

# **PLACING PRESENTATION FOR THE WORLD TRADE CENTER PROPERTY INSURANCE**

## **OVERVIEW**

The World Trade Center is one of the most prominent commercial real estate complexes in the world and a hallmark of the Manhattan skyline.

This document discusses many of the physical characteristics of the complex, various protection and risk control aspects and some of the potentially catastrophic incidents that might occur.

The discussion focuses on the following components of the complex:

- The two 110-story office towers (One and Two World Trade Center)
- The office portion of the two nine-story buildings (Four and Five World Trade Center)
- The retail area of the World Trade Center, referred to in the report as the Mall which consists of retail space located on the Concourse level
- The Subgrade space, which consists of six basement, levels (B-1 through B-6) that project about 70 below the Concourse.

It is estimated that 50,000 people work in the World Trade Center and that 150,000 commuters' travel through the concourse to access Path and MTA subway trains, on a daily basis. Annually approximately 2 million tourists visit the Observation Deck.

Much of the discussion of the physical characteristics has been taken from documents developed by the Port Authority's real estate advisors. The loss estimates (PMI's and MFL's) outlined in the report are predicated on conventional risk control conventions of the major HPR underwriters.

# **FIRE PROTECTION**

## **FIRE ALARM SYSTEM**

The Fire Alarm system in the ETC combines fire alarm signaling with an intercom, enabling fire safety personnel to speak to the person turning in the alarm. Alarms may be turned in at Break-Glass Stations in public and common areas throughout the Trade Center. Control and intercom equipment for the system is monitored in the Police Security Room located at level B-1.

An alarm signal is transmitted to one of many intercom panels in the Fire Alarm Console where it is processed. Each intercom panel represents a separate fire zone and there is a reel-to-reel tape recorder that transcribes conversations made over the fire intercom system

PA employees test the fire alarm signal boxes monthly.

## **SMOKE DETECTION AND ALARM SYSTEM**

There is smoke detection and alarm systems protecting the return air ducts, elevator lobby and the ventilation duct in the Mechanical Equipment Rooms (MER'S).

The return air system has detectors in the hung ceiling of each tenanted floor, in close proximity to the intake of the return air ducts. The detectors are connected to a computer-multiplex system, which scans each smoke detector and reports alarm conditions to the Police Security Room on level B-1.

There is at least one smoke detector at the ceiling of each elevator lobby, directly above the elevator call button. These detectors transmit to the Police Security Room and cause the elevators to return to their main lobby.

The ventilation alarm system monitors the supply and return air ducts in the MER's. The system shuts down the affected ventilation fans and alerts police security personnel when smoke or products of combustion are detected in the supply or return air ducts. The MER exhaust fan ducts are monitored and controlled in a similar manner.

All detectors are inspected and tested annually by PA personnel.

## **TENANT SMOKE ALARM SYSTEMS**

Many tenants have their own smoke alarm systems. These systems are inspected and tested at least annually in accordance with the equipment manufacturer's specifications.

## **SMOKE PURGE SYSTEM**

After a fire has been extinguished in the Towers the smoke purge procedures draw in fresh outside air and exhaust the return air from the building. The Fire Safety Director initiates the operation by having the smoke purge switches (there is one for each quadrant) in the MERS turned on.

## **WATER SUPPLIES FOR SPRINKLER AND STANDPIPE SYSTEMS**

The primary water supplies for the WTC consist of connections to 12" city mains and total capacity in 14 steel gravity tanks of 70,000 gallons. These water supplies are delivered to sprinkler and standpipe systems by a total of 12 pumps. The tanks are automatically refilled from a 2" connection to the domestic water system.

Eight of the pumps are multi-stage, high net head pumps serving the standpipe system. These eight pumps are 3-stage, Peerless pumps rated at 750 gpm with net heads from 228 to 360 psi. These pumps are situated on the following levels; B-1, 7th, 41st, and 75th floors of each tower.

On floor 108 of both towers there are 500 gpm Peerless pumps with a net head of 60 psi. These pumps take suction from 5,000-gallon steel gravity tanks and provide water supplies to both the standpipe and sprinkler systems for the top floors (sprinklers - floors 99 to 107 and standpipe floors 99 to the roof)

At level B-1 there are two separate, 1500 gpm, Peerless pumps with net heads of 90 psi, taking suction from separate 12" connections to city mains and supplying the sprinkler systems protecting the Northeast Plaza Building (NEPB), Southeast Plaza Building (SEPB), Concourse level, and the 6 Subgrade areas.

## **SPRINKLER SYSTEMS**

Sprinklers protect all tenanted floors in the towers. The exceptions are; all Mechanical Equipment Rooms (MERs), Chiller Plant, Power Distribution Plant and Auxiliary Condenser Water Room.

The design of the sprinkler systems of both towers is similar. The direction of water flow within the risers is downward. Each tower has three separate risers, with each serving different groups of floors. Riser A supplies the top most floors, 99 through 110; Riser B supplies floors 98 through 32; and Riser C supplies floors 31 through 1. Water supplies for systems A and B are from the 10,000-gallon, steel sprinkler tank on the 110" floor. The 5,000-gallon steel tank on floor 41 serves both sprinklers from riser C and standpipe systems. The C risers for both buildings are interconnected through a divisional control valve that allows isolating in the event of impairments. There are separate control valves for each floor in the towers as well as water flow switches, tamper alarms and 2" drains. The down risers are equipped with divisional or isolation valves on floors 1, 15, and 67 of Tower A and on floors 1, 15 and 77 of Tower B.

The 500-gpm 60-psi pumps on floor 108 of both buildings serve to boost water pressure to the sprinklers on floors 107 to 99 and the fire hose header on the 110<sup>th</sup> floor. As the downward distance from the holding tanks increases below the 99<sup>th</sup> floor additional pump pressure is not required. Pressure Control Valves (PCV's) are used to control water pressure on the lower floors.

The rest of the WTC complex, namely the Subgrades B-1 through 6, Concourse, NEPB, and SEPB are served by a second completely separate fire protection system. This system consists of two - 8" loop mains, with isolation valves, feed by two 1500-gpm 90 psi booster pumps. One loop main feeds sprinkler risers going down to the Concourse and Subgrades and up risers into the NEPB and SEPB are feed through the other loop main.

Sprinkler systems for the stores in the Concourse are fed off completely separate risers from the sprinklers the common areas. The system was design in this manner to insure a fire originating in an impaired store would be confined to that store while sprinklers in the common area that were feed from a separate unimpaired riser.

The booster pumps deliver fire protection water at 150 psi to the loop mains.

Both the tower systems and the Concourse/Subgrade systems have multiple siamese connections for the NYC Fire Department.

The World Trade Center, "Design Guidelines, Guide Specifications, and Standard Details" requires all tenant areas to be protected by a sprinkler system designed in accordance with NFPA Standards. All systems are hydraulically designed. Office spaces are designed for light hazard occupancy with a minimum of 0.1 gpm per sq. fl. over the most remote 1,500 sq. fL and protected area per sprinkler not exceeding 225 sq. ft. Protection for commercial spaces, and storage areas, are designed to the requirements of NFPA 13. Sprinkler systems for Restaurant Service Areas and Concourse Retail Stores are designed to 0.16 gpm per sq. ft. over 1,500-sq. ft with a maximum 130-sq. fl. per head of protected area.

Electrical and telephone closets are not sprinkled, however no storage of combustibles is allowed, closets have 2 hour-rated walls with penetrations protected, and a smoke detector connected to the alarm system installed in the closet.

Smoke curtains, in the form of dropped soffits, with a water curtain provide protection for tenants with internal staircases. Water curtains consist of closed sprinklers spaced 6'-0" on center, 12 in. from the opening.

All openings between the main Concourse public corridors and tenanted spaces are protected with a water curtain- The Water curtain consists of closed heads spaced 6 -0" on center, 12 in. from the opening on the tenants side.

Sprinkler control valves are located in the janitor closets on each floor of the Tower buildings. The floor control valves consist of either a manual operated gate valve (OS&Y type) or a combination pressure reducing and shut-off valve, with tamper switch, water flow alarm, pressure gage, inspector's test connection and drain valve. Pressure reducing valves (PRV's) are set at a locked out outlet pressure (at no flow) of 125 psi.

## PROBABLE MAXIMUM LOSS

### Probable Maximum Loss From Fire

The underlying premise of this PML is that a fire originates on an upper floor (assume 90<sup>th</sup> floor) with the sprinkler protection out of service and that the fire floor is connected to the floor above via unprotected, open stairs.

Under these conditions fire damage would be on floors 90 and 91. Floors 93 through 97 would receive varying degrees of smoke damage and floors 85 through 89 would receive damage from the water used to extinguish the fire.

Assuming that criteria, a building value for a tower of \$1.19b (\$250/sf) and a floor value of \$10.8m, then the damage to the fire floors, at 100%, would amount to \$21.6m. If smoke damage averaged \$2m for the 5 floors above the fire or a total of \$10m and water damage of \$2m to the 6 floors below the fire floor, then a PML in the range of \$40m could result. In reality the combustible loading of the typical occupancy in the Towers is not sufficient to create the spalling and ensuing structural damage associated with this scenario and a PML in the \$10-20M range is reasonable.

The mitigating circumstances are an outstanding, well-trained PA emergency organization and the close proximity of the NYC Fire Department that monitors the PA's emergency communication channels and would be responding before being called.

### Probable Maximum Loss From Flood

In the event of a stage 2 or 3 hurricane coming ashore along the New Jersey Coast and coinciding with a full moon and high tide, it is possible for the waters of New York Harbor to rise to a level where the water level might be slightly higher than some of the grade level openings along the west side of the WTC complex. See Flood Appendix for a discussion of this type of event and emergency procedures to deal with it.

The failure at one of the sandbagged openings could allow floodwaters to enter the Subgrade levels. There could be some build up of water in levels B-1 to B-5 with the greatest buildup at level B-6 with ensuing damage to the electric motors and controls for the New Chiller Plant.

Assume:

Catastrophic failure of the sandbagging protection at the lowest opening - 6WTC Vesey Street Door.

Tidal flow of 2 knots per hour = 12,200 feet / hour.

Opening allowing water to enter Subgrade 2.45' high and 30' wide = 73.5sf

Failure lasts for 3 hours

- Floor area of B-6 level = 1/6th of 2,656,435sf or 442,739sf

Then: Depth of water at B-6 level =  $73.5\text{sf} \times 12,200\text{ft/hr} \times 3\text{hrs} / 442,739\text{sf} = 6\text{ feet}$ .

## 500-Year Flood

Conditions surrounding this event are, at best, difficult to document. In the appendix of the report a discussion of flood and the procedures to protect against it are reviewed. A significant factor in this scenario would be the tidal action. Normal tidal variation, in this area of New York Harbor, is about 6 feet. The 100-year flood assumes increasing this by about 6 feet and the 500-year flood would add another 2 feet. This 500-year storm and ensuing flood would most probably be a Category 4 hurricane with prior warning from the National Weather Service and allowing time to obtain additional sandbags to raise dikes another 5 feet. If the same catastrophic failure outlined in the flood PML occur, then 3.5 times as much water could enter the opening with the expectation that the floodwaters would be 21 feet deep inundating the B-6 level and rising 5 feet above the B-5 floor. Under these conditions an MFL loss of \$200-300m seems likely.

## FIRE

The following estimates of damage from a maximum foreseeable fire loss have been estimated using generally accepted insurance industry loss control criteria.

Assume:

Special Category when  $(1.45a \text{ to } 1.55a) < A < (1.70a \text{ to } 1.80a)$   
(a = window height)  
(A = from floor to bottom of window of floor above)

Sprinkler system on fire floor is out of service  
Perimeter flue space with adequate safing  
NYFD expected to be able to handle an "exterior" fire  
Poke-through / penetrations properly sealed  
No interconnected floors with unprotected openings  
Building value of \$1.2b and floor value of \$10.8m

If 5 floors involved in the fire and 25 floors with water damage

Then.

$5 \times \$10.8 \times 70\% = \$37.8\text{m}$   
 $25 \times \$10.8 \times 15\% = \underline{\$40.5\text{m}}$   
\$78.3m

A more conservative scenario would have the fire originating just above one MER and progressing externally to the next MER where due to the double height (24') the fire would stop. The only combustibles in an MER are the filters in the air handling equipment and they are sprinklered. The MER's are double floors at levels 7/8, 41/42, 75/76, and 108/109.

If fire originates on the 43rd floor and progresses externally from floor to floor until it is stopped at the 75th floor and the first 41 floors have some water damage:

Then

$42 \times \$10.8 \times 70\% = \$234$   
 $41 \times \$10.8 \times 10\% = \underline{\$82}$   
\$316

The mitigating circumstance to this scenario is that the B-6 level has a large opening into the Path train tracks. This opening is large enough to allow major pieces of equipment to be brought to this area by Path train, then off loaded into the B-6 level. Therefore storm floodwaters seeking the lowest level would leave the B-6 level filling the Path tunnel (if the tunnel's sumps failed).

Assuming the Path Tunnel to be 1.5 miles long and having a 30-foot diameter or an area of 1400sf

$1.5\text{mi} \times 5280\text{f/mi} \times 1400 = \text{a volume of about 11 million cu. ft.}$

It would take about 12 hours to fill the Path tunnel at this rate of flow, of 2 knots per hour, through the failed sandbag dike at the Vesey Street Door.

Conservative estimates of the potential damage to machinery, electric motors and electronic controllers on levels B-1 to B-5 run to \$2-3m per level or a total of \$15m on the high side with the potential of another \$10m on level B-6, for a total PML of \$25m.

## **MAXIMUM FORSEEABLE LOSS**

### **1993 Terrorist Bombing**

The 1993 terrorist bombing of the WTC resulted in a maximum foreseeable property loss. This event shut Tower 1 down for 6 weeks and Tower 2 for 4 weeks. The explosion, that occurred in the garage area of B-2, caused portions of the Plaza and two Subgrade floors (about 4 bays by 4 bays) to collapse on to the B-6 level damaging mechanical and electrical equipment of the Chiller Plant. As large a blast as it was, there was negligible structural damage done to structural members. Damage was limited to the replacement of these concrete floors, repairing spalled concrete where reinforcing steel had been exposed and rebuilding non-bearing walls.

The magnitude of this type of MFL loss can be estimated at 5 weeks rent or 1/10<sup>th</sup> of the \$364m annual rent or \$35m. Plus property damage to the building from the 1993 incident is estimated to be \$175m and equipment damage of \$120m or a total of \$330m.

The mitigating circumstance to a reoccurrence is the control that is in place to prevent this from happening again. The rigorous security controls now in place have significantly reduced the likelihood of this type of incident. No one can gain entrance to the towers without authorization from a tenant, presenting a photo ID and being photographed. There is a lower than average probability of a reoccurrence as access to the premises is now severely restricted. Expert opinion suggests that there are many more easily accessed sites for any group attempting this sort of protest. The guards physically check trucks delivering to the facility. Delivery documentation or manifests are reviewed, as are the contents of the vehicles. The guards use mirrors to examine the under carriage of each vehicle before it enters the Subgrade. Substantial mechanical barriers allow only one truck to enter at a time. These barriers are of sufficient strength to lift a car or truck 3 or so feet off its tires and immobilize it by suspending it on the barrier. Drivers are identified by photo ID. Similar physical barriers have been erected at the entrances to the parking garages. The parking patron vehicles and drivers are identified and matched electronically. If they cannot be matched entrance is denied. Only employees of tenants have access to the parking garage and a through background check is made before issuing a parking permit.

### **Aircraft Striking a Tower**

This scenario is within the realm of the possible, but highly unlikely.

In 1946 a military aircraft struck the Empire State Building. Since that time the manner in which aircraft are "controlled" has dramatically changed. In the event such an unlikely occurrence, what might result? The structural designers of the towers have publicly stated that in their opinion that either of the Towers could withstand such an impact from a large modern passenger aircraft.

The ensuing fire would damage the "skin", in this scenario, as the spilled fuel would fall to the Plaza level where it would have to be extinguished by the NYC Fire Department. The replacement of the "skin" is estimated at 35% of the building replacement value or \$420m. Loss of rents for 1 year or \$150m for a total estimate of < \$600m.