

# Selection and Responsible Use of Fire Models

Morgan Hurley  
Technical Director  
Society of Fire Protection Engineers



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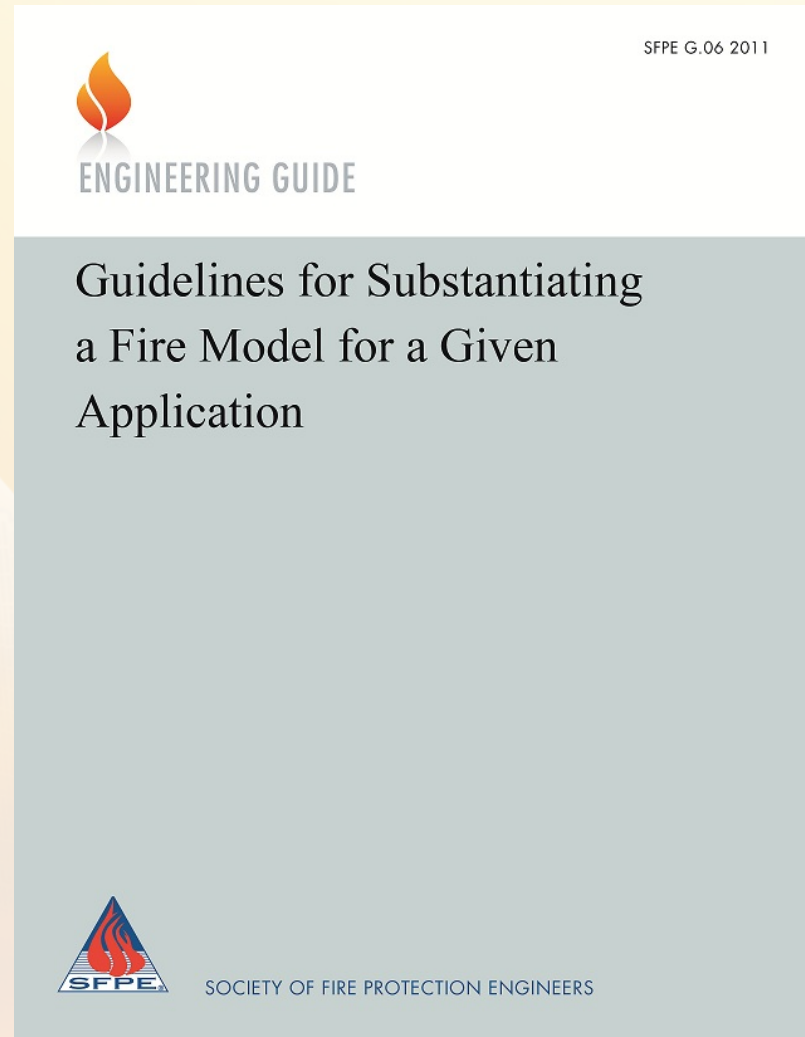


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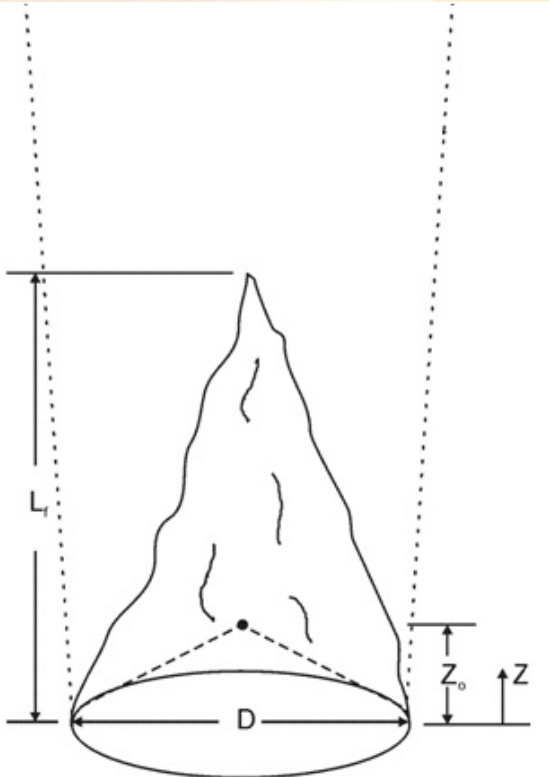
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# Impetus

- Computer models are increasingly being used in building design, post-fire analysis, and research
- Modeler and their stakeholders should have confidence in model results



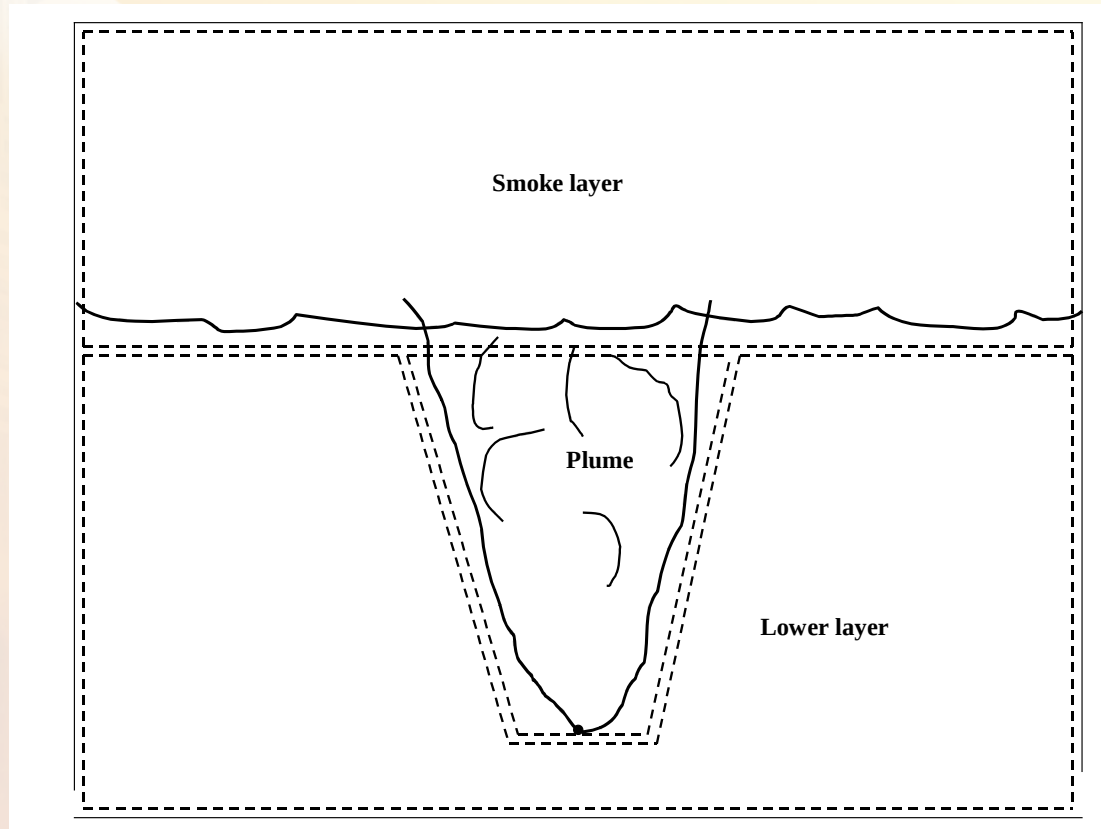
# Types of Models



$$\Delta T = 25 \dot{Q}_c^{2/3} (z - z_0)^{-5/3}$$

## Correlations

# Types of Models



## Zone Models

# Types of Models



Field (CFD)  
Models

# Other Evaluation Guides

## ASTM E-1355

- First published in 1990
- Model definition and evaluation scenarios
- Verification of theoretical basis and model assumptions
- Verification of mathematical and numerical robustness
- Quantification of uncertainty and accuracy

# SFPE's Activity

- ASTM E-1355 process impractical for individual project-scale applications
- SFPE assembled a task group in 2007
- Draft guide released for review and comment in late 2009/early 2010
- Publication in late 2010

# Guide Organization

- Introduction/Definitions
- Define the Problem of Interest
- Select a Candidate Model
- Verification and Validation
- User Effects
- Documentation
- Appendices

# General Background

- Frequency of model(s) use and range of applications increasing in recent years
  - Smoke movement, flame spread, fire growth, etc.
- Fire model correlations also becoming more complicated/difficult to understand as models become more sophisticated
- Is a model being used appropriately for the particular application?

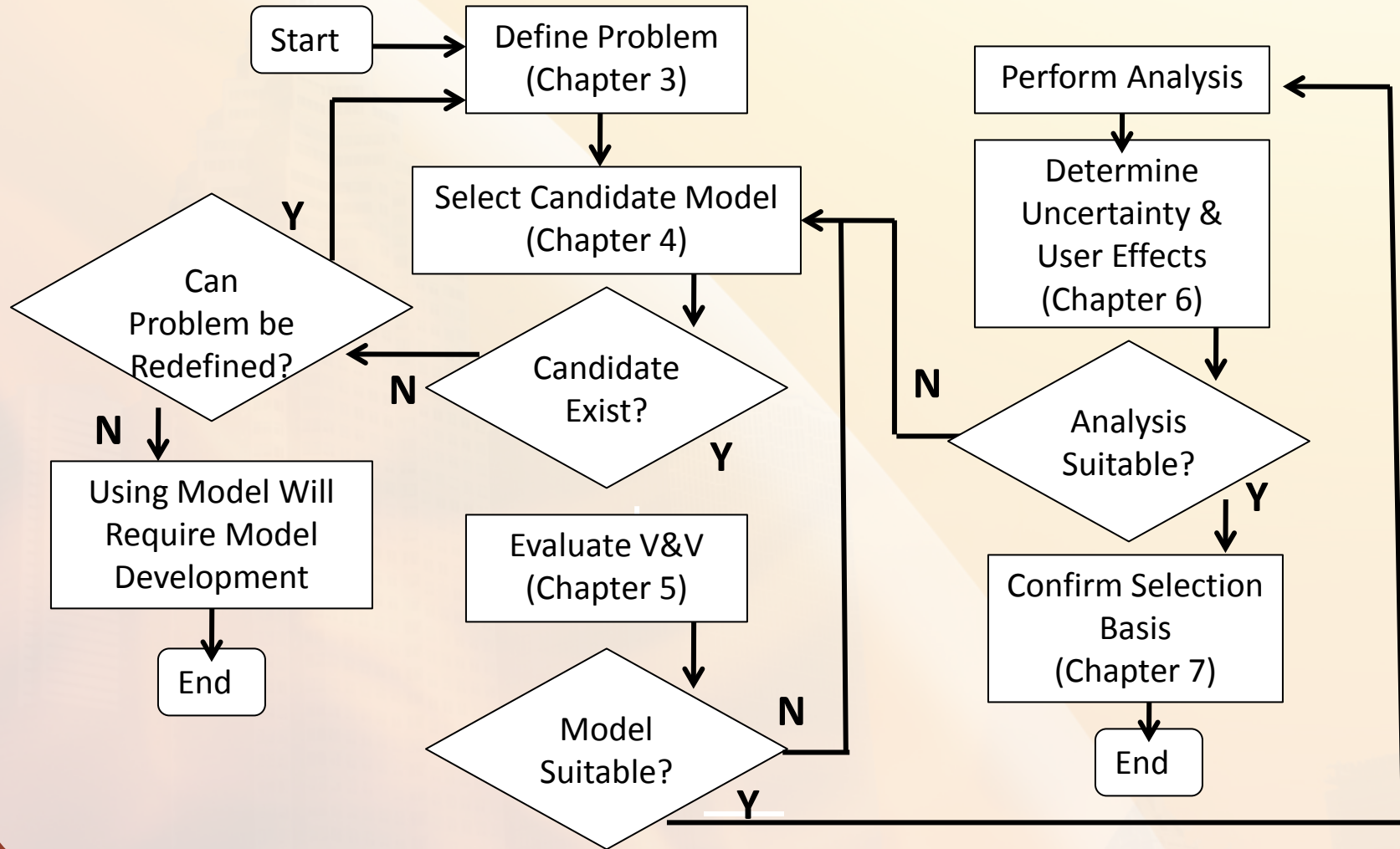
# Purpose and Scope

**Purpose:** To provide a framework with which one can determine and document if a particular model is suitable for use for a specific fire protection application.

- Serves both model user and consumer/reviewer/AHJ

**Scope:** The guide applies once a decision has been made to use a computer fire model for a fire protection application.

# Basic Framework



# Define Problem of Interest

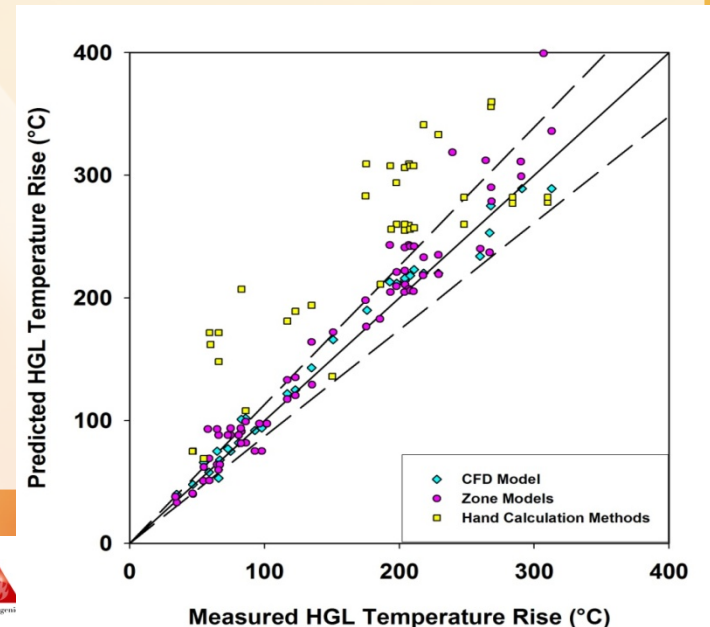
- Describe Relevant Phenomena and Key Physics
  - Smoke movement, flame height, plume temperature, etc.
- List Available Information
  - Geometry, Timeline, Events, Materials, Boundary Conditions, etc.
- State Analysis Objectives
  - Identify specific results quantities.

# Select a Candidate Model

- Evaluate Available Model Inputs
  - Required or needed information to conduct analysis.
- Define Desired Model Outputs
  - Also may include evaluation of available resources
- Choose a Candidate Fire Model
  - Algebraic models, Zone/Lumped Parameter models, Field/CFD models

# Verification and Validation

- Definitions
  - Verification: Are the equations are being solved correctly?
  - Validation: Are the right equations are being solved?
- Steps for Validation: comparison with experimental data
  1. Select Experiments
  2. Choose a Metric To Quantify Accuracy
  3. Report Results



# User Effects

- Sources of Uncertainty
  - Spatial Domain, Input Assumptions
  - Identification and Quantification
- Implications on the Design Process
  - Safety Factors, Performance Criteria
- Treatment of “User Effects”
  - Sensitivity Analysis, Parametric Analysis, Bounding Analysis, Differential Analysis, Power Dependence Analysis, Model Calibration and Conditioning

# Documentation

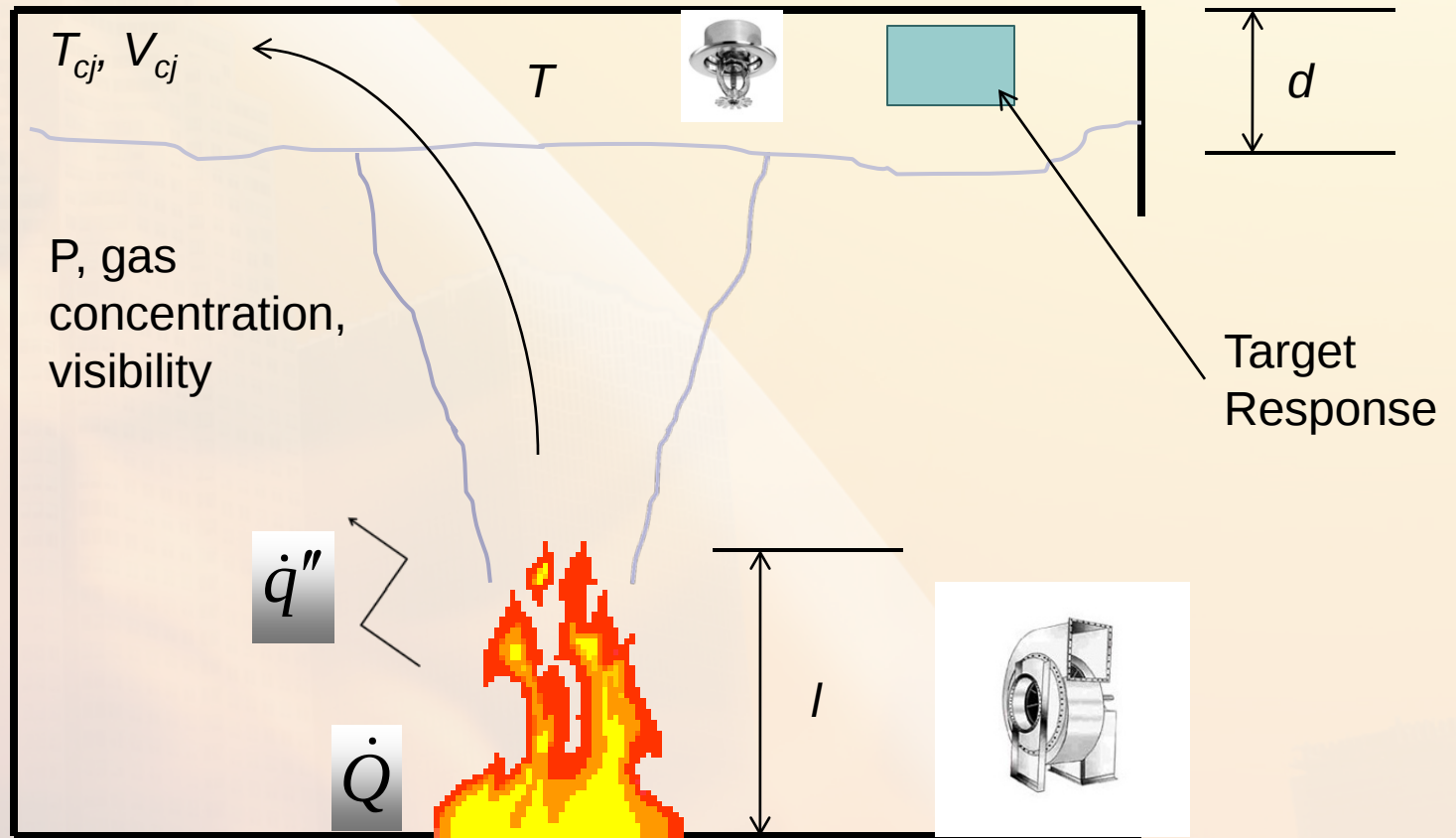
- Method of communicating the evaluation to the consumers of the modeling results
- Should address each aspect of the evaluation
  - problem definition, model selection, V&V and consideration of user effects

# Appendices

- Provides an overview of how fire-related phenomena can be modeled
- For each type of phenomena, the applications, key physics, and methods of modeling using algebraic models, zone models and field models are addressed

# Phenomena Addressed

Explosions  
gas  
dispersion



Gracias por su atención  
Thanks for your attention



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