May 12, 2006

CODE CONSULTANTS
PROFESSIONAL ENGINEERS, PC

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The Fire Protection & Life Safety Experts
- Code Consultation
- Alarm Systems Design
- Fire Sprinkler Design

Ms. Tamara Saakian, P.E.
Director of Engineering
Bureau of Fire Prevention
9 Metrotech Center
Brooklyn, NY 11201-3857

RE: APRIL 12, 2006 MEETING
WTC MEMORIAL AND MEMORIAL MUSEUM
PROJECT NOS. 7383-4 & 7966-4

Dear Tamara:

Thank you for the time that you spent with us discussing the Fire and Egress Modeling Studies for the World Trade Center Memorial and Memorial Museum projects. We have prepared the following notes to document the discussions that occurred at the meeting and the additional information that was requested.

The following persons attended the meeting:

City of New York Fire Department, Bureau of Fire Prevention (FDNY)
Chief Howard Hill
Ms. Tamara Saakian
Mr. Leo Subbarao

Code Consultants Professional Engineers, PC (CCI)
Mr. Kevin Morin
Mr. Steven Wolin

The following is a summary of the discussions that occurred at the meeting and provides additional information requested at the meeting. If any of the following information is not consistent with your understanding or if you feel any additional information should be included, please let us know.

1. Responses to each of the questions in the email from Ms. Saakian dated March 31, 2006 were discussed. Responses are documented in the enclosed letters from CCI and Davis Brody Bond, LLP (DBB) dated April 12, 2006 (Enclosure A). Copies of the letters from CCI and DBB were provided to the FDNY at the meeting.

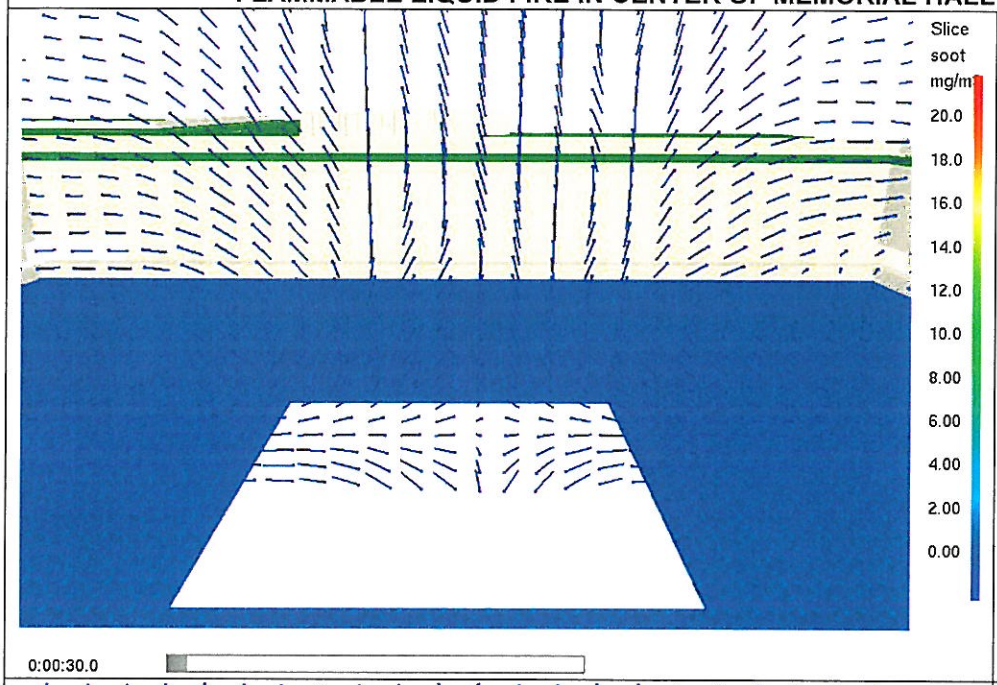
2. Mr. Subbarao requested that data be submitted indicating the concentration of soot in the air that travels through the openings at the center of the Memorial pools during the Memorial Hall fire and indicating the time at which the concentrations were measured. CCI noted that the air traveling through the openings is fresh air drawn from above the Memorial, which is not expected to carry any smoke particles.

   The following tables illustrate the concentration of soot in the air flowing through the opening in the center of the reflecting pool during a 30 MW flammable liquid fire in the Memorial Hall, with and without the effects of the waterfall.

   The figures show a section through Memorial pools, with the airflow indicated using velocity vectors. The snapshots are taken at the end of the flammable liquid fire (30 seconds) and at the time of

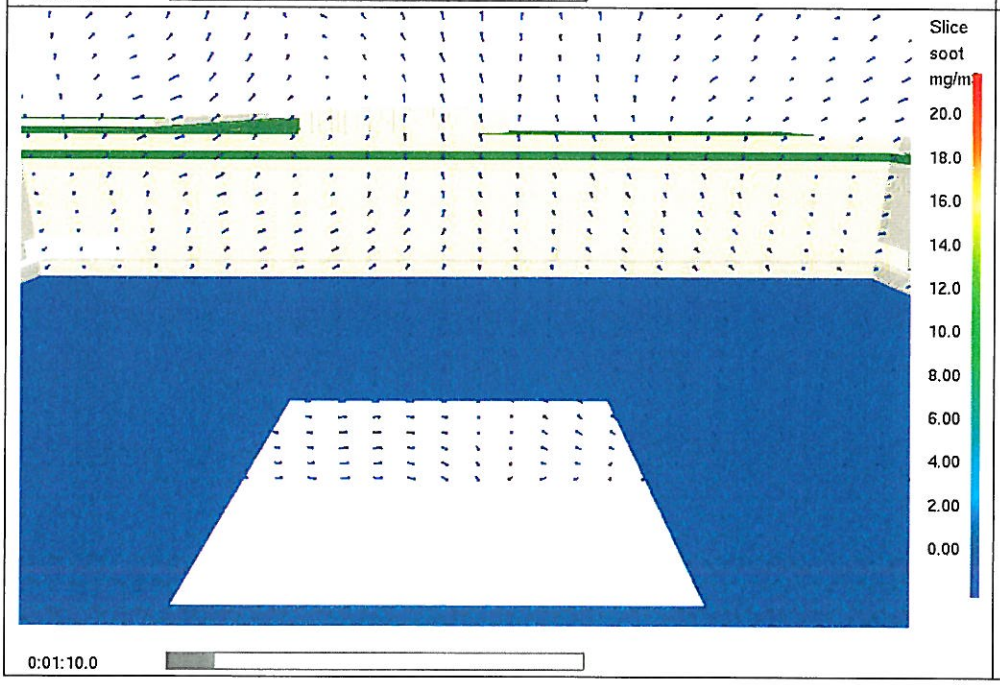
maximum smoke spread (1 minute 10 seconds). In the following figures, the velocity vectors are shaded to indicate the concentration of the soot in the air, with blue indicating no soot.

SOOT CONCENTRATION WITH WATERFALL
FLAMMABLE LIQUID FIRE IN CENTER OF MEMORIAL HALL



End of Flammable Liquid Fire **(30 seconds)**

Waterfall Active



Time of Maximum Smoke Spread **(1 minute 10 seconds)**

Waterfall Deactivated by Fire Alarm System

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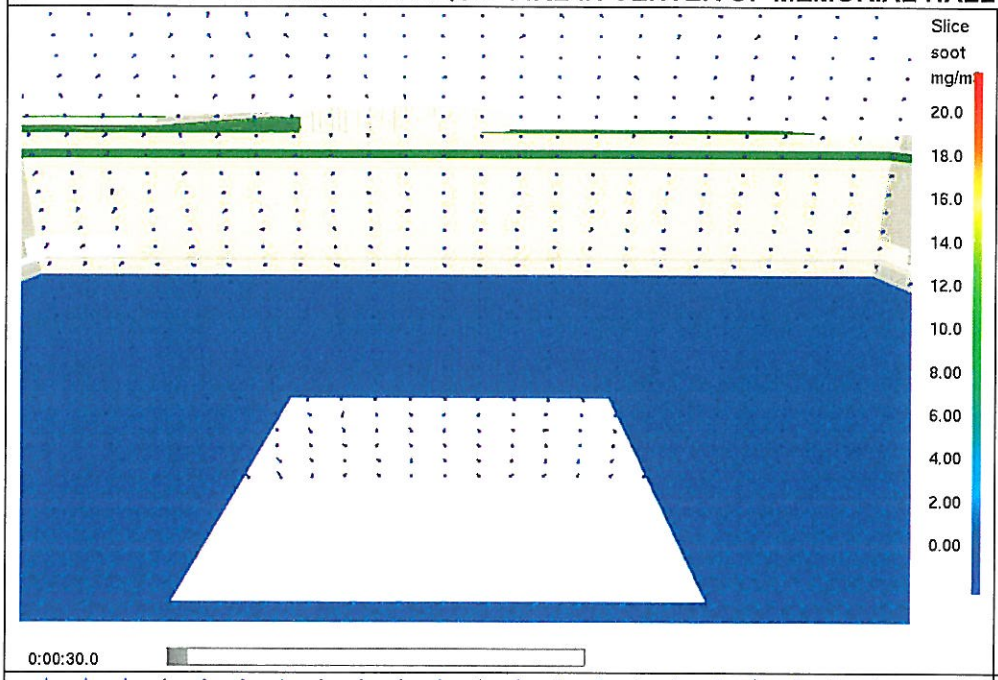
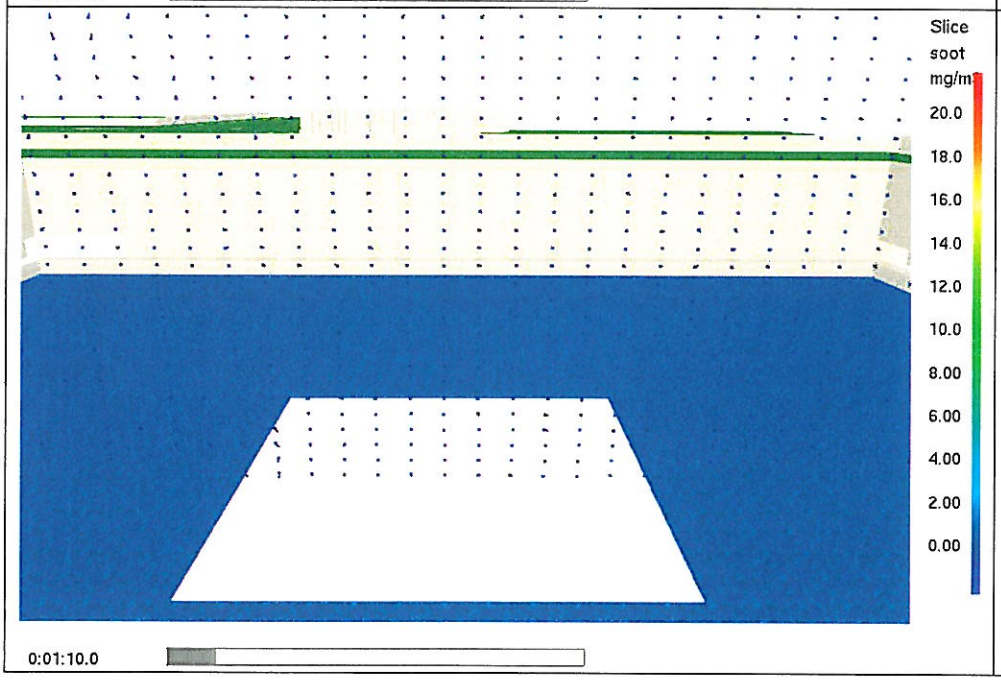
SOOT CONCENTRATION WITHOUT WATERFALL
FLAMMABLE LIQUID FIRE IN CENTER OF MEMORIAL HALL



End of Flammable Liquid Fire **(30 seconds)**

Waterfall Inactive



Time of Maximum Smoke Spread **(1 minute 10 seconds)**

Waterfall Inactive

The figures above show that the air flow entering the levels below +284'-0" is induced by the waterfall, the effects of which were included in the CFD model for the Memorial. After the waterfall shuts off, the air flow entering the levels below +284'-0" is minimal. As demonstrated in the figures above, the soot concentration of the air traveling through the opening is near zero. This indicates that smoke is not traveling to the floors below. The Fire Dynamics Simulator (FDS) input files for simulations of a flammable liquid fire in the Memorial Hall with and without the waterfall are included on the enclosed CD-ROM.

3. Ms. Saakian was designated as the point of contact for correspondence with the FDNY related to the Fire and Egress Modeling Studies. The FDNY has requested that any color documents be sent to them in hard copy.

4. Chief Hill requested that the latest set of plans for the Memorial and Memorial Museum be sent to the FDNY in hard copy for receipt prior to the meeting on April 20, 2006.

   The plans requested were forwarded to Chief Hill on April 19, 2006.

5. Chief Hill requested that plans indicating the location, enclosure, tank details, suppression systems, and venting of fuel oil storage be submitted to the FDNY.

6. Chief Hill requested that plans more clearly indicate which areas of the project are the Memorial and which areas of the project are the Memorial Museum.

7. Chief Hill requested that a summary be provided indicating the use and corresponding elevation for the floors of each building.

   The following table provides the summary requested:

ELEVATION	MEMORIAL	MUSEUM
311'	Plaza (Exterior)	Entry Pavilion
294'	Security screening	Lobby Level
284'	Gallery	Exhibition
264'-270'	Mechanical	Exhibition
242'	Mechanical	Exhibition/Bedrock

8. The FDS input file for the flammable liquid fire in the Memorial Hall was reviewed. Exhaust vents were identified in the input file and the corresponding vents were located in the Smokeview rendering.

9. Mr. Subarrao requested that results be submitted for a flammable liquid fire in the Memorial Hall with the smoke control system inactive.

   The results requested are provided below. The FDS input file for this scenario is provided on the attached CD-ROM.

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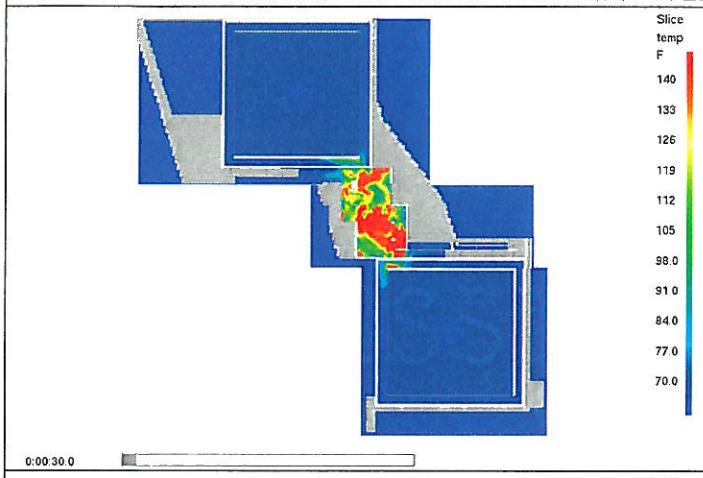
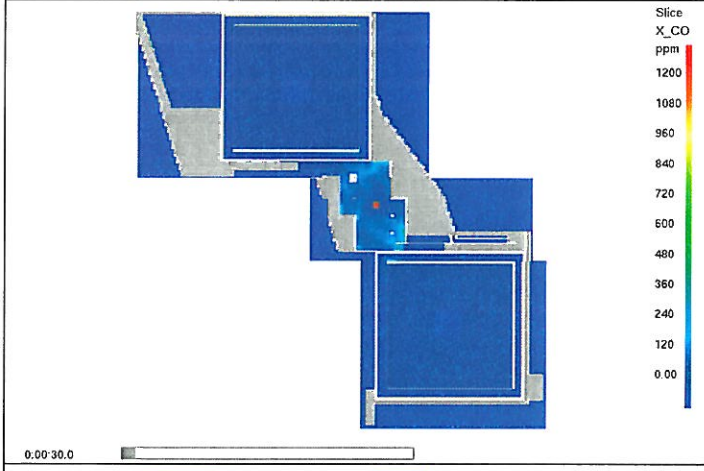
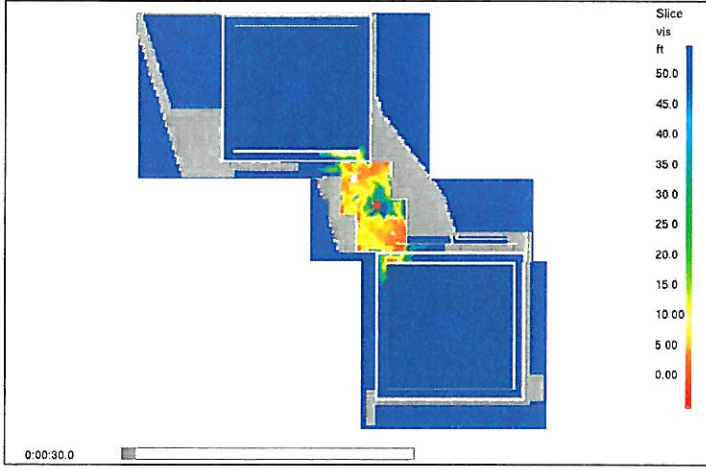
FLAMMABLE LIQUID FIRE IN CENTER OF MEMORIAL HALL – WITHOUT SMOKE CONTROL
CONDITIONS AT END OF FLAMMABLE LIQUID FIRE (30 SECONDS)



Temperature



Carbon monoxide concentration



Visibility

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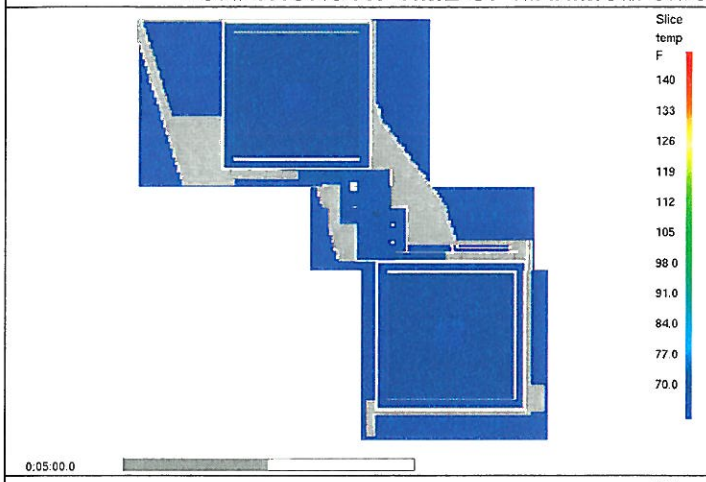
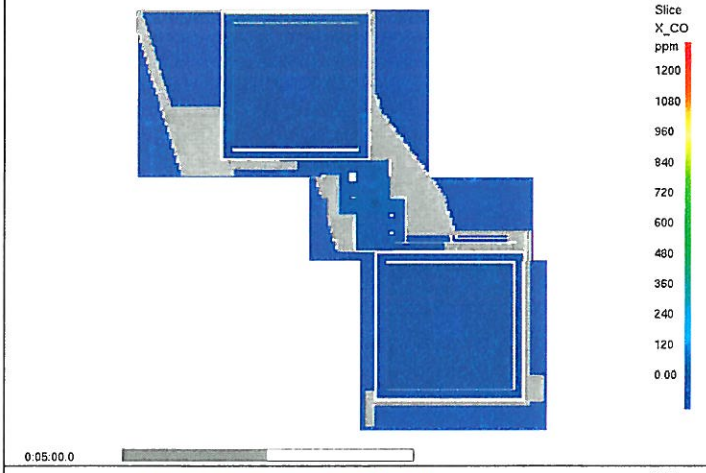
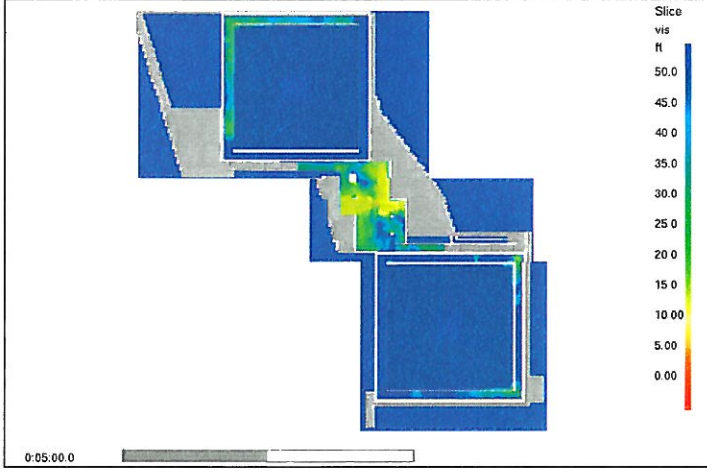
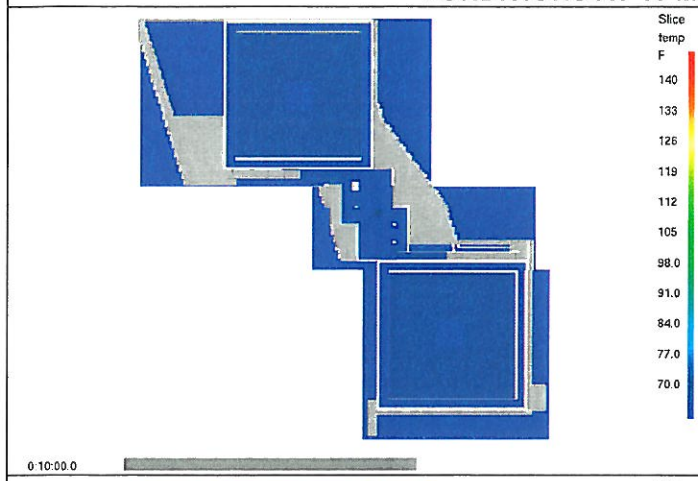
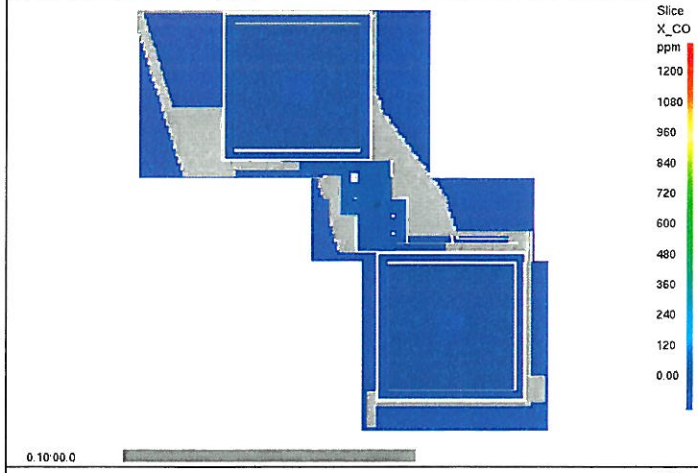
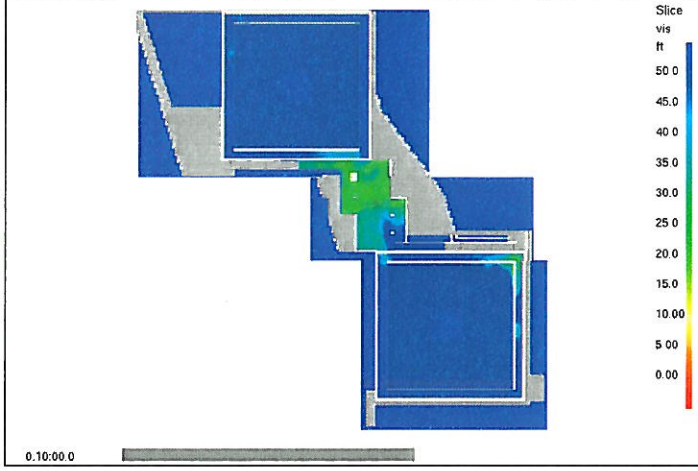
FLAMMABLE LIQUID FIRE IN CENTER OF MEMORIAL HALL – WITHOUT SMOKE CONTROL CONDITIONS AT TIME OF MAXIMUM SMOKE SPREAD (5 MINUTES)

	Temperature
	Carbon monoxide concentration
	Visibility

FLAMMABLE LIQUID FIRE IN CENTER OF MEMORIAL HALL – WITHOUT SMOKE CONTROL CONDITIONS AT 10 MINUTES

	Temperature
	Carbon monoxide concentration
	Visibility

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Thank you for the time that you spent reviewing the Fire and Egress Modeling Simulations for the World Trade Center Memorial and Memorial Museum projects. If there are any further questions that arise as the project review continues, please contact us at your convenience.

Very truly yours,

Steven D. Wolin, P.E.
Technical Director

CODE CONSULTANTS

Kevin D. Morin, P.E.
Project Manager

Enclosures

c: Chief Patrick McNally, Bureau of Fire Prevention, FDNY
Fatma Amer, Department of Buildings, City of New York
Carl Krebs, Davis Brody Bond, LLP
Richard Bikse, Lower Manhattan Development Corporation

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ENCLOSURE A

DAVIS BRODY BOND

Davis Brody Bond, LLP Architects and Planners 315 Hudson Street New York, New York 10013 Tel: 212.633.4700 Fax: 212.633.4760

Memorandum

Date: 9 April 2006

To: Kevin Morin – CCI

From: Carl Krebs

Subject: Questions from FDNY

Here are the responses to Questions 5, 7 and 8 that were requested by Tamara Saakian and Leo Subbarao of FDNY in their email to you on 31 March 2006. Please incorporate or attach these to your FDNY response.

5. Provide the latest exit layout for all the floors

The egress drawings showing all exits are currently being revised in response to recent NYC Department of Buildings (DOB) review comments and will be ready shortly. When the drawings are submitted to DOB we will be able to forward the current set to FDNY. We anticipate the drawings to be ready by next week. If needed earlier, we can submit progress copies with the expectation that they will be revised slightly.

7. Indicate the proposed location and capacity of the emergency power diesel storage tank.

The emergency generator is sized at 3,000 kw and is located on the roof of the Museum Entry Pavilion. The Diesel Tank is located at Elevation 242' between column lines 11and 12 and column lines T and U. The tank contains 8,000 gallons of #2 diesel fuel, a 24 hour supply.

8. Indicate the location of the flammable/combustible liquid storage rooms in the facility and the quantity and nature of liquids proposed to be stored.

At this point we are not aware of any flammable/combustible liquid storage in the facility, except for the previously mentioned diesel fuel tank room.

cc: Anne Papageorge, LMDC
Richard Vikse, LMDC

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The Fire Protection &
Life Safety Experts
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April 12, 2006

Ms. Tamara Saakian, P.E.
Director of Engineering
Bureau of Fire Prevention

RE: FIRE SIMULATION STUDIES
WTC MEMORIAL AND MEMORIAL MUSEUM
PROJECT NOS. 7383-4 & 7966-4

Dear Ms. Saakian:

We have prepared this letter to document our responses to the requests outlined in your email of March 31, 2006.

1. *Submit the FDS input data file for the fire simulations carried out at the Bedrock level +242*
2. *Submit the FDS input data file for the fire simulation that is for a flammable liquid spill fire and a kiosk fire.*

CCPE: Enclosed with this letter please find a CD-ROM with the input file for the flammable liquid spill fire on the +242'-0" level that ignites adjacent combustible materials.

3. *An input data file was submitted previously to the Fire Department for the Memorial fire at +284. Arrange for an individual to identify the vents on the input file and smoke view and turn off such vents that may be required by the Fire Department to study conditions under a no emergency ventilation scenario.*

CCPE: Enclosed with this letter please find a CD-ROM with an input file for the requested fire scenario. Vents used for smoke control have been removed from the attached input file to simulate the conditions without emergency ventilation.

4. *Provide information of tenable condition parameters such as heat and smoke density for the slice where air is drawn into floors below +284.*

The following table illustrates the air flow into the floors below the +284'-0" level during a flammable liquid fire in Memorial Hall. The figures show a section of the Memorial pools, where airflow is indicated using velocity vectors. In the first figure, the velocity vectors are shaded to indicate the velocity of the flow. In the second figure the velocity vectors are shaded to indicate the temperature of the air.

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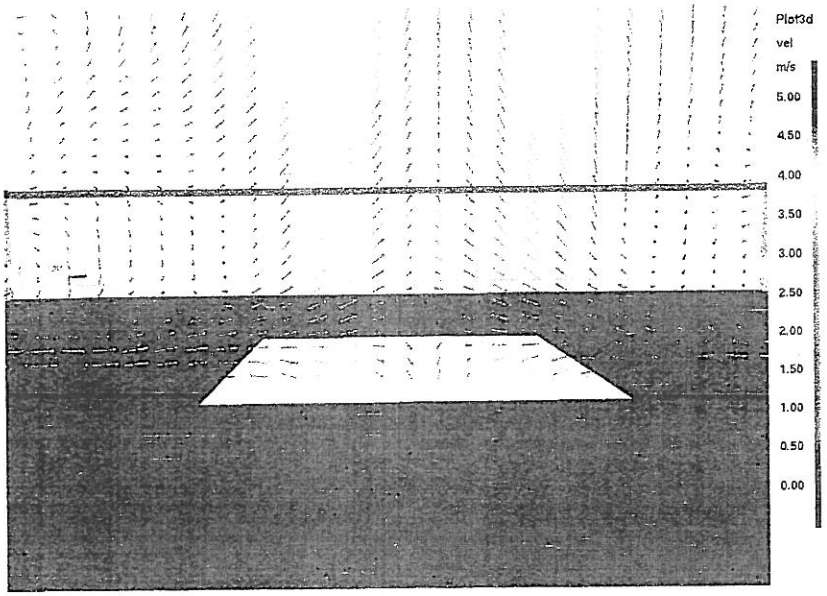
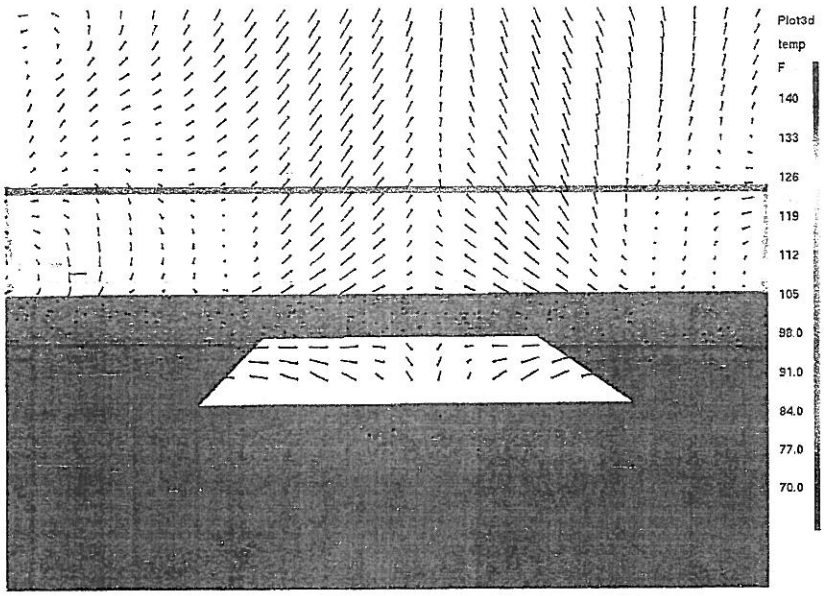
FLAMMABLE LIQUID FIRE IN CENTER OF MEMORIAL HALL



Velocity



Temperature

The air flow entering the levels below +284'-0" is induced by the waterfall, the effects of which were included in the CFD model for the Memorial. Thus, the air entering the level below +284'-0" is fresh, outside air. Note that the temperature of the air passing into the opening is at ambient temperature (70°F) indicating that smoke or products of combustion are not present.

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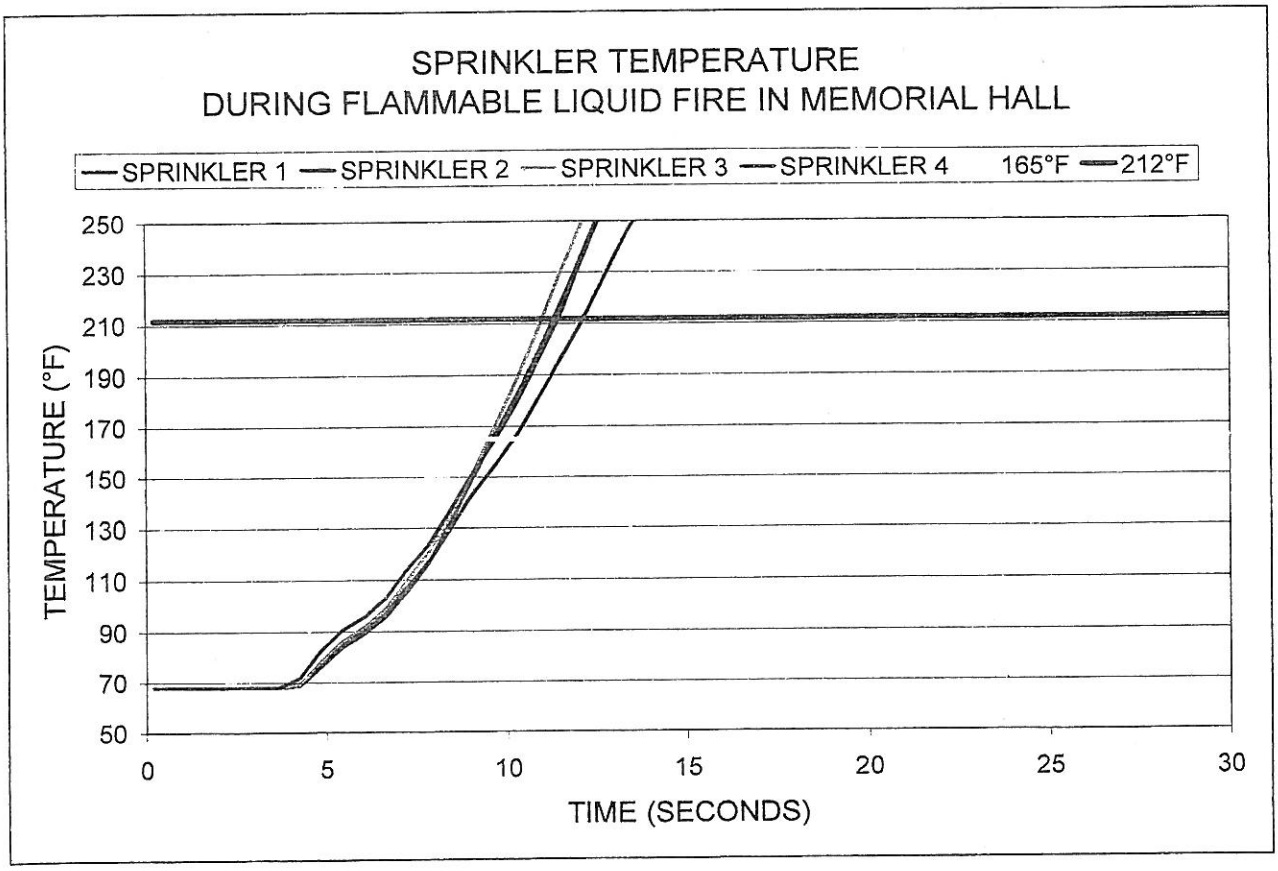
5. *Provide the latest exit layout for all the floors.*

CCPE: The latest exit layout will be submitted by Davis Brody Bond, LLP.

6. *Submit sprinkler actuation time calculations for the 5 gal spill fire in the memorial hall.*

CCPE: The following graph shows the temperature of the four sprinklers closest to the flammable liquid fire in Memorial Hall. The sprinkler activation time depends on the activation temperature of the sprinklers used in that portion of the building. Ordinary temperature sprinklers with an activation temperature of 165°F would be expected to activate in approximately 10 seconds and intermediate temperature sprinklers with an activation temperature of 212°F would be expected to activate in less than 15 seconds. We anticipate ordinary temperature sprinklers being used in this application.

Because the Memorial is an outdoor space, dry-pipe sprinkler systems will be used. Thus, after sprinkler activation an additional 60 seconds of time is permitted before water reaches the most remote sprinkler. The CFD model is based on smoke exhaust fans reaching full capacity 30 seconds after sprinklers activation.



7. *Indicate the proposed location and capacity of the emergency power diesel storage tank.*

CCPE: The information requested will be provided by Jaros Baum & Bolles, the mechanical and electrical engineers for the project.

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PROFESSIONAL ENGINEERS, PC

8. *Indicate the location of the flammable/combustible liquid storage rooms in the facility and the quantity and nature of liquids proposed to be stored.*

CCPE: The information requested will be provided by Davis Brody Bond, LLP.

Thank you for the time that you have spent reviewing the Fire and Egress Modeling Simulations for the World Trade Center Memorial and Memorial Museum projects. If there are any further questions that arise as the project review continues, please contact us at your convenience.

Very truly yours,

Steven D. Wolin, P.E.
Technical Director

CODE CONSULTANTS

Kevin D. Morin, P.E.
Project Manager

Enclosure

cc: Carl Krebs, Davis Brody Bond, LLP