

EXECUTIVE SUMMARY

E.1 INTRODUCTION

The collapses of the World Trade Center (WTC) towers on September 11, 2001, resulted from a combination of aircraft impact damage and the ensuing fires. A prime focus of the National Institute of Standards and Technology (NIST) Investigation was to learn the relative importance of these two factors and their interaction leading to the collapses of the buildings. This entailed such facets as:

- What were the location, magnitude, and duration of the fires that brought about the collapses of the WTC towers?
- Were the natures of these fires typical of what might be expected in common occupancies, or were there special features that made these fires especially dangerous?
- Could an extreme but conventional fire, occurring without the aircraft impact, have led to the collapse of a WTC tower?

This effort began with the objective to reconstruct, with assessed uncertainty limits, the time-evolving temperature, thermal radiation, and smoke fields in WTC 1, 2, and 7 for use in understanding the behavior and fate of occupants and responders and the structural performance of the buildings. Operationally, this was divided into eight technical tasks:

- Acquisition and application of photographs, videos, and other relevant information to develop detailed time lines for the spread and growth of fires at the peripheries of the WTC buildings.
- Characterization of the types, mass, and distribution of combustibles in the pertinent floors of the WTC buildings at the time of the disaster.
- Location and characterization of the fire endurance properties of the internal partitions (floors, walls, and ceilings) in the pertinent floors of the WTC buildings.
- Determination of the effective thermal properties of the structural insulation systems, the effect of vibration, impact, and shock on their thermal insulation performance, and whether chemical interaction between the insulation materials and the steel at elevated temperatures could degrade the steel and insulation performance during thermal insult.
- Upgrade of the NIST Fire Dynamics Simulator (FDS) for its application to the reconstruction of the fires in the WTC buildings. Development of a computational methodology for mapping the FDS-generated thermal environment onto and through the buildings' structural elements.
- Conduct of experiments to provide input to and guidance for the FDS combustion sub-model.