April 2008 – Limited scope industry peer review of Fire PRA
  - May 28, 2008, Progress submitted NFPA 805 LAR [562 pages]
  - August 14, 2008, Acceptance Review Conference Call
  - September 26, 2008, NRC Acceptance Review Letter

Background

- Shearon Harris NFPA 805 Licensing Timeline:
  - November 14, 2008 1st LAR Supplement [516 pages]
  - December 11, 2008 2nd LAR Supplement [125 pages]
  - March 16 to 20, 2009, NRC Staff Onsite Audit of HNP
  - August 13, 2009, First RAI Response Letter
  - August 29, 2009, Second RAI Response Letter

Background

- Shearon Harris NFPA 805 Licensing Timeline:
  - October 9, 2009, Third RAI Response Letter & **Revised LAR** [955 pages]
    - Licensee submitted a completely revised LAR which superseded all previous submittals
  - February 4, 2009, Fourth RAI Response Letter

Statistics

- Acceptance Review identified 8 major issues
- NRC Staff initially identified 149 RAIs
- Upon receiving the RAI responses:
  - NRC staff asked 19 follow-up questions on the RAI responses
  - NRC staff asked 16 additional RAIs
- Total of 184 RAIs through entire LAR review process
- HNP NFPA 805 Safety Evaluation is 529 pages

HNP NFPA 805 Safety Evaluation Level of Detail

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- SE includes detailed reviews in the form of numerous tables:
  - NFPA 805 Chapter 3 (NEI 04-02, Table B-1)
  - Nuclear Safety Capability Assessment Methods (NEI 04-02, Table B-2)
  - Fire PRA Quality (Internal Events F&Os and Fire PRA Findings)
  - Fire PRA RAIs (to fully document the Staff Review)
  - Fire Area Reviews (NEI 04-02 Table B-3 and others)
    - Previously Approved Licensing Actions (Deviations/Exemptions)
    - Variations from Deterministic Requirements
    - Recovery Actions
    - Suppression impacts on nuclear safety performance criteria
    - Required Suppression and Detection Systems

NFPA 805 Safety Evaluation Template

- Template originally used structure and content based on NFPA 805 SRP chapter 9.5.1.2
- Structure modified during Harris SE development
- Broken down by types of technical review being performed
    - Process/methods
    - Results

NFPA 805 Safety Evaluation Template Schedule

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- NRC staff and NEI NFPA 805 Task Force (industry) have held several public meetings on LAR template and SE template
- SE Template is currently under NRC management review
- Expect SE Template approval by end of September 2010
- NRC staff plans to make the SE Template available through a publicly available closure memo
  - The plan is to make the SE Template an attachment to SRP Chapter 9.5.1.2 in the next revision

- Safe Shutdown Issues
  - Living Program – must be able to demonstrate configuration control sufficient to maintain compliance with NFPA 805
  - Some Appendix R technical Issues don't go away with NFPA 805 – must still be able to meet requirements for:
    - Common Enclosure
    - Common Power Supply

NFPA 805 Transition Lessons Learned

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- Pilots vs. Non-Pilots
  - Pilots are finishing some key program attributes (i.e. monitoring) during implementation
    - Resulted in an Implementation Item that is being tracked in SE
- Items not complete at the time the SE is developed will be tracked as Implementation Items

NFPA 805 Transition Lessons Learned

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- When developing your LAR, make sure the process descriptions reflect the process you want to follow
  - e.g., If you want to perform your Monitoring Program Expert Panel reviews using your fire zones as the basis, don't say that you will use the fire areas in the LAR

Summary

- Harris NFPA 805 License Amendment was approved June 28, 2010
- The SE Template is currently under NRC management review
- Incorporate Lessons Learned from Harris SE into your LARs
  - Safe shutdown issues
  - Non-pilots must submit full description of Monitoring Program

Revising Inspection Procedures and Guidance in Support of NFPA 805

Plenary 8, Session 2
NEI Fire Protection Information Forum
Sept. 13-15, 2010
Dana Point, Ca

Sunil Weerakkody
Deputy Director-Fire Protection
NRC/NRR/DRA

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Agenda

- Fundamentals
- Inspection Scope
- Table Top Exercise
- Changes To-Date
- Work-in-Progress
- Next Steps

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Fundamentals

- Continued focus on defense-in-depth elements of fire safety

- Reliance on regional inspector expertise.

- Opportunities to receive external stakeholder input
  - Public Meetings
  - Harris self-inspection
  - Harris Triennial

- Increased reliance on risk-informed insights.

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Inspection Scope

- Quarterly Inspections
  - DID walkdown of 4-6 areas
  - Material Condition
  - Compensatory Measures
- Annual Inspections
  - Fire Brigade
- Triennial Inspections
  - Design
  - Operational Status
  - Material Condition

Progress To-Date

- Developed Draft Quarterly Inspection Procedure
- Developed Draft Annual Inspection Procedure
- Developed Draft Triennial Procedure
- Developed Formal Qual. Program for FP Inspectors.

Next Steps

- Table-Top of Triennial Inspection Procedure (IP) (Nov. 2010)(internal stakeholders only, RGN II)
- Category II Public Meeting (internal and external stakeholders, at Head Quarters, Dec. 2010)
- Establish Review Panel
- Inspect NFPA 805 Pilot Plants and Refine