

# Technical Conference on the NIST Federal Building and Fire Safety Investigation of the World Trade Center Disaster

Project #4: Investigation of Active Fire Protection Systems  
Suppression Systems Sub-task (NCSTAR 1-4B)

September 14, 2005

Mark Hopkins, P.E.  
John Schoenrock, P.E.  
Edward Budnick, P.E.



HUGHES ASSOCIATES, INC.  
FIRE SCIENCE & ENGINEERING

3610 Commerce Drive, Suite 817, Baltimore, MD 21227-1652

Phone:410-737-8677 Fax:410-737-8688

Web Site: [www.haifire.com](http://www.haifire.com)

# **NIST WTC Investigation**

## **Project #4: Investigation of Active Fire Protection Systems Suppression Systems Sub-task**

### **Purpose:**

Investigate the performance of the active fire protection systems in WTC 1, 2 and 7 and their role in fire control, emergency response, and fate of occupants and responders.

# **NIST WTC Investigation**

## **Project #4: Investigation of Active Fire Protection Systems Suppression Systems Sub-task**

### **Scope:**

Evaluation of the design, installation and performance of the automatic sprinkler systems, the pre-connected hoses, the standpipe systems, and the associated water supply(s) for WTC 1, 2 and 7.

# **NIST WTC Investigation**

## **Project #4: Investigation of Active Fire Protection Systems Suppression Systems Sub-task**

### **Objectives:**

- 1) Documentation of design and installation and comparison to applicable codes (Task 1)
- 2) Documentation of design and capacity of water supply (Task 2)
- 3) Identification and documentation of differences in design among WTC 1, 2 and 7 (Task 3)
- 4) Documentation of normal and fully functional systems for fire control (Task 4)
- 5) Documentation of performance of systems in WTC 1, 2 and 7 on September 11, 2001 (Task 5)

# NIST WTC Investigation

## Project #4: Investigation of Active Fire Protection Systems Suppression Systems Sub-task

### General Approach:

- ❑ Literature review
  - Public domain
  - Document Resource Center
  - Retrieval and control
- ❑ Reconstruction of Systems
- ❑ Hydraulic analyses
  - Baseline
  - Fire incident scenarios
  - September 11, 2001
- ❑ Comparison with installation standards
  - NFPA 13
  - NFPA 14

# **NIST WTC Investigation**

## **Project #4: Investigation of Active Fire Protection Systems Suppression Systems Sub-task**

### **Limitations and Assumptions:**

- Limited detail
- Unavailable documents
- Differences in documentation
- Documentation of systems on September 11th

# Task 1: Installed Fire Suppression Features in WTC 1 and 2

Automatic fire sprinkler systems essentially throughout

- Sub-grade systems installed during original construction
- Tower systems retrofit installed in 2 phases
- Individual system per floor in towers

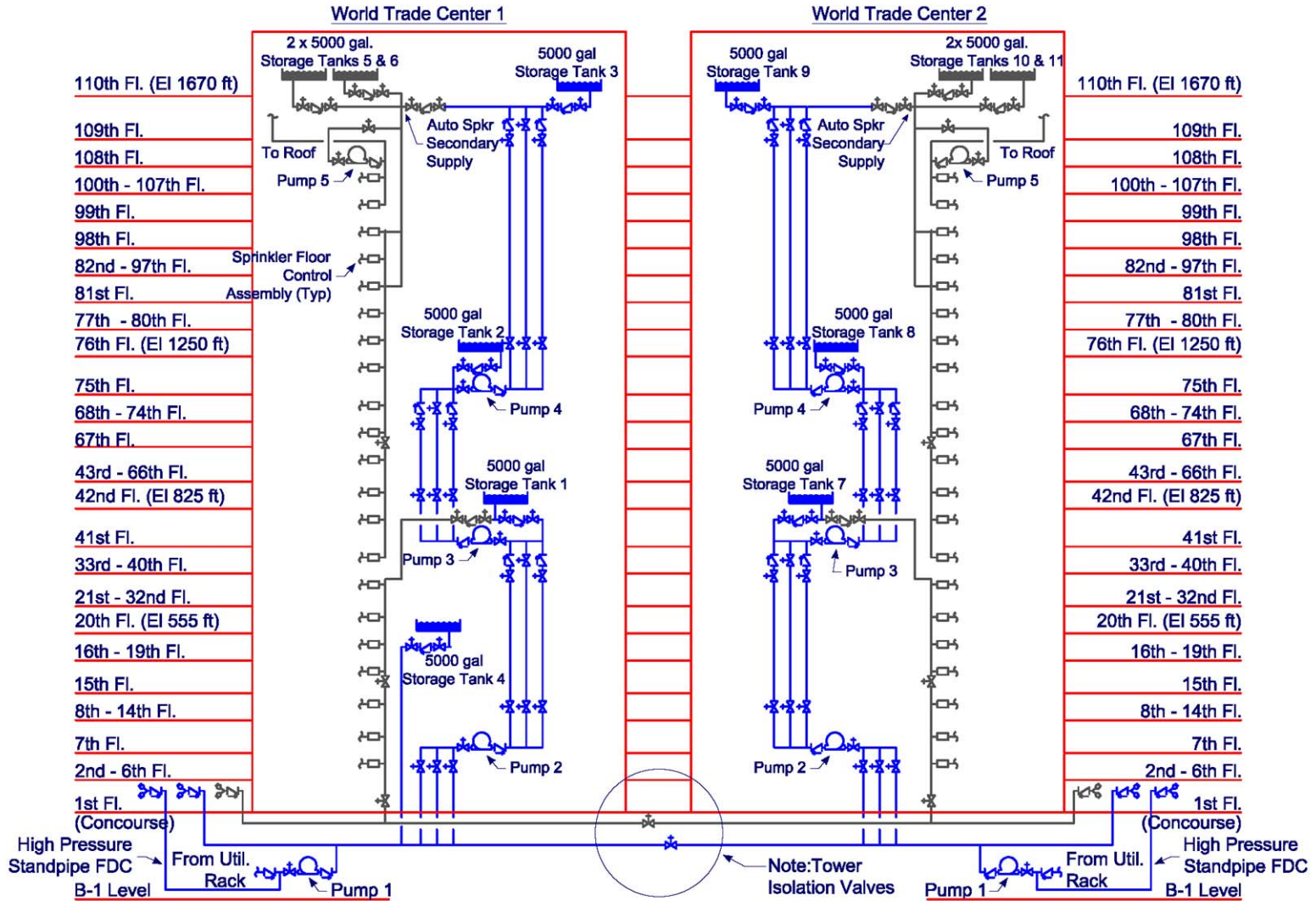
Standpipe and pre-connected hose systems throughout

- Pre-connected Class III hose stations in each stairway
- Pre-connected Class III hose stations in corridors and certain tenant spaces

Special hazard fire suppression systems

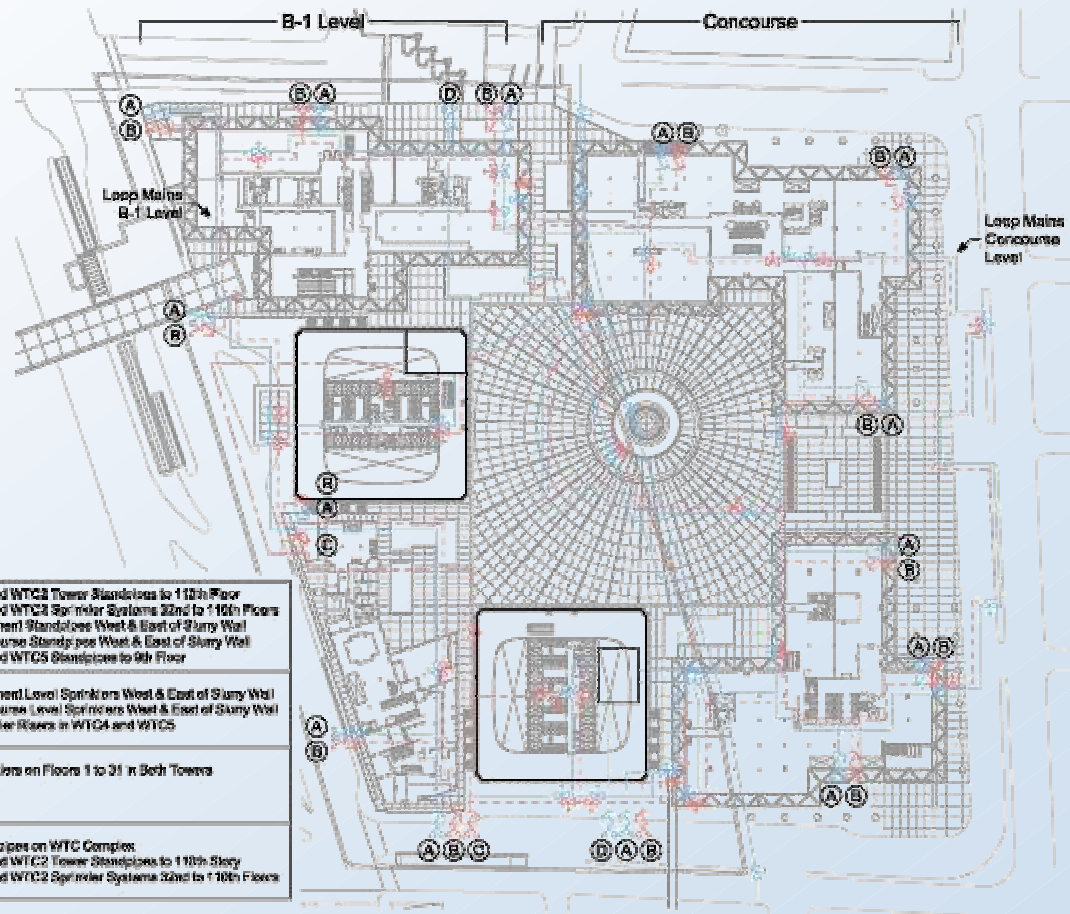
- Halon 1301 total flooding systems
- Pre-action sprinkler systems
- Dry chemical systems
- Steam smothering systems
- Carbon dioxide systems







# Task 1: Fire Department Connections and Sub-Grade Infrastructure for WTC 1 and 2



## Legend.

(A)	Standpipe 8-inch Loop Main, B-1 and Concourse Levels	WTC1 and WTC2 Tower Standpipes to 110th Floor WTC1 and WTC2 Sprinkler Systems 22nd to 110th Floors All Basement Standpipes West & East of Slurry Wall All Concourse Standpipes West & East of Slurry Wall WTC4 and WTC5 Standpipes to 9th Floor
(B)	Sprinkler 8-inch Loop Main, B-1 and Concourse Levels	All Basement Level Sprinklers West & East of Slurry Wall All Concourse Level Sprinklers West & East of Slurry Wall All Sprinkler Risers in WTC4 and WTC5
(C)	Partial Sprinkler Systems - 4-inch Connector Between WTC1 and WTC2 Towers	All Sprinklers on Floors 1 to 31 in Both Towers
(D)	High-Pressure to Suction Inlet of Standpipe System Pumps, WTC1 and WTC2, B-1 Level	All Standpipes on WTC Complex WTC1 and WTC2 Tower Standpipes to 110th Floor WTC1 and WTC2 Sprinkler Systems 22nd to 110th Floors

## Task 2: Evaluation of the Water Supply

Source – NYC Distribution System

Maintained at average steady state pressure of 50 psi

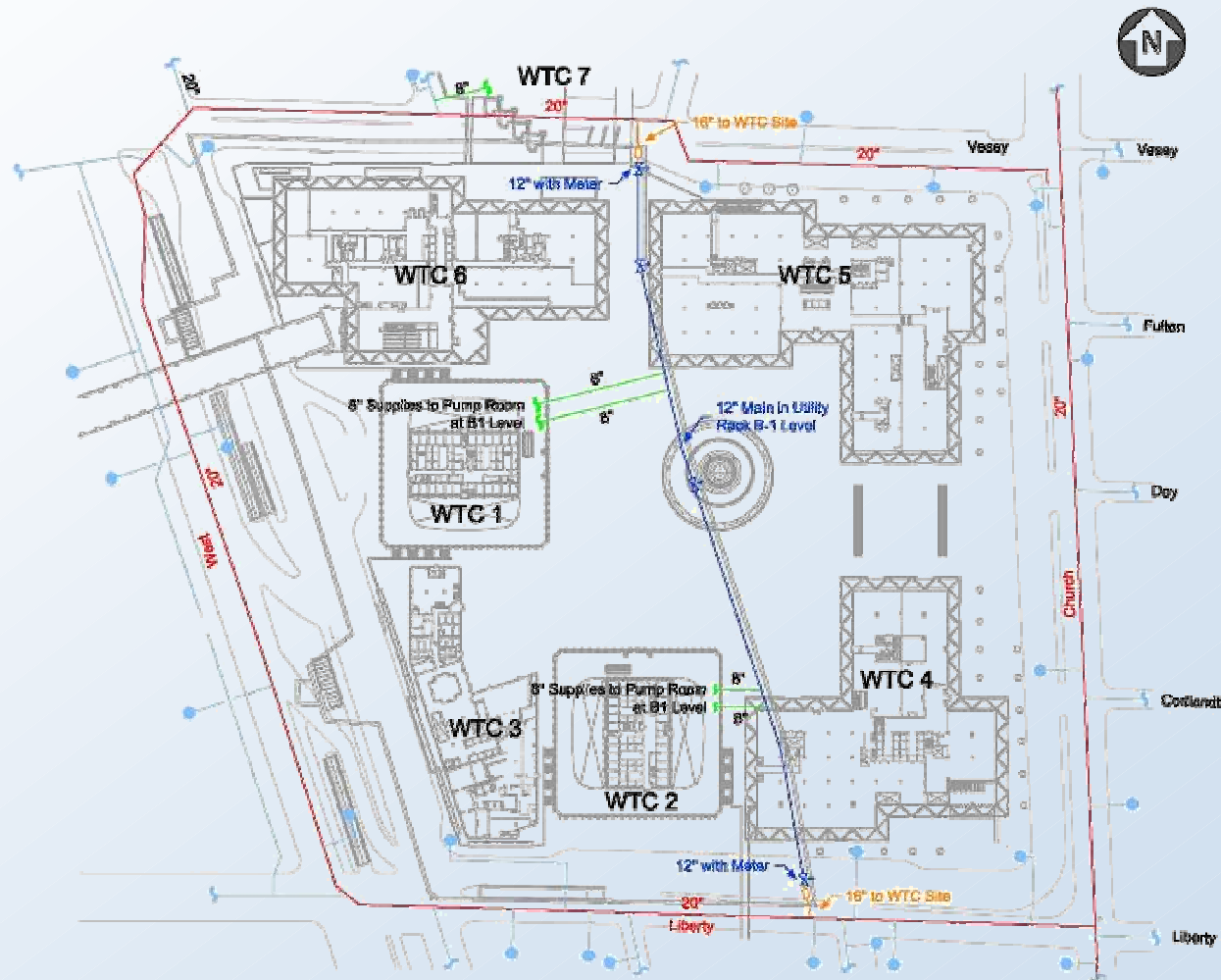
Data

- Static: 50 psi
- Residual: 11 psi
- Flow: 150,000 gpm

# Task 2: NYC Water Distribution System Supply to WTC 1 and 2

## Legend

- Red – 20" Plaza Loop
- Orange – 16" Connection to Distribution System
- Blue – 12" Cross-Connection Main for Plaza
- Green – 8" Feed Mains for Standpipe and Sprinkler Systems
- Cyan – Continuation of Distribution System



## Task 2: Method of Analysis

- Hydraulic analysis using HASS – Hydraulic Analyzer of Sprinkler Systems Program
- Determination of delivered densities and areas of coverage
- Assessment of primary and secondary water supplies
- Determination of water supply duration

## Task 2: Hydraulic Node Representation for Primary Water Supplies (Storage Tanks) in WTC 1 and 2

