



Jaros Baum & Bolles
Consulting Engineers

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2 PM
May 30, 2008

FREEDOM TOWER

DESCRIPTION OF FIRE STANDPIPE SYSTEM

Building Overview

- The building contains 69 office floors, 12 mechanical floors, an observation deck and restaurant on the top floors of the building.
- The total gross area of the building is approximately 3.5 million sq. ft.
- Floor plates range in size from 30,000 sq. ft. to 42,000 sq. ft.
- The highest occupied floor is 1,093 ft. 4 in. and the elevation of the roof manifold is 1,333 ft. 0 in.
- The top of the spire is the "iconic height of 1776 feet."

New Building Code Requirements

1. Each zone above 300 ft. must have a captive fire reserve.
2. Each fire reserve tank must be filled from the domestic water system with a minimum flow rate of 65 gpm.
3. The maximum zone height is 300 ft.
4. The pressure at the hydraulically remote hose connection must be no less than 65 psi.
5. Siamese (FDNY pumper) connections must be provided in maximum zone heights of 600 ft.
6. The maximum pressure at any point in the system cannot be greater than 350 psi (with the exception of the express portions of the high pressure siamese.)
7. Standpipes must be provided in each required exit stairway.
8. Where the building height >500 ft. above the grade plane, all zones must have a primary and auxiliary means of supply.
9. Intermediate tanks must be located to provide the required pressure at the next lowest zone by gravity only.

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10. Zone heights must be selected such that the topmost zone has a minimum height ≥ 150 ft. above the highest hose outlet of the topmost floor in the zone below.
11. The required automatic fire pumps must draw from two (2) independent mains.
12. The capacity of the tanks must be capable of supplying system demand for thirty minutes (for this building two [2] standpipes are required ≈ 750 gpm x 30 minutes or 22,500 gal.).

System Description

1. Tank Systems

- a. The building is divided into six (6) pressure zones with no zone having a pressure greater than 195 psi.

<u>Zone #</u>	<u>Floors Served</u>	<u>Location of Tank</u>
1	90 - 105	103
2	70 - 89	(1) @ 82, (1) @ 84*
3	49 - 69	61
4	29 - 48	(1) @ 41, (1) @ 43*
5	2 - 28	6
6	B-4 - 1	Saction Tank @ B-4

* Due to the size of the tanks and the space constrictions, tanks are located at two (2) different floors and the high tank drains into the lower tank.

- b. The tank zones are arranged such that the minimum pressure at the top floor of the zone is 65 psi and the maximum pressure in the zone ≤ 195 psi.

<u>Zone #</u>	<u>Top Floor (Pressure)</u>	<u>Lowest Floor (Pressure)</u>
1	See pump description below	
2	89 (78 psi)	70 (188.5 psi)
3	69 (73.8 psi)	49 (189.3 psi)
4	48 (73.8 psi)	29 (183.5 psi)
5	28 (73.8 psi)	2 (189.3 psi)
6	1 (70.6 psi)	B-4 (98 psi)

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- c. Each tank is filled via the domestic water system as required by Code but the fill rate is in excess of 600 gpm in lieu of the mandated 65 gpm.
- d. In addition, each tank can be supplied from the automatic fire pumps of the zone below through a normally closed valve located at the tank.
- e. All tanks are located in the "hardened" core.

2. Pump Systems

- a. Two (2) separate fire services from two (2) independent water mains (one located in Vesey and one located in West Street) supply two (2) suction tanks located in the B-4 Level with a total capacity of 45,000 gal.
- b. Each zone is provided with two (2) automatic fire pumps - one primary, the other standby, both on emergency power. Thus, not only is a backup power supply provided but also mechanical backup is provided.
- c. Each pump is rated at 750 gpm.

Zone #	Pump Location*	Top floor (pressure)	Lowest Floor (Pressure)
6	B-4	1 (65 psi)	B-4 (98 psi)
5	(1) @ 4 and (1) @ 5	28 (65 psi)	2 (180.5 psi)
4	(1) @ 39 and (1) @ 40	48 (65 psi)	29 (174.7)
3	(1) @ 59 and (1) @ 60	69 (65)	49 (180.5)
2	(1) @ 80 and (1) @ 81	89 (65)	70 (175.2)
1	(1) @ 80 and** (1) @ 102	105 (65)	90 (154)

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* Pumps are provided on separate floors to insure redundancy in the event of an occurrence on the primary pump floor.

** The roof tank is provided with a special service fire pump located at the 102nd Floor, in accordance with Code, and the redundant pump is located at 80 to provide not only redundancy but also separation from the primary pump.

- d. Each pump zone can supply the suction of the zone immediately above (FDNY request) and can supply the gravity tank in the zone above through a normally closed valve.
- e. All pumps are in the "hardened" core.
- f. All zones are supplied from FDNY siamese connections. The upper zones (>600 ft.) are supplied from a high pressure siamese which "expresses" through the low zones of the building. A pressure-reducing station is provided on the high zone siamese for Zone 4 to limit the pressure on all zone piping to 350 psi. FDNY allowed the use of the pressure-reducing station in lieu of providing a third siamese connection and express riser.

Fire Protection System Enhancements above Code Requirements

1. Standby pumps provided in each zone, providing mechanical as well as electrical redundancy.
2. 50,000 gal. of water storage provided at each intermediate and roof tank location in lieu of the Code-mandated 22,500 gal.
3. Provision of 45,000 gal. suction tank at the B-4 Level.
4. The total captive fire reserve below the 500 ft. level is a minimum of one hour and increases as you rise up the building to a maximum of 6.5 hours for any floor in Zone 1 (the total capacity of all tanks without input from the city water mains or FDNY pumper connections).
5. All fire protection equipment, including standpipes and siamese piping, located in the "hardened" core.
6. The provision of an additional fire standpipe in the dedicated "firemen's stair".

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7. The design of the combination standpipe/sprinkler system is based upon Ordinary Hazard requirements (0.16 gpm/1500 sq.ft.) in lieu of the Code-mandated Light Hazard (0.1 gpm/1500 sq.ft.) requirements.
8. Provision of two (2) independent sprinkler feeds and loops up to the 60th Floor and alternate sprinkler supplies for each floor above 60.
9. The provision of ABC (Automatic Breach Control) Valves on each riser at the top and bottom of each zone.
10. Three (3) sources of water for fire fighting are provided to each floor - pump, tank, and FDNY pumper connection.
11. Three (3) makeup connections are provided to each intermediate and roof tank - automatic fire pump, domestic makeup (~600 gpm), and FDNY pumper connection.

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FIRE DEPARTMENT
9 METROTECH CENTER BROOKLYN, N.Y. 11201-3857

November 5, 2007

William J. Dougherty
Inspection & Safety/Risk Management
Port Authority Technical Center
241 Erie Street
Jersey City, NJ 07310-1397

Re: Freedom Tower, Standpipe Water Supply System
Fire Prevention Index # 0710063

Mr. William J. Dougherty:

The Bureau of Fire Prevention acknowledges your letter dated September 7, 2007 and supporting drawing, SKF-FT-3, created 05-17-07 concerning the above referenced building and subject matter.

The Bureau has examined the aforementioned drawing depicting a Standpipe/Sprinkler water supply system designed according to *New York City Construction Code* adopted by *Local Law 33/2007* by JB&B Consulting Engineers.

Based on the information provided, the Bureau of Fire Prevention has **NO OBJECTION TO** the proposed design.

Signed,

A handwritten signature in cursive script, reading "Thomas M. Jensen".

Thomas Jensen
Chief of Fire Prevention

TJ/JT

C: Fatma Amer, P.E. Deputy Commissioner for Technical affairs
Robert V. Benazzi, JB&B Consulting Engineers
Thomas Meara, Battalion Chief
Jack Taddeo, Chief of Technology Management

THE PORT AUTHORITY OF NY & NJ

September 7, 2007

Chief Thomas Jensen
Chief of Fire Prevention
New York City Fire Department
9 MetroTech Center
Brooklyn NY 11201-3867

Dear Chief Jensen:

Robert Benazzi of JB&B Engineers has spoken to Chief Tom Meara on our behalf regarding my letter to you of 7/26/07 on the Freedom Tower standpipe system (attached). At that time, Chief Meara's only question was in regard to Item #4. It is our understanding that Bob Benazzi and Chief Meara spoke and the Chief is now satisfied that the system has the flexibility for allowing FDNY to operate the system in a pump to pump fashion. This is accomplished with the additional valves referenced in my letter (Item #4) and through the normally open bypass at the Breach Control Valve at the top of each zone. This bypass allows the connection between siamese zones. We are attaching a copy of drawing SKF-FT-3 marked up to show the flow path up the building fire standpipe system. We trust this satisfies all of the departments concerns regarding the fire protection system and request a formal approval of the system.

I will send you under separate cover 10 copies of the colored drawing for distribution with your letter. If you have any questions, please call.

An additional concern for the recent submittal was that the omission of the manual fire pump was not specifically addressed in our recent letter. The manual fire pump had been discussed at length during prior meetings and is not indicated on the submitted riser diagram, however, it was felt that the question must be formally submitted and answered. Does FDNY have no objection to the omission of the manual fire pump for One World Trade Center design?

We request that you respond to this communication directly to confirm that no objections or comments exist with regard to fire department operations or fire prevention issues. Your response can be under separate cover, or by countersignature below.

Thank you for the cooperative spirit and efforts the fire department has provided.

Our best regards,


William J. Dougherty
Inspection & Safety/Risk Management
Port Authority of NY & NJ

Attachment: 8 copies - Sketch SK-FT-3, Memo - W. J. Dougherty to Chief T. Jensen Jul 26, 2007

cc: J. Keane, A. Reiss

Port Authority Technical Center
221 Pine Street
Jersey City, NJ 07310-1397

July 26, 2007

Chief Thomas Jensen
Chief of Fire Prevention
New York City Fire Department
9 MetroTech Center
Brooklyn NY 11201-3867

Thank you for meeting with us on Tuesday, May 29, 2007 regarding the fire protection systems for WTC Tower One (Freedom Tower). Summarized below are corrections and modifications that were made to the plans as a result of our discussions.

1. Isolation and check valves have been added to each fire standpipe riser at the base of Fire Zone No. 2 on the 70th Floor.
2. A normally closed valve mistakenly shown on Standpipe Riser No. 2 has been removed.
3. The FDNY requested that the bypass valve arrangement at each set of fire tanks be eliminated, thus removing the means of filling the fire tanks through the siamese. After further review, we recommend that the bypass valve arrangement remain, but with normally closed valves. This would provide the FDNY the option of filling the fire tanks from the siamese connections if required by the actual fire conditions, and allow the FDNY the ability to use the building's automatic fire pumps to supplement their pumper. Normal means of make-up water for the fire reserve tanks and the combination domestic water/fire reserve tanks will be accomplished through the domestic water system.
4. The piping from each tank has been modified to permit the FDNY to manually pump water from an automatic fire pump in a lower zone to the suction side of the automatic fire pump of the zone above. However, this series pumping arrangement would only occur within the siamese zones, since the standpipe risers are not interconnected between each siamese zone.
5. In order to provide a redundant water supply to Zone No. 1 (the highest zone), it was agreed that the second automatic fire pump (AEP-5B) has been relocated from the 102nd Floor Mezzanine Level to the 80th Floor and take suction from the fire reserve tanks serving Zone 2/3. This arrangement will require express piping from the new pump location on the 80th Floor through the stairs and connecting with the Zone No. 1 cross main on the 90th Floor.



THE PORT AUTHORITY OF NY & NJ

6. In lieu of a second high pressure siamese system that would serve Floors 90 to 105 (nominaly the 1,200 ft. to 1,350 ft. zone), an alternate design was proposed utilizing one (1) high pressure siamese system. The alternative design will utilize a master pressure-reducing valve station (two pressure-reducing valves in parallel) to serve Floors 49 to 89 (nominaly the 600 ft. to 1,200 ft. zone), limiting the pressure to 365 pounds per square inch, and the common high pressure siamese riser (HPF-1) will extend up to the cross main on the 90th Floor. The proposed design includes a normally closed remote-operated bypass valve with a remote control located at the Fire Command Center. This remote-operated bypass valve can also be manually operated at the valve. Also at the Fire Command Center, an alarm for high-pressure condition with pressure sensors located downstream of the pressure-reducing valves is provided.

The above has been incorporated on the enclosed revised Fire Protection Riser Diagram SKF-FT-3, dated June 4, 2007. Please review and comment at your earliest convenience; a confirmation of the above is requested if no comments are forthcoming. We are available for a follow-up meeting if desired.

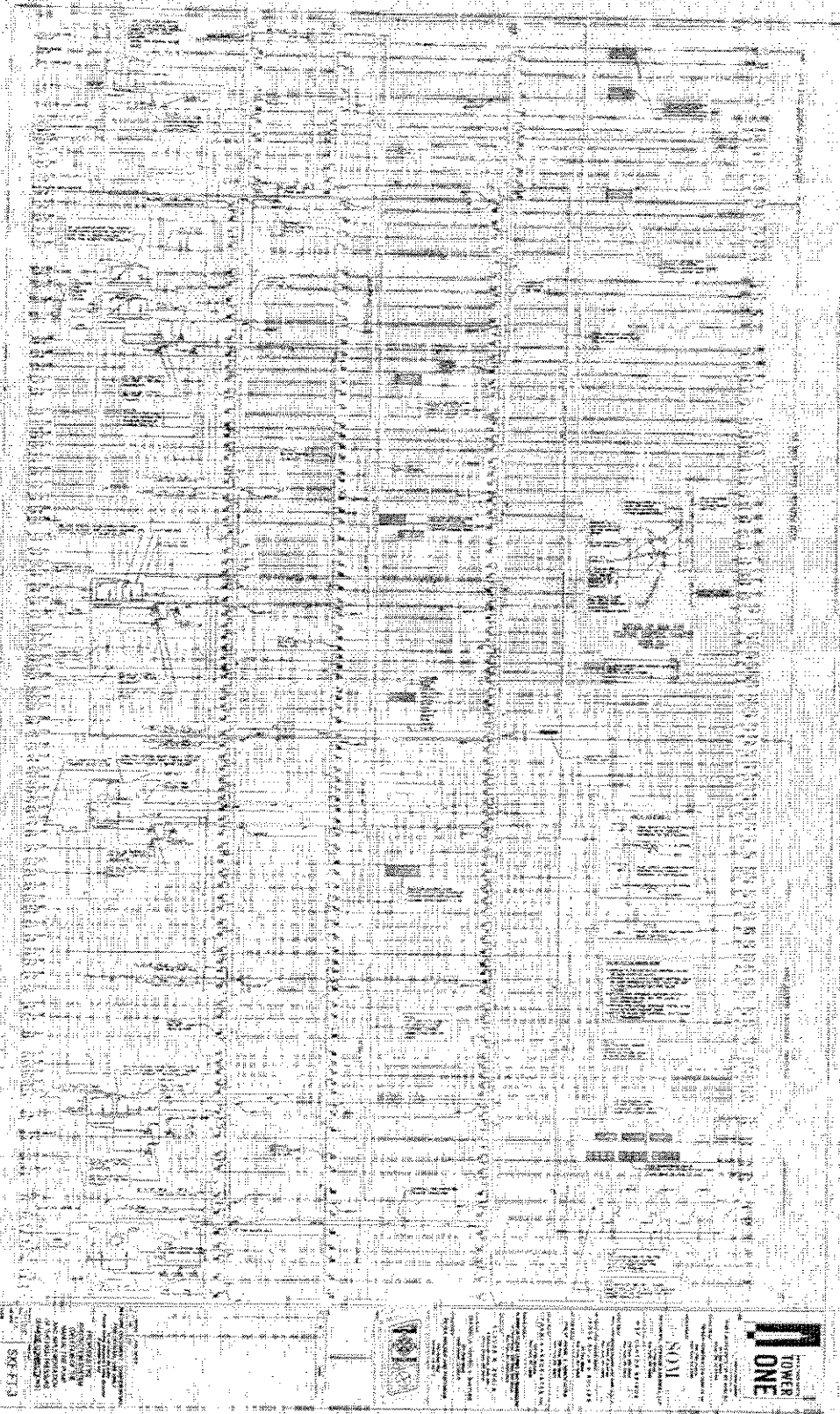
Our best regards,

William J. Dougherty
Inspection & Safety
Port Authority of NY & NJ

cc: J. Keane, A. Reiss

att: SKF-FT-3

Port Authority Technical Center
240 Pine Street
New York, NY 10038-1357



LOWER
ONE

NO. 1



Architectural
Firm
Name
Address
City
State
Zip

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Jaros Baum & Bolles
Consulting Engineers

Robert V. Benazzi
Partner
212.530.9300

One World Trade Center
Freedom Tower
New York, New York
Project No. 12767.0.000

June 5, 2007

Chief Thomas Jensen
Chief of Fire Prevention
New York City Fire Department
9 MetroTech Center
Brooklyn, New York 11201

Dear Chief Jensen:

Thank you for meeting with us on Tuesday, May 29, 2007 regarding the fire protection system for WTC 1.

During our review, a number of items were discussed, which we have summarized as follows:

1. Isolation and check valves will be added to each fire standpipe riser at the base of Fire Zone No. 2 on the 70th Floor.
2. A normally closed valve mistakenly shown on Standpipe Riser No. 2 will be removed.
3. The FDNY requested that the bypass valve arrangement at each set of fire tanks be eliminated, thus eliminating the means of filling the fire tanks through the siamese. After further review, we recommend that the bypass valve arrangement remain, but with normally closed valves. This would provide the FDNY the option of filling the fire tanks from the siamese connections if required by the actual fire conditions, and allow the FDNY the ability to use the building's automatic fire pumps to supplement their pumper. Normal means of make-up water for the fire reserve tanks and the combination domestic water/fire reserve tanks will be accomplished through the domestic water system.
4. The piping from each tank will be modified to permit the FDNY to manually pump water from an automatic fire pump in a lower zone to the suction side of the automatic fire pump of the zone above. However, this series pumping arrangement would only occur within the siamese zones, since the standpipe risers are not interconnected between each siamese zone.

80 Pine Street, New York, NY 10005 212.530.9300 Fax 212.269.5894

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5. In order to provide a redundant water supply to Zone No. 1 (the highest zone), it was agreed that the second automatic fire pump (AFP-6B), currently located on the 102nd Floor Mezzanine Level, will be relocated down to the 80th Floor and take suction from the fire reserve tanks serving Zone 2/3. This arrangement will require express piping from the new pump location on the 80th Floor through the stairs and connecting with the Zone No. 1 cross main on the 90th Floor.
6. In lieu of providing a second high pressure siamese system which currently serves Floors 90 to 105 (nominally the 1,200 ft. to 1,350 ft. zone), an alternate design was proposed utilizing one (1) high pressure siamese system. The alternative design will utilize a master pressure-reducing valve station (two [2] PRV's in parallel) to serve Floors 49 to 89 (nominally the 600 ft. to 1,200 ft. zone), limiting the pressure to 365 psi, and the common high pressure siamese riser (HPF-1) will extend up to the cross main on the 90th Floor. The proposed alternative design would include a normally closed bypass with a remote operator located at the Fire Command Center along with a pressure sensor located downstream of the PRV's to alert the Fire Command Center of a high pressure condition.

We have incorporated Items 1 to 6 on the enclosed revised Fire Protection Riser Diagram SKF-FT-3, dated June 4, 2007. Please review and comment at your earliest convenience. We are available for a follow-up meeting if desired.

Very truly yours,

JAROS, BAUM & BOLLES

RVB:jz

cc: (1) Mr. T. Meara
(1) Mr. J. Taddeo
(1) Mr. M. Rivero
(1) Mr. M. Perciavalle
(1) Mr. W. Dougher
(1) Mr. E. DelValle
(1) Mr. A. A. DiGiacomo
(1) Mr. R. V. Benazzi
(1) Mr. J. K. McGarity
(1) File

Enc. (All Listed)

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RECORD OF ATTENDANCE AT MEETINGS 280 BROADWAY, 7TH FLOOR NEW YORK, NY 10007

DATE: May 13, 2008

SUBJECT: Freedom Tower Standpipe System Presentation

NAME	TITLE	REPRESENTING	PHONE #	FAX #	E-MAIL
JAMES COLGATE	Exec. Architect	DOB	212-566-3204		jpcolgate@buildings.nyc.gov
MAHMER SHAH	Exec. Eng'r	DOB	212-566-3258		
Antie Carles	Director	DOB	212-566-5341	212-566-5757	Antie.C@buildings.nyc.gov
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MARIO RAMIERA	SUPERVISOR ARCHITECT	PA	973-792-3985	3907	mpulviner@nyc.gov
John Lee	sr. Arch	DOB	63167		jlee
ROBERT BENAZZI	PARTNER	IB&B	212-530-9303		benazzir@jbb.com
VINCENT RABOLI	ASSOCIATE	IB&B	212-530-9410		raboli@jbb.com
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WILLIAM J. DOUGHERTY	FIRE PROTECTION	PA ISTD	212-435-3389		william.dougherty@ny.gov
DANNY K. COBOURNE	FIRE PROTECTION	PA - PFP	973-565-7626		dkcobourne@pfpny.net
SAROS BISHOL	Manager	PA	973-792-3536		sbishol@pfpny.net

June xx, 2008

Ms. Fatma M. Amer, P. E.
Deputy Commissioner Technical Affairs
& Chief Code Engineer
NYC Department of Buildings
280 Broadway, 7th Floor
New York, NY 10007

Re: World Trade Center – Freedom Tower- Standpipe/Sprinkler Water Supply System

Dear Commissioner Amer:

Thank you for providing the opportunity to meet with your staff on May 13, 2008 and discuss the proposed standpipe system design in the Freedom Tower. The system design presented in drawing SKF-FT-3, dated 05/17/07 was discussed in detail at the meeting.

The primary water supply is through a tank system. Each tank is filled via the domestic water supply as required by code but the fill rate is in excess of 600 GPM in lieu of the mandated 65 GPM. The building is divided into six (6) pressure zones with no zone having a pressure greater than 195 psi and the minimum pressure at the top floor of the zone is 65 psi. Automatic fire pumps are provided for supplementing the primary water supply, instead of the manual fire pumps that are required under the current code. The system also provides an express high pressure Siamese to supply the upper zones above 600 feet.

The building is equipped with standpipes in each of the two exit stairs. In addition, a third standpipe has been provided within the other stair in the building, which is for firemen's access during emergency. With the concurrence of the Department of Buildings, this stair was contemplated to be used as an additional exit from the restaurant and observation deck on floors 100, 101 and 102. However the Port Authority has decided not to use this stair as an exit and limit the number of occupants to the capacity of the two exit stairs. Therefore, the standpipe in the emergency access stair is not required by code and the fire pumps are accordingly sized for 750 GPM capacity for the two required standpipes.

The system complies with the new Building Code (NYCBC) that will take effect on July 1, 2008, with the following exceptions:

- Due to the height of the building, the pressure in the express riser will exceed the 350 psi maximum pressure specified in the code.
- A pressure reducing valve (PRV) station is provided on the upper zone to limit the pressure in all zone piping to 350 psi.

As per the memorandum of understanding between the Fire Department and the Port Authority, the design was presented to FDNY and discussed in details. FDNY has agreed with all aspects of the standpipe system design, as depicted in Drawing SKF-FT-3, dated 05/17/07. A copy of the drawing and the following are enclosed:

- A detailed description of the system including the enhancements above code requirements
- FDNY letter of no objection, dated 11/05/07, and all correspondence with them
- List of attendees at the 5/13/08 meeting with your staff

The system as designed, with enhancements that are above the code requirement, provides substantial redundancy and is a superior system than if it was designed according to the current code. If you concur with the design, I would appreciate if you please sign this letter where indicated below and return one of the originals to me.

Very truly yours,

Saroj Bhol, P.E.
Manager, Design Standards
Quality Assurance Division
The Port Authority of NY & NJ

Concurred:

Fatma M. Amer, P.E.
Deputy Commissioner Technical Affairs
& Chief Code Engineer

CORRESPONDENCE ROUTING SHEET

FROM: The Office of the Deputy Commissioner-Technical Affairs

Control No.	8168
Referred to	Manher Shah
Date Referred	6/25/2008
Last Name	Dougherty
Subject	Fire Standpipe System
Premises	Freedom Tower
Required Action	See me
Due Date	
Comments	Talk to me now.
Date Received	6/25/2008
Letter Date	5/30/2008
Also Referred To	James Colgate
CC	