Highlights of Fire Experiments and Modeling, 2003-2018

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

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

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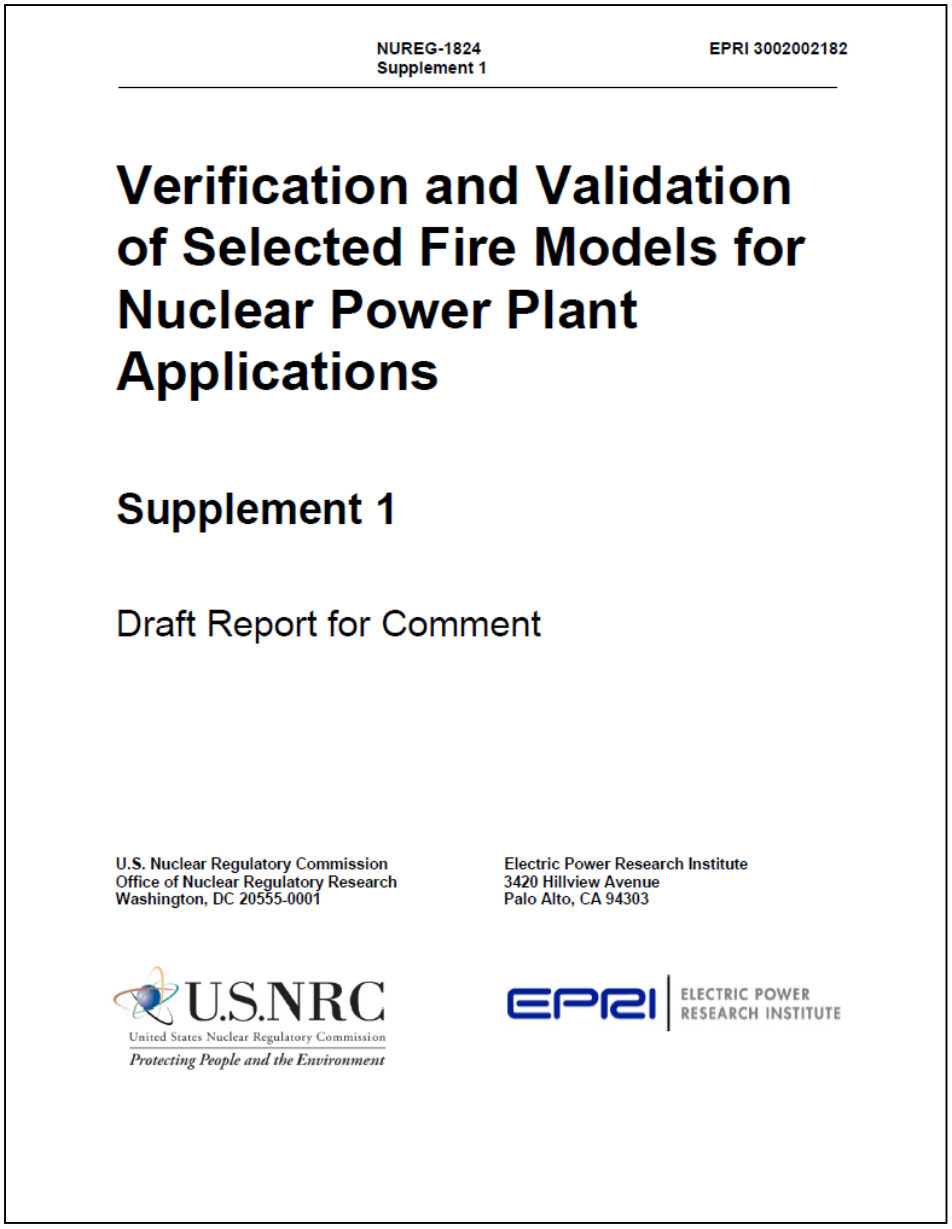
Fire Model Verification and Validation

NUREG-1824

44 sets of experiments; 860 individual experiments; 5000+ point to point comparisons



NUREG-1824
Supplement 1

EPRI 3002002182

Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications

Supplement 1

Draft Report for Comment

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

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

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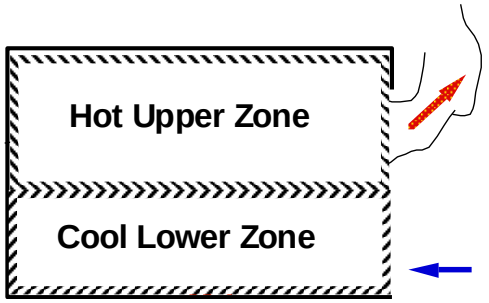
Models Selected for NRC/EPRI V&V Study

Fire Dynamics Tools (FDTs)	NRC Spreadsheets
FIVE-Rev1	EPRI Spreadsheets
Cons. Fire & Smoke Transport (CFAST)	NIST zone model
MAGIC (EPRI/MOU)	Électricité de France zone model
Fire Dynamics Simulator (FDS)	NIST CFD Model

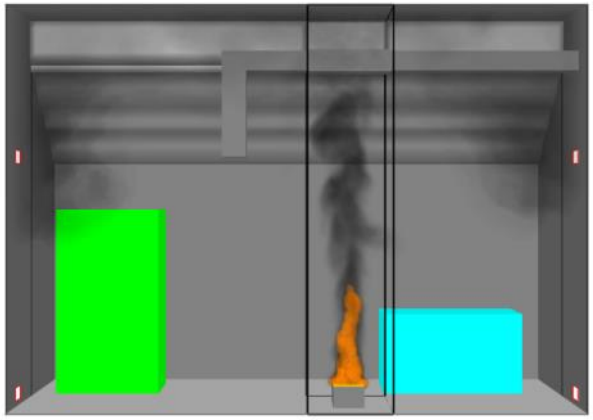
Empirical Models

$$L_f = 0.23\dot{Q}^{2/5} - 1.02D$$

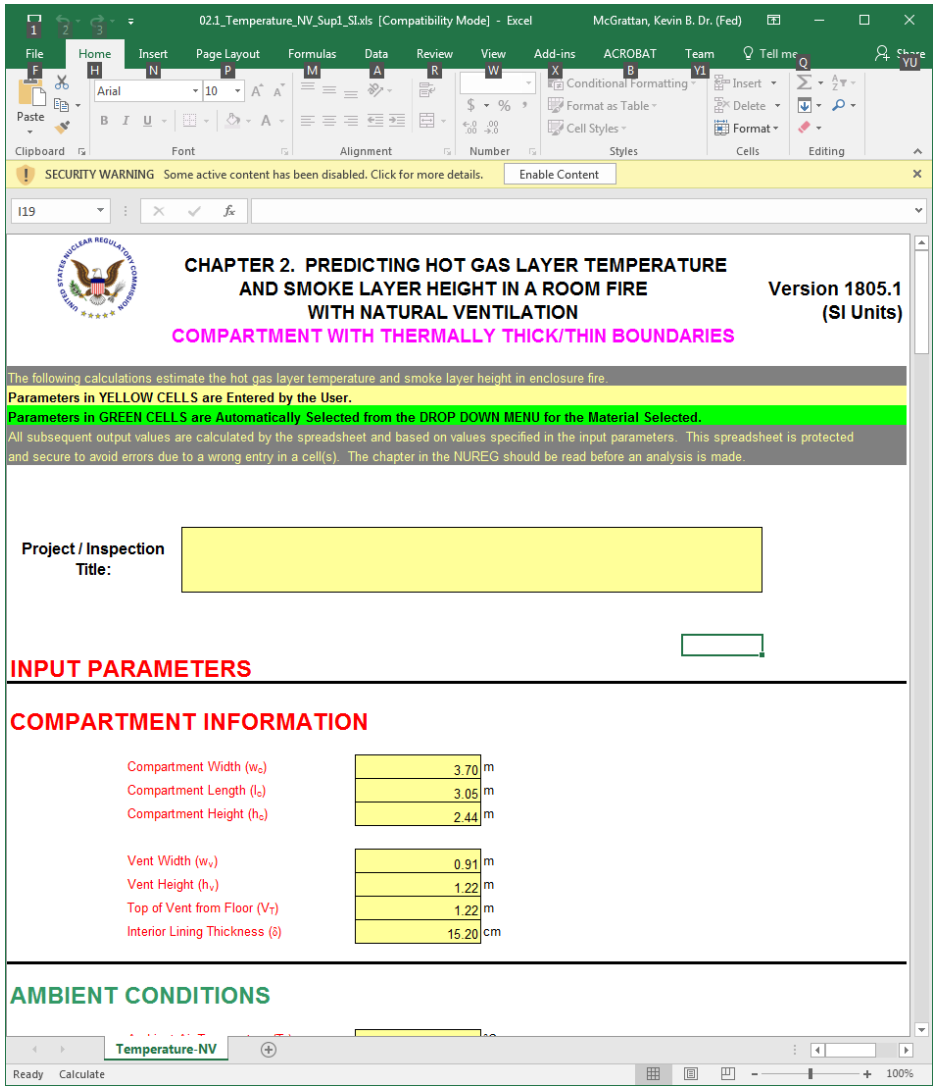
Zone Models

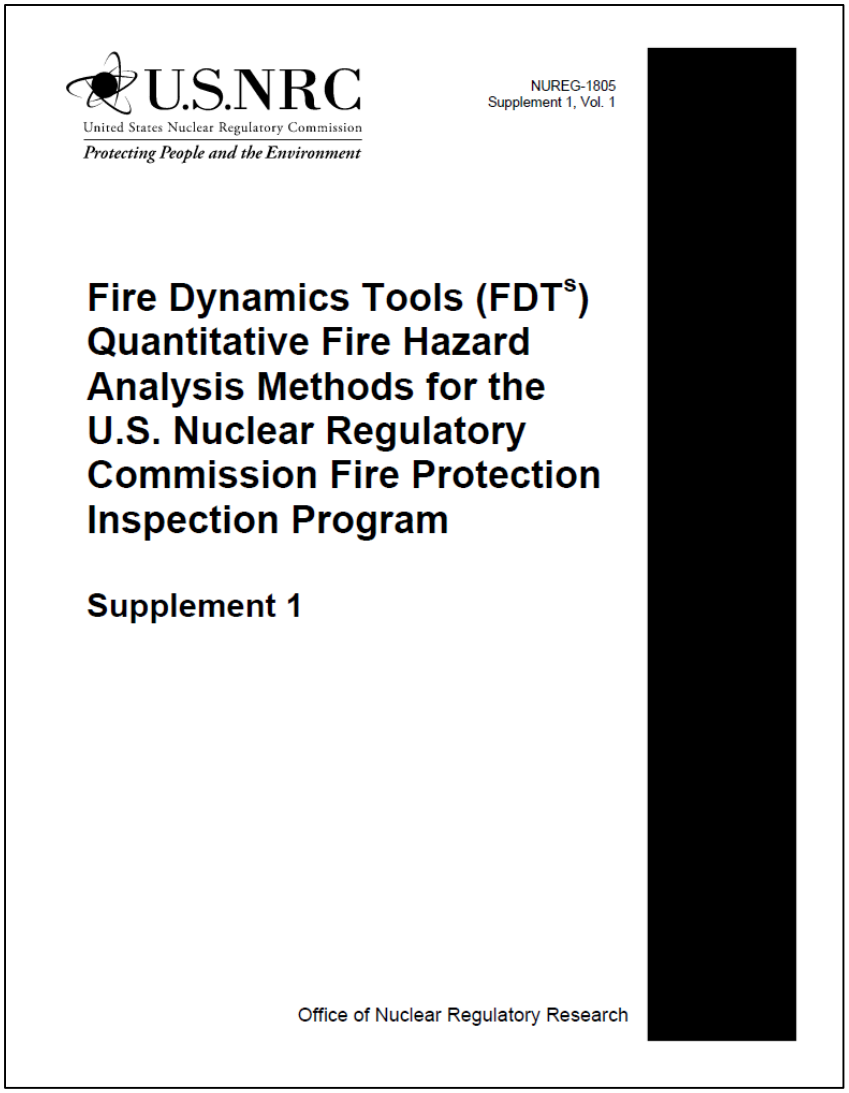


CFD Models

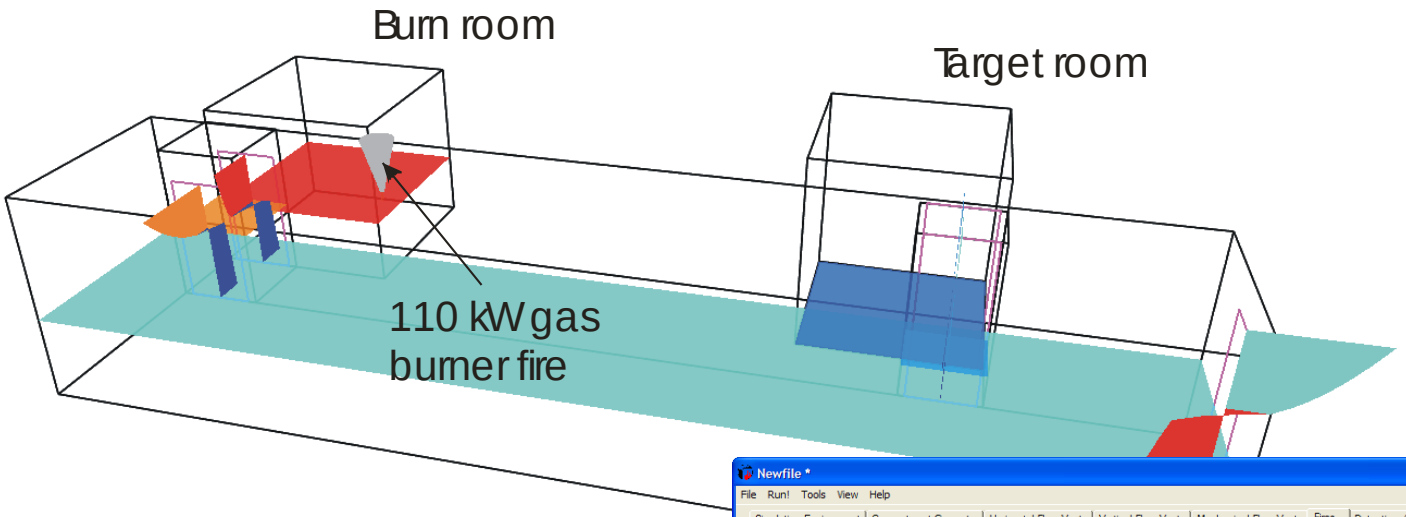


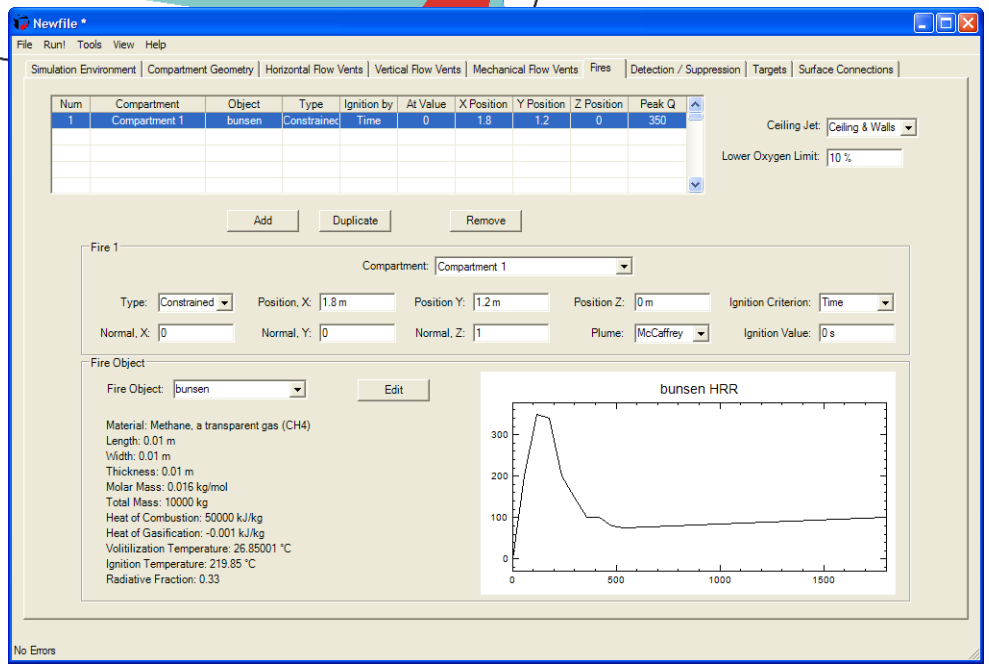
NUREG-1805: Fire Dynamics Tools



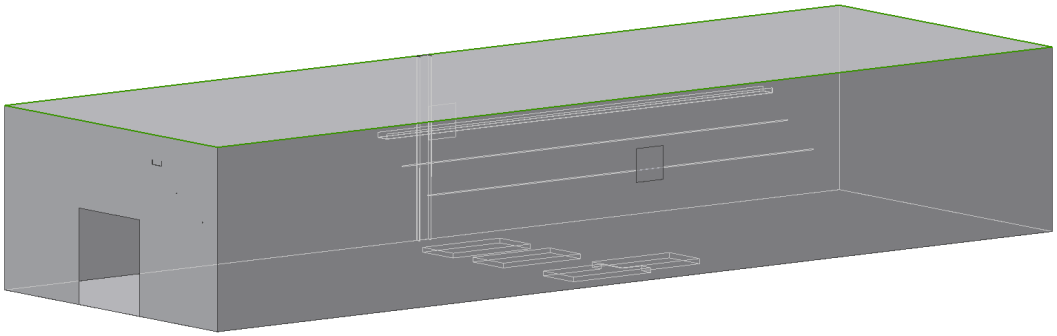


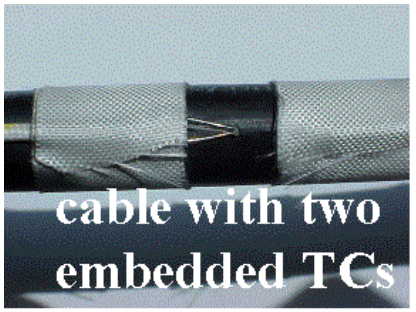
CFAST
Consolidated Fire And Smoke Transport

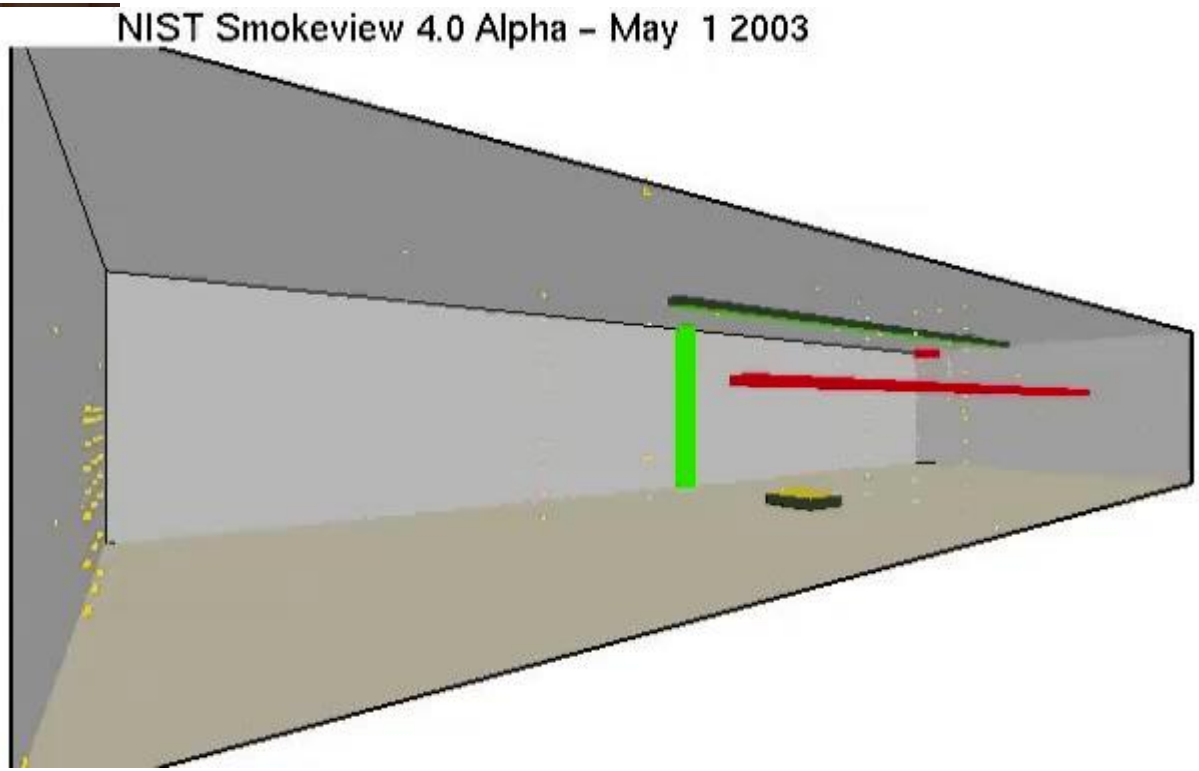




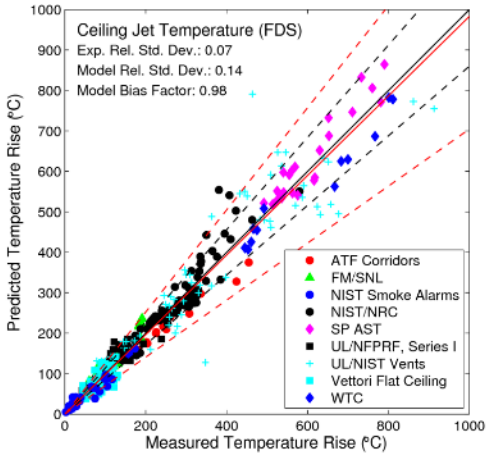
NIST/NRC Fire in a Switch Gear Room (2003)







Summary of NRC/EPRI validation study



Models of Interest

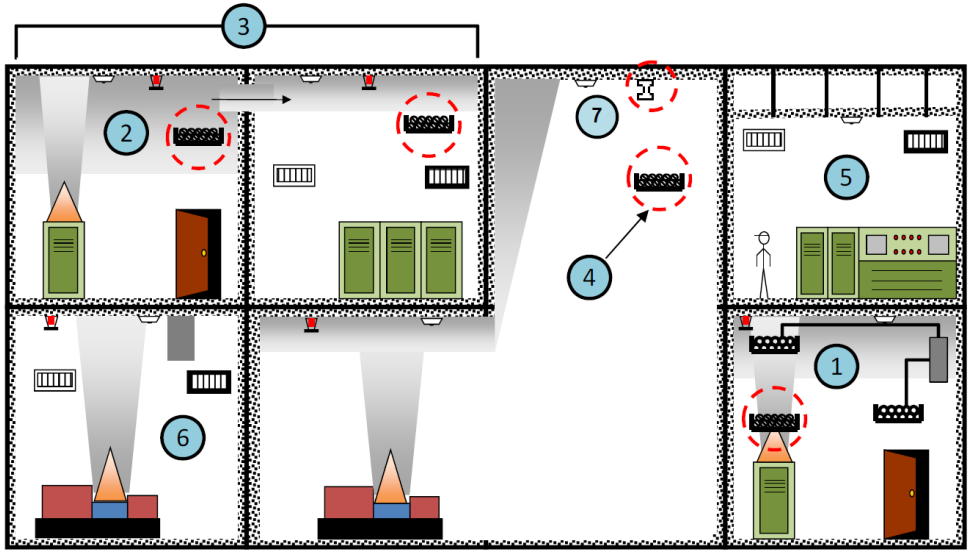
Quantities of Interest

Output Quantity	Empirical Correlations			CFAST		MAGIC		FDS		Exp
	Corr.	δ	$\tilde{\sigma}_M$	δ	$\tilde{\sigma}_M$	δ	$\tilde{\sigma}_M$	δ	$\tilde{\sigma}_M$	$\tilde{\sigma}_E$
HGL Temp. Rise, Natural	MQH	1.17	0.15	1.20	0.36	1.12	0.32	1.01	0.12	0.07
HGL Temp. Rise, Forced	FPA	1.29	0.32	1.15	0.20	1.08	0.17	1.21	0.22	0.07
	DB	1.18	0.25							
HGL Temp. Rise, Closed	Beyler	1.04	0.37	0.99	0.08	1.07	0.16	1.20	0.12	0.07
HGL Depth	ASET/YT	-	-	1.04	0.33	1.12	0.29	1.03	0.06	0.05
Ceiling Jet Temp. Rise	Alpert Unconfined	0.86	0.11	1.18	0.33	1.04	0.45	0.98	0.14	0.07
	Alpert Compartment	0.31	0.49							
Plume Temp. Rise	Heskestad	0.84	0.33	1.08	0.20	1.04	0.20	1.20	0.21	0.07
	McCaffrey	0.90	0.31							
Oxygen Concentration	N/A			1.00	0.15	0.93	0.22	1.01	0.11	0.08
Smoke Concentration	N/A			3.16	0.68	3.71	0.66	2.63	0.59	0.19
Pressure Rise	N/A			1.36	0.66	1.49	0.45	0.96	0.27	0.21
Target Temp. Rise	Steel	1.29	0.45	1.58	0.64	1.08	0.38	0.98	0.18	0.07
Target Heat Flux	Point Source	1.44	0.47	0.93	1.16	0.85	0.66	0.98	0.25	0.11
	Solid Flame	1.17	0.44							
Surface Temp. Rise	N/A			1.05	0.28	0.95	0.29	0.99	0.12	0.07
Surface Heat Flux	N/A			0.98	0.34	0.78	0.35	0.92	0.15	0.11
Cable Failure Time	THIEF	0.90	0.11	-	-	-	-	1.10	0.16	0.12
Sprinkler Activation Time	Sprinkler	1.11	0.41	0.80	0.21	0.93	0.20	0.93	0.15	0.06
Smoke Detector Activation Time	Temp. Rise	0.66	0.57	1.12	0.46	1.54	0.36	0.85	0.29	0.34
	Milke	0.65	0.60							
	Mowrer	0.11	0.50							

Nuclear Power Plant Fire Modeling Analysis Guidelines (FIRE MAG)

NUREG-1934
EPRI 1023259

November 2012



NUREG-1934 EPRI 1023259
Final Report

Nuclear Power Plant Fire Modeling Analysis Guidelines (NPP FIRE MAG)

Final Report

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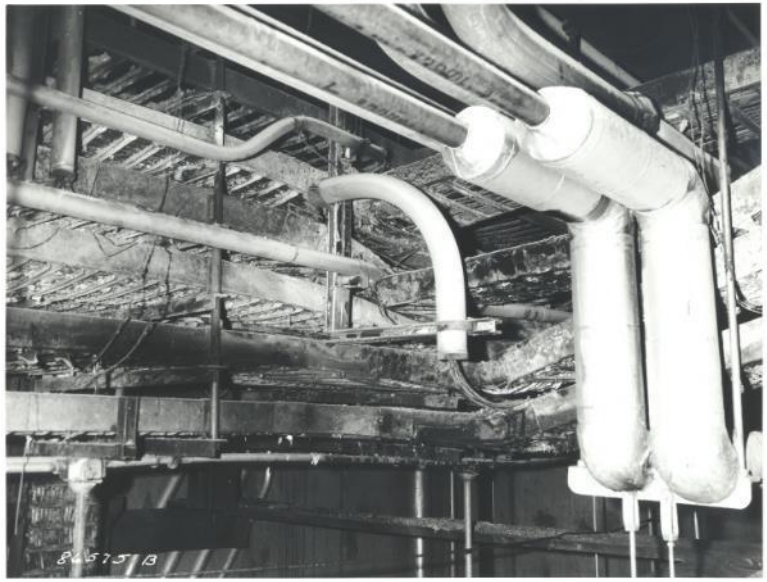
Fire Modeling PIRT (Phenomena Identification and Ranking Table November 2008

NUREG/CR-6978

What are the fire modeling challenges?



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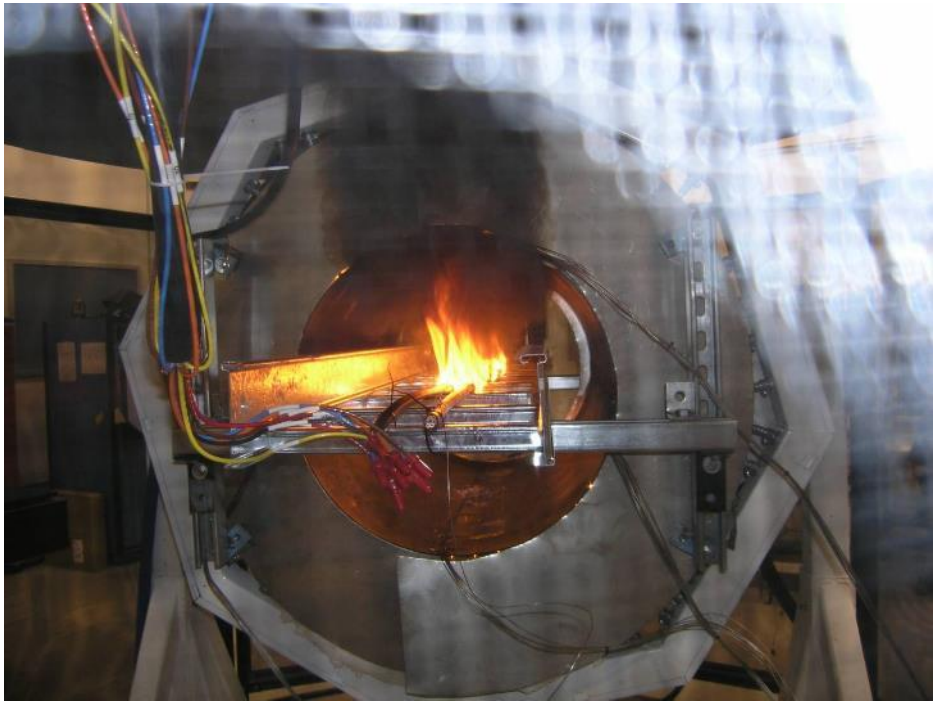
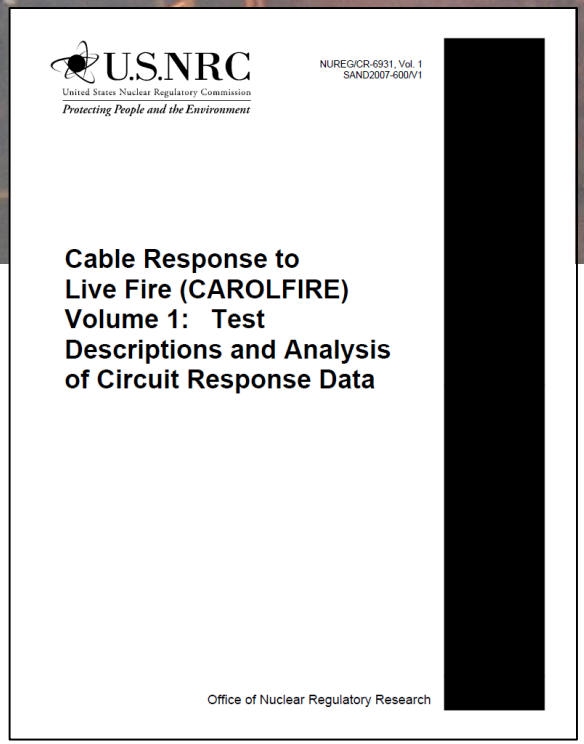
NUREG/CR-6978
SAND2008-3997P

A Phenomena Identification and Ranking Table (PIRT) Exercise for Nuclear Power Plant Fire Modeling Applications

Office of Nuclear Regulatory Research

CAROLFIRE: Cable Response to Live Fire

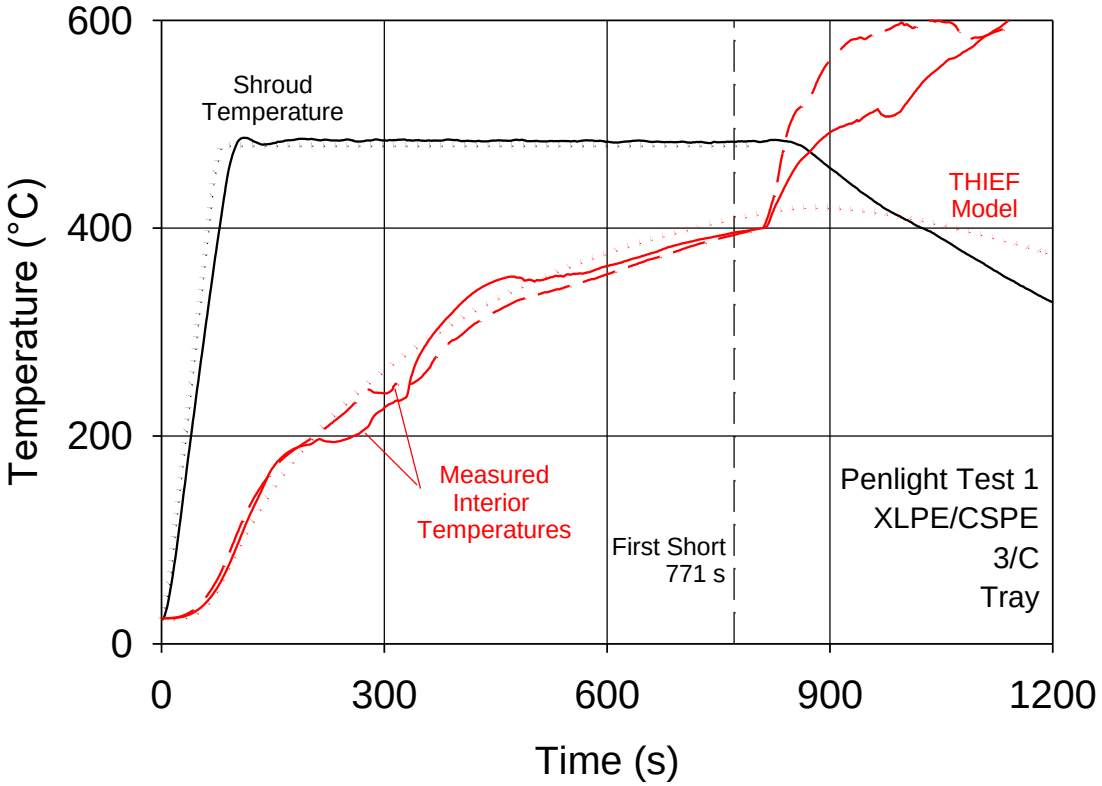




NUREG/CR-6931

Volume 1-3

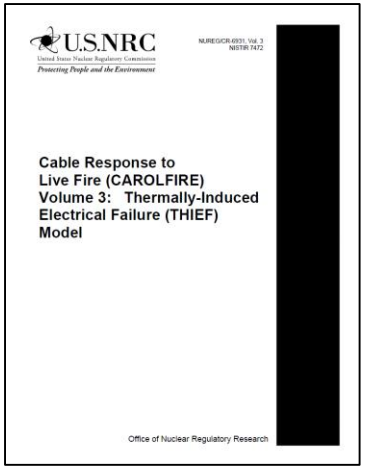
Thermally-Induced Electrical Failure (THIEF) Model



$$\rho c \frac{\partial T}{\partial t} = \frac{1}{r}\frac{\partial}{\partial r} k\, r \frac{\partial T}{\partial r}$$

NUREG/CR-6931

Volume 3



Cables used in CHRISTIFIRE

(Cable Heat Release, Ignition, Spread in Tray Installations in Fire)

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NUREG/CR-7010, Vol. 1

Cable Heat Release, Ignition, and Spread in Tray Installations During Fire (CHRISTIFIRE) Phase 1: Horizontal Trays

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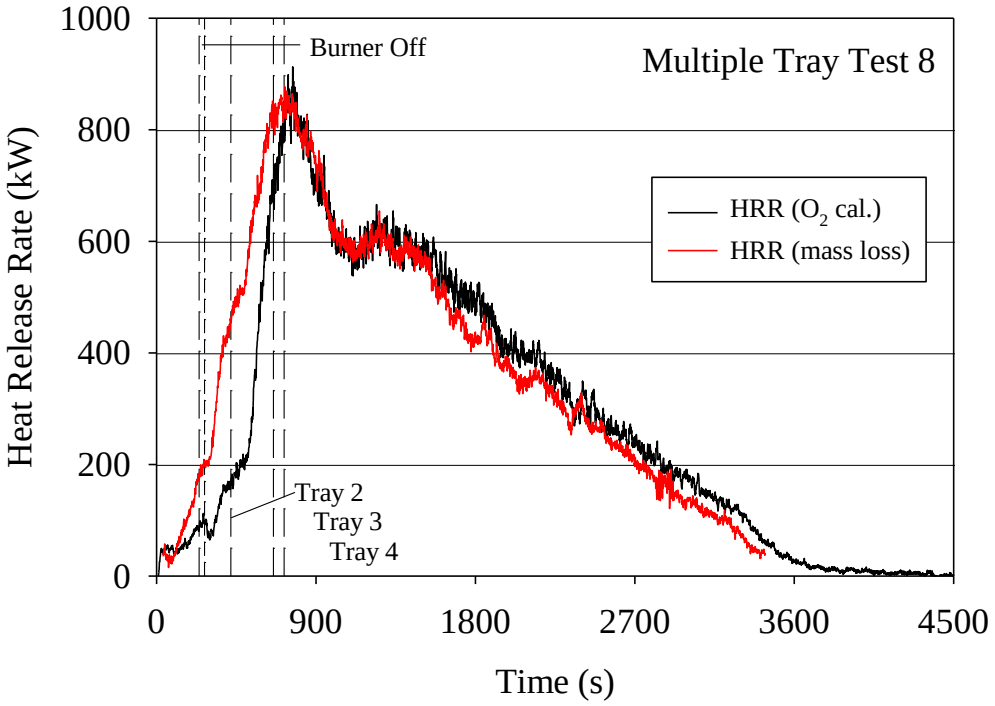
NUREG/CR-7010, Vol. 2

Cable Heat Release, Ignition, and Spread in Tray Installations During Fire (CHRISTIFIRE) Phase 2: Vertical Shafts and Corridors

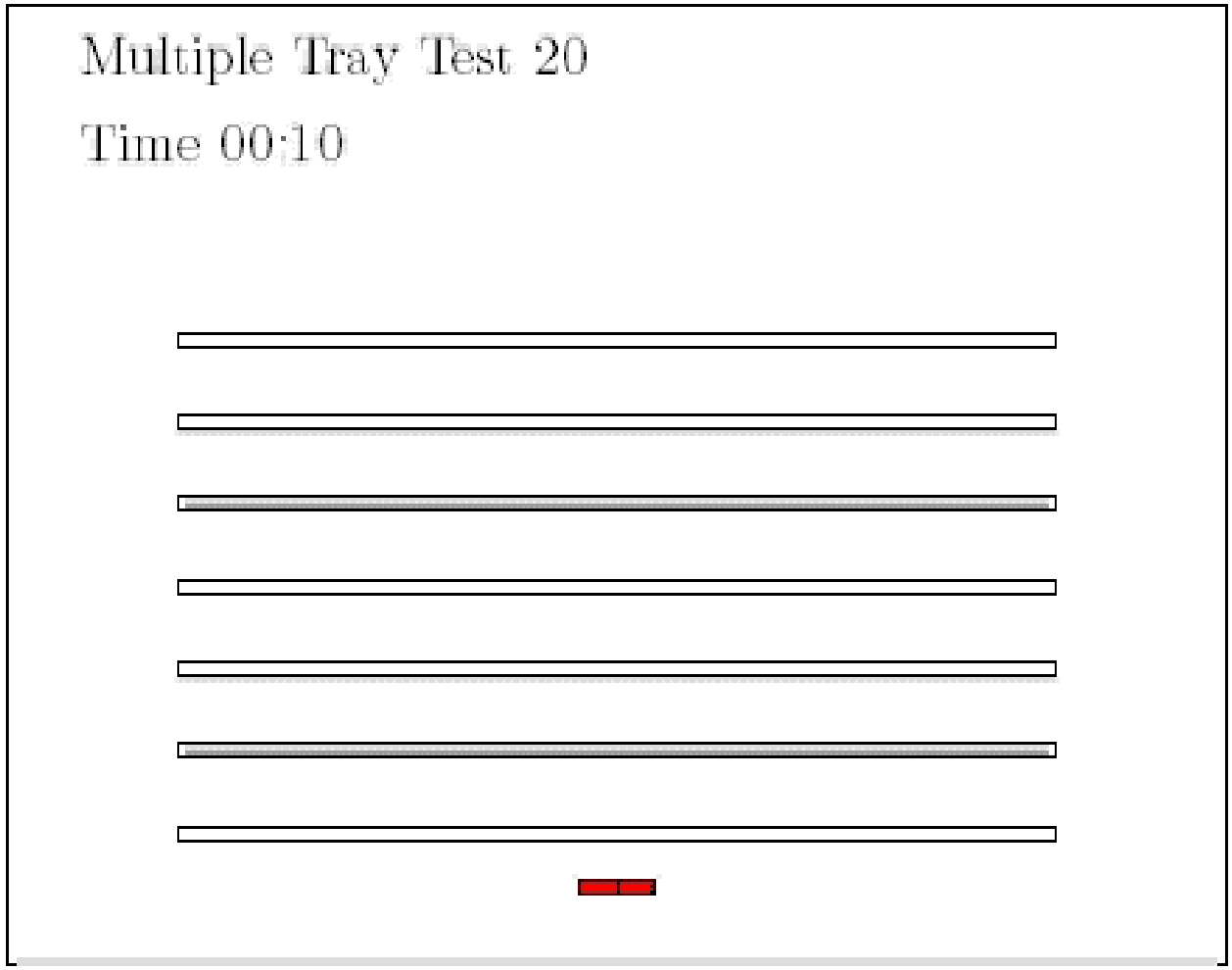
Office of Nuclear Regulatory Research

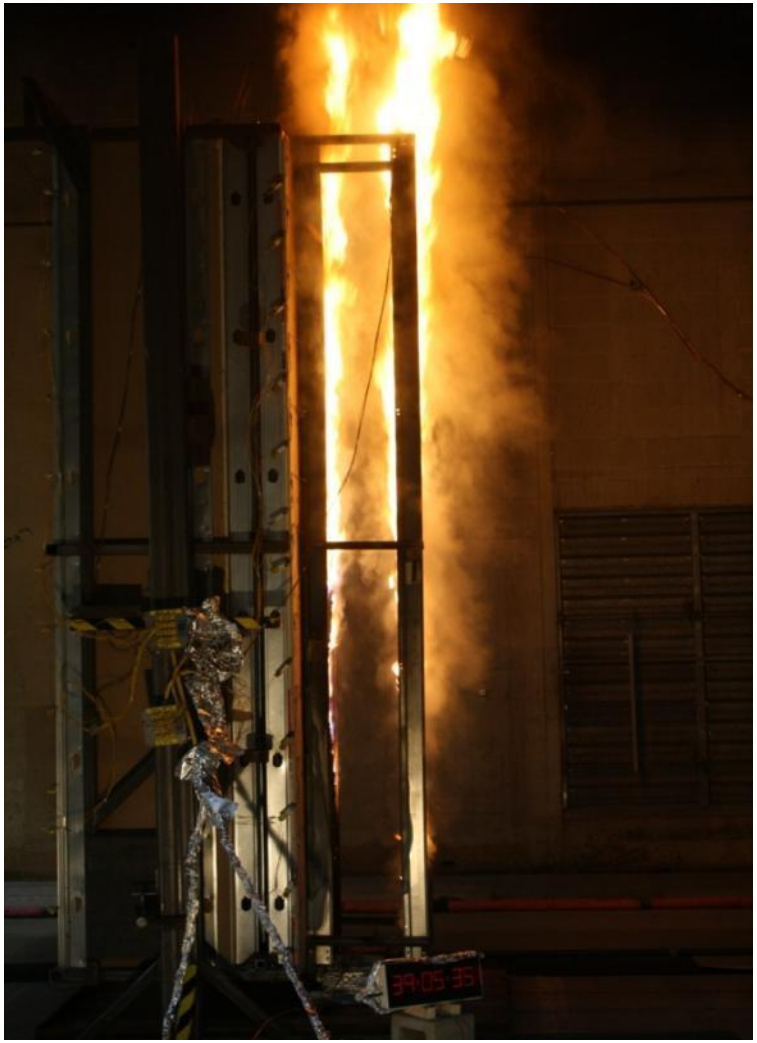
NUREG/CR-7010, Volumes 1 and 2



Thermoplastic Cable

FLASH-CAT: Flame Spread in Horizontal Cable Trays



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NUREG/CR-7197

Heat Release Rates of Electrical Enclosure Fires (HELEN-FIRE)

Final Report

Office of Nuclear Regulatory Research

NUREG-2178, Vol. 1 EPRI 3002005578

Refining And Characterizing Heat Release Rates From Electrical Enclosures During Fire (RACHELLE-FIRE)

Volume 1:
Peak Heat Release Rates and
Effect of Obstructed Plume

Final Report

U.S. Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
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NUREG/CR-7197

NUREG/CR-2178





PEMS SYSTEM
DANGER
HIGH VOLTAGE

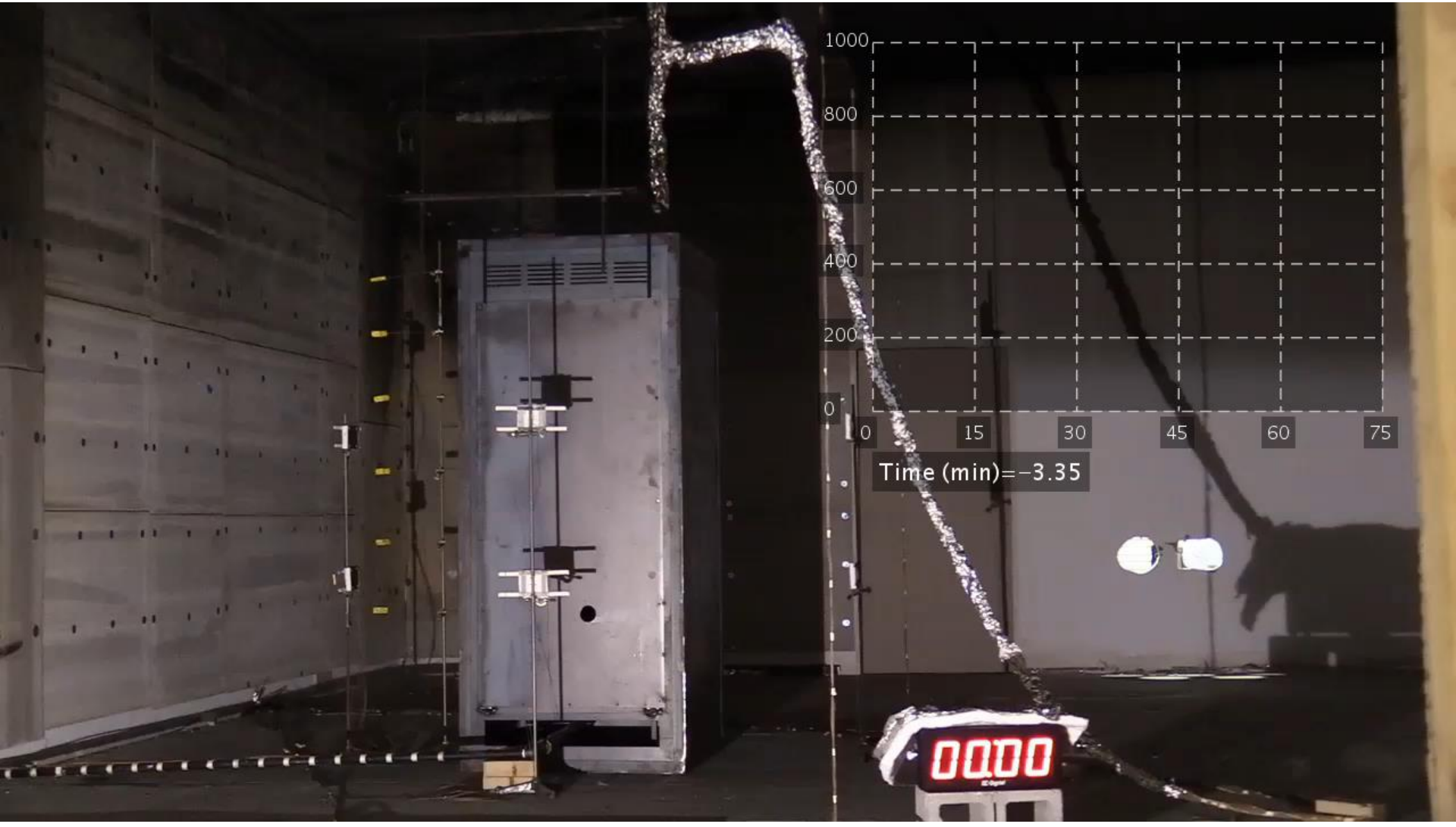

STAY CLEAR

Open electrical cabinet, 0.6 m by 0.6 m by 2.1 m

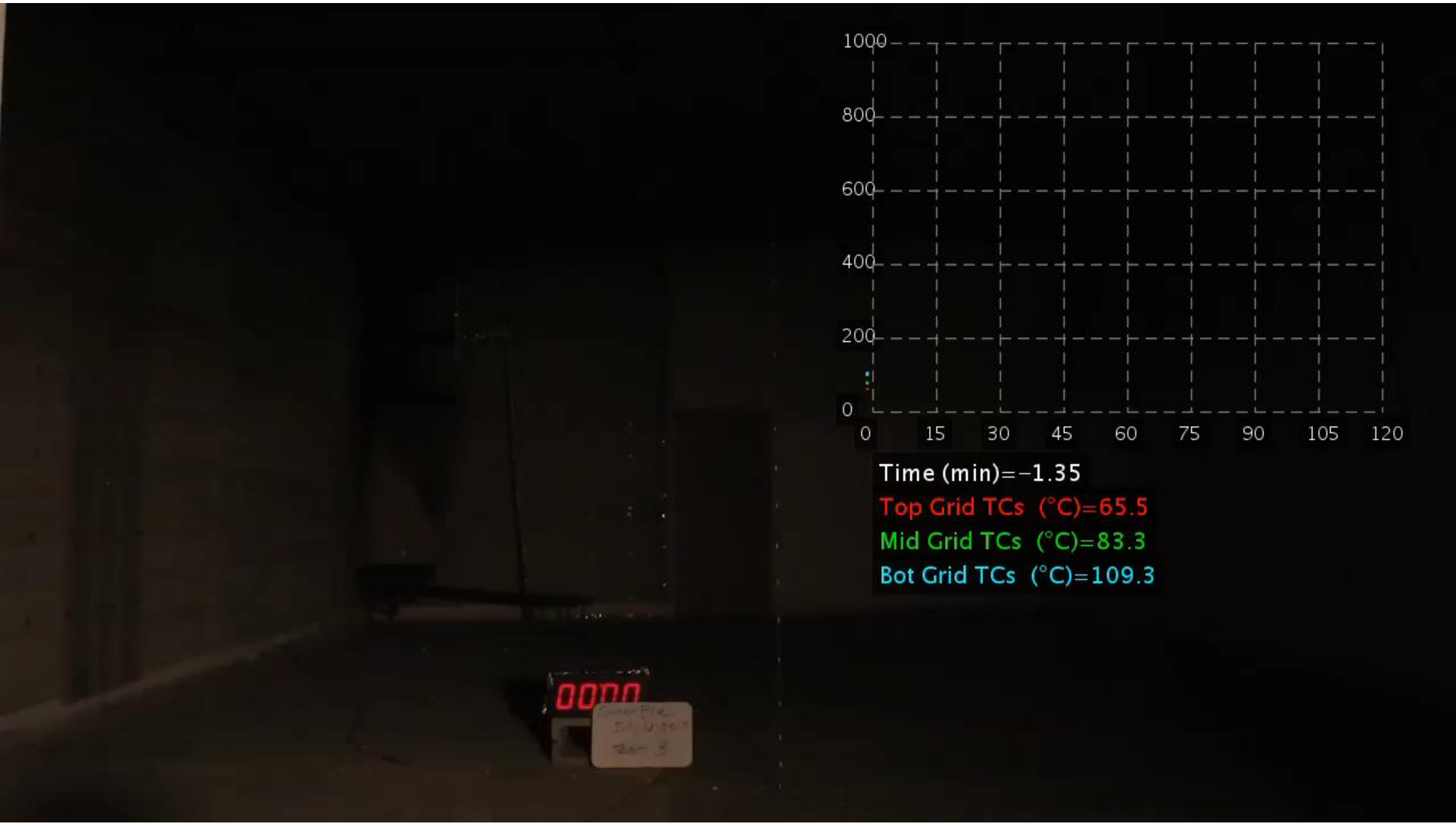
Thermoset cables placed on each side

Loose, unjacketed, thermoplastic insulated wire

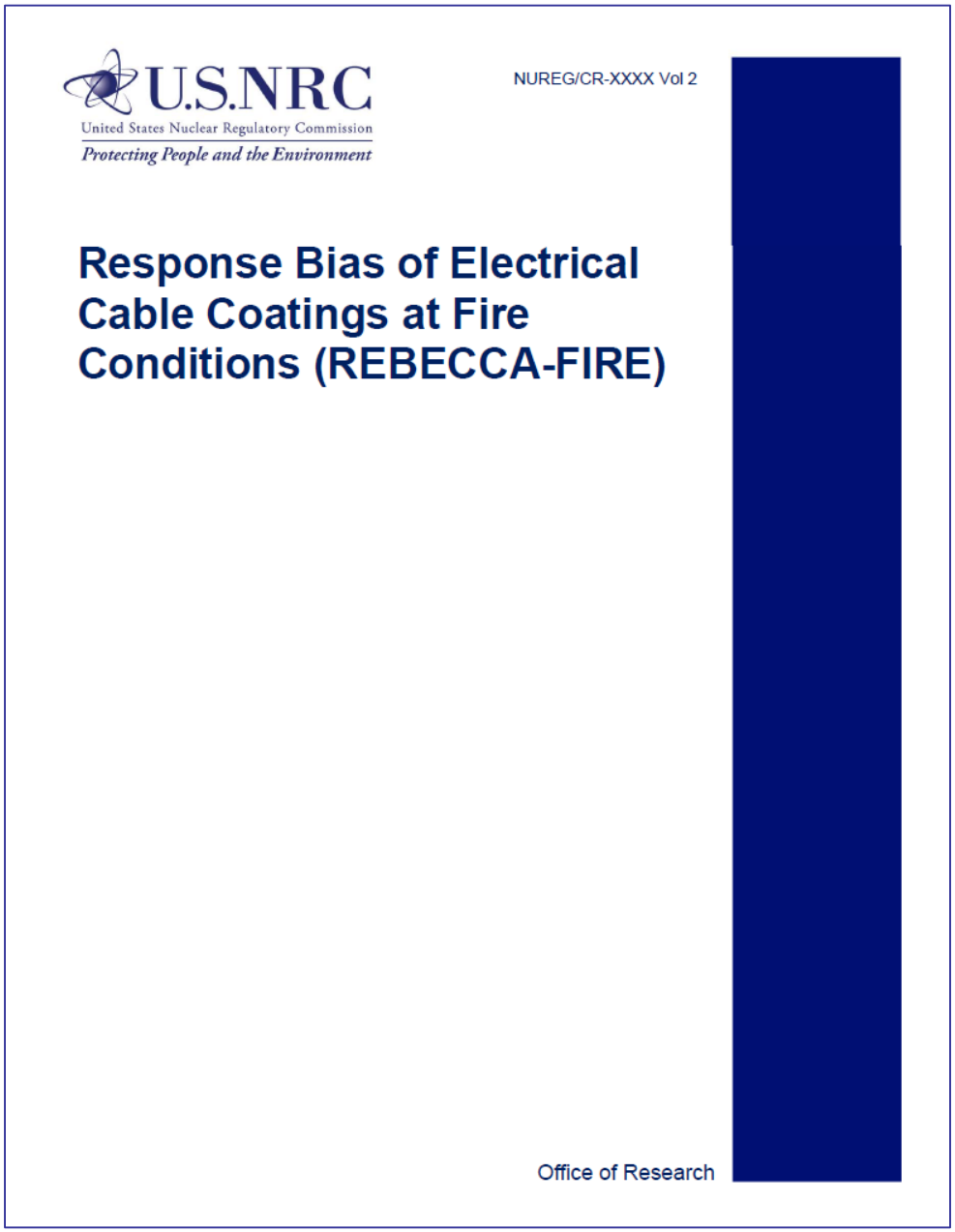
RACHELLE-FIRE Validation: Obstructed Plumes
NIST Technical Note 1984



RACHELLE-FIRE Validation: Corner Plumes
NIST Technical Note 1984



RACHELLE-FIRE Validation: Wall Plumes
NIST Technical Note 1984

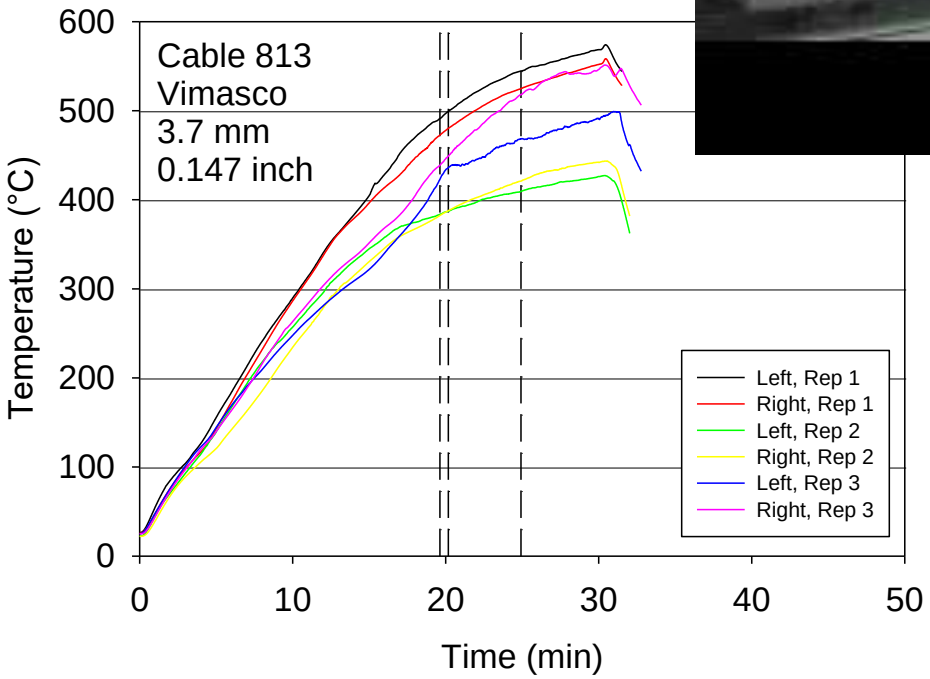


To be published as a NUREG/CR

IEC* 60331-11

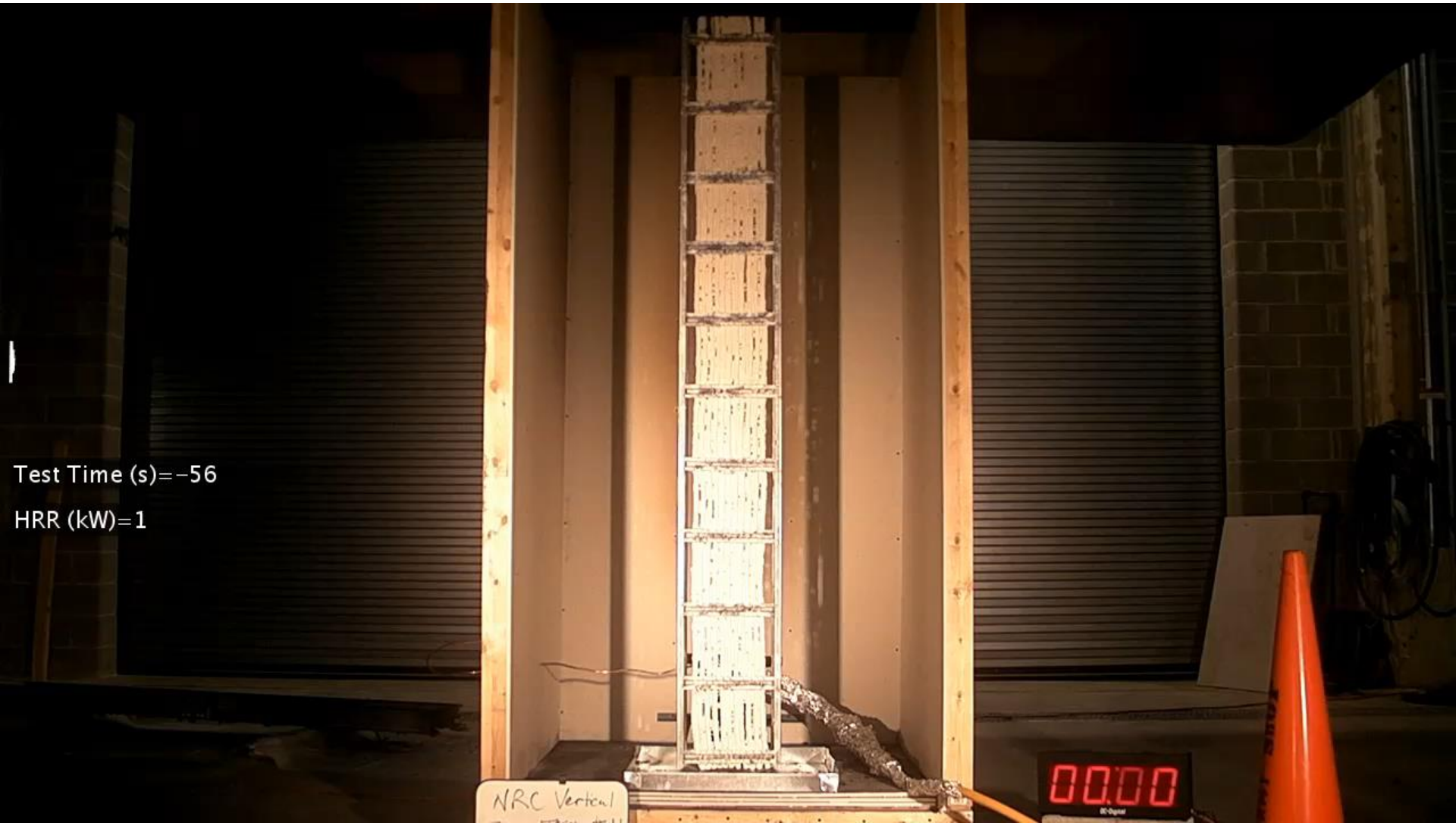
Tests for Electric Cables under Fire Conditions – Circuit Integrity

*International Electrotechnical Commission

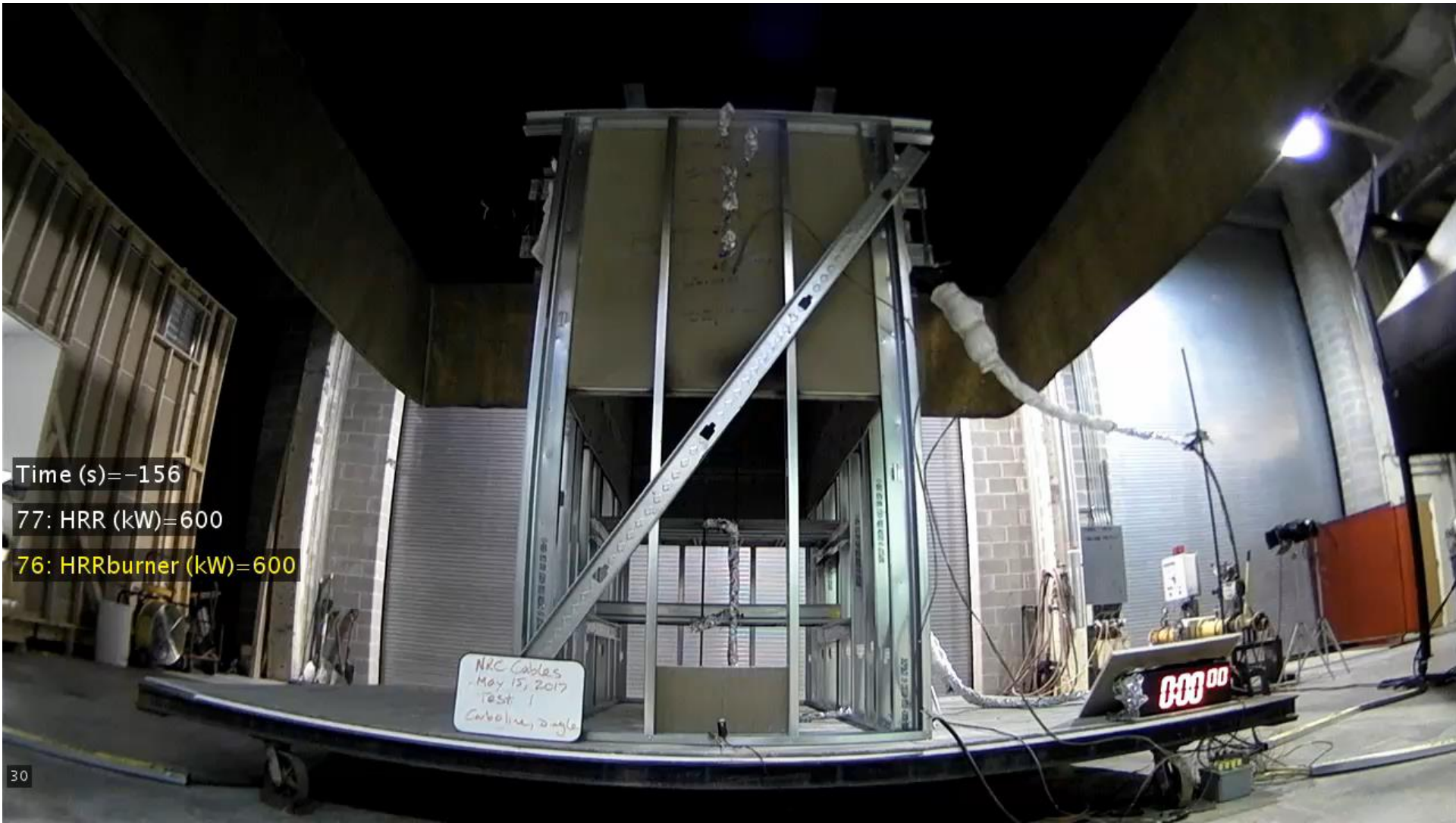


Vertical Tray of Unqualified Electrical Cables

Vertical Tray of Unqualified Electrical Cables, Coated



Coated and Uncoated Cables within the Fire, Fire Plume, and Hot Gas Layer



NUREG/CR-6886, Rev. 1
PNNL-15313

Spent Fuel Transportation Package Response to the Baltimore Tunnel Fire Scenario

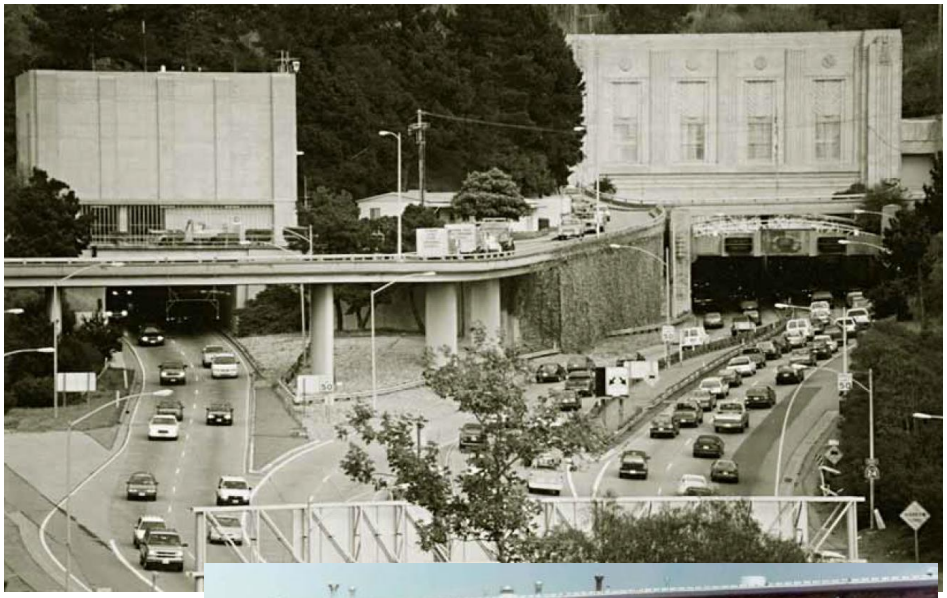
Final Report

Pacific Northwest National Laboratory

U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards
Washington, DC 20555-0001

NUREG/CR-6886, Revision 1

Caldecott Tunnel Fire
Oakland, California
April 7, 1982



NUREG/CR-6894, Rev. 1
PNNL-15346

Spent Fuel Transportation Package Response to the Caldecott Tunnel Fire Scenario

Pacific Northwest National Laboratory

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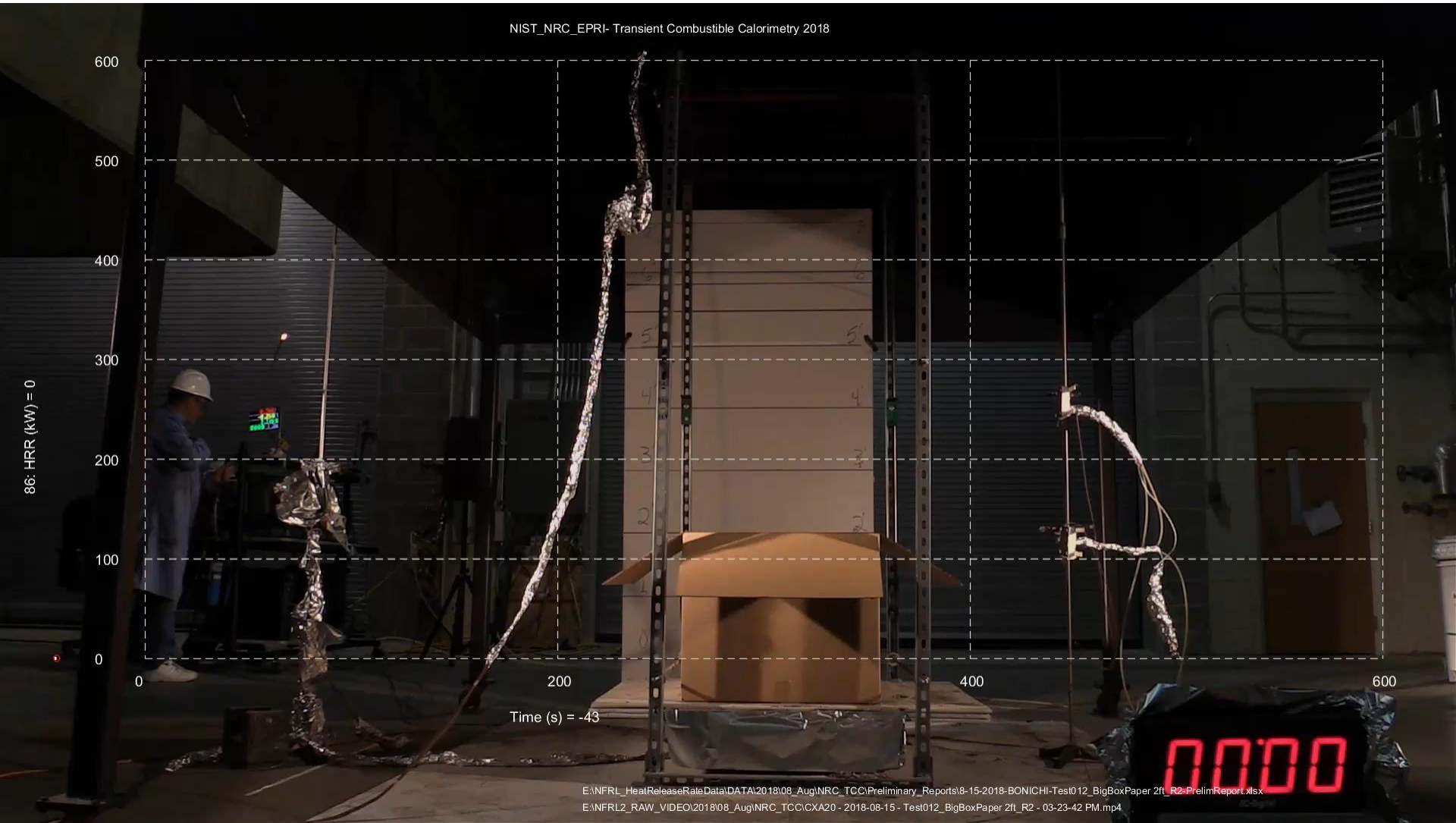
Washington, DC 20555-0001

NUREG/CR-6894, Revision 1

Recent Activity: Heat Release Rate of Transient Combustibles



Plastic work cart with printer and laptop computer