Table 17.1: Guidelines for Risk Assessment

OCCUPANCY	REQUIRMENTS
5. **FIRE MODELS**	**5.a. FDS (Fire Dynamics Simulator) MODELS** i. FDS allows for "Direct Numerical Simulation" or "Large Eddy Simulations (LES)" of fire effects. ii. The LES approach most readily lends itself to solving the types of fire problems typically found in fire engineering design and forensic applications. LES uses a low Mach number approximation for the Navier-Stokes equations and a formulation of the complex governing equations to provide a very efficient solution. iii. Under the LES mode, the user inputs the parameters of the fire in terms of heat release rate and species generation. iv. Although FDS includes algorithms for flame spread, burning rate, and suppression, these have not been developed and validated so as to allow their application to problems in these areas. v. FDS calculates the temperature, pressure, species concentrations and flow field in relation to the prescribed fire. FDS provides for calculating the activation of heat detectors and sprinklers. In addition, the sprinklers can dispense droplets, which yield evaporative cooling and prewetting. vi. The model supports prediction of multiple sprinkler activations. FDS also has the built-in capability of predicting the response of smoke detectors. vii. The major geometric limitation of FDS is its exclusive use of rectilinear computational meshes, which effectively limits the model to "stair stepped" approximations for curved or sloped geometries. viii. Although there are commercial CFD packages that allow better definition of realistic geometries, these are much less efficient and there has been limited validation of commercial CFD codes for use in fire applications. ix. Heat transfer is treated as one-dimensional and is calculated by using thermally thin or thermally thick elements, but heat is not conducted through wall portions to other parts of the domain. The model also supports heat-activated vents that "open," allowing flow through the vent. x. Smokeview is the companion software that is designed to visualize the numerical predictions generated by FDS. **5.b. RANS (Reynolds Averaged Navier-Stokes) MODELS** i. There are many commercially available CFD models. These general-purpose CFD models are designed to solve a wide range of flow phenomena including steady and transient, laminar and turbulent and incompressible and compressible. ii. Model features include heat transfer (convection, conduction, and radiation), mass transfer and chemical reaction (including combustion), porous media, scalar transport equations, discrete particle transport, multiple fluid streams, and multiphase flows. iii. Commercial codes include graphical user interfaces (GUI) to aid the user in mesh generation, variable input, and postprocessing of results. iv. These codes allow for body-fitted coordinates, structured and unstructured grids, as well as adaptive and moving grids. v. Output displays of variables include perspective views, contour mapping, vector diagrams, particle tracks, and gradients. The most widely used commercially available and general-purpose CFD codes for the simulation of combustion and fire include STAR*CD, Fluent, and CFX.