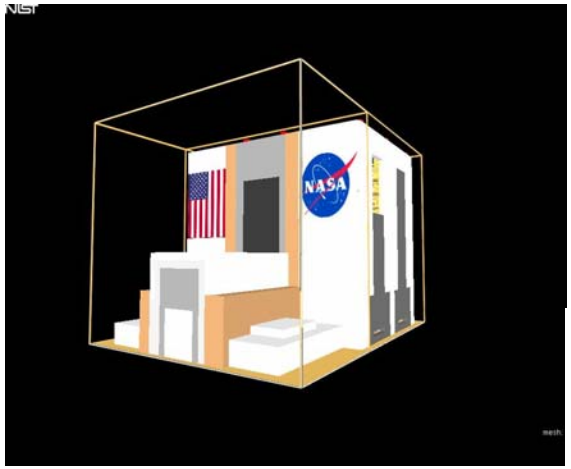
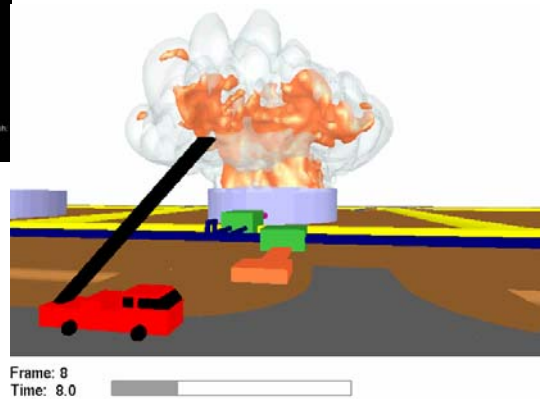
FDS Development

Kevin McGrattan

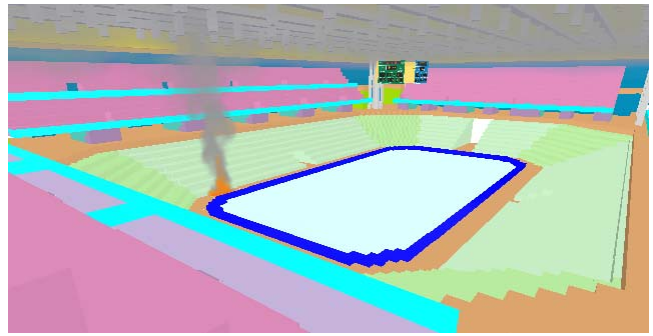
Building and Fire Research Laboratory
National Institute of Standards and Technology
Gaithersburg, Maryland, USA



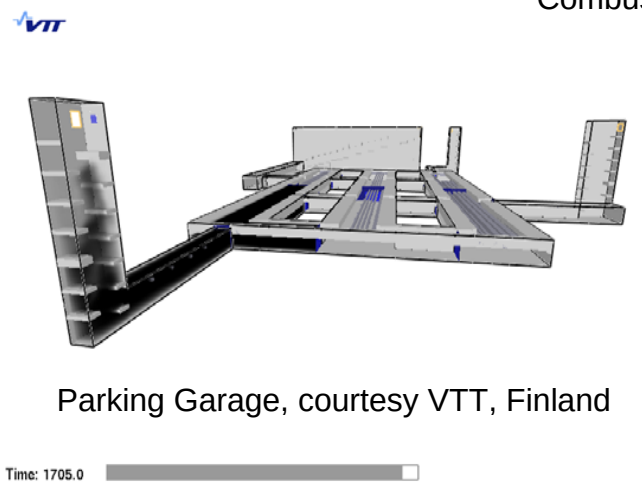
NASA Vehicle Assembly Building
Kennedy Space Center
courtesy Rolf Jensen



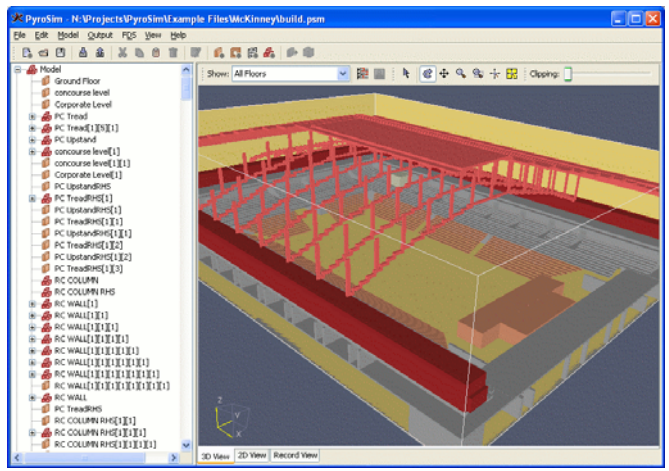
Tank Fire Analysis, courtesy
Combustion Science and Engineering



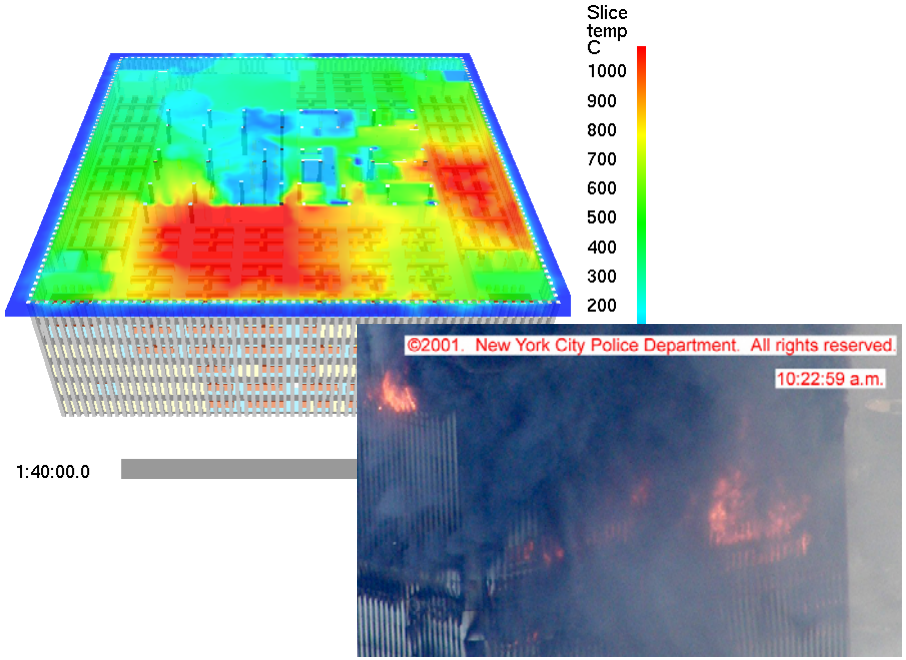
2006 Olympic Ice Hockey Stadium,
Turin, Italy, courtesy Arup



Parking Garage, courtesy VTT, Finland



PyroSim, courtesy Thunderhead
Engineering Consultants, Manhattan, Kansas



World Trade Center Investigation

Kevin McGrattan, Chuck Bouldin, Glenn Forney

Figure 5-43. Initial growth of fire on foam at corner of the alcove (10 seconds)

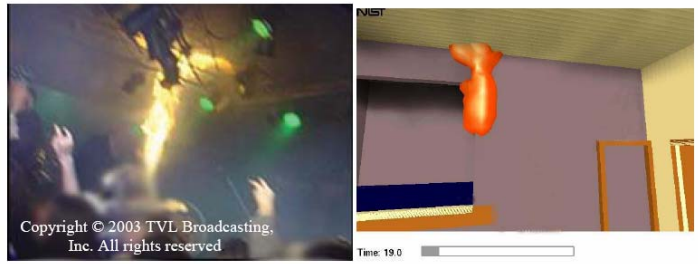
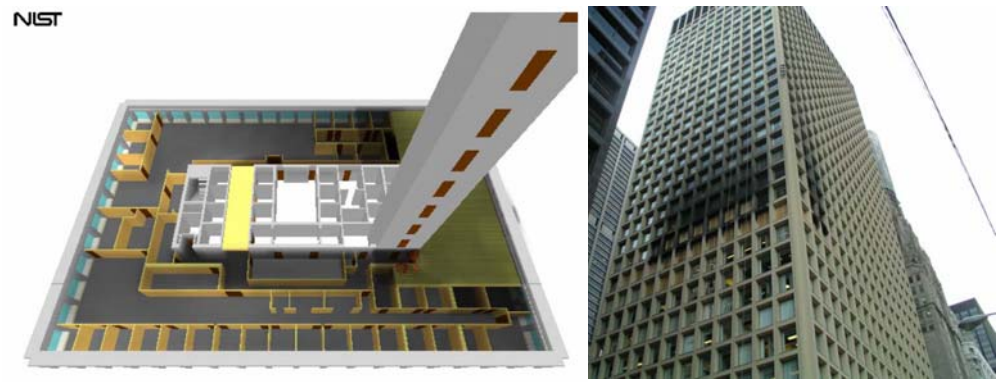


Figure 5-44. Flames impinging on ceiling (19 seconds)

The Station Nightclub Fire

Dan Madrzykowski and Steve Kerber



Cook County Administration Building Fire

69 West Washington, Chicago, Illinois, October 17, 2003

Doug Walton and Dan Madrzykowski

Since 2000, the US Nuclear Regulatory Commission has participated in an international effort to evaluate fire models for nuclear power plant applications.

NIST has participated, evaluating FDS and CFAST, along with modelers and experimentalists from:

Fire Research Station, UK (JASMINE)

GRS, Germany (COCOSYS, CFX)

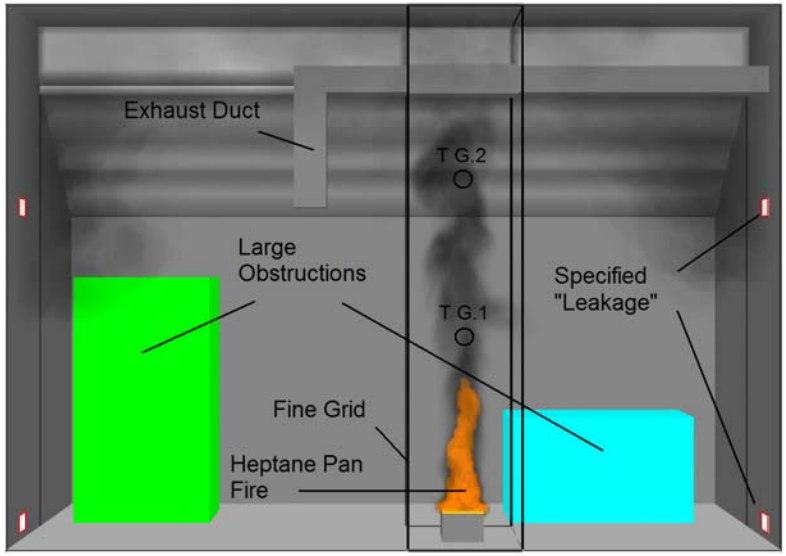
iBMB, Germany (Validation Experiments)

Électricité de France (Magic)

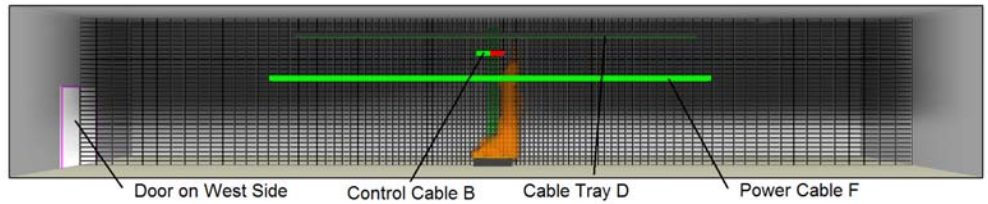
IPSN, France (Flamme-S)

VTT, Finland (Validation Experiments)

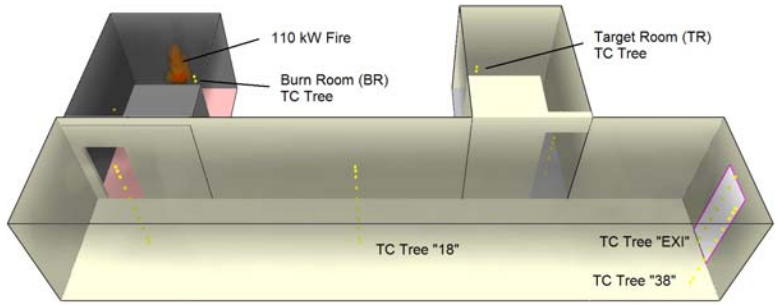
VTT, Finland



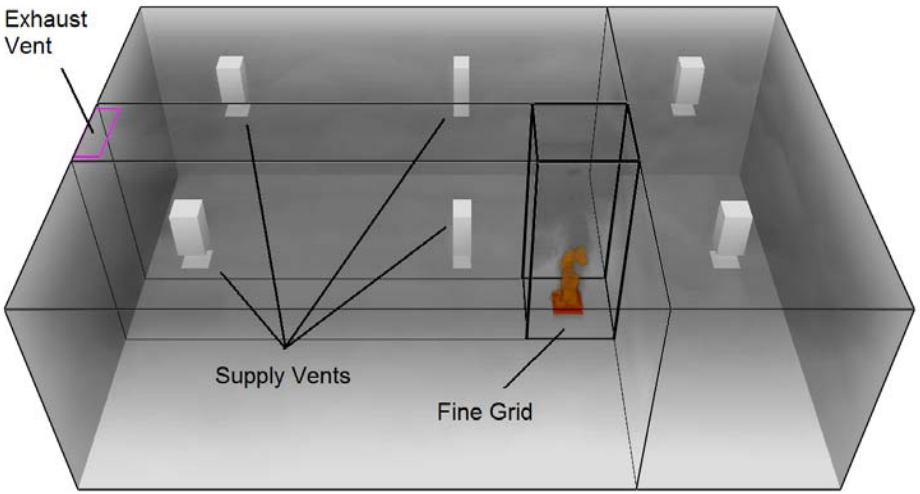
NIST, USA



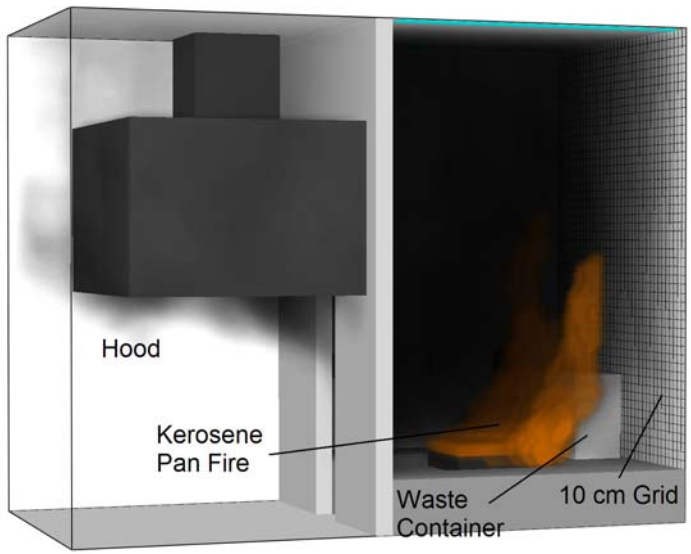
NBS, USA



Sandia/FM (USA)



iBMB, Germany



NUREG-1824
Draft for Comment

EPRI 1011999
Preliminary Report

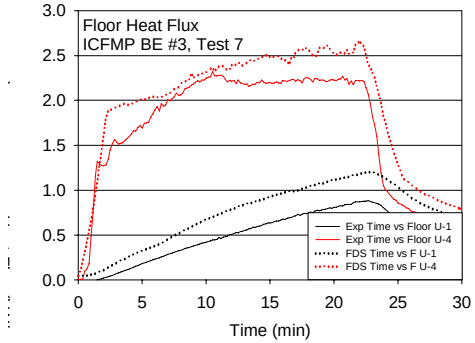
Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications

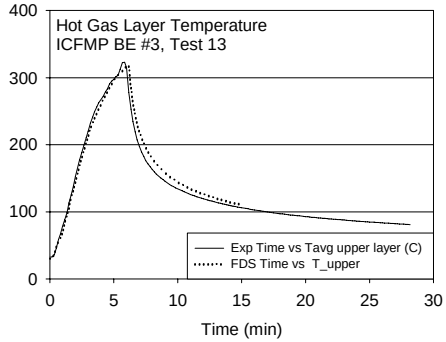
Volume 1: Main Report

December 2005

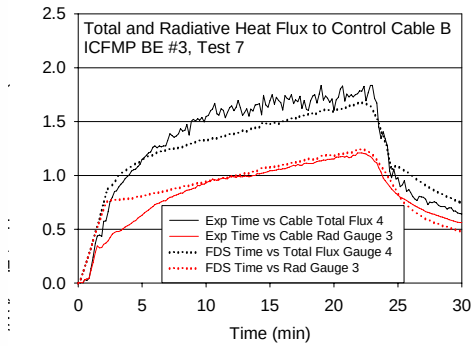
U.S. Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
Washington, DC 20555-0001

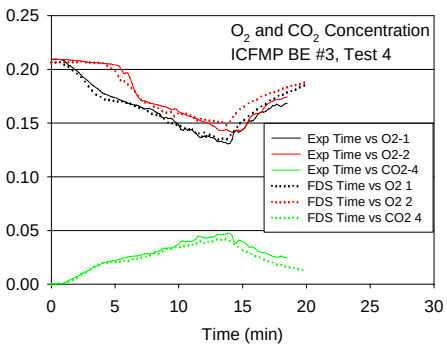
Electric Power Research Institute
3412 Hillview Avenue
Palo Alto, CA 94303

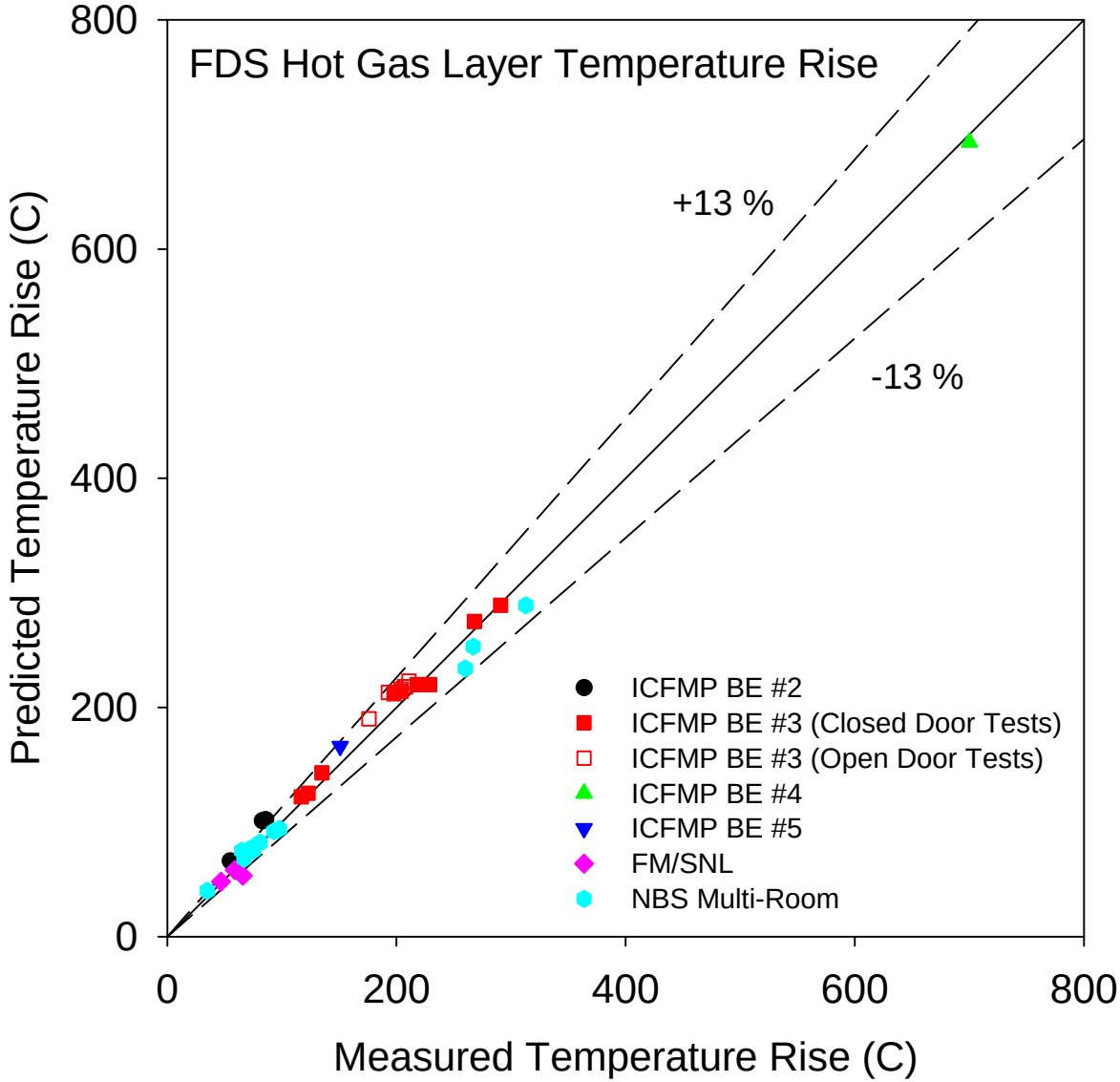


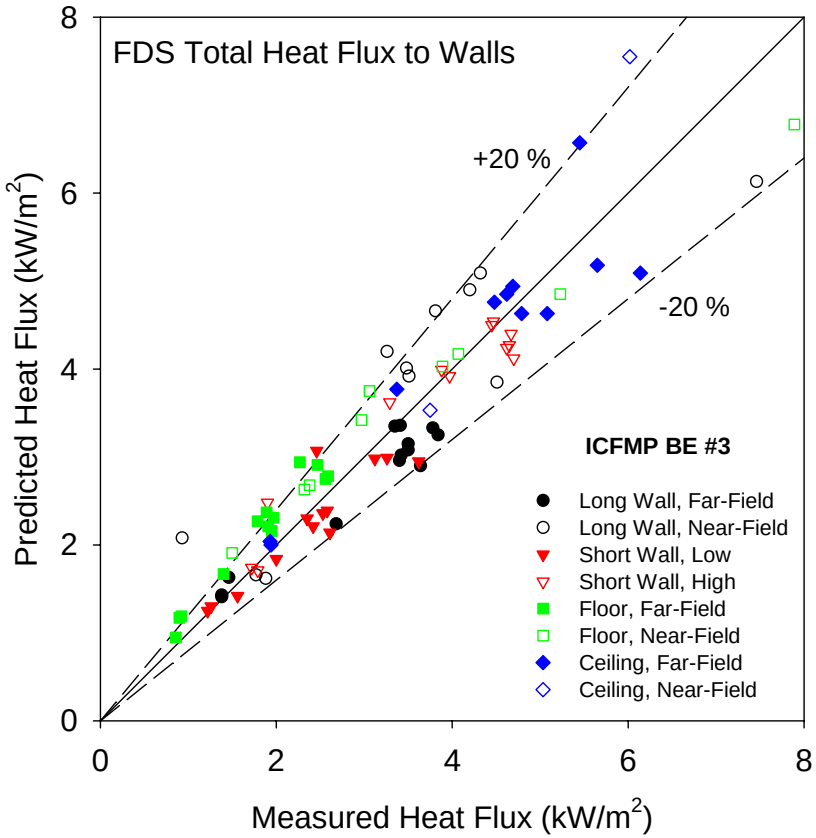


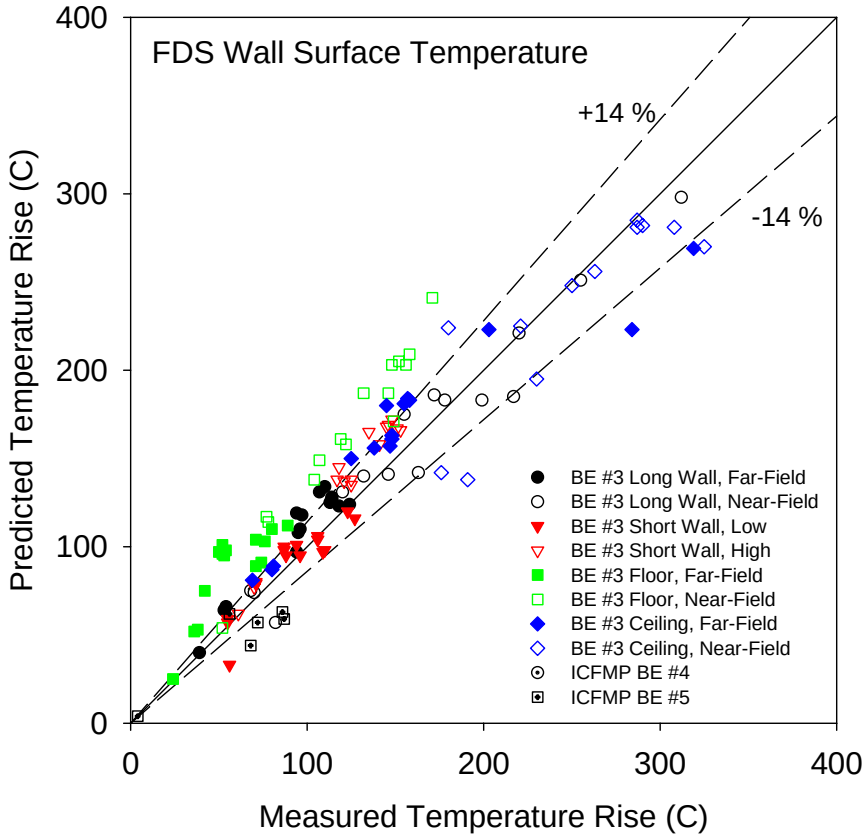
		HGL Temperature Rise			HGL Depth		
		Exp. (°C)	FDS (°C)	Rel. Diff. (%)	Exp. (m)	FDS (m)	Rel. Diff. (%)
BE #2	Case1	55	66	21	14.6	14.9	3
	Case2	86	102	18	14.8	15.3	4
	Case3	83	101	23	13.9	14.1	2
	Test 1	123	125	2	3.0	3.0	-1
		117	122	5	3.1	3.0	-1
		229	220	-4	3.0	2.9	-3
		218	220	1	3.0	2.9	-2
		204	214	5	3.0	2.9	-2
		198	212	7	3.2	2.9	-9
	BE #4 Test 1						
	BE #5 Test 4						
FM/SNL	Test 4						
	Test 5						
		21					
	EXI	--	92	--	2.2	2.1	-4
	BR	260	234	-10	1.2	1.1	-2
	18	65	75	16	1.2	1.2	-1
	38	67	68	2	1.2	1.4	13
	TR	35	40	14	1.5	1.5	-1

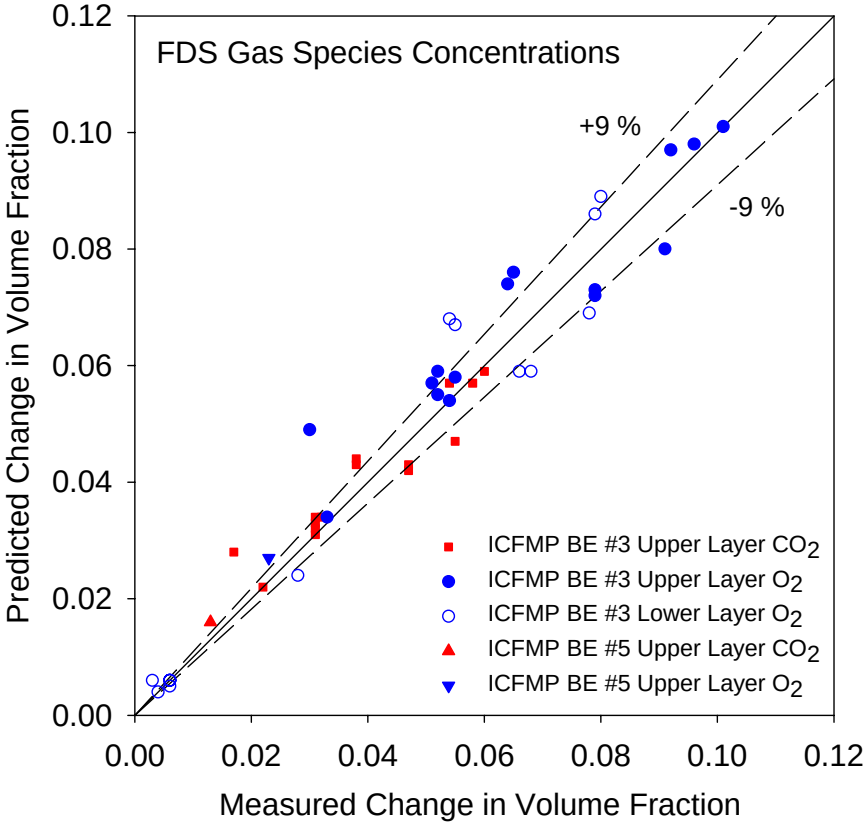


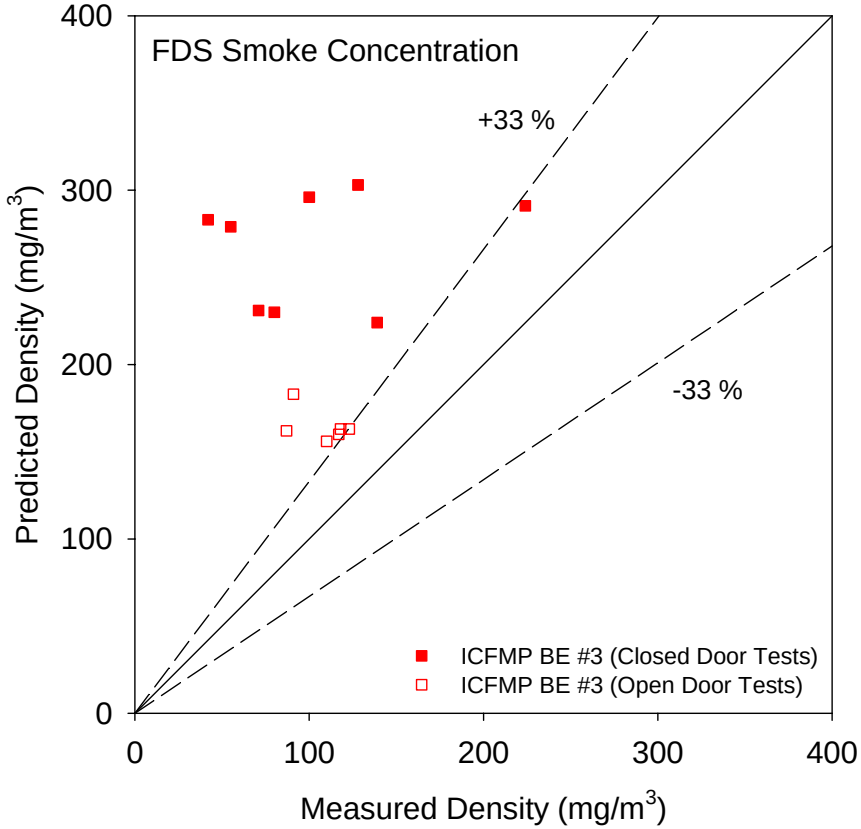



FDS Hot Gas Layer Temperature Rise
+13 %
-13 %
ICFMP BE #2
ICFMP BE #3 (Closed Door Tests)
ICFMP BE #3 (Open Door Tests)
ICFMP BE #4
ICFMP BE #5
FM/SNL
NBS Multi-Room
Predicted Temperature Rise (C)
Measured Temperature Rise (C)
0
200
400
600
800


FDS Total Heat Flux to Walls
+20 %
-20 %
ICFMP BE #3
Long Wall, Far-Field
Long Wall, Near-Field
Short Wall, Low
Short Wall, High
Floor, Far-Field
Floor, Near-Field
Ceiling, Far-Field
Ceiling, Near-Field
Predicted Heat Flux (kW/m2)
Measured Heat Flux (kW/m2)
0
2
4
6
8


FDS Wall Surface Temperature
+14 %
-14 %
BE #3 Long Wall, Far-Field
BE #3 Long Wall, Near-Field
BE #3 Short Wall, Low
BE #3 Short Wall, High
BE #3 Floor, Far-Field
BE #3 Floor, Near-Field
BE #3 Ceiling, Far-Field
BE #3 Ceiling, Near-Field
ICFMP BE #4
ICFMP BE #5
Predicted Temperature Rise (C)
Measured Temperature Rise (C)
0
100
200
300
400


FDS Gas Species Concentrations
+9 %
-9 %
ICFMP BE #3 Upper Layer CO_2
ICFMP BE #3 Upper Layer O_2
ICFMP BE #3 Lower Layer O_2
ICFMP BE #5 Upper Layer CO_2
ICFMP BE #5 Upper Layer O_2
Predicted Change in Volume Fraction
Measured Change in Volume Fraction
0.00
0.02
0.04
0.06
0.08
0.10
0.12


FDS Smoke Concentration
+33 %
-33 %
ICFMP BE #3 (Closed Door Tests)
ICFMP BE #3 (Open Door Tests)
Predicted Density (mg/m^3)
Measured Density (mg/m^3)
0
100
200
300
400

Where are we going?

Multi-Step Combustion – Floyd, McGrattan, Trouve, Hu

Improved Solid Phase and Charring – Hostikka, *et al*., VTT Finland

Improved Parallel Processing – McGrattan and Baum

Improved Visualization of Smokeview – Forney

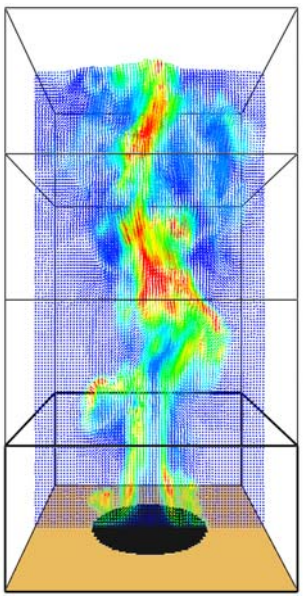
Continued Support for FDS user community -- McGrattan

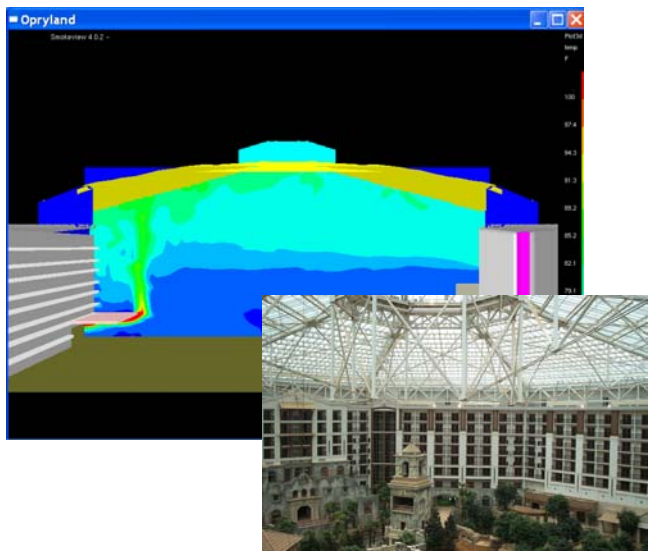
Continued Validation Work – NIST, NRC, SFPE, Sandia *et al*.

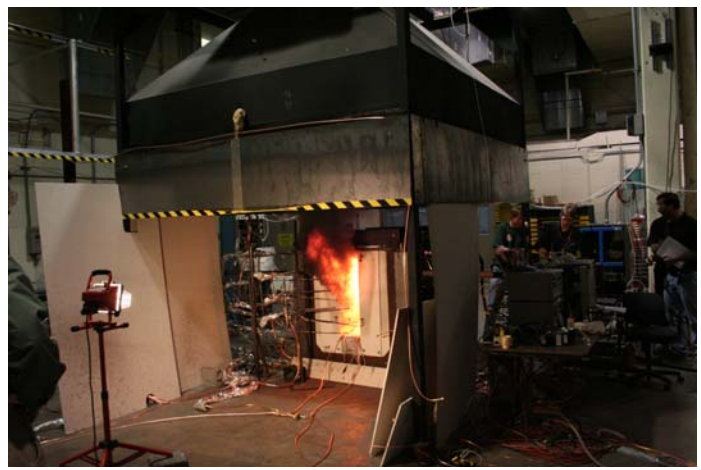
Wildland Fire – Mell, Maranghides, Rehm *et al*.

J Floyd, Hughes

Y Xin, FM Global





Courtesy, Schirmer Engineering

Courtesy, Matt Bundy, NIST